PLANNING & NATURAL SYSTEMS

ATTACHMENT E

DA-577/2017 - RESIDENTIAL FLAT BUILDING
PEEL STREET, TUNCURRY

DEVELOPMENT CONTROL UNIT MEETING

30 NOVEMBER 2017

LIDBURY, SUMMERS & WHITEMAN

Consulting Surveyors, Planners & Engineers
Incorporating Degotardi, Smith & Partners (Forster)

LS&W

The Institution of Surveyors NSW

The Institution of Engineers Australia

A.B.N. 48 470 231 954
P.O. BOX 510, FORSTER
FIRST FLOOR
3 WHARF STREET
FORSTER NSW 2428
Phone: (02) 6554 7988
Fax: (02) 6554 9378
consult@lswsurveyors.com.au
www.lswsurveyors.com.au

Partners
B. A. LIDBURY & ASSOCIATES PTY. LTD.
S. P. WHITEMAN & ASSOCIATES PTY. LTD.

Registered Surveyors
B. A. Lidbury B. Surv. (Hons.) M.I.S.
S. P. Whiteman B. Surv. M.I.S.

Civil Engineers
P. J. Lidbury B.Surv.(Hons.) B.Civ.Eng.(Hons.) M.I.S. MIEAust.

Your Ref:
Our Ref: 7893
Document Ref: 7893 WSD Strategy
Date: 8th June 2017

WATER SENSITIVE DESIGN STRATEGY FOR

PROPOSED RESIDENTIAL APARTMENTS LOT 17 SEC 2 DP759005 & LOTS 54 & 55 DP31768, No.15 PEEL ST, TUNCURRY

June 2017
Issue 2

Prepared for:

Wakefield Ashurst Developments Pty. Ltd
PO Box 359
Castle Hill NSW 1765

Prepared by:

Phillip J. Lidbury
Registered Surveyor
B.Surv. (Hons.) B.Civ. Eng. (Hons.) MIS MIEAUST

LIDBURY, SUMMERS & WHITEMAN
Consulting Surveyors, Planners & Engineers

ABN: 48 470 231 954

P.O. BOX 510, FORSTER
First Floor
3 Wharf Street
FORSTER NSW 2428

Website: www.lswsurveyors.com.au
Email: consult@lswsurveyors.com.au
Phone: (02) 6554 7988
Fax: (02) 6554 9378

1 INTRODUCTION

This document has been prepared to address stormwater quality and quantity management strategies for a proposed multi-storey residential apartment development on Lot 17, Sec 2, DP759005 and lots 54 and 55 DP31768, located at No.15 Peel Street, Tuncurry.

This strategy will conceptually size stormwater water quality measures to comply with Mid-Coast Council's stormwater quality management objectives. Stormwater will be treated by a combination of traditional drainage measures, as well as water sensitive urban design (WSUD) techniques. The strategy will also address stormwater quantity.

The 2336m^2 site is located on the corner of Peel Street, Kent Street and Manning Lane in the central business district of Tuncurry on the NSW Mid North Coast. The site is bordered by existing commercial to the north, and existing residential dwellings to the east, west and south.

The site contains an existing masonry building with awning and associated hardstand areas. The aforementioned areas are fully impervious with roof drainage outlets to Peel Street and Manning Lane kerb and gutter respectively. The pervious areas of the site contain sparse vegetation and grade gradually to the street in each direction. The majority of flow directed to the kerb grades to the existing sag pit in Peel Street.

The soils on the site are expected to generally consist of a highly impermeable sand with a groundwater depth of at least 3m. The soil characteristics will be confirmed by geotechnical investigations.

The development proposes to create a multi-storey residential apartment\ development consisting of 35 serviced apartments, a basement carpark, On-site Modular Detention System and water quality Bioretention Basin located on the ground floor.

1.1 STORMWATER MANAGEMENT PERFORMANCE TARGETS

The objectives for water quality adopted for this Water Sensitive Design Strategy are based on *Great Lakes Council's* DCP Chapter 11 *Water Sensitive Design (May 2015).* As the development footprint is greater than 2000m^2 and is a "redevelopment" of an existing urban area, the targets are:

- Post development loads of Gross Pollutants, TSS, TN and TP are to be reduced by 90%, 80%, 60% and 45% respectively compared to the untreated post developed pollutant loads.

Additionally, given the location of the site and the catchment, the objectives for water quantity are:

- Attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 100 year ARI rainfall event.

1.2 PROPOSED STORMWATER MANAGEMENT STRATEGY

This Water Sensitive Design Strategy proposes to incorporate a Water Sensitive Urban Design (WSUD) "treatment train" approach, consisting of control measures at source and end-of-line measures to manage the discharge of nutrients and pollutants leaving the site to be reduced to meet the objectives proposed above.

The strategy proposes that the roofwater (including first flush) and balcony surface water will be captured by a roof drainage system (to hydraulic engineers design), which will be conveyed to grated surface inlet pits located on the Ground Floor. These pits will contain *Enviropod* (or similar) pit inserts or an outlet screen and dry sump to capture coarse sediment, trash and vegetation matter, and screen finer particulates, and with a grated pit to accept surface flows from the landscaped areas.

Ground floor hardstand and landscaped areas are proposed to be captured by grated surface inlet pits and piped to the Bioretention Basin.

As the basement will form the lowest part of the site, any stormwater flows which exceed traditional capture measures will need pumping (to hydraulic engineers design) into the Bioretention Basin for treatment.

All flows captured in the underground piped stormwater system will enter an end-of-line low flow inlet control (splitter pit), directing the three-month event to the water quality bioretention basins. Any flows exceeding the three month event will be piped to the underground modular detention system. If the capacities of the bioretention basins are exceeded, flows will be discharged via a weir or surcharge pit to Peel Street.

BASIX will apply to the development, and there is no proposed stormwater harvesting or re-use proposed at this time.

2 WATER QUALITY ASSESSMENT

2.1 MUSIC Water Quality Model

MUSIC (Model for Stormwater Improvement Conceptualisation) Version 6.2.1 was developed by the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC is a conceptual continuous simulation water quality assessment design tool that estimates stormwater pollutant generation from different land uses and routes the stormwater pollutants through a user defined network of stormwater treatment measures ('treatment train') to estimate the performance of a proposed water quality strategy in meeting specified water quality objectives.

As the name suggests, MUSIC is a conceptual tool that simplifies a complex system. MUSIC is based on observed average water quality data, and while all effort has been made to accurately model the proposed scenario, there should be some recognition of the variability in the final performance of the proposed water quality treatment measures to the estimated average results modelled in MUSIC.

To undertake the water quality assessment, a MUSIC model was established for the subject site with two post development scenarios. The results from the post development (without water quality treatment measures) modelling were compared to the post development (with water quality treatment measures) modelling to assess the performance of the proposed stormwater quality controls to meet the water quality objectives stated above.

2.2 Rainfall and Evaporation

In order to establish a MUSIC model, rainfall and evaporation records in the vicinity of Tuncurry were sought.

2.2.1 Rainfall

Bureau of Meteorology records from the nearest Station 60013 (Forster Tuncurry Marine Rescue) were reviewed to determine that the average annual rainfall depth is approximately 1,217mm. The nearest reliable *Bureau of Meteorology* station with complete 6 minute pluviograph data is Taree (*Station 060030*). A 9-year consecutive period of data was required which included both wet and dry years with an average annual rainfall over the 9-year period being close to the historic average. The period from January 1967 to December 1975 was considered to be the most appropriate period to use for modelling (*Draft NSW MUSIC Modelling Guidelines – August 2010).*

A 6 minute rainfall time step was considered necessary to more accurately model the performance of rainwater tanks and biofiltration devices. It should be noted that this water quality modelling exercise is a comparative assessment (i.e. post development versus post development with treatment). Therefore the actual rainfall year selected is not significant to the final outcome provided a reasonable correlation to the average rainfall depth is achieved.

2.2.2 Evaporation

Monthly areal potential evapotranspiration values were obtained for the site from *'Climate Atlas of Australia, Evapotranspiration'* (BoM, 2001) and are shown in Table 1.

