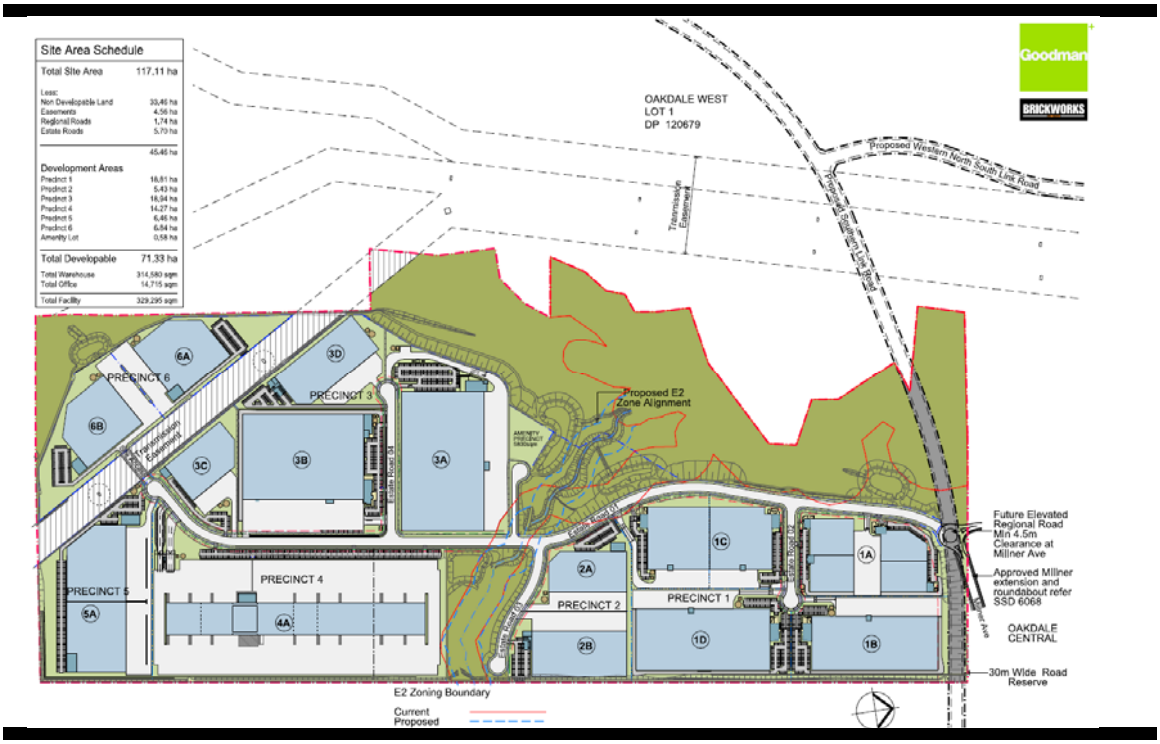
Oakdale South Development

State Significant Development Application



Civil, Stormwater and Infrastructure Services Report – Section 96

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Report no: 14-193-R001 **Revision:** 10 **Date:** September 2016

Document information

Level 7, 153 Walker Street North Sydney NSW 2060

Document registration

Document title	Oakdale South Development – State Significant Development Application
Document file name	14-193-R001-08-S96 Oakdale South Civil Report.docx
Section	Civil Engineering
Document author	Andrew Tweedie

Issue	Description	Date
01	Issue for Client Review	15/08/2015
02	Re-Issued for Client Review	21/08/2015
03	Final Client Review	28/08/2015
04	Final SSD Application	4/09/2015
05	Final SSD Application	8/09/2015
06	Issue for Section 96	05/08/2016
07	Issue for Section 96	12/08/2016
08	Issue for Section 96	16/08/2016
09	Issue for Section 96	19/09/2016
10	Issue for Section 96	21/09/2016

Finalisation signatures

The design described in this report is considered to have been finalised.

	Signature	**Date**
Andrew Tweedie Civil Engineer (Author)		21/09/2016
Frank Xie Lead Designer / Civil Engineer		21/09/2016
Anthony McLandsborough Director		21/09/2016

Notes: The finalisation signatures shown above do not provide evidence of approval to the design. Approval signatures are shown on the title sheet of the design plans.

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Abbreviations

OSE	Oakdale South Estate
OEH	Office of Environment and Heritage
NOW	NSW Office of Water
EE	Endeavour Energy
EP	Equivalent Persons
ET	Equivalent Tenancy
IWM	Integrated Water Management
MG	Goodman Property Services (Aust) Pty Ltd
STP	Sewerage Treatment Plant
SWC	Sydney Water Corporation
WELS	Water Efficiency Labelling
WSEA	Western Sydney Employment Area
EIS	Environmental Impact Statement
SSDA	State Significant Development Application

Executive Summary

Goodman Property Services (Aust) Pty Ltd is developing the Oakdale South site for the purposes of providing a warehouse and distribution complex. The Oakdale South site is a precinct within the wider 'Oakdale' Estate development and forms part of a progressive development designed to make 'Oakdale' a regional distribution park of warehouses, distribution centres and freight logistics facilities.

Purpose of Report:

This Civil report has been prepared to support the Section 96 application for the revisions to the approved State Significant Development (SSD) for Oakdale South (SSD 6917).

The development will be constructed over three (3) stages with each construction stage consisting of the construction of the estate road, bio-retention basins, lead-in services and utility reticulation as required to service each civil stage.

Proposed Modifications:

A copy of the revised master plan is included in Appendix A. With respect to the civil works the proposed revisions are as follows:

- Revisions to Road 01 and 03 alignment to reflect specific end user requirements
- Expansion of the Precinct 02 development allotment to utilise land no longer required for a future EE substation
- Adjustment in proposed levels to better suit existing topography and the revised road alignment
- Re-align the proposed culverts for the creek crossing to Drainage line 1 allowing for a shorter culvert run underneath estate road 01
- Reduction of basin C size and creation of a new Basin E due to revisions in the stormwater catchments associated with the revised road alignments
- Avoid impacts to the existing dam within Drainage line 1
- Inclusion of road 05 and a small amenity precinct

This report has been prepared to addresses the Secretary's Environmental Assessment Requirements (SEARs) for the original SSD with respect to the Section 96 plan. It outlines the proposed components of the design including Civil Design and Infrastructure, Road geometry and pavement design, Sedimentation and Erosion Control, Stormwater Management (On Site Detention, Piped and Overland Flows, Water Sensitive Urban Design) and Construction as modified in the new Section 96 layout.

A summary of findings is as follows:

Earthworks & Retaining Walls:

A description of the revised earthworks is included in Section 2 of this report and as documented in the revised civil plans. There is a slight decrease in the expected amount of import required of approximately 74,600 m^3 as a result of the modified layout in the Section 96. This decrease will consequently reduce the project duration and volume of construction traffic.

The revised setout of retaining walls is detailed in Section 4 of this report and as documented in the revised civil plans. Notably the changes to the retaining walls are as follows:

- **SSD RW01** (S96 RW10) no change
- **SSD RW02** (S96 RW07) design of this retaining wall has been changed from proposed soil nail walls to keystone retaining walls. This design change will result in an improved aesthetic appearance consistent with the retaining walls across the remainder of the estate.
- **SSD RW03** (S96 RW09) no change
- **SSD RW04** (S96 RW05) has been amended to allow for a 30m landscape setback on the southern boundary. Design of this retaining wall has been changed from proposed soil nail walls to keystone retaining walls. This design change will result in an improved aesthetic appearance consistent with the retaining walls across the remainder of the estate.
- **SSD RW05** (S96 RW08) no change
- **SSD RW06** has been removed due to realignment of Estate Road No.1
- **SSD RW07** has been removed due to realignment of Estate Road No.1
- **SSD RW08** (S96 RW06) height and extent has been altered due to realignment of Estate Road No.1
- **SSD RW09** (S96 RW14) height and extent has been altered due to realignment of Estate Road No.1
- **SSD RW10** (S96 RW12) no change
- **SSD RW11** (S96 RW01) no change
- **SSD RW12** (S96 RW03) has been amended to allow for a 30m landscape setback on the southern boundary and reduced extents and height along the TransGrid easement to allow for grading within the TransGrid transmission easement
- **SSD RW13** has been removed to allow for grading within the TransGrid transmission easement
- **SSD RW14** (S96 RW14) extents have changed due to the realignment of Estate Road No.1
- **SSD RW15** (S96 RW11) no change
- **SSD RW16** (S96 RW02) reduced extents and height along the TransGrid transmission easement to allow for grading within the TransGrid transmission easement
- **S96 RW16** has been added at the north eastern corner of Lot 1B to enable maintenance of the vegetation on the Eastern boundary.
- **SSD RW17** (S96 RW13) no change
- **SSD RW18** has been removed due to realignment of Estate Road No.1
- **SSD RW19** has been removed due to realignment of Estate Road No.1

Sediment & Erosion Control Measures:

As articulated in Section 3 of this report all sediment and erosion control measures will be consistent with the initial SSD approval.

Road Design:

The revised road alignments are as articulated above and documented in the revised civil drawings. There is no proposed changes to the typical road cross sections other than the inclusion of Road 5 which is described in Section 5 of this report.

Stormwater Management:

As outlined in Section 6 of this report the water quantity & quality targets are the same as that of the original SSD approval. Updated DRAINs and MUSIC modelling outputs have been included to demonstrate the stormwater design will achieve the approved water quantity and quality targets of the exisiting approval.

Water Balance:

An updated assessment of the potable water demand has been carried out for the revised Section 96 layout and is detailed in Section 7 of this report. The non-potable targets of the original approval have been maintained and will be adhered to.

Flood Modelling:

As outlined in Section 8, the flood model has been re-run for the Section 96 layout to demonstrate there are no impacts on upstream or downstream adjoinging properties, and that the proposed floor levels will have greater than 500 mm freeboard above the 1 in 100 yr ARI flood level.

The Section 96 flood modelling report concludes that the local flood impacts are expected to have negligible impact on the maintenance of Transgrid's easement and consequently do note pose a risk to existing transmission stanchions.

The 100 yr ARI flood levels in the vicinity of the Warragamba Pipelines Corridor either do not increase or slightly decrease while the 100 yr ARI flood velocities in the vicinity of the pipeline are effectively unchanged.

Creek Re-alignment:

As detailed in Section 9 of this report the impact of the project on watercourses is generally limited to the establishment period. The creek re-alignment overall is expected to be beneficial with increased cover of remnant plants and reduced edge effects. The proposed revisions to the creek re-alignment are as follows:

- Upstream of the Estate Road No.1 a relatively small re-alignment will be undertaken to connect with the culvert crossing point
- The re-aligned waterway has changed from 250m long to 410m long and will include two instream benches and pools
- The single road crossing under Estate Road No.1 now consists of two culvert structures

Staging:

The development will be conducted over three (3) stages . The size of each stage and quantum of work is generally consistent with the previous approval and is explained in Section 11 of this report.

Construction:

The construction methodology of the Oakdale South Estate has been updated to reflect the Section 96 layout. There are no key changes with respect to the original approval as further shown in Section 12 of this report.

Compliance with Secretary's Environmental Assessment Reports (SEARs)

This report responds to the SEAR's issued by the NSW Planning and Environment on 22nd April 2015. The table below summaries all key civil / infrastructure issues raised in the SEAR's and how they have been dealt with.

Key Issue	Response
Soils and Water	
an outline of the proposed water requirements, including a consolidated site water balance, details of water supply sources, usage data and efficiency measures	A Water Balance section has been included in this report. Refer Section 7 for all site water balance details, water supply source, usage calculations and efficiency measures.
A detailed assessment of potential soil (including contamination and acid sulphate soil), surface water, groundwater and salinity impacts of the proposed development, including adequate mitigation and monitoring measures	A soil salinity and aggressivity investigation has been undertaken by PSM which covers this issue. Refer to Report PSM1541-112L dated 9th July 2015 Refer to the EIS.
An assessment of the potential impact of the development on Ropes Creek, it's on-site tributaries and riparian areas	This study has been carried out by Aecom as part of the Ropes Creek Realignment study. Refer to Section 9 and the EIS.
A description of the surface and stormwater management designed in accordance with Water Sensitive Urban Design principles, including on site detention, and measures to treat or reuse water	A detailed description of all Stormwater Management including WSUD design principles is included within Section 6 of this report
Description of the proposed erosion and sediment controls during construction and operations	A detailed description of the Erosion and Sediment Control measures is included within Section 3 of this report. Note also a full set of Erosion and Sediment Control plans has been provided within the EIS
Proposed cut and fill works associated with the development, and measures to minimize the extent of cut and fill	Refer to Section 2 of this report and the EIS
Infrastructure Requirements	
Provision of a detailed written and/or geographical description of the infrastructure required on site	Refer to Section 10 within this report for a description of all proposed infrastructure services to the site. We have also included a full set of services and utilities coordination plans within our drawings set within the EIS
Identification of any infrastructure upgrades required off-site to facilitate the development, and describe any arrangements to ensure that the upgrades will be implemented in a timely manner and maintained	Refer to Section 10 within this report.
An infrastructure delivery and staging plan including a description of how infrastructure on and off site will be coordinated and funded to ensure it is in place prior to commencement of construction	Refer Section 10 and Appendix F for proposed combined utility drawings

Table 1 – SEARS Compliance

Agency Consultation

This report summarises all consultation and correspondence undertaken with the relevant authorities during the design phase. The following table summarises these consultations and the relevant correspondence. It should be noted not all authorities were consulted during the initial design phase. The reason for no consolation is summarized below.

Agency Consulted	Correspondence
Penrith City Council	In addition to consultation with PCC during the design development of the SSD proposal, AT&L met with Penrith City Council (PCC) on 5th of May 2016 & 30TH May 2016 to discuss responses to the original SSD proposal for Oakdale South. Further Consultation to be added once SSD approval received and discussed with PCC.
Sydney Water	AT&L has undertaken extensive consultation with Sydney Water during the development of the OSE SSD proposal. As a result of the ongoing development within the Western Sydney Employment Area (WSEA) Precinct No.8 – Area South of Pipeline, Sydney Water requested that a Local Area Servicing Plan (LASP) for both sewer and potable water infrastructure was prepared to ensure that future Sydney Water infrastructure could ultimately service future developments within the WSEA Precinct No.8 – Area South of Pipeline. The LASP for sewer and potable water (GH 2016) identifies the servicing strategy for the WSEA Precinct No.8 – Area South of Pipeline. At the request of Sydney Water, GHD were engaged to prepare the LASP for both sewer and potable water. During preparation of these documents, extensive consultation was undertaken with Sydney Water, Jacfin and CSR to ensure compliance with Sydney Water's performance requirements for both sewer and potable water. For further details on the LASP for potable water and sewer refer to Section 10.1 and Appendix G.
Endeavour Energy	Over the past 18 months' numerous meetings have been held with Endeavour Energy (EE) in relation to servicing the proposed development site. Currently EE have indicated that a new Zone Substation willbe required to service the development. EE have advised that a new Zone Substation will be provided within Oakdale West in the future. Interim supply to Oakdale South can be made via connection to the Eastern Creek Zone Substation. A copy of this correspondence is attached within Appendix I.

