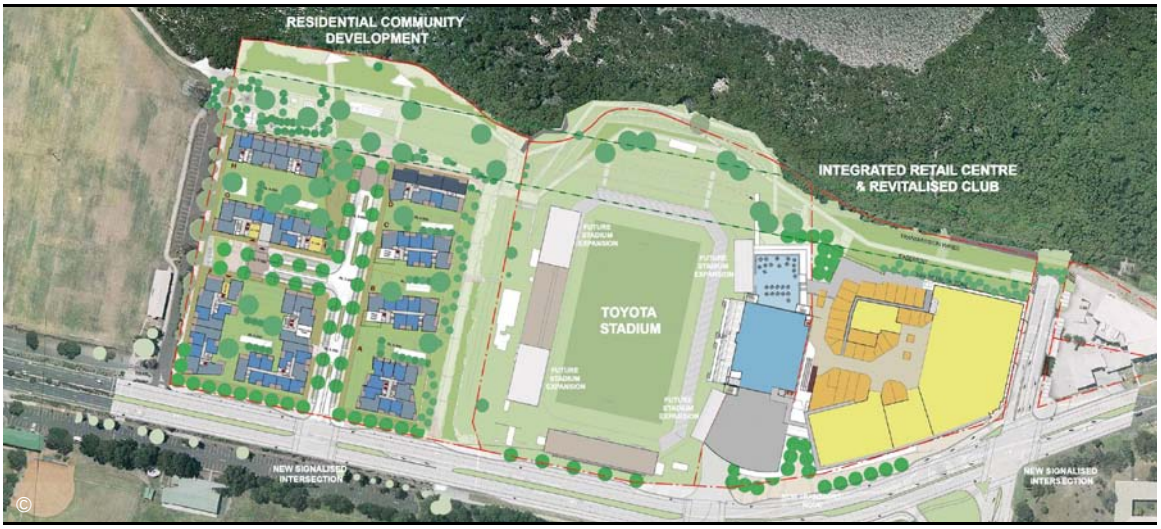
Woolooware Bay Town Centre Redevelopment



Retail Civil Infrastructure Report : Project Application

Author: Andrew Tweedie

Approver: Anthony McLandsborough

Report no: 11-59-5003 **Revision:** 03 **Date:** February 2013

This report has been prepared for Bluestone Capital Ventures No.1 Pty Ltd in accordance with the terms and conditions of appointment. AT&L (ABN 96 130 882 405) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

In relation to existing services, this report is based upon a desktop review and relies upon information supplied by utility providers and Council. To the extent that the report incorporates such material, AT&L takes no responsibility for any loss or damage caused by any error or omission arising from reliance on it.

Please note that utility providers reserve the right to change their decision in relation to network deployment within the development without prior notice. Additionally it is our experience that utility providers will not reserve capacity. For this reason, they operate on a first come first serve basis.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. AT&L has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by AT&L described in this report. AT&L disclaims liability arising from any of the assumptions being incorrect.

Suite 702, 154 Pacific Highway

St Leonards NSW 2065

www.atl.net.au

Contents

LIST OF FIGURES AND TABLES

APPENDIX

1 Introduction

1.1 Scope of Report

AT&L have been engaged by Bluestone Capital Ventures No. 1 Pty Ltd to undertake the Project Application Design and Documentation for the proposed Woolooware Bay Town Centre development.

This report provides a summary of the design principles and planning objectives for the flooding and stormwater management, infrastructure services and general civil engineering for the site.

This report should be read in conjunction with the following reports:

- Cronulla Sharks Redevelopment – Stormwater and Services Report : Concept Application prepared by AT&L dated March 2012;
- Concept Flooding and Stormwater Quality Assessment: Proposed Toyota Stadium Development by Martens Consulting Engineers, August 2011. (Document Number P1103017JR01V02);
- Woolooware Bay Town Centre Redevelopment – Retail Site: Flood Assessment Report by MWA Water, January 2013;
- Water Management Report: Woolooware Bay Town Centre report by Insync Services Pty Ltd, January 2013;

Summary

This report generally covers the following items:

- Flooding and Stormwater Management
  - Piped and Overland Flows
  - Sedimentation and Erosion Control
- Road Design
- Infrastructure Services

1.2 Site Description

The Cronulla Sutherland Leagues Club site is legally described as Lot 11 DP 526492 and Lot 20 DP 529644 and is known as 461 Captain Cook Drive, Woolooware. Three lots owned by Sutherland Shire Council (being Lot 21 DP 529644, Lot 1 DP 711486 and Lot 1 DP 501920) are also included within the proposed scheme.

The site is located on the northern side of Captain Cook Drive approximately 1.5 kilometres from Caringbah (to the south west) and 2 kilometres from Cronulla (to the south east). The site is bounded by the Solander playing fields to the west,

Woolooware Bay to the north, and a service station and gymnasium to the east. The Woolooware Golf Club and the Captain Cook Oval are located to the south of the site across Captain Cook Drive.

The overall site is irregular in shape with an area of approximately 10 hectares, of which approximately 6ha is occupied by Toyota Stadium, Leagues Club building and the eastern carpark and 4ha is occupied by the western training fields and car park. Refer to Figure 1 and 2.

Toyota Stadium (also known as Endeavour Field and Shark Park) and the Cronulla Sutherland Leagues Club building occupy the central portion of the site, and represent a major community and entertainment hub within the region. The western playing fields within the site are private open space used as training fields for the Cronulla Sharks and for local games by the Cronulla Caringbah Junior Rugby League Football Club, whilst the remainder of the site is occupied by car parking.

The Taren Point Employment Area is located approximately 200 metres to the northwest of the site and occupies land located generally between the waterfront, Taren Point Road and the Captain Cook Bridge. Woolooware Railway Station is located 1 kilometre to the south west of the site, and Caringbah Town Centre is approximately 3 kilometres by road to the south west.

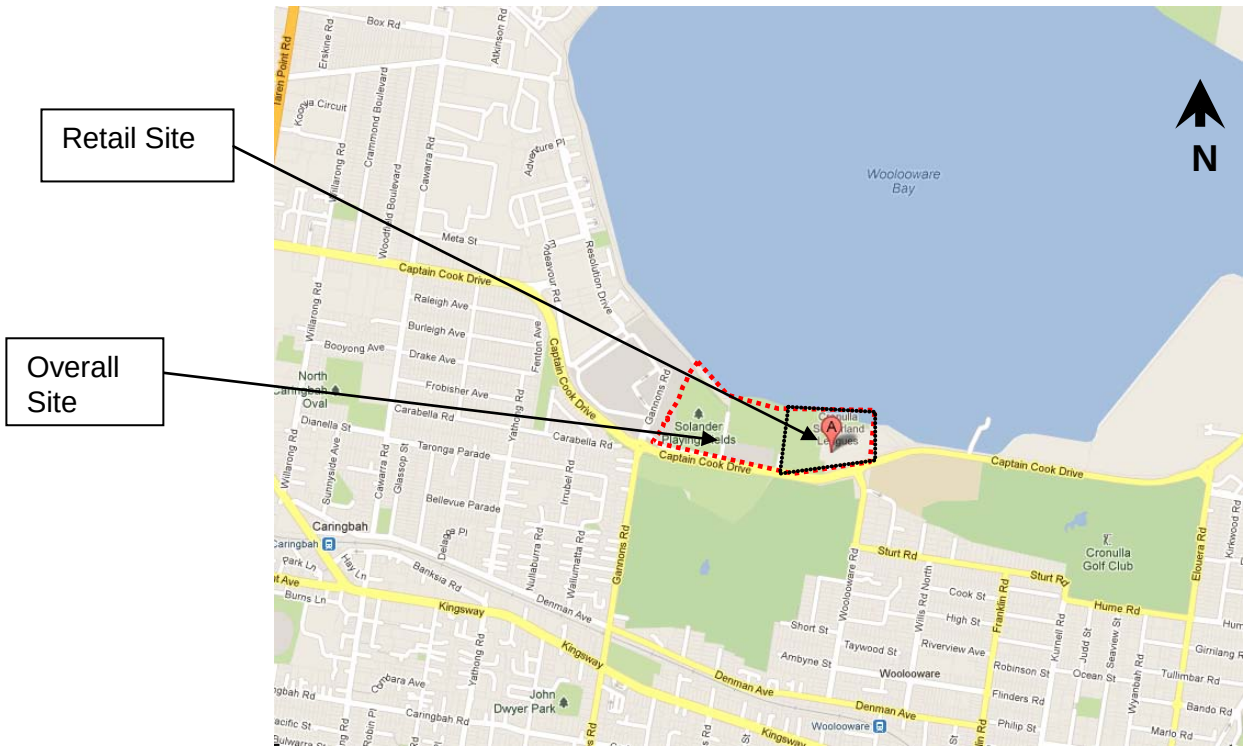


Figure 1 Locality Plan 1 ***(Source: Google Maps)***

Figure 2 **Locality Plan 2** ***(Source: Near Map)***

1.2.1 Topography

The site is generally flat with a gentle slope towards Captain Cook Drive to the south.

1.2.2 Proposed Development

The proposed mixed use redevelopment of the Cronulla Sutherland Leagues Club site including a new neighbourhood retail centre, residential development and upgrades to the sports facilities, including the Toyota Stadium, will create a new centre and destination location that meets the needs of the surrounding community. The Concept Plan prepared for the site is seeking to develop the site in three stages, being:

Stage 1 - New Neighbourhood Retail Centre, Medical and Leisure facilities on the eastern car park site with rooftop carparking and redevelopment of the Leagues Club facilities;

Stage 2 - Residential Masterplanned Estate on the western car park and field area; and

Stage 3 - Extension and improvement of the Sharks playing field facilities including grandstand extensions.

It is recognised that this site represents an ideal opportunity to provide an environmental benchmark for residential and retail development within NSW. To this effect, a strong commitment has been made to develop the site in such a way which incorporates the latest principles of Ecologically Sustainable Development (ESD).

This Development Application report deals with civil infrastructure associated with Stage 1 of the development; this being the construction of the new retail, medical and leisure facilities over the eastern carpark. Part of this Stage 1 works will include upgrade of Captain Cook Drive which will result in additional stormwater drainage, relocation of existing services, signage and line marking and pavement design. Refer to Civil DA Drawings in Appendix E for details.

2 Stormwater Management

2.1 General Design Principles

The stormwater management plan for the site has been generally designed in accordance with the following codes and guidelines:

- Concept Approval Application No. MP 10_0229 given by the Minister of Planning and Infrastructure dated 27 August 2012. Within this approval is a list of Statement of Commitments which needs to be met. The statements relevant to civil infrastructure are presented in Table 1.
- Sutherland Shire Council Stormwater and On Site Detention Code
- AS 3500.3 National Plumbing and Drainage Code Part 3 - Stormwater Drainage.
- Australia publication "Australian Rainfall and Runoff, Volumes 1 and 2 (AR&R).

Subject	Comments	Approved by	Timing
Traffic Management	The future Project Application for development of the neighbourhood retail centre shall include detailed plans of the following proposed road and intersection upgrades: • Signalised intersection including pedestrian activated traffic signal on Captain Cook Drive at the western entry point • Relocated and signalised intersection of the junction of Captain Cook Drive and Woolooware Road and northern extension of Woolooware Road • Modifications to Captain Cook Drive to accommodate bus bays	Relevant Consent Authority	Relevant application for development

Stormwater and Flooding	Future applications for development shall include a detailed Stormwater Management Plan addressing: • Water quality management measures to be implemented including Water Sensitive Urban Design • Provide details with regards to improvements in water quality and the hydraulic regimes to protect the mangrove areas in the drainage channel and Woolooware Bay	Relevant Consent Authority	Relevant application for development
	Future applications for development shall include a detailed flood assessment incorporating: • Prepare hydrological model of the catchments draining to the site using the RAFTS modelling software. Assessment of the 1 in 20, 1 in 100 year and PMF events climate change impact considered by increasing design rainfall intensities of each storm in accordance with state government policy. • Prepare detailed hydrologic model for the site using the TUFLOW 2D flood modelling system. This will require a detailed contour survey of the site and surrounding areas. • Review pre and post-development flooding inundation levels/extents • Produce hydraulic hazard map for the developed site • Assess development and community safety on flood prone land up to the PMF in accordance with the NSW FDM (2005), relevant sections of Council's DCP and other relevant guidelines.		

	Future applications for development will address the NSW Coastal Planning Guideline: Adapting to Sea Level Rise.		
	Future applications for development will be accompanied by a draft Erosion and Sediment Control Plan.		

- **Table 1 – Statement of Commitments (Civil Infrastructure)**

2.2 Stormwater Management

2.2.1 Hydrology

- Pipe drainage shall be designed to accommodate the 5-year ARI storm event within street, accessway and pathways and 20-year ARI storm event for relief from low point areas and major systems traversing developed areas.
- 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 volume 2.
- Runoff coefficients shall be calculated in accordance with AR&R. The fraction impervious shall be determined from analysis of the subcatchments.
- Flow width in gutter shall not exceed 1.5m 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.
- Blockage factors of 20% and 50% shall be adopted for pits on grade and at sags respectively for all storm events.
- The maximum spacing between pits shall be 60m.
- The minimum lintel size within a sag shall be 2.4m.
- The minimum lintel size for any road drainage pit shall be 0.9m.

