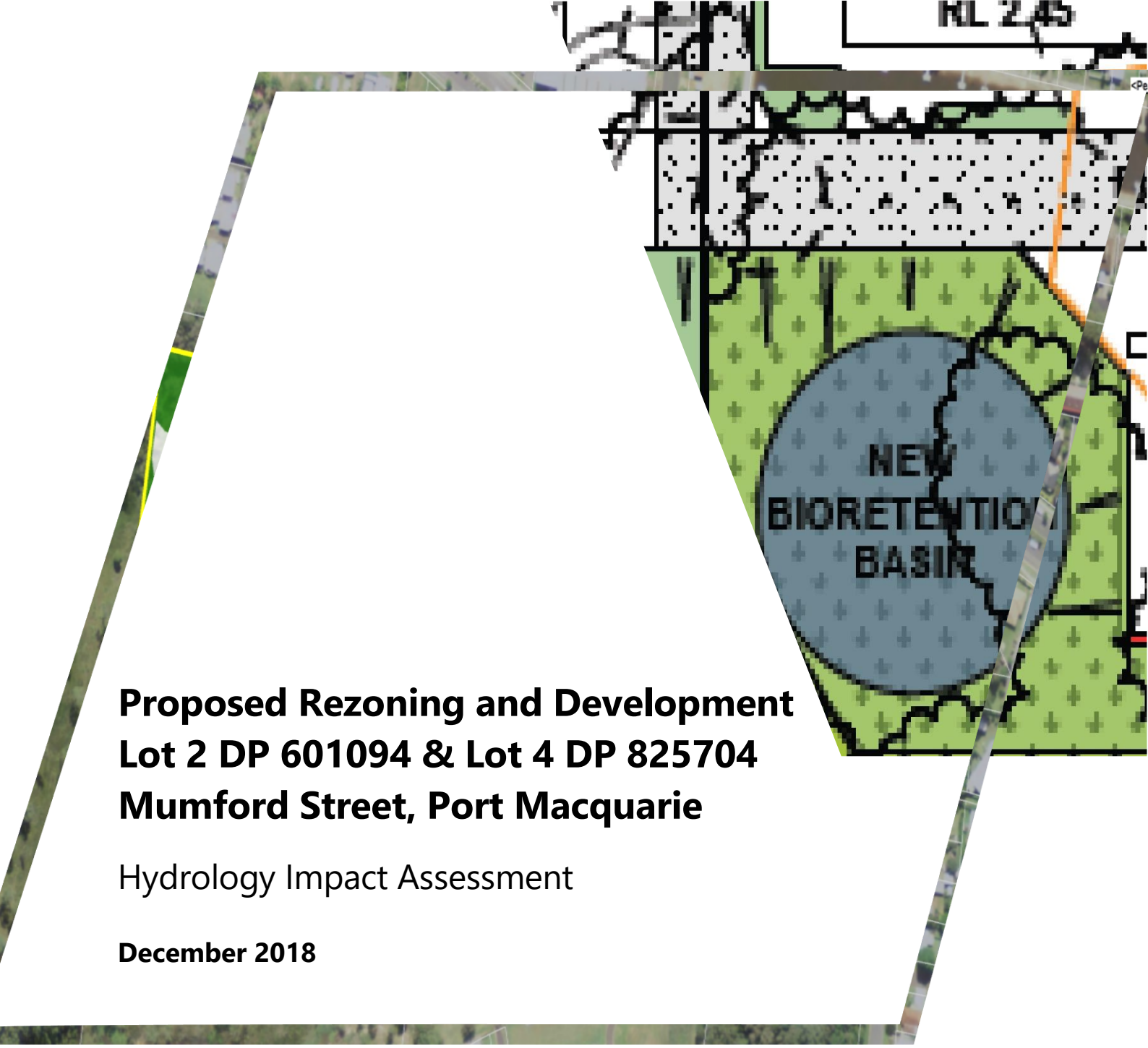

Proposed Rezoning and Development Lot 2 DP 601094 & Lot 4 DP 825704 Mumford Street, Port Macquarie

Hydrology Impact Assessment

December 2018

Level 17, 141 Walker St
North Sydney NSW 2060
Australia

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Revision B

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Project: Proposed Rezoning and Development of Lot 2 DP 601094 & Lot 4 DP 825704, Mumford Street, Port Macquarie
Hydrology Impact Assessment

Rev	Description	Author	Review	Advisian Approval	Date
A	**Draft Report**	AJD	CRT		18/12/2018
B	**Final Draft Report**	AJD	CRT		19/12/2018

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Appendices

1. INTRODUCTION

East Coast Screw Piers Pty Ltd plans to rezone and develop Lot 2 DP 601094 and Lot 4 DP 825704 at Mumford Street, Port Macquarie. Lot 2 is currently operated as a Christian Outreach Centre (*also referred to as the Gantons Pty Ltd site*) while Lot 4 is the Heritage Christian School. The location of the site is shown in **Figure 1**.

The proposal will see the capacity of the Heritage Christian School (*Lot 4*) increase through the construction of additional buildings which will serve as classrooms and administration buildings, as well as an additional car parking facility. Lot 2 will be redeveloped to become an automotive workshop and detailing business. The change will involve construction of additional buildings to act as workshops and spray facilities, as well as spaces for parking and vehicle storage. Details of the proposal for redevelopment of the site including filling details, are included within **Appendix A**.

An application for rezoning of the site is currently being assessed by Port Macquarie-Hastings Council. However, since submission of the rezoning application, the *State Environmental Planning Policy (Coastal Management) 2018* has come into effect. The Coastal Management SEPP requires consideration of the potential for development to significantly impact on the hydrology of adjacent coastal wetlands. As the proposed development site is located upstream of a coastal wetland, there is a need to understand the potential for the proposed development to impact on the hydrology of the area and the wetland.

