

## Appendix E

### STORMWATER IMPACT ASSESSMENT

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Our Ref: 239566/DR/DR

23 January 2018

Murray Towndrow  
Urbanise Consulting  
P.O.Box 87  
Warners Bay NSW 2282

Dear Murray,

### **Nords Wharf Development MP10\_088 MOD1**

#### **Impact of Amended Design on Swamp Sclerophyll Forest on Coastal Floodplains Endangered Ecological Community (Mahogany Forest)**

Nords Wharf Development Company has submitted an application to the Department of Planning for modification to the approved concept plan. As part of the assessment of this application, the Department has issued comments from referral parties relating to the proposed amendments, one of which came from the Office of Environment and Heritage (OEH). ADW Johnson (ADWJ) have been requested to address one of the comments from OEH as listed below:

- analysis and impact assessment of increases to stormwater run-off and changes to drainage in relation to swamp sclerophyll forest on coastal floodplains endangered ecological community (EEC); and

ADWJ have undertaken a review of the design and provide the following advice in relation to these matters as outlined below.

#### Previous Reports for DA

The previous site owner commissioned several reports as part of a Development Application to Lake Macquarie City Council in 2013. Two reports, applicable to this review, are as follows:

- Nords Wharf Development Project Stormwater Management Plan, by SMEC. Project Number 30011459, revision B dated 26 April 2013 (the "SMEC DA Report"); and

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- Additional Ecological Information Southern Estates – Nords Wharf, by RPS. Report Number PR117657, revision FINAL dated 29 April 2013

These reports were nominated as approved documents under DA/640/2013, which was approved by Lake Macquarie City Council on 10 September 2014. ADWJ has reviewed these documents and will make reference to these reports in response to the comments made by OEH.

Impact analysis on the swamp sclerophyll forest on coastal floodplains endangered ecological community (Mahogany Forest)

The performance of the revised concept stormwater design was assessed using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software developed by eWater, including the MUSIClink specifically designed for Lake Macquarie City Council LGA. MUSIC has been specifically designed to model the effectiveness of stormwater management systems in achieving pollutant reduction targets and mitigating hydrologic impacts, such as increases in runoff volume.

The MUSIC model was established generally in accordance with the SMEC DA Report, with the exception of the MUSIClink that requires the specific use of parameters as set by LMCC. The results of the modelling was then compared to both the GHD Report (October 2010) approved with the concept design, and the SMEC DA Report as follows:

Author	Existing Flow (ML/yr)	Post WSUD (no) (ML/yr)	Post WSUD (with) (ML/yr)	Reduction % with WSUD	Change in load (ML/yr)
GHD 2010	13.2	43.1	20.7	52.0	+7
SMEC 2013	21	58	47	19	+26
ADWJ 2018	20	53	47	11.5	+27

With reference to the difference between the concept approved report (GHD, 2010) and both the SMEC DA Report and ADWJ modelling we note the following:

- GHD have used a range of sources to determine the parameters used in MUSIC, including default MUSIC parameters, a 2004 report identifying gaps in the MUSIC modelling, and Williamstown rainfall data. The Williamstown rainfall data was chosen due to its long history of 6 min rainfall data, with no mention of its appropriateness and alignment with expected rainfall on this site in Lake Macquarie.
- ADWJ have utilised the Lake Macquarie City Council MUSIClink parameters, developed specifically by LMCC and eWater for use in the Lake Macquarie region. This is a tool that was not available at the time of the GHD assessment.
- The smaller reduction in flow from the SMEC DA Report, in comparison to the concept approved study by GHD, is a result of a review of the Geotechnical Report prepared for the concept approval (Douglas Partners, 2010). This report identifies that infiltration rates across the site are expected to be limited by low permeability clays and weathered rock. For this reason, SMEC (2013) have commented "While no specific recommendations were made regarding the suitability of infiltration systems, it is considered that infiltration based stormwater controls would be technically

feasible for this site. However, their effectiveness in meeting stormwater management objectives would be limited by the low permeability rates of the existing soils" and for this reason individual lot infiltration was removed from the design in consultation with council. This report and design was approved by LMCC in DA/640/2013.

