Flood Report

UOW - Arts and Social Sciences Building

82017208-01

Prepared for

University of Wollongong

7 February 2018

Cardno

Contact Information

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Ground Floor
16 Burelli Street
Wollongong 2500
Australia

Phone +612 4228 4133
Fax +612 4228 6811

Document Information

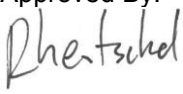
Prepared for	University of Wollongong
Project Name	UOW - Arts and Social Sciences Building
File Reference	Report 001 Ver 1_UOW_Flood Study_Robsons Culvert.docx
Job Reference	82017208-01
Date	7 February 2018
Version Number	1

Author(s):

Nathan Pomfret
Water Engineer

Effective Date 7/02/2018

Approved By:



Rory Hentschel
Manager - Water

Date Approved 7/02/2018

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
1	07/02/2018	Submit to Client	NGP	RJH

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Background

The University of Wollongong (UOW) has engaged Cardno (NSW/ACT) Pty Ltd to undertake a flood study for the proposed flood remediation works involving a Culvert upgrade at Robsons Road located at UOW's Wollongong campus. This report presents the outcome of the assessment to demonstrate that the proposal is in accordance with the relevant floodplain management policies.

Further, UOW is proposing to construct the Arts and Social Sciences Building (ASSB) via a State Significant Development application. This report provides details on the flood conditions and requirements for the proposed building in accordance with the relevant floodplain management policies.

1.2 Site Description

The culvert (the site) is situated at the western end of the UoW main campus on Robsons Road in Keiraville. The site connects a tributary to Fairy Creek, through Robsons Road. The area upstream of the site acts as an informal flood storage area in large flood events. It is proposed to replace the existing 1.8 m diameter RCP with a 1.8 m (h) x 3.6 m (W) Reinforced Concrete Box Culvert (RCBC).

The ASSB is situated in the north west of the UOW main campus on Northfields Avenue in Keiraville. The ASSB fronts a car parking area, has direct access to the Ring Road and backs onto the riparian corridor of an upper tributary of Fairy Creek. The proposed building is to replace a group of existing demountable buildings and some ground level carpark area. The layout of the proposed site can be observed in **Appendix D**.

2 Available Data

2.1 Topographic Data

2.1.1 Aerial Laser Survey

ALS survey data provides complete coverage of the study area and catchments, and has been purchased from LPI. The ALS survey data was captured in 2013. This ALS digital elevation model (DEM) data was used to define catchment boundaries and to represent the existing surface in the hydraulic model where detailed survey or DA approved design was not available. The DEM has been used in the development of the ground surface in the TUFLOW hydraulic model as discussed in **Section 4**.

2.1.2 Detailed Site Survey

Detailed site survey was obtained on 12 July 2017 by K.F. Williams & Associates Pty Ltd (refer **Appendix F**). The survey contains topographic information of the existing site.

Detailed topographic survey of areas surrounding the subject site were also used in this study. The surveyed area including details of the survey are presented in **Figure 2-1**.

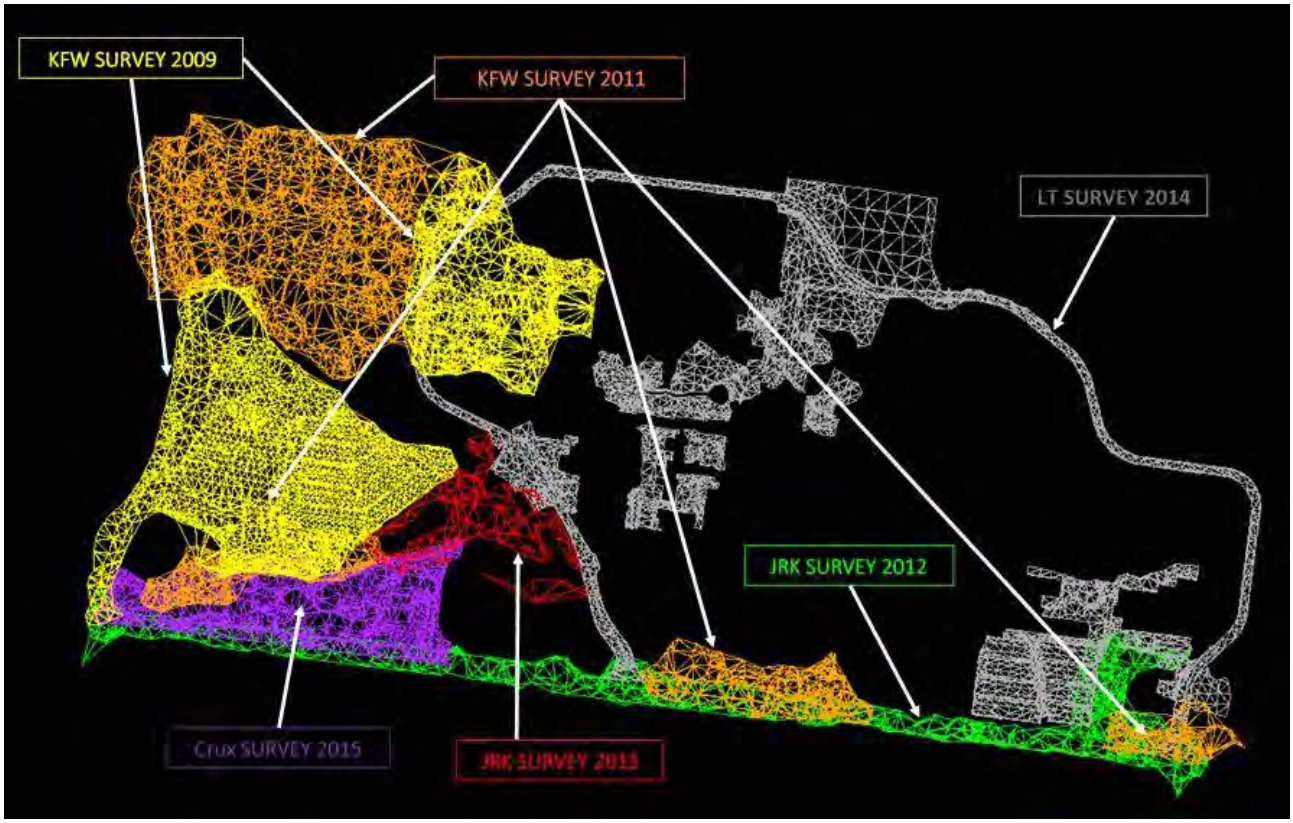


Figure 2-1 Detailed Site Survey

2.1.3 Site Inspection

A number of site inspections have been undertaken by Cardno to confirm catchment boundaries, flow paths, basin configurations and culvert sizes.

2.2 Previous Studies

2.2.1 Fairy and Cabbage Tree Creeks Flood Study, F&CTCFS

A flood study of Fairy Creek and Cabbage Tree Creeks was developed for Wollongong City Council in 2009 by Bewsher Consulting. Hydrologic and hydraulic models in this study were developed to define existing flood behaviour and problems within the study area. The hydrologic and hydraulic models were calibrated to historical flood events to demonstrate the validity of the models, using the August 1998 with the smaller October 1999 flood event used as verification. The study also predicts flood levels for design events up to and including the Probable Maximum Flood (PMF) event, and Provisional Hydraulic Hazard for the 1% Annual Exceedance Probability (AEP) flood. The findings provide means for assessing floodplain management measures within the study area. This study is abbreviated and referenced in this report as the F&CTCFS, 2009.

2.2.2 Fairy and Cabbage Tree Creeks Floodplain Risk Management Study and Plan

A Floodplain Risk Management Study and Plan for Fairy Creek and Cabbage Tree Creek (FCTCFRMS) was developed for Wollongong City Council in 2010 by Bewsher Consulting. The study covers the Fairy Creek, Cabbage Tree Creek and Towradgi Arm catchments. The study investigates what can be done to minimise the effects of flooding while the Floodplain Risk Management Plan (FRMP) outlines the best measures to reduce future flood damages, based on consideration of economic, social, ecological and engineering issues.

3 Hydrological Modelling

3.1 Catchment Description

The main University of Wollongong campus contains two major tributaries, which form part of the Fairy Creek catchment to the south and Cabbage Tree Creek catchment to the north (refer to catchment plan in **Appendix A**).

The Fairy Creek tributary headwaters originate at the summit of Mount Keira, and are conveyed down the escarpment which is characterised by steep slopes with minimal urbanisation. The tributary then enters a flatter grazing area before flowing through a culvert under Robsons Road and into the University. The Robsons Road culvert and the storage area immediately upstream provide some degree of (informal) attenuation of peak flows during major storm events.

3.2 Hydrological Model Selection

The computer model 'Watershed Bounded Network Model' WBNM2007 v104 (Boyd et al, 2007) was used for hydrological modelling of the study area. WBNM is an advanced storage-routing model that allows simulation of complex catchment behaviour. This particular model was considered most appropriate to the task of modelling the study area, given its ability to model a wide range of catchment characteristics, its local development and its use in the Fairy and Cabbage Tree Creek Flood Study, F&CTCFS (WCC, 2009). The model allowed peak flows to be established at various locations throughout the subject site. Model input and results are provided in **Appendix B**. The WBNM model was used to derive flows for input to flood model.

3.3 Model Inputs

3.3.1 Sub-Catchment Topology

The site lies within the upper reaches of the Fairy Creek Catchment. A ridgeline which separates the Cabbage Tree & Fairy Creek catchments traverses the campus. This boundary was confirmed during the site visit (2013) and was incorporated in the catchment plan (**Appendix A)**. The catchment plan illustrates the Cabbage Tree Creek catchment which discharges from the site and was further delineated into smaller sub-catchments using:

- Aerial Laser Survey (ALS);
- 2m contours; and
- Site inspection confirmation.

3.3.2 Impervious Fractions

The catchment consists of dense bush land, residential lots, paths, roads, car parks, commercial buildings and grassed recreation areas. Within the site, the impervious fraction of each sub-catchment was determined by accounting for each impervious area, as illustrated in **Appendix B**. Impervious fractions we adopted for sub catchments outside the site in accordance with Wollongong City Council's (WCC) Development Control Plan (DCP 2009) as follows:

- Normal Residential Lots - 60% impervious;
- Public Recreation Areas – 25% impervious;

The 25% impervious fraction for public recreation areas was used on areas with short grass and light vegetation. Areas covered in dense vegetation were represented by a 10% impervious fraction (confirmed via site inspection) while buildings, roads and hardstand areas were considered 100% impervious.

3.3.3 Hydrological Parameters

Hydrological parameters incorporated in the WBNM model are listed in **Table 3-1** and were adopted from the Fairy and Cabbage Tree Creeks Flood Study (WCC, 2009).

Table 3-1 WBNM Hydrological Parameters

Parameter	Value(s)
Initial loss (pervious surface)	0 mm
Initial loss (impervious surface)	0 mm
Continuing loss (pervious surface)	2 mm/hr
C (Lag parameter)	1.3
Stream routing factor	1.00

3.4 Design Storm Events

3.4.1 Critical Duration

The WBNM hydrological model was simulated for a range of storm durations to determine critical durations for the existing catchment. It was established that for events up to and including the 100 year ARI event, the critical duration is 120 minutes and 60 minutes for the PMF event.

4 Hydraulic Modelling

4.1 Selection of Hydraulic Model

A 2D flood model (TUFLOW) was used to simulate flooding on the site and surrounding area for the 1% AEP and PMF storm events. The model covers the study area shown in **Appendix C** and extends approximately 500 m upstream of Robsons Road to approximately 200 m downstream of the Southern Freeway. A 2D model was selected in preference over a 1D model to better represent the complex hydraulics associated with this site. The location of the downstream model boundary is shown in the Hydraulic Model Configuration map in **Appendix C**.

4.2 Model Geometry, Boundary Conditions and Roughness

4.2.1 Existing Scenario

The TUFLOW model was established over a 2 m grid with elevations extracted from ALS data. The model grid extent covers the entire UoW Campus and the adjacent sub-catchments.

Hydrographs were extracted from the WBNM model for input to the hydraulic model. The downstream boundary conditions were modelled using a constant tailwater level which was taken immediately downstream of the Southern Freeway. The tailwater levels were adopted from the F&CTCFS (2009) and were identified as 14 m AHD for the 1% AEP and 16 m AHD for the PMF event.

Culverts and pipes inspected within the study area were modelled in accordance with WCC's new blockage policy as detailed in the Review of Conduit Blockage Policy Summary Report (WMA, May 2016).

Manning's roughness values were assigned to the model based on areas identified from aerial imagery. Values adopted from the F&CTCFS (2009) and included in the model are provided in **Table 4-1**.

Table 4-1 Manning's 'n' Roughness Values

Land Type	Land Type (F&CTCFS, 2009)	Manning's 'n' Values
Ponds	-	0.010
Roads	Road Surface	0.025
Pasture	Grass (un-maintained)	0.045
Buildings	Building	0.500
Short Grass	Grass (maintained)	0.035
Trees	Dense Creek Vegetation	0.080

The Hydraulic Model Configuration Plan for the existing scenario is provided in **Appendix C**.

4.2.2 Proposed Scenario

The TUFLOW model was updated to reflect the proposed culvert upgrade and development associated with the ASSB. The proposed building envelope was modelled as an obstruction based on the proposed layout plan. The Culvert upgrade concept design plans are provided in **Appendix D** whilst the Concept Civil plans are provided in **Appendix E**.

The Manning's roughness values within the proposed development areas were updated based on the proposed layout plan. Values adopted from the F&CTCFS (2009) and included in the model are provided in **Table 4-1**.

Hydraulic Model Configuration Plan for the developed scenario is provided in **Appendix C**.

4.3 Simulation Results

4.3.1 Existing Scenario

The hydraulic model was simulated for the 1% AEP and PMF storm events. Flood maps indicating flood extents, depths, elevations, velocities and hazards were produced from the simulation results and are presented in **Appendix C**.

The hydraulic modelling results show that flooding occurs in the storage area to the west of Robsons Road until it overtops and continues as sheet flow through the proposed ASSB site in both the 1% AEP and PMF events.

Depth of flow in the vicinity of the proposed ASSB is generally below 100 mm in the 1% AEP and 300 mm in the PMF event. Flood velocities are generally less than 2 m/s in both storm events with marginal areas reaching a maximum velocity of 1.3 and 2.5 m/s in the 1% AEP and PMF events, respectively. Flood maps are provided in **Appendix C**.

4.3.2 Model Calibration

The 1% AEP results from this assessment were compared against the results from the F&CTCFS (2009) using the 100% blocked case in accordance with Councils blockage policy at the time of undertaking the F&CTCFS. The downstream boundary condition used in the model is adopted and consistent with the level presented in the F&CTCFS (2009).

The flood extents and water levels along Northfield Avenue show general parity between the 100 year ARI obtained in this assessment and that presented in the F&CTCFS (2009). However, the existing MLS site and surrounding areas are shown as flooded in this study although the F&CTCFS (2009) presents no flood affectation within this area. It should be noted that flood modelling in this study includes detailed site surveys within the vicinity of the UoW Campus. As such, the result obtained in this study establishes a more detailed and accurate representation of the flood behaviour across the subject site.

4.3.3 Proposed Scenario

The hydraulic modelling results in the proposed scenario demonstrate that the increased Culvert has the capacity to convey the 1% AEP storm event when accounting for blockage. The proposed ASSB site is not considered to be flood affected in the 1% AEP storm event and is more than 500 mm above the relative 1% AEP flood level.

The proposed results are similar to existing in the PMF event, with slightly lower flood levels and velocities. The exception to this is in the immediate vicinity of the proposed ASSB, where flood level increases up to 600 mm are experienced in the PMF event.

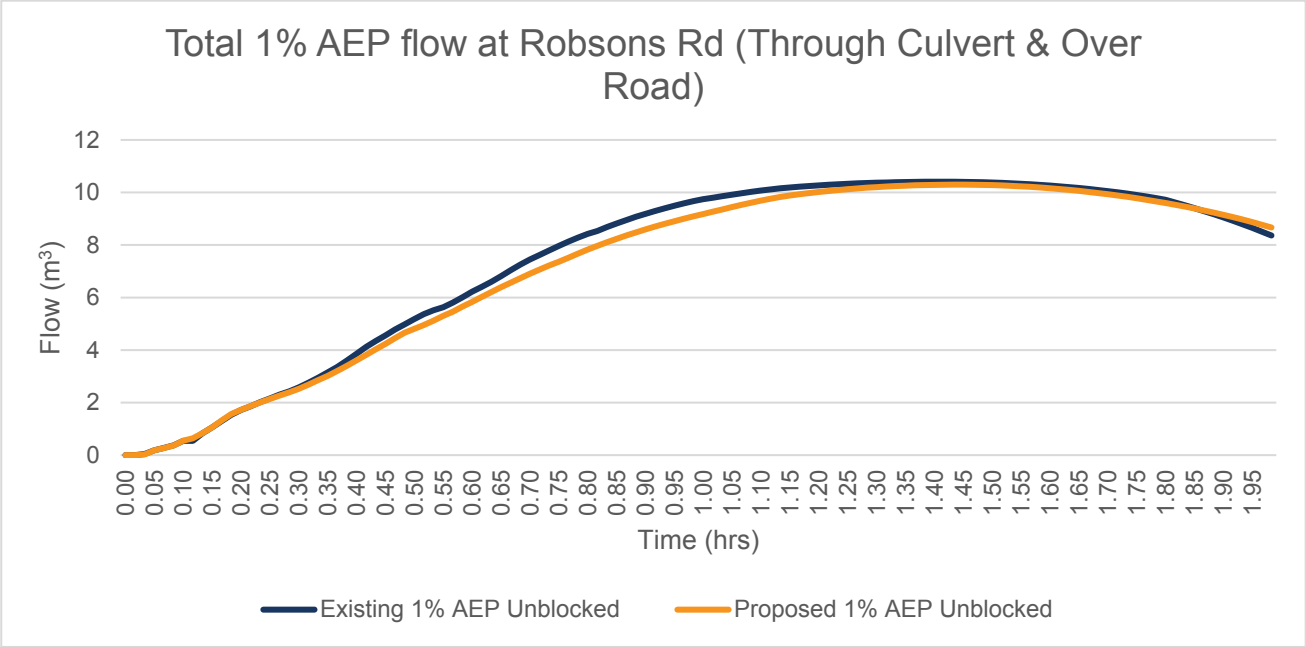
4.3.4 Flood Storage Weir

A weir is proposed upstream of the culvert as detailed in **Appendix E**. The weir has been designed to ensure the attenuation of the informal flood storage basin is maintained.

The weir has been modelled as a 1D structure within the TUFLOW model. In order to maintain the attenuation of the informal flood storage basin the weir has been sized such that the flow rate across Robson's road is not increased as a result of the proposed development in the 1% AEP event.

An assessment of the flow through the culvert and across the road have been extracted from the TUFLOW model in both the existing and proposed case. **Figure 4-1** demonstrates that the flow rate does not increase in the developed case and therefore that the effective floodplain storage has been maintained. The flow rates for the unblocked scenario are shown as this is the worst case for downstream flooding.

Figure 4-1 Total Flow Crossing Robsons Road



5 Discussion

5.1 Hydraulic Hazard Categorisation

The NSW Floodplain Development Manual (FDM, 2005) provides guidelines to assess the safety and hazard of floodwaters based on the velocity and depth. Appendix L of the FDM (2005) provides two graphs which are used to assess flood waters, as provided in **Figure 5-1** and **Figure 5-2** below.

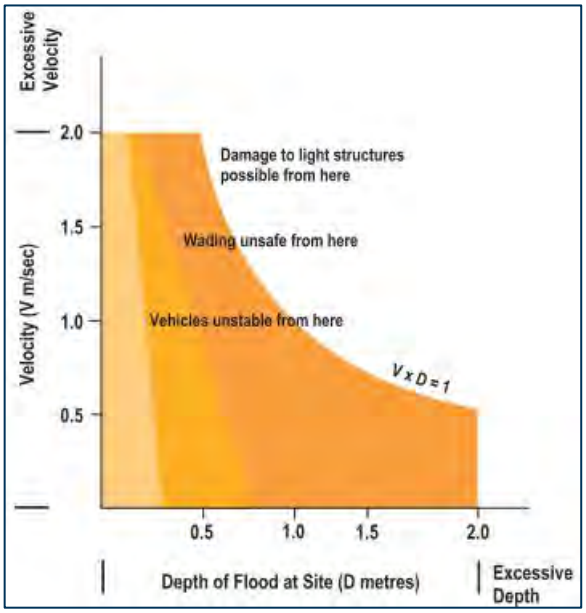


Figure 5-1 Velocity & Depth Relationships (FDM, 2005)

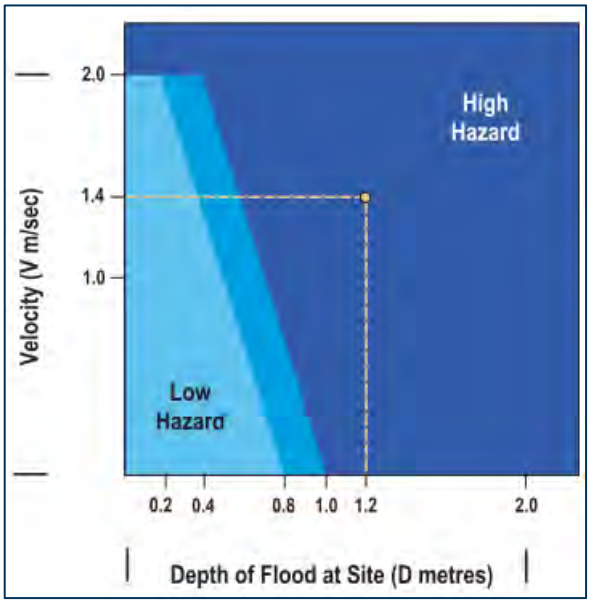


Figure 5-2 Provisional Hydraulic Hazard Categories (FDM, 2005)

FDM (2005) defines the hazard categories as follows:

- ***High hazard****: possible danger to personal safety: evacuation by trucks difficult: able-bodied adults would have difficulty in wading to safety; potential for significant structural damage to buildings;*
- ***Low hazard****: should it be necessary, truck could evacuate people and their possessions; able-bodied adults would have little difficulty in wading to safety.*

Flood maps were derived to demonstrate the flood behaviour exhibited across the site to identify potential safety and hazardous flooding. The flood extents, depths and elevations including velocities and hydraulic hazards are provided in **Appendix C**. All flood model results and observations are based on the major flood event, i.e. the 1% AEP event, in accordance with the FDM (2005) guidelines.

Flood model results were assessed to identify hazardous areas. It is demonstrated that the ASSB exhibits primarily low hazard to flood free.

5.2 Flood Risk Precincts

WCC's DCP 2009 states that flood prone land should be divided into three flood risk areas (**Table 5-1**).