This report and the associated investigations have been undertaken to determine the potential for the proposed development to impact on the hydrology of the wetland, including the water quantity and quality.

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Project
Proposed Development of Lot 2 DP 601094 and Lot 4 DP 825704, Mumford St, Port Macquarie

Consultant
Advisian

Client
East Coast Screw Piers

Title
Hydrologic Assessment
Location of the Subject Site

Figure No.
1

Date
December 2018

2. DESIGN REQUIREMENTS

Clause 11(1)(b) of *State Environmental Planning Policy (Coastal Management) 2018*, requires that the proposed development must not significantly impact on *"the quantity and quality of surface and groundwater flows to and from an adjacent wetland or littoral rainforest"*.

The following is noted in Port Macquarie-Hastings Council's Development Design Specification entitled *D7 Stormwater Management* and dated February 2004.

- **Section D7.05 Design Requirements Clause 1**

  Works to capture pollutants from stormwater runoff shall be designed to accommodate a design storm equivalent to a 3 month ARI storm event (for calculation purposes 40% of the 1 in 100 year ARI storm event is to be adopted).

- **Section D7.10 Stormwater Runoff Clause 3**

  Detention facilities shall be designed to attenuate the change in peak flow rate due to a change in landuse within a catchment to a level equal to the pre developed flow rate.

- **Section D7.11 Water Quality Clause 6**

  High risk developments are classified according to the following criteria. Any development or development proposal:
  b. located within the catchment of a wetland area.

- **Section D7.11 Water Quality Clause 7**

  The long-term water quality sustainability of a high-risk development shall be based on viable protection levels of aquatic ecosystems. The classification of protection levels of aquatic ecosystems is defined as:

  *a. Pristine ecosystem or **unmodified ecosystem**, having high conservation values and 'protection' status.*

  *b. Slightly to moderately **modified ecosystem**, where the ecosystem is largely intact (habitats, limited catchment clearing) such that some 'restoration' of the original values is viable.*

  *c. **Highly modified ecosystem**, where the original ecosystem is so disturbed that it cannot be restored to a slightly to moderately disturbed condition but is capable of sustaining some ecological and conservation values with appropriate 'management'.*

- **Section D7.11 Water Quality Clauses 10, 11 and 12**

  Ecosystem median pollutant levels shall be below those indicated in Tables D7.4 to D7.6 (of the specification). Of the receiving water classifications presented in the tables Lowland Stream is the most applicable.

  Table 1 lists the median pollutant levels for Lowland Streams as presented in the abovementioned tables for unmodified, modified and highly modified ecosystems.

Table 1 Median Pollutant Levels for Lowland Streams

Ecosystem Type	Total Phosphorus (TP) (g/L)	Total Nitrogen (TN) (g/L)	Dissolved Oxygen (%) Sr	pH	Suspended Solids (mg/L)
Unmodified	10 -20	100 - 250	80 – 90	6.5 – 7.5	50
Modified	50	500	85 – 110	6.5 - 8	50
Highly Modified	60	620	75 – 110	6.2 – 8.6	62

- **Section D7.11 Water Quality Clause 13**

  In addition to the aforementioned median pollutant levels, any stormwater treatments shall be designed to meet the minimum level of pollutant load objectives in accordance with Table D7.7 (of the specification).

  The pollutant load objectives are listed in **Table 2**.

Table 2 Council's Stormwater Treatment Pollutant Loads

Pollutant	Objective
Total Suspended Solids (TSS)	80% retention of average annual load
Total Phosphorus (TP)	45% retention of average annual load
Total Nitrogen (TN)	45% retention of average annual load
Litter	100% retention of litter greater than 5 mm for flows up to the 3 month ARI peak flow
Sediment	100% retention of sediment greater than 0.125 mm for flows up to the 3 month ARI peak flow
Oil & Grease	No visible oils for flows up to the 3 month ARI peak flow

Note: ARI = average recurrence interval

3. SITE CONSTRAINTS

The key site constraint that is relevant to this hydrology impact assessment is that the proposed stormwater management measures will need to discharge to an existing drainage flow path on the southern side of the lots.

Ground surface elevations have been estimated using Light Detection and Ranging (*LiDAR*) survey obtained via Geoscience Australia's ELVIS portal. The LiDAR information is considered to provide the most reliable contemporary description of the variation in topography across the Port Macquarie-Hastings Council local government area. During future design phases of the project a detailed survey should be undertaken to confirm the surface levels at the proposed discharge point from the proposed stormwater management system.

4. PROPOSED STORMWATER MANAGEMENT SYSTEM

It is proposed that a combined bioretention / detention basin be used to manage stormwater at the sites. The proposed arrangement is shown in **Figure 2** and an indicative section through the basin is provided in **Figure 3**.

4.1 Concept for Stormwater Detention

The pre-development and post-development runoff conditions were modelled using the DRAINS hydraulic modelling software in order to determine the size and configuration of the required stormwater detention basin.