The above flow increases are attributed to 9.5 Ha of the development site, however a portion of the stormwater is diverted around the Mahogany Forest and drains directly into Lake Macquarie. With reference to the SMEC DA Report, they have determined that an additional 14ML/year of water was entering the Mahogany Forest, which is an increase of 5% over the entire catchment of the forest. This 14ML/year (5%) increase was an estimate based on a pro-rata of pre-development flow in the development area. RPS (2013) reviewed the SMEC report and assessed the 5% increase of flow on the Mahogany Forest and determined that "This does not represent a significant change in the hydrologic regime and should not affect the current condition of the Mahogany Swamp Forest."

ADWJ has modelled the entire catchment of the Mahogany Forest, including the additional development area of the revised concept plan, which has resulted in the same increase of 14ML/year, an increase of 5%. There is no additional runoff to the Mahogany Forest from the previous concept approval design and modelling by SMEC, as ADWJ were able to amend catchments to maximise the amount of runoff being diverted around the forest into the catchment draining directly to Lake Macquarie. Referring to the RPS (2013) assessment of the same increases (14ML, 5%), the additional runoff resulting from the amended concept design and additional yield does not represent a significant change in the hydrologic regime and should not affect the current condition of the Mahogany Forest.

ADWJ have also modelled the pollutant load and reductions using the MUSIC software with MUSIClink parameters from Lake Macquarie City Council. The results are in the table as follows:

Pollutant	Existing	DEVELOPED CONDITIONS			LMCC Target
		Unmitigated	Mitigated	% Reduction	
TSS (kg/yr)	857	8180	899	89.0%	80%
TP (kg/yr)	1.76	17.1	6.42	62.6%	45%
TN (kg/yr)	20.3	117	51.5	55.9%	45%

The above table demonstrates compliance with the concept approval Statement of Commitments regarding stormwater quality:

*"Construct stormwater management controls to ensure that the percentage level of pollutant export loads (achieved through WSUD) is within the limits specified in relevant Council policies."*

We trust this addresses the comment from OEH relating to this matter, however please don't hesitate to contact the undersigned for any further clarification.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'David Rutter'.

David Rutter  
**Senior Engineer**  
**ADW JOHNSON**

Attachments:

*MUSIClink Report, Nord's Wharf Development, 04/01/2018.*

*ADW Johnson catchment plan*

*SMEC catchment plan for Mahogany Forest*

*Nords Wharf Development Project Stormwater Management Plan, by SMEC. Project Number 30011459, revision B dated 26 April 2013 (the "SMEC DA Report")*

*Additional Ecological Information Southern Estates – Nords Wharf, by RPS. Report Number PR117657, revision FINAL dated 29 April 2013*

## MUSIC-*link* Report

Project Details		Company Details	
<b>Project:</b>	Nord's Wharf Development	<b>Company:</b>	ADW Johnson
<b>Report Export Date:</b>	4/01/2018	<b>Contact:</b>	Mitchell Knox
<b>Catchment Name:</b>	LMCC_MUSICLINK	<b>Address:</b>	7/335 Hillsborough Rd Warners Bay NSW 2282
<b>Catchment Area:</b>	9.877ha	<b>Phone:</b>	02 4978 5100
<b>Impervious Area*:</b>	57.35%	<b>Email:</b>	mitchellk@adwjohnson.com.au
<b>Rainfall Station:</b>			
<b>Modelling Time-step:</b>	6 Minutes		
<b>Modelling Period:</b>	1/01/1999 - 31/12/2008 11:54:00 PM		
<b>Mean Annual Rainfall:</b>	902mm		
<b>Evapotranspiration:</b>	1408mm		
<b>MUSIC Version:</b>	6.3.0		
<b>MUSIC-link data Version:</b>	6.30		
<b>Study Area:</b>	North Region		
<b>Scenario:</b>	North Region		

\* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: DEV_OVERALL	Reduction	Node Type	Number	Node Type	Number
<b>Flow</b>	11.5%	Bio Retention Node	3	Urban Source Node	11
<b>TSS</b>	89%	Rain Water Tank Node	3	Forest Source Node	5
<b>TP</b>	62.6%	Swale Node	2		
<b>TN</b>	55.9%	GPT Node	2		
<b>GP</b>	98%				

### Comments

Exfiltration of 2mm/hr is appropriate for medium clay soils which typify the subject site.

Extended detention depth greater than 0.3m is suitable for open space area (BMT Draft Music Guidelines for NSW). Vegetation should be selected to suit.