TransGrid	AT&L met with TransGrid on 19th April 2016 to discuss the proposed Oakdale South Estate, specifically in relation to the existing TransGrid electrical easement located to the south of the proposed Oakdale South Estate. In regards to the OSE SSD proposal, TransGrid agreed to hold detailed discussions relating to works adjacent to the TransGrid easement post determination of the SSD. It is proposed to continue on the same approach with TransGrid with the S96 proposal and will seek this in writing for issue to the NSW P&E. Noting the S96 proposal is consistent with the works proposed adjacent to the TransGrid easement within the approved OSE SSD proposal. AT&L met with TransGrid on 16th August 2016 to discuss the detailed design surrounding the TransGrid transmission easement. In addition, AT&L discussed and tabled the Oakdale South S96 masterplan with TransGrid. TransGrid were generally supportive of the S96 proposal in consideration that the S96 proposal is consistent with the works proposed adjacent to the TransGrid easement within the approved OSE SSD proposal. Further the proposed TransGrid transmission easement driveway crossing location shown within the S96 proposal is preferential to TransGrid. Transgrid were issued documentation surrounding the proposed easement drainage on the 9th August 2016. Transgrid stated on the 6th September 2016: *"TransGrid's engineers currently don't have any comments to raise at this stage, however if we have any further concerns they will be formally advised to both AT&L and the Department of Planning and Environment".* Refer to Appendix K.

Table 2 – Agency Consultation

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1 Introduction

This updated civil works report has been prepared to inform a S96 application to the approved State Significant Development (SSD 6917) for the staged development of the Oakdale South Estate (OSE).

In summary, with reference to civil works, the Oakdale South masterplan has been revised to:

- Utilise land no longer required to be reserved for an Endeavour Energy Zone Substation
- Maintain ability to provide a potential future connection of estate road No.3 based on revised masterplan layout
- To suit specific end user requirements
- Better suit existing topography
- Realign proposed culverts allowing for shorter culvert run underneath estate road No.1
- Reduce size of Basin C due to splitting of catchments
- Include additional Basin E; and
- Avoid impacts to the existing dam within Oakdale South

The below Figure 1 shows the SSDA (green) to S96 (orange) general arrangement plan comparison. For further details, refer to Appendix J drawing SKC191[P8].

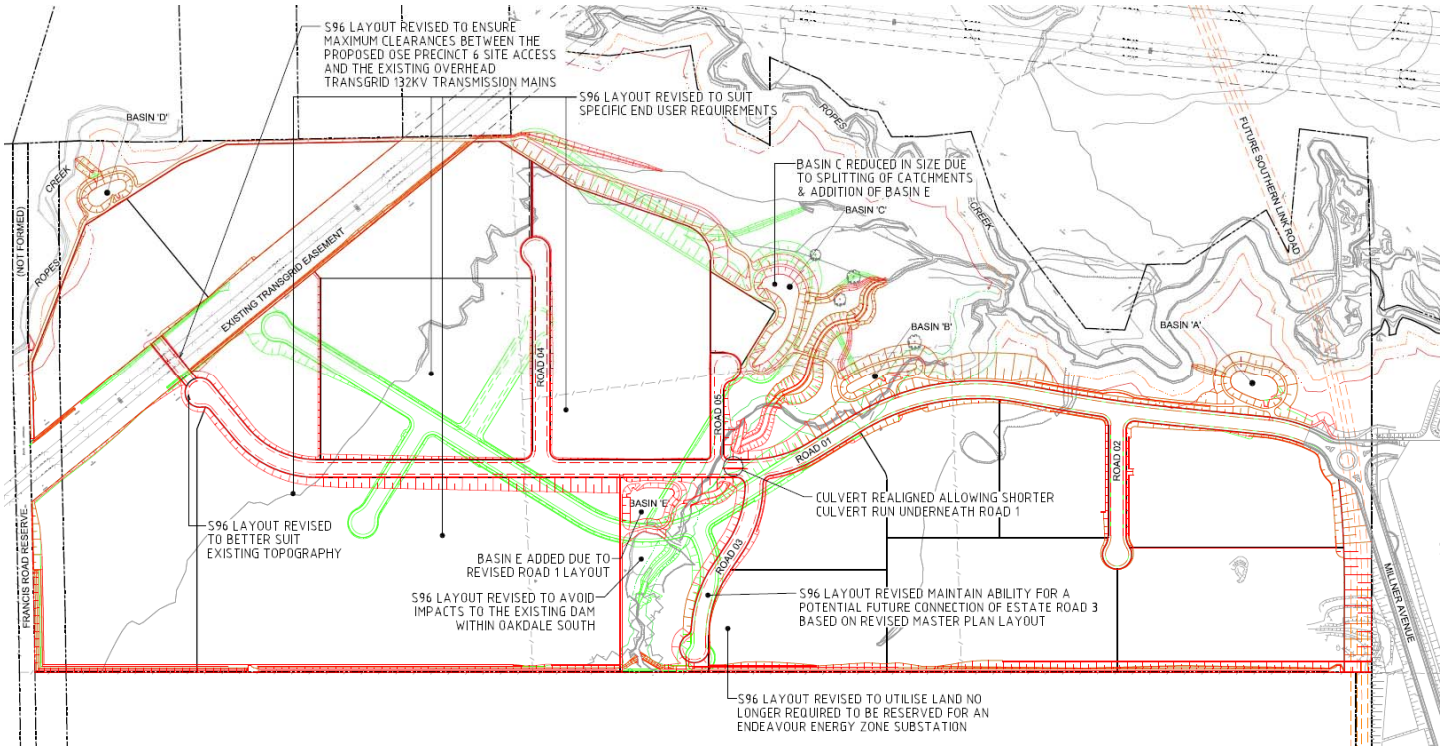

Figure 1 – SSDA to S96 Comparison Plan

(Source: *AT&L drawing SKC191[P8]*)

The Oakdale South estate roads within the S96 masterplan have been revised as follows:

- **Estate Road No.1:** Estate Road No.1 has essentially been revised to run parallel with the OSE eastern boundary. Estate Road No.1 has been revised to:
    - Better suit the existing topography
    - Suit specific end user requirements
    - To ensure maximum clearances between the proposed OSE Precinct 6 site access and the existing overhead TransGrid 132kV transmission mains.
    - Avoid impacts to the existing dam within Oakdale South; and
    - Maintain ability to provide a potential future connection of estate road No.3 to the adjacent Jacfin site at a later date if deemed appropriate

- **Estate Road No.2:** Remains unchanged.

- **Estate Road No.3:** Has been realigned to provide a potential future connection between Oakdale South and the adjacent future Jacfin development. The OSE proposal however does not include a connection to the Jacfin Estate, rather makes allowance for a potential future connection should this be deemed appropriate. The realignment has been further enabled due to Endeavour Energy no longer requiring a zone substation within Oakdale South, for further details refer Section 10.4.

- **Estate Road No.4:** Largely remains unchanged as positioned between lots 3A and 3B, though it has been rotated to remain perpendicular to the revised Estate Road No.1 alignment.

- **Estate Road No.5:** Has been relocated to the northern side of lot 3A. Estate Road No.5 now provides access to the proposed amenity precinct.

This report has been prepared in accordance with Penrith City Council current design guidelines, the relevant Australian Standards and the relevant Austroads Guidelines. The report responds to the Secretary's Environmental Assessment Requirements (SEARs) as they relate to Civil and Infrastructure, specifically as outlined in the SEAR Compliance Table above. This report supports an Environmental Impact Statement (EIS) prepared in respect of the proposal and should be read in conjunction with the EIS and development plans submitted with the S96 application for Oakdale South SSD 6917.

1.1 Scope of Report

Objective of Report

The objective of this civil, stormwater and infrastructure services report is an updated report to inform a S96 application to the approved State Significant Development (SSD 6917) for Oakdale South Estate (OSE). This report outlines the design criteria used for the Engineering design of all components of the development and compare to the requirements of the Penrith City Council Development Control Plans (DCP).

Summary

This report generally discusses the design philosophy behind the following components of the design for Oakdale South Estate (OSE):

- Earthworks
- Sedimentation and Erosion Control
- Retaining Walls
- Road Design
- Stormwater Management
    - On Site Detention (OSD)
    - Piped and Overland Flows
    - Water Sensitive Urban Design (WSUD)
    - Water Balance across the site
- Flood Modelling
- Creek Realignment
- Servicing
    - Water
    - Sewerage
    - Communications
    - Gas
    - Electrical
- Infrastructure Staging
- Construction
    - Clearing and Grubbing
    - Demolition
    - Earthworks
    - Roadworks and Services
    - Program
    - Plant and Equipment

Supporting documentation that is referenced and commented on within the report include the following sections;

- Flooding (Cardno)
- Creek realignment and associated riparian works (Aecom)
- Geotechnical review (PSM)
- Salinity Management Report (PSM)

The proposed site plan covering the entire Oakdale South development along with all proposed lot layouts are attached within Appendix B.

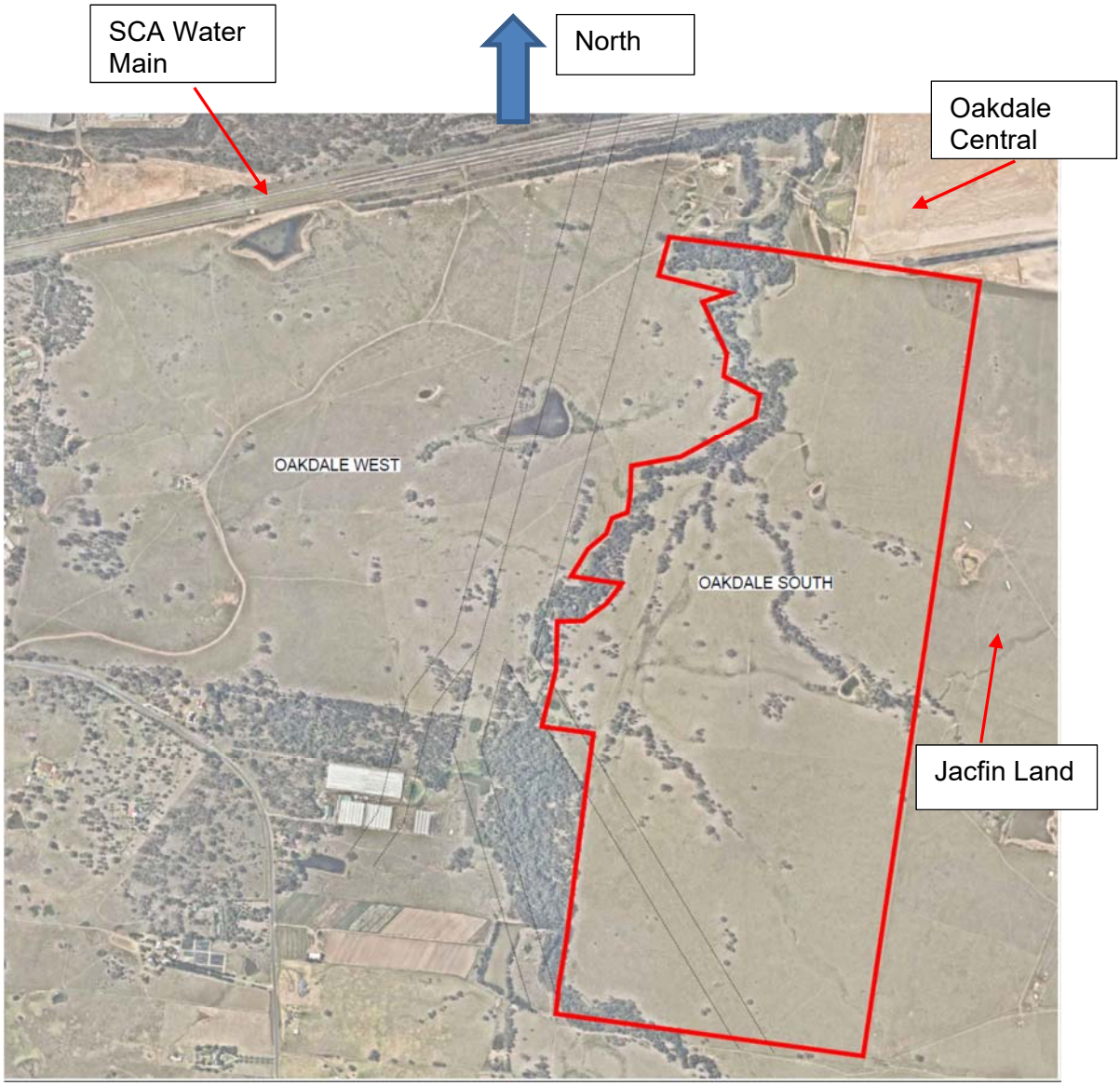

Figure 2 – Locality Plan

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2 Earthworks

2.1 Existing Geology

Based on a Geotechnical Report undertaken by Pells Sullivan Meynink (PSM) in February 2015 the following sub surface soils were encountered across the site:

- Topsoil – Sandy Clay Depth 0.0 -0.1m
- Natural Soil – Sandy Clay to Clay: Depth 0.1 to 0.4m
- Bedrock – Sandstone, Siltstone, Shale: Depth 0.8 to 5.0m

2.2 Cut/Fill Requirements

The site will require bulk and detail earthworks to be carried out across the various stages.

The site falls approximately 30m from the high points along the eastern boundary to the low points along Ropes Creek.

It is noted that following an options analysis process which included numerous design options by;

- Either maximising cut to fill and minimising import,
- Multiple smaller earthworks pads and minimising both cut / fill and retaining walls
- Maximising import and minimising cut and retaining walls

During the design development of Oakdale South, priority has been to create large flat pads throughout OSE to meet specific end user requirements. Creating large flat pads optimises site utilisation and is achieved via utilising current market availability of surplus fill material. This design limits the height of required retaining to a maximum of 10-12m for cut walls and generally 6m for fill walls.