2.2.2 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 375 diameter.
- The minimum pipe grade shall be 0.5%.
- All pipes shall be Rubber Ring Jointed.
- The minimum cover over pipes shall be 450mm in grassed areas and 600mm within carriageways.
- The minimum cover over culverts shall be 300mm within carriageways.
- All trafficable pipes shall be Class 3 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	0.3	3
FRC	0.01	0.15	3

Table 2 – Pipe Details

- All pipes classes shall be designed for the ultimate service loads and where applicable, constructions loads will be designed for.
- The flood levels determined in the WMA Water Flood Assessment report have been adopted as the tailwater levels for hydraulic modelling.
- 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.
- Minimum freeboard of 500mm over the 100 year ARI event water surface level will be provided for habitable floor levels and 200mm for garage floors, car parks and pedestrian access ways.
- Pits deeper than 1.2m shall contain step irons at 300 mm centres.

2.2.3 Existing Stormwater

The existing street storm water network was identified from a number of sources including:

- Survey provided by Harrison Friedmann and Associates Pty Ltd Surveyors
- Sutherland Shire Council drawings
- Dial Before You Dig drawings and

- Site Inspections

Internal Site Drainage

The site is located between Woolooware Bay and the Woolooware Golf Course. The site was reclaimed some 30 years ago by landfill of building and domestic refuse.

The site can be divided into these hydrological parts:

- The Toyota Stadium, playing field which drains to the tidal channel. The tidal channel which is shown on the survey drawings within Appendix B is an existing stormwater channel which starts within the Woolooware Golf Course. It drains in a northerly direction beneath Captain Cook Drive, flowing between Toyota Stadium and the western carpark before discharging into the Woolooware Bay;

- The club's building which drains towards Captain Cook Drive's drainage system, which eventually discharges to the tidal channel;

- The carpark adjacent to the club's building. Approximately one third of the bitumen covered carpark area drains towards Captain Cook Drive, one third discharges to Woolooware Bay as a diffuse outflow through grassed buffer located to the east of the site and one third drains through a 150mm diameter pipe directly to the Bay as concentrated flow; and

As mentioned previously this report concentrates on the redevelopment of the eastern carpark adjacent to the club's building into retail, medical and leisure facilities.

Survey Drawings within Appendix B indicate the existing stormwater drainage network within the site. Even though the existing eastern carpark is bitumen sealed, there does not seem to be any evidence of stormwater pits or pipes within the majority of the area. It is likely most of the stormwater drains overland onto Captain Cook Drive to the south and the mangrove swamp to the north. There is however an existing grated pit and 375mm diameter outlet pipe in the south western corner draining a small portion of the carpark. This pipe drains in a south westerly direction and connects into a 900mm diameter storm pipe within Captain Cook Drive. This 900mm diameter pipe then drains along Captain Cook Drive in a westerly direction before discharging into the tidal channel adjacent the western playing fields.

To the north west of the existing carpark are two 225mm diameter pipes which outlet into the mangrove swamp.

Stormwater drainage also exists to the south east of the existing carpark adjacent the Caltex petrol station entrance off Captain Cook Drive. Existing pits pick up stormwater within the Caltex and Fitness First driveway and carpark and drain in an easterly direction along Captain Cook Drive before discharging via a swale drain into the mangrove area to the east of Fitness First.

2.2.4 Proposed Stormwater

With the construction of the retail centre over the existing eastern carpark, new stormwater drainage will need to be built to drain the additional impervious areas. The upgrade of Captain Cook Drive will also require additional stormwater drainage.

As the proposed retail development is large in area (approximately 1.9Ha) a number of existing stormwater networks will likely be required to drain all stormwater off site. A Stormwater Catchment Plan is shown in Appendix E.

Stormwater from the southern portion of the club building will likely need to be directed into the existing network within Captain Cook Drive to the south east of the site. This will also include the loading dock and entrance road off Captain Cook Drive. This is shown as area G in the catchment plan.

The new entrance road off Captain Cook Drive to the east of the carpark adjacent to the Fitness First building will also require a new stormwater network which will be directed into the Captain Cook Drive drainage system. This system drains to the east along Captain Cook Drive and will then discharge into the mangrove swamp east of the Fitness First building. This connection into the mangrove swamp Captain Cook Drive. This is shown as area E in the catchment plan.

A grassed landscaped area to the north of the retail area will be dedicated for bio-filtration to both convey stormwater from retail and carparking hardstanding areas and treat the water to ensure the Sutherland Shire Council target reductions are met. This stormwater will then discharge into the entrance road system. This is shown as area F in the catchment plan.

There is also the option of utilizing the two existing 225mm diameter outlets into the mangrove swamp to discharge the northern part of the proposed club building. This will be confirmed at detailed design stage.

DRAINs modelling software has been used to calculate the Hydraulic Grade Line (HGL) for all stormwater networks. DRAINs data files and output results are attached in Appendix C. The proposed stormwater network for the retail site and associated roadworks are shown in the Civil DA drawings.

On Site Detention

The purpose of On Site Detention (OSD) systems is to detain storms and reduce peak discharge rates, however volumetric runoff remains unchanged. OSD is usually beneficial in the upper and middle parts of the catchment. However, OSD is ineffective in the downstream parts of the catchment, such as for this development, and can even increase the peak discharge because of the coincidence of peaks of the catchment hydrograph and the outlet hydrograph from the OSD. Therefore, OSD is not recommended for this development on the basis that there is no significant benefit and increases risk of the peak discharge value coinciding. This will need to be confirmed with Sutherland Shire Council.

2.2.5 Water Sensitive Urban Design (WSUD)

Policy and Guidelines

The stormwater design considers the following guidelines:

- Australian Rainfall Quality (2006);
- Department of Environment and Climate Change NSW (DECC), Management Urban Stormwater: Urban design (Consultation Draft, 2008)
- Sutherland Shire Council Stormwater and On Site Detention Code

Objectives

Sutherland Shire Council Guidelines encourage best practice urban stormwater management with the aim to achieve the below target reductions:

Pollutants	Reduction Objectives
Total Suspended Solids (TSS)	70%
Total Phosphorus (TP)	20%
Total Nitrogen (TN)	35%
Gross Pollutants	Retention of litter greater than 50mm to be maximum extent possible for storm events up 1 in 3 month ARI

Table 3 – Target Reductions

In order to achieve these reductions, a treatment train approach will be implemented into the development where the stormwater treatment flow path for runoff would generally be:

1. Runoff from roofed areas would be collected and detained in rainwater tanks with an overflow by-pass to a bioretention swale where it would be filtered and treated biologically ;
2. Excess flows from the bioretention swales would flow to the pipe drainage system designed to cater for the 20 year ARI event;
3. Stormwater exiting the pipe drainage system would pass through a GPT to remove remaining coarse sediment, litter, debris, oils and greases; and;
4. Stormwater would drain from the GPT to the discharge point either in the tidal channel or Woolooware Bay. Appropriate scour protection measures will be in place at all outlets;

5. Reduce gross pollutants entering the tidal channel through external catchments via implementation of a trash rack at the upstream end of the culvert under Captain Cook Drive.

A Water Management Report for the retail development written by Insync Services Pty Ltd discusses the proposed methodology for the water consumption reduction strategies to meet the Environmental Sustainable Development (ESD) targets for the development. Refer to Appendix H. Within this report stormwater harvesting is discussed with a rainwater tank proposed for the retail site to reduce potable water usage. This report also discusses the water quality treatment required to re-use the rainwater.

MUSIC Analysis

The software package developed by the CRC for Catchment Hydrology termed "MUSIC" (Model for Urban Stormwater Improvement Conceptualisation) was used to assess the effectiveness of the proposed "treatment train" and therefore ensure compliance with the proposed objectives.

All MUSIC input and output data are shown in Appendix D.

As shown in the Stormwater Catchment Plan in Appendix E the retail site comprises two different catchments. The entire multi storey carpark, northern extension of the club building and the entrance road off Captain Cook Drive comprise one catchment. This is shown as catchment F in the Catchment Plan. This stormwater will drain via a bio-retention swale north of the carpark and discharge into the entrance road system before draining along Captain Cook Drive into the proposed Council stormwater network south of the Fitness First building.

The second catchment incorporates the majority of the re-developed club building and the main entrance and loading dock off Captain Cook Drive as indicated by catchment G in the Catchment Plan. All the stormwater from this area will drain via specified treatment gullies and discharge into the 900mm diameter pipe within Captain Cook Drive.

2.2.6 Flooding and Overland Flows

Hydraulic modelling of the entire catchment through DRAINS software was carried out for all catchments in the Retail development stage. All input data and results are shown in Appendix C.

WMA Water has carried out a flood assessment report for the retail site. This report is attached in Appendix F.

This report used DRAINS and TUFLOW software to determine the design flood levels and hazard information for the 20 and 100 year ARI storm events and the Probable Maximum Flood (PMF) for both the existing and post developed site. Within the modelling it was determined the maximum 100 year flood level along Captain Cook Drive is RL 2.46mAHD and the PMF peak flood level is RL 3.14mAHD. Given the proposed finished floor level of the retail development is RL 4.00mAHD

it is summarised the site is not at risk to flooding and is compliant with Sutherland Shire Council's development controls.

The proposed entrance road level off Captain Cook Drive is at RL 2.60mAHD which is still above the maximum 100 year flood level.

The WMA Water report also summarised the impacts of flood depths around the site with the development. It was determined the proposed retail development results in up to 50mm off-site impacts for the 100 year ARI storm, however this can be mitigated by upgrading the stormwater drainage network within Captain Cook Drive. The proposed civil drawings indicate these upgrade works.

The report has also taken into account climate change in line with the Statement of Commitments as in Table 1. It summarised the peak flood levels would increase by 0.2m as a result of climate change. This 0.2m rise would still result in peak flood levels being below the finished floor levels and as such still be compliant with Council's development controls.

The 20 and 100 year ARI post development flood levels determined in the flood assessment report were adopted as tailwater levels for the DRAINS analysis for stormwater design purposes. All DRAINs results are within Appendix C.

It should be noted the WMA Water Flood Report concludes the retail development does not affect the existing flood levels of the tidal channel adjacent to Toyota Stadium. A separate flood report will be carried out for the residential development to determine the impacts of this development on the tidal channel and surrounding areas.

3 Sedimentation and Erosion Control

3.1 Sedimentation and Erosion Control (Construction)

Stormwater runoff generated from within the works area during construction will likely contain sediments and oils from construction machinery. A number of options are available for the removal of these contaminants from stormwater, some of which include:

- Wheel wash down/ Cattle Shaker Grid
- Sedimentation settlement pits
- Sediment fences
- Diversion banks
- Stabilisation of finished areas
- Cut off drains

3.2 Implementation of devices

Preliminary Engineering plans have been developed in accordance with Department of Housing, *Managing Urban Stormwater, Soils and Construction*, Fourth Edition. The contractor shall implement all aspects of the plans relating to the particular area where construction is taking place. Following are possible levels of control that are to be constructed.

- The vehicular access points are to be stabilised preferably with cattle shaker grid and washdown.
- Sediment fence and filter socks are to be placed at the downstream end of the site to prevent runoff.
- Kerb inlet sediment traps to be installed at existing and proposed stormwater pits.
- Areas disturbed by road and stormwater construction shall be stabilised (progressively) as soon as practically possible after completion of works.

4 Road Design

4.1 Captain Cook Drive

As mentioned previously, the retail development involves upgrading and widening works of Captain Cook Drive and Woolooware Road. These upgrade works have been proposed by McLaren Traffic Engineering Consultants. Refer to Drawings in Appendix B. The majority of the works will involve the alteration of the Captain Cook Drive / Woolooware Road intersection. Refer to drawing Civil DA Drawings proposed road alignments. These intersection drawings have received Approval in Principal from the RMS.

Currently there is no kerb and gutter along Captain Cook Drive east of the intersection with Woolooware Road. Included in the upgrade works will be constructing kerb and gutter on both sides of Captain Cook Drive to match into Council's upgrade works east of the Fitness First Building. Vehicle crossovers into the existing Caltex Service Station and Fitness First building will also need to be constructed.

Included within the upgrade works will be an extension of the Woolooware Road north of the intersection with Captain Cook Drive to service the proposed loading dock within the retail carpark. Currently there is only a minor access road and carpark off Captain Cook Drive which services the Caltex station and Fitness First. This road will be removed and a new dual lane Council road will be constructed at the intersection of Captain Cook Drive and Woolooware Road.

4.2 Horizontal and Vertical Geometry

The internal roads, access ways, loading docks and carparking bays have been designed generally in accordance with Sutherland Shire Council's DCP, AS2890.1, and AS1428.1.