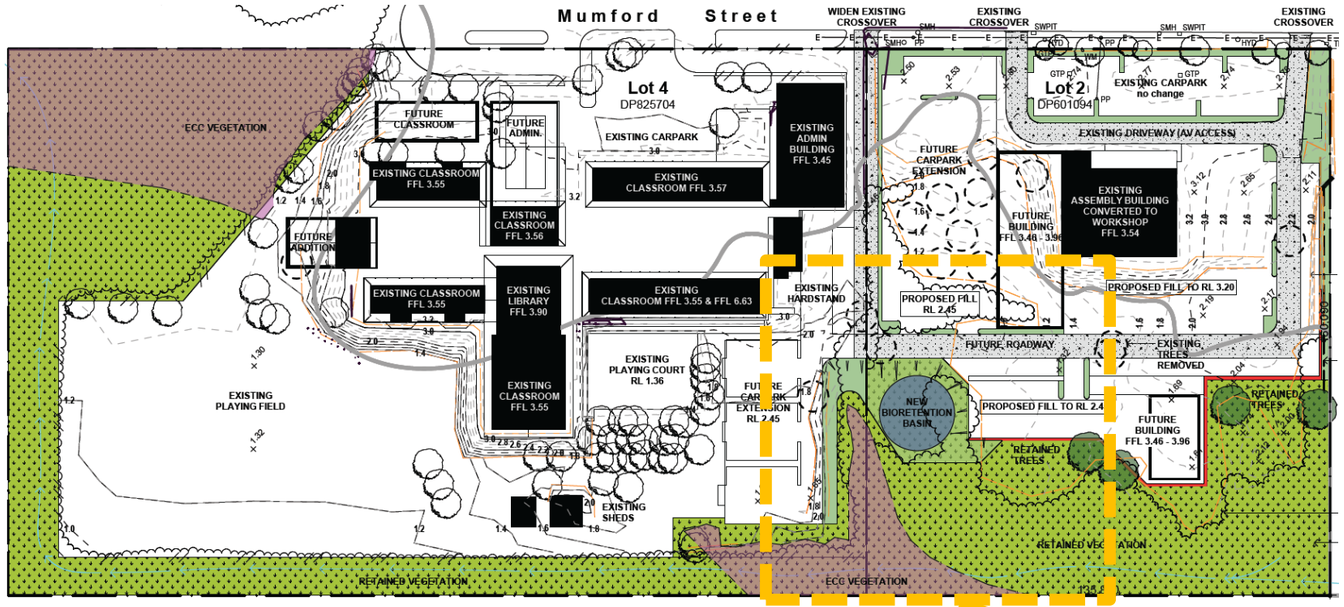
4.1.1 Model Setup

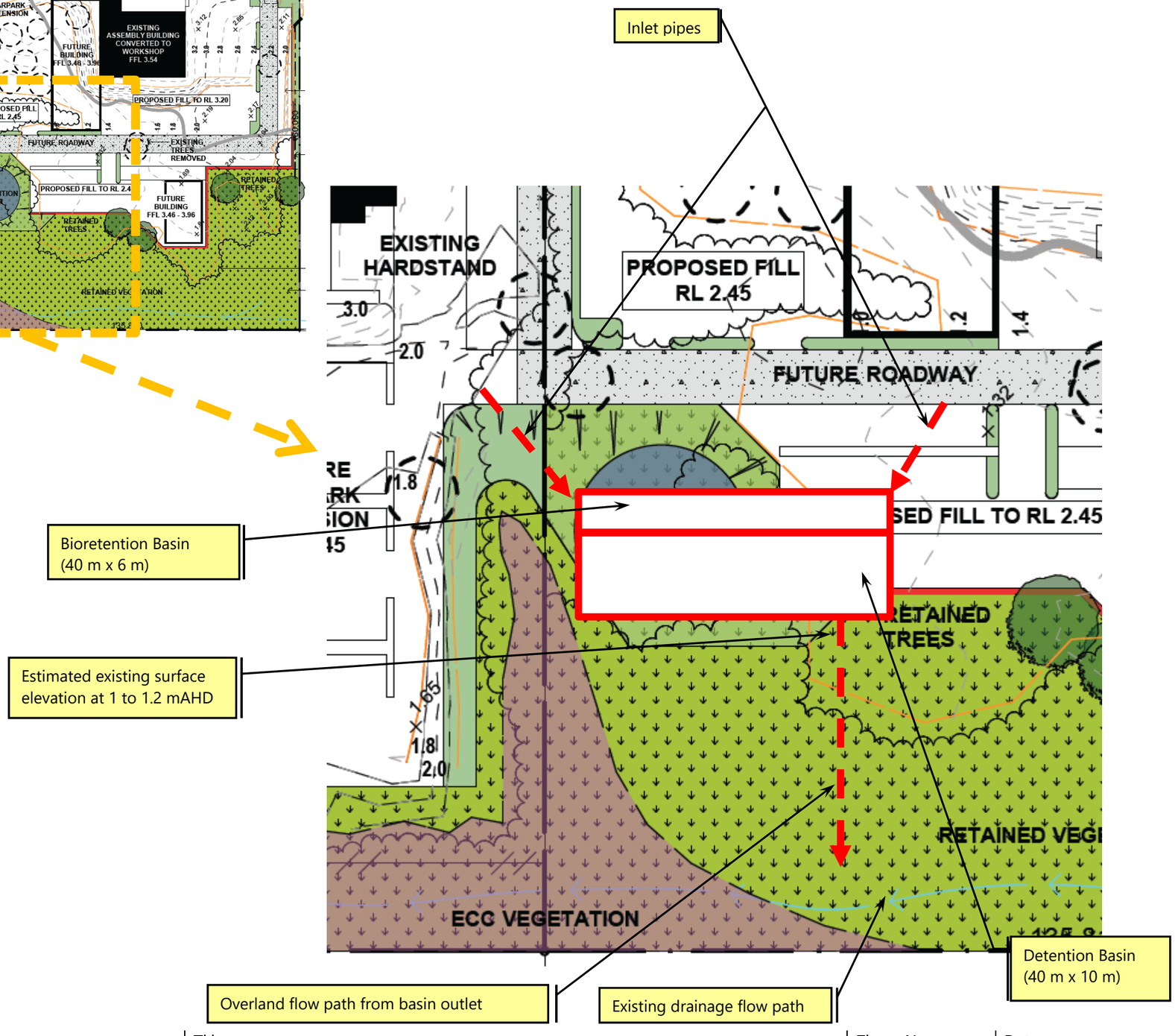
A summary of the data that were input into the DRAINS model is as follows.