Table 5-1 Council DCP 2009 Risk Precinct Definitions

Risk Precinct	Definition
High	The area within the envelope of land subject to a high provisional hydraulic hazard (in accordance with FPDM, 2005) in a 100 year flood event plus all land within 10m from the top of the creek bank.
Medium	Land below the 100 year flood level (plus 500mm freeboard) that is not within the High Flood Risk precinct.
Low	All other land within the floodplain (ie the extent of the PMF) but not defined within either the High or Medium Flood Risk precincts.

The proposed ASSB is considered to be in the medium Flood Risk Precinct (FRP) in the existing case. This reduces to Low Flood Risk Precinct in the developed case.

5.3 Floodplain Management

5.3.1 Finished Floor Levels

As the ASSB is considered to be Low FRP in the proposed case when accounting for climate change, a flood planning level is therefore not required.

5.3.2 Flood Compatible Buildings Materials and Structural Soundness

Flood compatible building components would be required for any portion of the building which is below the PMF level. This includes masonry foundations and other such features. An extensive list of approved materials is available in WCC's DCP (2009) and should be referenced during detailed design.

A structural soundness certificate will be required as part of the Construction Certificate to demonstrate that the proposed works can withstand the force of floodwater, debris and buoyancy up to and including the PMF.

5.3.3 Evacuation and Safe Access

The proposed building is multistorey with well in excess of 20 m^2 above the PMF flood level, therefore a stay in place evacuation policy is recommended. Further access from the proposed building to the flood free section of the Western carpark (north) is safe for pedestrians. Details are further discussed in **Section 5.5.**

5.4 Flood Affectation

Changes in flood elevations in the 1% AEP and PMF storm events as a result of the proposed works were assessed using the hydraulic model. Flood Impact Maps are provided in **Appendix C.** Key findings are discussed in the sections below.

5.4.1 1% AEP

Results indicate that the proposed site changes do not result in any detrimental flooding impacts. This is demonstrated in the flood maps provided in **Appendix C**.

5.4.2 PMF

Results indicate that the proposed site changes do not result in any detrimental flooding impacts. This is demonstrated in the flood maps provided in **Appendix C**.

5.4.3 Floodplain Storage

Schedule 10 of Chapter E13 of Council's DCP requires that Flood affectation including the the loss of storage in the floodplain is considered. The proposed changes do not cause detrimental flood impacts (refer **Sections 5.4.1 & 5.4.2**). Effective flood storage is maintained as detailed in **Section 4.3.4**.

The combination of these factors demonstrates that the proposed changes will not result in cumulative flood impacts.

5.5 Trafficability

The results from the hydraulic flood model demonstrate that the proposed carpark within the site (located to the north of the MLS building) is flood free in the 1% AEP event and is therefore considered to be trafficable.

6 Conclusions

It can be concluded that:

- Flooding occurs as overland flows which overtop Robsons Road and flow through the proposed ASSB site in the existing 1% AEP, PMF and the developed PMF case.
- The proposed ASSB site is not flood affected in the developed 1% AEP event.
- The depth of inundation adjacent to the ASSB is generally below 100 mm in the existing 1% AEP Event.
- The depth of inundation adjacent to the ASSB is generally below 300 mm in both the existing and proposed PMF events. Velocities are generally less than 2 m/s in both events.
- The proposed development will not cause any detrimental flooding impacts.
- Effective floodplain storage is maintained in the developed case.
- The proposed ASSB building is considered to be Low FRP and hence, Flood Planning Level's do not apply.
- All proposed carparking areas and accesses are trafficable up to the 1% AEP storm event.
- Safe evacuation is provided up to the PMF event as a result of the proposed development.

APPENDIX A

CATCHMENT MAP

UNIVERSITY OF WOLLONGONG AUSTRALIA

Catchment Plan

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Watercourses (LPI)
- 10m Contours (LPI)
- Site Discharge Locations
- Major Catchment Boundary
- Sub Catchment Boundary
- Cadastre (LPI, 2015)

1:8,000 Scale at A3

Metres

0 100 200 300 400

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2017-03-09
Coordinate System: GDA 1994 MGA Zone 56
Project: 82017137_01
Map: 82017137-GS-014-CatchmentPlan.mxd 01
Aerial imagery supplied by Nearmap (October, 2016).

APPENDIX

B

HYDROLOGICAL ASSESSMENT

2. Catchment Details

Steps 2.1 to 2.4: Enter Data for each Subarea in the Model, including Topology, Surface and Flowpath Blocks and Loss Details

Catchment Statistics

Total Area [ha]	136.5
Total Impervious Percent [%]	36.0
No. of Subareas	26
No. of Subareas with WC Factor	26

2.1 Catchment Details

Routing Options | Sort Subareas

2.2 Lag Parameters

Populate

2.3 Flowpaths

Populate

2.4 Rainfall Losses

Continuing Loss Rate | Populate

Subarea Name	D/S Subarea	Area	CG Coords (MGA)		Outlet Coords (MGA)		Imp Fraction	C	Imp Lag	Type	Value	IL	CLR	Imp IL	
		ha	E	N	E	N	%	1.3	0.1	R	1	0	2	0	0
												mm	mm/hr	mm	
4A	5A	1.94	0	0	0	0	65.6	1.3	0.1	R	1	0	2	0	
7A	5A	2.6	0	0	0	0	66.1	1.3	0.1	R	1	0	2	0	
8C	8B	1.7	0	0	0	0	63.1	1.3	0.1	R	1	0	2	0	
8B	8A	1.95	0	0	0	0	55.2	1.3	0.1	R	1	0	2	0	
8A	5B	1.66	0	0	0	0	43.0	1.3	0.1	R	1	0	2	0	
5E	5D	0.5	0	0	0	0	66.2	1.3	0.1	R	1	0	2	0	
5D	5C	1.48	0	0	0	0	63.9	1.3	0.1	R	1	0	2	0	
5C	5B	1.77	0	0	0	0	56.6	1.3	0.1	R	1	0	2	0	
5B	5A	3.78	0	0	0	0	63.8	1.3	0.1	R	1	0	2	0	
5A	DUMMY	4.77	0	0	0	0	20.8	1.3	0.1	R	1	0	2	0	
6D	6C	9.83	0	0	0	0	39.3	1.3	0.1	R	1	0	2	0	
6C	6B	5.01	0	0	0	0	54.8	1.3	0.1	R	1	0	2	0	
6B	6A	8.23	0	0	0	0	48.3	1.3	0.1	R	1	0	2	0	
6A	DUMMY	10.15	0	0	0	0	32.5	1.3	0.1	R	1	0	2	0	
2A	1A	3.97	0	0	0	0	33.7	1.3	0.1	R	1	0	2	0	
1G	1F	23.29	0	0	0	0	10.0	1.3	0.1	R	1	0	2	0	
1F	1E	14.75	0	0	0	0	13.4	1.3	0.1	R	1	0	2	0	
1E	1D	2.11	0	0	0	0	39.9	1.3	0.1	R	1	0	2	0	
3A1	3A	1.19	0	0	0	0	66.7	1.3	0.1	R	1	0	2	0	
3B	3A	5.06	0	0	0	0	19.0	1.3	0.1	R	1	0	2	0	
3A	1C	5.49	0	0	0	0	43.7	1.3	0.1	R	1	0	2	0	
1D	1C	1.33	0	0	0	0	25.6	1.3	0.1	R	1	0	2	0	

3. Local & Outlet Structures

Steps 3.1 to 3.3: Enter Data for each Structure in the Model (both outlet structures and local structures)

Structure Statistics

No. of Structures	8
No. of Outlet Structures	8
No. Local Structures	0

Update Sub List | Show 5 | Show 10 | Show 20 | Show 50 | GOTO Fuse

Populate after steps 3.2 & 3.3 (optional)

Populate Directed Subs

	Structure Summary					Local			Fuse	Basin Details			Directed Subareas				
3.1	Lock	ID	Subarea	Type	Description of Structure	Local / Out	%Per to LS	%Imp to LS	Fuse Plug	IWL	Surf_Area	Stor_Fac	1	2	3	4	5
GOTO	TRUE	1	3A1	HS		OUTLET				36.1	0	1	3A				
GOTO	TRUE	2	3A	HS		OUTLET				29.95	0	1	1D	1C			
GOTO	TRUE	3	1D	HS		OUTLET				31.75	0	1	3A	1C			
GOTO	TRUE	4	1C	HS		OUTLET				28.9	0	1					
GOTO	TRUE	5	1F	HS		OUTLET				44.56	0	1					
GOTO	TRUE	6	5A	HS		OUTLET				16.5	0	1	DUMMY				
GOTO	TRUE	7	6A	HS		OUTLET				15.5	0	1	DUMMY				
GOTO	TRUE	8	8A	HS		OUTLET				24	0	1	5B				
GOTO	TRUE	9															
GOTO	TRUE	10															

Lock/Unlock ALL

Structure Templates

3.2 Build Structure Templates From Structure Summary

Build ALL | Build Unlocked | Delete Unlocked

3.3 Edit Individual Structure Templates

TOP

ID	1	3A1	OUTLET				
Weir	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	3A					
Crest Elev.	36.5					
Length [m]	12					
Weir Coeff.	1.7					
Disch_Fac	1					
Blck_Time						
Directed to	TOP					
Delay [mins]	0					
Pipe/Box	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	3A					
Invert	36.1					
No.	1					
Ent. Type	1					
Dia / Width	250					
Height						
Disch_Fac	1					
Blck_Time	0					
Directed to	TOP					
Delay [mins]	0					
Ent. Coeff						
Length [m]						
Out Invert						
n						

HSQ	1	2	3	4	5
Sub	BRCK_04				
DFactor	1				
Btime					
T/B	BOTTOM				
Delay	0				

H	S
m	m3
36.1	0
36.2	45.35
36.3	90.7
36.4	136.05
36.5	181.4
36.6	226.75
36.7	272.1

ID	2	3A	OUTLET				
Weir	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	1D	1C	1C	1C		
Crest Elev.	33.40	33.45	33.64	33.87		
Length [m]	10	9.33	13.97	14.19		
Weir Coeff.	1.7	1.7	1.7	1.7		
Disch_Fac	1	1	1	1		
Blck_Time						
Directed to	TOP	TOP	TOP	TOP		
Delay [mins]	0	0	0	0		
Pipe/Box	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	1C	1D				
Invert	29.95	31.75				
No.	1	2				
Ent. Type	1	1				
Dia / Width	950	450				
Height						
Disch_Fac	1	1				
Blck_Time	0	0				
Directed to	TOP	TOP				
Delay [mins]	0	0				
Ent. Coeff						
Length [m]						
Out Invert						
n						

HSQ	1	2	3	4	5
Sub					
DFactor					
Btime					
T/B					
Delay					

H	S
m	m3
29.95	0
31.8	0
31.9	9
32	41
32.1	100
32.2	198
32.3	337
32.4	496
32.5	672
32.6	863
32.7	1070
32.8	1291
32.9	1523
33	1766
33.1	2020
33.2	2283
33.3	2557
33.4	2847
33.5	3154
33.6	3475
33.7	3808
33.8	4154
33.9	4514
34	4883

ID	3	1D	OUTLET				
Weir	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	1C					
Crest Elev.	33.23					
Length [m]	9					
Weir Coeff.	1.7					
Disch_Fac	1					
Blck_Time						
Directed to	TOP					
Delay [mins]	0					
Pipe/Box	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	1C					
Invert	31.8					
No.	3					
Ent. Type	2					
Dia / Width	3000					
Height	930					
Disch_Fac	1					
Blck_Time	0					
Directed to	TOP					
Delay [mins]	0					
Ent. Coeff						
Length [m]						
Out Invert						
n						

HSQ	1	2	3	4	5
Sub					
DFactor					
Btime					
T/B					
Delay					

H	S
m	m3
31.75	0
31.8	0
31.9	13
32	33
32.1	56
32.2	84
32.3	115
32.4	151
32.5	191
32.6	236
32.7	287
32.8	346
32.9	414
33	492
33.1	580
33.2	678
33.3	787
33.4	909
33.5	1052
33.6	1211
33.7	1382
33.8	1566
33.9	1764
34	1975

TOP

ID	4	1C	OUTLET				
Weir	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	1B					
Crest Elev.	29.96					
Length [m]	6					
Weir Coeff.	1.7					
Disch_Fac	1					
Blck_Time						
Directed to	TOP					
Delay [mins]	0					
Pipe/Box	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	1B					
Invert	28.9					
No.	2					
Ent. Type	2					
Dia / Width	3000					
Height	600					
Disch_Fac	1					
Blck_Time	0					
Directed to	TOP					
Delay [mins]	0					
Ent. Coeff						
Length [m]						
Out Invert						

ID	5	1F	OUTLET				
Weir	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	1E					
Crest Elev.	48					
Length [m]	40					
Weir Coeff.	1.7					
Disch_Fac	1					
Blck_Time						
Directed to	TOP					
Delay [mins]	0					
Pipe/Box	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	1E					
Invert	44.56					
No.	1					
Ent. Type	1					
Dia / Width	1800					
Height						
Disch_Fac	1					
Blck_Time	0					
Directed to	TOP					
Delay [mins]	0					
Ent. Coeff						
Length [m]						
Out Invert						

ID	6	5A	OUTLET				
Weir	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	DUMMY					
Crest Elev.	17.7					
Length [m]	100					
Weir Coeff.	1.7					
Disch_Fac	1					
Blck_Time						
Directed to	TOP					
Delay [mins]	0					
Pipe/Box	**1**	**2**	**3**	**4**	**5**	**6**
Subarea	DUMMY					
Invert	16.5					
No.	1					
Ent. Type	1					
Dia / Width	600					
Height						
Disch_Fac	1					
Blck_Time	0					
Directed to	TOP					
Delay [mins]	0					
Ent. Coeff						
Length [m]						
Out Invert						

n						
HSQ		1	2	3	4	5
	Sub					
	DFactor					
	Btime					
	T/B					
	Delay					

H	S
m	m3
28.9	0
29	263
29.1	543
29.2	839
29.3	1151
29.4	1487
29.5	1855
29.6	2247
29.7	2660
29.8	3095
29.9	3550
29.96	3835
30	4025
30.1	4519
30.2	5032
30.3	5566
30.4	6119
30.5	6691
30.6	7282
30.7	7891
30.8	8519
30.9	9165
31	9828
31.1	10507
31.2	11200
31.3	11909
31.4	12632
31.5	13370
31.6	14123
31.7	14890
31.8	15672
31.9	16467
32	17276

n						
HSQ		1	2	3	4	5
	Sub					
	DFactor					
	Btime					
	T/B					
	Delay					

H	S
m	m3
44	0
44.1	10
45.2	15.167
45.4	39.215
45.6	101.318
45.8	225.917
46	402.89
46.2	719.807
46.4	1098.296
46.6	1614.212
46.8	2307.208
47	3123.742
47.2	4194.691
47.4	5410.035
47.6	6848.77
47.8	8492.3
48	10270.12
48.2	12331.75
48.4	14534.81
48.6	16952.4
48.8	19610.84
49	22434.95
49.2	25476.68
49.4	28622.9
49.6	31902.52
49.8	35315.09
50	38837.06

n						
HSQ		1	2	3	4	5
	Sub					
	DFactor					
	Btime					
	T/B					
	Delay					

H	S
m	m3
16.5	0
17.5	1
17.52	165
17.54	332
17.56	501.628
17.58	673.198
17.6	846.889
17.62	1022.667
17.64	1200.495
17.66	1380.339
17.68	1562.164
17.7	1745.935
17.72	1931.616
17.74	2119.171
17.76	2308.558
17.78	2499.735
17.8	2692.66
17.82	2887.292
17.84	3083.586
17.86	3281.495
17.88	3480.973
17.9	3681.974
18	3884.448

TOP

ID	7	8A	OUTLET
Weir	1	2	3	4	5	6
Subarea	DUMMY					
Crest Elev.	15.50					
Length [m]	5					
Weir Coeff.	1.7					
Disch_Fac	1					
Blck_Time						
Directed to	TOP					
Delay [mins]	0					
Pipe/Box	1	2	3	4	5	6
Subarea						
Invert						
No.						
Ent. Type						
Dia / Width						
Height						
Disch_Fac						
Blck_Time						
Directed to						
Delay [mins]						
Ent. Coeff						
Length [m]						
Out Invert						
n						

HSQ		1	2	3	4	5
	Sub					
	DFactor					
	Btime					
	T/B					
	Delay					

H	S
m	m3
15.5	0
15.6	0.393
15.8	1.821
16	4.39
16.2	8.51
16.4	14.333
16.6	26.206
16.8	51.215
17	92.171
17.2	222.422
17.4	393.51
17.6	631.066
17.8	925.495
18	1253.126
18.2	1647.159
18.4	2087.854
18.6	2600.365
18.8	3195.698
19	3854.086
19.2	4604.776
19.4	5421.899
19.5	5854.093

ID	8	6A	OUTLET
Weir	1	2	3	4	5	6
Subarea	5B					
Crest Elev.	24.5					
Length [m]	27					
Weir Coeff.	1.7					
Disch_Fac	1					
Blck_Time						
Directed to	TOP					
Delay [mins]	0					
Pipe/Box	1	2	3	4	5	6
Subarea						
Invert						
No.						
Ent. Type						
Dia / Width						
Height						
Disch_Fac						
Blck_Time						
Directed to						
Delay [mins]						
Ent. Coeff						
Length [m]						
Out Invert						
n						

HSQ		1	2	3	4	5
	Sub					
	DFactor					
	Btime					
	T/B					
	Delay					

H	S
m	m3
24	0
24.05	57.042
24.1	118.073
24.15	183.26
24.2	252.769
24.25	326.765
24.3	405.414
24.35	488.882
24.4	577.335
24.45	670.938
24.5	769.858
24.55	897.833
24.6	1031.267
24.65	1170.013
24.7	1313.889
24.75	1462.483
24.8	1615.453
24.85	1772.63
24.9	1933.841
24.95	2098.915
25	2267.686

ID	9
Weir	1	2	3	4	5	6
Subarea						
Crest Elev.						
Length [m]						
Weir Coeff.						
Disch_Fac						
Blck_Time						
Directed to						
Delay [mins]						
Pipe/Box	1	2	3	4	5	6
Subarea						
Invert						
No.						
Ent. Type						
Dia / Width						
Height						
Disch_Fac						
Blck_Time						
Directed to						
Delay [mins]						
Ent. Coeff						
Length [m]						
Out Invert						
n						

HSQ		1	2	3	4	5
	Sub					
	DFactor					
	Btime					
	T/B					
	Delay					

H	S
m	m3

TOP

ID	10
Weir	1	2	3	4	5	6
Subarea						
Crest Elev.						
Length [m]						
Weir Coeff.						
Disch_Fac						
Blck_Time						
Directed to						
Delay [mins]						
Pipe/Box	1	2	3	4	5	6
Subarea						
Invert						
No.						

ID	11
Weir	1	2	3	4	5	6
Subarea						
Crest Elev.						
Length [m]						
Weir Coeff.						
Disch_Fac						
Blck_Time						
Directed to						
Delay [mins]						
Pipe/Box	1	2	3	4	5	6
Subarea						
Invert						
No.						

ID	12
Weir	1	2	3	4	5	6
Subarea						
Crest Elev.						
Length [m]						
Weir Coeff.						
Disch_Fac						
Blck_Time						
Directed to						
Delay [mins]						
Pipe/Box	1	2	3	4	5	6
Subarea						
Invert						
No.						