Passing Parameters					
Node Type	Node Name	Parameter	Min	Max	Actual
Bio	BIO BASIN A	Hi-flow bypass rate (cum/sec)	None	None	100
Bio	BIO BASIN A	PET Scaling Factor	2.1	2.1	2.1
Bio	BIO BASIN B	Hi-flow bypass rate (cum/sec)	None	None	100
Bio	BIO BASIN B	PET Scaling Factor	2.1	2.1	2.1
Bio	BIO SWALE C	Hi-flow bypass rate (cum/sec)	None	None	0.225
Bio	BIO SWALE C	PET Scaling Factor	2.1	2.1	2.1
Forest	EXISTING - CONTRIBUTING	Area Impervious (ha)	None	None	0
Forest	EXISTING - CONTRIBUTING	Area Impervious (ha)	None	None	0
Forest	EXISTING - CONTRIBUTING	Area Pervious (ha)	None	None	111.7
Forest	EXISTING - CONTRIBUTING	Area Pervious (ha)	None	None	121.1
Forest	EXISTING - CONTRIBUTING	Total Area (ha)	None	None	111.7
Forest	EXISTING - CONTRIBUTING	Total Area (ha)	None	None	121.1
Forest	EXISTING - DEV. AREA	Area Impervious (ha)	None	None	0
Forest	EXISTING - DEV. AREA	Area Pervious (ha)	None	None	9.9
Forest	EXISTING - DEV. AREA	Total Area (ha)	None	None	9.9
Forest	UNDISTURBED CATCHMENT	Area Impervious (ha)	None	None	0
Forest	UNDISTURBED CATCHMENT	Area Pervious (ha)	None	None	2.4
Forest	UNDISTURBED CATCHMENT	Total Area (ha)	None	None	2.4
Forest	UNDISTURBED CATCHMENT 2	Area Impervious (ha)	None	None	0
Forest	UNDISTURBED CATCHMENT 2	Area Pervious (ha)	None	None	7
Forest	UNDISTURBED CATCHMENT 2	Total Area (ha)	None	None	7
GPT	GPT A	Hi-flow bypass rate (cum/sec)	None	None	100
GPT	GPT B	Hi-flow bypass rate (cum/sec)	None	None	100
Rain	Rainwater Tank A	% Reuse Demand Met	80	None	100
Rain	Rainwater Tank B	% Reuse Demand Met	80	None	100
Rain	Rainwater Tank C	% Reuse Demand Met	80	None	100
Swale	SWALE A	Bed slope	0.01	0.04	0.03
Swale	SWALE C	Bed slope	0.01	0.04	0.03
Urban	ALOTS	Area Impervious (ha)	None	None	0
Urban	ALOTS	Area Pervious (ha)	None	None	2.209
Urban	ALOTS	Total Area (ha)	None	None	2.209
Urban	ARoads	Area Impervious (ha)	None	None	1.049
Urban	ARoads	Area Pervious (ha)	None	None	0.450
Urban	ARoads	Total Area (ha)	None	None	1.5
Urban	ARoads TO SWALE	Area Impervious (ha)	None	None	0.832
Urban	ARoads TO SWALE	Area Pervious (ha)	None	None	0.357
Urban	ARoads TO SWALE	Total Area (ha)	None	None	1.19
Urban	ARoof	Area Impervious (ha)	None	None	2.209
Urban	ARoof	Area Pervious (ha)	None	None	0
Urban	ARoof	Total Area (ha)	None	None	2.209

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	B LOTS	Area Impervious (ha)	None	None	0
Urban	B LOTS	Area Pervious (ha)	None	None	0.456
Urban	B LOTS	Total Area (ha)	None	None	0.456
Urban	B ROADS	Area Impervious (ha)	None	None	0.239
Urban	B ROADS	Area Pervious (ha)	None	None	0.102
Urban	B ROADS	Total Area (ha)	None	None	0.342
Urban	B ROOF	Area Impervious (ha)	None	None	0.456
Urban	B ROOF	Area Pervious (ha)	None	None	0
Urban	B ROOF	Total Area (ha)	None	None	0.456
Urban	C LOTS	Area Impervious (ha)	None	None	0
Urban	C LOTS	Area Pervious (ha)	None	None	0.456
Urban	C LOTS	Total Area (ha)	None	None	0.456
Urban	C ROADS	Area Impervious (ha)	None	None	0.112
Urban	C ROADS	Area Pervious (ha)	None	None	0.048
Urban	C ROADS	Total Area (ha)	None	None	0.161
Urban	C ROADS TO SWALE	Area Impervious (ha)	None	None	0.309
Urban	C ROADS TO SWALE	Area Pervious (ha)	None	None	0.132
Urban	C ROADS TO SWALE	Total Area (ha)	None	None	0.442
Urban	C ROOF	Area Impervious (ha)	None	None	0.456
Urban	C ROOF	Area Pervious (ha)	None	None	0
Urban	C ROOF	Total Area (ha)	None	None	0.456