- Rainfall Intensity–Frequency–Duration (*IFD*) data was sourced from the Bureau of Meteorology website (BOM, 2017). The latitude and longitude of the proposed development was input into the online ARR 2016 IFD data generator to obtain the applicable data.
- The details of the modelled pre and post development catchments are presented in **Table 3**. All areas draining to the basin in both the pre and post development scenarios have been modelled. Of the areas that are not draining to the basin only those areas where the land use has changed have been modelled.
- At the proposed discharge point from the basin, the ground surface elevation is estimated to be between 1 and 1.2 mAHD based on the available LiDAR information. Due to the uncertainty with the ground surface elevations on the downstream side of the basin it has been assumed that at the discharge point the ground surface elevation is 1 mAHD (*refer* **Section 3**) and therefore the basin floor is at 1 mAHD. Note, a DRAINS model was also developed whereby the surface elevations on the downstream side of the basin were assumed to be at 1.2 mAHD. Comments relating to this alternate model are included in the commentary that follows.

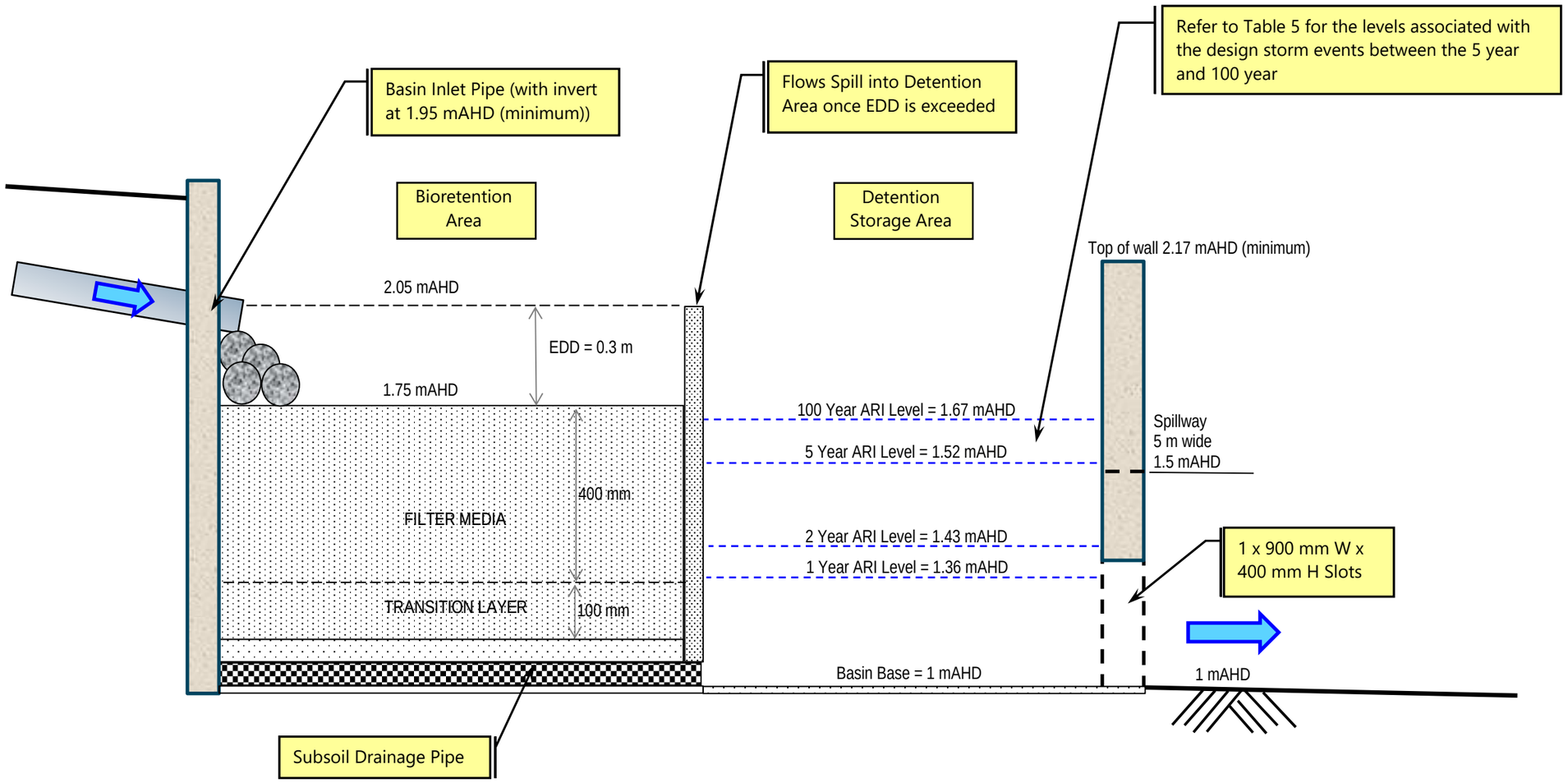
Table 3 DRAINS Model Catchment Details

Catchment No.	Catchment Label in DRAINS Model	Area (ha)	Imperviousness (%)
Pre-Development			
1	SCHOOL (not via basin)	0.118	100
2	SCHOOL (via basin)	0.376	62
3	GANTONS	1.587	74
Post-Development			
1	SCHOOL (not via basin)	0.118	100
2	SCHOOL (via basin)	0.376	0
3	GANTONS	1.587	0





Project Proposed Development of Lot 2 DP 601094 and Lot 4 DP 825704, Mumford St, Port Macquarie Consultant Advisian	Client East Coast Screw Piers Pty Ltd	Title Hydrologic Assessment **Detention / Bioretention Basin Indicative General Arrangement**	Figure No. 2	Date December 2018



Note: *Not to scale*

Project Proposed Development of Lot 2 DP 601094 and Lot 4 DP 825704, Mumford St, Port Macquarie Consultant Advisian	Client East Coast Screw Piers	Title Hydrologic Assessment **Detention / Bioretention Basin Indicative Section**	Figure No. 3	Date December 2018

4.1.2 Simulation of Detention Basin

Several iterations of the DRAINS modelling were completed to determine suitable design features and parameters for the proposed detention basin.