4.3 Pavement

All new pavements will be designed based on the requirements of Austroads Pavement Design Guide - A Guide to the Structural Design of Road Pavements and Sutherland Shire Council standards. Site specific subgrade CBR values or traffic ESA's are not available at this stage and will require further investigation at the detailed design stage.

5 Services

5.1 Existing

5.1.1 Sewerage (Sydney Water)

There is an existing 1800mm diameter trunk sewer carrier with two 225mm diameter stubs that currently service the site.

As part of the Future Environmental Assessment Requirements within the Concept Approval there is a Sydney Water condition stating "Future applications shall address Sydney Water's requirements in relation to the required upsizing of the existing 225mm wastewater main to a 300mm main in Captain Cook Drive, will require an extension of at least one metre inside the property boundary"

These upgrade works of the sewerage network within Captain Cook Drive will need to be undertaken as part of Stage 1 (Retail Site) of the Woolooware Bay Town Centre development.

5.1.2 Water (Sydney Water)

There is an existing 100 and 150mm diameter mains in Captain Cook Drive which currently service the site.

As part of the Future Environmental Assessment Requirements within the Concept Approval there is a Sydney Water condition stating "Future applications shall address Sydney Water's requirements in relation to the required upsizing of the existing 150mm drinking water main to a 200mm main from the existing 375mm main on the corner of Kurnell Road and Hume Road"

These construction and upgrade works of the water main will need to be undertaken as part of Stage 1 (Retail Site) of the Woolooware Bay Town Centre development.

5.1.3 Power (Ausgrid)

Our assessment of power supply for this project is based on the development requiring an 11kV feeder to supply a number of on-site kiosk type substations. It is expected the retail site will require a single chamber type substation.

From the network diagrams received via our DBYD enquiry and initial discussions with Ausgrid, it appears there will be sufficient supply within the existing 11kV overhead and underground cables that front the site along Captain Cook Drive.

With the proposed retail development and associated road works on Captain Cook Drive and Woolooware Road it is likely existing overhead power lines and poles will need to be relocated.

All electrical power requirements for the site and relocation of existing cables and poles will need to be confirmed with Ausgrid at detailed design stages. Preliminary discussions will also be entered into with Ausgrid to explore the option of relocating the existing overhead transmission lines north of the site to underground cables.

5.1.4 Telecommunications (NBN Co)

National Broadband Network (NBN Co) have committed to servicing the future development.

5.1.5 Gas (Jemena)

The existing Gas network in the area consists of:

- 110mm Nylon main (300kPa) near the corner of Captain Cook Drive and Woolooware Road. This main would be suitable for connection depending on the required demand.
- 300mm Secondary main (1050kPa) running along Captain Cook Drive which appears to currently service the site. This main may be suitable for connection depending on the required demand.

Based on our initial discussions with Jemena it is expected the existing services have sufficient capacity to service the development.

6 Conclusion

This report in conjunction with the Civil Engineering drawings listed in Appendix G has demonstrated that a stormwater drainage system consistent with good management practices can be provided for the proposed development. The proposed in ground pipe network can accommodate the 20 year design ARI. Overland flows through the site have been accommodated in the site layout to compensate for the 100 year ARI storm event.

The stormwater management plan demonstrated within this report also complies with the Statement of Commitments required within the Concept Approval issued by the Minister of Planning and Infrastructure.

The flood assessment report carried out by WMA Water within Appendix F also demonstrates compliance with the Statement of Commitments regarding flood assessment. The report:

- investigates the proposed development flood levels,
- effects of flooding within and outside of the site,
- investigates increased flood levels with increases in rainfall intensities due to predicted climate changes ;
- discusses evacuation routes and emergency procedures during flood events

Initial discussions with the various service authorities have determined that the development can be adequately serviced subject to planning and future negotiations.

Appendix A

Photographs

A01 – Existing eastern carpark

A02 – Existing access road to Fitness First off Captain Cook Drive

A03 –View looking west to the north of Fitness First building

A04 - View from Club building looking west over carpark

A05 – Existing entrance to Caltex off Captain Cook Drive

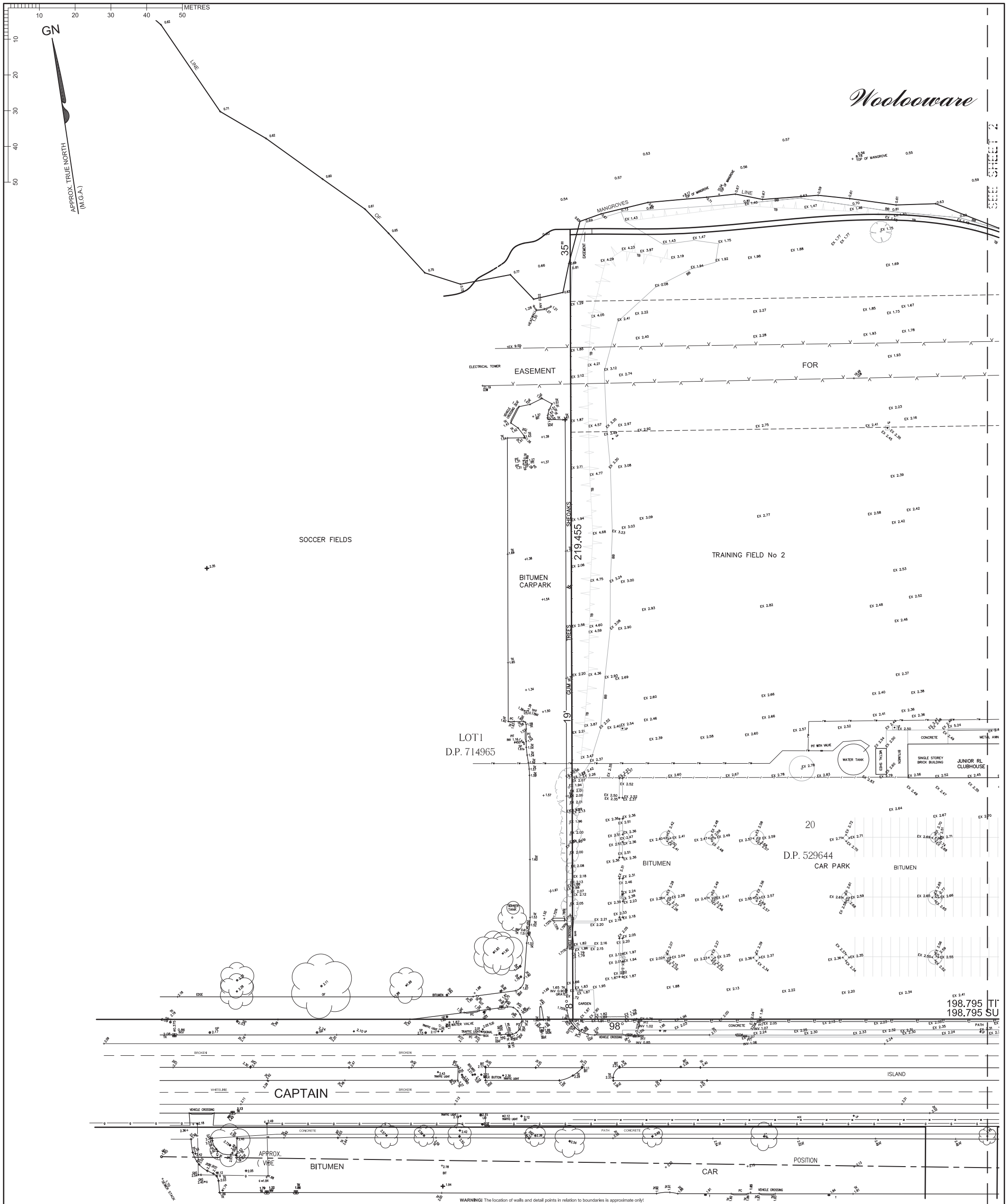
A06 – Existing roundabout at intersection of Captain Cook Drive and Woolooware Rd

A07 – Captain Cook Drive looking east

A08 – Existing Club building

Appendix B

Existing Drawings



WARNING! The location of walls and detail points in relation to boundaries is approximate only!

NOTES

1. COPYRIGHT This drawing and/or design is the property of Harrison Friedmann & Associates Pty Ltd and should not be reproduced in part or whole without the written permission of the company.
2. Bearings, distances and areas of boundaries are from the Land and Property Management Authority records only. They are on Map Grid of Australia . If accurate True North is required a further survey would be necessary.
3. Relationship of Improvements to boundaries is diagrammatic only. Boundary fences and retaining walls have not been accurately located and may not be shown on this plan.DO NOT SCALE OFF THIS PLAN. Where offsets from improvements, fences or walls to boundaries are critical for future building design and construction they MUST be confirmed by a further boundary survey. This survey has not investigated any subterranean structures.
4. The services information shown on this plan have been determined from visual inspection only and information provided by the relevant authorities through "Dial before you dig" . It is passed on with the understanding that no excavation or works will be commenced without a current services search of all services being obtained from "Dial before you dig" (DBYD) (phone 1100 or fax 1300 652 077) or from any individual service provider. Note that not all services providers are members of DBYD.
5. The location of Sydney Water's Sewer Main has been plotted approximately, based on visible maintenance holes and information from Sydney Water. This information can not be relied on. Any construction near Sydney Water Mains requires further Investigation, a Service Protection Report (sewer pegout) and approval from Sydney Water.
6. The locations of spot levels are diagrammatic only. They are accurate to ± 0.3m in relation to boundaries. Levels critical to design, excavation or construction must be verified. If contours are shown they depict the topography rather than represent the exact level at any particular point. Care should be taken if extrapolating levels or contours.
7. The spread of the crown of the trees shown on this plan is diagrammatic only, based on the average spread observed in the field. Prior to any development proposal which might be affected by trees it is recommended that the tree spreads be verified by field inspection.
8. Australian Height Datum was established from PM. 31619 R.L. 1.279 located at the intersection of Captain Cook Drive & Woolooware Road Woolooware . Datum source obtained from S.C.I.M.S. 22/06/2011.
9. The plan has been compiled from field survey information and Plans prepared by Rygate & Company Pty Ltd and Johnathan C. Keen & Co. Pty Ltd

ALL ABOVE NOTES ARE AN INTEGRAL PART OF THIS PLAN

UNDERGROUND ELECTRICAL
OVERHEAD ELECTRICAL
EXISTING GAS
RECYCLED WATER
EXISTING TELECOMMUNICATIONS
EXISTING WATER
FENCE

Legend

BB	Bottom of Bank	USG	Underside of Gutter
BFL	Balcony Floor Level	UW	Upper Window
BRW	Bottom Retaining Wall	VC	Vehicle Crossing
CONC	Concrete	W	Window
EC	Edge of Concrete	WC	Toilet
FL	Floor Level	LEW	Lowest Electrical Wire
G	Grate	TETW	Top Of Electrical Tower/Pole
INV	Invert Level	TOC	Table on Concrete
LW	Lower Window	TTTW	Top Of Telecommunication Tower
PC	Pedestrian Crossing		Hydrant
RL	Relative Level	LH	Lamp Hole
TB	Top of Bank	LP	Light Pole
TG	Top of Gutter	MH	Maintenance Hole
TK	Top of Kerb	PP	Power Pole
TRW	Top Retaining Wall	SP	Sign Pole
TW	Top Wall	SV	Stop Valve
		T	Telstra

HARRISON FRIEDMANN & ASSOCIATES PTY LTD
INCORPORATING THE PRACTICE OF **MICHAEL J. STYNES** ABN 69 001 953 331
SURVEYORS, ENGINEERS, PLANNERS,
BUILDING, ENVIRONMENTAL & BUSHFIRE CONSULTANTS
WATER SERVICING CO-ORDINATOR FOR SYDNEY WATER
P.O. BOX 4025, KOGARAH BAY, N.S.W. 2217 365 PRINCES HIGHWAY, CARLTON, N.S.W. 2218
PHONE: (02) 9546 2377
FAX: (02) 9546 4418
EMAIL: mail@hfasurveyors.com.au
ISO 9001 FS 520963
Liability is limited by a scheme approved under Professional Standards Legislation
COVER OF EXCELLENCE
JAS-ANZ