Ent. Type			
Dia / Width			
Height			
Disch_Fac			
Blck_Time			
Directed to			
Delay [mins]			
Ent. Coeff			
Length [m]			
Out Invert			
n			
HSQ	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Sub			
DFactor			
Btime			
T/B			
Delay			
H S			
m m3			

Results-Tables

ET Results View Results in Tabular Format
ET Strc on: CAT2

Inflow Peak (m3/s)	1.444	2.185	2.491	2.819	2.857	2.771	2.914	3.123	3.328	3.265	2.569	2.556	2.183	1.863	1.972

Results for Runfile: U:\FY17\137_UOW MLS Flood Study\Des-An\Hydrology\WBNM\Existing_Meta.out

Results

View Results at Location: OUTLET Outflow Flowrates Volumes Time to Peaks Structures

Storm No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ARI	**5**	**5**	**10**	**10**	**20**	**20**	**50**	**50**	**100**	**100**	**PMF**				
Duration	120	270	120	270	120	270	120	270	120	270	60				
Catchment Area	136.48	136.48	136.48	136.48	136.48	136.48	136.48	136.48	136.48	136.48	136.48				
Impervious percent (%)	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02	36.02				
Rainfall Depth (mm)	90.82	128.3	106.2	151.3	125.81	180.5	152.23	220.14	172.87	251.31	330.21				
Excess Rainfall (mm)	88.26	122.54	103.64	145.54	123.25	174.74	149.67	214.39	170.31	245.55	328.93				
Runoff Depth (mm)	87.93	122.29	103.33	145.37	122.97	174.65	149.46	214.38	170.11	245.6	328.91				
Time to Rain Peak (mins)	35	75	35	75	35	75	35	75	35	75	10				
VOLUMES at Outlet [m3]															
4A	1734	2428	2032	2874	2413	3441	2926	4210	3326	4815	6392				
7A	2325	3255	2725	3854	3235	4613	3922	5644	4458	6454	8568				
8C	1518	2124	1779	2515	2112	3011	2562	3685	2913	4215	5601				
8B	3252	4545	3813	5385	4529	6451	5494	7899	6247	9037	12023				
8A	3951	5820	4767	7042	5809	8593	7212	10700	8308	12355	16718				
5E	447	626	524	741	622	887	754	1085	857	1241	1647				
5D	1767	2475	2072	2930	2460	3508	2984	4294	3392	4911	6523				
5C	3343	4675	3919	5538	4655	6633	5646	8121	6420	9290	12353				
5B	10675	15225	12651	18181	15169	21932	18565	27026	21214	31029	41540				
5A	18940	26700	22346	31807	26687	38278	32555	47063	37119	53972	72204				
6D	8694	12081	10207	14343	12136	17215	14735	21115	16766	24181	32356				
6C	13159	18310	15443	21728	18356	26065	22282	31955	25348	36584	48870				
6B	20478	28497	24031	33810	28561	40553	34662	49710	39431	56909	75995				
6A	29449	40932	34568	48583	41094	58294	49885	71488	56753	81855	109419				
2A	3499	4857	4109	5771	4888	6930	5938	8505	6757	9743	13060				
1G	20375	28028	23966	33389	28543	40195	34709	49444	39527	56717	76574				
1F	33313	45853	39181	54618	46658	65743	56732	80857	64601	92739	125144				
1E	35183	48459	41378	57711	49268	69458	59902	85423	68208	97957	132114				
3A1	1063	1490	1246	1763	1480	2111	1794	2583	2040	2954	3920				
3B	4434	6125	5212	7290	6204	8769	7542	10777	8587	12355	16637				
3A	10372	14385	12172	17095	14489	20533	17583	25187	20003	28848	38682				
1D	36882	50222	43673	60161	52426	72834	64204	89897	73541	103580	149809				
1C	48602	67078	57125	79833	68009	96033	82649	118039	94083	135300	182158				
1B	52305	72271	61467	85985	73157	103410	88888	127058	101173	145614	195812				
1A	70721	98040	83066	116547	98808	140038	120014	171885	136566	196893	263973				
DUMMY	120001	166899	141027	198397	167834	238367	203977	292591	232171	335194	448893				
PEAK FLOWRATES [m3/s]															
PEAK Stream Top															
4A	0	0	0	0	0	0	0	0	0	0	0				
7A	0	0	0	0	0	0	0	0	0	0	0				
8C	0	0	0	0	0	0	0	0	0	0	0				
8B	0.788	0.453	0.926	0.535	1.103	0.64	1.249	0.729	1.424	0.834	2.174				
8A	1.411	0.936	1.666	1.11	1.995	1.332	2.29	1.523	2.618	1.744	4.612				
5E	0	0	0	0	0	0	0	0	0	0	0				
5D	0.252	0.135	0.295	0.159	0.351	0.19	0.396	0.216	0.451	0.247	0.654				
5C	0.859	0.521	1.011	0.617	1.207	0.738	1.372	0.842	1.566	0.963	2.523				
5B	3.291	2.19	3.899	2.609	4.672	3.156	5.423	3.622	6.202	4.158	11.219				
5A	5.746	4.081	6.929	4.865	8.399	5.877	9.837	6.762	11.291	7.773	20.824				
6D	0	0	0	0	0	0	0	0	0	0	0				
6C	3.487	2.357	4.127	2.803	4.951	3.374	5.689	3.872	6.517	4.445	11.582				
6B	4.855	3.349	5.763	3.999	6.934	4.829	8.082	5.568	9.273	6.408	17.168				
6A	6.642	4.766	7.929	5.709	9.598	6.919	11.285	8.026	13.003	9.258	25.629				
2A	0	0	0	0	0	0	0	0	0	0	0				
1G	0	0	0	0	0	0	0	0	0	0	0				
1F	6.22	4.542	7.438	5.46	9.017	6.64	10.629	7.732	12.262	8.938	23.76				
1E	7.105	6.568	8.02	7.509	9.088	8.603	10.146	9.585	11.413	10.527	37.912				
3A1	0	0	0	0	0	0	0	0	0	0	0				
3B	0	0	0	0	0	0	0	0	0	0	0				
3A	2.268	1.515	2.686	1.803	3.234	2.171	3.746	2.49	4.299	2.859	7.51				
1D	7.649	6.861	8.762	8.077	10.085	9.401	11.365	10.542	12.74	11.647	44.612				
1C	10.328	9.344	11.601	10.79	13.088	12.351	14.602	13.69	16.103	14.977	52.87				
1B	9.956	9.089	11.551	10.705	13.204	12.359	14.822	13.805	16.278	15.165	52.529				
1A	10.862	9.701	12.634	11.483	14.415	13.419	16.243	15.176	17.773	16.868	57.516				
DUMMY	24.423	22.862	29.58	27.187	36.156	32.568	42.961	37.654	49.525	42.827	118.589				
PEAK Stream Bottom															
4A	0	0	0	0	0	0	0	0	0	0	0				
7A	0	0	0	0	0	0	0	0	0	0	0				
8C	0	0	0	0	0	0	0	0	0	0	0				
8B	0.644	0.424	0.761	0.504	0.91	0.606	1.05	0.694	1.199	0.796	2.133				
8A	1.325	0.883	1.567	1.051	1.88	1.267	2.177	1.455	2.493	1.672	4.527				
5E	0	0	0	0	0	0	0	0	0	0	0				
5D	0.192	0.126	0.226	0.15	0.271	0.18	0.312	0.206	0.357	0.236	0.629				
5C	0.738	0.488	0.872	0.581	1.045	0.699	1.207	0.802	1.381	0.92	2.473				
5B	2.823	2.044	3.414	2.439	4.159	2.951	4.879	3.403	5.624	3.917	10.904				
5A	4.995	3.771	6.087	4.513	7.485	5.465	8.864	6.321	10.248	7.279	20.373				
6D	0	0	0	0	0	0	0	0	0	0	0				
6C	3.021	2.131	3.603	2.548	4.354	3.082	5.093	3.562	5.857	4.105	11.225				
6B	4.046	3.056	4.837	3.65	5.872	4.413	6.907	5.116	7.967	5.895	16.481				
6A	5.631	4.593	6.763	5.485	8.243	6.621	9.756	7.684	11.283	8.843	24.923				
2A	0	0	0	0	0	0	0	0	0	0	0				
1G	0	0	0	0	0	0	0	0	0	0	0				
1F	4.852	4.217	5.861	5.068	7.181	6.158	8.567	7.201	9.951	8.314	23.055				
1E	7.073	6.533	7.999	7.478	9.071	8.577	10.136	9.562	11.337	10.509	37.803				
3A1	0	0	0	0	0	0	0	0	0	0	0				
3B	0	0	0	0	0	0	0	0	0	0	0				
3A	1.878	1.342	2.251	1.608	2.73	1.946	3.2	2.253	3.693	2.598	7.154				
1D	7.618	6.8	8.746	8.014	10.067	9.355	11.357	10.535	12.678	11.639	44.553				
1C	10.28	9.262	11.567	10.718	13.066	12.279	14.585	13.627	16.048	14.919	52.694				
1B	9.81	8.967	11.45	10.58	13.131	12.294	14.761	13.756	16.216	15.125	52.145				
1A	10.263	9.419	11.996	11.133	13.873	13.021	15.811	14.714	17.441	16.265	55.556				
DUMMY	24.365	22.686	29.38	26.994	35.839	32.401	42.594	37.519	49.157	42.725	118.246				
PEAK Local Perv															
4A	0.271	0.171	0.322	0.203	0.388	0.244	0.444	0.279	0.509	0.32	0.846				
7A	0.346	0.223	0.411	0.266	0.495	0.319	0.568	0.365	0.652	0.419	1.112				
8C	0.257	0.161	0.305	0.191	0.367	0.23	0.42	0.263	0.482	0.301	0.796				
8B	0.343	0.221	0.408	0.263	0.491	0.317	0.564	0.362	0.647	0.415	1.102				
8A	0.368	0.239	0.437	0.284	0.527	0.342	0.605	0.391	0.695	0.449	1.191				
5E	0.079	0.045	0.094	0.053	0.112	0.063	0.128	0.072	0.146	0.083	0.216				
5D	0.223	0.138	0.265	0.164	0.318	0.197	0.364	0.225	0.417	0.258	0.679				
5C	0.307	0.196	0.364	0.233	0.439	0.28	0.503	0.32	0.577	0.367	0.972				
5B	0.506	0.339	0.601	0.404	0.726	0.486	0.836	0.557	0.961	0.639	1.703				
5A	1.274	0.869	1.512	1.039	1.817	1.256	2.117	1.447	2.426	1.666	4.414				
6D	1.897	1.313	2.257	1.572	2.722	1.905	3.183	2.202	3.656	2.538	6.791				
6C	0.805	0.543	0.952	0.648	1.141	0.781	1.324	0.898	1.515	1.032	2.75				
6B	1.415	0.968	1.681	1.158	2.021	1.4	2.357	1.615	2.702	1.86	4.943				
6A	2.134	1.485	2.542	1.78	3.068	2.158	3.591	2.497	4.129	2.879	7.718				
2A	0.922	0.624	1.092	0.745	1.31	0.899	1.522	1.034	1.742	1.189	3.166				
1G	5.302	3.93	6.364	4.715	7.745	5.752	9.162	6.722	10.595	7.785	21.286				
1F	3.577	2.564	4.278	3.083	5.187	3.75	6.105	4.362	7.041	5.041	13.543				
1E	0.474	0.315	0.563	0.376	0.679	0.452	0.782	0.518	0.899	0.595	1.582				
3A1	0.171	0.103	0.203	0.123	0.244	0.147	0.278	0.168	0.319	0.192	0.505				
3B	1.37	0.936	1.625	1.119	1.954	1.353	2.278	1.56	2.613	1.797	4.77				
3A	1.066	0.723	1.263	0.864	1.516	1.044	1.763	1.201	2.019	1.382	3.673				
1D	0.382	0.249	0.455	0.297	0.548	0.357	0.629	0.408	0.723	0.469	1.244				
1C	0.537	0.36	0.635	0.429	0.766	0.516	0.883	0.592	1.015	0.68	1.81				
1B	0.614	0.412	0.725	0.491	0.868	0.592	1.005	0.679	1.152	0.78	2.079				
1A	2.179	1.518	2.596	1.82	3.134	2.206	3.669	2.553	4.219	2.945	7.896				
DUMMY	0.386	0.252	0.459	0.3	0.553	0.36	0.635	0.413	0.729	0.473	1.257				
PEAK Local Imp															
4A	0.625	0.346	0.731	0.408	0.866	0.487	0.975	0.553	1.108	0.631	1.634				
7A	0.83	0.467	0.971	0.55	1.15	0.657	1.296	0.746	1.472	0.852	2.205				
8C	0.531	0.292	0.621	0.344	0.736	0.41	0.829	0.466	0.941	0.532	1.377				
8B	0.533	0.293	0.624	0.345	0.739	0.412	0.832	0.468	0.945	0.534	1.382				
8A	0.361	0.194	0.422	0.229	0.499	0.273	0.562	0.311	0.638	0.355	0.926				
5E	0.172	0.09	0.201	0.106	0.239	0.127	0.268	0.144	0.305	0.164	0.438				
5D	0.471	0.257	0.551	0.303	0.653	0.362	0.735	0.411	0.835	0.47	1.215				
5C	0.498	0.272	0.582	0.321	0.69	0.383	0.777	0.436	0.882	0.497	1.286				
5B	1.143	0.654	1.336	0.771	1.583	0.92	1.785	1.046	2.027	1.194	3.092				
5A	0.493	0.27	0.577	0.318	0.684	0.38	0.77	0.431	0.874	0.493	1.274				
6D	1.777	1.044	2.077	1.231	2.461	1.469	2.778	1.67	3.155	1.906	4.943				
6C	1.29	0.744	1.509	0.877	1.787	1.046	2.017	1.19	2.29	1.358	3.519				
6B	1.825	1.074	2.134	1.267	2.528	1.511	2.854	1.718	3.241	1.961	5.085				
6A	1.533	0.893	1.792	1.053	2.123	1.256	2.396	1.428	2.721	1.63	4.224				
2A	0.655	0.364	0.766	0.429	0.908	0.511	1.023	0.581	1.161	0.664	1.718				
1G	1.106	0.632	1.293	0.745	1.532	0.888	1.727	1.01	1.961	1.153	2.987				
1F	0.947	0.536	1.108	0.633	1.312	0.755	1.48	0.858	1.68	0.979	2.536				
1E	0.422	0.229	0.494	0.27	0.585	0.322	0.658	0.366	0.747	0.418	1.086				
3A1	0.399	0.216	0.467	0.255	0.553	0.304	0.622	0.345	0.706	0.394	1.026				
3B	0.479	0.261	0.56	0.308	0.663	0.368	0.747	0.418	0.848	0.477	1.235				
3A	1.137	0.65	1.329	0.767	1.575	0.915	1.776	1.04	2.017	1.188	3.076				
1D	0.177	0.093	0.207	0.109	0.245	0.13	0.276	0.148	0.313	0.169	0.45				
1C	0.331	0.177	0.387	0.209	0.458	0.25	0.515	0.284	0.585	0.324	0.848				
1B	1.157	0.663	1.353	0.782	1.603	0.932	1.808	1.06	2.053	1.21	3.135				
1A	4.164	2.581	4.869	3.044	5.768	3.631	6.527	4.13	7.412	4.715	12.244				
DUMMY	0	0	0	0	0	0	0	0	0	0	0				
PEAK Directed to Btm															
4A	0	0	0	0	0	0	0	0	0	0	0				
7A	0	0	0	0	0	0	0	0	0	0	0				
8C	0	0	0	0	0	0	0	0	0	0	0				
8B	0	0	0	0	0	0	0	0	0	0	0				
8A	0	0	0	0	0	0	0	0	0	0	0				
5E	0	0	0	0	0	0	0	0	0	0	0				
5D	0	0	0	0	0	0	0	0	0	0	0				
5C	0	0	0	0	0	0	0	0	0	0	0				
5B	0	0	0	0	0	0	0	0	0	0	0				
5A	0	0	0	0	0	0	0	0	0	0	0				
6D	0	0	0	0	0	0	0	0	0	0	0				
6C	0	0	0	0	0	0	0	0	0	0	0				
6B	0	0	0	0	0	0	0	0	0	0	0				
6A	0	0	0	0	0	0	0	0	0	0	0				
2A	0	0	0	0	0	0	0	0	0	0	0				
1G	0	0	0	0	0	0	0	0	0	0	0				
1F	0	0	0	0	0	0	0	0	0	0	0				
1E	0	0	0	0	0	0	0	0	0	0	0				
3A1	0	0	0	0	0	0	0	0	0	0	0				
3B	0	0	0	0	0	0	0	0	0	0	0				
3A	0	0	0	0	0	0	0	0	0	0	0				
1D	0	0	0	0	0	0	0	0	0	0	0				
1C	0	0	0	0	0	0	0	0	0	0	0				
1B	0	0	0	0	0	0	0	0	0	0	0				
1A	0	0	0	0	0	0	0	0	0	0	0				
DUMMY	0	0	0	0	0	0	0	0	0	0	0				
PEAK OUTLET Inflow															
4A	0.896	0.517	1.053	0.611	1.253	0.731	1.419	0.832	1.617	0.951	2.48				
7A	1.176	0.69	1.382	0.816	1.645	0.976	1.865	1.112	2.125	1.271	3.317				
8C	0.788	0.453	0.926	0.535	1.103	0.64	1.249	0.729	1.424	0.834	2.174				
8B	1.411	0.936	1.666	1.11	1.995	1.332	2.29	1.523	2.618	1.744	4.612				
8A	1.956	1.304	2.311	1.552	2.767	1.869	3.202	2.143	3.66	2.461	6.6				
5E	0.252	0.135	0.295	0.159	0.351	0.19	0.396	0.216	0.451	0.247	0.654				
5D	0.859	0.521	1.011	0.617	1.207	0.738	1.372	0.842	1.566	0.963	2.523				
5C	1.422	0.953	1.677	1.131	2.005	1.358	2.312	1.553	2.642	1.78	4.721				
5B	3.981	2.874	4.861	3.438	5.945	4.17	7.002	4.818	8.069	5.551	15.404				
5A	6.405	4.784	7.802	5.731	9.58	6.943	11.362	8.035	13.151	9.259	25.846				
6D	3.487	2.357	4.127	2.803	4.951	3.374	5.689	3.872	6.517	4.445	11.582				
6C	4.855	3.349	5.763	3.999	6.934	4.829	8.082	5.568	9.273	6.408	17.168				

6B	6.642	4.766	7.929	5.709	9.598	6.919	11.285	8.026	13.003	9.258	25.629
6A	8.197	6.585	9.854	7.846	12.015	9.463	14.269	10.984	16.518	12.638	35.682
2A	1.534	0.987	1.814	1.173	2.175	1.41	2.492	1.615	2.853	1.853	4.883
1G	6.22	4.542	7.438	5.46	9.017	6.64	10.629	7.732	12.262	8.938	23.76
1F	8.465	7.062	10.222	8.456	12.52	10.232	14.935	11.924	17.35	13.728	38.278
1E	7.334	6.8	8.308	7.736	9.442	8.84	10.587	9.86	11.818	10.834	39.805
3A1	0.57	0.319	0.669	0.377	0.796	0.451	0.9	0.513	1.025	0.586	1.525
3B	1.745	1.197	2.072	1.427	2.496	1.721	2.881	1.978	3.31	2.274	5.986
3A	3.828	2.655	4.558	3.173	5.496	3.835	6.418	4.423	7.372	5.091	13.633
1D	7.788	7.029	8.937	8.267	10.296	9.618	11.64	10.789	12.962	11.897	45.813
1C	10.554	9.636	11.878	11.098	13.438	12.687	15.039	14.076	16.482	15.422	54.617
1B	10.339	9.307	12.026	10.975	13.696	12.722	15.371	14.277	16.864	15.712	54.768
1A	12.218	11.651	14.186	13.862	16.415	16.569	18.903	19.153	20.947	21.639	66.198
DUMMY	24.618	22.88	29.717	27.224	36.256	32.675	43.09	37.837	49.72	43.087	119.098
PEAK OUTLET Outflow											
4A	0.896	0.517	1.053	0.611	1.253	0.731	1.419	0.832	1.617	0.951	2.48
7A	1.176	0.69	1.382	0.816	1.645	0.976	1.865	1.112	2.125	1.271	3.317
8C	0.788	0.453	0.926	0.535	1.103	0.64	1.249	0.729	1.424	0.834	2.174
8B	1.411	0.936	1.666	1.11	1.995	1.332	2.29	1.523	2.618	1.744	4.612
8A	1.887	1.264	2.239	1.509	2.686	1.822	3.119	2.093	3.569	2.404	6.556
5E	0.252	0.135	0.295	0.159	0.351	0.19	0.396	0.216	0.451	0.247	0.654
5D	0.859	0.521	1.011	0.617	1.207	0.738	1.372	0.842	1.566	0.963	2.523
5C	1.422	0.953	1.677	1.131	2.005	1.358	2.312	1.553	2.642	1.78	4.721
5B	3.981	2.874	4.861	3.438	5.945	4.17	7.002	4.818	8.069	5.551	15.404
5A	6.21	4.753	7.597	5.689	9.35	6.892	11.093	7.977	12.855	9.189	25.855
6D	3.487	2.357	4.127	2.803	4.951	3.374	5.689	3.872	6.517	4.445	11.582
6C	4.855	3.349	5.763	3.999	6.934	4.829	8.082	5.568	9.273	6.408	17.168
6B	6.642	4.766	7.929	5.709	9.598	6.919	11.285	8.026	13.003	9.258	25.629
6A	8.182	6.585	9.835	7.846	12	9.462	14.248	10.984	16.42	12.638	35.639
2A	1.534	0.987	1.814	1.173	2.175	1.41	2.492	1.615	2.853	1.853	4.883
1G	6.22	4.542	7.438	5.46	9.017	6.64	10.629	7.732	12.262	8.938	23.76
1F	7.105	6.568	8.02	7.509	9.088	8.603	10.146	9.585	11.413	10.527	37.912
1E	7.334	6.8	8.308	7.736	9.442	8.84	10.587	9.86	11.818	10.834	39.805
3A1	0.539	0.318	0.633	0.376	0.763	0.45	0.869	0.512	0.99	0.585	1.524
3B	1.745	1.197	2.072	1.427	2.496	1.721	2.881	1.978	3.31	2.274	5.986
3A	3.136	2.554	3.447	2.918	3.763	3.31	4.065	3.642	4.354	3.951	13.565
1D	7.786	7.025	8.936	8.266	10.295	9.62	11.639	10.789	12.958	11.896	45.734
1C	9.956	9.089	11.551	10.705	13.204	12.359	14.822	13.805	16.278	15.165	52.529
1B	10.339	9.307	12.026	10.975	13.696	12.722	15.371	14.277	16.864	15.712	54.768
1A	12.218	11.651	14.186	13.862	16.415	16.569	18.903	19.153	20.947	21.639	66.198
DUMMY	24.618	22.88	29.717	27.224	36.256	32.675	43.09	37.837	49.72	43.087	119.098
TIME to Peaks [mins]											
TIME Stream Top											
4A	0	0	0	0	0	0	0	0	0	0	0
7A	0	0	0	0	0	0	0	0	0	0	0
8C	0	0	0	0	0	0	0	0	0	0	0
8B	35	75	35	75	35	75	35	75	35	75	20
8A	36	75	36	75	35	75	36	75	36	75	20
5E	0	0	0	0	0	0	0	0	0	0	0
5D	35	75	35	75	35	75	35	75	35	75	10
5C	35	75	35	75	35	75	35	75	35	75	20
5B	40	75	40	75	40	75	40	75	40	75	21
5A	40	75	40	75	40	75	40	75	40	75	24
6D	0	0	0	0	0	0	0	0	0	0	0
6C	35	75	35	75	35	75	35	75	35	75	20
6B	40	75	40	75	40	75	40	75	40	75	25
6A	40	75	40	75	40	75	40	75	40	75	27
2A	0	0	0	0	0	0	0	0	0	0	0
1G	0	0	0	0	0	0	0	0	0	0	0
1F	40	75	40	75	40	75	40	75	40	75	30
1E	53	93	56	95	59	96	64	98	65	99	38
3A1	0	0	0	0	0	0	0	0	0	0	0
3B	0	0	0	0	0	0	0	0	0	0	0
3A	36	75	35	75	36	75	35	75	35	75	20
1D	52	90	54	90	58	90	63	97	65	98	39
1C	52	90	54	91	59	91	62	91	66	91	40
1B	59	96	64	97	67	100	69	101	71	102	48
1A	64	98	65	90	65	90	65	90	65	90	48
DUMMY	43	90	41	90	41	90	40	90	41	90	45
TIME Stream Bottom											
4A	0	0	0	0	0	0	0	0	0	0	0
7A	0	0	0	0	0	0	0	0	0	0	0
8C	0	0	0	0	0	0	0	0	0	0	0
8B	40	76	40	76	40	76	40	76	40	76	21
8A	41	77	41	76	40	76	40	76	40	76	22
5E	0	0	0	0	0	0	0	0	0	0	0
5D	40	76	40	76	39	76	39	75	39	75	21
5C	40	76	40	76	40	76	40	76	40	76	21
5B	44	81	43	80	43	80	42	79	42	79	26
5A	43	81	43	80	42	79	42	79	42	79	27
6D	0	0	0	0	0	0	0	0	0	0	0
6C	41	78	41	78	41	78	41	78	41	77	26
6B	45	85	44	84	44	83	44	83	44	82	31
6A	47	90	47	90	46	90	46	89	46	87	35
2A	0	0	0	0	0	0	0	0	0	0	0
1G	0	0	0	0	0	0	0	0	0	0	0
1F	47	91	47	91	46	90	46	90	46	90	38
1E	56	96	59	97	62	99	66	101	67	102	40
3A1	0	0	0	0	0	0	0	0	0	0	0
3B	0	0	0	0	0	0	0	0	0	0	0
3A	42	79	42	79	42	78	41	78	41	78	26
1D	53	92	57	92	60	95	65	98	67	100	40
1C	54	91	56	93	61	94	65	95	68	96	42
1B	64	100	67	100	70	104	72	105	74	106	50
1A	71	105	72	105	75	106	80	107	81	106	54
DUMMY	45	90	43	90	43	90	42	90	42	90	45
TIME Local Perv											
4A	35	75	35	75	35	75	35	75	35	75	20
7A	35	75	35	75	35	75	35	75	35	75	20
8C	35	75	35	75	35	75	35	75	35	75	20
8B	35	75	35	75	35	75	35	75	35	75	20
8A	35	75	35	75	35	75	35	75	35	75	20
5E	35	75	35	75	35	75	35	75	35	75	20
5D	35	75	35	75	35	75	35	75	35	75	20
5C	35	75	35	75	35	75	35	75	35	75	20
5B	40	75	35	75	35	75	35	75	35	75	20
5A	40	75	40	75	40	75	40	75	40	75	25
6D	40	75	40	75	40	75	40	75	40	75	25
6C	40	75	40	75	40	75	40	75	40	75	20
6B	40	75	40	75	40	75	40	75	40	75	25
6A	40	75	40	75	40	75	40	75	40	75	25
2A	40	75	40	75	40	75	40	75	40	75	20
1G	40	90	40	75	40	75	40	75	40	75	35
1F	40	75	40	75	40	75	40	75	40	75	25
1E	35	75	35	75	35	75	35	75	35	75	20
3A1	35	75	35	75	35	75	35	75	35	75	20
3B	40	75	40	75	40	75	40	75	40	75	25
3A	40	75	40	75	40	75	40	75	40	75	20
1D	35	75	35	75	35	75	35	75	35	75	20
1C	40	75	35	75	35	75	35	75	35	75	20
1B	40	75	40	75	35	75	40	75	35	75	20
1A	40	75	40	75	40	75	40	75	40	75	25
DUMMY	35	75	35	75	35	75	35	75	35	75	20
TIME Local Imp											
4A	35	75	35	75	35	75	35	75	35	75	20
7A	35	75	35	75	35	75	35	75	35	75	20
8C	35	75	35	75	35	75	35	75	35	75	20
8B	35	75	35	75	35	75	35	75	35	75	20
8A	35	75	35	75	35	75	35	75	35	75	10
5E	35	75	35	75	35	75	35	75	35	75	10
5D	35	75	35	75	35	75	35	75	35	75	10
5C	35	75	35	75	35	75	35	75	35	75	20
5B	35	75	35	75	35	75	35	75	35	75	20
5A	35	75	35	75	35	75	35	75	35	75	20
6D	35	75	35	75	35	75	35	75	35	75	20
6C	35	75	35	75	35	75	35	75	35	75	20
6B	35	75	35	75	35	75	35	75	35	75	20
6A	35	75	35	75	35	75	35	75	35	75	20
2A	35	75	35	75	35	75	35	75	35	75	20
1G	35	75	35	75	35	75	35	75	35	75	20
1F	35	75	35	75	35	75	35	75	35	75	20
1E	35	75	35	75	35	75	35	75	35	75	10
3A1	35	75	35	75	35	75	35	75	35	75	10
3B	35	75	35	75	35	75	35	75	35	75	20
3A	35	75	35	75	35	75	35	75	35	75	20
1D	35	75	35	75	35	75	35	75	35	75	10
1C	35	75	35	75	35	75	35	75	35	75	10
1B	35	75	35	75	35	75	35	75	35	75	20
1A	35	75	35	75	35	75	35	75	35	75	20
DUMMY	0	0	0	0	0	0	0	0	0	0	0
TIME Directed to Btm											
4A	0	0	0	0	0	0	0	0	0	0	0
7A	0	0	0	0	0	0	0	0	0	0	0
8C	0	0	0	0	0	0	0	0	0	0	0
8B	0	0	0	0	0	0	0	0	0	0	0
8A	0	0	0	0	0	0	0	0	0	0	0
5E	0	0	0	0	0	0	0	0	0	0	0
5D	0	0	0	0	0	0	0	0	0	0	0
5C	0	0	0	0	0	0	0	0	0	0	0
5B	0	0	0	0	0	0	0	0	0	0	0
5A	0	0	0	0	0	0	0	0	0	0	0
6D	0	0	0	0	0	0	0	0	0	0	0
6C	0	0	0	0	0	0	0	0	0	0	0
6B	0	0	0	0	0	0	0	0	0	0	0
6A	0	0	0	0	0	0	0	0	0	0	0
2A	0	0	0	0	0	0	0	0	0	0	0
1G	0	0	0	0	0	0	0	0	0	0	0
1F	0	0	0	0	0	0	0	0	0	0	0
1E	0	0	0	0	0	0	0	0	0	0	0
3A1	0	0	0	0	0	0	0	0	0	0	0
3B	0	0	0	0	0	0	0	0	0	0	0
3A	0	0	0	0	0	0	0	0	0	0	0
1D	0	0	0	0	0	0	0	0	0	0	0
1C	0	0	0	0	0	0	0	0	0	0	0
1B	0	0	0	0	0	0	0	0	0	0	0
1A	0	0	0	0	0	0	0	0	0	0	0
DUMMY	0	0	0	0	0	0	0	0	0	0	0
TIME OUTLET Inflow											
4A	35	75	35	75	35	75	35	75	35	75	20
7A	35	75	35	75	35	75	35	75	35	75	20
8C	35	75	35	75	35	75	35	75	35	75	20
8B	36	75	36	75	35	75	36	75	36	75	20
8A	40	75	40	75	40	75	40	75	40	75	20
5E	35	75	35	75	35	75	35	75	35	75	10
5D	35	75	35	75	35	75	35	75	35	75	20
5C	40	75	39	75	38	75	38	75	38	75	20
5B	40	75	40	75	40	75	40	75	40	75	25
5A	41	79	41	78	40	77	40	77	40	77	26
6D	35	75	35	75	35	75	35	75	35	75	20
6C	40	75	40	75	40	75	40	75	40	75	25
6B	40	75	40	75	40	75	40	75	40	75	27
6A	40	90	40	89	40	87	40	86	40	85	33
2A	35	75	35	75	35	75	35	75	35	75	20
1G	40	75	40	75	40	75	40	75	40	75	30
1F	40	90	40	90	40	90	40	90	40	90	35
1E	57	90	59	90	62	97	65	99	65	101	40
3A1	35	75	35	75	35	75	35	75	35	75	20