Inflows to the basin will first enter the bioretention system (*refer* **Section 4.2**). The bioretention area will cover nearly 40% of the floor area of the basin. Once the Extended Detention Depth (*EDD*) has been exceeded *(i.e., the capacity of the bioretention system is exceeded*), flows will overtop into the detention storage area of the basin.

During the 1 year average recurrence interval (*ARI*) storm event the discharge from the basin will be controlled by a slot located in the base of the basin wall that has been sized to attenuate the peak flow during this event.

During larger events, discharge from the basin will be controlled by a spillway included in the wall of the basin. After passing through the slot or over the spillway, flows will continue overland across the lot and will meet with the existing drainage flow path on the southern side of Lot 2.

Localised scour protection works, such as rock rip rap, are to be installed immediately downstream of the discharge point from the basin to prevent downstream scour and erosion.

The details of the basin are summarised in **Table 4**.

4.1.3 Model Results

The pre-development flows discharging from the site and the post-development peak flows from the proposed detention basin are listed in **Table 5**. This table also includes the peak detention basin water level for each storm event as determined using DRAINS.

As shown in **Table 5**, the post-development peak flows do not exceed the pre-development peak flows. The outlet discharge arrangement has been adjusted to minimise the difference between the pre- and post-development flows and therefore minimise the impact on the downstream wetlands.

If the basin floor is positioned at 1.2 mAHD, the peak flows are similar to those presented in **Table 5**. However, the peak water levels in the basin are approximately 200 mm higher than the levels in **Table 5**. This correlates with the slot and spillway also being 200 mm higher than the basin when the floor is at 1 mAHD.

To ensure that stormwater can be conveyed both to and from the basin a combination of both surface drains and pipes should be used across the site so that the basin ties in with the surrounding surface levels.

Table 4 Stormwater Detention Basin Details

Parameter	Value	Comments
Base Length	40 m	
Base Width	16 m	
Area – Total	640 m^2	
Bioretention Area		***In the area vertically above the extended detention depth (EDD) of the bioretention system, detention volume is available. However due to the level constraints at the site this area will not be used.***
Area	240 m^2	Refer to **Section 4.2** for further details about the proposed bioretention system.
Top of extended detention depth RL (*also level of overflow weir between bioretention area and detention area*)	2.05 mAHD	Refer Note 1. An EDD of 300mm is required for the quality control measure.
Base of extended detention depth	1.75 mAHD	
Minimum incoming pipe invert level	1.95 mAHD	The incoming pipes must connect with the basin a minimum of 200 mm above the surface level of the top of the bioretention media. The Water by Design *Bioretention Technical Design Guidelines* (2014) indicate that this is required to minimise sediment build up within the incoming pipes.
Detention Only Area		
Area	400 m^2	
Floor RL	1 mAHD	
Low flow outlet	1 mAHD	One 900 mm W x 400 mm H rectangular slot
Spillway RL	1.5 mAHD	
Spillway length	5 m	100 year ARI capacity
Crest level of basin (minimum)	2.17 mAHD	Assuming a minimum of 500 mm freeboard above the 100 year ARI peak water level in the basin

*Note 1: The basin will operate as both a quantity and quality control measure. Further details about quality control are provided in **Section 4.2**. Storage is required in the basin to assist with the quality aspect of the basin (referred to as extended detention depth). This storage (i.e., the volume associated with the EDD) has not been included in the quantity related investigations.*

Table 5 DRAINS Model Results

Design Storm Event (ARI) (years)	Pre-Development Peak Flow (m^3/s)	Post-Development Peak Flow (with effect of basin) (m^3/s)	Peak Water Level Basin (mAHD)
1	0.353	0.345	1.36
2	0.506	0.450	1.43
5	0.679	0.568	1.52
9.49	0.885	0.786	1.58
20	1.05	0.978	1.61
50	1.21	1.15	1.64
100	1.40	1.30	1.67

4.2 Concept for Stormwater Treatment

The software package called *Model for Urban Stormwater Improvement Conceptualisation* (*MUSIC*) was used to determine the size and configuration of the required bioretention basin.