Table 1 – Monthly Areal Potential Evapotranspiration

Month	Areal Potential Evapotranspiration (mm)
January	180
February	135
March	135
April	90
May	65
June	50
July	50
August	70
September	100
October	135
November	150
December	165

2.3 Soil Data and Model Parameters

A rainfall-runoff calibration was undertaken to match the predicted runoff to expected values. The model was calibrated in accordance with the *Draft NSW MUSIC Modelling Guidelines – August 2010* for a Sand. The volumetric runoff coefficient for a free draining, 100% pervious site was 0.34 which is within the acceptable range for Urban (*'Managing Urban Stormwater', NSW EPA, 1997* and *Fletcher, 2004*). The adopted parameters are summarised below;

Table 2 – MUSIC Rainfall-Runoff parameters

Impervious Properties	Pervious properties	Groundwater Properties
Rainfall threshold: 1mm (roofs with first flush) and 1.5mm (roads and Impervious areas) Pervious areas 1mm	Soil storage:175 Initial Storage:30 Field Capacity: 74 Infiltration coefficient A: 360 Infiltration coefficient B: 0.5	Initial Depth: 10mm Daily recharge rate: 100% Daily baseflow rate: 50% Daily deep seepage rate: 0%

2.4 Pollutant Concentrations

The pollutant concentrations adopted for the post-developed state modelling are shown in Table 3. The event mean concentrations (EMC's) for each of these land uses were derived from *Fletcher et al (2004)* and *Draft NSW MUSIC Modelling Guidelines.*

Table 3 – Pollutant Concentrations

Land use/ Surface Type	Storm flow Concentration Log_{10} mg/l	Std. Dev. Log_{10} mg/l	Baseflow Concentration Log_{10} mg/l	Std. Dev. Log_{10} mg/l
Sealed Roads				
Suspended Solids	2.43	0.32	1.20	0.17
Total Phosphorous	-0.30	0.25	-0.85	0.19
Total Nitrogen	0.34	0.19	0.11	0.12
Roofs				
Suspended Solids	1.30	0.32	-	-
Total Phosphorous	-0.89	0.25	-	-
Total Nitrogen	0.30	0.19	-	-
Urban Residential				
Suspended Solids	2.15	0.32	1.20	0.17
Total Phosphorous	-0.60	0.25	-0.85	0.19
Total Nitrogen	0.30	0.19	0.11	0.12

2.5 Catchment Definition

For the post-developed model the proposed site was separated into Roof Area, Balconies, driveway, other ground floor hardstand areas (Impervious area) and pervious landscaped curtilage. The impervious balcony areas have been assigned the Roof EMC's.

The Architect's layout has been adopted for the calculation of the catchments, which shows the development footprint as 73% impervious.

Table 4 – Water Quality Post-Developed Catchment Details

POST-DEVELOPED Sub-Catchment	Area (m^2)	% Imperviousness
1 Main Roof (inc. 6th floor balcony areas) (Roofs)	1160	100%
2 Uncovered Driveway to trench grate (Sealed Roads)	100	100%
3 Ground Floor Hardstand (Urban)	330	100%
4 Driveway - Basement Pumpout (Sealed Roads)	110	100%
5 Pervious (inc. Bioretention Basin) (Urban)	142	0%
5 Bypass Pervious (Urban)	488	0%
6 Bypass Hardstand (Stairs) (Sealed Roads)	6	100%
TOTAL (entire site)	**2336**	**73%**

2.6 Modelling Stormwater Management Controls

The following water quality treatment devices were included in the developed state water quality model:

2.6.1 Sediment Reduction (GPT) Pits

Sediment reduction/pre-filter pits are a type of at source *Gross Pollutant Trap (GPT)* and is a stormwater treatment *Best Management Practice* device designed to capture coarse sediment, trash and vegetation matter. *GPT's* play an important role in stormwater quality management as pre-treatment for other downstream treatment measures, such as retention and infiltration systems, by removing coarse material and preventing downstream measures from being overloaded.

All grated surface inlet pits (including pits within basement for pumpout) will contain *Enviropod* (or similar) pit inserts or filter screens with dry sumps which will act as gross pollutant traps and will capture coarse sediment, trash and vegetation matter, and screen finer particulates. The grates shall be removable for access and maintenance.

It was assumed that the Sediment Reduction Pit had the following pollutant removal efficiencies:

- 100% to 075mg/L, 65% to 1000mg/L Total Suspended Solids removal*
- 0% to 0.5mg/L, 15% to 1mg/L Total Phosphorus Removal*
- 0% to 0.5mg/L, 14% to 5mg/L Total Nitrogen Removal*
- 90% Gross Pollutant Removal*

*Based on Draft *NSW MUSIC Modelling Guidelines – August 2010*

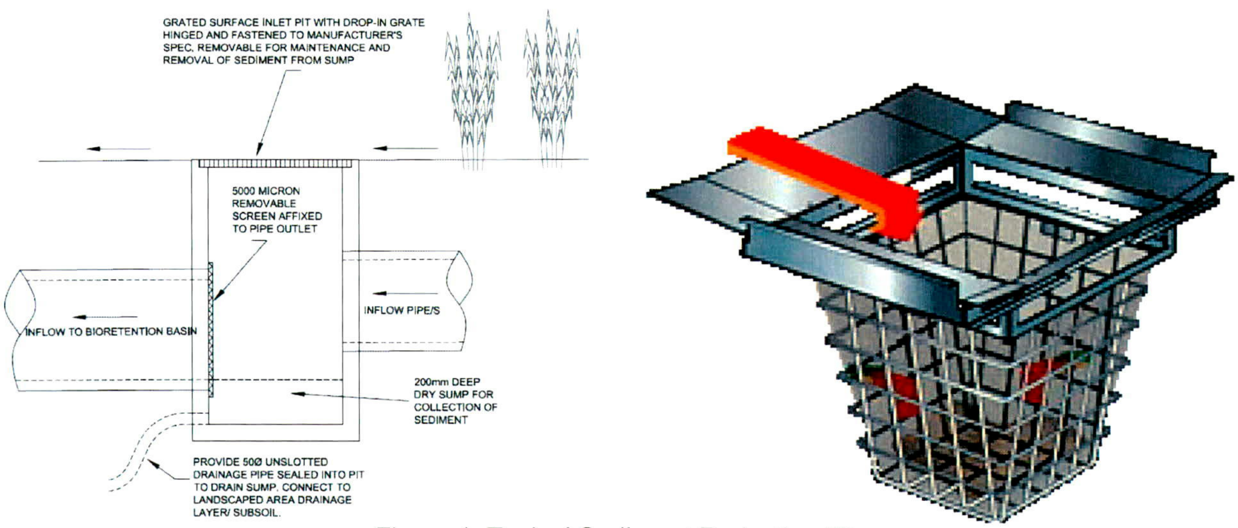


Figure 1: Typical Sediment Reduction Pits

2.6.2 Water Quality Bioretention Planter Box

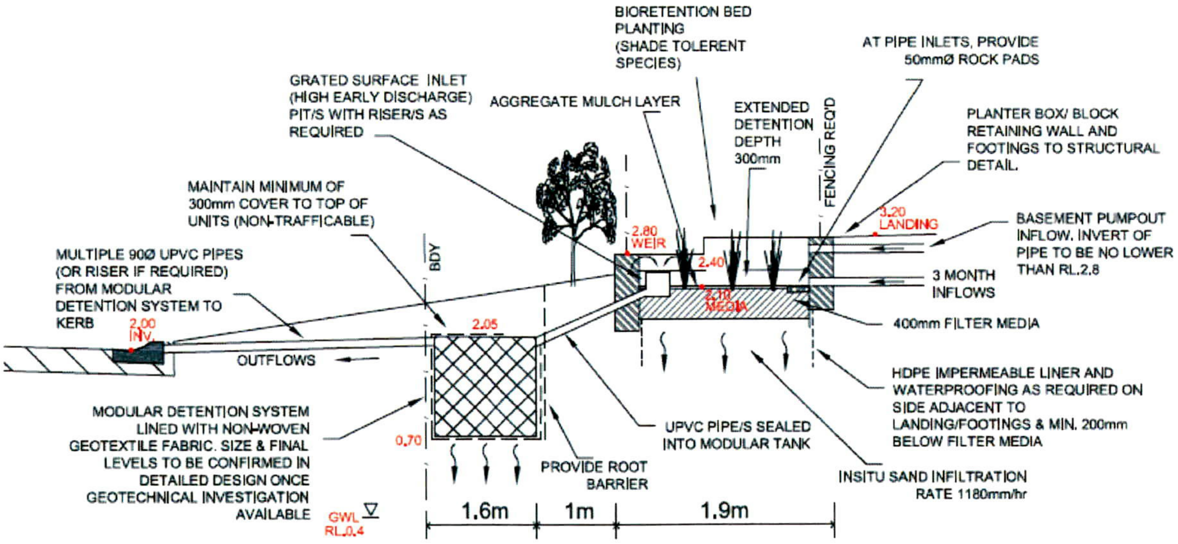
Constructed water quality bioretention basins are shallow, extensively vegetated water bodies that use enhanced sedimentation, fine filtration and pollutant uptake processes to remove pollutants from stormwater. These processes are engaged by slowly passing runoff through vegetated areas. Plants filter sediments and pollutants from the water, while bio-films that grow on the plants can absorb nutrients and other associated contaminants.