3B	40	75	35	75	35	75	35	75	35	75	20
3A	40	75	40	75	40	75	40	75	40	75	25
1D	53	90	57	90	60	91	65	91	66	91	40
1C	53	90	57	90	61	90	65	92	65	91	41
1B	64	99	65	100	65	103	65	104	77	105	49
1A	65	90	65	90	65	90	65	90	65	90	50
DUMMY	45	90	43	90	42	90	42	90	42	90	45
TIME OUTLET Outflow											
4A	35	75	35	75	35	75	35	75	35	75	20
7A	35	75	35	75	35	75	35	75	35	75	20
8C	35	75	35	75	35	75	35	75	35	75	20
8B	36	75	36	75	35	75	36	75	36	75	20
8A	41	77	41	77	41	77	41	76	40	76	22
5E	35	75	35	75	35	75	35	75	35	75	10
5D	35	75	35	75	35	75	35	75	35	75	20
5C	40	75	39	75	38	75	38	75	38	75	20
5B	40	75	40	75	40	75	40	75	40	75	25
5A	44	82	43	81	43	80	42	80	42	79	26
6D	35	75	35	75	35	75	35	75	35	75	20
6C	40	75	40	75	40	75	40	75	40	75	25
6B	40	75	40	75	40	75	40	75	40	75	27
6A	41	90	40	89	41	87	41	86	41	85	35
2A	35	75	35	75	35	75	35	75	35	75	20
1G	40	75	40	75	40	75	40	75	40	75	30
1F	53	93	56	95	59	96	64	98	65	99	38
1E	57	90	59	90	62	97	65	99	65	101	40
3A1	36	75	36	75	36	75	36	75	36	75	20
3B	40	75	35	75	35	75	35	75	35	75	20
3A	45	78	46	82	47	90	49	91	50	92	26
1D	53	91	57	91	61	91	65	91	66	91	41
1C	59	96	64	97	67	100	69	101	71	102	48
1B	64	99	65	100	65	103	65	104	77	105	49
1A	65	90	65	90	65	90	65	90	65	90	50
DUMMY	45	90	43	90	42	90	42	90	42	90	45
OUTLET Results											
OUTLET Strc on: 8A											
Inflow Peak (m3/s)	1.956	1.304	2.311	1.552	2.767	1.869	3.202	2.143	3.66	2.461	6.6
Outflow Peak (m3/s)	1.887	1.264	2.239	1.509	2.686	1.822	3.119	2.093	3.569	2.404	6.556
Inflow Volume (m3)	4721	6590	5537	7812	6579	9363	7982	11470	9078	13125	17488
Max Vol. Stored (m3)	1081	1004	1121	1038	1172	1073	1215	1104	1260	1140	1531
Max Water Elevation (m)	24.618	24.59	24.632	24.602	24.651	24.615	24.666	24.626	24.681	24.639	24.773
OUTLET Strc on: 5A											
Inflow Peak (m3/s)	6.405	4.784	7.802	5.731	9.58	6.943	11.362	8.035	13.151	9.259	25.846
Outflow Peak (m3/s)	6.21	4.753	7.597	5.689	9.35	6.892	11.093	7.977	12.855	9.189	25.855
Inflow Volume (m3)	18928	26700	22338	31800	26684	38272	32541	47060	37115	53970	72204
Max Vol. Stored (m3)	2701	2519	2860	2637	3049	2779	3224	2902	3394	3031	3838
Max Water Elevation (m)	17.801	17.782	17.817	17.794	17.836	17.809	17.854	17.822	17.871	17.835	17.977
OUTLET Strc on: 6A											
Inflow Peak (m3/s)	8.197	6.585	9.854	7.846	12.015	9.463	14.269	10.984	16.518	12.638	35.682
Outflow Peak (m3/s)	8.182	6.585	9.835	7.846	12	9.462	14.248	10.984	16.42	12.638	35.639
Inflow Volume (m3)	29449	40932	34568	48583	41094	58294	49885	71488	56753	81855	109419
Max Vol. Stored (m3)	18	13	26	17	46	24	73	37	124	52	1449
Max Water Elevation (m)	16.473	16.341	16.602	16.446	16.757	16.573	16.909	16.684	17.05	16.803	18.099
OUTLET Strc on: 1F											
Inflow Peak (m3/s)	8.465	7.062	10.222	8.456	12.52	10.232	14.935	11.924	17.35	13.728	38.278
Outflow Peak (m3/s)	7.105	6.568	8.02	7.509	9.088	8.603	10.146	9.585	11.413	10.527	37.912
Inflow Volume (m3)	33311	45851	39179	54616	46655	65741	56730	80855	64599	92737	125142
Max Vol. Stored (m3)	2211	1631	3429	2707	5346	4430	7827	6447	10407	8865	15996
Max Water Elevation (m)	46.772	46.605	47.057	46.898	47.389	47.239	47.719	47.544	48.013	47.842	48.521
OUTLET Strc on: 3A1											
Inflow Peak (m3/s)	0.57	0.319	0.669	0.377	0.796	0.451	0.9	0.513	1.025	0.586	1.525
Outflow Peak (m3/s)	0.539	0.318	0.633	0.376	0.763	0.45	0.869	0.512	0.99	0.585	1.524
Inflow Volume (m3)	1064	1490	1247	1764	1480	2111	1795	2583	2040	2954	3921
Max Vol. Stored (m3)	214	199	220	203	228	208	232	212	237	217	257
Max Water Elevation (m)	36.572	36.538	36.586	36.547	36.603	36.558	36.612	36.567	36.622	36.579	36.667
OUTLET Strc on: 3A											
Inflow Peak (m3/s)	3.828	2.655	4.558	3.173	5.496	3.835	6.418	4.423	7.372	5.091	13.633
Outflow Peak (m3/s)	3.136	2.554	3.447	2.918	3.763	3.31	4.065	3.642	4.354	3.951	13.565
Inflow Volume (m3)	10361	14383	12168	17086	14471	20518	17576	25177	20001	28839	38637
Max Vol. Stored (m3)	422	47	792	210	1358	619	2042	1117	2815	1767	4129
Max Water Elevation (m)	32.353	32.01	32.563	32.209	32.829	32.47	33.108	32.721	33.389	33	33.793
OUTLET Strc on: 1D											
Inflow Peak (m3/s)	7.788	7.029	8.937	8.267	10.296	9.618	11.64	10.789	12.962	11.897	45.813
Outflow Peak (m3/s)	7.786	7.025	8.936	8.266	10.295	9.62	11.639	10.789	12.958	11.896	45.734
Inflow Volume (m3)	36882	50222	43673	60161	52426	72834	64204	89897	73541	103580	149809
Max Vol. Stored (m3)	188	170	218	201	253	235	290	266	329	297	2489
Max Water Elevation (m)	32.494	32.447	32.559	32.521	32.634	32.598	32.705	32.66	32.77	32.717	34.244
OUTLET Strc on: 1C											
Inflow Peak (m3/s)	10.554	9.636	11.878	11.098	13.438	12.687	15.039	14.076	16.482	15.422	54.617
Outflow Peak (m3/s)	9.956	9.089	11.551	10.705	13.204	12.359	14.822	13.805	16.278	15.165	52.529
Inflow Volume (m3)	48602	67078	57125	79833	68009	96034	82649	118039	94084	135300	182158
Max Vol. Stored (m3)	4778	4424	5442	5084	6110	5772	6732	6342	7276	6860	19489
Max Water Elevation (m)	30.15	30.081	30.277	30.21	30.398	30.337	30.507	30.439	30.599	30.529	32.274

APPENDIX C

HYDRAULIC ASSESSMENT

UNIVERSITY OF WOLLONGONG AUSTRALIA

TUFLOW Model Configuration (Existing)

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Culvert
- Tailwater
- Flow Path (Cardno)
- 10m Contours (LPI)
- Catchment Areas
- Cadastre (DFSI-SS, 2017)

Materials Used for Modelling (Manning's n)

- Buildings (n = 0.5)
- Ponds (n = 0.01)
- Short Grass (n = 0.035)
- Pasture (n = 0.045)
- Trees (n = 0.08)
- Roads (n = 0.025)
- Default (n = 0.04)

1:4,000 Scale at A3

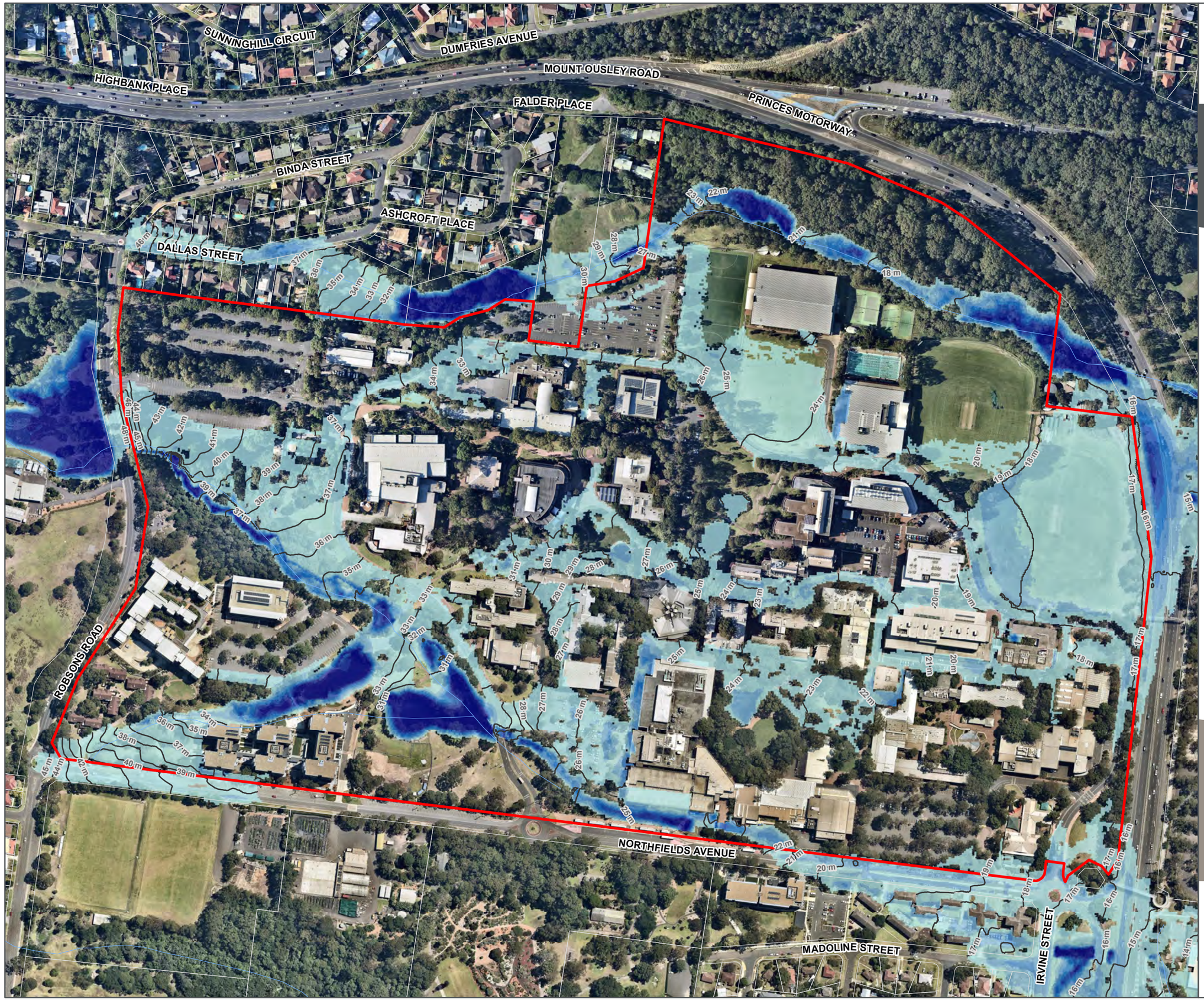
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2017-12-06 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-001-TUFLOWModelConfigExi.mxd 01
Aerial imagery supplied by Nearmap (October, 2017).



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Extent Existing 100 Year ARI

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Watercourse (LPI)
- 1m Flood Height Contour (mAHD)
- Cadastre (DFSI-SS, 2017)

Flood Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- > 1.50

1:3,500 Scale at A3

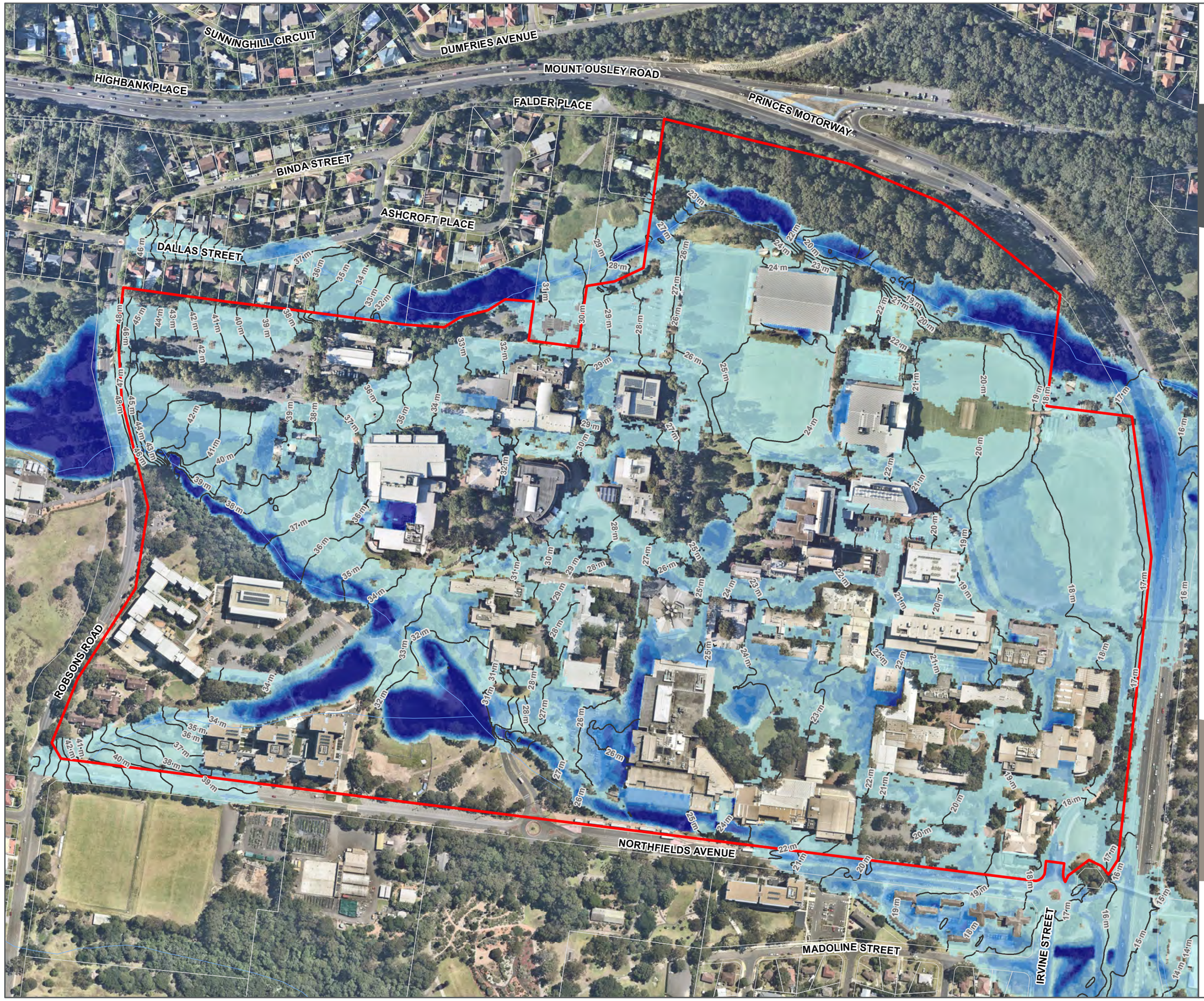
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-002-ExDepth100y.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Extent Existing PMF

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Watercourse (LPI)
- 1m Flood Height Contour (mAHD)
- Cadastre (DFSI-SS, 2017)