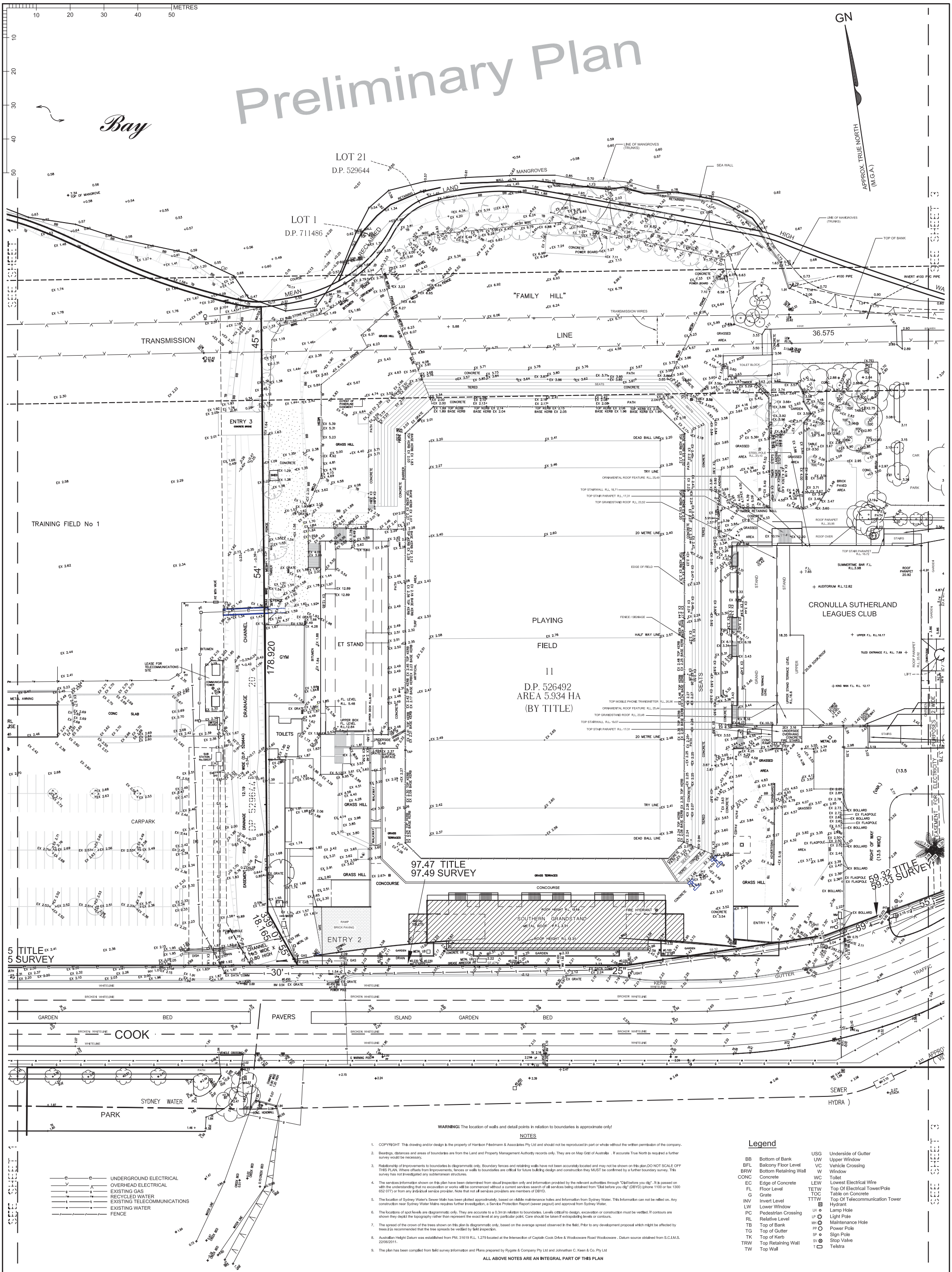
PLAN SHOWING SITE DETAILS AND LEVELS
FOR BUILDING DESIGN PURPOSES
AT CAPTAIN COOK DRIVE WOOLOOWARE
LOT 20 IN D.P. 529644 LOT 11 IN D.P. 526492

FOR BLUESTONE CAPITAL VENTURES No.1

REDUCTION RATIO 1:500 @ A1	SURVEYED / DRAWN ML/CK
DATUM A.H.D.	CHECKED
DATE 2/6/2011	REFERENCE **40966DT** SHEET 1 OF 3

CAD FILE NAME: 40966DT DET.DWG PLOTTED: 08/07/11 – 4:38PM

Preliminary Plan



WARNING! The location of walls and detail points in relation to boundaries is approximate only!

NOTES

1. COPYRIGHT This drawing and/or design is the property of Harrison Friedmann & Associates Pty Ltd and should not be reproduced in part or whole without the written permission of the company.
2. Bearings, distances and areas of boundaries are from the Land and Property Management Authority records only. They are on Map Grid of Australia . If accurate True North is required a further survey would be necessary.
3. Relationship of Improvements to boundaries is diagrammatic only. Boundary fences and retaining walls have not been accurately located and may not be shown on this plan.DO NOT SCALE OFF THIS PLAN. Where offsets from Improvements, fences or walls to boundaries are critical for future building design and construction they MUST be confirmed by a further boundary survey. This survey has not investigated any subterranean structures.
4. The services information shown on this plan have been determined from visual inspection only and information provided by the relevant authorities through "Dial before you dig" . It is passed on with the understanding that no excavation or works will be commenced without a current services search of all services being obtained from "Dial before you dig" (DBYD) (phone 1100 or fax 1300 652 077) or from any individual service provider. Note that not all services providers are members of DBYD.
5. The location of Sydney Water's Sewer Main has been plotted approximately, based on visible maintenance holes and information from Sydney Water. This information can not be relied on. Any construction near Sydney Water Mains requires further Investigation, a Service Protection Report (sewer pegout) and approval from Sydney Water.
6. The locations of spot levels are diagrammatic only. They are accurate to ± 0.3m in relation to boundaries. Levels critical to design, excavation or construction must be verified. If contours are shown they depict the topography rather than represent the exact level at any particular point. Care should be taken if extrapolating levels or contours.
7. The spread of the crown of the trees shown on this plan is diagrammatic only, based on the average spread observed in the field. Prior to any development proposal which might be affected by trees it is recommended that the tree spreads be verified by field inspection.
8. Australian Height Datum was established from PM. 31619 R.L. 1.279 located at the Intersection of Captain Cook Drive & Woolooware Road Woolooware . Datum source obtained from S.C.I.M.S. 22/06/2011.
9. The plan has been compiled from field survey information and Plans prepared by Rygate & Company Pty Ltd and Johnathan C. Keen & Co. Pty Ltd

ALL ABOVE NOTES ARE AN INTEGRAL PART OF THIS PLAN

Legend

BB	Bottom of Bank	USG	Underside of Gutter
BFL	Balcony Floor Level	UW	Upper Window
BRW	Bottom Retalning Wall	VC	Vehicle Crossing
CONC	Concrete	W	Window
EC	Edge of Concrete	WC	Toilet
FL	Floor Level	LEW	Lowest Electrical Wire
G	Grate	TETW	Top Of Electrical Tower/Pole
INV	Invert Level	TOC	Table on Concrete
LW	Lower Window	TTTW	Top Of Telecommunication Tower
PC	Pedestrian Crossing	H	Hydrant
RL	Relative Level	LH	Lamp Hole
TB	Top of Bank	LP	Light Pole
TG	Top of Gutter	MH	Malntenance Hole
TK	Top of Kerb	PP	Power Pole
TRW	Top Retalning Wall	SP	Sign Pole
TW	Top Wall	SV	Stop Valve
		T	Telstra

[A] EASEMENT FOR ELECTRICITY AND OTHER PURPOSES 2 WIDE AND 3.3WIDE

[B] RIGHT OF CARRIAGEWAY 4 WIDE AND VARIABLE WIDTH

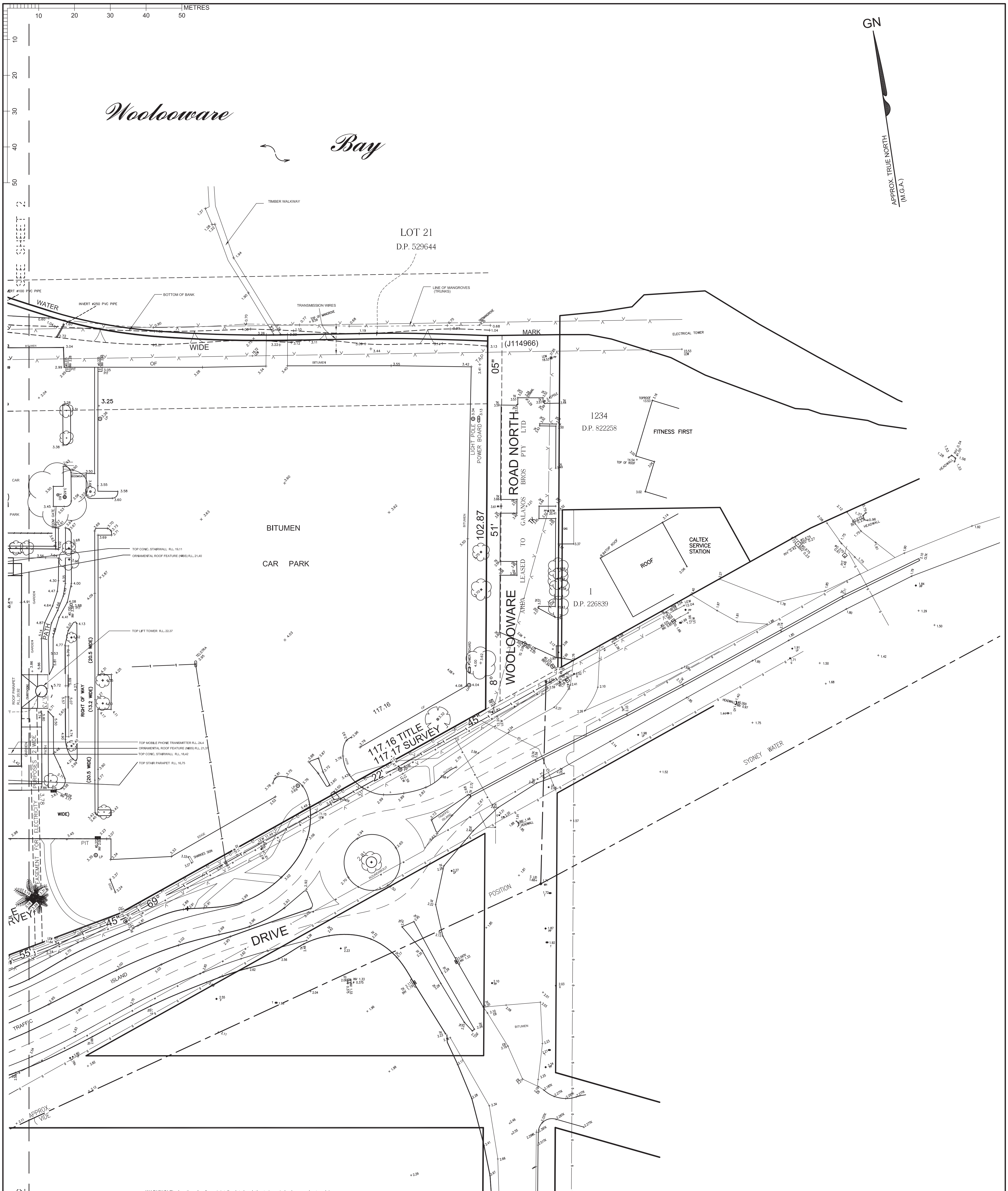
HARRISON FRIEDMANN & ASSOCIATES PTY LTD
INCORPORATING THE PRACTICE OF **MICHAEL J. STYNES** ABN 69 001 953 331
SURVEYORS, ENGINEERS, PLANNERS,
BUILDING, ENVIRONMENTAL & BUSHFIRE CONSULTANTS
WATER SERVICING CO-ORDINATOR FOR SYDNEY WATER
P.O. BOX 4025, KOGARAH BAY, N.S.W. 2217 365 PRINCES HIGHWAY, CARLTON, N.S.W. 2218
PHONE: (02) 9546 2377
FAX: (02) 9546 4418
EMAIL: mail@hfasurveyors.com.au
ISO 9001 FS 520963
Liability is limited by a scheme approved under Professional Standards Legislation
COVER OF EXCELLENCE
JAS-ANZ

PLAN SHOWING SITE DETAILS AND LEVELS FOR BUILDING DESIGN PURPOSES AT CAPTAIN COOK DRIVE WOOLOOWARE LOT 20 IN D.P. 529644 LOT 11 IN D.P. 526492

FOR BLUESTONE CAPITAL VENTURES No. 1

REDUCTION RATIO 1:500 @ A1	SURVEYED / DRAWN ML/CK
DATUM A.H.D.	CHECKED
DATE 2/6/2011	REFERENCE **40966DT** SHEET 2 OF 3

CAD FILE NAME: 40966DT DET.DWG PLOTTED: 08/07/11 – 4:39PM



WARNING! The location of walls and detail points in relation to boundaries is approximate only!