For this development, it is proposed to construct an end-of-line water quality Bioretention Basin (planter box style) and undertake vegetation planting so as to provide water quality benefits.

For MUSIC modelling, the following parameters were used:

- 0.30m extended detention depth, vertical sides. Sides and base lined and waterproofed
- Filter Area = 16.25m^2 (13m long x 1.25m wide)
- Energy Dissipator at pipe inlet reducing the inflow velocity to prevent scouring
- Effective vegetation planted
- Filter media 400mm thick (Sandy Loam) and free-draining base into insitu sands
- Filter Media Total Nitrogen = 400mg/kg and Orthophosphate = 35mg/kg
  (*Using MUSIC in Sydney's Drinking Water Catchment* , SCA, Dec 2012 and FAWB Study 2009)
- HDPE Impermeable liner on sides as shown
- Basin inlet/outlet arrangement will form part of the detailed design for construction certificate

The 3 month peak flow from the development into the Basin is approximately 20L/s. The Bioretention Planter Box can accept the entire flow subject to reducing the inflow velocity to prevent scouring. Subject to the hydraulic engineer's design and/or the use of a siphonic roof drainage system, the sediment reduction pits are also intended to reduce the velocities of the inflow into the Planter to a maximum velocity of 1m/s. Energy dissipators will also be provided at the inlets to prevent scour.



TYPICAL BIORETENTION BASIN & OSD DETAIL
Not to Scale

Figure 2: Typical Bioretention Planter Box
Levels are indicative and subject to final detailed design

Figure 3: Indicative Planter Box style Bioretention Basins

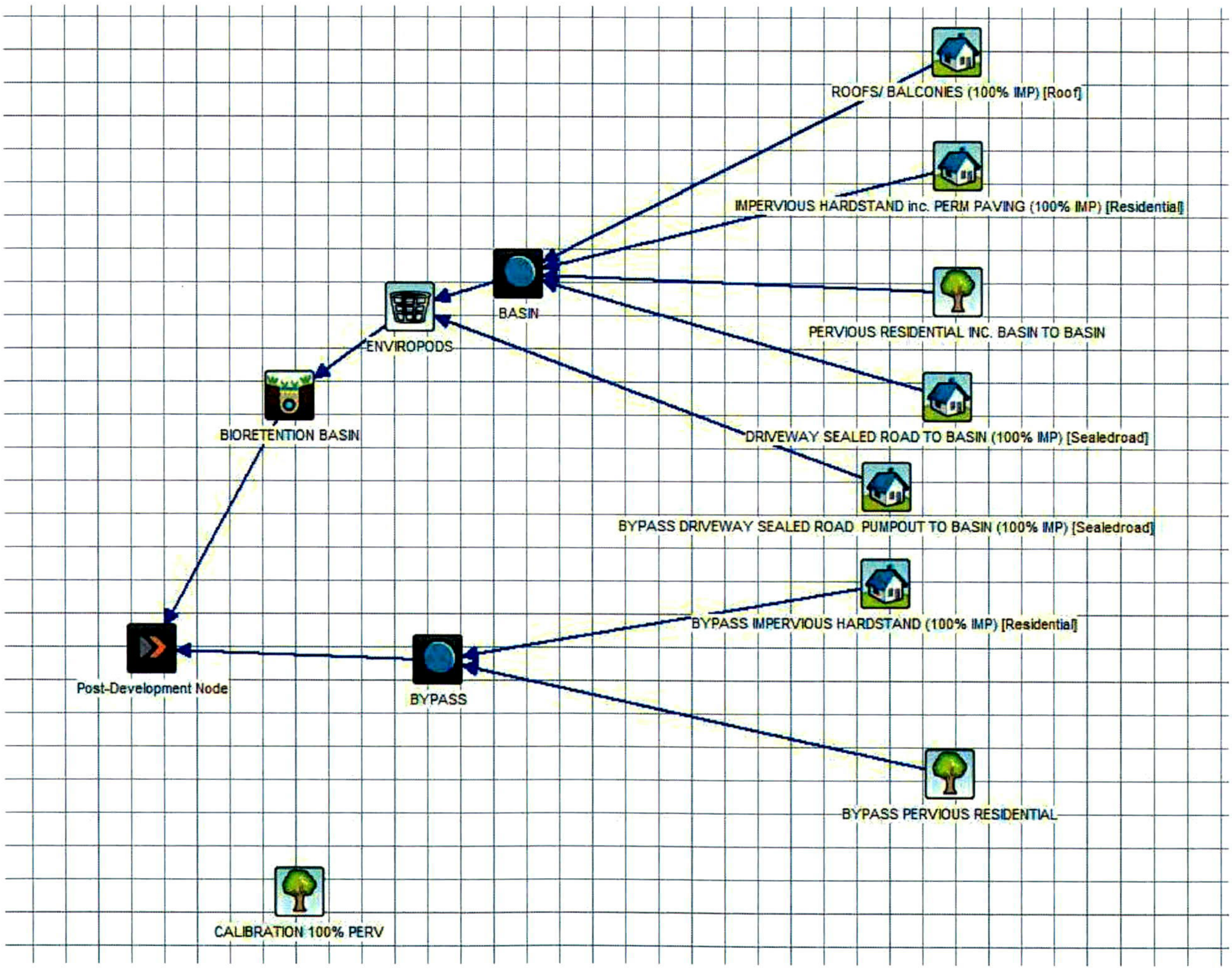


Figure 4: Post-Developed MUSIC model

2.7 Model Results

Table 5 presents the average annual pollutant export loads at the downstream extent of the development footprint under the post developed conditions .

Table 5 - Annual Average Pollutant Export Loads

Pollutant	Developed Site Load (without treatment) (kg/yr)	Developed Site Load (with treatment) (kg/yr)	% Reduction
Gross Pollutants	46.0	0.37	**99.2**
TSS	185	34.2	**81.5**
TP	0.46	0.18	**61.0**
TN	4.32	2.02	**53.4**

The results in Table 5 indicate that the proposed Water Sensitive Design Strategy would meet or exceed the water quality objectives for the site, which were:

- Post development loads of Gross Pollutants, TSS, TN and TP are to be reduced by 90%, 80%, 60% and 45% respectively compared to the untreated post developed pollutant loads.

Refer to the Water Sensitive Design Plan for the locality, size and details of the proposed stormwater treatment measures.

2.8 Construction Stage

Water quality during the construction stage will be addressed by a Stormwater Management plan prepared in accordance with NSW Department of Housing "Blue Book" 2004.

2.9 Maintenance

An Operations and Maintenance Manual is to be prepared for the stormwater quality devices proposed for the development. This document will be prepared at construction certificate stage.

2.10 Lifecycle Costs

As the development is to remain in private ownership (i.e. stormwater quality devices not handed over to Council), maintenance costs are not an essential aspect of this development application and hence have not been included in this Strategy.