The cut/fill comparison volumes between the approved OSE SSD and the revised S96 are as follows:

Application	NET CUT (m^3)	NET FILL (m^3)	BALANCE (m^3) Import required
SSD	**-659,000**	**+1,666,000**	**1,007,000**
S96	**-568,404**	**+1,500,804**	**932,400**
Difference (-reduced +additional)	**-90,596**	**-165,196**	**-74,600**

Note these volumes are based on the current S96 and approved SSD designs, further detailed design may alter these.

Table 3 – OSE SSDA/S96 Cut/Fill Summary

As highlighted with the above Table 3, the revised S96 masterplan has resulted in slightly lower quantities of cut, fill and subsequent required import based on an optimised civil works design for the revised S96 masterplan.

The import of material will be classified as either Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM) or as specified by in the Geotechnical Engineering Specification for the project. We anticipate for a development of this scale and the close proximity of fill to the site, 100 truck and dog movements per day during the filling process would be estimated for each stage.

Topsoil is only proposed to be stripped from cut areas and or areas that have less than 1 metre of filling over. In all other areas, topsoil is to be left insitu with filling to occur directly over. Where topsoil has been stripped, the topsoil will be blended with the either cut material or imported material and used as general fill.

It is not proposed to export any topsoil from the site. However, some minor quantities may be removed and disposed of in accordance with waste classification guidelines.

3 Sedimentation and Erosion Control

3.1 Sedimentation and Erosion Control (Construction)

Soil and Water Management Plans (SWMP) has been prepared in accordance with the NSW Department of Housing Publication titled: Managing Urban Stormwater-Soils and Construction (2004) for the whole site. Refer to AT&L Civil drawings within the EIS.

Suitable erosion and sediment controls shall be provided and maintained throughout all stages of works, including at completion of the bulk earthworks. Design, documentation, installation and maintenance of sediment and erosion controls will be in accordance with the requirements of the *Protection of the Environment Operations Act, Penrith City Council's specifications* and the *Office of Environment and Heritage's 'Managing Urban Stormwater: Soils and Construction. Landcom, (4th Edition) (The "Blue Book") Volume 1 and Volume 2*.

Sediment and erosion controls shown on AT&L Civil drawings have been amended to address the revised OSE masterplan and PCC requirements identified within the SSD approval.

Summary of changes to the proposed sediment and erosion control are as follows:

- Bio-retention basins are to be utilised as temporary sediment control basins. The bio-retention basins shall not be converted into the final/ultimate basins until such time as all building and construction works within the relevant stage has been completed and 90% of the site is stabilised.
- Sediment and erosion controls have been amended to suit revised OSE masterplan layout.
- Within the approved OSE SSD proposal, temporary sediment basins were provided within each proposed lot prior to discharge to precinct bio-retention basins. The OSE S96 proposal has been revised to adopt precinct style temporary sediment basins whilst utilising bio-retention basins as temporary sediment basins as required.

Ultimately the final temporary sediment basin locations and sizes will be provided to suit development staging requirements and will be sized & maintained in accordance with the requirements of the *Protection of the Environment Operations Act, Penrith City Council's specifications* and the *Office of Environment and Heritage's 'Managing Urban Stormwater: Soils and Construction. Landcom, (4th Edition) (The "Blue Book") Volume 1 and Volume 2*.

3.2 Sources of Pollution

The activities and aspects of the works that have potential to lead to erosion, sediment transport, siltation and contamination of natural waters include:

- Earthworks undertaken immediately prior to rainfall periods
- Work areas that have not been stabilised

- Extraction of construction water from waterways during low rainfall periods
- Clearing of vegetation and the methods adopted, particularly in advance of construction works
- Stripping of topsoil, particularly in advance of construction works
- Bulk earthworks and construction of pavements
- Works within drainage paths, including depressions and waterways
- Stockpiling of excavated materials
- Storage and transfer of oils, fuels, fertilisers and chemicals
- Maintenance of plant and equipment
- Ineffective implementation of erosion and sediment control measures
- Inadequate maintenance of environmental control measures
- Time taken for the rehabilitation / revegetation of disturbed areas

3.3 Potential Impacts

The major potential impacts on the riparian environment relate to erosion of distributed areas or stockpiles and sediment transportation. Potential adverse impacts from erosion and sediment transportation can include:

- Loss of topsoil
- Increased water turbidity
- Decreased levels of dissolved oxygen
- Changed salinity levels
- Changed pH levels
- Smothering of stream beds and aquatic vegetation
- Reduction in aquatic habitat diversity
- Increased maintenance costs
- Decrease in waterway capacity leading to increased flood levels and durations

3.4 Construction Methodology

The following construction methodology will be followed to minimise the impact of sedimentation due to construction works:

- Diversion of “clean” water away from the disturbed areas and discharge via suitable scour protection.
- Provision of hay bale type flow diverters to catch drainage and divert to “clean” water drains.
- Diversion of sediment-laden water into temporary sediment control basins to capture the design storm volume and undertake flocculation (if required).
- Provision of construction traffic shaker grids and wash-down to prevent vehicles carrying soils beyond the site.
- Provision of catch drains to carry sediment-laden water to sediment basins.
- Provision of silt fences to filter and retain sediments at source.
- Rapid stabilisation of disturbed and exposed ground surfaces with hydro seeding in areas where future construction and building works are not proposed

- All temporary sediment basins shall be located clear of the 100yr ARI flood event from Ropes Creek and Ropes Creek tributaries.
- The weir levels of all temporary sediment basins shall be located above the 100yr ARI flood event levels from surrounding Ropes Creek and Ropes Creek tributaries.
- Bio-retention basins are to be utilised as temporary sediment control basins. The bio-retention basins shall not be converted into the final/ultimate basins until such time as all building and construction works within the relevant stage has been completed and 90% of the site is stabilised.

Note these sediment and erosion control measures will be in place during all construction works.

3.5 Site Inspection and Maintenance

The inspection and maintenance requirements outlined in this section will need to be carried out as long as either earthworks or quarrying is being conducted and all areas re-established.

The Contractor's site Superintendent will inspect the site after every rainfall event and at least weekly, and will:

- Inspect and assess the effectiveness of the SWMP and identify any inadequacies that may arise during normal work activities or from a revised construction methodology. Construct additional erosion and sediment control works as necessary to ensure the desired protection is given to downstream lands and waterways
- Ensure that drains operate properly and to effect any repairs
- Remove spilled sand or other materials from hazard areas, including lands closer than 5 metres from areas of likely concentrated or high velocity flows especially waterways and paved areas
- Remove trapped sediment whenever less than design capacity remains within the structure
- Ensure rehabilitated lands have affectively reduced the erosion hazard and to initiate upgrading or repair as appropriate
- Maintain erosion and sediment control measures in a fully functioning condition until all construction activity is completed and the site has been rehabilitated
- Remove temporary soil conservation structures as the last activity in the rehabilitation

3.6 Conclusion

The erosion control measures proposed for the site will comply with the requirements of Penrith City Council and The Department of Environment, Climate Change and Water (DECC).

The proposed SWMP will ensure that the best management practice is applied to the development site in controlling and minimising the negative impacts of soil erosion.

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4 Retaining Walls

4.1 Retaining Walls

Where possible, batter slopes will be provided to accommodate level changes. Where this is not possible retaining walls will be constructed along the estate road, lots and basins based on the current civil and earthworks design. An Austral product or other similar face block will be adopted for all retaining walls as detailed on the civil drawings.

The proposed retaining walls will be built to the manufacturers design guideline requirements and verified by a structural engineer prior to construction. This practice was adopted on Oakdale Central and considered input from the geotechnical engineer, utility coordination as well as entry and exit points from proposed lots.

Significant retaining is required along the eastern boundary where it is required to cut down from existing to create the new building pads. Retaining walls will be designed and constructed using standard industry practises.

All retaining walls will be constructed on a stage basis. Where the walls are not constructed a batter of 1 in 4 will be maintained for stability purposes. Any batter steeper than 1 in 5 shall be vegetated.

All retaining walls will be located within private property and not within the road reserve areas.

All retaining walls will have pedestrian and vehicular safety barriers in accordance with Austroads Guidelines.

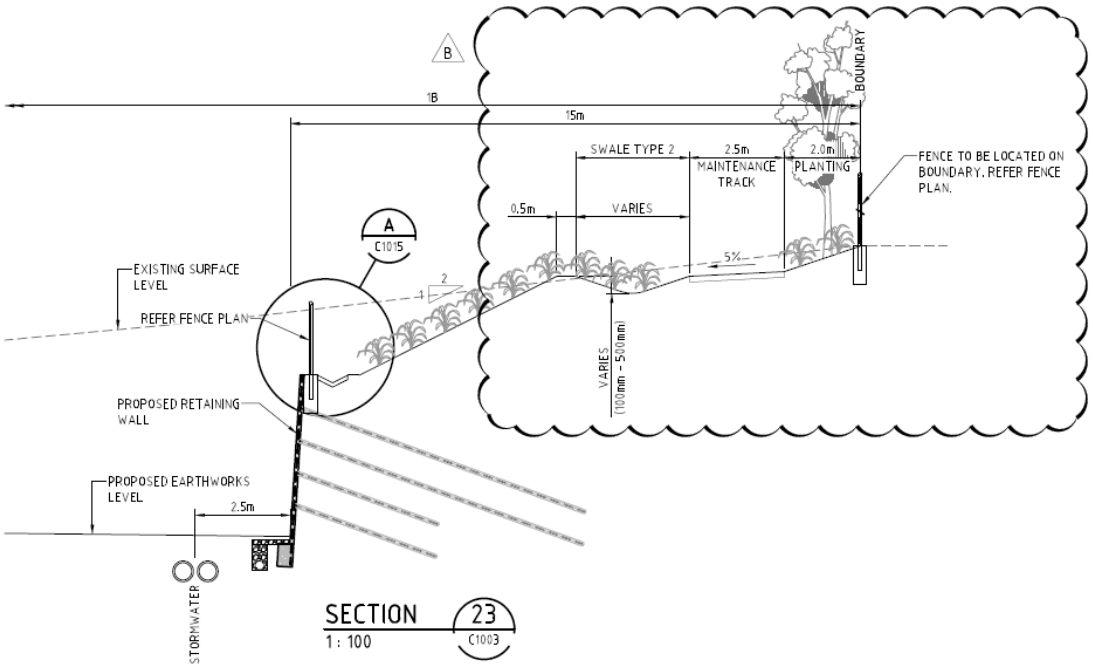

Figure 3 – Eastern Boundary Interface

(Source: *Section 23 AT&L drawing C1008[B])*

The Oakdale South estate retaining walls within the S96 masterplan have been revised as follows:

- **SSD RW01** (S96 RW10) no change
- **SSD RW02** (S96 RW07) design of this retaining wall has been changed from proposed soil nail walls to keystone retaining walls. This design change will result in an improved aesthetic appearance consistent with the retaining walls across the remainder of the estate.
- **SSD RW03** (S96 RW09) no change
- **SSD RW04** (S96 RW05) has been amended to allow for a 30m landscape setback on the southern boundary. Design of this retaining wall has been changed from proposed soil nail walls to keystone retaining walls. This design change will result in an improved aesthetic appearance consistent with the retaining walls across the remainder of the estate.
- **SSD RW05** (S96 RW08) no change
- **SSD RW06** has been removed due to realignment of Estate Road No.1
- **SSD RW07** has been removed due to realignment of Estate Road No.1
- **SSD RW08** (S96 RW06) height and extent has been altered due to realignment of Estate Road No.1
- **SSD RW09** (S96 RW14) height and extent has been altered due to realignment of Estate Road No.1
- **SSD RW10** (S96 RW12) no change
- **SSD RW11** (S96 RW01) no change
- **SSD RW12** (S96 RW03) has been amended to allow for a 30m landscape setback on the southern boundary and reduced extents and height along the TransGrid easement to allow for grading within the TransGrid transmission easement
- **SSD RW13** has been removed to allow for grading within the TransGrid transmission easement
- **SSD RW14** (S96 RW14) extents have changed due to the realignment of Estate Road No.1
- **SSD RW15** (S96 RW11) no change
- **SSD RW16** (S96 RW02) reduced extents and height along the TransGrid transmission easement to allow for grading within the TransGrid transmission easement
- **S96 RW16** has been added at the north eastern corner of Lot 1B to enable maintenance of the vegetation on the Eastern boundary.
- **SSD RW17** (S96 RW13) no change
- **SSD RW18** has been removed due to realignment of Estate Road No.1

SSD RW19 has been removed due to realignment of Estate Road No.1

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5 Road Design

5.1 Horizontal and Vertical Geometry

The Estate Road extension from Millner Avenue and the cul-de-sac's have generally been designed to meet Austroads requirements and Australian Standards to accommodate B-Double truck movements.

The proposed road reserve as described below does not conform to Penrith City Council's standard road reserves which requires a minimum 20.6m road reserve. A wider road reserve width has been adopted as it was used on the adjacent Oakdale Central development.

To ensure consistency between the two developments the Oakdale Central road reserve alignment has been adopted for the design base for the OSE. It should be noted the road reserve being adopted for the OSE exceeds the road reserve widths as specified in the Penrith City Council and hence a more conservative option.