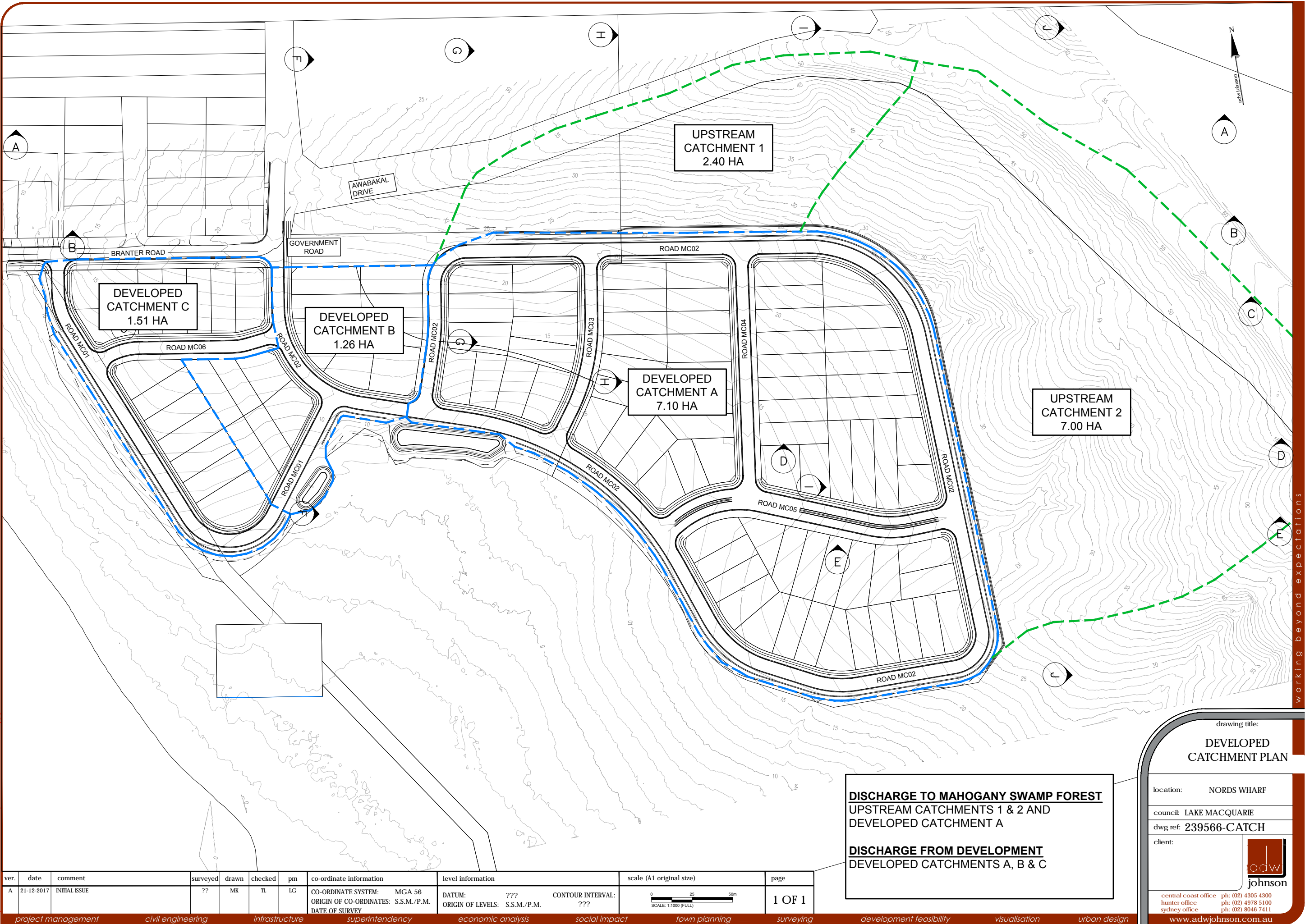
Only certain parameters are reported when they pass validation



#### Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	BIO BASIN A	Exfiltration Rate (mm/hr)	0	0	2
Bio	BIO BASIN A	Extended detention depth (m)	None	0.3	0.5
Bio	BIO BASIN B	Exfiltration Rate (mm/hr)	0	0	2
Bio	BIO BASIN B	Extended detention depth (m)	None	0.3	0.5
Bio	BIO SWALE C	Exfiltration Rate (mm/hr)	0	0	2
Swale	SWALE A	Exfiltration Rate (mm/hr)	0	0	2
Swale	SWALE C	Exfiltration Rate (mm/hr)	0	0	2

Only certain parameters are reported when they pass validation



working beyond expectations

**DISCHARGE TO MAHOGANY SWAMP FOREST**  
UPSTREAM CATCHMENTS 1 & 2 AND  
DEVELOPED CATCHMENT A

**DISCHARGE FROM DEVELOPMENT**  
DEVELOPED CATCHMENTS A, B & C

ver.	date	comment	surveyed	drawn	checked	pm	co-ordinate information	level information	scale (A1 original size)	page
A	21-12-2017	INITIAL ISSUE	??	MK	TL	LG	CO-ORDINATE SYSTEM: MGA 56 ORIGIN OF CO-ORDINATES: S.S.M./P.M. DATE OF SURVEY	DATUM: ??? ORIGIN OF LEVELS: S.S.M./P.M. CONTOUR INTERVAL: ???	0 25 50m SCALE 1:1000 (FULL)	1 OF 1

project management

civil engineering

infrastructure

superintendency

economic analysis

social impact

town planning

surveying

development feasibility

visualisation

urban design

drawing title:  
**DEVELOPED  
CATCHMENT PLAN**

location: NORDS WHARF  
council: LAKE MACQUARIE  
dwg ref: 239566-CATCH  
client:



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sydney office ph: (02) 8046 7411  
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LAKE  
MACQUARIE

EXISTING TOWNSHIP  
OF NORDS WHARF

AWABAKAL DRIVE

DEVELOPMENT  
AREA - 10.2ha

MAHOGANY  
SWAMP FOREST  
(INDICATIVE AREA)

CONTRIBUTING  
CATCHMENT AREA TO  
MAHOGANY SWAMP  
FOREST - 131Ha

PACIFIC  
HIGHWAY

#### LEGEND

- |                                   |                              |
|-----------------------------------|------------------------------|
|                                   | DEVELOPMENT AREA             |
|                                   | EXISTING 2m CONTOURS         |
|                                   | EXISTING WATERCOURSE         |
|                                   | MAHOGANY SWAMP FOREST        |
|                                   | CATCHMENT EXTENTS            |
| <b>CATCHMENT<br/>AREA - 1.0ha</b> | <b>CATCHMENT NAME / AREA</b> |

**SOURCES:** .  
THIS FIGURE SHOWS CONCEPTUAL INFORMATION ONLY

75 0 75 150 225m  
SCALE 1:7500

EXISTING CATCHMENTS AND WATERCOURSES  
**FIGURE No. 2**



## Appendix F

### ROAD CROSS SECTIONS

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ver.	date	comment	surveyed	drawn	checked	pm	co-ordinate information	level information	scale (A1 original size)	page
A	05.12.2017	INITIAL ISSUE		SS.	TL.	D.R.	CO-ORDINATE SYSTEM: MGA 56	DATUM: ???	0 20.0 40.0m	1 OF 3
B	09.04.2018	ROAD SECTION ADDED		L.G.	L.G.	D.R.	ORIGIN OF CO-ORDINATES: S.S.M./P.M.	CONTOUR INTERVAL: ???	SCALE: 1:800 (FULL)	
							DATE OF SURVEY			

drawing title:

CARRIAGEWAY  
SECTION LOCATION

location:

NORDS WHARF

council:

LAKE MACQUARIE

dwg ref:

239566-ESK-005-B

client:

central coast office

hunter office

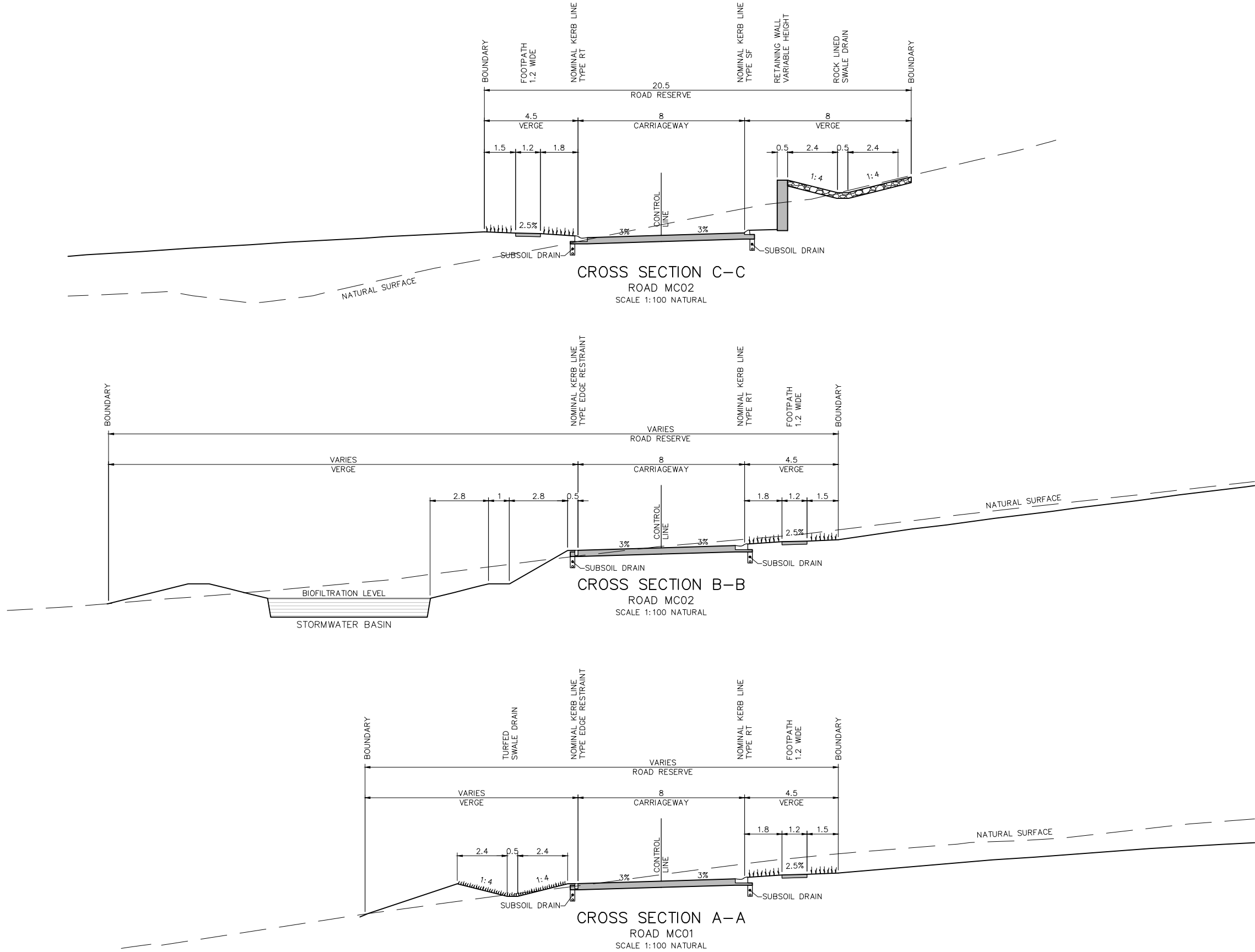
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ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
C	09.04.18	UPDATE SECTIONS	Z.J.	L.G.	DATUM: N/A CONTOUR INTERVAL: N/A	NOT TO SCALE	

project managementcivil engineeringinfrastructuresuperintendencyeconomic analysissocial impacttown planningsurveyingdevelopment feasibilityvisualisationurban design