Flood Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- > 1.50

1:3,500 Scale at A3

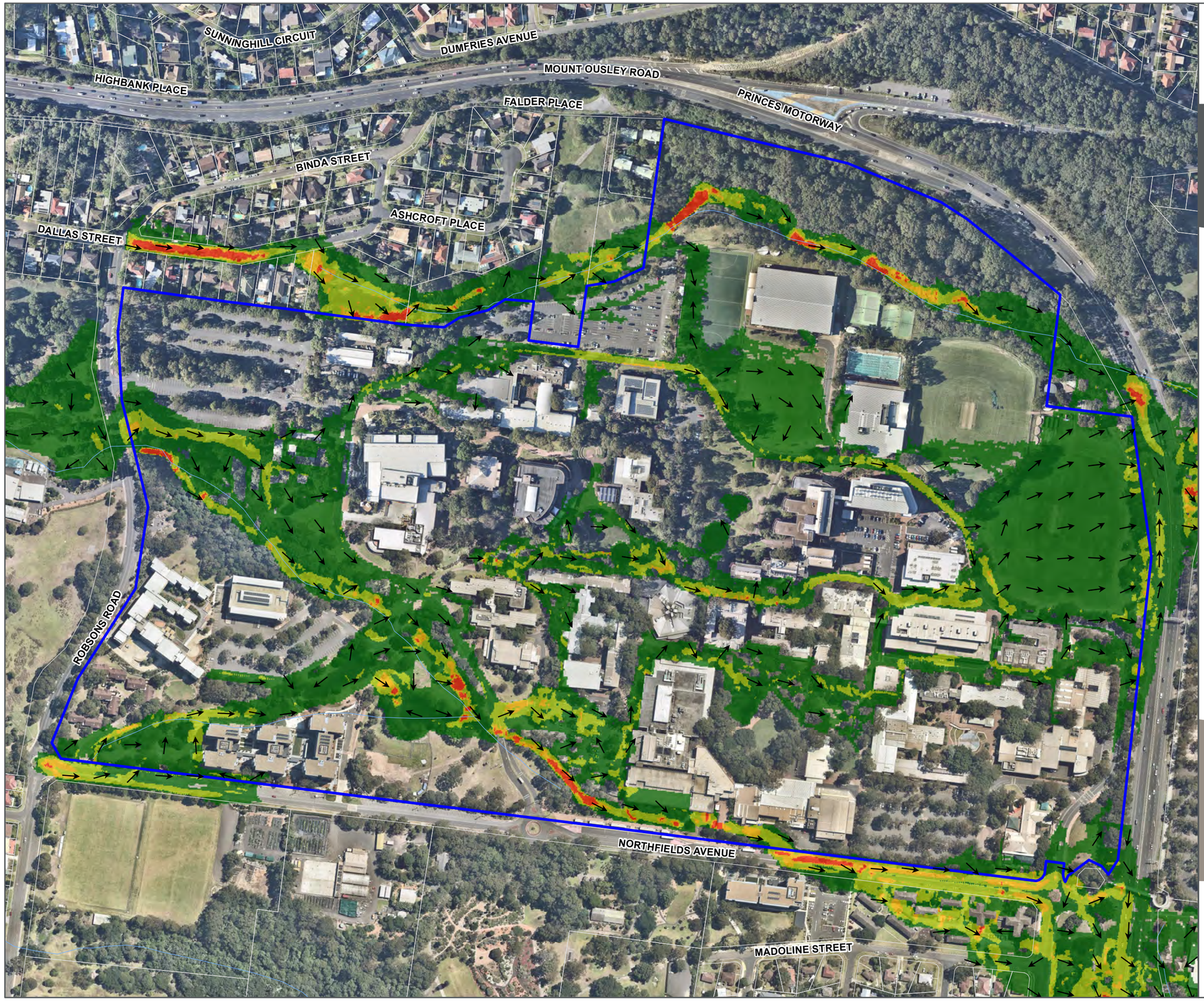
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-003-ExDepthPMF.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Velocity Existing 100 Year ARI

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Velocity Vector
- Watercourse (LPI)
- Cadastre (DFSI-SS, 2017)

Flood Velocity (m/s)

- 0 - 1
- 1 - 2
- 2 - 3
- > 4

1:3,500 Scale at A3

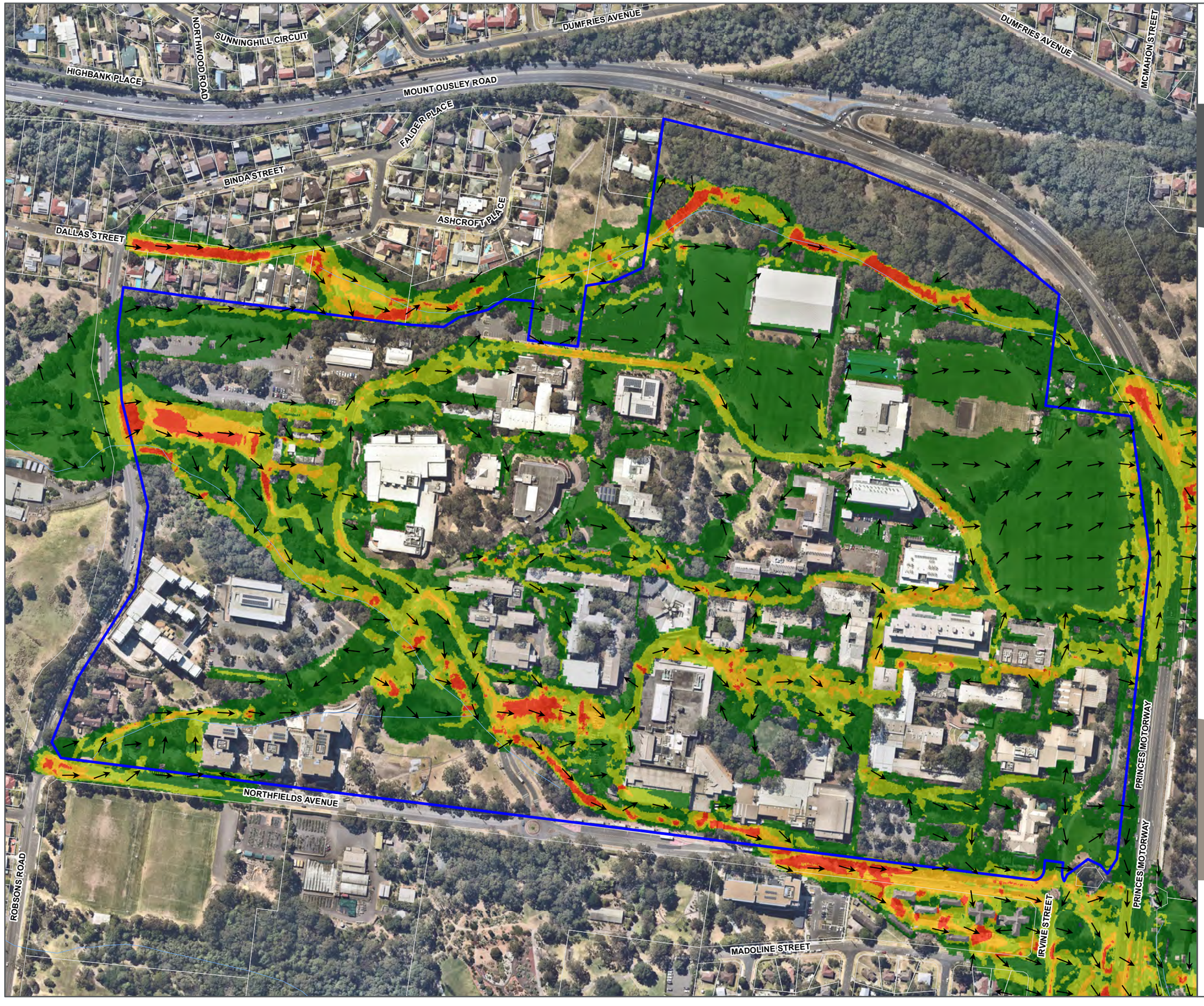
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-004-ExVelocity100y.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Velocity Existing PMF

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Velocity Vector
- Watercourse (LPI)
- Cadastre (DFSI-SS, 2017)

Flood Velocity (m/s)

- 0 - 1
- 1 - 2
- 2 - 3
- > 4

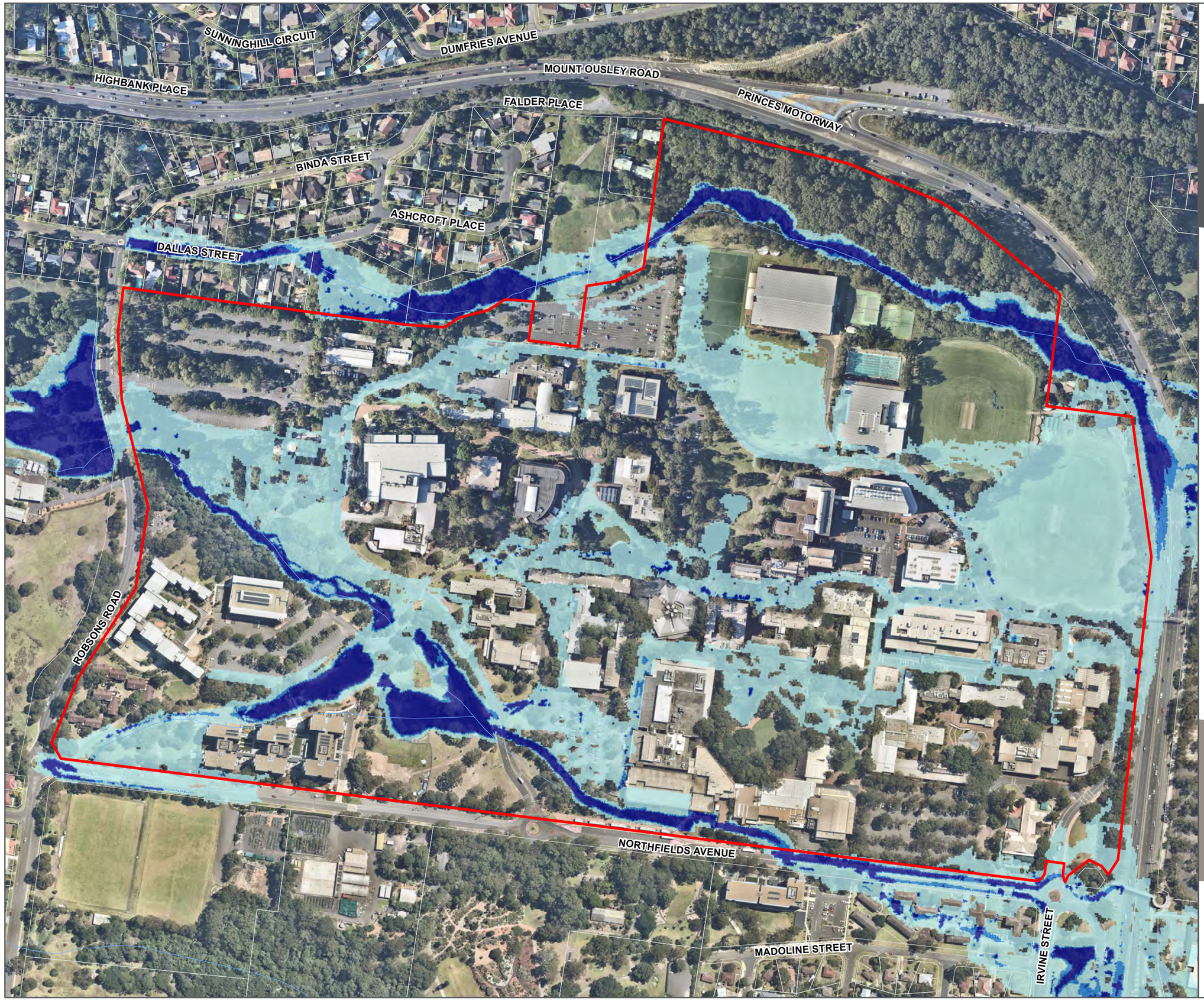
1:3,500 Scale at A3

Metres

0 50 100 150 200

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-005-ExVelocityPMF.mxd 01
Aerial imagery supplied by Nearmap (October, 2017)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Hazard for Existing 100 Year ARI

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Watercourse (LPI)
- Cadastre (DFSI-SS, 2017)

Flood Hazard

- Low Hazard
- Medium Hazard
- High Hazard

1:3,500 Scale at A3

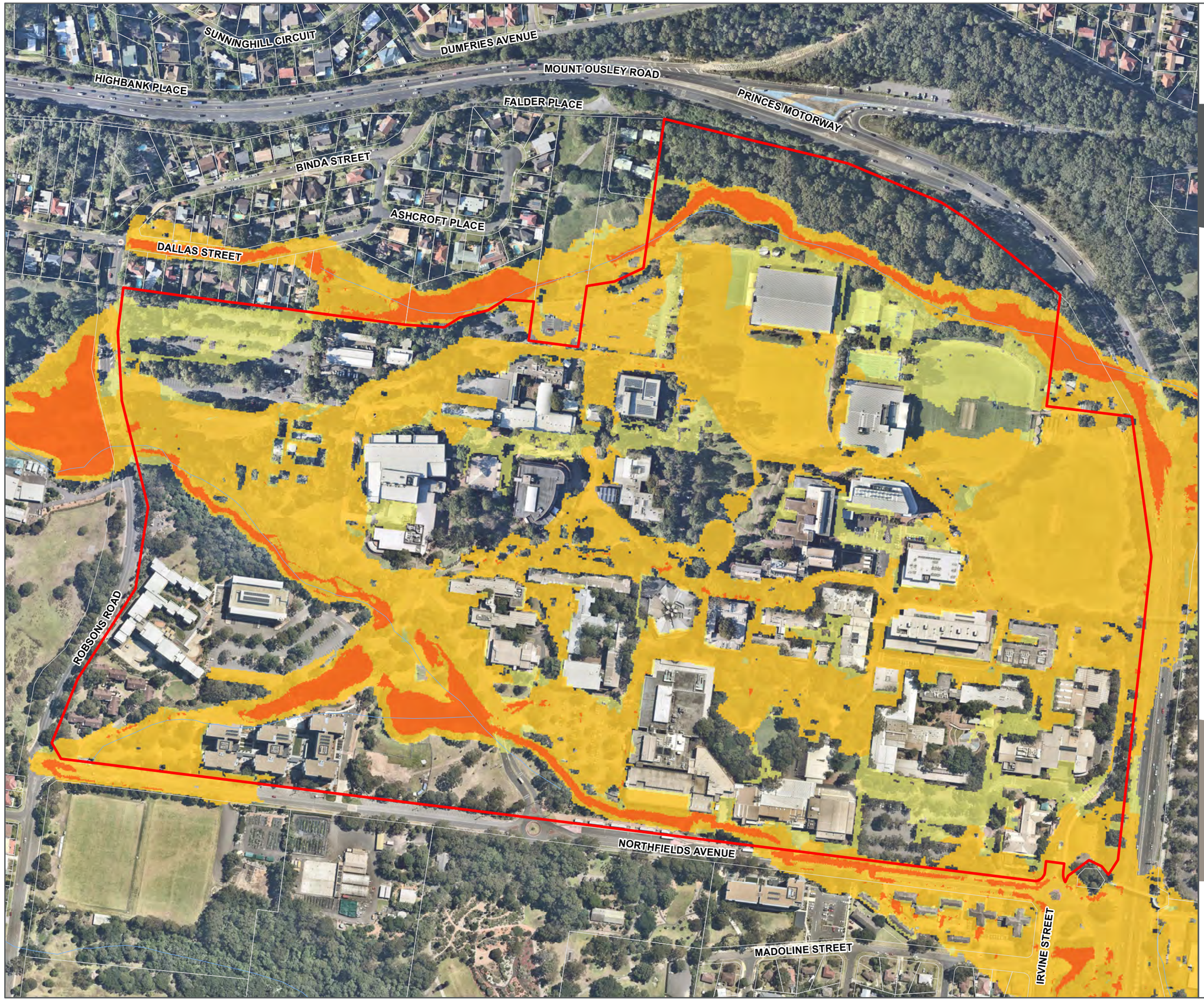
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-006-ExHazard100y.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Risk Precinct Existing

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Watercourse (LPI)
- Cadastre (DFSI-SS, 2017)

Flood Risk Precinct

- Low
- Medium
- High

1:3,500 Scale at A3

Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-007-ExFRP.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)

UNIVERSITY OF WOLLONGONG AUSTRALIA

100 Year ARI Existing Calibration

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Watercourse (LPI)
- 1m Flood Height Contour (mAHD)
- Cadastre (DFSI-SS, 2017)
- 100 Year ARI Existing Flood Extent

Catchment Boundary

Water Level Contour (m AHD)

Limit of Mapping

Modelled Depth (m)

- 0.0 to 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 1.25
- 1.25 to 1.50
- >1.50

Note: Flooding may also occur beyond the extent of flooding shown here as a result of flow along overland flowpaths and urban drainage systems that were not modelled in this study.

Source: Fairy and Cabbage Tree Creeks Flood Study, October 2009, BMT WBM

1:4,000 Scale at A3

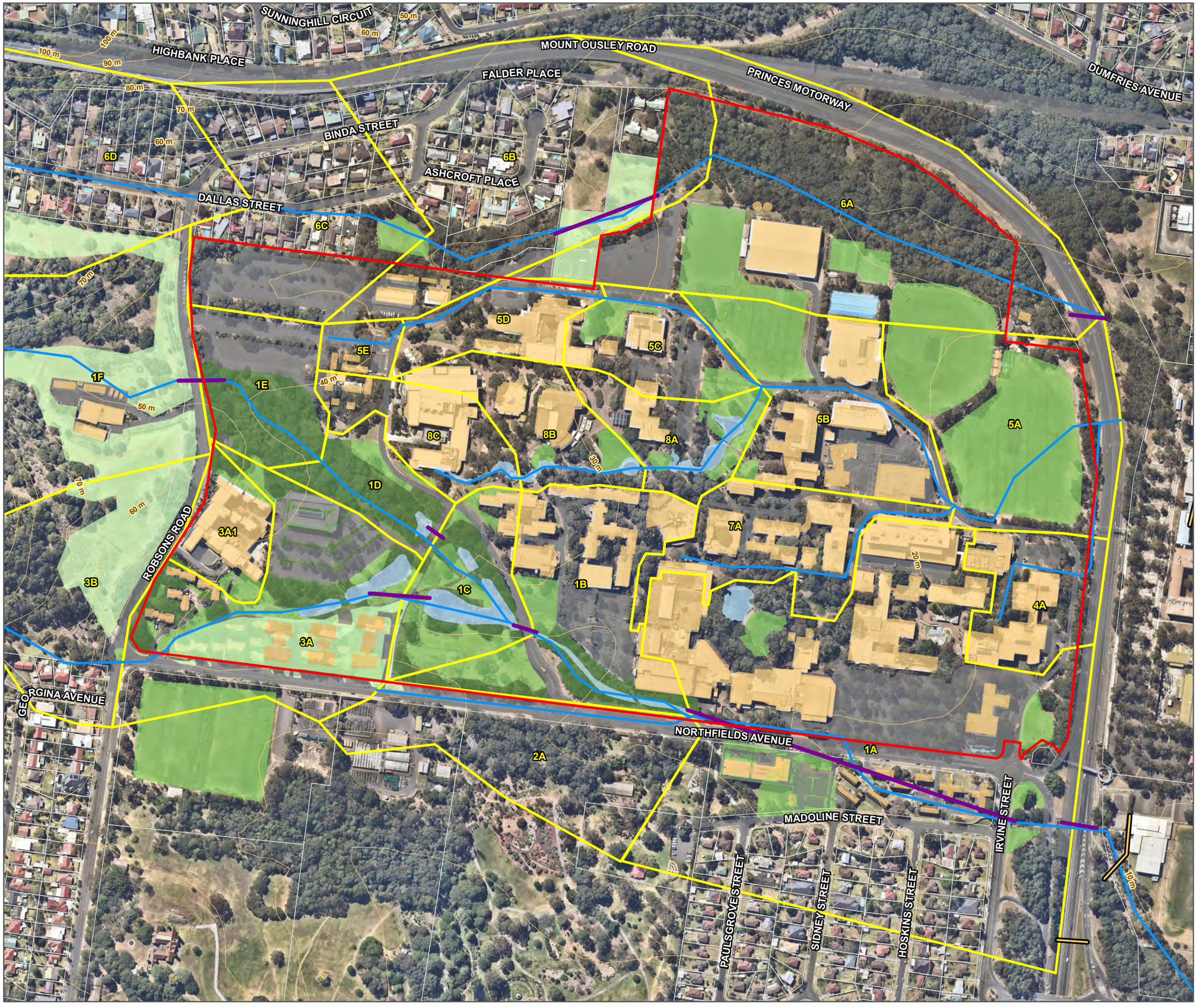
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-008-100yCalibration.mxd 01
Aerial imagery from BMT WBM Flood Study (2009).