As approved within the SSD for Oakdale South, the Oakdale South estate roads comprise of the following:

Road No.1 – Main Estate Road

- 23.0m wide Road Reserve
- 15.5m wide Carriageway comprising:
    - 2 x 3.5m wide central traffic lanes
    - 2 x 4.25m wide traffic lanes adjacent kerb
- Verges as follows:
    - 4.0m wide verge on the western verge including:
        - 1.5m landscape zone between kerb face and shared footpath
        - 2.5m wide shared path network to permit cyclists to ride to work. Footpath designed at 2% crossfall
    - 3.5m wide verge on the Eastern verge including:
        - 1.7m landscape zone between kerb face and footpath
        - 1.2m wide footpath. Footpath designed at 2% crossfall
        - 0.6m landscape zone between boundary and footpath with provision for street lighting

Roads No.2, No.3 & No.4

- 23.0m wide Road Reserve
- 15.5m wide Carriageway comprising:
    - 2 x 3.5m wide central traffic lanes
    - 2 x 4.25m wide traffic lanes adjacent kerb
- Verges as follows:
    - 3.75m wide verges on both verges including:
        - 1.95m landscape zone between kerb face and footpath
        - 1.2m wide footpath. Footpath designed at 2% crossfall
        - 0.6m landscape zone between boundary and footpath with provision for street lighting

Road No.5

- 16.80m wide Road Reserve
- 8.0m wide Carriageway comprising:
    - 2 x 4.0m wide traffic lanes adjacent kerb
- Verges as follows:
    - 5.05m wide verge on the Southern verge including:
        - 1.2m wide footpath. Footpath designed at 2% crossfall
        - 3.25m landscape zone between kerb face and shared footpath
        - 0.6m landscape zone between boundary and footpath with provision for street lighting
    - 3.5m wide verge on the Northern verge including:
        - 1.95m landscape zone between kerb face and footpath
        - 1.2m wide footpath. Footpath designed at 2% crossfall
        - 0.6m landscape zone between boundary and footpath with provision for street lighting

General

- Cul-De-Sac have been shown at 30m Diameter to accommodate the largest design vehicle
- The largest design vehicle is a 26m B-Double
- Design Speed of Road = 60km/hr
- No guard fences have been shown and these will be assessed at detailed design stage in accordance with Austroads.
- Estate road No.1 is proposed to be constructed over the existing Ropes Creek Tributary. A box culvert 3.6m wide by 1.8m high is proposed to ensure the Ropes Creek Tributary drains beneath the proposed road. An additional 1.2m wide by 1.2m high box culvert is also proposed at a higher level to provide for fauna connectivity. Refer to the Civil drawings for culvert plan location and sections.

Refer to Figures 4, 5 & 6 below indicating typical road sections. Figure 4 is the typical arrangement incorporating the 2.5m wide shared path whilst Figure 5 is the typical section indicating standard 1.2m wide footpaths on each verge. Figure 6 is the typical section for Road 05, for further details refer to AT&L civil drawings.

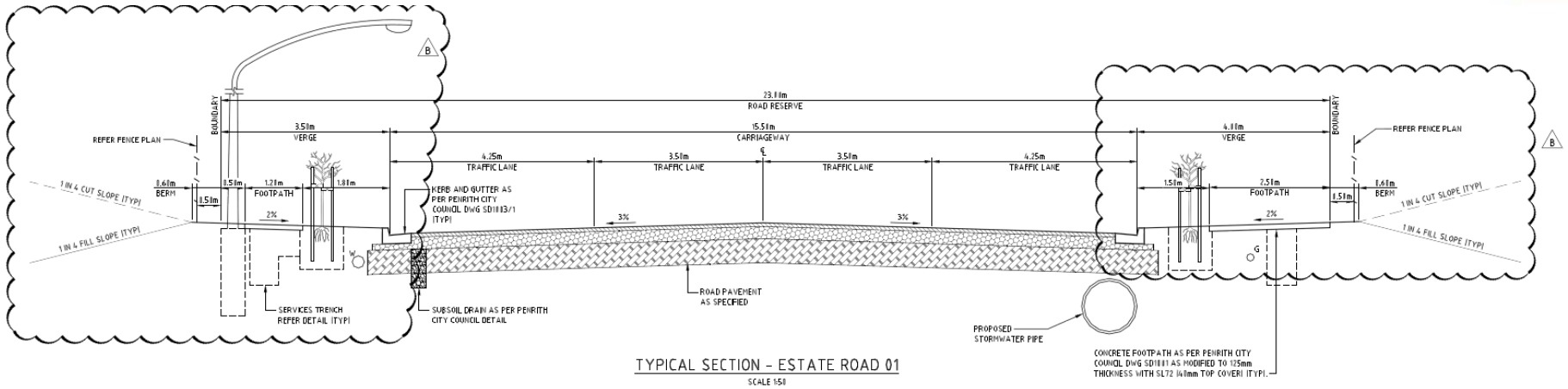

Figure 4 - Typical Estate Road 01 Section (with 2.5m shared path)

(Source: *AT&L drawing C1011[B])*

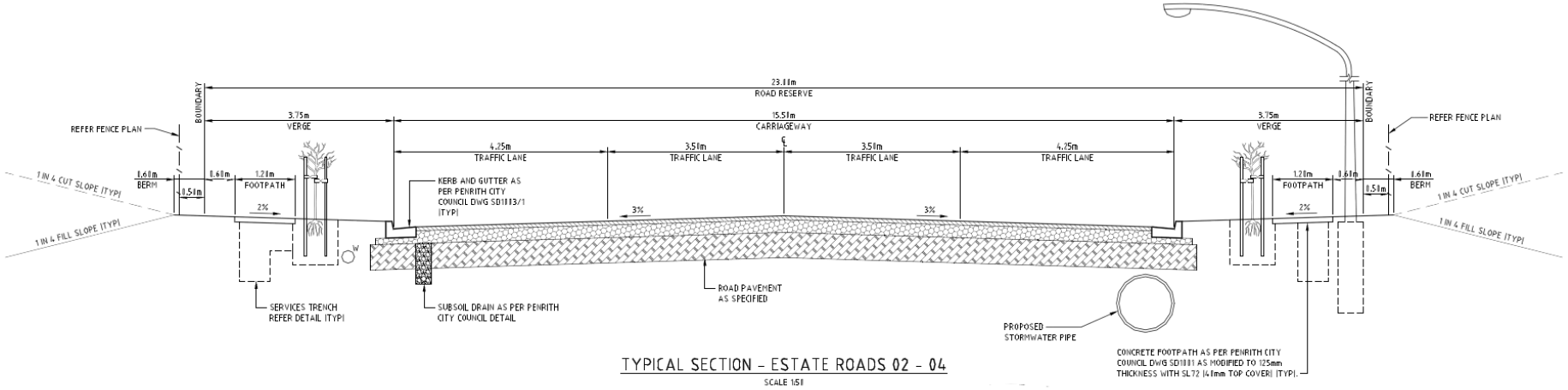

Figure 5 - Typical Estate Roads 02, 03 & 04 Section (without 2.5m shared path)

(Source: *AT&L drawing C1011[B])*

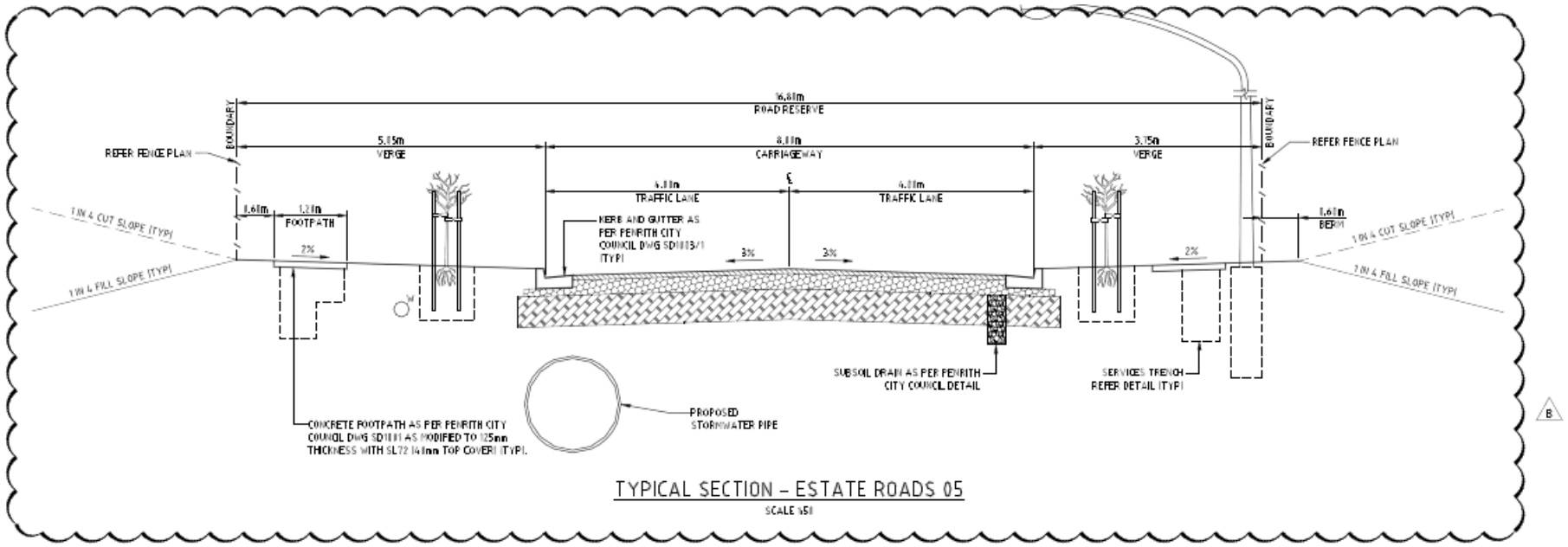

Figure 6 - Typical Estate Road 05 Section

(Source: *AT&L drawing C1011[B])*

5.2 Pavement

Pavement will be designed based on the requirements of Austroads Pavement Design Guide – A Guide to the Structural Design of Road Pavements and recommendations provided by Pells Sullivan Meynink (PSM) in report PSM1541-019L dated February 2012.

The basis of this design is:

- Design Traffic Loading: N =1x10^7 ESA
- Design subgrade CBR = 2% with a reduction if the subgrade is CBR 5%

Based on these parameters the pavement design is as follows:

- 35mm AC 14 320 Bitumen
- 35mm AC 14 320 Bitumen
- 7mm Spray Seal
- 250mm DGB 20 (placed in two layers)
- 500mm Select Sandstone Fill with minimum CBR= 35% (placed in three layers)

If the subgrade CBR = 5% the bottom 200mm of select sandstone fill can be replaced with select fill with minimum CBR of 5%.

CBR testing is proposed to the undertaken at the subgrade level to confirm this pavement design.

5.3 Batter Design

Any batters steeper than 1 in 5 will be vegetated. All external batters to the development have been limited to 1 in 4 as a minimum generally. The area below the future SLR have been cut to 1 in 10 to provide a landscape buffer.

Any temporary batters constructed during the works will be in accordance with the geotechnical report and ongoing advice from the Level 1 supervisor

5.4 Southern Link Road Location

As part of the SSD approval for Oakdale South, it was resolved to adopt a revised concept alignment for the future Southern Link Road (SLR) following peer review by both Aecom and GHD.

No further revisions to the approved SLR concept alignment are proposed as part of this S96 application.

5.4.1 Proposed Site Access

The existing Millner Avenue Roundabout does not form part of this application and has been previously approved and constructed as part of the SSD 6078.

5.4.2 Interconnectivity to the Rest of the BWSEA

As mentioned above, as part of the OSE S96 proposal, Road No.3 has been realigned to provide a potential future connection between Oakdale South and the adjacent future Jacfin development. The OSE proposal however does not include a connection to the Jacfin Estate, rather makes allowance for a potential future connection should this be deemed appropriate.

Trunk sewer and potable water is also proposed to allow for the future connection to the Jacfin development in accordance with the Sydney Water Local Area Servicing Plan (LASP) for Oakdale. For further details, refer to Section 10.1.

5.5 Conclusion

All road design as demonstrated above is in accordance with Austroads Standards and the requirements of Penrith City Council, as a minimum.

A professional geotechnical engineer will be engaged to design the structural pavement. This is also in accordance with Austroads Pavement Design Guide – A Guide to Structural Design of Road Pavements.

6 Stormwater Management

6.1 Existing Site Stormwater Drainage

Currently the site comprises farmland and is classified as a “greenfield” site with an entire coverage of pervious areas.

The site slopes down from east to west with the existing site draining via overland flow into the Ropes Creek to the west of the site.

There are two existing tributaries of Ropes Creek and a floodway within the middle section of the site which currently drain the majority of the site into the adjacent Ropes Creek. Refer to SKC008 within Appendix B for a pre-development stormwater catchment plan indicating the location of these catchments.

6.2 Proposed Site Stormwater Drainage

The updated stormwater management report has been prepared to inform a S96 application to the approved State Significant Development (SSD 6917).

In summary, with reference to stormwater works, the Oakdale South masterplan has been revised to:

- Incorporate an additional bio-retention basin (Basin E)
- Alteration of the proposed stormwater catchments due to road alignment changes and the additional basin

As discussed in Section 2.2 of this report, due to the existing steep grades across the site extensive filling is required to ensure level pads are created for proposed roads and on lot pads.

As a result of this filling the northern and southern Ropes Creek Tributaries will be filled in. These tributaries are shown in Catchment C and F within SCK008. To compensate for the overland flows from the land to the east of the site which pre-development drained into these tributaries, a combination of swale drains and pipe and pit networks at the eastern boundary of the site will capture these flows.

All overland flows to the east of the site adjacent Catchment G and F will be collected by swale drains and pits and pipes and directed into the Ropes Creek Tributary within Catchment E.

All overland flows to the east of the site adjacent Catchment C will be collected by swale drains and pits and pipes and drain along the southern boundary of the site to discharge into Ropes Creek.

All stormwater on the lots and within the road reserve is proposed to be collected via pits and pipes and connect into one of the four On-Site Detention basins to the west adjacent Ropes Creek. All basins will have an outlet structure and overflow weir system to drain into Ropes Creek. Scour protection will be provided on these outlet structures to minimize the effects of erosion on the existing Ropes Creek. Refer to Section 6.3.3 and 6.3.4 of this report for a more detailed description of these post developed catchment areas.

Refer to the Civil Drawings for layout and details for the proposed stormwater network across the site.

6.3 Council Requirements & Recommendations

All estate level stormwater drainage for the OSE development is designed to comply with the following:

- Penrith City Council Design Guidelines for Engineering Works
- Penrith City Council Water Sensitive Urban Design (WSUD) Policy December 2013
- C3 Water Management DCP.

A summary of the design requirements adopted is listed below:

- Precinct based basins will serve the development as detention and bio-retention basins
- All stormwater drainage within the estate roads will be dedicated to Penrith City Council. Maintenance and repair works of the stormwater drainage network outside of the lots will be the responsibility of Penrith City Council. All stormwater drainage within the lots will be the responsibility of the individual property owners.
- OSD to be sized to ensure that for all rainwater events up to and including the 1:100 ARI event, new developments do not increase stormwater peak flows in any downstream areas.
- OSD to mitigate post development flows to pre-developed flows for peak Average Reoccurrence Interval (ARI) events.
- All OSD basins have been designed with a 3.0m wide sprayed seal access road along the berm to ensure maintenance vehicles can access the entire exterior of the basin
- WSUD to achieve target reductions:
    - 85% Total Suspended Solids (TSS)
    - 60% Total Phosphorus (TP)
    - 45% Total Nitrogen (TN)
    - 90% Gross Pollutants (GP)
- Finished Floor Levels (FFL) to have minimum 500mm freeboard to 100 year overland flows.
- A gross pollutant trap (GPT) will be installed within each development site on the final downstream stormwater pit prior to discharging. As these GPT's will be located on-lot as they will be owned and maintained by the individual property owner.