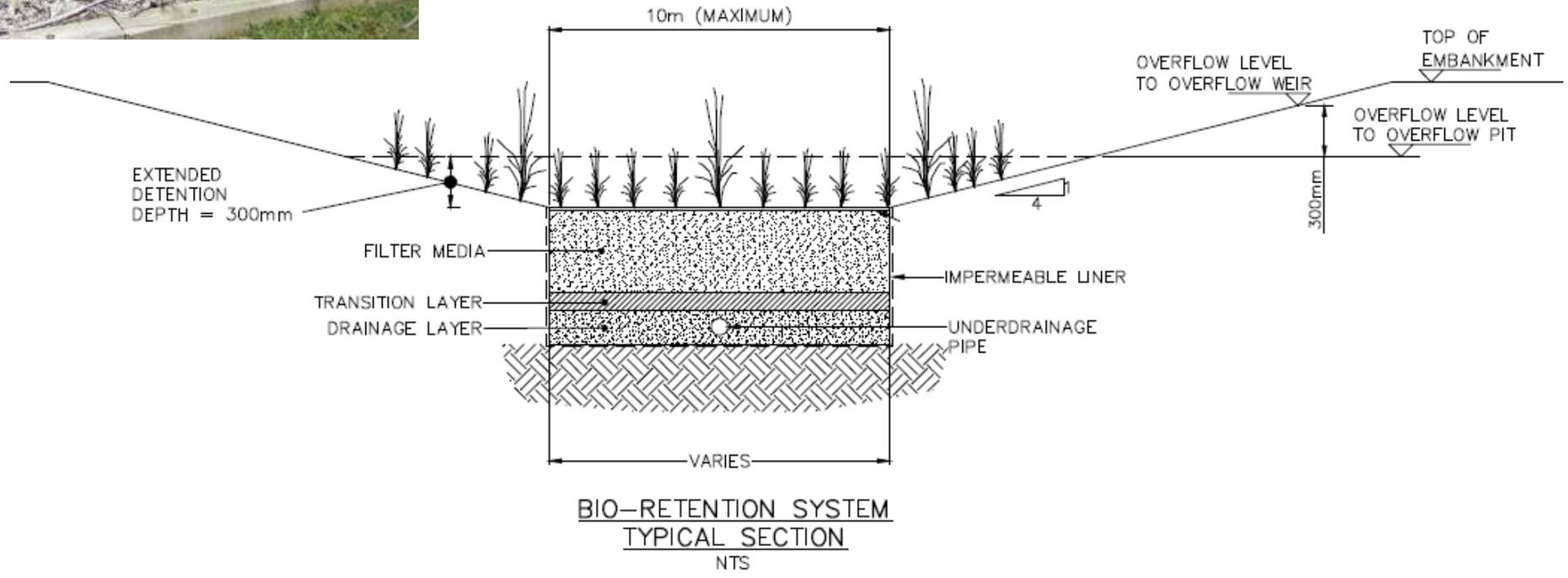
The function of a bioretention basin is to filter stormwater runoff via a densely vegetated layer and sand and loam filter media. As the water moves through the system pollutants are captured by filtration, adsorption and biological processing. Bioretention systems are effective at removing litter, fine sediment, phosphorus, nitrogen, metals and hydrocarbons from stormwater. The treated water discharges to groundwater or is conveyed via subsoil pipes to a downstream drainage system or receiving water.

An example of a typical bioretention basin and a typical section through a basin is shown in **Figure 4**.

4.2.1 Model Setup

A summary of the data that were input into the MUSIC model is outlined in the following.

- Six-minute rainfall data and potential evapotranspiration (*PET*) data for the period from September 1952 to December 1973 were obtained from the Port Macquarie DMR (*Station no. 060076*) rain gauge and used in the model. This data was sourced using the online eWater *Pluviograph Rainfall Data Tool* (2018). This tool provides access to rainfall data from stations all over Australia that is compatible with MUSIC models.
- The areas, percent imperviousness and rainfall threshold rates that have been adopted for the modelled stormwater sources are listed in **Table 6**. The rainfall threshold values have been adopted from the NSW MUSIC Modelling Guidelines (2015).
- To assess whether Council's post-development pollution reduction targets are met (*refer* **Section 2** *for additional background information*) of the areas that are not draining to the basin only those where the land use is changing have been modelled. This is because this assessment is based on comparing post-development loads with and without treatment measures for stormwater. The pollutant loads are not changing from the areas where the land use is not changing and therefore these areas have been excluded from the assessment.



BIO–RETENTION SYSTEM
TYPICAL SECTION
NTS

Project	Client	Title	Figure No.	Date
Proposed Development of Lot 2 DP 601094 and Lot 4 DP 825704, Mumford St, Port Macquarie	East Coast Screw Piers	Hydrologic Assessment Bioretention Basin – Typical Section	4	December 2018

Consultant
Advisian
WorleyParsons Group

- Whereas, to assess whether Council's concentration targets (*maximum allowed*) for ecosystems (*refer* **Section 2** *for additional background information*) are met, all areas have been modelled as the targets need to be compared with what is ultimately being discharged from the site.
- The pervious area and groundwater properties for medium clay conditions were adopted in the MUSIC model. The values presented in the NSW MUSIC Modelling Guidelines (2015) were adopted. A sensitivity analysis was undertaken to determine the impact of any variability in soil type. This established that a change in soil type did not significantly impact the results.
- The Pollutant Event Mean Concentrations (*EMCs*) for base flow and storm flow scenarios were adopted from the NSW MUSIC Modelling Guidelines by BMT WBM (2015).

4.2.2 Simulation of Bioretention Basin

Several iterations of the MUSIC modelling were completed to determine suitable design features and parameters for the proposed bioretention basin. The details of the bioretention basin are summarised in **Table 7**.