UNIVERSITY OF WOLLONGONG AUSTRALIA

TUFLOW Model Configuration (Developed)

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Culvert
- Tailwater
- Flow Path (Cardno)
- 10m Contours (LPI)
- Cadastre (DFSI-SS, 2017)

Materials Used for Modelling (Manning's n)

- Buildings (n = 0.5)
- Ponds (n = 0.01)
- Short Grass (n = 0.035)
- Pasture (n = 0.045)
- Trees (n = 0.08)
- Roads (n = 0.025)
- Default (n = 0.04)

1:4,000 Scale at A3

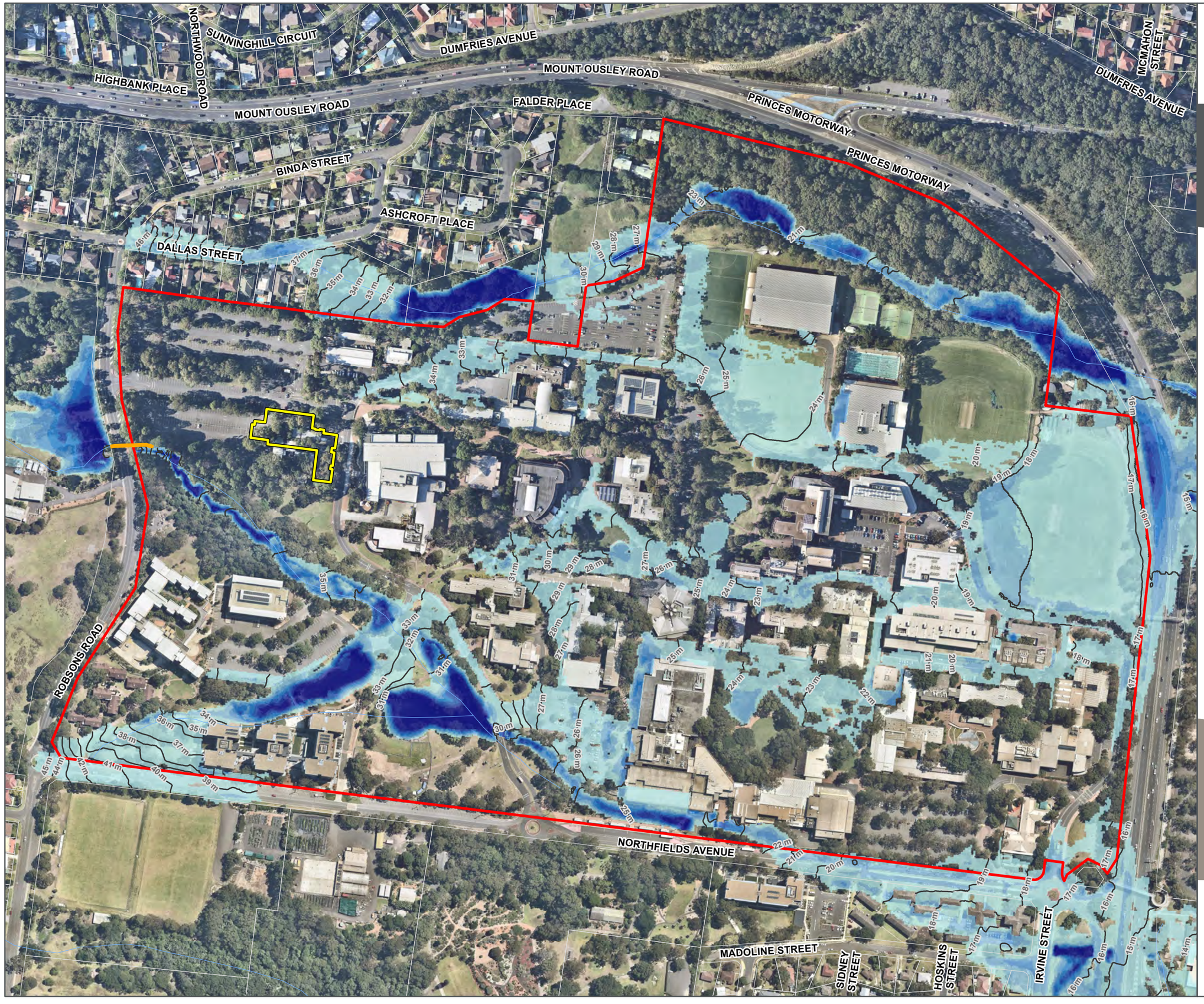
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2017-12-08 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-009-TUFLOWModelConfigDev.mxd 01
Aerial imagery supplied by Nearmap (October, 2017).



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Extent Developed 100 Year ARI

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Proposed Culvert Upgrade
- Watercourse (LPI)
- 1m Flood Height Contour (mAHD)
- ASSB Footprint
- Cadastre (DFSI-SS, 2017)

Flood Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- > 1.50

1:3,500 Scale at A3

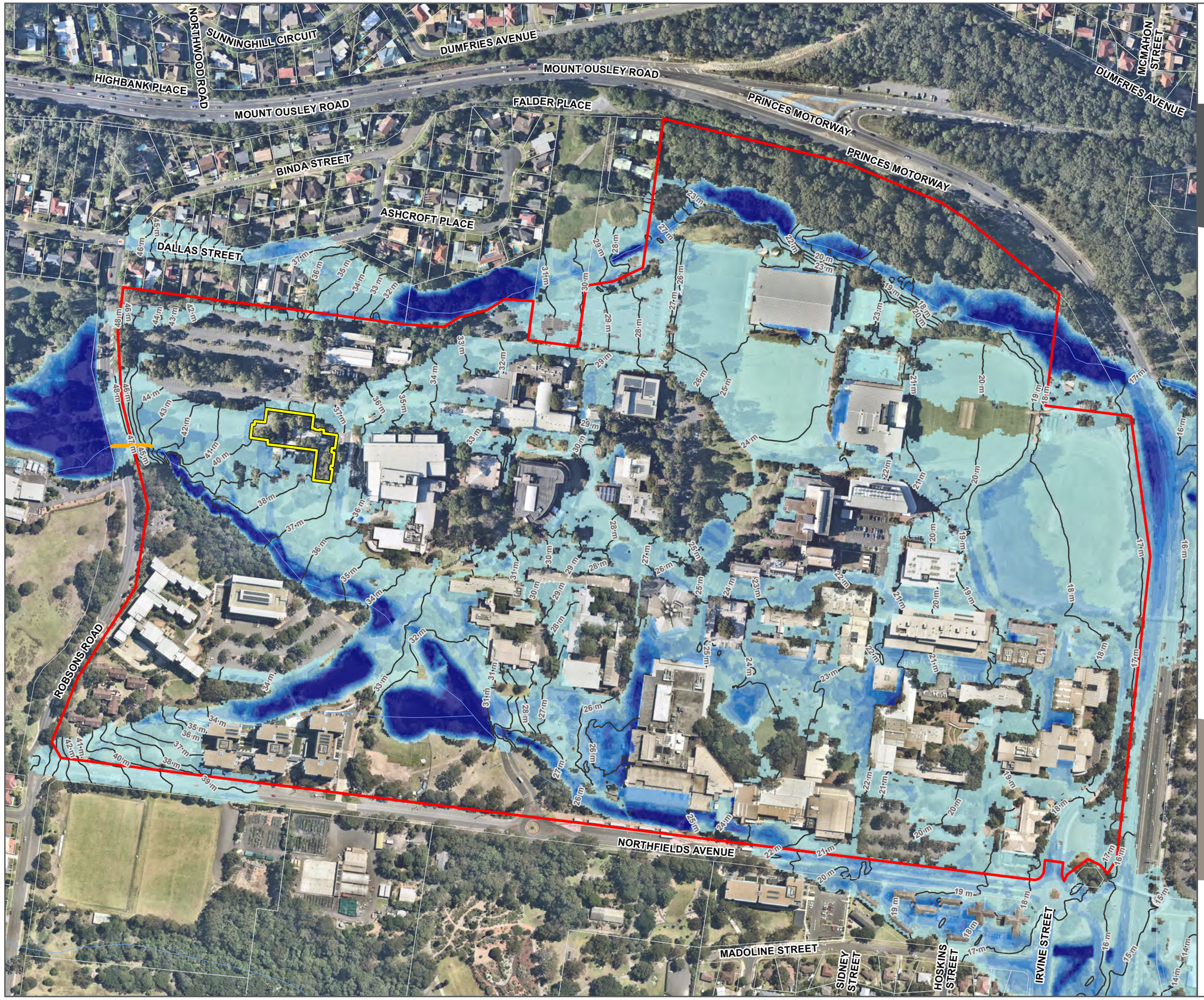
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-010-DevDepth100y.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Extent Developed PMF

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Proposed Culvert Upgrade
- Watercourse (LPI)
- 1m Flood Height Contour (mAHD)
- ASSB Footprint
- Cadastre (DFSI-SS, 2017)

Flood Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- > 1.50

1:3,500 Scale at A3

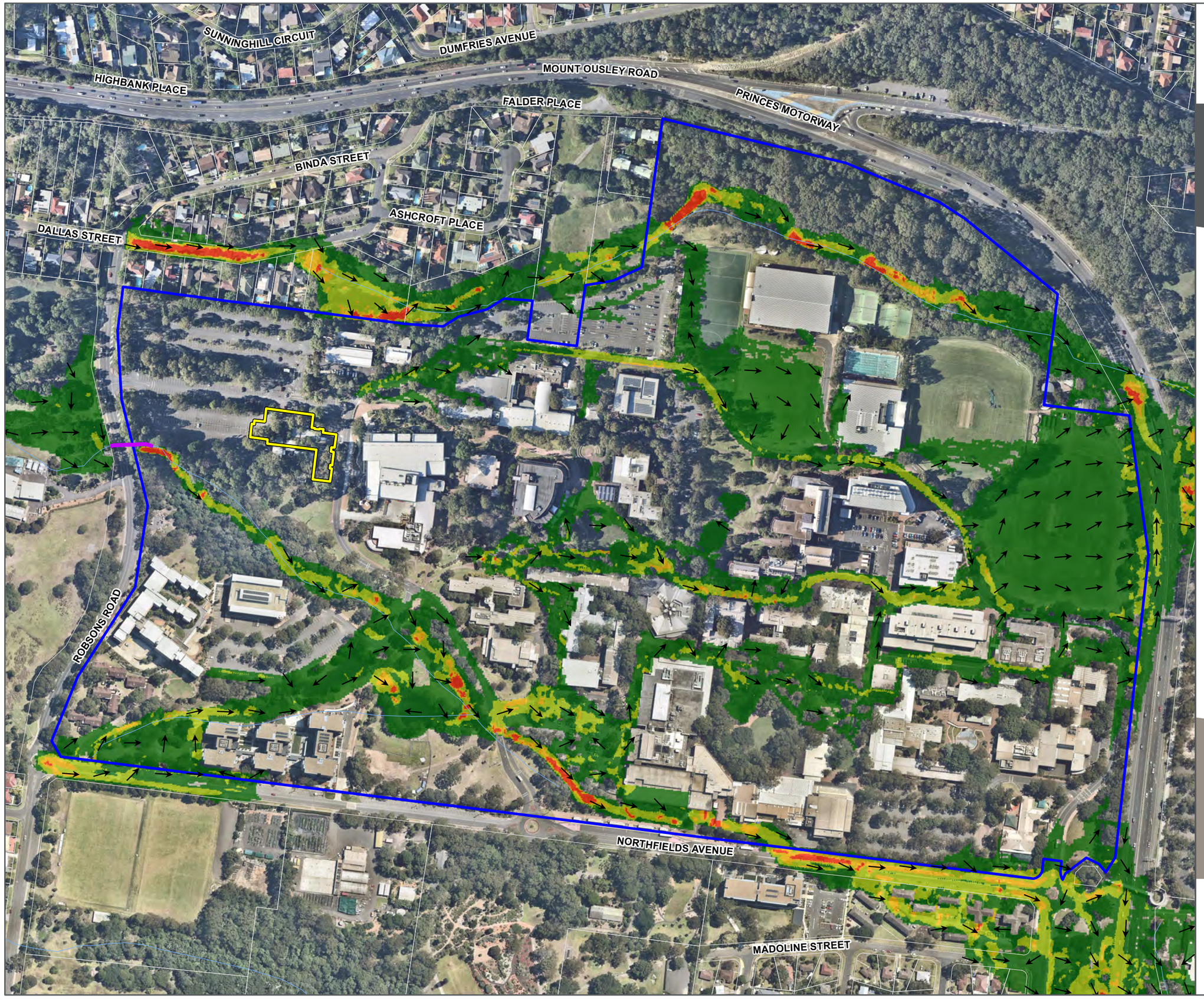
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-011-DevDepthPMF.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Velocity Developed 100 Year ARI

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Velocity Vector
- Proposed Culvert Upgrade
- Watercourse (LPI)
- ASSB Footprint
- Cadastre (DFSI-SS, 2017)

Flood Velocity (m/s)

- 0 - 1
- 1 - 2
- 2 - 3
- > 4

1:3,500 Scale at A3

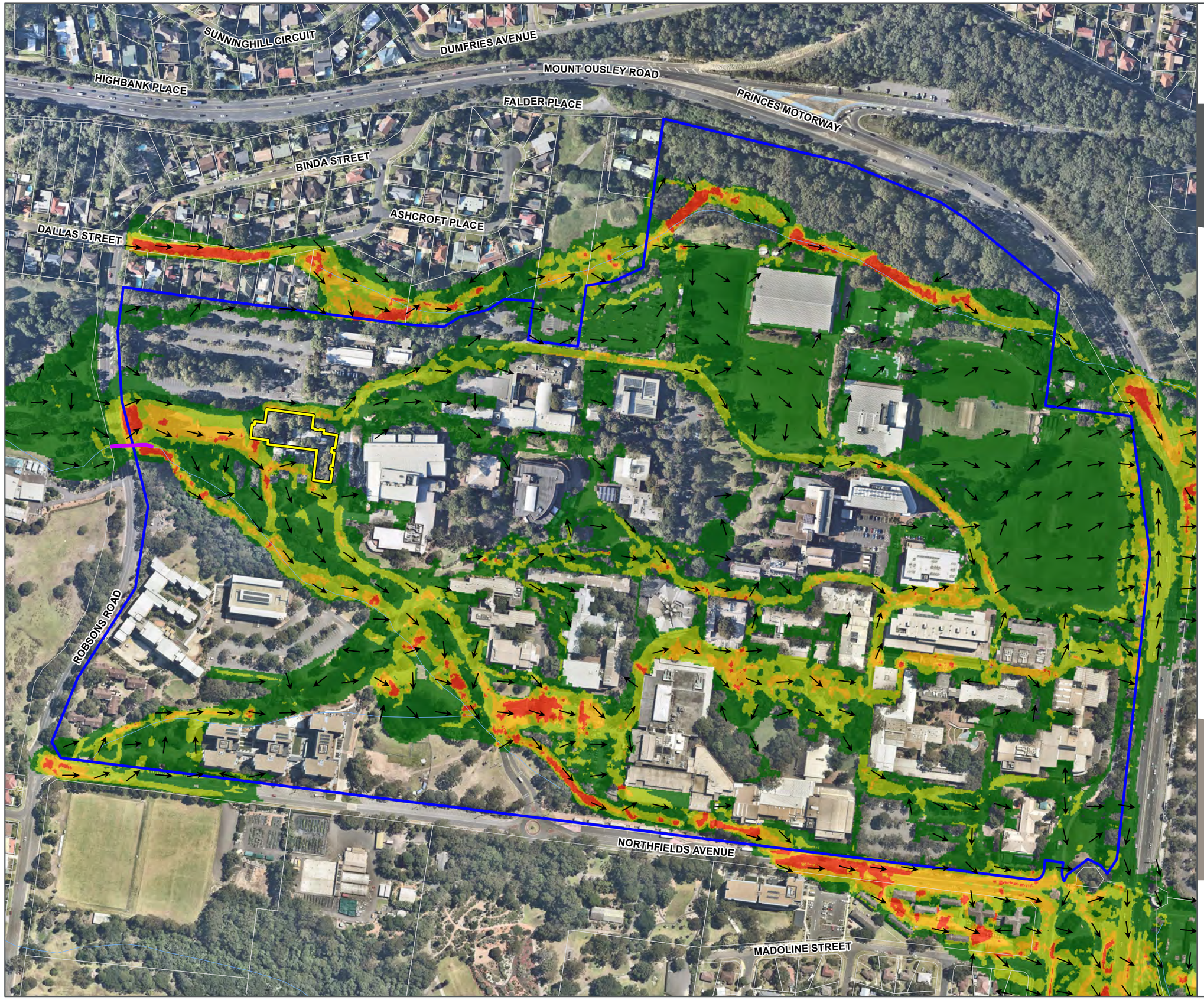
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-012-DevVelocity100y.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Velocity Developed PMF

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Proposed Culvert Upgrade
- Velocity Vector
- Watercourse (LPI)
- ASSB Footprint
- Cadastre (DFSI-SS, 2017)

Flood Velocity (m/s)

- 0 - 1
- 1 - 2
- 2 - 3
- > 4

1:3,500 Scale at A3

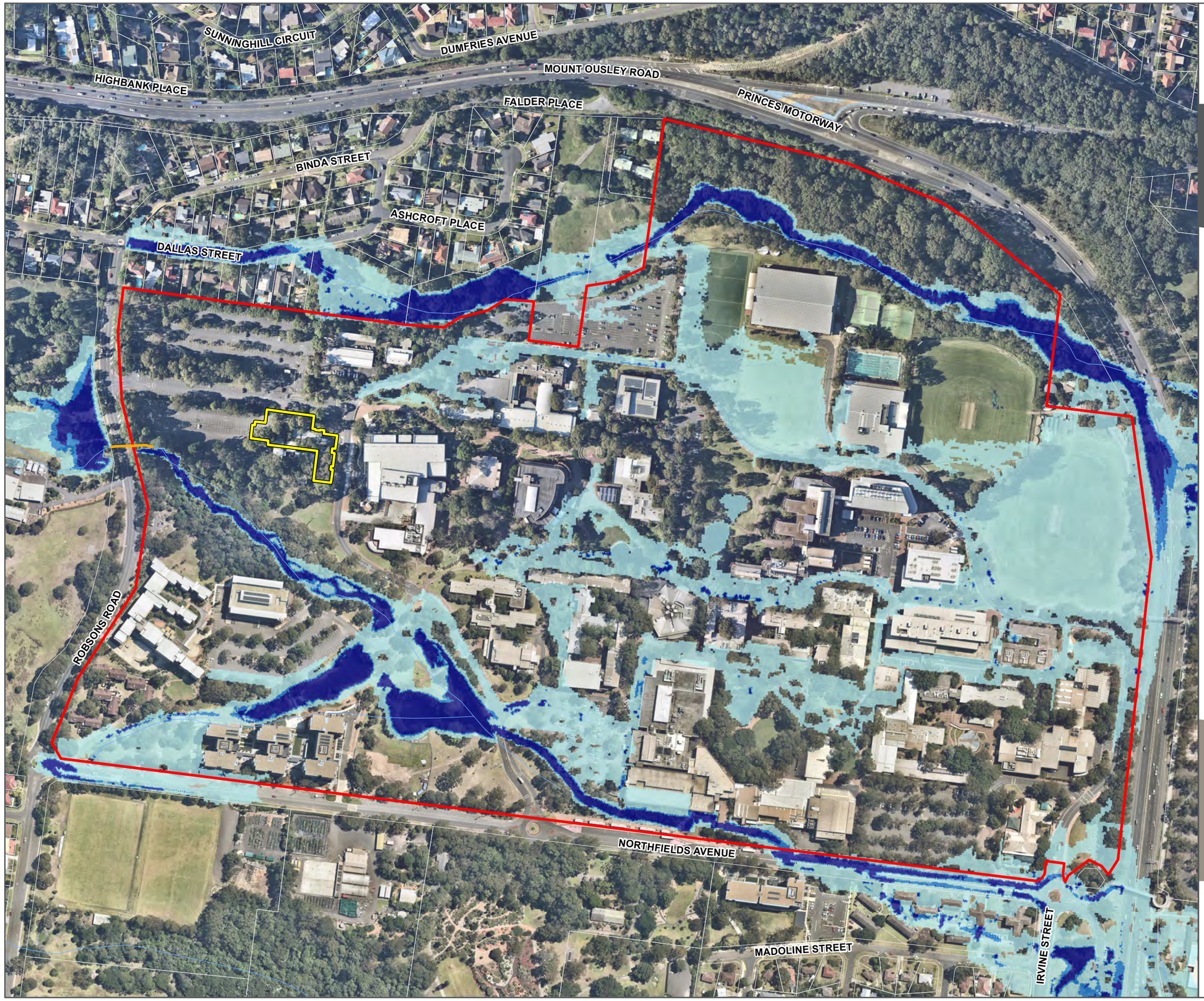
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-013-DevVelocityPMF.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Hazard for Existing 100 Year ARI

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Proposed Culvert Upgrade
- Watercourse (LPI)
- ASSB Footprint
- Cadastre (DFSI-SS, 2017)

Flood Hazard

- Low Hazard
- Medium Hazard
- High Hazard

1:3,500 Scale at A3

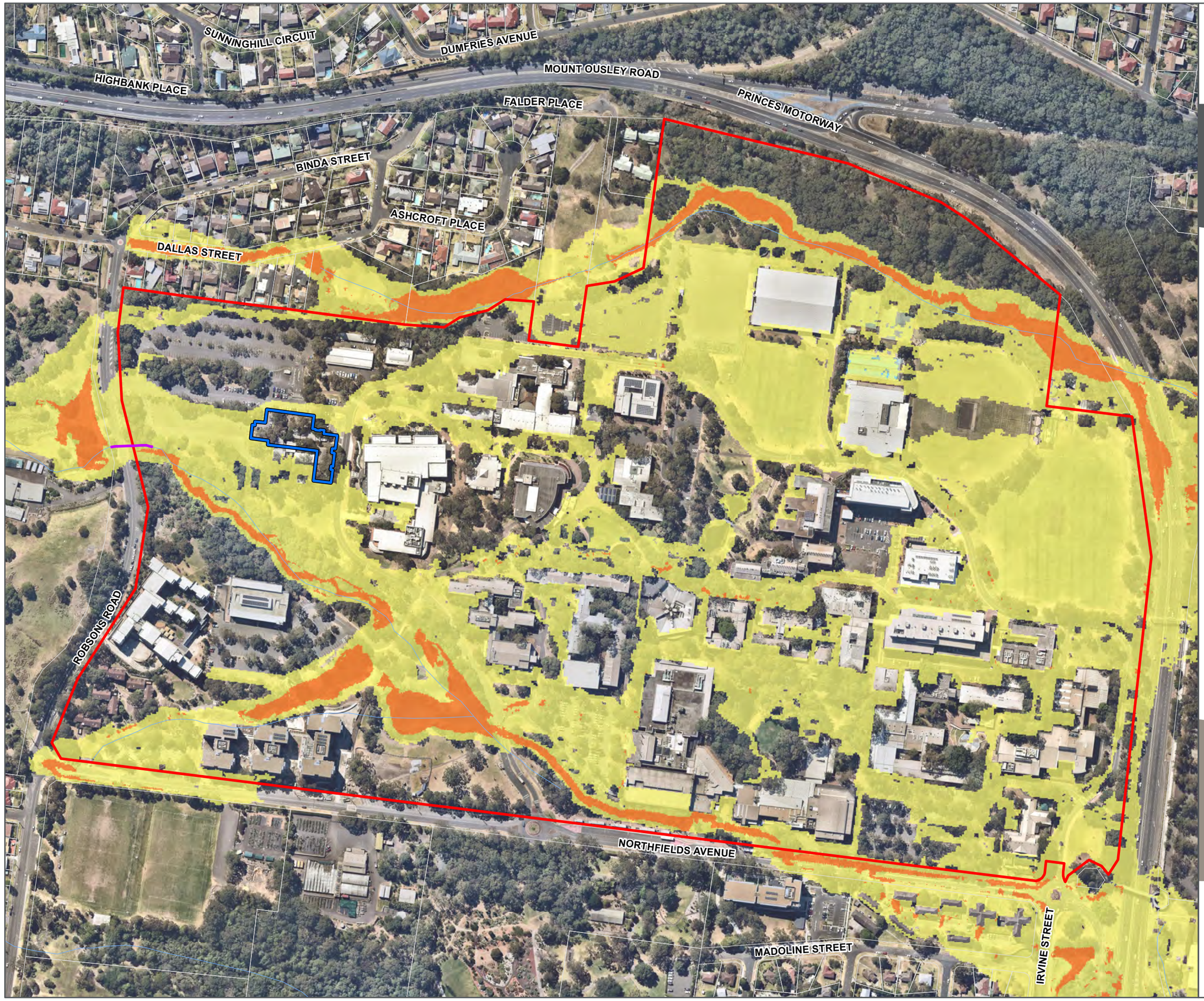
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-014-DevHazard100y.mxd 01
Aerial imagery supplied by Nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Risk Precinct Existing