Rainwater tanks are desirable for re-use for irrigation, toilet and other non-potable water uses. Rainwater tank size is determined in accordance with the Penrith City Council C3 Water Management DCP. Refer to Section 7 of this report for a more detailed description on rainwater harvest tanks.

6.3.1 Modelling Software

DRAINs modelling software has been used to calculate the Hydraulic Grade Line (HGL) of the estate level stormwater pipes. DRAINs is a computer program used for designing and analyzing urban stormwater drainage systems and catchments. It is widely accepted by Council's across NSW as the basis for stormwater design and has been confirmed by Penrith City Council as the preferred stormwater software analysis package. DRAINs data files and output results are attached in Appendix D.

MUSIC modelling software has been used to evaluate pollutant loads from each developed lot. For a detailed description of the MUSIC modelling refer to Section 6.3.7 of this report. MUSIC data files and output results are attached in Appendix E.

6.3.2 Hydrology

- Pipe drainage shall be designed to accommodate the 20-year ARI storm event.
- The combined piped and overland flow paths shall be designed to accommodate the 100-year ARI storm event.
- Where trapped low points are unavoidable and potential for flooding private property is a concern, an overland flowpath capable of carrying the total 100-year ARI storm event shall be provided. Alternatively, the pipe and inlet system may be upgrade to accommodate the 100 year ARI storm event.
- Rainfall intensities shall be as per the Intensity-Frequency-Duration table in accordance with the Australian Rainfall and Runoff (AR&R) volume 2.
- Times of concentration for each sub catchment shall be determined using the kinematic wave equation.
- Runoff coefficients shall be calculated in accordance with AR&R. The fraction impervious shall be determined from analysis of the sub catchments.
- Flow width in gutter shall not exceed 2.5m for the minor design storm event.
- Velocity depth ratios shall not exceed 0.4 for all storms up to and including the 100 year ARI event.
- Inlet pits to be spaced so that flow width shall not exceed 80l/sec
- Bypass from any pit on grade shall not exceed 15% of the total flow at the pit
- Blockage factors of 20% and 50% shall be adopted for pits on grade and at sags respectively.

6.3.3 Hydraulics

- A hydraulic grade line HGL design method shall be adopted for all road pipe drainage design. The HGL shall be shown on all drainage long sections.
- The minimum pipe size shall be 375mm diameter RCP.
- Maximum spacing between pits shall not exceed 75m.
- The minimum pipe grade shall be 0.5%.

- All pipes shall be Rubber Ring Jointed unless noted otherwise.
- The minimum cover over pipes shall be 450mm in grassed areas and 600mm within carriageways.
- Where minimum cover cannot be achieved due to physical constraints the pipe class shall be suitably increased.
- All trafficable shall be Reinforced Concrete Pipes or Fibre Reinforced Cement equivalent.
- The pipe friction coefficients to adopted shall be:

Materials	Mannings – n	Colebrook-White – k	Min. Pipe Class
RCP	0.012	0.6	3
FRC	0.01	0.15	3

Table 4 – Pipe Details

- All pipes classes shall be designed for the ultimate service loads and where applicable, construction loads will be designed for.
- Pipes discharging to the overland flow path shall adopt a minimum tailwater level equivalent to respective overland flow level.
- Pit Loss coefficients shall be calculated in accordance with Missouri Charts.
- A minimum 150mm freeboard shall be maintained between pit HGL and pit surface levels.
- Overland flowpaths shall maintain a minimum of 300mm freeboard to all habitable floor levels.
- Pits deeper than 1.2m shall contain step irons at 300 mm centres.

6.3.4 Catchments

A Stormwater Catchment Plan for each Catchment and the overall site is shown in Appendix B. As indicated in the Catchment Plan each of the basins are bio-retention basins designed to both attenuate stormwater flows and treat the nutrients to Penrith City Council treatment rates. These treatment rates are from the Penrith City Council C3 Water Management DCP.

It should be noted whilst Catchments A, B, C, D and E all drain into bio-retention basins, all stormwater runoff within Catchment F (TransGrid Easement) bypasses the basins and drains directly into Ropes Creek. The existing ground levels within Catchment F do not allow gravity drainage to any of the proposed basins.

All runoff within this catchment has been allowed to drain un-attenuated and untreated. However, this area has been allowed for in the overall hydraulic calculations in determining basins sizes and bio-retention areas and is therefore considered acceptable from the perspective of Council's adopted standards.

The proposed stormwater catchment associated with each Catchment is

- Catchment A = 173,700m2 (17.37Ha)
- Catchment B = 94,400m2 (9.44Ha)
- Catchment C = 280,700m2 (28.07Ha)
- Catchment D = 68,400m2 (6.84Ha)
- Catchment E = 14,380m2 (14.38Ha)
- Catchment F (Bypass TransGrid Easement) = 47,800m2 (4.78Ha)

6.3.5 On-Site Detention (OSD)

As discussed in Section 6.1, OSD is required within the development to mitigate post developed flows to pre-developed flow rates for peak Average Recurrence Intervals (ARIs).

A summary of the OSD requirements for each catchment is as follows:

Catchment A

All stormwater runoff from Catchment A will drain into the adjacent bio-retention Basin A to the north west of Road 01.

Outflows from Basin A have been positioned to coincide with the downstream location of Catchment G in the pre-developed case. Refer SCK008 and drawing C1302.

The OSD within the basin has been designed to achieve the following outcomes:

- OSD volume of 5,660m^3 (capacity of the basin from extended detention RL 57.0 to weir of basin RL 59.05)

- Post developed peak flows to be mitigated to pre-developed peak flows for all storm events between and including the 1 and 100 year events. Refer to Table 5

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.601	0.464
2 YR ARI	1.71	0.898
5 YR ARI	3.22	1.65
10 YR ARI	3.77	2.15
20 YR ARI	4.48	2.82
100 YR ARI	6.02	4.702

Table 5 – Pre-Post Developed Flows from Bio-Retention Basin A

Catchment B

All stormwater runoff from Catchment B will drain into the bio-retention Basin B adjacent to Ropes Creek to the west of Road 01.

Outflows from Basin B have been positioned to coincide with the downstream location of Catchment E in the pre-developed case. Refer SCK008 and drawing C1301.

The OSD within the basin has been designed to generally achieve the following outcomes:

- OSD volume of 3,006m^3 (capacity of the basin from extended detention RL 59.8 to weir of basin RL 61.655
- Post developed peak flows to be mitigated to pre-developed peak flows for all storm events between and including the 1 and 100 year events. Refer to Table 6

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.501	0.236
2 YR ARI	1.55	0.276
5 YR ARI	3.04	0.711
10 YR ARI	3.59	0.898
20 YR ARI	4.30	1.41
100 YR ARI	5.60	1.91

Table 6 – Pre-Post Developed Flows from Bio-Retention Basin B

Catchment C

All stormwater runoff from Catchment C will drain into the adjacent bio-retention Basin C adjacent Ropes Creek to the west of Road 01.

Outflows from Basin C have been positioned to coincide with the downstream location of Catchments C and D in the pre-developed case. Refer SCK008 and drawing C1301. The outflow position of Basin C is immediately downstream of the outflow location of Basin E. As such the combined outflows of Basin C and E have been compared to the existing catchment C and D for the pre-developed case.

The OSD within the basin has been designed to generally achieve the following outcomes:

- OSD volume of 10,379m^3 (capacity of the basin from extended detention RL 58.4 to weir of basin RL 60.65)
- Post developed peak flows to be mitigated to pre-developed peak flows for all storm events between and including the 1 and 100 year events. Refer to Table 7

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	1.27	1.07
2 YR ARI	3.93	2.25
5 YR ARI	7.73	4.33
10 YR ARI	9.11	5.9
20 YR ARI	10.90	7.54
100 YR ARI	14.20	9.97

Table 7 – Pre-Post Developed Flows from Bio-Retention Basin C

Catchment D

All stormwater runoff from Catchment D will drain into the adjacent bio-retention Basin D at the southern end of the development.

Outflows from Basin D have been positioned to coincide with the downstream location of Catchment A in the pre-developed case. Refer to SCK008 and drawing C1301.

The OSD within the basin has been designed to generally achieve the following outcomes:

- OSD volume of 2,759m^3 (capacity of the basin from extended detention RL 61.5 to weir of basin RL 63.25)
- Post developed peak flows to be mitigated to pre-developed peak flows for all storm events between and including the 1 and 100 year events. Refer to Table 8

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	0.283	0.107
2 YR ARI	0.806	0.367
5 YR ARI	1.52	0.83
10 YR ARI	1.77	1.27
20 YR ARI	2.11	1.37
100 YR ARI	2.83	1.749

Table 8 – Pre-Post Developed Flows from Bio-Retention Basin D

Catchment E

All stormwater runoff from Catchment E will drain into the adjacent bio-retention Basin E at the south of Ropes Creek.

Outflows from Basin E have been positioned to coincide with the downstream location of Catchments C and D in the pre-developed case. Refer to SCK008 and drawing C1301.

As mentioned previously for Basin C, the outflow position of Basin E is immediately upstream of the outflow location of Basin C. as such the combined outflows of Basin C and E have been compared to the existing catchment C and D for the pre-developed case.

The OSD within the basin has been designed to generally achieve the following outcomes:

- OSD volume of 4,289m^3 (capacity of the basin from extended detention RL 61.6 to weir of basin RL 63.1)
- Post developed peak flows to be mitigated to pre-developed peak flows for all storm events between and including the 1 and 100 year events. Refer to Table 8

Duration	Pre Developed Flows (m^3/s)	Post Developed Flows (m^3/s)
1 YR ARI	1.27	1.07
2 YR ARI	3.93	2.25
5 YR ARI	7.73	4.33
10 YR ARI	9.11	5.9
20 YR ARI	10.90	7.54
100 YR ARI	14.20	9.97

Table 9 – Pre-Post Developed Flows from Bio-Retention Basin E

6.3.6 Overland Flows

Overland flows within the access roads, carparks and hardstanding areas have been designed to be safely conveyed within the road carriageway complying with flow widths and velocities within the Penrith City Council Design Guidelines for Engineering Works.

The 100 year ARI flood level determined by Cardno within Ropes Creek adjacent to the proposed basins have been adopted as the tailwater levels for the hydraulic modelling of the basin and stormwater network for all catchments.

6.3.7 Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design encompasses all aspects of urban water cycle management, including water supply, wastewater and stormwater management. WSUD is intended to minimise the impacts of development upon the water cycle and achieve more sustainable forms of urban development.

The WSUD strategy, MUSIC Model and subsequent WSUD designs prepared by AT&L are based upon requirements within the Penrith City Council C3 Water Management DCP.

All stormwater runoff from catchments A, B, C and D as mentioned in Section 6.3.4 is proposed to drain into Bio-Retention basins allowing the water to be treated and discharged at rates acceptable to Penrith City Council. A summary of the Basin parameters is indicated in Table 13,details and cross sections included on the Civil drawings.

Discharge from the basins will be controlled via a rock lined swale that will intersect the existing creek system. These discharge swales will be design and documented to meet the NSW Office of Water (NOW) Guidelines for outlet structures on waterfront land.

Refer to attached Civil Drawings list in Appendix C.

6.3.7.1 WSUD Modelling – MUSIC Model

The MUSIC Model for Urban Stormwater Improvement Conceptualisation (MUSIC, Version 5.00.10) was used to evaluate pollutant loads from each of the proposed lots for Post-development (treated) conditions based on the proposed site development.

A conceptual view of the MUSIC model used in this report can be found in Appendix E.

Pluviograph data (6-minute rainfall intensity and evapotranspiration) for Horsley Park (Station 067119) was used in the MUSIC model.

6.3.7.2 Catchment Areas and MUSIC Parameters

All building lot catchment areas were assumed to be 65% roofed. Of the non-roofed areas, 90% of this area was assumed to be impervious. To provide a more accurate model, separate catchment nodes were created to simulate the roofed area and non-roofed areas for each lot.

MUSIC model input parameters for these catchments including rainfall-runoff, base flow concentration and stormflow concentration parameters were selected as per the Penrith City Council Water Sensitive Urban Technical Guidelines – Version 3 June 2015 document. The parameters used for the various catchment areas can be seen in tables 9, 10, 11 and 12.

Rainfall-Runoff Parameters

Parameter	Unit	Figure
Rainfall Threshold	mm/day	1.40
Soil Storage Capacity	Mm	150
Initial Storage	% of Capacity	30
Field Capacity	Mm	70
Infiltration Capacity Coefficient	a	150
Infiltration Capacity Coefficient	b	3.5
Initial Depth (Ground Water)	mm	10
Daily Recharge Rate	%	25
Daily Baseflow Rate	%	10
Daily Seepage Rate	%	0.00

Table 10 – Rainfall-Runoff Parameters – All Catchment Areas

Base Flow/Stormflow Concentration Parameters – Impervious (Roofed) Areas

Pollutant	Baseflow Concentration Parameter – Mean (log mg/L)	Baseflow Concentration Parameter – Std Dev (log mg/L)	Stormflow Concentration Parameters – Mean (log mg/L)	Stormflow Concentration Parameters – Std Dev (log mg/L)
TSS	0.000	0.000	1.300	0.320
Phosphorus	0.000	0.000	-0.890	0.250
Nitrogen	0.000	0.000	0.300	0.190

Table 11 – Base Flow/Stormflow Concentration Parameters – Impervious (Roofed) Areas

Base Flow/Stormflow Concentration Parameters – Pervious Areas

Pollutant	Baseflow Concentration Parameter – Mean (log mg/L)	Baseflow Concentration Parameter – Std Dev (log mg/L)	Stormflow Concentration Parameters – Mean (log mg/L)	Stormflow Concentration Parameters – Std Dev (log mg/L)
TSS	1.200	0.170	2.150	0.320
Phosphorus	-0.850	0.190	-0.600	0.250

Nitrogen	0.110	0.120	0.300	0.190

Table 12 – Base Flow/Stormflow Concentration Parameters – Pervious Areas

Base Flow/Stormflow Concentration Parameters – Road

Pollutant	Baseflow Concentration Parameter – Mean (log mg/L)	Baseflow Concentration Parameter – Std Dev (log mg/L)	Stormflow Concentration Parameters – Mean (log mg/L)	Stormflow Concentration Parameters – Std Dev (log mg/L)
TSS	0.000	0.00	2.430	0.320
Phosphorus	0.000	0.000	-0.300	0.250
Nitrogen	0.000	0.000	0.340	0.190

Table 13 – Base Flow/Stormflow Concentration Parameters – Road

MUSIC model parameters used for the Bio-retention basin were based off guidelines provided by FAWB – Stormwater Biofiltration Systems – Version 1, 2009, and were modified accordingly. Parameters used to model the bio-retention basin are shown in the table 13 below.