NOTES

1. COPYRIGHT This drawing and/or design is the property of Harrison Friedmann & Associates Pty Ltd and should not be reproduced in part or whole without the written permission of the company.
2. Bearings, distances and areas of boundaries are from the Land and Property Management Authority records only. They are on Map Grid of Australia . If accurate True North is required a further survey would be necessary.
3. Relationship of improvements to boundaries is diagrammatic only. Boundary fences and retaining walls have not been accurately located and may not be shown on this plan.DO NOT SCALE OFF THIS PLAN. Where offsets from improvements, fences or walls to boundaries are critical for future building design and construction they MUST be confirmed by a further boundary survey. This survey has not investigated any subterranean structures.
4. The services information shown on this plan have been determined from visual inspection only and information provided by the relevant authorities through "Dial before you dig" . It is passed on with the understanding that no excavation or works will be commenced without a current services search of all services being obtained from "Dial before you dig" (DBYD) (phone 1100 or fax 1300 652 077) or from any individual service provider. Note that not all services providers are members of DBYD.
5. The location of Sydney Water's Sewer Main has been plotted approximately, based on visible maintenance holes and information from Sydney Water. This information can not be relied on. Any construction near Sydney Water Mains requires further investigation, a Service Protection Report (sewer pegout) and approval from Sydney Water.
6. The locations of spot levels are diagrammatic only. They are accurate to ± 0.3m in relation to boundaries. Levels critical to design, excavation or construction must be verified. If contours are shown they depict the topography rather than represent the exact level at any particular point. Care should be taken if extrapolating levels or contours.
7. The spread of the crown of the trees shown on this plan is diagrammatic only, based on the average spread observed in the field. Prior to any development proposal which might be affected by trees it is recommended that the tree spreads be verified by field inspection.
8. Australian Height Datum was established from PM. 31619 R.L. 1.279 located at the intersection of Captain Cook Drive & Woolooware Road Woolooware . Datum source obtained from S.C.I.M.S. 22/06/2011.
9. The plan has been compiled from field survey information and Plans prepared by Rygate & Company Pty Ltd and Johnathan C. Keen & Co. Pty Ltd

ALL ABOVE NOTES ARE AN INTEGRAL PART OF THIS PLAN

UNDERGROUND ELECTRICAL
OVERHEAD ELECTRICAL
EXISTING GAS
RECYCLED WATER
EXISTING TELECOMMUNICATIONS
EXISTING WATER
FENCE

Legend

BB	Bottom of Bank	USG	Underside of Gutter
BFL	Balcony Floor Level	UW	Upper Window
BRW	Bottom Retaining Wall	VC	Vehicle Crossing
CONC	Concrete	W	Window
EC	Edge of Concrete	WC	Toilet
FL	Floor Level	LEW	Lowest Electrical Wire
G	Grate	TETW	Top Of Electrical Tower/Pole
INV	Invert Level	TOC	Table on Concrete
LW	Lower Window	TTTW	Top Of Telecommunication Tower
PC	Pedestrian Crossing		Hydrant
RL	Relative Level	LH	Lamp Hole
TB	Top of Bank	LP	Light Pole
TG	Top of Gutter	MH	Maintenance Hole
TK	Top of Kerb	PP	Power Pole
TRW	Top Retaining Wall	SP	Sign Pole
TW	Top Wall	SV	Stop Valve
		T	Telstra

HARRISON FRIEDMANN & ASSOCIATES PTY LTD
INCORPORATING THE PRACTICE OF MICHAEL J. STYNES ABN 69 001 953 331
SURVEYORS, ENGINEERS, PLANNERS,
BUILDING, ENVIRONMENTAL & BUSHFIRE CONSULTANTS
WATER SERVICING CO-ORDINATOR FOR SYDNEY WATER
P.O. BOX 4025, KOGARAH BAY, N.S.W. 2217 365 PRINCES HIGHWAY, CARLTON, N.S.W. 2218
PHONE: (02) 9546 2377
FAX: (02) 9546 4418
EMAIL: mail@hfasurveyors.com.au
ISO 9001 FS 520963
Liability is limited by a scheme approved under Professional Standards Legislation
COVER OF EXCELLENCE
JAS-ANZ

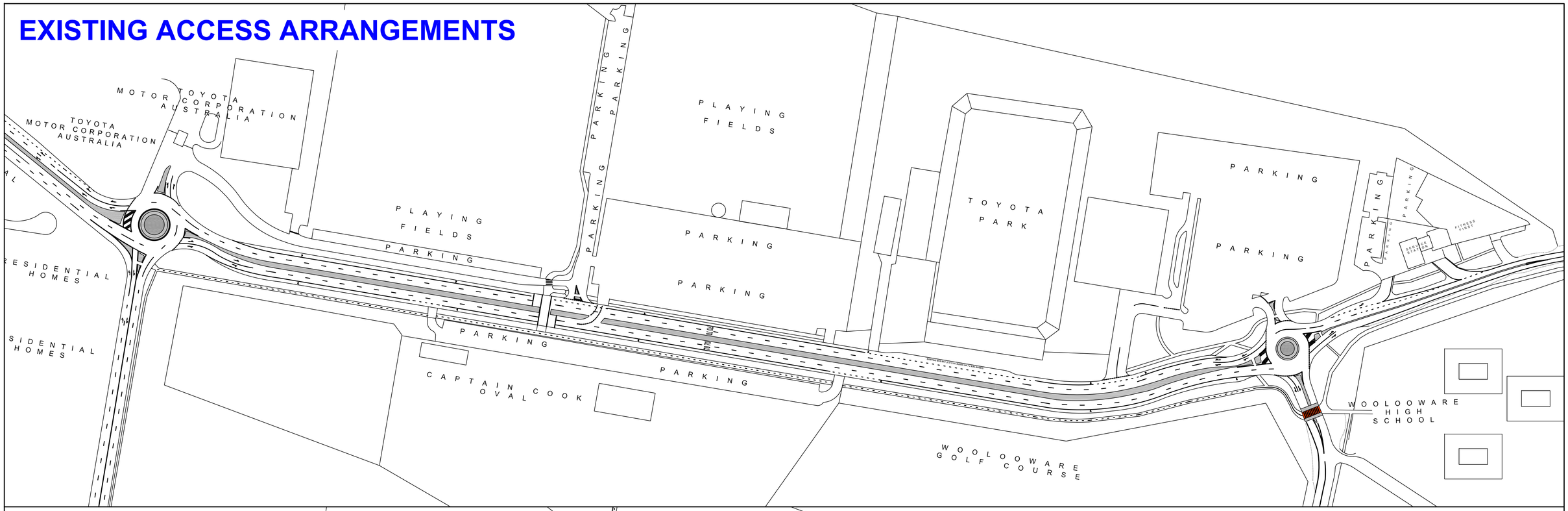
PLAN SHOWING SITE DETAILS AND LEVELS
FOR BUILDING DESIGN PURPOSES
AT CAPTAIN COOK DRIVE WOOLOOWARE
LOT 20 IN D.P. 529644 ,LOT 11 IN D.P. 526492

FOR BLUESTONE CAPITAL VENTURES No. 1

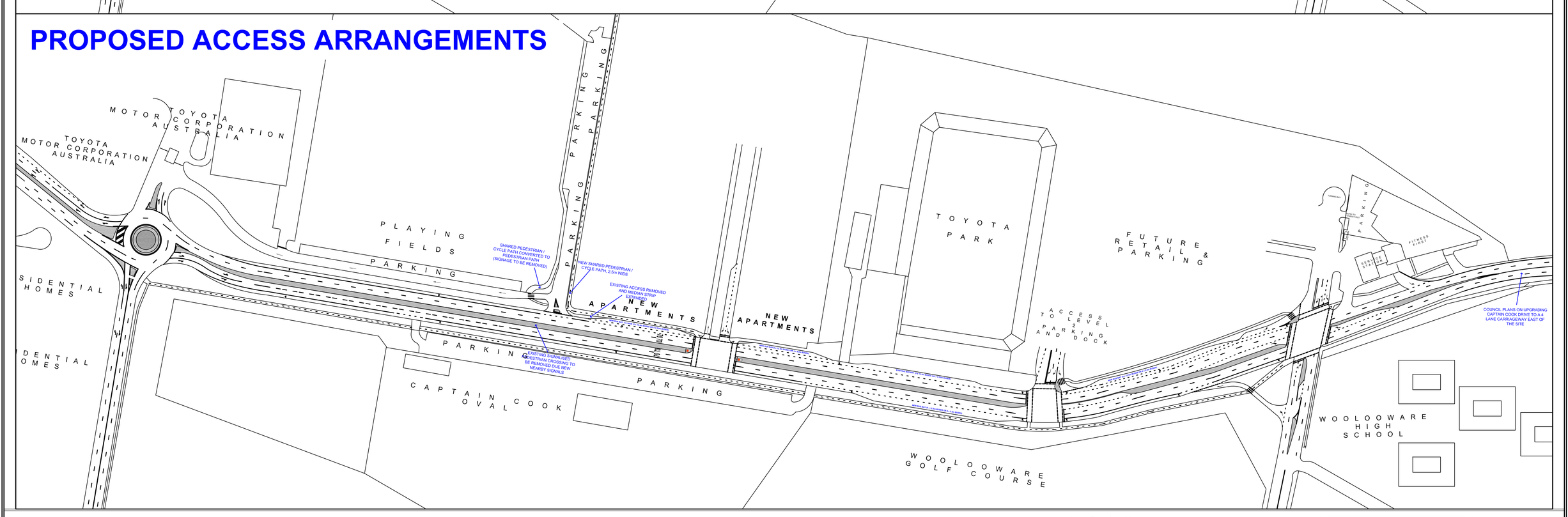
REDUCTION RATIO	SURVEYED / DRAWN
1:500 @ A1	ML/CL
DATUM	CHECKED
A.H.D.	
DATE	REFERENCE
2/6/2011	40966DT SHEET 3 OF 3

CAD FILE NAME: 40966DT DET.DWG PLOTTED: 08/07/11 - 4:40PM

EXISTING ACCESS ARRANGEMENTS



PROPOSED ACCESS ARRANGEMENTS



McLaren Traffic Engineering

Level 1, 29 Kiora Road, Miranda NSW 2228
mclarenc@ozemail.com.au
www.mclarentraffic.com.au
P : (02) 8543 3811
M : 0412 949 578

Client:
CRONULLA SHARKS

Project:
Access plan for Cronulla Sharks Mixed Use DA

Notes:
CONCEPT PLAN ONLY. Not for construction.

New bus bays designed in accordance with "Bus Stop Installation Guide for Local Councils: Design Manual" by State Transit Authority NSW / PPK

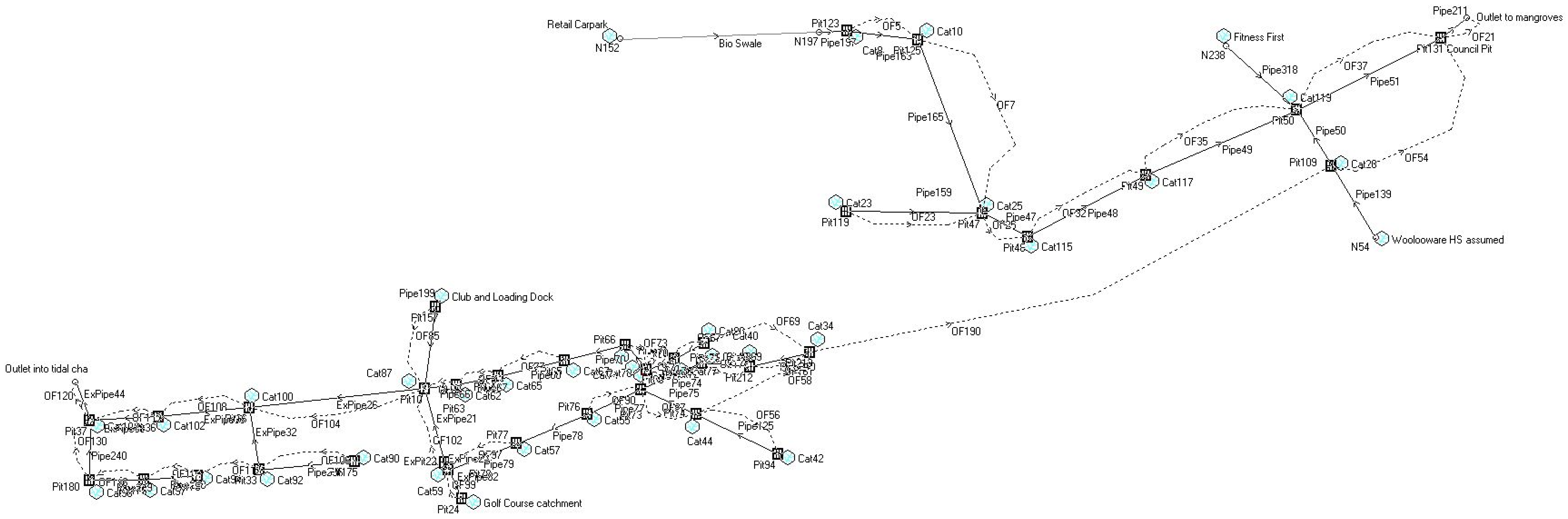
Drawing title:
PROPOSED ACCESS CHANGES

Job No.:	Date:	Drawing no:
10166	23 June 2011	7

Revision	Date	Details

Appendix C

DRAINS Model & Results



Retail Carpark
N152
Bio Swale
N197
Pit123
OF5
Cat10
Pit125
Pipe163
Pipe165
OF7
Pipe211
Outlet to mangroves
OF21
Pit131 Council Pit
Fitness First
N238
Pipe318
OF37
Pipe51
Cat119
Pit50
Pipe50
OF35
Pipe49
Pit109
Cat28
OF54
Pipe139
N54
Woolooware HS assumed
Cat117
Pit49
Pipe48
OF32
Cat23
Pit119
Pipe159
OF23
Pit47
Cat25
Pipe47
Pit46
Cat115
Pipe199
Club and Loading Dock
Pit157
OF85
OF190
Outlet into tidal cha
OF120
ExPipe44
Pit37
OF130
Pipe240
Pit180
Cat100
Cat102
OF104
ExPipe26
ExPipe32
Cat87
Pit10
Pit63
ExPipe21
OF102
ExPit22
Cat59
Pit24
Golf Course catchment
Cat90
Cat92
Pit33
Cat62
Cat65
Pit66
OF73
Cat40
OF69
Cat34
Pit212
OF58
Pipe74
Pipe75
Pit76
Cat55
Pipe78
Pit77
Cat57
Pipe79
Pit74
OF56
Pipe125
Cat44
Pit94
Cat42