3 HYDROLOGIC ANALYSIS

3.1 DRAINS Parameters

Hydraulic modelling has been undertaken using DRAINS software with an Ilsax Hydrological model. The DRAINS Parameters were modified to provide a realistic hydrological model for the subject site. The following parameters were adopted for the DRAINS Ilsax Models:

- Paved (Impervious) Depression Storage – 1mm
- Supplementary Depression Storage – 1mm
- Grassed (Pervious) Depression Storage – 5mm
- Soil Type – 1 (typically high infiltration rate)
- Antecedent Moisture Condition – 3 (indicates rather wet starting condition for storm event)

Rainfall inputs were entered using IFD relationships from BOM for Forster and temporal patterns from AR&R (2001).

Peak Flows were also calculated using the Rational Method (methodology as per AR&R 2001). Table 6 below shows favourable correlation between DRAINS and the Rational Method.

Table 6 - DRAINS v Rational Method

	Q_5 DRAINS	Q_{100} DRAINS	Q_5 RM	Q_{100} RM
Site (0% Impervious)	0.031m^3/s	0.074m^3/s	0.032m^3/s	0.069m^3/s

3.2 Catchment Definition

For the purpose of the hydrologic modelling, the site was separated into Roof Area, Hardstand Curtilage and Driveways (Impervious area) and pervious areas.

Due to the existing stormwater layout within the site, roofwater is discharged via kerb outlets to Peel Street and Manning Lane respectively. Despite this there is a consistent 1% grade on the kerb from Manning Lane to the low point within Peel Street. Conservatively, the longer time of concentration has been adopted for the pre-developed scenario. A conservative time of concentration of 5 minutes has been adopted for the post-developed scenario per AS3500.3.

The pre and post developed catchment breakdown is shown below in Tables 7 and 8 respectively. Catchment plans are shown in Appendix C.

Table 7 – Hydrologic Pre-Developed Catchment Details

PRE-DEVELOPED Sub-Catchment	Area (m^2)	% Imperviousness
1 Existing Lot Impervious (East)	24	100%
2 Existing Pervious (East)	352	0%
3 Existing Roof (West)	600	100%
4 Existing Lot Impervious (West)	140	100%
5 Existing Pervious (West)	1220	0%
TOTAL (entire site)	**2336**	**33%**

Table 8 – Hydrologic Post-Developed Catchment Details

POST-DEVELOPED Sub-Catchment	Area (m^2)	% Imperviousness
1 Main Roof & Balconies	1160	100%
2 Driveway	210	100%
3 Ground Floor Hardstand	336	100%
4 Pervious	630	0%
TOTAL (entire site)	**2336**	**73%**

3.3 Results and Commentary

As mentioned previously, the roofwater (including first flush) and balcony surface water will be captured by a roof drainage system (to hydraulic engineers design), which will be conveyed to grated surface inlet pits located on the ground floor. These pits will contain *Enviropod* (or similar) pit inserts or an outlet screen and dry sump to capture coarse sediment, trash and vegetation matter, and screen finer particulates, and with a grated pit to accept surface flows from the landscaped areas.

Ground floor hardstand and landscaped areas are proposed to be captured by grated surface inlet pits and piped to the Bioretention Basin.

As the basement will form the lowest part of the site, any stormwater flows which exceed traditional capture measures will need pumping (to hydraulic engineers design) into the Bioretention Basin for treatment.

All flows captured in the underground piped stormwater system will enter an end-of-line low flow inlet control (splitter pit), directing the three-month event to the water quality bioretention basins. Any flows exceeding the three month event (up to 100 year ARI) will be piped to the underground modular detention system, where flows can then infiltrate into the soil stratum. It is proposed to have a overall storage volume of $36.9m^3$, based on an insitu infiltration rate of 28.34m/day with a 50% factor of safety applied for long-term clogging potential. The recorded groundwater in the vicinity of the onsite detention system is 3m deep. A series of high level 90Ømm UPVC outlets will be constructed to the adjacent kerb to discharge flows once the detention has been exceeded.

If the capacity of the bioretention basin is exceeded, a surcharge pit at RL.2.4 will convey flows to the modular detention system. If flows further exceed this level to RL.2.8, they will be discharged via a weir to Peel Street.

The minor (Q_5) and major flow (Q_{100}) modelling criteria is to attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 100 year ARI peak rainfall event.

The total peak discharge from the 5 year ARI peak storm event for the catchment is $0.02m^3/s$, being less than the pre-developed $0.04m^3/s$. Refer to Table 8 below for a summary of pre and post developed discharges.

The total peak discharge from the 100 year ARI peak storm event for the catchment is $0.08m^3/s$, being less than the pre-developed $0.09m^3/s$. Refer to Table 8 below for a summary of pre and post developed discharges.

The basin outlet arrangement will form part of the detailed design for construction certificate. The pipe outlets will be provided with either a coarse sediment forebay or energy dissipator. The scour velocities may need to be assessed based on the hydraulic engineers future downpipe arrangement.

Table 8 – Summary of Stormwater Quantity

NODE	Q_5	Q_5	Q_{100}	Q_{100}
	Existing	**Developed**	**Existing**	**Developed**
	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)
West Outflow	0.03	0.03	0.07	0.08
East Outflow	0.01	-	0.02	-
Total Outflow	**0.04**	**0.03**	**0.09**	**0.08**

*DRAINS ILSAX Worst Case Peak Flows (i.e. worst case storm event for each outlet). 50% Blockage factor applied to Q100 developed model.

3.4 Climate Change

The minimum site level is approximately R.L.2.8m AHD which is above the projected flood planning level (2100 100 year ARI with projected sea level rise). The site is not mapped as a flood planning area in Great Lakes LEP 2014. The proposed habitable ground floor level and underground basement entry is R.L.3.5m AHD.

4 SUMMARY

A combination of measures discussed above including sediment reduction pits and an end-of-line water quality Bioretention Basin have been proposed to manage the discharge of nutrients and pollutants leaving the site.

The modelling shows that the proposed Water Sensitive Design Strategy would meet the water quality objectives for the site, which were to reduce post development loads of Gross Pollutants, TSS, TN and TP by 90%, 80%, 60% and 45% respectively compared to the untreated post developed pollutant loads.

Additionally, the utilisation of traditional stormwater capture measures, as well as a modular underground detention system will attenuate captured stormwater runoff. The criteria is to attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 100 year ARI peak rainfall event.

The modelling shows that the total post-developed peak discharges from the 5 year and 100 year ARI's peak storm event for the catchment are less than the pre-developed peak discharges.

Refer to the Water Sensitive Design Strategy Plan (Appendix C) for the locality, size and details of the proposed stormwater treatment measures.

PHILLIP J. LIDBURY
Registered Surveyor
B.Surv. (Hons.) B.Civ. Eng. (Hons.) MIS MIEAUST
LIDBURY, SUMMERS & WHITEMAN

A Large Scale Development Application Checklist

MidCoast Council

Large Scale Development Application Checklist

Breese Parade Forster
PO Box 450 Forster NSW 2428
phone 02 6591 7222
fax 02 6591 7200
email council@greatlakes.nsw.gov.au
website www.midcoast.nsw.gov.a

Development Control Plan - Water Sensitive Design

LARGE SCALE DEVELOPMENT PROPERTIES GREATER THAN 2000M²			
Site/Project Name	Peel St, Tuncurry	DA No.	
Lot and DP No.	Lot 17 Sec 2 DP759005 & Lots 54 & 55 DP31768 Peel St, Tuncurry		