Parameter	Unit	Figure
Extended Detention Depth	m	0.30
Surface Area	m2	2000
Filter Area	m2	1900
Unlined Filter Media Perimeter	M	0.01
Saturated Hydraulic Conductivity	mm/hour	180
Filter Depth	m	0.50
TN Content of Filter Media	mg/kg	900
Orthophosphate Content of Filter Media	mg/kg	30.0
Exfiltration Rate	mm/hour	0.00
Base Lined	-	Yes
Vegetation Properties	-	Effective Nutrient Removal Plants

Overflow Weir Width	m	10.00
Underdrain Present	-	Yes
Submerged Zone	-	No

Table 14 – Bio-Retention Basin Parameters

6.3.7.3 Results

MUSIC modelling results presented as mean annual loads at the receiving node indicate that adopted target reductions are achieved, as shown in Table 8 and 9.

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	16,400	2,400	85.4	85
Total Phosphorus	32.6	10.4	68.2	60
Total Nitrogen	214	104	51.5	45
Gross Pollutants	2,720	11	99.6	90

Table 15 – Pollutant Loads – Combined Basin A

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	8,660	1,060	87.7	85
Total Phosphorus	17.8	5.54	69	60
Total Nitrogen	117	59.4	49.1	45
Gross Pollutants	1,490	16.4	98.9	90

Table 16 – Pollutant Loads – Combined Basin B

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	26,400	3,990	85	85
Total Phosphorus	53.8	18.7	65.3	60
Total Nitrogen	347	183	47.4	45
Gross Pollutants	4,420	4.46	99.9	90

Table 17 – Pollutant Loads – Combined Basin C

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	5,300	538	89.8	85
Total Phosphorus	11.6	3.46	70.3	60
Total Nitrogen	85	38.2	55.1	45
Gross Pollutants	1,090	14.3	98.7	90

Table 18 – Pollutant Loads – Combined Basin D

Pollutant	Sources (Kg/yr)	Residual Load (Kg/yr)	Reduction (%)	Target Reduction (%)
Total Suspended Solids	11,200	1,560	86.1	85
Total Phosphorus	24.4	7.71	68.4	60
Total Nitrogen	180	81.2	55	45
Gross Pollutants	2,290	119	94.8	90

Table 19 – Pollutant Loads – Combined Basin E

6.4 Conclusion

As highlighted in the above section all stormwater drainage within the Oakdale South development has been designed in accordance with the Penrith City Council Engineering Guidelines. This includes design of all pipework, On-Site Detention basins and WSUDs infrastructure. To summarise:

- OSD to be sized to ensure that for all rainwater events up to and including the 1:100 ARI event, new developments do not increase stormwater peak flows in any downstream areas.
- OSD to mitigate post development flows to pre-developed flows for peak Average Reoccurrence Interval (ARI) events.
- WSUD to achieve target reductions:
    - 85% Total Suspended Solids (TSS)
    - 60% Total Phosphorus (TP)
    - 45% Total Nitrogen (TN)
    - 90% Gross Pollutants (GP)
- Finished Floor Levels (FFL) to have minimum 500mm freeboard to 100 year overland flows
- The implementation of OSD to mitigate flows and WSUD systems to treat the water runoff prior to discharging into Ropes Creeks demonstrates a commitment to adhere to the Sydney Regional Environmental Plan (SREP) No 20 – Hawkesbury-Nepean River guidelines.

7 Water Balance

7.1 General

The water balance was simulated using a water cycle management model as part of the MUSIC Model to allow the evaluation of various elements of the water cycle to be assessed at differing stages in the development.

7.2 Water Balance Objective

Potable water supplies in the Sydney area are in recognised short supply with projected population increases, potential climate change, periods of extended drought and development in water sources of the Sydney region accentuating the growing demand. As a result, government bodies, together with Sydney Water have encouraged sustainable development by the implementation of an integrated approach to water cycle management (potable water, sewage, stormwater and rainwater) to offset demands of potable water supplies.

Whilst opportunities for Water Reuse include such initiatives as regional stormwater harvesting, black water recycling and recycled water, this development is limited to rainwater collection and reuse on an individual lot by lot basis.

As such, we have used MUSIC to establish an estimated tank size for each lot within the development and demonstrated the volume of water reuse possible and provide a more sustainable servicing solution.

7.3 Water Balance End Uses

AT&L has identified the following water demand end uses to be required across the development:

- toilet and urinal flushing, hand basin washing, showering;
- kitchen (food preparation, washing), drinking;
- air conditioning cooling;
- internal cleaning;
- leaking water devices;
- truck/car wash;
- external cleaning; and
- watering (outdoor garden use).

End Use (Water Demand)	Water Demand* (L/day for a total development)	Percentage of Total Water Demand	Assumptions
Toilet and Urinal Flushing	586	12%	Based on '3-star' toilet and urinal fittings. Based on being flushed
Hand Basin Washing	348	7%	Based on 3 uses of the hand basin per person/day for 15 seconds each time using a 3-star tap fitting (8.5 L/min).
Showering	698	14%	20% of staff have showers each day for 8 minutes each time using a 3-star shower head (8L/min)
Kitchen (washing& drinking)	164	3%	3 L / EP/ day
Air Conditioning Cooling	496	10%	10% of total water consumption-of which 88% evaporates.
Leaking Water Devices	Negligible	0%	Traditionally 0.7% of total water consumption in residential dwellings is attributed to leaks (SWC, 2005). However, as the new dwellings will be fitted with efficient, correctly installed and appropriately maintained fittings- the water consumption attributed to leaking water devices were assumed to be negligible.
Unaccounted for Water	499*	10%*	Unaccounted for water accounted for 10% of overall water demand in 2005 (SWC, 2005). *It has been assumed that "unaccounted for water" is equivalent to 10% of pressurised water demands. In reality this will be made up from a portion of both the potable and non-potable demands. This results in an overall "unaccounted for water" demand, except in the case where rainwater tanks are used to supplement end uses. In this case the total "unaccounted for water" demand will be less than 10%.
Truck Wash (Not on all lots)	300	6%	Based on two trucks being washed each day, requiring 150 L per wash.
Internal Cleaning	74	1.5%	Based on the assumption that cleaning involves toilet flushing (8 toilet flushes- 24L) and mopping (5 buckets each 10 L- 50L).

External Cleaning	20	0.4%	Assuming each bucket of water requiring for mopping contains 10 L
Watering (Outdoor Garden use)	1,777	36%	Using subsurface irrigation (and other water efficient watering methods)- the watering required during an 'average' rainfall year was assumed to be 0.88 mm/day (source unavailable).
Total (L/day/ Generic Warehouse (or per 2.04 net hectares)	4,962	100%	
Total (L/day/ net hectare)	2,432	-	

Note * the water demand rates indicated in this table are based on the Oakdale Concept Plan Water Balance Options Report prepared by GHD in December 2007. Refer to Appendix H for Water Demands – End Uses section summarising the proposed water usages.

Table 20 – Summary of Adopted End Use Assumptions within the Development

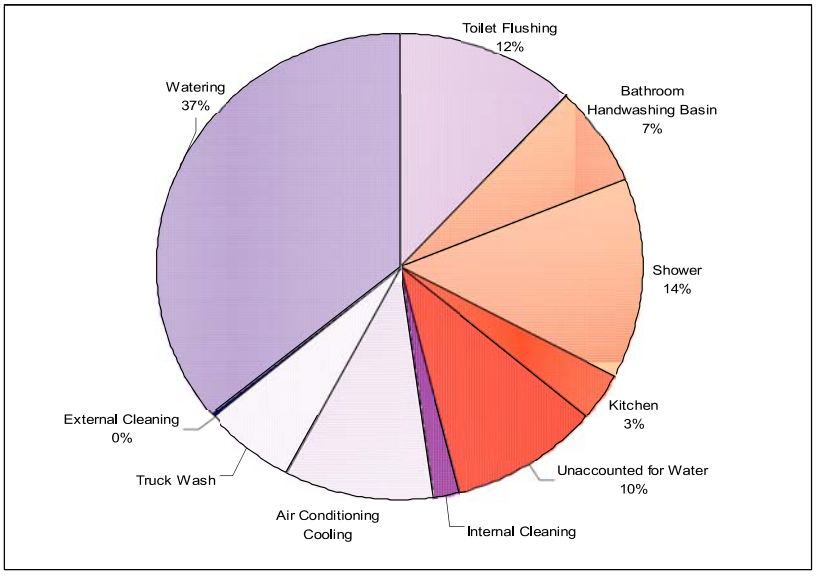

Table 21 – Water Demand Breakdown by End Use within the Development

The above image shows the proportion of total water demands for irrigation and toilet flushing within the development could be as much as 50% across the development that may be potentially substituted for by rainwater reuse.

The remaining 50% of the development's water demands requires a potable water supply.

As such maximising the substitution of non-potableend use demand would result in a maximum potable water saving in the order of 50%.

7.4 Total Site Demands

Portion of Proposed Warehouse Facility	**1A Area (m^2)**	**1B Area (m^2)**	**1C Area (m^2)**	**1D Area (m^2)**
Warehouse (including dock office lower level)	20,395	23,675	26,550	28,760
Office	1,554	1,029	1,368	1,028
Hardstand (including internal circulation roads, footpaths, car parks)	11,575	13,305	13,129	14,088
Garden / Landscape Area (including courtyards)	6,938	8,730	10,143	7,201
Total Area of Proposed Warehouse Facility	40,462	46,739	49,822	51,077
Total Number of Toilets	37	16	28	16
Daily Water Usage (based on 2.432kL/day/ net Hectare) as per Table 4	**5.34kL/day**	**6.0kL/day**	**6.79kL/day**	**7.24kL/day**

Table 22 – Total Site Demands and Daily Usage

7.5 Rainwater Reuse

The use of rain water collected in rainwater tanks from roof runoff of the warehouse roofs provides a valuable alternative to potable water for a variety of non-potable end uses, such as vehicle washing, air conditioning cooling, toilet flushing and watering.

We have assumed for this development irrigation and toilet flushing will be plumbed to the rainwater tanks. Other uses such as truck washing maybe considered at the detailed design stage.

A rainwater tank model was constructed to simulate the rainwater tank operations and select the optimal rainwater tank size, in doing so, the following considerations were made:

- Rainfall received;
- Roof area or runoff area;
- Roof Wetting;
- First Flush; and
- Rainwater demands (by end use).

Refer Appendix F for illustration of reuse.

7.6 Rainwater Tank Model Assumptions

The rainwater tank model assumptions built into the scenarios assumed the following:

Rainfall received

The rainfall runoff that could potentially be captured by the rainfall tank from the roof of each building was simulated individually for the 'dry', 'wet' and 'average' rainfall year within each scenario run.

Roof Wetting, First Flush Diversions and Overflow

While it is assumed that rainfall runoff has the potential to runoff 100% of the area of the roof into the rainwater tank, the proportion of rainfall that actually reaches the rainwater tank is affected by four factors:

- It is assumed that the initial 2mm of rainfall that falls on the roof is considered 'wetting', that is, potential rainfall runoff that is not captured by the rainwater tank, but is rather 'lost runoff' as evaporation or other;
- To prevent sediment and other pollutants entering the rainwater tank, a portion of the initial runoff from the roof is transferred to stormwater, this is known as the 'first flush'. The portion of water diverted as part of the first flush

differs for each facility depending on the amount of pollution each roof is susceptible to.

- As the development is located in a predominantly light industrial area, where there may be potential for some roof pollution, a standard first flush volume of 1mm of runoff from across the roof area has been adopted.
- Any roof runoff that exceeds the rainwater tank capacity is 'overflow', and is directed to the stormwater drainage system.

7.7 Rainwater Tank Modelling

7.7.1 General

For the MUSIC analysis the following parameters are assumed:

- An allowance for 20% loss in rainwater tank size volume to allow for anaerobic zones, mains water top up levels and overflow levels
- Approximately 30% of the total roof area can drain into the rainwater harvest tank
- The daily usage is calculated based on 2.432kL/day/ building area as per the requirements from Table 20.

7.7.2 Rainwater Tank Modelling Results

The use of a rainwater tank was simulated for 'average' rainfall conditions to service three differing combinations of end uses for each Facility being:

Lot Number	Total Roof Area (m^2)	Roof Area draining to tank (m^2)	Size of Tank(kL)	% of total non-potable water used from tank (based on MUSIC modelling)
1A	21,949	6,585	55	**54.8**
1B	24,704	7,411	55	**52.6**
1C	27,918	8,375	60	**52.1**
1D	29,788	8,936	70	**53.9**

Table 23 – Percentage of Non-Potable Water Used from Tank

7.8 Conclusion

The use of rainwater harvest tanks and the design basis to size the tanks to ensure as a minimum 50% of all non-potable water on each lot can be sourced from the

tank, demonstrates a commitment to water recycling and minimising the usage of mains water.

This is in line with the NSW Stage Government's objective of reducing the amount of potable (drinking) water consumed for non-potable uses.

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8 Flood Modelling

A Flood Impact Assessment of the Proposed Oakdale South Estate was undertaken by Cardno in May 2016 for the OSE SSD Proposal. Cardno have provided a revised Flood Impact Assessment Report for the OSE S96 masterplan.

See attached within the EIS for flood report.

8.1 Purpose of Flood Report

The purpose of this report is determine the flood impact assessment to the surrounding areas and proposed building pads and roads within the Oakdale South site due to the proposed development. For the basis of the proposed development conditions Cardno used the latest Architectural masterplan and AT&L design siteworks plan. *Both the 100 yr ARI and PMF (Probable Maximum Flood) levels have been identified within this report.*

As mentioned above, Cardno have provided a revised Flood Impact Assessment Report to reflect the OSE S96 masterplan.