Table 6 MUSIC Catchment Details

Catchment Number	Catchment Label in MUSIC Model	Land Use	Area (ha)	Imperv-iousness (%)	Rainfall Threshold (mm/day)
Pre-Development					
1	SCHOOL Buildings / Sheds	Roofs	0.532	100	0.3
2	SCHOOL Playing Field and Surrounds	Rural	1.39	35	1
3	SCHOOL Carpark / Road (Existing Northern)	Sealed road pavement	0.3	85	1.5
4	SCHOOL Carpark / Road (Existing Hardstand)	Sealed road pavement	0.097	85	1.5
5	SCHOOL Playing Court	Sealed road pavement	0.096	95	1.5
6	SCHOOL Open Space	Rural	0.48	35	1
7	GANTONS Buildings / Sheds	Roofs	0.103	100	0.3
8	GANTONS Carpark / Road	Sealed road pavement	0.308	85	1.5
9	GANTONS Open Space	Rural	1.176	35	1
10	Retained Vegetation	Forest	1.84	20	1
Post-Development					
1	SCHOOL Buildings / Sheds	Roofs	0.65	100	0.3
2	SCHOOL Playing Field and Surrounds	Rural	1.39	35	1
3	SCHOOL Carpark / Road (Existing Northern)	Sealed road pavement	0.3	85	1.5
4	SCHOOL Carpark / Road (Existing Hardstand)	Sealed road pavement	0.097	85	1.5
5	SCHOOL Future Carpark Extension	Sealed road pavement	0.161	85	1.5
6	SCHOOL Playing Court	Sealed road pavement	0.096	95	1.5
7	SCHOOL Open Space	Rural	0.201	35	1
8	GANTONS Buildings / Sheds	Roofs	0.241	100	0.3
9	GANTONS Carpark / Road	Sealed road pavement	1.346	85	1.5
10	Retained Vegetation	Forest	1.84	20	1

Table 7 Bioretention Basin Details

Parameter	Value	Comments
Inlet properties		
Low flow bypass	0	
High flow bypass	0.2	Assumed to be 40% of the 1 year ARI peak flow. Value obtained from the DRAINS model.
Storage properties		
Extended detention depth (EDD)	0.3 m	
Surface area	240 m^2	Vertical walls are proposed to surround the bioretention / detention basin and therefore the values adopted for the bioretention basin 'surface area' and 'filter area' are equal.
Filter and media properties		
Filter area	240 m^2	Vertical walls are proposed to surround the bioretention / detention basin and therefore the values adopted for the bioretention basin 'surface area' and 'filter area' are equal.
Unlined filter media perimeter	0.01 m	Nominally zero as basin is lined.
Saturated hydraulic conductivity	100 mm/hr	Value recommended in the *NSW MUSIC Modelling Guidelines* (BMT WBM, 2015)
Filter depth	0.4 m	
TN content of filter media	400 mg/kg	Value recommended in the *NSW MUSIC Modelling Guidelines* (BMT WBM, 2015)
Orthophosphate content of filter media	40 mg/kg	Value recommended in the *NSW MUSIC Modelling Guidelines* (BMT WBM, 2015)
Infiltration properties		
Exfiltration rate	0 mm/hr	The base of the bioretention system is lined
Lining Properties		
Is base lined?	Yes	
Vegetation properties		
Vegetated with effective nutrient removing plants	Yes	
Outlet properties		
Overflow weir length	40	
Underdrain present?	Yes	
Submerged zone with carbon present?	No	

4.2.3 Model Results

The results of the MUSIC simulations are summarised in **Table 8** and **Table 9** for pollutant loads and concentrations, respectively. In addition, **Table 9** lists the concentration targets (*maximum allowed*) for compliance with Council's Design Specification D7 Stormwater Management (2004) (*refer* **Section 2** *for additional background information*). Where the concentration achieved is less than the target the cell is highlighted green.

Table 8 Pollutant Loads – MUSIC Model Results

Parameter	Load (kg/yr)	
	Pre-Development	Post-Development
Total Suspended Solids (TSS)	2,150	735
Total Phosphorus (TP)	4.22	2.43
Total Nitrogen (TN)	28.1	20.8
Gross Pollutants	288	32.8

Table 9 Pollutant Concentrations – MUSIC Model Results and Council Targets

Parameter	Concentration (mg/L)				
	Achieved		Target (maximum)		
	Pre-Development	Post-Development	Unmodified Ecosystem	Modified Ecosystem	Highly Modified Ecosystem
Total Suspended Solids (TSS)	10.6	6.89	50	50	62
Total Phosphorus (TP)	0.038	0.047	0.01 – 0.02	0.05	0.06
Total Nitrogen (TN)	0.354	0.44	0.1 – 0.25	0.5	0.62

The aim is for post-development pollutant loads and concentrations to be kept as close as possible to the pre-development loads and concentrations, and thereby minimise the potential impact on the water quality of the downstream wetlands.

If considering pollutant loads only, it could be argued that the bioretention basin footprint of 240 m^2 could be reduced as the post-development loads are all less than the pre-development loads. However, both the TP and TN post-development concentrations are greater than the pre-development concentrations and any further reduction in the basin footprint would increase post-development concentrations to above the concentrations determined for pre-development conditions.

Comparing Council's concentration targets based on ecosystem type with the concentrations achieved as part of the modelling found that for both the Modified Ecosystem and Highly Modified Ecosystem classifications the concentration targets for TSS, TP and TN are met. Only the TSS targets are met for the Unmodified Ecosystem. However, the wetlands are downstream of a developed catchment and modifications to the flow conveyance arrangement at Boundary Street mean that it is reasonable to assume that the downstream wetlands are not classified as an Unmodified Ecosystem.

The post-development pollutant percentage reductions are presented in **Table 10**. With the installation of a 240 m^2 bioretention basin Council's pollutant load percentage reduction targets are met (*refer* **Section 2** *for additional background information*).

Table 10 MUSIC Model Results – Pollutant Load Percentage Reductions

Parameter	Load (kg/yr)		Reduction (%)	
	Source	Residual	Target	Achieved
Total Suspended Solids (TSS)	4,690	735	80	84.3
Total Phosphorus (TP)	8.25	2.43	45	70.5
Total Nitrogen (TN)	39.1	20.8	45	46.8
Gross Pollutants	400	32.8	-	91.8

4.2.4 Consideration of Other Pollutants

A limitation of the MUSIC modelling software is that it only considers TSS, TP, TN and gross pollutants. These pollutants can occur in runoff from carparks, roads and roof areas in urban environments and therefore are relevant for the proposed development. However, as an automotive workshop and detailing business is proposed on Lot 2, consideration must also be given to hydrocarbons and heavy metals which could be carried by runoff from this land use type.