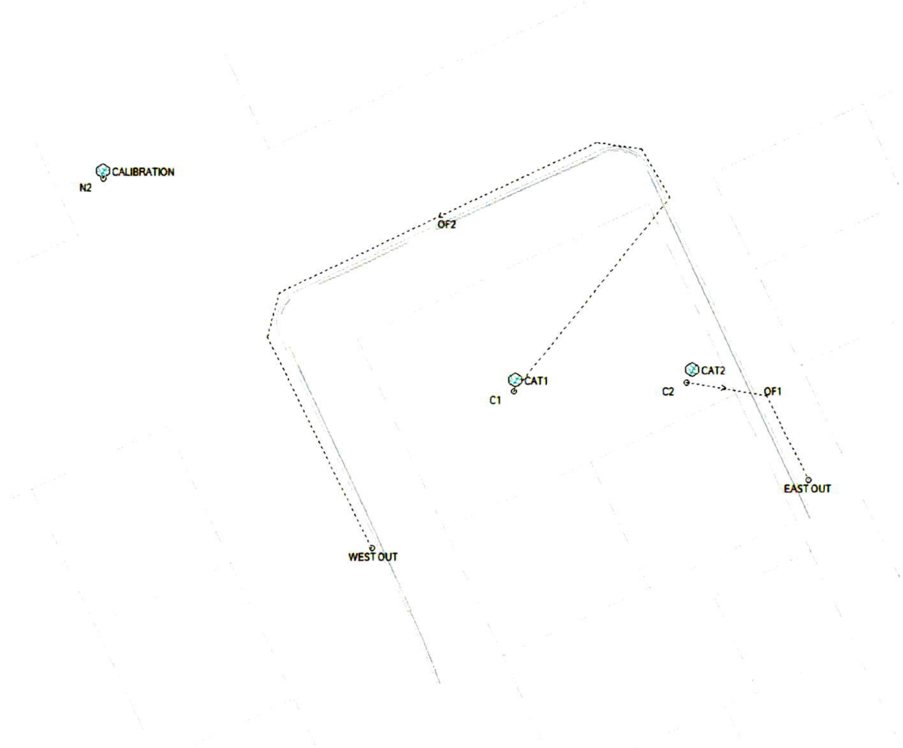
ITEM		Y	N
1.	Has a Water Sensitive Design (WSD) Strategy been submitted as part of the Development Application?	√	
2.	Is BASIX Certification Required? (if No, then proceed to item 3.)	√	
	2a. Has the BASIX Certificate been obtained and attached? by Applicant		√
	2b. Have integrated water management measures been implemented consistent with the WSD Chapter of the Great Lakes DCP requirements and documented within the WSD Strategy.	N/A	
3.	Is the development either greenfield or non-urban? (if Yes, then proceed to item 4a, otherwise item 4b).		√
4.	4a. Have the treatment measures (as modelled consistent with the NSW MUSIC Modelling Guidelines) demonstrated compliance with the Neutral or Beneficial Effect DCP target?	N/A	
	4b. Have the treatment measures (as modelled consistent with the NSW MUSIC Modelling Guidelines) demonstrated compliance with the % reduction WSD Chapter targets	√	
5.	Have the Stormwater Flows requirements been addressed and documented within the WSD Strategy?	√	
6.	Does the WSD Strategy contain the following chapters?		
	a. Background information	√	
	b. Site context	√	
	c. Proposed development	√	
	d. WSD objectives	√	
	e. Constraints and opportunities - Best planning practices	√	
	f. Integrated Water Cycle Management	√	
	g. Stormwater management	√	
	h. Integration with the urban design	√	
	i. Costs	√	
	j. Operation and Maintenance Plan at Construction Certificate Stage		√
7.	Has the digital version of the MUSIC model been provided? Available upon request		√
8.	Have conceptual plans of the proposed stormwater treatment measures been included on the plans? (Note detailed engineering plans will be required for Construction Certification)	√	

Please attach this checklist to the Development Application Submission

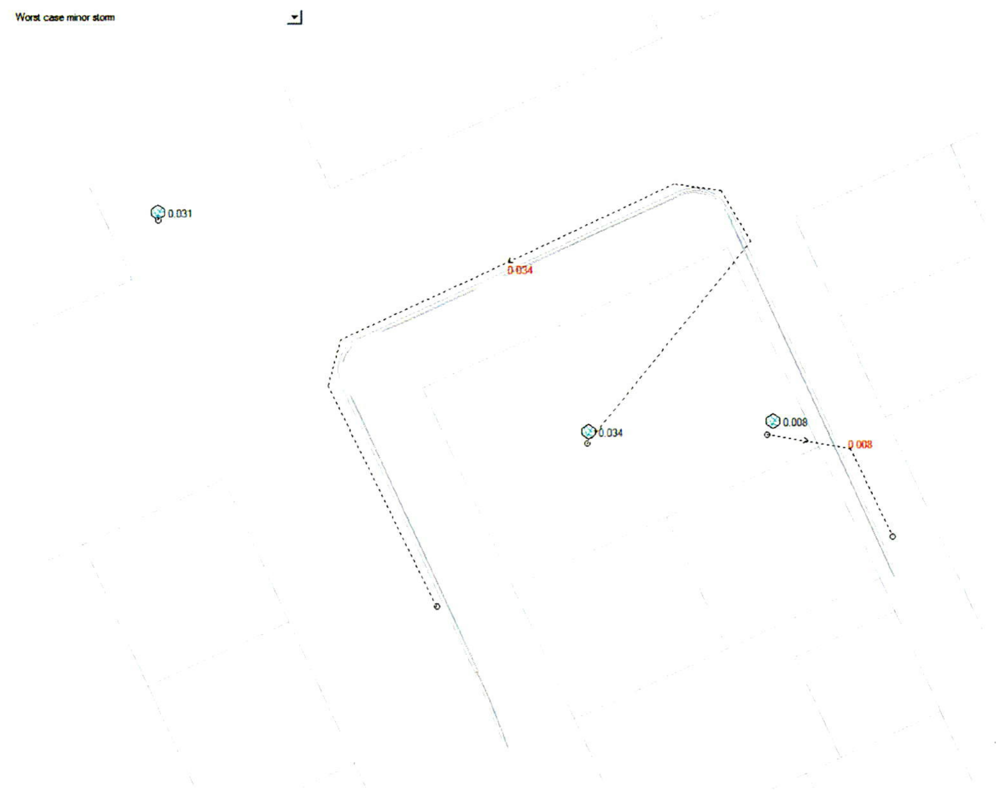
MUSIC = Model for Urban Stormwater Improvement Conceptualisation

B HYDRAULIC OUTPUT FILES

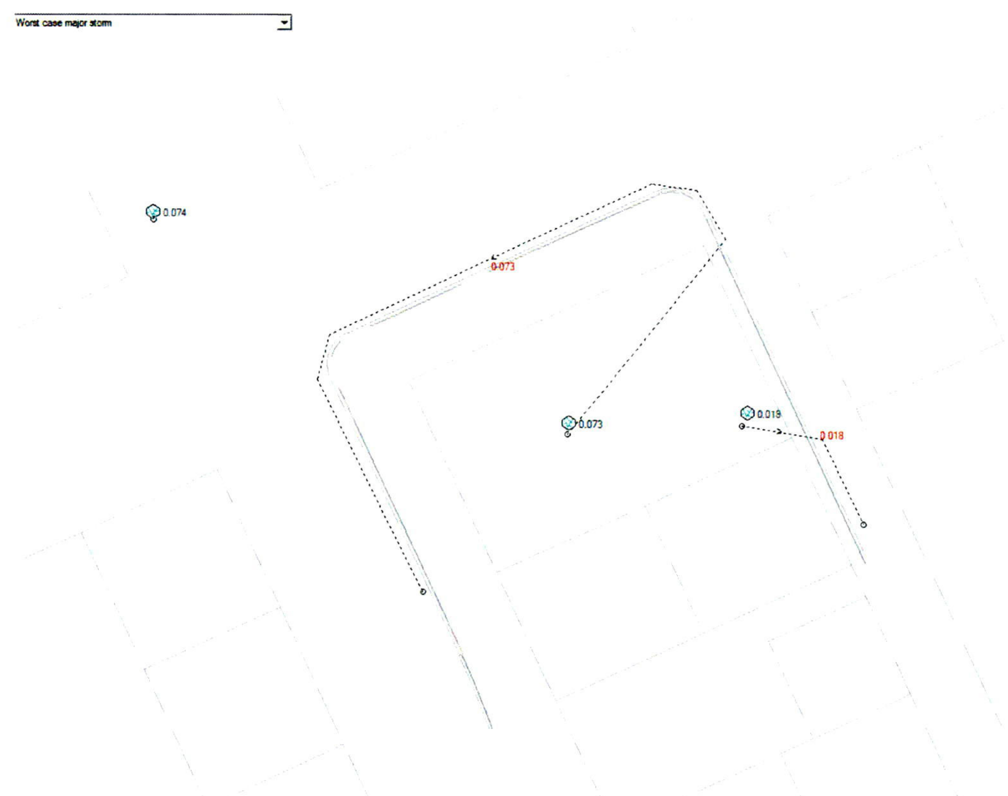
B.1 DRAINS Pre-Developed Model Schematic Layout