8.2 Flood Modelling Results

Based on the Cardno flood report the following impacts were discovered when comparing the proposed development flood conditions against the existing flood conditions:

- There are minor impacts on 100 yr ARI flooding on the Ropes Creek floodplain which does not adversely impact on any adjoining property subject to Post Development peak flows being limited to Pre-Development levels
- It is noted that within the easement the 100 yr ARI flood extents are reduced, velocities maintained and that while the depth is locally increased (generally 0.1-0.2m increase with local increases of 0.2-0.5m) these local impacts are located around 60m from the existing transmission tower. It is concluded that these local flood impacts, which are confined close to the development, are expected to have negligible impact on the maintenance of TransGrid's easement and do not pose a risk to existing transmission stanchions.
- It is concluded these local flood impacts are expected to have negligible impact on the maintenance of Transgrid's easement and do not pose a risk to existing transmission stanchions.
- There are some local increases in the 100 yr ARI velocities due to local earthworks however these changes are confined within the 100 yr ARI flood extent which is not significantly changed by proposed earthworks.
- The 100 yr ARI flood levels in the vicinity of the Warragamba Pipelines Corridor either do not increase or slightly decrease while the 100 yr ARI flood velocities in the vicinity of the pipeline are effectively unchanged.
- There are both local reductions and increases in the PMF levels due to the development. These minor changes do not significantly change the PMF extents on any adjoining properties.

- The PMF levels in the vicinity of the Warragamba Pipelines Corridor are largely unchanged or slightly reduced in level.
- The PMF velocities in the vicinity of the Warragamba Pipelines Corridor are effectively unchanged.

As part of the approved SSD proposal, significant consultation was undertaken with TransGrid in relation to potential flood impacts within the existing TransGrid transmission easement within OSE. In summary the SSD proposal confirmed the following:

- No stormwater runoff from OSE allotments and/or road reserves will be directed to the existing TransGrid transmission easement
- Catch drains/ swales will be provided within the TransGrid transmission easement to convey flows
- The 1 in 100 year ARI post-development flood extents within the TransGrid easement are reduced in comparison to pre-development conditions. The distance between the base of the existing TransGrid 132kV transmission tower to the 100 year ARI post-development flood extents being approximately 60m.

The above are still confirmed within the OSE S96 application and revised Cardno Flood Impact Assessment.

8.3 Conclusion

The Cardno report concludes that the proposed development will have minor impacts on the 100 yr ARI flooding on the Ropes Creek floodplain however this will not adversely impact on any adjoining property. This is subject to the post-developed peak flows being limited to pre-developed flows which has been discussed in Section 6 of this report.

The PMF levels in the vicinity of the Warragamba Pipelines Corridor are largely unchanged or slightly reduced in level.

It is noted that within the easement the 100 yr ARI flood extents are reduced, velocities maintained and that while the depth is locally increased (generally 0.1-0.2m increase with local increases of 0.2-0.5m) these local impacts are located around 60m from the existing transmission tower. It is concluded that these local flood impacts, which are confined close to the development, are expected to have negligible impact on the maintenance of TransGrid's easement and do not pose a risk to existing transmission stanchions.

The OSE S96 post-development flooding conditions remain largely unchanged and/or reduced to the approved OSE SSD flood conditions. For further details, refer Cardno's revised OSE S96 Flood Impact Assessment report within the EIS.

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9 Creek Realignment

A Watercourse Realignment design and report for Ropes Creek Tributary within the OSE was undertaken by Aecom in August 2015 for the OSE SSD proposal. Aecom have provided a revised Watercourse Realignment report for the OSE S96 masterplan. See attached within the EIS for Watercourse Realignment report.

Ropes Creek and associated Tributaries (Drainage Lines) surrounding Oakdale South are shown below within Figure 7.

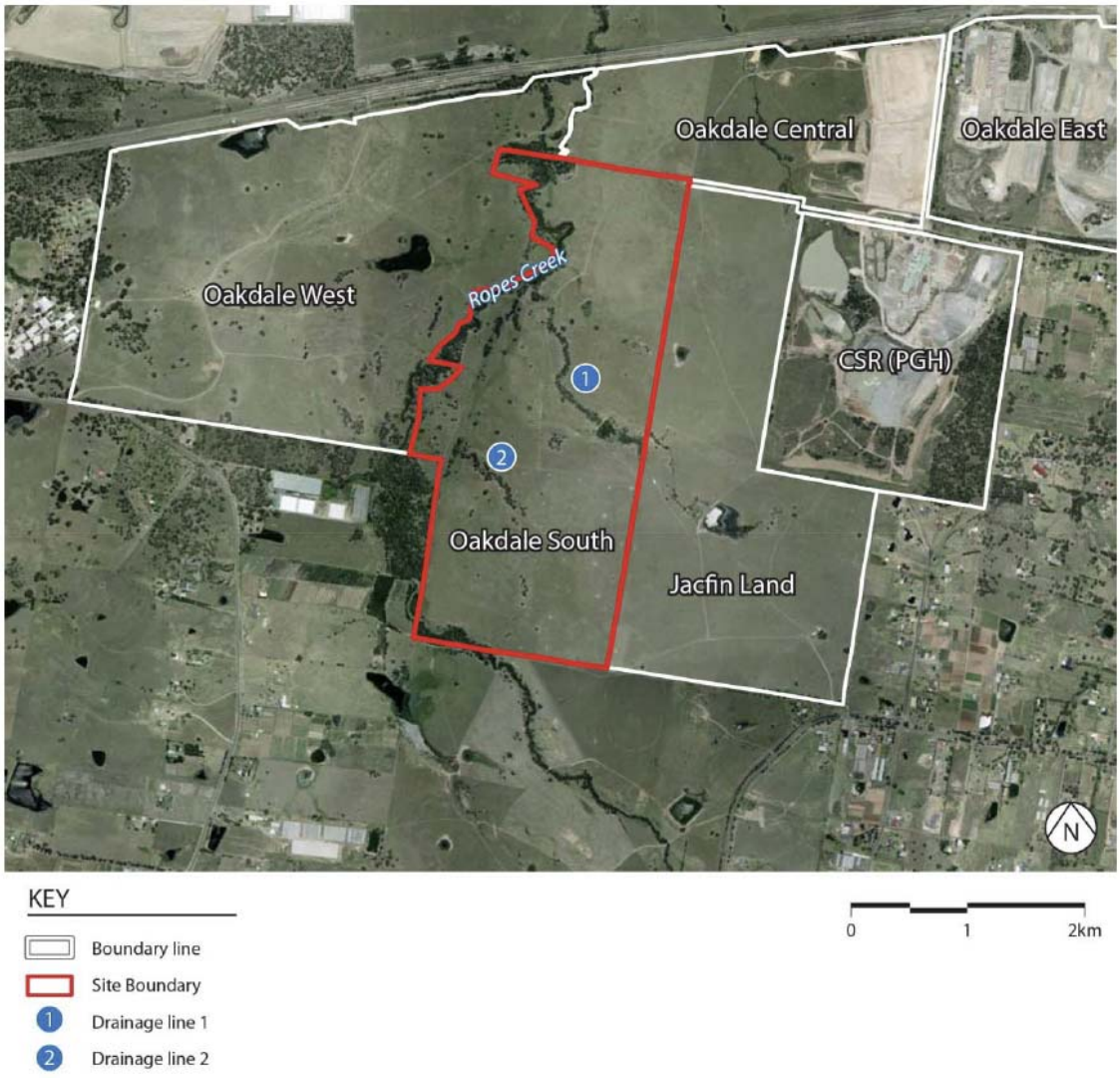

Figure 7 – Ropes Creek Drainage Lines

(Source: Figure 2 of Aecom Riparian Corridor Assessment Ref: 60333552[3]*)*

9.1 Purpose of Realignment Report

The purpose of Aecom's report is:

- To meet the requirements of the Department of Primary Industries – Office of Water (DPI-OW) as per *the Guidelines for Watercourse Crossings on Waterfront Land* and *the Guidelines for instream works on waterfront land*
- To undertake the detailed design of the waterway
- To protect and enhance stormwater flow, water quality, stream ecology and existing riparian vegetation within the riparian corridor
- To minimise impacts of the development on the hydrologic, hydraulic and geomorphic function of the waterway
- To have limited impact on the 1% AEP peak flood levels as a result of any physical change to the waterway
- To create a visually attractive riparian environment though the coordination of a weed control and revegetation program that is consistent with the existing character of the creek

9.2 Creek Realignment Results

Key elements as identified in the Aecom Creek Realignment report is as follows:

- Ropes Creek Drainage Line 1 (refer Figure 7) is a 1st order watercourse which flows in a westerly direction through the centre of the Oakdale South development. As Ropes Creek Drainage Line 1 is a 1st order watercourse, it is required to be retained, generally with a 10m vegetated riparian zone both sides of the channel.
- Drainage Line 2 (refer Figure 7) is not defined as a watercourse that is required to be treated in accordance with NOW guidelines. In this regard, it is permissible for it to be removed.
- The development layout involves the diversion of the Ropes Creek Drainage Line 1 to enable a local perimeter road to be incorporated into the estate as well as providing a location to construct a water quality treatment facility (bio-retention basin).
- The development will divert all stormwater runoff from lots and roads into storage basins that provide two functions;
    - detention of stormwater flow
    - water quality treatment through bio retention
- The section of Ropes Creek Drainage Line 1 upon which development will occur, will be filled and compacted with construction materials suitable for a road embankment.
- Upstream of the Estate Road No.1 a relatively small re-alignment will be undertaken to connect with the culvert crossing point, retaining vegetation

upstream of this point including an existing farm dam which will be kept as a habitat feature.

- A small section of Drainage Line 1 about 50 metres downstream of Estate Road No.1 will be remaining intact as a low flow channel. High flows will be diverted to the main re-alignment channel.

- A small section of Drainage Line 1 between the take-off point for the re-alignment section of the watercourse and the Estate Road No.1 embankment will be retained to preserve the bank and bench vegetation and maintain as much ecological value as possible. The creek (instream) will be filled and regraded to prevent permanent ponding of stormwater against the road embankment and also limit the potential for problems to occur due to shallow stagnant water (e.g. water quality).

- The re-aligned waterway is 410m long and at the downstream end connects with an existing smaller tributary stub of Ropes Creek, and has been designed to incorporate ecological features such as the inclusion of two instream benches and two pools.

- The length of the waterway re-alignment has been extended through the incorporation of a number of meanders. The re-alignment length, inclusion of three longitudinal drops (riffles) and increased channel width (compared to the existing tributary) has allowed for improved hydraulic conditions.

- A single road crossing has been included in the waterway design which consists of two culvert structures under Estate Road No.1 (one for drainage and one for fauna passage). Culvert outlet protection is incorporated into the culvert design.

- The waterway re-alignment includes bank batters between a 1:6 and 1:8 grade. This feature allows for easier rehabilitation and management for biodiversity gain, promoting the eventual return to a mature community characteristic of Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion.

- Provenance plant material will be used for planting of the re-aligned section of the watercourse where practicable.

- The waterway re-alignment area will be reinstated to a plant community type characteristic of the EEC forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain; Sydney Basin Bioregion.

- The ecological integrity of these corridors will be substantially increased as a result of additional biodiversity offset, riparian corridor and native grassland planting.

- These areas will then be subject of long-term management in accordance with the provisions of the Biodiversity Offset Strategy.

9.3 Conclusion

The Aecom Creek Realignment report presents a design for the realignment of Ropes Creek Tributary and the associated vegetation management. The report indicates the results of the watercourse re-design, meet the requirements of the NSW Department of Primary Industries Office of Water. This report can be used to satisfy the requirement for obtaining approval for the watercourse works.

On the basis of the above, Aecom's report states that it is considered that the potential impacts on watercourses will generally be limited to the initial works and plant establishment period for the re-aligned section of Drainage Line 1, after which this re-aligned watercourse is expected to attain a stable and ecologically robust outcome. The impact of the project on all other watercourses is expected to be beneficial, with increased cover of remnant plant communities and associated reduced edge effects.

10 Services

10.1 Sydney Water

AT&L has undertaken extensive consultation with Sydney Water during the development of the OSE SSD proposal. As a result of the ongoing development within the Western Sydney Employment Area (WSEA) Precinct No.8 – Area South of Pipeline, Sydney Water requested that a Local Area Servicing Plan (LASP) for both sewer and potable water infrastructure was prepared to ensure that future Sydney Water infrastructure could ultimately service future developments within the WSEA Precinct No.8 – Area South of Pipeline.

The LASP for sewer and potable water (GHD 2016) identifies the servicing strategy for the WSEA Precinct No.8 – Area South of Pipeline as shown below within Figure 8.

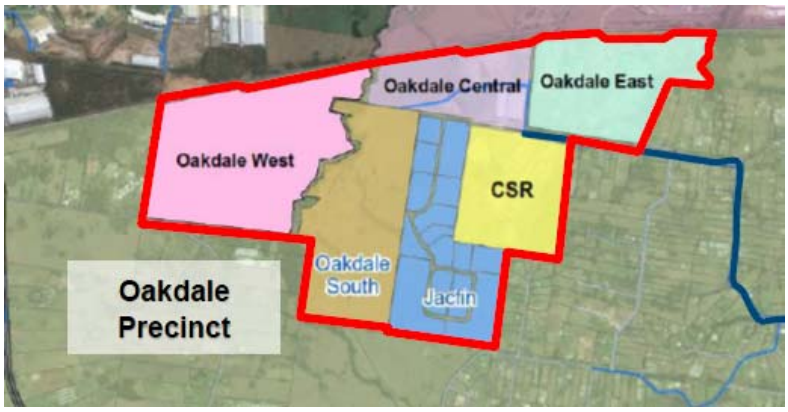

Figure 8 – WSEA Precinct No.8 – Area South of Pipeline.

At the request of Sydney Water, GHD were engaged to prepare the LASP for both sewer and potable water. During preparation of these documents, extensive consultation was undertaken with Sydney Water, Jacfin and CSR to ensure compliance with Sydney Water's performance requirements for both sewer and potable water.

An overview of the sewer and potable water servicing strategy for the WSEA Precinct No.8 – Area South of Pipeline with specific reference to Oakdale South is provided below.

10.1.1 Water Supply

Oakdale South is zoned as IN1 'General Industrial' under the State Environmental Planning Policy (Western Sydney Employment Area) 2009. Water demands were assessed for Oakdale South on this basis within the LASP for potable water (GHD 2016).