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Proposed Culvert Upgrade
- Watercourse (LPI)
- ASSB Footprint
- Cadastre (DFSI-SS, 2017)

Flood Risk Precinct

- Low to Medium
- High

1:3,500 Scale at A3

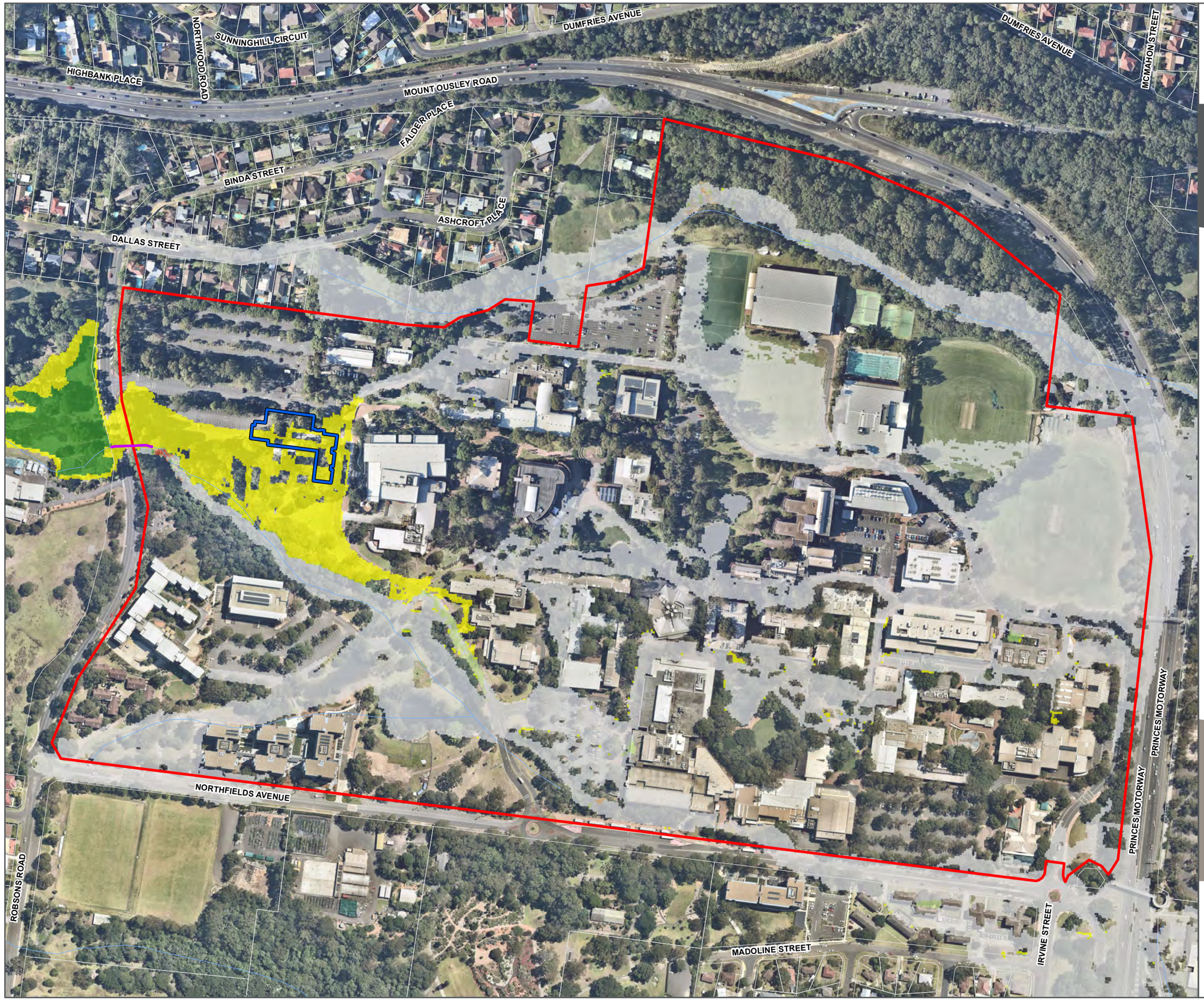
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208_01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-015-DevFRP.mxd 01
Aerial imagery supplied by Nearmap (October, 2017)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Impacts 100 Year ARI

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Proposed Culvert Upgrade
- Watercourse (LPI)
- Cadastre (DFSI-SS, 2017)
- ASSB Footprint

Change in Flood Levels (m)

- Was Wet Now Dry
- < -0.5
- -0.5 to -0.2
- -0.2 to -0.1
- -0.1 to -0.05
- -0.05 to -0.02
- -0.02 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- 0.2 to 0.5
- > 0.5
- Was Dry Now Wet

1:3,500 Scale at A3

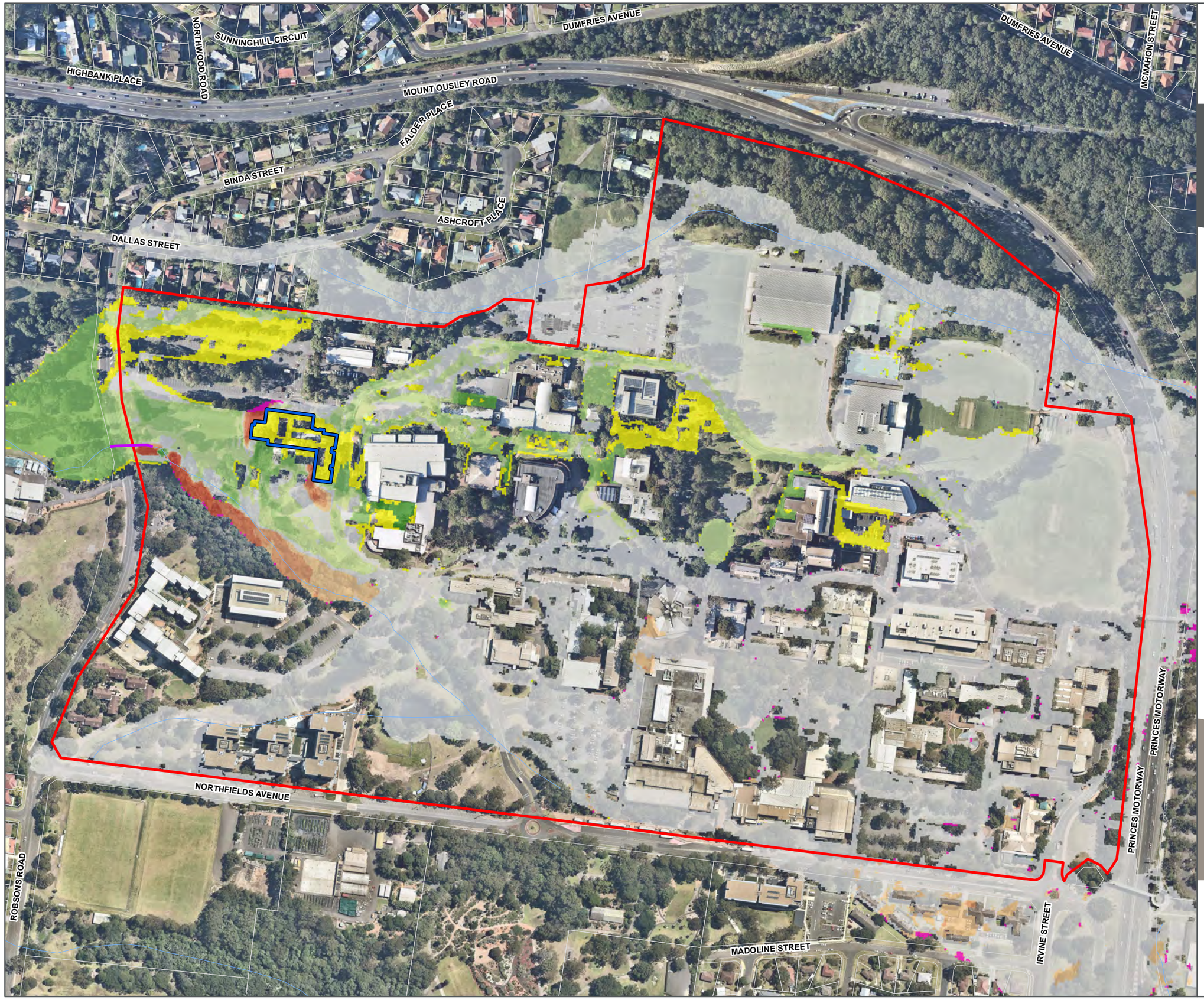
Metres

0 50 100 150 200

N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208-01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-016-Impacts100y.mxd 01
Aerial imagery supplied by nearmap (January, 2018)



UNIVERSITY OF WOLLONGONG AUSTRALIA

Flood Impacts PMF

UNIVERSITY OF WOLLONGONG

Legend

- Site Boundary
- Proposed Culvert Upgrade
- Watercourse (LPI)
- Cadastre (DFSI-SS, 2017)
- ASSB Footprint

Change in Flood Levels (m)

- Was Wet Now Dry
- < -0.5
- -0.5 to -0.2
- -0.2 to -0.1
- -0.1 to -0.05
- -0.05 to -0.02
- -0.02 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- 0.2 to 0.5
- > 0.5
- Was Dry Now Wet

1:3,500 Scale at A3

Metres

0 50 100 150 200

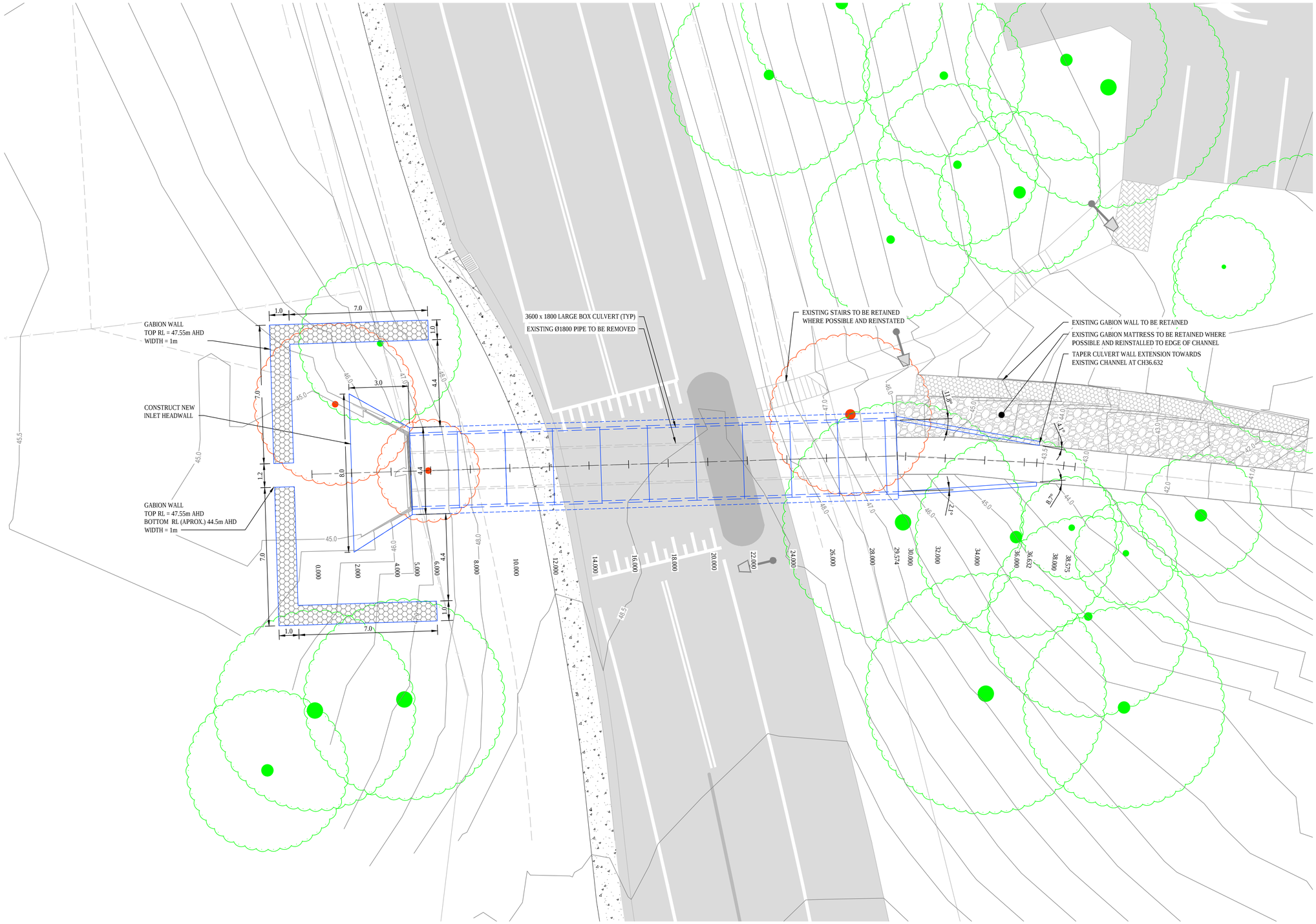
N

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2018-02-07 | Project: 82017208-01
Coordinate System: GDA 1994 MGA Zone 56
Map: 82017208-01-GS-017-ImpactsPMF.mxd 01
Aerial imagery supplied by nearmap (January, 2018)

APPENDIX D

CULVERT CONCEPT DESIGN



CULVERT LAYOUT PLAN
SCALE 1:100

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

Rev.	Date	Description	Des.	Verif.	Appd.
2	5/02/2018	GABION WALL ADDED	SCM	NP	MVP
1	15/01/2018	ISSUED FOR INFORMATION	ZJP	SV	

UNIVERSITY OF WOLLONGONG AUSTRALIA

Cardno
Shaping the Future
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Level 1, 47 Burelli Street
Wollongong NSW 2500
Tel: 02 4228 4133 Fax: 02 4228 6811
Web: www.cardno.com.au

		Date
Drawn	ZJP	15/01/2018
Checked		Date
Designed	ZJP	15/01/2018
Verified	SJB	15/01/2018
Approved		

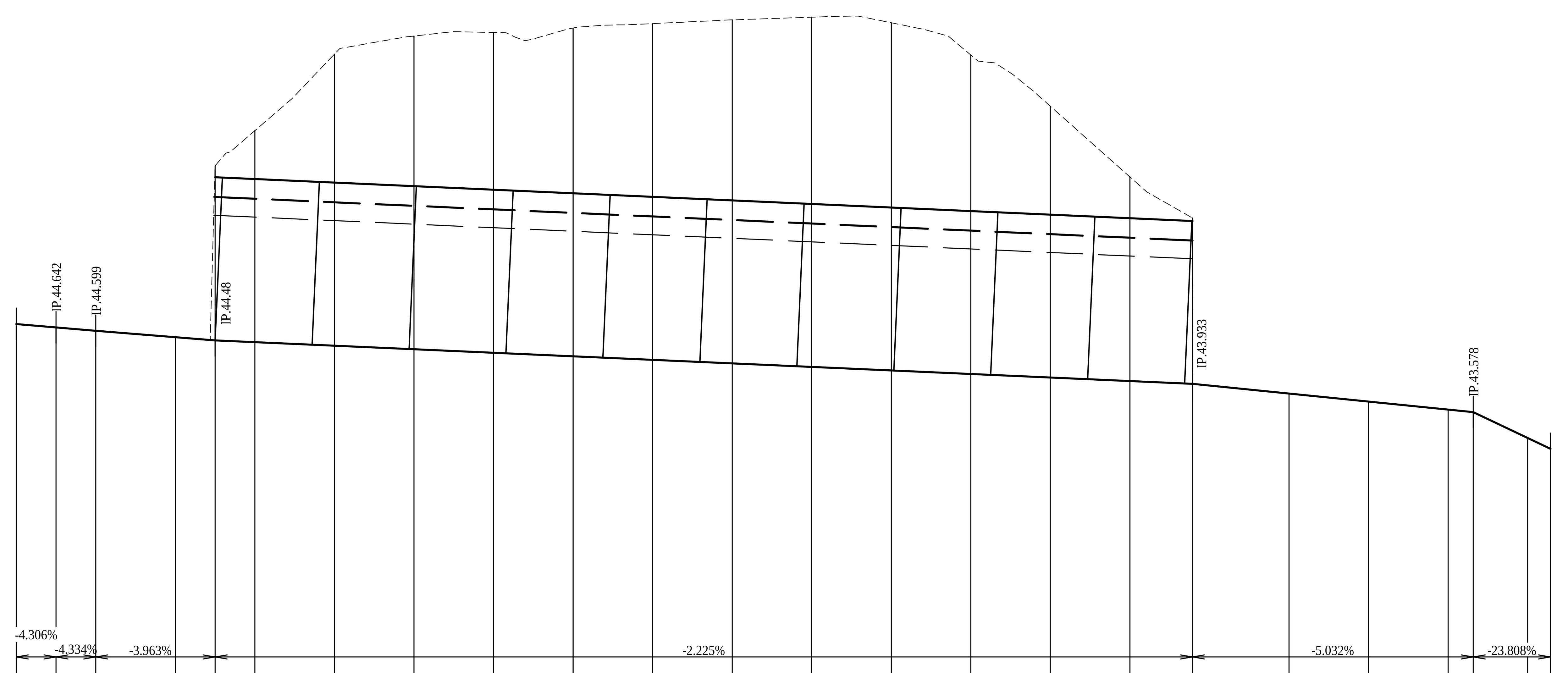
Client: UNIVERSITY OF WOLLONGONG
Project: ARTS AND SOCIAL SCIENCE BUILDING
PRELIMINARY FLOOD ASSESSMENT
Title: CULVERT LAYOUT PLAN

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

DATUM		Scale	Size
A.H.D.		1:100	A1

Drawing Number: 8201720801-001 SK005
Revision: 2

DATE PLOTTED: 16 January 2018 3:32 PM BY : ZAC PHILIPPA



DATUM RL 40

DESIGN LEVELS	44.685	44.642	44.599	44.520	44.480	44.458	44.413	44.369	44.324	44.280	44.235	44.191	44.146	44.102	44.057	44.013	43.968	43.933	43.811	43.710	43.610	43.578	43.252	43.115
CULVERT CROWN LEVELS					46.530	46.508	46.463	46.418	46.373	46.329	46.284	46.239	46.194	46.150	46.105	46.060	46.015	45.980						
EXISTING LEVELS	44.685	44.642	44.599	44.513	46.671	47.116	48.077	48.305	48.349	48.406	48.461	48.508	48.542	48.472	48.067	47.423	46.534	46.018	43.812	43.711	43.61	43.578	43.252	43.115
CHAINAGE	0.000	1.000	2.000	4.000	5.000	6.000	8.000	10.000	12.000	14.000	16.000	18.000	20.000	22.000	24.000	26.000	28.000	29.574	32.000	34.000	36.000	36.632	38.000	38.575

LONGITUDINAL SECTION - CULVERT INVERT

SCALES: HORIZ 1:100 VERTICAL 1:50

H: 0 1 2 4 6 8 10m
V: 0 0.5 1 2 3 4 5m
SCALE: H:1:100 V:1:50 @A1

XREF's:
CAD File: U:\FY17\208_UOW Arts Prelim Flood Study\Drawings\Build\SKTECHES\8201720801-001 SK006.dwg

Rev.	Date	Description	Des.	Verif.	Appd.
1	15/01/2018	ISSUED FOR INFORMATION	ZJP	SV	

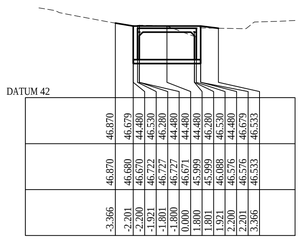
UNIVERSITY OF WOLLONGONG AUSTRALIA

Cardno Shaping the Future

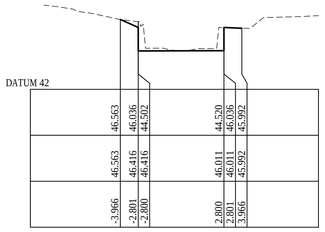
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Level 1, 47 Burelli Street
Wollongong NSW 2500
Tel: 02 4228 4133 Fax: 02 4228 6811
Web: www.cardno.com.au

Drawn ZJP Date 15/01/2018
Checked Date
Designed ZJP Date 15/01/2018
Verified SJB Date 15/01/2018
Approved

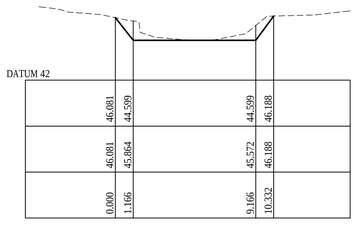
Client: UNIVERSITY OF WOLLONGONG
Project: ARTS AND SOCIAL SCIENCE BUILDING PRELIMINARY FLOOD ASSESSMENT
Title: LONG SECTION
Status: PRELIMINARY NOT TO BE USED FOR CONSTRUCTION PURPOSES
DATUM: A.H.D.
Scale: AS SHOWN
Size: A1
Drawing Number: 8201720801-001 SK006
Revision: 1