PIT / NODE DETAILS Version 11

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph
Pit24	OnGrade	JUNCTION	1.2 x 1.2	INFILL LID	4.4	2.4		0	0.2	283696.4	6284877	No	48	1 x Ku	No
Pit78	OnGrade	Sutherland	Sutherland	1.8 m lintel	2.1	2.37		0	0.2	283688.4	6284894	No	158	1 x Ku	No
ExPit22	OnGrade	JUNCTION	1.2 x 1.2	INFILL LID	1.6	2.28		0	0.2	283685.8	6284899	Yes	44	1 x Ku	No
Pit10	OnGrade	Sutherland	Sutherland	1.8 m lintel	1.3	2.35		0	0.2	283673.7	6284944	No	20	1 x Ku	No
Pit26	OnGrade	JUNCTION	1.2 x 1.2	GRATED SURFAC	1.6	2		0	0.2	283566.8	6284932	No	52	1 x Ku	No
Pit36	OnGrade	JUNCTION	1.2 x 1.2	GRATED SURFAC	0.5	1.67		0	0.2	283511.1	6284927	No	72	1 x Ku	No
Pit37	OnGrade	JUNCTION	1.2 x 1.2	INFILL LID	1.8	1.64		0	0.2	283469.4	6284925	No	75	1 x Ku	No
Outlet into	Node					0		0		283460.6	6284948		91		
N54	Node					3		0		284254	6285036		104		
Pit109	OnGrade	Sutherland	Sutherland	1.8 m lintel	0.2	1.8		0	0.2	284227.1	6285080	No	245	1 x Ku	No
Pit50	OnGrade	Sutherland	Sutherland	1.8 m lintel	1.4	1.9		0	0.2	284205.9	6285114	No	101	1 x Ku	No
Pit131 Cou	OnGrade	JUNCTION	1.2 x 1.2	GRATED SURFAC	1.1	1.55		0	0.2	284294.3	6285158	No	297	1 x Ku	No
Outlet to n	Node					1.2		0		284309.6	6285170		499		
Pit71	OnGrade	Sutherland	Sutherland	1.8 m lintel	2.8	2.4		0	0.2	283844.3	6284972	No	146	1 x Ku	No
Pit70	OnGrade	Sutherland	Sutherland	1.8 m lintel	1.3	2.5		0	0.2	283826.1	6284962	No	145	1 x Ku	No
Pit69	OnGrade	Sutherland	Sutherland	1.8 m lintel	1.5	2.6		0	0.2	283809.2	6284955	No	143	1 x Ku	No
Pit66	OnGrade	Sutherland	Sutherland	1.8 m lintel	1.2	2.83		0	0.2	283796.4	6284970	No	138	1 x Ku	No
Pit65	OnGrade	Sutherland	Sutherland	1.8 m lintel	0	2.8		0	0.2	283759.3	6284961	No	137	1 x Ku	No
Pit64	OnGrade	Sutherland	Sutherland	1.8 m lintel	0.7	2.8		0	0.2	283718.5	6284951	No	135	1 x Ku	No
Pit63	OnGrade	Sutherland	Sutherland	1.8 m lintel	0.6	2.4		0	0.2	283693.2	6284946	No	133	1 x Ku	No
Pit94	OnGrade	Sutherland	Sutherland	1.8 m lintel	3.1	2.4		0	0.2	283889.6	6284904	No	223	1 x Ku	No
Pit74	Sag	Sutherland	Sutherland	20	2.8	2	0.2	0	0.5	283839.5	6284928	No	152	1 x Ku	No
Pit73	Sag	Sutherland	Sutherland	15	1.3	2.4	0.2	0	0.5	283805.6	6284943	No	151	1 x Ku	No
Pit76	OnGrade	Sutherland	Sutherland	1.8 m lintel	0.5	2.6		0	0.2	283772.8	6284928	No	156	1 x Ku	No
Pit77	OnGrade	Sutherland	Sutherland	1.8 m lintel	0.4	2.59		0	0.2	283729.8	6284910	No	157	1 x Ku	No
Pit119	OnGrade	Sutherland	Sutherland	1.8 m lintel	3.3	2.83		0	0.2	283930.8	6285052	No	281	1 x Ku	No
Pit47	OnGrade	Sutherland	Sutherland	1.8 m lintel	1.2	2.6		0	0.2	284014.2	6285051	No	95	1 x Ku	No
Pit48	OnGrade	Sutherland	Sutherland	1.8 m lintel	0.9	2.45		0	0.2	284041.6	6285036	No	97	1 x Ku	No
Pit49	OnGrade	Sutherland	Sutherland	1.8 m lintel	0.4	2.2		0	0.2	284113.9	6285074	No	99	1 x Ku	No
N152	Node							0		283792.9	6285157		359		
N197	Node					2.8		0		283914.1	6285161		873		
Pit123	OnGrade	Sutherland	Sutherland	1.8 m lintel	0.3	3.1		0	0.2	283931.5	6285162	No	289	1 x Ku	No
Pit125	Sag	Sutherland	Sutherland	10	1.3	3	0.15	0	0.5	283974.6	6285157	No	291	1 x Ku	No
Pit157	Sag	JUNCTION	1.2 x 1.2	GI	15	3	2.3	0.1	0	0.5	283680.3	6284994	No	454	1 x Ku	No
Pit175	OnGrade	Sutherland	Sutherland	1.8 m lintel	4.4	2.12		0	0.2	283631.2	6284900	No	621	1 x Ku	No
Pit33	OnGrade	Sutherland	Sutherland	1.8 m lintel	1.8	2.1		0	0.2	283572.9	6284894	No	64	1 x Ku	No
Pit178	OnGrade	Sutherland	Sutherland	1.8 m lintel	3.7	1.9		0	0.2	283535.4	6284891	No	630	1 x Ku	No
Pit179	OnGrade	Sutherland	Sutherland	1.8 m lintel	1.5	1.86		0	0.2	283502.2	6284888	No	631	1 x Ku	No
Pit180	OnGrade	Sutherland	Sutherland	1.8 m lintel	2.5	1.69		0	0.2	283469.1	6284888	No	632	1 x Ku	No
Pit213	Sag	Sutherland	Sutherland	15	3.3	2	0.15	0	0.5	283908.6	6284966	No	1.25E+08	1 x Ku	No
Pit212	Sag	Sutherland	Sutherland	15	1.4	2.05	0.15	0	0.5	283872.3	6284957	No	1.25E+08	1 x Ku	No
Pit72	OnGrade	Sutherland	Sutherland	1.8 m lintel	0.9	2.12		0	0.2	283842.8	6284959	No	149	1 x Ku	No
N238	Node					2.4		0		284162.8	6285152		1.25E+08		

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Lengt	id

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor	Rainfall Multiplier
Golf Course	Pit24	0.5	50	50	0	10	15	0										0				1

Cat59	Pit78	0.056	90	10	0	5	10	0	0	1
Cat87	Pit10	0.05	90	10	0	5	10	0	0	1
Cat100	Pit26	0.11	90	10	0	5	10	0	0	1
Cat102	Pit36	0.111	90	10	0	5	10	0	0	1
Cat104	Pit37	0.03	90	10	0	5	10	0	0	1
Woolooowa	N54	0.6	70	30	0	10	15	0	0	1
Cat28	Pit109	0.06	90	10	0	5	10	0	0	1
Cat119	Pit50	0.07	90	10	0	5	10	0	0	1
Cat80	Pit71	0.056	90	10	0	5	10	0	0	1
Cat77	Pit70	0.055	90	10	0	5	10	0	0	1
Cat74	Pit69	0.06	90	10	0	5	10	0	0	1
Cat70	Pit66	0.01	90	10	0	5	10	0	0	1
Cat67	Pit65	0.02	90	10	0	5	10	0	0	1
Cat65	Pit64	0.048	90	10	0	5	10	0	0	1
Cat62	Pit63	0.045	90	10	0	5	10	0	0	1
Cat42	Pit94	0.03	90	10	0	5	10	0	0	1
Cat44	Pit74	0.106	90	10	0	5	10	0	0	1
Cat51	Pit73	0.043	90	10	0	5	10	0	0	1
Cat55	Pit76	0.035	90	10	0	5	10	0	0	1
Cat57	Pit77	0.025	90	10	0	5	10	0	0	1
Cat23	Pit119	0.06	90	10	0	5	10	0	0	1
Cat25	Pit47	0.064	90	10	0	5	10	0	0	1
Cat115	Pit48	0.036	90	10	0	5	7	0	0	1
Cat117	Pit49	0.052	90	10	0	5	7	0	0	1
Retail Carp	N152	1.329	95	5	0	10	15	0	0	1
Cat8	Pit123	0.025	90	10	0	5	10	0	0	1
Cat10	Pit125	0.042	90	10	0	5	10	0	0	1
Club and L	Pit157	0.6386	90	10	0	8	10	0	0	1
Cat90	Pit175	0.08	90	10	0	5	10	0	0	1
Cat92	Pit33	0.064	90	10	0	5	10	0	0	1
Cat94	Pit178	0.05	90	10	0	5	10	0	0	1
Cat97	Pit179	0.05	90	10	0	5	10	0	0	1
Cat98	Pit180	0.03	90	10	0	5	10	0	0	1
Cat34	Pit213	0.29	90	10	0	6	10	0	0	1
Cat40	Pit212	0.074	90	10	0	5	10	0	0	1
Cat48	Pit72	0.042	90	10	0	5	10	0	0	1
Fitness Firs	N238	0.51	80	20	0	5	10	0	0	1

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	Rl (m)	Chg (m)	RL (m)	etc (m)
ExPipe82	Pit24	Pit78	6.89	0.32	0.22	1.45	Concrete, u	900	900	0.3	New	1	Pit24		0				
ExPipe23	Pit78	ExPit22	4	0.22	0.21	0.25	Concrete, u	900	900	0.3	New	1	Pit78		0				
ExPipe21	ExPit22	Pit10	19.97	0.21	0.2	0.05	Concrete, u	900	900	0.3	New	1	ExPit22		0				
ExPipe26	Pit10	Pit26	76.03	0.191	0.1	0.12	Concrete, u	900	900	0.3	New	1	Pit10		0				
ExPipe36	Pit26	Pit36	45.85	0.099	0.044	0.12	Concrete, u	900	900	0.3	New	1	Pit26		0				
ExPipe38	Pit36	Pit37	28.59	0.044	0.01	0.12	Concrete, u	900	900	0.3	New	1	Pit36		0				
ExPipe44	Pit37	Outlet into	7.98	0.01	0	0.13	Concrete, u	900	900	0.3	New	1	Pit37		0				
Pipe139	N54	Pit109	15	0.575	0.5	0.5	Concrete, r	675	675	0.3	New	1	N54		0				
Pipe50	Pit109	Pit50	24.91	0.475	0.35	0.5	Concrete, u	675	675	0.3	New	1	Pit109		0				
Pipe51	Pit50	Pit131 Cou	50	0.515	0.265	0.5	Concrete, u	675	675	0.3	New	1	Pit50		0				
Pipe211	Pit131 Cou	Outlet to n	5	0.265	0.24	0.5	Concrete, r	1050	1070	0.3	New	1	Pit131 Cou		0				
Pipe72	Pit71	Pit70	26.87	0.991	0.857	0.5	Concrete, u	375	375	0.3	New	1	Pit71		0				
Pipe73	Pit70	Pit69	28.56	0.857	0.714	0.5	Concrete, u	375	375	0.3	New	1	Pit70		0				
Pipe71	Pit69	Pit66	16.07	0.714	0.634	0.5	Concrete, u	375	375	0.3	New	1	Pit69		0				
Pipe70	Pit66	Pit65	23.11	0.634	0.518	0.5	Concrete, u	375	375	0.3	New	1	Pit66		0				