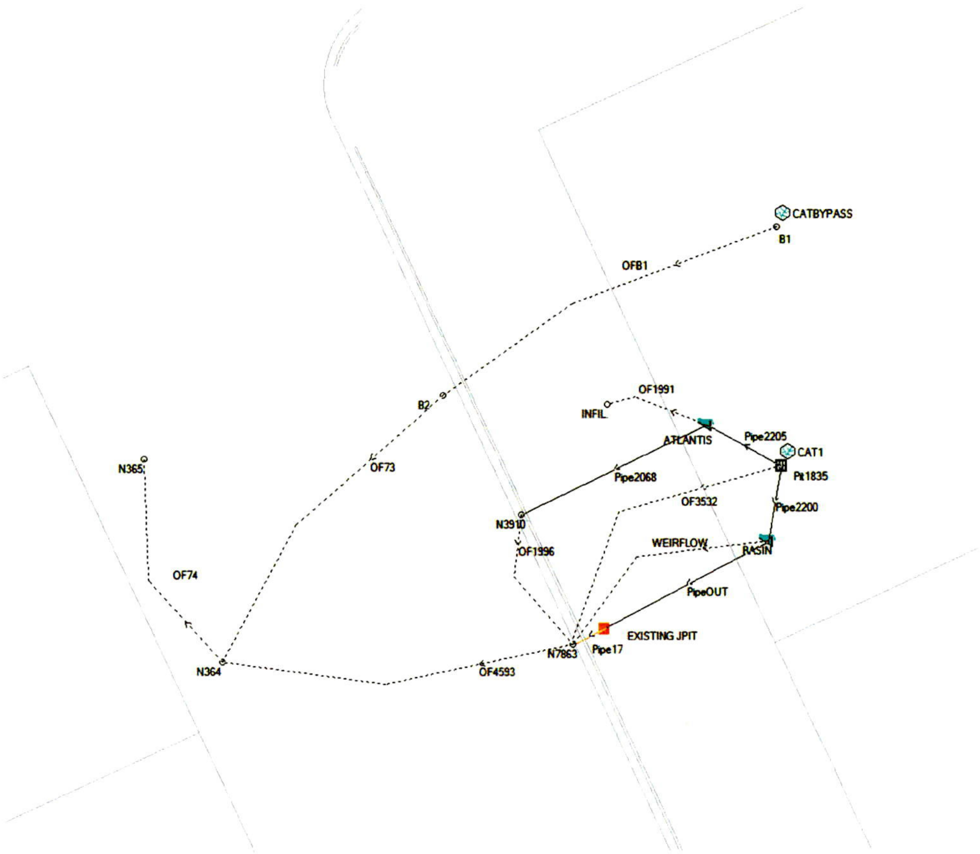
B.2 DRAINS Pre-Developed Model Schematic Layout (Q_5 Peak Flows)



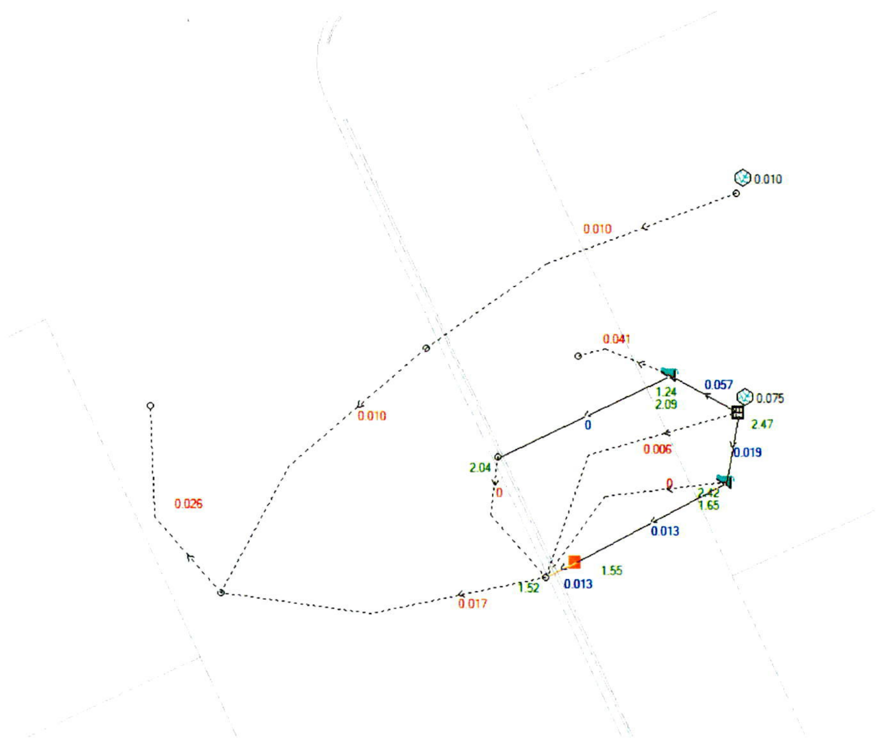
B.3 DRAINS Pre-Developed Model Schematic Layout (Q_{100} Peak Flows)



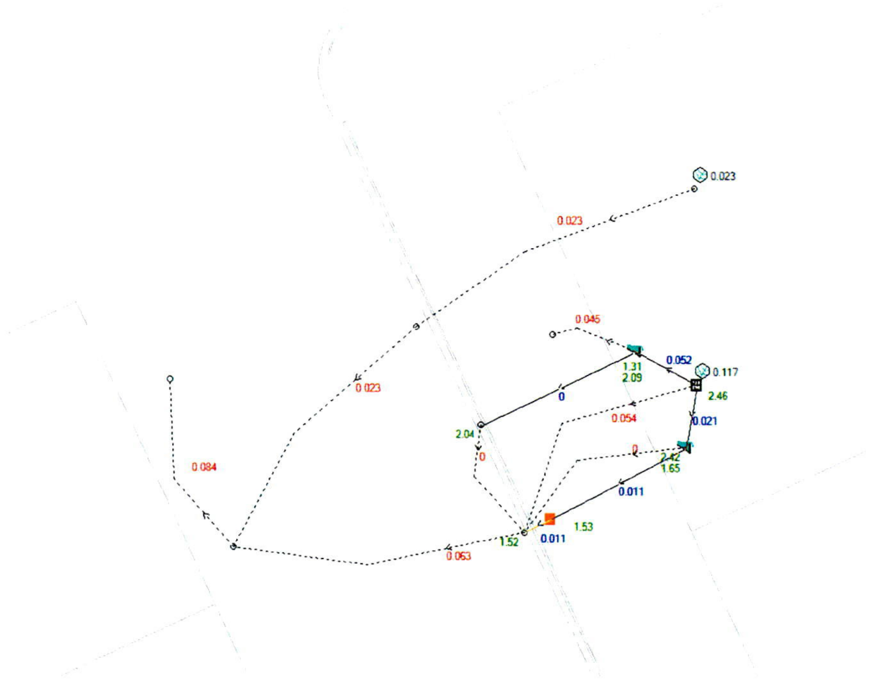
B.4 DRAINS Post-Developed Model Schematic Layout



B.5 DRAINS Post-Developed Model Schematic Layout (Q_5 Peak Flows)