Within the LASP for potable water (GHD 2016), an evidence based approach to forecasting future demands in the WSEA Precinct No.8 – Area South of Pipeline, based on observed demands in an adjacent water supply system, was adopted as per the 'Water System Planning Guidelines 2014".

The LASP for potable water (GHD 2016) calculated the potable water daily demands for Oakdale South as follows:

- Average Day Demand (ML/d): 0.65ML/d
- Max Day Demand (ML/d): 1.0ML/d

The LASP for potable water (GHD 2016) states that Oakdale South will be supplied via extension of the existing DN250 potable water main (Refer Section 3-4 within Figure 2 in Appendix G) within Millner Avenue which is supplied from the Cecil Park Supply System.

To improve system reliability, the LASP also requires a proposed DN300 connection (refer section 4-7 within Figure 2 in Appendix G) between the existing DN250 within Millner Avenue (refer section 3-4 within Figure 2 in Appendix G) to the proposed DN300 within Oakdale West (refer section 7-8 within Figure 2 in Appendix G) which ultimately connects to the existing DN300 within Erskine Park Link Road (EPLR). The proposed DN300 connection (refer section 4-7 within Figure 2 in Appendix G) between Millner Avenue and Oakdale West is included within this proposal and will be provided as part of the OSE development.

A DN300 connection between the existing DN450 within Burley Road and the Millner Avenue Roundabout (refer section 2-4 within Figure 2 in Appendix G) is also required as part of the LASP. This proposed DN300 connection will be provided as part of the OSE development subject to Sydney Water Notice of Requirements.

The provision of OSE potable water reticulation (internal and external works) will be undertaken in accordance with the Sydney Water endorsed LASP for potable water (GHD 2016), Sydney Water requirements and procurement process.

10.1.2 Sewerage

Oakdale South is zoned as IN1 'General Industrial' under the State Environmental Planning Policy (Western Sydney Employment Area) 2009. Sewer loads were assessed for Oakdale South on this basis within the LASP for sewer (GHD 2016).

The East St Clair trunk sewer system (construction in 2015-2016) connects the wider WSEA Precinct No.8 – Area South of Pipeline to the existing St Clair Carrier approximately 1.6km to the north west of the site.

The LASP for sewer (GHD 2016) calculated the sewer loads for Oakdale South as follows:

- Average Dry Weather Flow (ML/d): 0.99ML/d

The LASP for sewer (GHD 2016) identified the sizing of sewer infrastructure required to service Oakdale South as between DN450 to DN225. For further details on proposed sewer alignments for Oakdale South, refer to Appendix G.

The provision of OSE sewer infrastructure (internal and external works) will be undertaken in accordance with the Sydney Water endorsed LASP for sewer (GHD 2016), Sydney Water requirements and procurement process.

In the event of delays of delivery of sewer infrastructure to service OSE, temporary interim measures may need to be adopted such as provision of sewer rising main

systems between OSE and the East St Clair Carrier, located at Millner Avenue roundabout, subject to PCC and/or Sydney Water approvals.

An overview of the preliminary alignments and sizing of sewer infrastructure within the Sydney Water endorsed LASP for sewer (GHD 2016) is shown within Figure 6 in Appendix G.

10.2 Communications

Existing conduits were installed as part of the Oakdale Central development and are located with both verges of Millner Avenue. To service Oakdale South, the pit and pipe network will be extended and reticulated through the roadways to service the proposed lots.

No NBN is currently installed within the Oakdale Central Precinct.

Refer to AT&L combined utilities plans C1051 to C1063.

10.3 Gas

Existing Conduits were installed as part of the Oakdale Central development and are located with both verges of Millner Avenue. To service Oakdale South, the conduits will be extended and reticulated through the roadways to service the proposed lots.

Refer to AT&L combined utilities plans C1051 to C1063.

10.4 Electrical

Over the past 18 months numerous meetings have been held with Endeavour Energy (EE) in relation to servicing the proposed development site. Currently EE have indicated that a new Zone Substation (ZS) will ultimately be required to service the development. The new ZS will potentially have capacity to also service adjacent developments including the Jacfin, CSR and Oakdale West sites. This is subject to detailed design and investigation by EE.

The OSE SSD proposal included a Services Lot adjacent to Precinct 2 to allow for a potential Endeavour Energy Zone Substation. However, a letter received from Endeavour Energy dated 22nd February 2016 states the following:

> *"Current analysis of the servicing strategy indicates the ideal location for a zone substation to service Oakdale West, Oakdale South and Oakdale Central precincts is within the Oakdale West precinct. This is mainly due to the potential load requirements of Oakdale West Estate and accessibility to existing transmission infrastructure near Oakdale West.*
>
> *On the understanding that Goodman and Austral provide a zone substation site within Oakdale West Estate, Endeavour Energy confirms the existing dedicated service lot within the Oakdale South Estate is no longer required."*

Refer Appendix I for letter from Endeavour Energy.

As such the services lot and requirement for a zone substation has been removed from the OSE proposal.

EE has indicated that there is adequate spare capacity to service Oakdale South via the existing Eastern Creek Zone Substation.

Refer Appendix F for proposed service strategy drawings.

10.5 Conclusion

This section demonstrates that services including sewer, water, power, telecommunications and gas can be made available to the site.

Internal reticulation will be coordinated at the Construction Certificate (CC) stage of works and applications to the relevant authorities.

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11 Infrastructure Staging

11.1 Staging

It has been assumed that the development will be constructed over three (3) stages in accordance with proposed development layouts.

- Stage 1 - Precinct 1 and 2
- Stage 2 – Precinct 3,4 and 5
- Stage 3 – Precinct 6

A summary of the works required for the stages is outlined in the following sections. A copy of the staging plan is provided in Appendix B.

11.1.1 Stage 1

Works.	Description
General	Construction of estate roads, retaining walls, bio-retention basins, lead in services, utility reticulations, creek realignment and culvert works required for stage 1
Earthworks	Bulk and detail earthworks with the following volumes: Cut: -193,991 m3 Fill: +872,556 m3 Import: 678,645 m3
Creek works	Realignment of the Ropes Creek tributary, swales, open channels and surface treatment for scour protection
Basin Works	Bio-retention basin A and B
Road network	Road 1 Chainage 0 to 1,000 Road 02 Road 03 Stormwater Pits and Pipes
Services	<u>Water</u> Reticulation of DN250 watermain along estate road (Refer Section 4-5 within Figure 2 in Appendix G) and connection to the existing watermain in Millner Avenue Provision of a proposed DN300 connection (refer section 4-7 within Figure 2 in Appendix G) between the existing DN250 within Millner Avenue (refer section 3-4 within Figure 2 in Appendix G) to the proposed DN300 within Oakdale West (refer section 7-8 within Figure 2 in Appendix G) which ultimately connects to the existing DN300 within Erskine Park Link Road (EPLR). Provision of a proposed DN300 connection between the existing DN450 within Burley Road and the Millner Avenue Roundabout (refer section 2-4 within Figure 2 in Appendix G) subject to Sydney Water Notice of Requirements. <u>Sewer</u>

	Construction sewer infrastructure between DN450 to DN225 required to service OSE. Gas Provision of conduits in the road way Communications Extension of pit and pipe network from Millner Avenue Electrical Extend the existing 11kV cable at the end of Millner Avenue and loop around the new proposed road network.

Table 24 – Stage 1 works

11.1.2 Stage 2

Works.	Description
General	Construction of estate roads, retaining walls, bio-retention basins, lead in services, utility reticulation and creek realignment required for stage 2
Earthworks	Bulk and detail earthworks with the following volumes: Cut: -360,708 m3 Fill: +556,298 m3 Import: 195,590 m3
Basin Works	Bio-retention basin C and E
Creek works	Realignment of the Ropes Creek tributary, swales, open channels and surface treatment for scour protection
Road network	Road 1 Chainage 1,000 to 1,520 Road 04 Road 05 Stormwater Pits and Pipes
Services	Water Reticulation of DN200 watermain along estate road (Refer Section 5-6 within Figure 2 in Appendix G). Sewer Construction of sewer infrastructure between DN450 to DN225 required to service OSE, extension through to Jacfin property, Connection to the existing East St Clair Carrier. In the event of delays of delivery of sewer infrastructure to service OSE, temporary interim measures may need to be adopted such as provision of sewer rising main systems between OSE and the East St Clair Carrier, located at Millner Avenue roundabout, subject to PCC and/or Sydney Water approvals. Gas Provision of conduits in the road way Communications Extension of pit and pipe network along Road 01 Electrical As part of Stage 2, new 11kV feeders may need to be provided from

	Eastern Creek Zone Substation to OSE subject to Endeavour Energy Design Brief. If required, these feeders would be provided within the existing Old Wallgrove Road and Millner Avenue duct network. Alternatively, the existing 11kV cable at the end of Millner Avenue will be extended to loop around the new proposed road network.

Table 25 – Stage 2 works

11.1.3 Stage 3

Works.	Description
General	Construction of final building pad and bio-retention basin
Earthworks	Bulk and detail earthworks with the following volumes: Cut: - -13,785 m3 Fill: +71,950 m3 Import: 58,165 m3
Basin Works	Bio-retention basin D
Services	Sewer Reticulation to remaining building pad Lot 6A and Lot 6B, extension through to Jacfin property.

Table 26 – Stage 3 works

12 Construction

12.1 Clearing and Grubbing

The site is predominantly grassed paddocks with minor pockets of trees. Clearing and Grubbing would generally consist of slashing, tree removal and removal of grass and roots within the top layer of the topsoil where required.

Where trees are to be removed these will be mulched and then reused on site as part of the landscape treatment.

Clearing and grubbing would take place in a staged manner in line with civil and infrastructure works. Where possible existing ground coverings will be left undisturbed until such time it is required to be removed.

All riparian and offset lands would be fenced off and trees to be retained marked to prevent clearing and protected areas.

12.2 Demolition

There are no structures on the site requiring demolition.

12.3 Road works and Services

The roads and services to be constructed will be undertaken once the earthworks for the road corridor and adjacent lots are completed.

The performance of the imported sub grade may ultimately determine whether any modifications are required to the pavement design although at the time of tender, the contractors will be required to determine their source of material and the applicable CBR.

If the cut material from the site is better suited for sub grade, it will be separated and utilised for the final layers.

The general sequence of the road and services is as follows;

- Boxing and construction of base pavement layers
- Excavation for stormwater and laying of pipes and construction of pits
- Excavation for combined services trenches
- Where deep sewer is required to cross roads, this will be finalised
- Services road crossings including water
- Kerb and gutter
- Watermain installation
- Final pavement base layer
- First layer of asphalt

- Light poles stood
- Foot paths constructed
- Topsoil and Landscape completed
- Signage and linemarking

Note, final layer of asphalt will not be installed until 12 months after completion of that stage.

Stormwater basin will be established as a matter of priority to control sediment runoff and once the roads are completed these will be finalised in their final configuration.

12.4 Program

Subject to authority approvals, availability of suitable fill sources and other external factors the OSE development is anticipated to be constructed over an 18-month period.

12.5 Construction Plant and Equipment

Throughout the various stages of the project, it is expected that the following construction plant and equipment will be required. This list is includes but is not limited to:

- Construction compound
  - Site offices and facilities for staff
  - Car parking
  - Meeting rooms
  - Lay down area for delivery of materials
  - Mechanical bay for plant
- Construction plant
  - Skidsteer loader (Bobcat) 5 of
  - Backhoe (dig depth up to 5 m) 5 of
  - Backhoe + hammer 2 of
  - Dozer 98 to 145 kW (equivalent to Caterpillar D6) 1 of
  - Dozer 145 to 175 kW (equivalent to Caterpillar D7) 1 of
  - Dozer 220 to 305 kW (equivalent to Caterpillar D8) 1 of
  - Dozer 305 to 400 kW (equivalent to Caterpillar D9) 1 of
  - Grader 3 of
  - Loader (up to 90 kW) 5 of
  - Roller, multi-tyred 1 of
  - Roller, padfoot (various sizes) 3 of
  - Roller, smooth drum 1 of
  - Scraper, open bowl, 17 to 28 m3 5 of
  - Excavator < 10 t + hammer 1 of
  - Excavator 12 t + hammer 1 of
  - Excavator 20 t + hammer 1 of

- Excavator 30 t + hammer 1 of
- Watercart 15,000 L 1 of
- Truck 13 t payload 1 of
- Truck and dog 30 t payload 5 of
- Road profiler
- Air compressor (without operator) 41 L/s
- Generator 6.8 kVA (without operator)

12.6 Conclusion

This section demonstrates the works required to complete the OSE development and the likely construction program and plant and equipment to be used to complete these stages.

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Appendix A

Proposed S96 Masterplan

Site Area Schedule

Total Site Area	**117.11 ha**
Less:	
Non Developable Land	33.46 ha
Easements	4.56 ha
Regional Roads	1.74 ha
Estate Roads	5.70 ha
	45.46 ha
Development Areas	
Precinct 1	18.81 ha
Precinct 2	5.43 ha
Precinct 3	18.94 ha
Precinct 4	14.27 ha
Precinct 5	6.46 ha
Precinct 6	6.84 ha
Amenity Lot	0.58 ha
Total Developable	**71.33 ha**
Total Warehouse	314,580 sqm
Total Office	14,715 sqm
Total Facility	329,295 sqm

OAKDALE WEST
LOT 1
DP 120679

Proposed Western North South Link Road

Proposed Southern Link Road

Tranmission Easement

PRECINCT 6

6A

6B

3D

PRECINCT 3

3C

3B

3A

Transmission Easement

Site Access

Estate Road 04

AMENITY PRECINCT 5800sqm

Proposed E2 Zone Alignment

PRECINCT 5

5A

PRECINCT 4

4A

Estate Road 01

Estate Road 03

2A

PRECINCT 2

2B

1C

PRECINCT 1

1D

Estate Road 02

1A

1B

Millner Ave

Future Elevated Regional Road Min 4.5m Clearance at Millner Ave

Approved Millner extension and roundabout refer SSD 6068

OAKDALE CENTRAL

30m Wide Road Reserve

E2 Zoning Boundary

Current

Proposed

SBA ARCHITECTS

Oakdale South Estate

Horsley Park

SSDA Masterplan

1:2500 @ A1
1:5000 @ A3

20 Sept 2016

OAK MP 02 (Z)