Pipe68	Pit65	Pit64	26.55	0.518	0.385	0.5	Concrete, u	450	450	0.3	New	1	Pit65	0
Pipe67	Pit64	Pit63	26.6	0.385	0.252	0.5	Concrete, u	450	450	0.3	New	1	Pit64	0
Pipe66	Pit63	Pit10	10.42	0.252	0.2	0.5	Concrete, u	450	450	0.3	New	1	Pit63	0
Pipe125	Pit94	Pit74	32.1	1.064	0.903	0.5	Concrete, u	375	375	0.3	New	1	Pit94	0
Pipe75	Pit74	Pit73	32.8	0.903	0.739	0.5	Concrete, u	375	375	0.3	New	1	Pit74	0
Pipe77	Pit73	Pit76	29.83	0.739	0.59	0.5	Concrete, u	450	450	0.3	New	1	Pit73	0
Pipe78	Pit76	Pit77	37.82	0.59	0.401	0.5	Concrete, u	450	450	0.3	New	1	Pit76	0
Pipe79	Pit77	Pit78	36.22	0.401	0.22	0.5	Concrete, u	450	450	0.3	New	1	Pit77	0
Pipe159	Pit119	Pit47	14.52	1.63	1.56	0.48	Concrete, u	375	375	0.3	New	1	Pit119	0
Pipe47	Pit47	Pit48	12.28	0.96	0.899	0.5	Concrete, u	600	600	0.3	New	1	Pit47	0
Pipe48	Pit48	Pit49	33.1	0.879	0.714	0.5	Concrete, u	600	600	0.3	New	1	Pit48	0
Pipe49	Pit49	Pit50	39.81	0.714	0.515	0.5	Concrete, u	600	600	0.3	New	1	Pit49	0
Pipe197	N197	Pit123	4.635	2	1.2	17.26	Concrete, u	600	600	0.3	New	1	N197	0
Pipe163	Pit123	Pit125	18.69	1.325	1.232	0.5	Concrete, u	600	600	0.3	New	1	Pit123	0
Pipe165	Pit125	Pit47	53.68	1.232	0.964	0.5	Concrete, u	600	600	0.3	New	1	Pit125	0
Pipe199	Pit157	Pit10	15	0.65	0.5	1	Concrete, u	450	450	0.3	New	1	Pit157	0
Pipe236	Pit175	Pit33	35.71	1.209	1.03	0.5	Concrete, u	375	375	0.3	New	1	Pit175	0
ExPipe32	Pit33	Pit26	18.51	1.03	0.845	1	Concrete, u	375	375	0.3	New	1	Pit33	0
Pipe238	Pit178	Pit179	29.85	0.859	0.71	0.5	Concrete, u	375	375	0.3	New	1	Pit178	0
Pipe239	Pit179	Pit180	19.82	0.709	0.61	0.5	Concrete, u	375	375	0.3	New	1	Pit179	0
Pipe240	Pit180	Pit37	21.91	0.61	0.5	0.5	Concrete, u	375	375	0.3	New	1	Pit180	0
Pipe310	Pit213	Pit212	20.793	1.153	1.049	0.5	Concrete, u	375	375	0.3	New	1	Pit213	0
Pipe309	Pit212	Pit72	13.61	1.049	0.981	0.5	Concrete, u	375	375	0.3	New	1	Pit212	0
Pipe74	Pit72	Pit73	48.45	0.981	0.739	0.5	Concrete, u	375	375	0.3	New	1	Pit72	0
Pipe318	N238	Pit50	6	0.76	0.7	1	Concrete, u	450	450	0.3	New	1	N238	0

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	etc	etc

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed
Bio Swale	N152	N197	Prismatic	80	3.2	2.8	0.5	1	4	4	0.03	0.8	No

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Stor (m)	Safe Depth Minor Stor (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL	D/S IL	Length (m)
OF99	Pit24	Pit78		3			Dummy use	0.2	0.05	0.6	1	0		610		
OF102	Pit78	Pit10		5			Dummy use	0.2	0.05	0.6	1	0		614		
OF104	Pit10	Pit26		5			8 m wide rc	0.3	0.15	0.4	1	0		619		
OF108	Pit26	Pit36		5			8 m wide rc	0.3	0.15	0.4	1	0		636		
OF110	Pit36	Pit37		5			8 m wide rc	0.3	0.15	0.4	1	0		638		
OF120	Pit37	Outlet into		3			Dummy use	0.2	0.05	0.6	1	0		671		
OF54	Pit109	Pit131 Cou		5			Dummy use	0.2	0.05	0.6	1	0		563		
OF37	Pit50	Pit131 Cou		5			8 m wide rc	0.3	0.15	0.4	1	0		545		
OF21	Pit131 Cou	Outlet to m		3			Dummy use	0.2	0.05	0.6	1	0		503		
OF69	Pit71	Pit213		5			Dummy use	0.2	0.05	0.6	1	0		579		
OF67	Pit70	Pit71		4			8 m wide rc	0.3	0.15	0.4	1	0		577		
OF71	Pit69	Pit70		3			8 m wide rc	0.3	0.15	0.4	1	0		581		
OF73	Pit66	Pit69		4			Dummy use	0.2	0.05	0.6	1	0		583		
OF77	Pit65	Pit64		5			Dummy use	0.2	0.05	0.6	1	0		587		
OF81	Pit64	Pit63		5			Dummy use	0.2	0.05	0.6	1	0		591		
OF83	Pit63	Pit10		5			Dummy use	0.2	0.05	0.6	1	0		593		
OF56	Pit94	Pit74		6			8 m wide rc	0.3	0.15	0.4	1	0		565		

OF58	Pit74	Pit213	5	Dummy use	0.2	0.05	0.6	1	0	568
OF87	Pit73	Pit74	4	8 m wide r	0.3	0.15	0.4	1	0	597
OF90	Pit76	Pit73	5	8 m wide r	0.3	0.15	0.4	1	0	601
OF97	Pit77	Pit78	5	8 m wide r	0.3	0.15	0.4	1	0	608
OF23	Pit119	Pit47	5	Dummy use	0.2	0.05	0.6	1	0	531
OF25	Pit47	Pit48	4	8 m wide r	0.3	0.15	0.4	1	0	533
OF32	Pit48	Pit49	5	8 m wide r	0.3	0.15	0.4	1	0	540
OF35	Pit49	Pit50	5	8 m wide r	0.3	0.15	0.4	1	0	543
OF5	Pit123	Pit125	5	Dummy use	0.2	0.05	0.6	1	0	476
OF7	Pit125	Pit47	5	8 m wide r	0.3	0.15	0.4	1	0	478
OF85	Pit157	Pit10	5	Dummy use	0.2	0.05	0.6	1	0	595
OF106	Pit175	Pit33	5	8 m wide r	0.3	0.15	0.4	1	0	627
OF112	Pit33	Pit178	5	8 m wide r	0.3	0.15	0.4	1	0	643
OF114	Pit178	Pit179	5	8 m wide r	0.3	0.15	0.4	1	0	647
OF116	Pit179	Pit180	5	8 m wide r	0.3	0.15	0.4	1	0	650
OF130	Pit180	Pit37	3	Dummy use	0.2	0.05	0.6	1	0	87789205
OF190	Pit213	Pit109	7	8 m wide r	0.3	0.15	0.4	1	0	1.25E+08
OF181	Pit212	Pit213	4	Dummy use	0.2	0.05	0.6	1	0	1.25E+08
OF179	Pit72	Pit212	4	8 m wide r	0.3	0.15	0.4	1	0	1.25E+08

DRAINS results prepared 25 January, 2013 from Version 2012.15

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfa Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pit24	1.97		0.241		0.43	0.179	Inlet Capacity
Pit78	1.97		0.21		0.4	0.157	Inlet Capacity
ExPit22	1.96		0		0.32		None
Pit10	1.94		0.414		0.41	0.359	Inlet Capacity
Pit26	1.85		0.392		0.15	0.068	Inlet Capacity
Pit36	1.67		0.096		0	0.335	Outlet System
Pit37	1.64		0.37		0	0.904	Outlet System
Outlet into	1.64		0.904				
N54	1.82		0.316				
Pit109	1.8		0.215		0	0.772	Outlet System
Pit50	1.87		0.188		0.03	0.146	Inlet Capacity
Pit131 Cou	1.55		0.791		0	0.831	Outlet System
Outlet to n	1.53		0.831				
Pit71	2.29		0.049		0.11	0.015	Inlet Capacity
Pit70	2.27		0.047		0.23	0.014	Inlet Capacity
Pit69	2.24		0.039		0.36	0.012	Inlet Capacity
Pit66	2.16		0.006		0.67	0	None
Pit65	2.08		0.013		0.72	0.001	Inlet Capacity
Pit64	2.06		0.032		0.74	0.008	Inlet Capacity
Pit63	2.01		0.037		0.39	0.009	Inlet Capacity
Pit94	2.14		0.019		0.26	0.003	Inlet Capacity
Pit74	2.13	2.2	0.071	17.1	-0.13	0.047	Outlet System
Pit73	2.11	2.49	0.032	3.4	0.29	0	Inlet Capacity
Pit76	2.07		0.022		0.53	0.004	Inlet Capacity
Pit77	2.02		0.016		0.57	0.002	Inlet Capacity
Pit119	2.61		0.039		0.21	0.012	Inlet Capacity
Pit47	2.6		0.298		0	0.265	Outlet System
Pit48	2.4		0.273		0.05	0.229	Inlet Capacity
Pit49	2.11		0.238		0.09	0.187	Inlet Capacity
N152	3.56		0.771				
N197	3.18		0.763				
Pit123	3.1		0.016		0	0.337	Outlet System
Pit125	3.01	3.15	0.355	8.6	-0.01	0.289	Outlet System
Pit157	2.07	2.4	0.382	12.9	0.23	0.256	Inlet Capacity
Pit175	1.93		0.051		0.19	0.02	Inlet Capacity
Pit33	1.9		0.061		0.2	0.02	Inlet Capacity
Pit178	1.74		0.051		0.16	0.013	Inlet Capacity
Pit179	1.73		0.044		0.13	0.011	Inlet Capacity
Pit180	1.69		0.03		0	0.024	Outlet System
Pit213	2.12	2.15	0.264	12.9	-0.12	0.187	Outlet System
Pit212	2.12	2.2	0.065	12.9	-0.07	0.028	Outlet System
Pit72	2.12		0.027		0	0.02	Inlet Capacity
N238	2		0.31				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Golf Cours	0.241	0.148	0.099	10	15	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat59	0.036	0.034	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat87	0.032	0.03	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat100	0.071	0.067	0.006	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat102	0.071	0.067	0.006	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat104	0.019	0.018	0.002	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Wooloowa	0.316	0.248	0.072	10	15	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat28	0.039	0.036	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat119	0.045	0.043	0.004	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat80	0.036	0.034	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat77	0.035	0.033	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat74	0.039	0.036	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat70	0.006	0.006	0.001	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat67	0.013	0.012	0.001	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat65	0.031	0.029	0.002	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat62	0.029	0.027	0.002	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat42	0.019	0.018	0.002	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat44	0.068	0.064	0.006	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat51	0.028	0.026	0.002	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat55	0.022	0.021	0.002	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat57	0.016	0.015	0.001	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat23	0.039	0.036	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat25	0.041	0.039	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat115	0.024	0.022	0.002	5	7	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1

Cat117	0.034	0.032	0.003	5	7	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Retail Carp	0.771	0.746	0.026	10	15	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat8	0.016	0.015	0.001	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat10	0.027	0.026	0.002	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Club and L	0.382	0.352	0.033	8	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat90	0.051	0.049	0.004	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat92	0.041	0.039	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat94	0.032	0.03	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat97	0.032	0.03	0.003	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat98	0.019	0.018	0.002	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat34	0.18	0.169	0.015	6	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat40	0.048	0.045	0.004	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Cat48	0.027	0.026	0.002	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Fitness Firs	0.31	0.276	0.053	5	10	0	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1

Outflow Volumes for Total Catchment (4.70 impervious + 0.86 pervious = 5.56 total ha)

Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff
	cu.m	cu.m (Runc	cu.m (Runc	cu.m (Runoff %)
AR&R 100	1190.04	1055.48 (8	958.86 (95	96.63 (52.4%)
AR&R 100	1861.46	1710.18 (9	1526.33 (9	183.85 (63.8%)
AR&R 100	2815.34	2638.29 (9	2332.54 (9	305.76 (70.2%)
AR&R 100	3528.44	3326.83 (9	2935.24 (9	391.59 (71.7%)
AR&R 100	4900.83	4650.82 (9	4095.17 (9	555.65 (73.2%)
AR&R 100	6523.5	6209.14 (9	5466.63 (9	742.51 (73.5%)
AR&R 100	7601.43	7235.97 (9	6378.25 (9	857.71 (72.9%)
AR&R 100	9801.84	9293.52 (9	8236.78 (9	1056.75 (69.6%)
AR&R 100	12802.13	12064.86 (	10785.86 (	1279.00 (64.5%)
AR&R 100	16935.96	15637.81 (	14189.40 (	1448.42 (55.2%)
AR&R 100	22241.96	20302.44 (	18687.85 (	1614.59 (46.9%)
AR&R 100	25160.29	22710.42 (	20929.76 (	1780.65 (45.7%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
ExPipe82	0.063	0.1	1.972	1.972	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
ExPipe23	0.231	0.36	1.959	1.955	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
ExPipe21	0.231	0.36	1.945	1.942	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
ExPipe26	0.545	0.86	1.896	1.855	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
ExPipe36	0.767	1.21	1.771	1.67	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
ExPipe38	0.493	0.77	1.668	1.64	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
ExPipe44	0	0	1.64	1.64	AR&R 100 year, 48 hours storm, average 8.34 mm/h, Zone 1
Pipe139	0.316	0.88	1.818	1.8	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Pipe50	0.125	0.35	1.8	1.867	AR&R 100 year, 5 minutes storm, average 257 mm/h, Zone 1
Pipe51	0.528	1.48	1.733	1.55	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Pipe211	0.521	0.58	1.538	1.53	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Pipe72	0.029	0.26	2.278	2.273	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe73	0.057	0.52	2.256	2.237	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe71	0.083	0.75	2.198	2.159	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe70	0.09	0.81	2.121	2.082	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe68	0.101	0.63	2.082	2.059	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe67	0.123	0.78	2.039	2.006	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe66	0.147	0.93	1.98	1.942	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe125	0.016	0.15	2.132	2.129	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Pipe75	0.054	0.49	2.116	2.108	AR&R 100 year, 10 minutes storm, average 201 mm/h, Zone 1
Pipe77	0.125	0.78	2.088	2.07	AR&R 100 year, 10 minutes storm, average 201 mm/h, Zone 1
Pipe78	0.125	0.79	2.058	2.025	AR&R 100 year, 10 minutes storm, average 201 mm/h, Zone 1
Pipe79	0.131	0.83	2.011	1.972	AR&R 100 year, 5 minutes storm, average 257 mm/h, Zone 1
Pipe159	0.036	0.33	2.604	2.6	AR&R 100 year, 5 minutes storm, average 257 mm/h, Zone 1
Pipe47	0.488	1.72	2.437	2.396	AR&R 100 year, 1 hour storm, average 88.2 mm/h, Zone 1
Pipe48	0.517	1.83	2.258	2.109	AR&R 100 year, 10 minutes storm, average 201 mm/h, Zone 1
Pipe49	0.541	1.91	2.052	1.867	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Pipe197	0.762	2.69	3.183	3.1	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Pipe163	0.459	1.62	3.071	3.012	AR&R 100 year, 3 hours storm, average 45.6 mm/h, Zone 1
Pipe165	0.483	1.71	2.827	2.6	AR&R 100 year, 10 minutes storm, average 201 mm/h, Zone 1
Pipe199	0.129	0.81	1.976	1.942	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Pipe236	0.032	0.29	1.924	1.897	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
ExPipe32	0.063	0.57	1.87	1.855	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe238	0.028	0.25	1.732	1.726	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Pipe239	0.054	0.49	1.709	1.69	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe240	0.057	0.52	1.659	1.64	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
Pipe310	0.054	0.49	2.124	2.124	AR&R 100 year, 12 hours storm, average 19.2 mm/h, Zone 1
Pipe309	0.069	0.62	2.12	2.119	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe74	0.07	0.63	2.115	2.108	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
Pipe318	0.311	1.95	2.004	1.867	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q	Max V	Due to Storm

	(cu.m/s)	(m/s)						
Bio Swale	0.763	0.86						AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF99	0.179	0.179	7.665	0.044	0.03	12.71	0.59	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF102	0.157	0.157	7.665	0.042	0.02	12.35	0.56	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF104	0.359	0.359	1.19	0.174	0.2	5.21	1.13	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF108	0.068	0.068	1.19	0.103	0.1	2.08	0.92	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF110	0.335	0.335	1.19	0.171	0.19	5.04	1.12	AR&R 100 year, 1 hour storm, average 88.2 mm/h, Zone 1
OF120	0.904	0.904	7.665	0.084	0.08	20.79	0.92	AR&R 100 year, 1 hour storm, average 88.2 mm/h, Zone 1
OF54	0.772	0.772	7.665	0.079	0.07	19.72	0.89	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF37	0.146	0.146	1.19	0.129	0.14	2.94	1.05	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF21	0.831	0.831	7.665	0.08	0.07	20.08	0.92	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF69	0.015	0.015	7.665	0.018	0.01	5.84	0.29	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF67	0.014	0.014	1.19	0.064	0.05	0.79	0.78	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF71	0.012	0.012	1.19	0.06	0.05	0.66	0.76	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF73	0	0	7.665	0	0	0	0	
OF77	0.001	0.001	7.665	0.007	0	2.25	0.17	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF81	0.008	0.008	7.665	0.014	0	4.64	0.24	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF83	0.009	0.009	7.665	0.014	0	4.64	0.27	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF56	0.003	0.003	1.19	0.038	0.02	0.31	0.54	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF58	0.047	0.047	7.665	0.026	0.01	8.83	0.4	AR&R 100 year, 1 hour storm, average 88.2 mm/h, Zone 1
OF87	0	0	1.19	0	0	0	0	
OF90	0.004	0.004	1.19	0.043	0.02	0.35	0.58	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF97	0.002	0.002	1.19	0.032	0.02	0.27	0.5	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF23	0.012	0.012	7.665	0.016	0	5.24	0.29	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF25	0.265	0.265	1.19	0.161	0.17	4.51	1.06	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF32	0.229	0.229	1.19	0.148	0.17	3.58	1.14	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF35	0.187	0.187	1.19	0.139	0.15	3.28	1.09	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF5	0.337	0.337	7.665	0.056	0.04	15.23	0.7	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF7	0.289	0.289	1.19	0.165	0.18	4.73	1.07	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF85	0.256	0.256	7.665	0.05	0.03	13.97	0.66	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF106	0.02	0.02	1.19	0.071	0.06	1.02	0.8	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF112	0.02	0.02	1.19	0.071	0.06	1.02	0.82	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF114	0.013	0.013	1.19	0.063	0.05	0.75	0.77	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF116	0.011	0.011	1.19	0.059	0.04	0.61	0.76	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF130	0.024	0.024	7.665	0.021	0.01	7.03	0.33	AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1
OF190	0.187	0.187	1.19	0.139	0.15	3.28	1.09	AR&R 100 year, 1 hour storm, average 88.2 mm/h, Zone 1
OF181	0.028	0.028	7.665	0.022	0.01	7.33	0.35	AR&R 100 year, 30 minutes storm, average 127 mm/h, Zone 1
OF179	0.02	0.02	1.19	0.071	0.06	1	0.82	AR&R 100 year, 1 hour storm, average 88.2 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

CONTINUITY CHECK for AR&R 100 year, 20 minutes storm, average 152 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
Pit24	212.48	212.48	0	0
Pit78	423.42	423.43	0	0
ExPit22	303.92	303.92	0	0
Pit10	888.26	888.35	0	0
Pit26	998.65	998.65	0	0
Pit36	1052.25	1061.06	0	-0.8
Pit37	1163.22	1163.3	0	0
Outlet into	1162	1162	0	0
N54	272.19	272.19	0	0
Pit109	435.04	439.9	0	-1.1
Pit50	875.57	875.57	0	0
Pit131 Cou	1507.15	1704.35	0	-13.1
Outlet to n	1698.39	1698.39	0	0
Pit71	35.34	35.33	0	0
Pit70	59.19	59.19	0	0
Pit69	79.86	79.86	0	0
Pit66	78.28	78.28	0	0
Pit65	87.94	87.94	0	0
Pit64	111.12	111.12	0	0
Pit63	132.84	132.84	0	0
Pit94	14.49	14.48	0	0
Pit74	65.66	64.22	0	2.2
Pit73	157.3	157.08	0	0.1
Pit76	173.98	173.97	0	0
Pit77	183.91	183.9	0	0
Pit119	28.97	28.85	0	0.4
Pit47	741.67	752.6	0	-1.5
Pit48	769.4	769.4	0	0

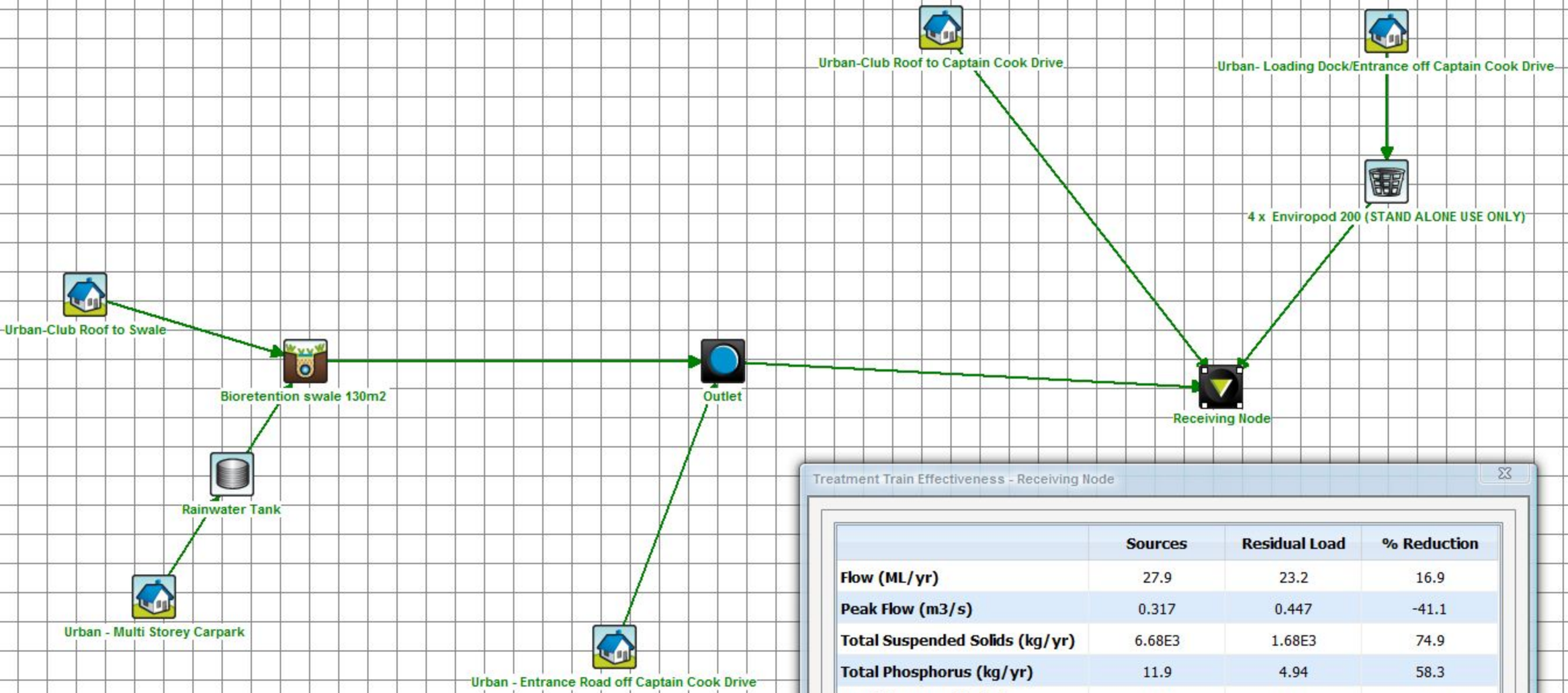
Pit49	794.52	794.52	0	0
N152	650.54	648.65	0	0.3
N197	648.65	645.03	0	0.6
Pit123	657.1	661.87	0	-0.7
Pit125	681.94	681.93	0.16	0
Pit157	308.34	307.85	0	0.2
Pit175	38.63	38.62	0	0
Pit33	69.52	69.52	0	0
Pit178	36.48	36.47	0	0
Pit179	60.62	60.61	0	0
Pit180	75.1	88.63	0	-18
Pit213	165.18	165.23	0	0
Pit212	73.41	72.3	0	1.5
Pit72	86.01	86	0	0
N238	239.19	239.2	0	0

Upwelling occurred at Pit131 Council Pit, Pit123, Pit109, Pit47, Pit37, Pit36
Freeboard was less than 0.15m at Pit213, Pit212, Pit180, Pit179, Pit125, Pit74, Pit72, Pit71, Pit50, Pit49, Pit48, Pit26
Flows were safe in all overflow routes.

The following overflow routes carried water uphill (adding energy): OF179, OF5
These results may be invalid. You should check for water flowing round in circles at these locations. You may need to reformulate the model.

Appendix D

MUSIC Model & Results



Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	27.9	23.2	16.9
Peak Flow (m3/s)	0.317	0.447	-41.1
Total Suspended Solids (kg/yr)	6.68E3	1.68E3	74.9
Total Phosphorus (kg/yr)	11.9	4.94	58.3
Total Nitrogen (kg/yr)	64.5	41.1	36.2
Gross Pollutants (kg/yr)	676	175	74.1

Appendix E

Stormwater Catchment Plan