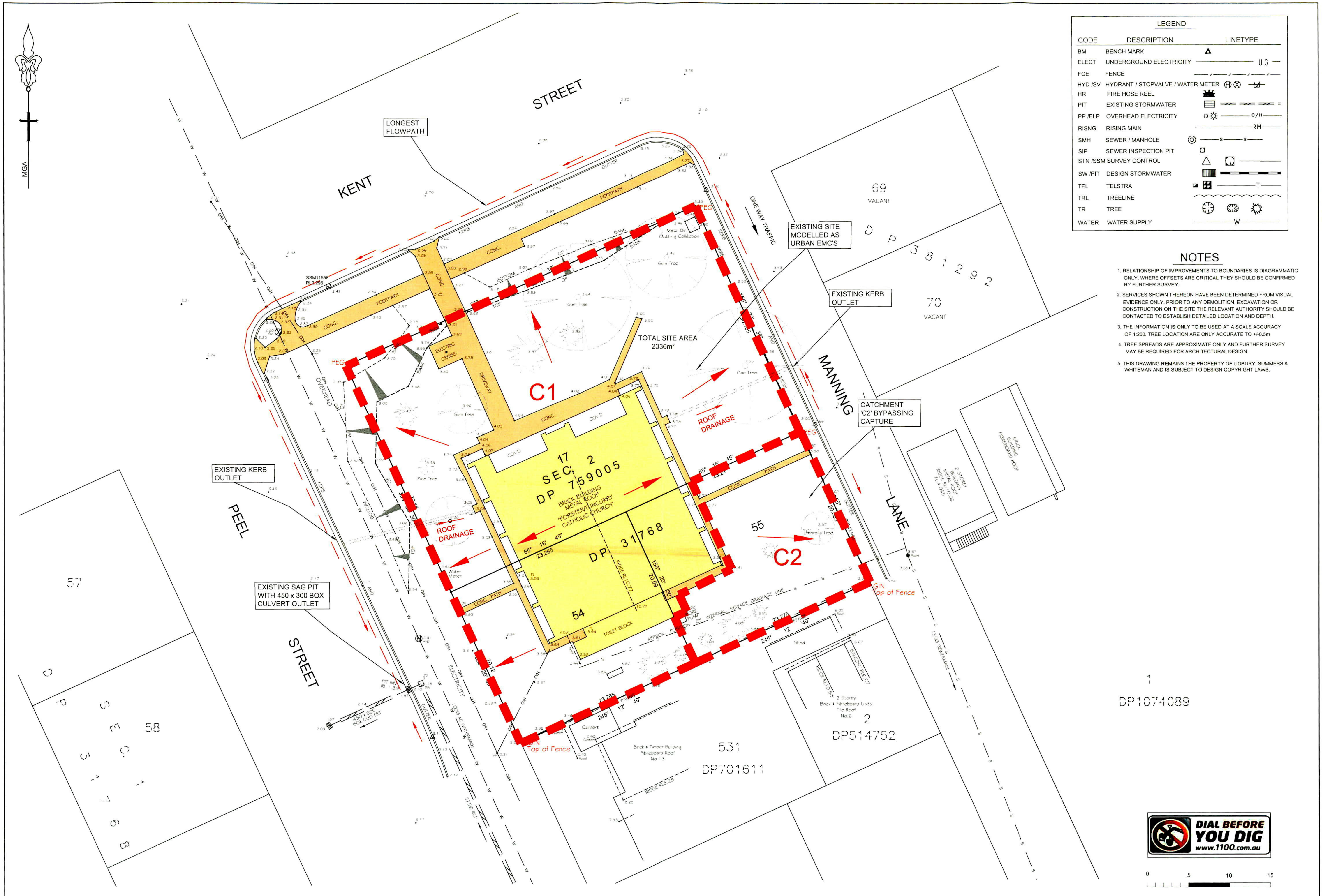


B.6 DRAINS Post-Developed Model Schematic Layout (Q_{100} Peak Flows 50% Blockage)



C.1 Pre-Developed Catchment Plan

C.2 Water Sensitive Design Strategy Plan



LEGEND

CODE	DESCRIPTION	LINETYPE
BM	BENCH MARK	
ELECT	UNDERGROUND ELECTRICITY	UG
FCE	FENCE	
HYD /SV	HYDRANT / STOPVALVE / WATER METER	
HR	FIRE HOSE REEL	
PIT	EXISTING STORMWATER	
PP /ELP	OVERHEAD ELECTRICITY	O/H
RISNG	RISING MAIN	RM
SMH	SEWER / MANHOLE	S
SIP	SEWER INSPECTION PIT	
STN /SSM	SURVEY CONTROL	
SW /PIT	DESIGN STORMWATER	
TEL	TELSTRA	T
TRL	TREELINE	
TR	TREE	
WATER	WATER SUPPLY	W

NOTES

1. RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY. WHERE OFFSETS ARE CRITICAL THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.
2. SERVICES SHOWN THEREON HAVE BEEN DETERMINED FROM VISUAL EVIDENCE ONLY. PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE THE RELEVANT AUTHORITY SHOULD BE CONTACTED TO ESTABLISH DETAILED LOCATION AND DEPTH.
3. THE INFORMATION IS ONLY TO BE USED AT A SCALE ACCURACY OF 1:200. TREE LOCATION ARE ONLY ACCURATE TO +/-0.5m
4. TREE SPREADS ARE APPROXIMATE ONLY AND FURTHER SURVEY MAY BE REQUIRED FOR ARCHITECTURAL DESIGN.
5. THIS DRAWING REMAINS THE PROPERTY OF LIDBURY, SUMMERS & WHITEMAN AND IS SUBJECT TO DESIGN COPYRIGHT LAWS.

DIAL BEFORE YOU DIG www.1100.com.au

0 5 10 15

NOTE: The contractor shall check and verify all works on site (including works by others) before commencing any works. All discrepancies are to be reported to the Project Manager or Lidbury, Summers & Whiteman prior to commencing work. Do not scale dimensions from the plan. All dimensions to be confirmed by dimensions from the plan. All dimensions to be confirmed by Lidbury, Summers & Whiteman.

HORIZONTAL
CO-ORDINATE SYSTEM: MGA LOCAL
MARKS ADOPTED: SSM 11558
EAST: 452761.687 NORTH: 6439854.968

PLOT FILE/DWG No.: F:\D7893\7893 Detail.dwg

VERTICAL
DATUM: AHD
BENCHMARK: SSM 11558
R.L.: 2.296

DRAWN/CHECKED: SH

PROJECT

PRE-DEVELOPED CATCHMENT PLAN
LOT 17 SEC 2 DP759005 & LOTS 54 & 55 DP31768
CNR KENT STREET & PEEL STREET
TUNCURRY

LS&W LIDBURY, SUMMERS & WHITEMAN
CONSULTING SURVEYORS, PLANNERS & ENGINEERS
INCORPORATING DEGOTARDI, SMITH & PARTNERS (FORSTER)
1st FLOOR, 3 WHARF ST. FORSTER 2428 (02) 65547988 FAX (02) 65549378
PO BOX 510 FORSTER NSW 2428 EMAIL consult@lswsurveyors.com.au WEBSITE www.lswsurveyors.com.au