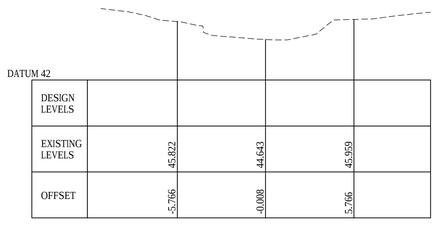
Ch 5.000



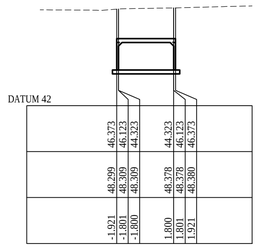
Ch 4.000



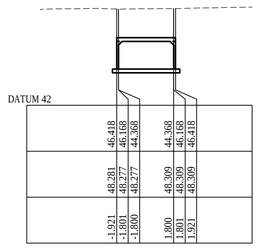
Ch 2.000



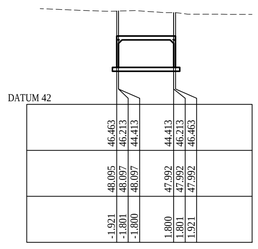
Ch 1.000



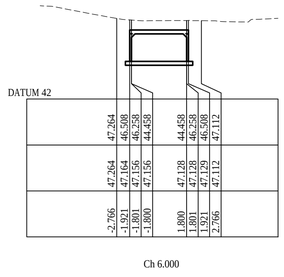
Ch 12.000



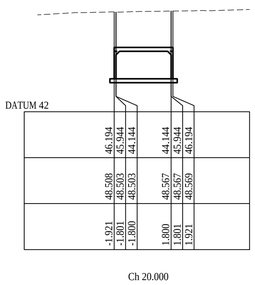
Ch 10.000



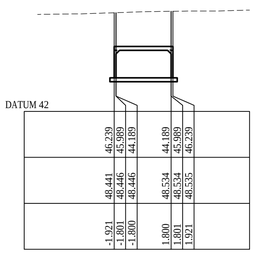
Ch 8.000



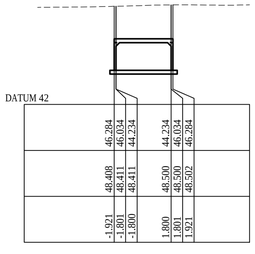
Ch 6.000



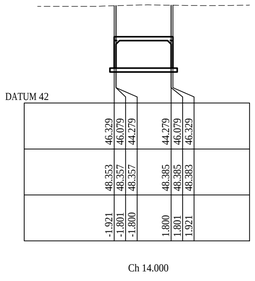
Ch 20.000



Ch 18.000



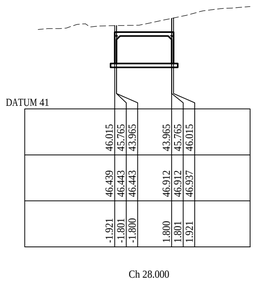
Ch 16.000



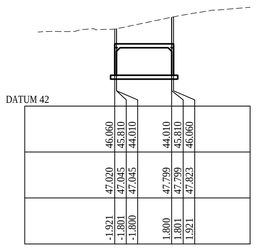
Ch 6.000

Ch 16.000

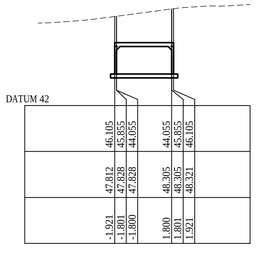
Ch 14.000



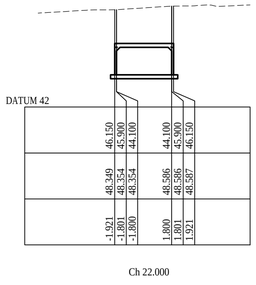
Ch 28.000



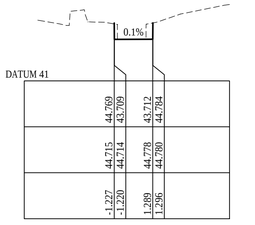
Ch 26.000



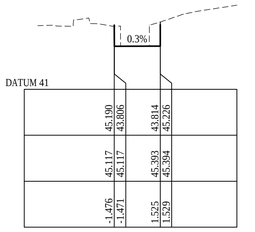
Ch 24.000



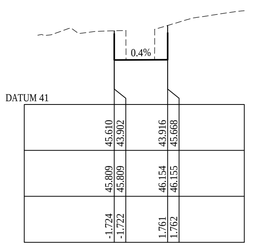
Ch 22.000



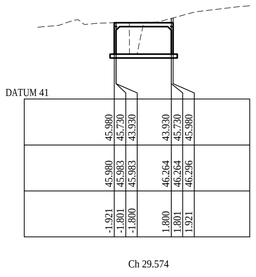
Ch 34.000



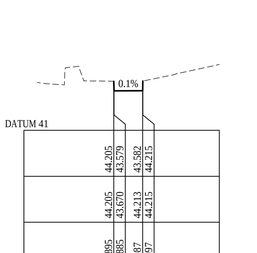
Ch 32.000



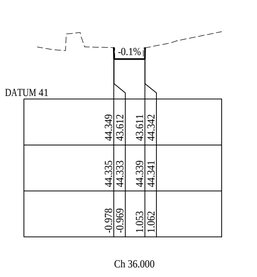
Ch 30.000



Ch 29.574



Ch 36.632



Ch 36.000

CROSS SECTIONS - CULVERT INVERT

SCALE: 1:200

0 5 10 15 20m

SCALE 1:200 @A1

Rev.	Date	Description	Des.	Verif.	Appd.
1	15/01/2018	ISSUED FOR INFORMATION	ZJP	SV	

UNIVERSITY OF WOLLONGONG AUSTRALIA

Cardno
Shaping the Future
Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Level 1, 47 Burelli Street
Wollongong NSW 2500
Tel: 02 4228 4133 Fax: 02 4228 6811
Web: www.cardno.com.au

Drawn	ZJP	Date 15/01/2018
Checked		Date
Designed	ZJP	Date 15/01/2018
Verified	SJB	Date 15/01/2018
Approved		

Client: UNIVERSITY OF WOLLONGONG

Project: ARTS AND SOCIAL SCIENCE BUILDING
PRELIMINARY FLOOD ASSESSMENT

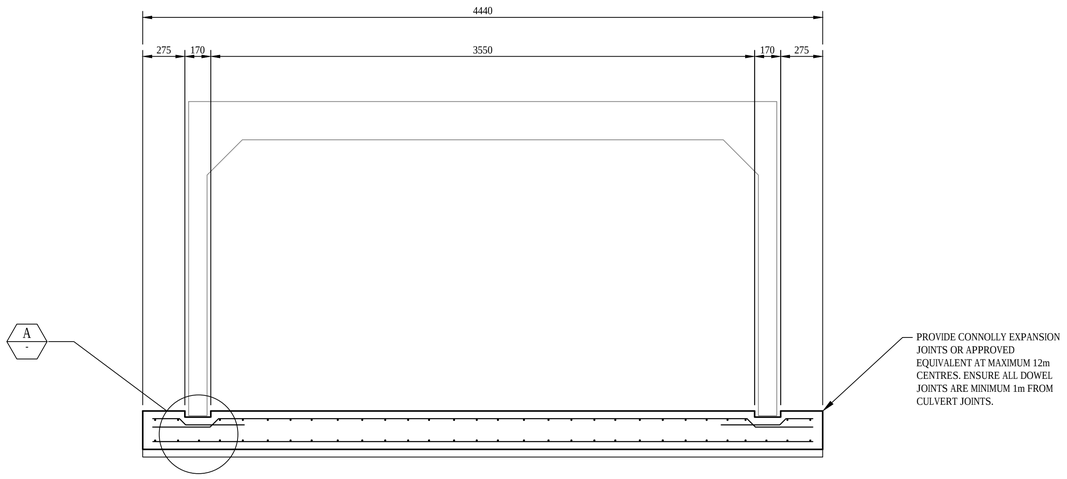
Title: CROSS SECTIONS

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

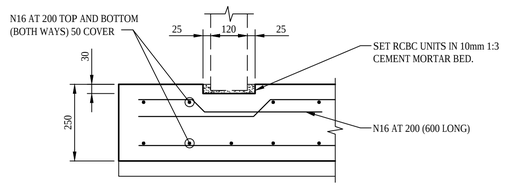
DATUM		Scale	Size
A.H.D.		1:200	A1

Drawing Number: 8201720801-001 SK007

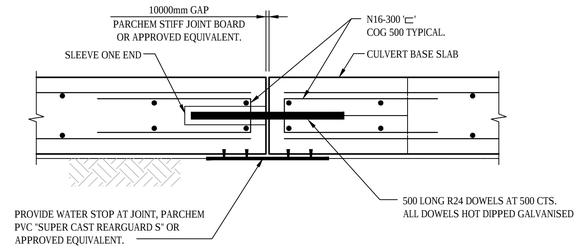
Revision: 1



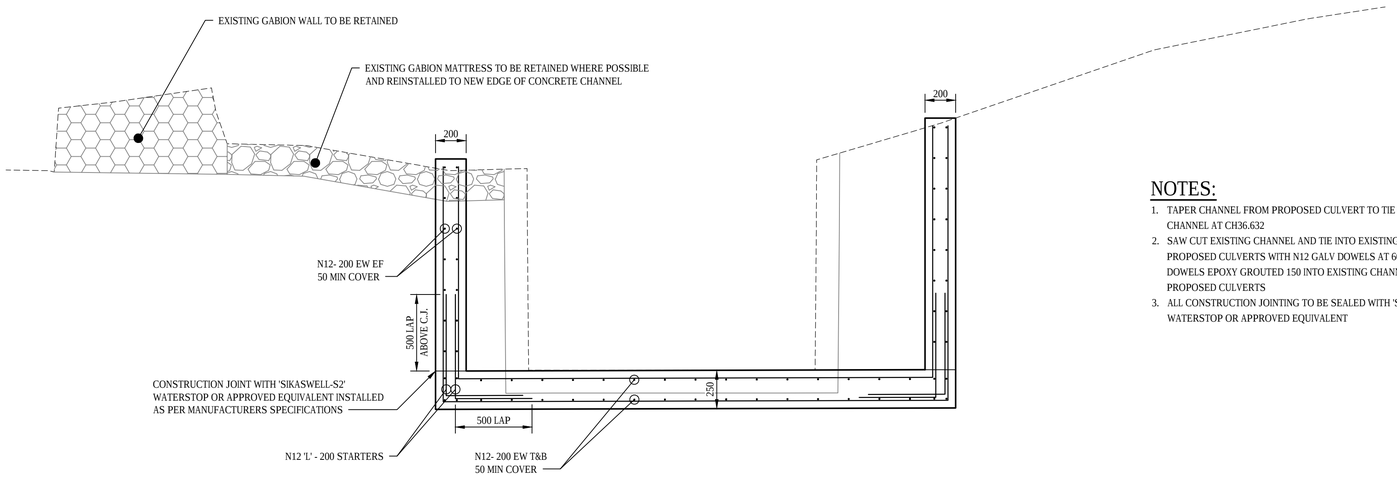
CULVERT BASE SLAB DETAIL
SCALE 1:20



DETAIL A
SCALE 1:10



TYPICAL EXPANSION JOINT - EJ
JOINTS AT 12m CTS OR SUIT CULVERT UNIT LENGTH
SCALE 1:10



TYPICAL CONCRETE CHANNEL
SCALE 1:20

NOTES:
1. TAPER CHANNEL FROM PROPOSED CULVERT TO TIE INTO EXISTING CHANNEL AT CH36.632
2. SAW CUT EXISTING CHANNEL AND TIE INTO EXISTING CHANNEL AND PROPOSED CULVERTS WITH N12 GALV DOWELS AT 600 CTS. 300 LONG DOWELS EPOXY GROUTED 150 INTO EXISTING CHANNEL AND PROPOSED CULVERTS
3. ALL CONSTRUCTION JOINTING TO BE SEALED WITH 'SIKASWELL-S2' WATERSTOP OR APPROVED EQUIVALENT

0 200 400 600 800 1000mm
SCALE 1:10 @A1

0 500 1000 1500 2000mm
SCALE 1:20 @A1

Rev.	Date	Description	Des.	Verif.	Appd.
1	15/01/2018	ISSUED FOR INFORMATION	ZJP	SV	

UNIVERSITY OF WOLLONGONG AUSTRALIA

Cardno (NSW/ACT) Pty Ltd | ABN 95 001 145 035
Level 1, 47 Burelli Street
Wollongong NSW 2500
Tel: 02 4228 4133 Fax: 02 4228 6811
Web: www.cardno.com.au

		Date
Drawn	ZJP	15/01/2018
Checked		Date
Designed	ZJP	15/01/2018
Verified	SJB	15/01/2018
Approved		

Client: UNIVERSITY OF WOLLONGONG
Project: ARTS AND SOCIAL SCIENCE BUILDING
PRELIMINARY FLOOD ASSESSMENT
Title: TYPICAL DETAILS

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

DATUM		Scale	Size
A.H.D.		AS SHOWN	A1

Drawing Number: 8201720801-001 SK008
Revision: 1

APPENDIX E

SURVEY

DO NOT SCALE

EXISTING SURVEY INFORMATION (SEPT. 2009) SEE SHEET 2

E304450 E304500 N6190950 N6190900

346° 03' 50" - 105.58

346°

55"

24'

94.62

H/WALL 1.80ø R.C.P.

SPEED HUMP

CONCRETE ISLAND

Vehicle Entry

TIMBER STEPS

BITUMEN STEPS

ELEC. PIT

PAVEMENT

GABION WALL

GABION WALL

GABION WALL

CONCRETE DRAINAGE CHANNEL

H/WALL

EB.48.45

EB.48.82

EB.49.07

EB.49.31

EB.49.65

EB.50.02

B.M. S.S.M.62237 R.L.49.94

P.M. 4442 R.L.47.531
M.G.A. 94 ZONE 56-1
E:304381.469, N:6190592.374

LEGEND

- LOT BOUNDARY
- SEWER MANHOLE & LINES
- STOP VALVE
- LIGHT POLE / PAY STATION — PAY STATION
- ELECTRIC LIGHT POLE WITH CCTV / SECURITY CAMERA
- ELECTRICITY PIT
- STREET SIGN / SIGN
- (BH) — BORE HOLE
- UNKNOWN SERVICE
- BITUMEN
- CONCRETE
- TOP OF BANK
- TOE OF BANK
- FENCE
- GATE
- TIMBER RETAINING WALL
- TELSTRA PIT
- STORMWATER PIT
- WATERMAIN PIT (CONC. LID)
- 64 / 43.51 — TREES, TREE NUMBER & LEVEL
- GROUP OF TREES

LEGEND

TG.44.87	TOP OF GABION WALL LEVEL
TK.48.66	TOP OF KERB LEVEL
L.49.41	LIP OF KERB AND GUTTER LEVEL
EB.49.31	EDGE OF BITUMEN LEVEL
80.6	TREE

CAUTION

1. THIS DETAIL SURVEY IS NOT A "SURVEY" AS DEFINED BY THE SURVEYING ACT, 2002. IF ANY CONSTRUCTION AND/OR BUILDING LOCATION/ AREA COMPUTATIONS ARE PLANNED, IT WOULD BE ADVISABLE TO CARRY OUT FURTHER SURVEY WORK TO DETERMINE THE BOUNDARY DIMENSIONS.

2. BEARINGS & DISTANCES OF BOUNDARIES & AREAS ARE BY TITLE AND/OR DEED ONLY.

3. RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY.

4. WHERE OFFSETS ARE CRITICAL, THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.

5. CONTOURS ARE INTERPOLATED FROM ACCURATE SPOT LEVELS AS SHOWN AND SHOULD BE USED AS A GUIDE ONLY. DO NOT REINTERPOLATE CONTOURS.

6. THE POSITION OR EXISTENCE OF UNDERGROUND SERVICES HAS NOT BEEN SHOWN. AN ACCURATE DETERMINATION OF UNDERGROUND SERVICES SHOULD BE OBTAINED PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION OR DIGGING.

Revision	Amendment or reason for issue	Issue date	Drawn by	Authorised

KFW INFRASTRUCTURE PROFESSIONALS

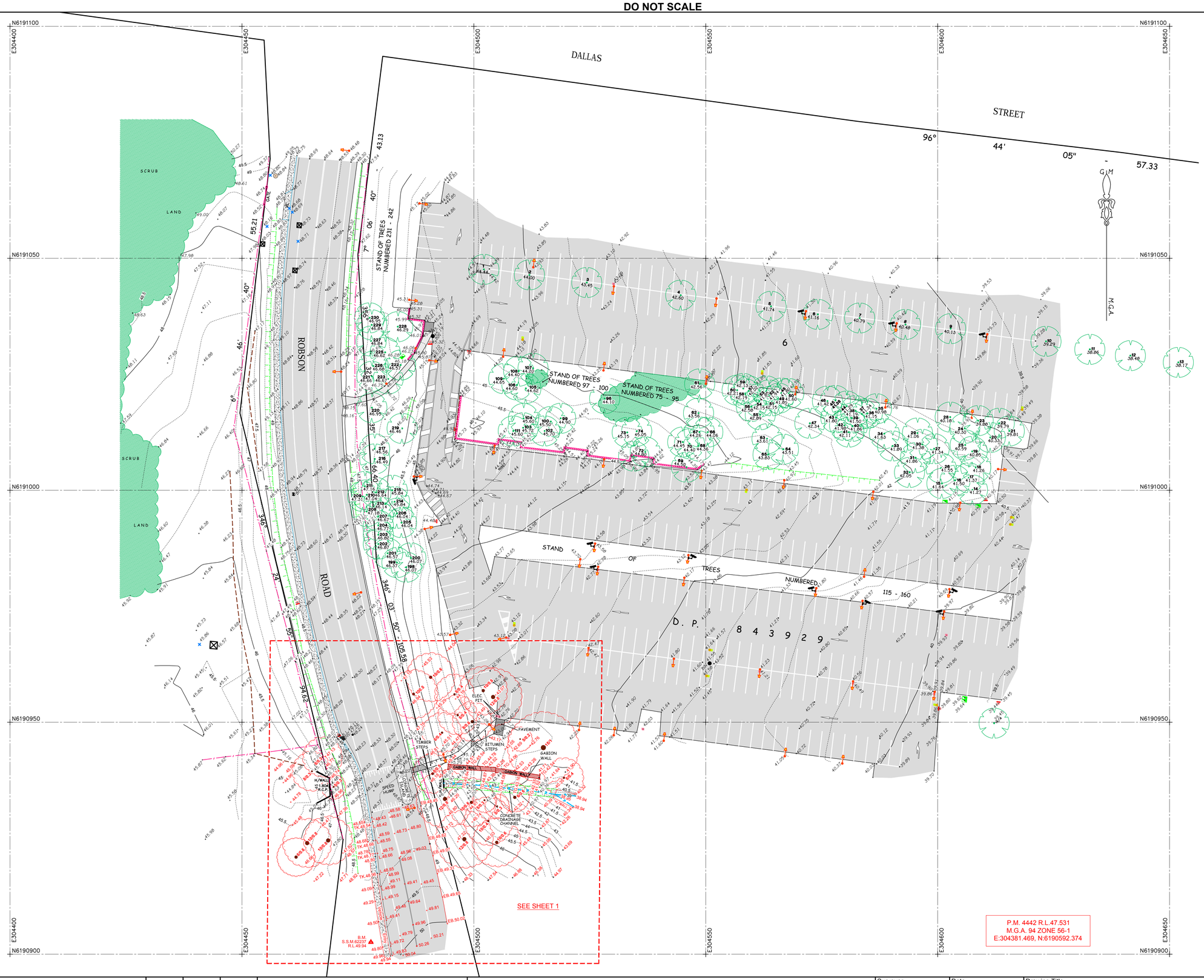
K.F. Williams & Associates Pty Ltd
28 Auburn Street
Wollongong NSW 2500
A.C.N 008 664 417
Project Management, Surveying, Civil, Structural, Water & Sewer

p (02) 4228 7044
f (02) 4226 2004
e mail@kfw.net.au
www.kfw.net.au

Surveyor J.H.	Date 12th July 2017	Drawing Title	Project No. KF112747
Date of Survey AUGUST 2017	Drawn Z.Dukleski	DETAIL AND CONTOUR SURVEY PLAN LOT 6 D.P. 843929 UNIVERSITY OF WOLLONGONG, WESTERN CARPARK	Drawing No. SV01
Height Datum AHD	Designed		Sheet 1 Of 2 / Revision
Origin S.S.M.62237 R.L.49.94	Checked		
Horiz. Datum M.G.A.	Approved	Scale 1:150 @ A1, 1:300 @ A3 / Drawing Status	

FILENAME: X:\KF\112747\Survey\Drawings\KF112747-EXTRA DETAIL.dwg
PLOTTED BY : zdukleski

DO NOT SCALE



LEGEND

- LOT BOUNDARY
- SEWER MANHOLE & LINES
- STOP VALVE
- PAY STATION (LIGHT POLE – PAY STATION)
- ELECTRIC LIGHT POLE WITH CCTV / SECURITY CAMERA
- ELECTRICITY PIT
- STREET SIGN / SIGN
- (BH) BORE HOLE
- UNKNOWN SERVICE
- BITUMEN
- CONCRETE
- TOP OF BANK
- TOE OF BANK
- FENCE
- GATE
- TIMBER RETAINING WALL
- TELSTRA PIT
- STORMWATER PIT
- WATERMAIN PIT (CONC. LID)
- 64 / 43.51 TREES, TREE NUMBER & LEVEL
- GROUP OF TREES

LEGEND

TG.44.87	TOP OF GABION WALL LEVEL
TK.48.66	TOP OF KERB LEVEL
L.49.41	LIP OF KERB AND GUTTER LEVEL
EB.49.31	EDGE OF BITUMEN LEVEL
80.6	TREE

CAUTION

1. THIS DETAIL SURVEY IS NOT A "SURVEY" AS DEFINED BY THE SURVEYING ACT, 2002. IF ANY CONSTRUCTION AND/OR BUILDING LOCATION/ AREA COMPUTATIONS ARE PLANNED, IT WOULD BE ADVISABLE TO CARRY OUT FURTHER SURVEY WORK TO DETERMINE THE BOUNDARY DIMENSIONS.

2. BEARINGS & DISTANCES OF BOUNDARIES & AREAS ARE BY TITLE AND/OR DEED ONLY.

3. RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY.

4. WHERE OFFSETS ARE CRITICAL, THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.

5. CONTOURS ARE INTERPOLATED FROM ACCURATE SPOT LEVELS AS SHOWN AND SHOULD BE USED AS A GUIDE ONLY. DO NOT REINTERPOLATE CONTOURS.

6. THE POSITION OR EXISTENCE OF UNDERGROUND SERVICES HAS NOT BEEN SHOWN. AN ACCURATE DETERMINATION OF UNDERGROUND SERVICES SHOULD BE OBTAINED PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION OR DIGGING.

DIAL BEFORE YOU DIG
www.1100.com.au

Revision	Amendment or reason for issue	Issue date	Drawn by	Authorised

KFW
INFRASTRUCTURE PROFESSIONALS

K.F. Williams & Associates Pty Ltd
28 Auburn Street
Wollongong NSW 2500
A.C.N 008 664 417
Project Management, Surveying, Civil, Structural, Water & Sewer

p (02) 4228 7044
f (02) 4226 2004
e mail@kfw.net.au
www.kfw.net.au

Surveyor J.H.	Date 12th July 2017	Drawing Title	Project No. KF112747
Date of Survey AUGUST 2017	Drawn Z.Dukleski	**DETAIL AND CONTOUR SURVEY PLAN LOT 6 D.P. 843929 UNIVERSITY OF WOLLONGONG, WESTERN CARPARK (EXISTING SURVEY SURVEY INFORMATION SEPT. 2009)**	Drawing No. SV01
Height Datum AHD	Designed		Sheet 2 Of 2 / Revision
Origin S.S.M.62237 R.L.49.94	Checked		
Horiz. Datum M.G.A.	Approved	Scale 1:400 @ A1, 1:800 @ A3	Drawing Status

PLOTTED BY : zdukleski FILENAME: X:\KF112747\Survey\Drawings\KF112747-EXTRA DETAIL.dwg