drawing title:  
**TYPICAL  
CARRIAGEWAY  
SECTIONS**

location: **NORDS WHARF**

council: **LAKE MACQUARIE**

dwg ref: **239566-ESK-003-C**

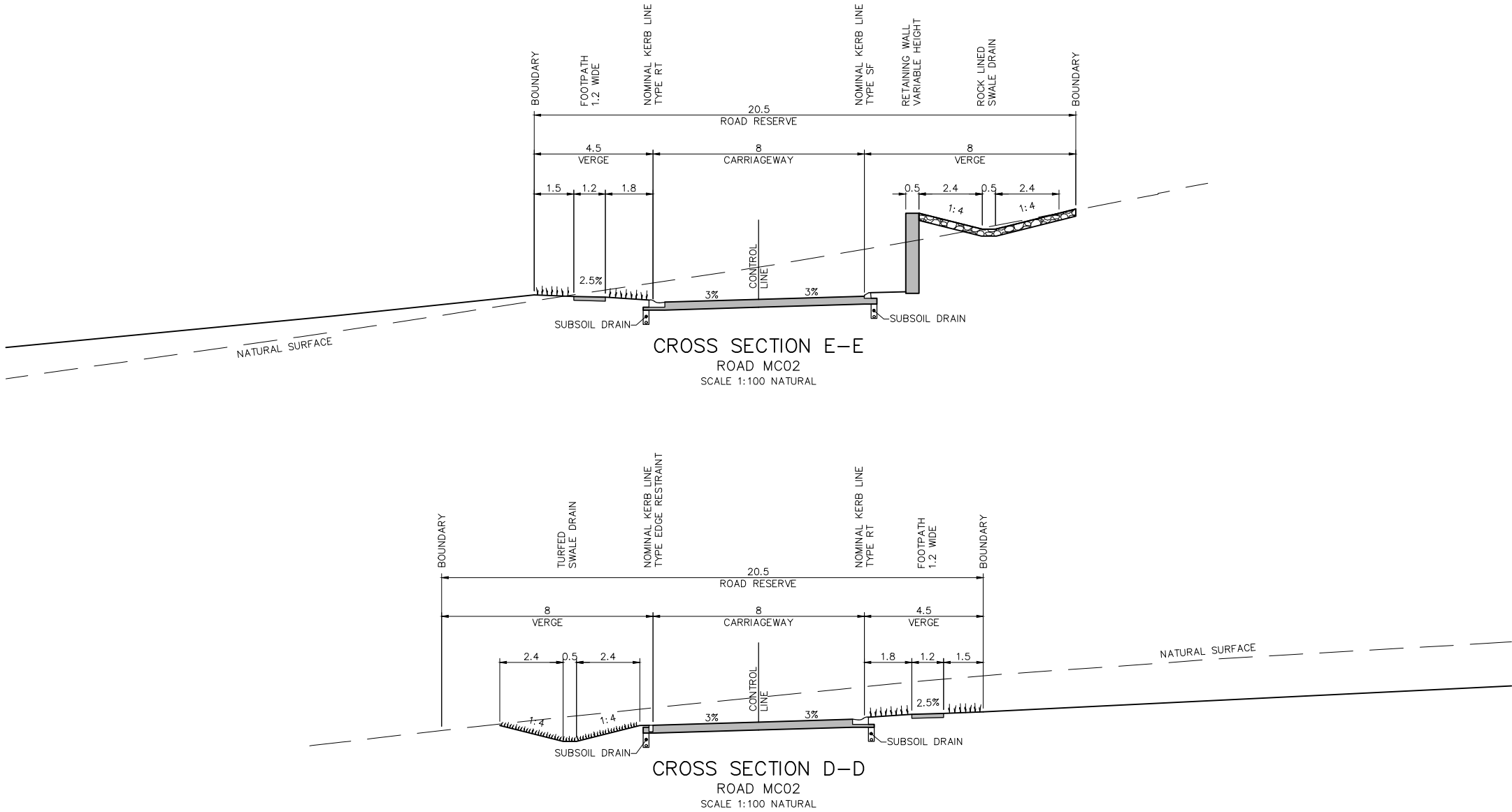
client:

**Nords Wharf  
development  
Company**



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ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
C	09-04-2018	UPDATE SECTIONS	Z.J.	L.G.	DATUM: N/A CONTOUR INTERVAL: N/A	NOT TO SCALE	
project managementcivil engineeringinfrastructuresuperintendencyeconomic analysissocial impacttown planningsurveyingdevelopment feasibilityvisualisationurban design							

drawing title:  
**TYPICAL  
CARRIAGEWAY  
SECTIONS**

location:  
NORDS WHARF

council:  
LAKE MACQUARIE

dwg ref:  
239566-ESK-004-C

client:  

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development  
Company

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