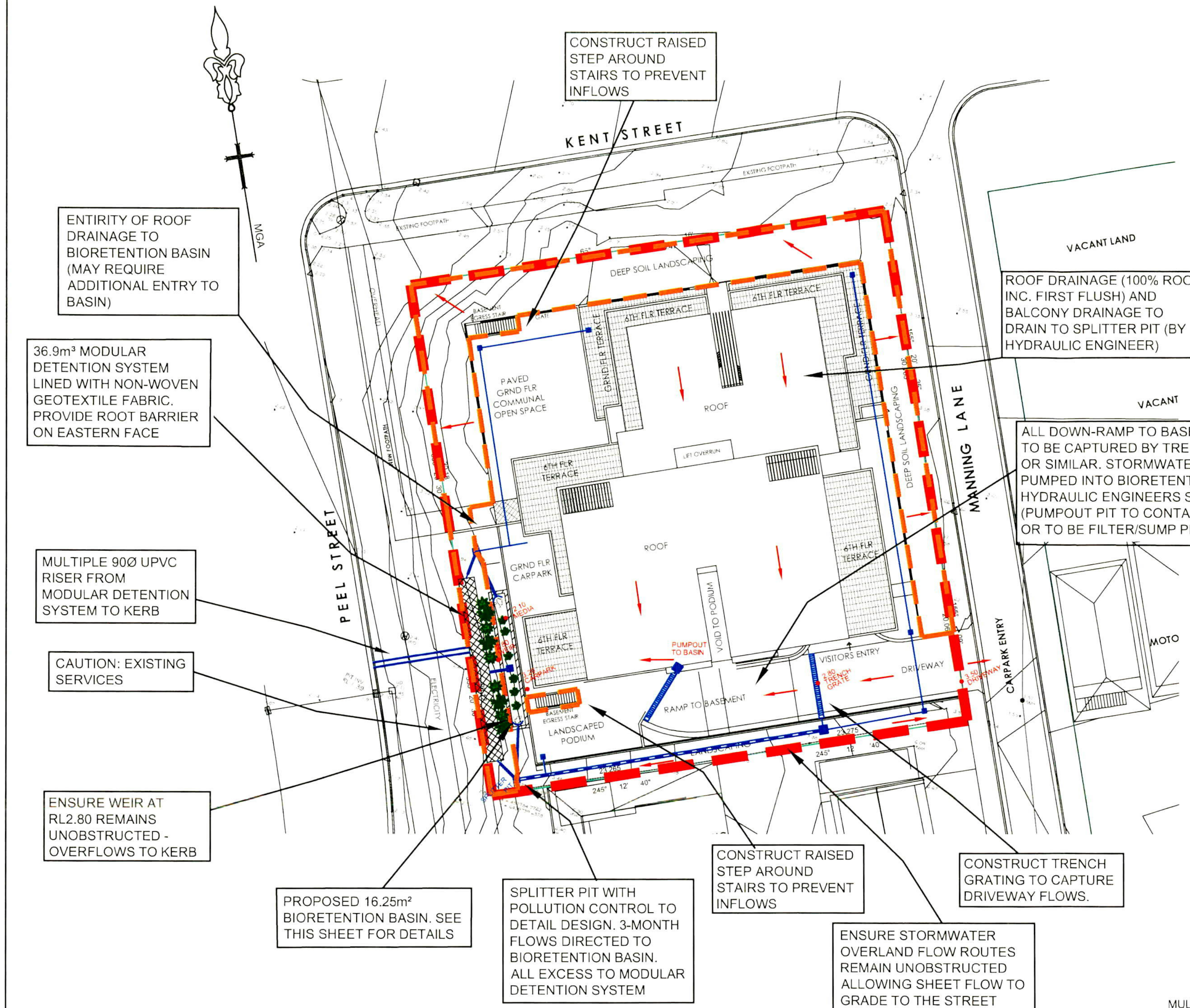
SCALES
HORIZONTAL: 1:200 @A1
VERTICAL: N/A
SHEET SIZE: A1

FIELD SHEETS
Date of survey: 12/01/2017

COUNCIL: MID-COAST
DA NUMBER:
DATE: 25/01/2017

SHEET 1 OF 1
FILE No.: 7893

ISSUE	DATE	COMMENTS
A	30/05/17	FIRST ISSUE



- DENOTES CATCHMENT BOUNDARIES
- DENOTES CATCHMENT BYPASSING BIORETENTION TREATMENT
- 3.13 DENOTES DRIVEWAY FINISHED SURFACE LEVELS
- DENOTES GSIP WITH 'ENVIROPOD' PIT INSERT/OR FILTER/SUMP PIT

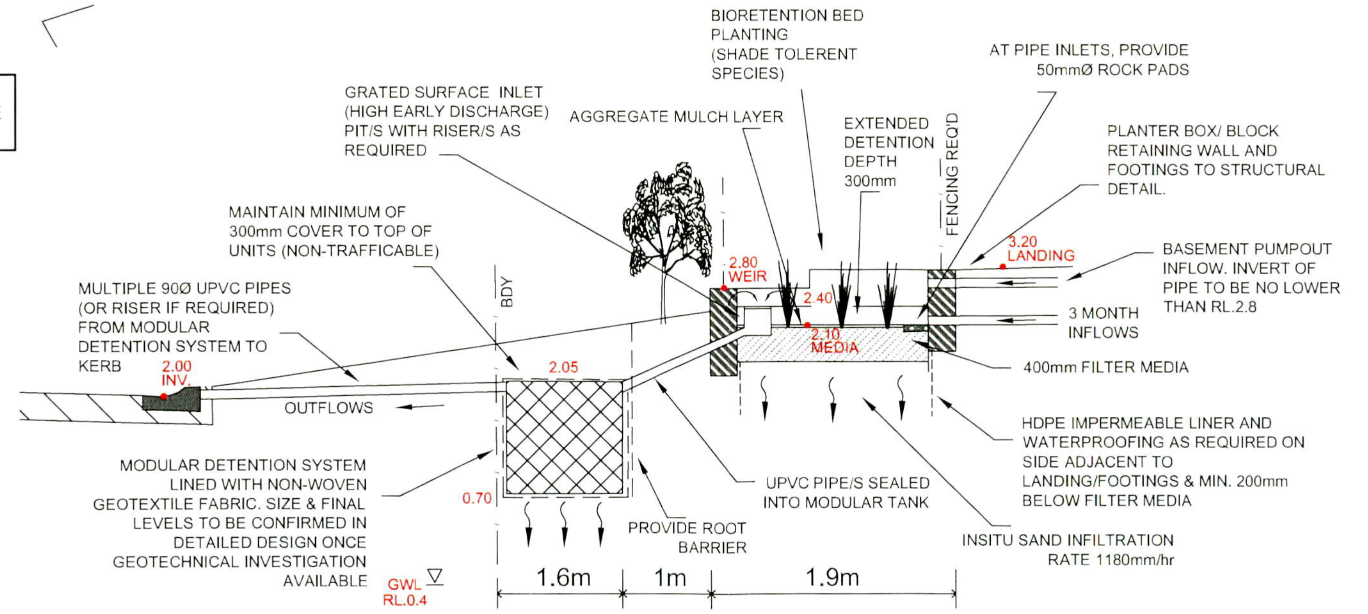
0 5 10 15

SCALE 1:500 AT A3

PRELIMINARY
SUBJECT TO APPROVAL, FINAL SURVEY AND DESIGN

NOTES

1. RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY. WHERE OFFSETS ARE CRITICAL THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.
2. CONTOURS SHOWN DEPICT THE TOPOGRAPHY EXCEPT AT SPOT LEVELS SHOWN. CONTOURS DO NOT REPRESENT THE EXACT LEVEL AT ANY PARTICULAR POINT.
3. SERVICES SHOWN THEREON HAVE BEEN DETERMINED FROM VISUAL EVIDENCE ONLY. PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE THE RELEVANT AUTHORITY SHOULD BE CONTACTED TO ESTABLISH DETAILED LOCATION AND DEPTH.
4. THE INFORMATION IS ONLY TO BE USED AT A SCALE ACCURACY OF 1:500.
5. BEARING AND DISTANCES ARE BY TITLE AND/OR DEED ONLY. NO BOUNDARY INVESTIGATION HAS BEEN CARRIED OUT.
6. THIS DRAWING REMAINS THE PROPERTY OF LIDBURY, SUMMERS & WHITEMAN AND IS SUBJECT TO DESIGN COPYRIGHT LAWS.



TYPICAL BIORETENTION BASIN & OSD DETAIL
Not to Scale

SCALES: H. 1: 200 @ A3 V.	DATUM: AHD	WATER SENSITIVE DESIGN STRATEGY LOT 17 SEC 2 DP759005 & LOTS 54 & 55 DP31768 CNR KENT STREET & PEEL STREET TUNCURRY	LS&W LIDBURY, SUMMERS & WHITEMAN CONSULTING SURVEYORS, PLANNERS & ENGINEERS INCORPORATING DEGOTARDI, SMITH & PARTNERS (FORSTER)	L.G.A. MID-COAST	SHEET No.: 1 of 1
DWG No.: F:\D7893\7893 WSD STRATEGY.DWG	DRAWN: SH/PJL		1st FLOOR, 3 WHARF ST, FORSTER 2428 (02) 65547988 FAX (02) 65549378 PO BOX 510 FORSTER NSW 2428 EMAIL consult@lswsurveyors.com.au WEBSITE www.lswsurveyors.com.au	DATE: 08/06/2017	FILE No.: 7893