Bioretention systems are able to remove both heavy metals and hydrocarbons from stormwater, as outlined in the following.

- Heavy metals occur in stormwater in particulate (*attached to sediments*) and soluble (*dissolved*) forms. Bioretention systems remove particulate metals from stormwater via physical filtration within the filter media. Soluble metals are removed via sorption onto finer particles within the filter media and to a lesser extent biological uptake by plants.
- Bioretention systems remove hydrocarbons from stormwater by volatilisation and processing by microorganisms.

To assist with the removal of oils and grease (*which are a source of hydrocarbons*) an oil and water separator, such as UltraSpin units or similar, will be installed as part of the workshop for the automotive facility. The specification of the UltraSpin, or similar, will vary depending on the flow of oily water generated and will be specified at the detailed design stage.

Each of the areas requiring oil and water separators will be roofed where possible, to prevent rainfall mixing with pollutants. Low lying bunds will surround these areas to reduce the potential for runoff to enter the area and will also serve as spill containment to prevent any spills reaching the stormwater system. The separated oils will be decanted and stored for safe disposal.

Of the parameters listed as part of Council's targets (*maximum allowed*) for ecosystems (*refer* **Section 2** *for additional background information*) pH and dissolved oxygen have not been discussed as yet.

A comprehensive study was undertaken by Duncan (2005) whereby he investigated stormwater runoff quality in relation to land use and catchment characteristics. As part of this study Duncan found that for an industrial land use the pH ranges between 6.2 and 8 and for all urban catchments (*i.e. including the industrial catchments*) the pH ranges between 6.25 and 7.6. Both these ranges are within Council's targets for a Highly Modified Ecosystem (*refer* **Table 11**), and are not significantly different to those reported for the other ecosystem types, particularly the Modified Ecosystem.

Therefore, stormwater runoff from the site is not anticipated to significantly impact on the pH of the downstream wetlands.

Table 11 Council Targets – pH

Parameter	Target		
	Unmodified Ecosystem	Modified Ecosystem	Highly Modified Ecosystem
pH	6.5 – 7.5	6.5 - 8	6.2 – 8.6

Pollutants, such as oil and grease, can adversely affect dissolved oxygen levels by limiting oxygen transfer from the atmosphere and by the oxygen demand of their own breakdown. The stormwater treatment management measures proposed for the site will ensure that the pollutants that may impact on dissolved oxygen levels are managed such that the downstream wetlands are not significantly impacted.

5 POTENTIAL IMPACT OF PROPOSED WORKS ON LOCAL GROUNDWATER AND NEARBY COASTAL WETLAND

The proposed development will lead to an increase in impervious areas across the site, as well as an increase in pollutants generated from the site. However, the installation of the proposed bioretention / detention basin will reduce the impacts of the development by both treating and controlling the discharge of runoff from the site. The investigations documented in **Section 4** show the following.

- The post-development peak flows do not exceed the pre-development peak flows, and the difference between them has been minimised to reduce the impact on the local groundwater and the downstream wetland.
- Both Council's pollutant reduction targets are met, as well as Council's ecosystem concentration targets. Therefore, from a quality perspective the impact on local groundwater and the downstream wetland will be minimal.

However, what the DRAINS modelling does not consider is the impacts of smaller storm events (*i.e. less than 1 year ARI events*). These events occur numerous times over the course of a year and generate relatively small flows. However, the site represents a relatively small portion (*less than 5%*) of the entire catchment (*approximately 135 ha*) that drains to the downstream wetlands. Therefore, the flows from the site are small relative to those generated from the larger contributing catchment. Hence, the impact on local groundwater and the downstream wetland will be minimal.

6 CONCLUSIONS

Under Clause 11(1)(b) of *State Environmental Planning Policy (Coastal Management) 2018* the proposed development at Lot 2 DP 601094 and Lot 4 DP 825704 at Mumford Street, Port Macquarie must not significantly impact on *"the quantity and quality of surface and groundwater flows to and from the adjacent wetland or littoral rainforest"*. A combined detention / bioretention basin is therefore proposed within Lot 2 to both treat and manage the release of stormwater from Lot 2 and the adjacent Lot 4 such that surface and groundwater flows and the downstream wetland are not significantly impacted. In addition, to assist with the removal of oils and grease an oil and water separator, such as UltraSpin units or similar, will be installed within the automotive workshop that is proposed for construction on Lot 2.

A concept design for the combined detention / bioretention basin has been developed using a DRAINS model to size the required detention area and a MUSIC model to size the bioretention system. The layout of the combined detention / bioretention basin is shown in **Figures 2** and **3**.

Outflows from the 640 m^2 detention / bioretention basin will be controlled by a low flow slot and a spillway in the basin wall. A bioretention system with an area of 240 m^2 is proposed to sit within the detention basin to treat stormwater flows. It is proposed to have a 400 mm deep filter media layer and an extended detention depth of 300 mm. The system is to be lined, with the bioretention subsoil collection drains installed above the liner and positioned to discharge to the detention area of the basin.

The assessment found that the minimum invert level of the inlet pipes to the bioretention basin is 1.95 mAHD (*assuming the basin floor is at 1 mAHD to tie in with the adjacent existing ground surface*). A sensitivity analysis showed that if required, this level could be raised by 200 mm to tie in with the bed level of the downstream drainage channel. To ensure that the basin can tie in with both upstream and downstream surface levels a combination of surface drains and pipes should be used across the site to convey stormwater to the basin.

It should be noted that the above advice is based solely on hydrologic and water quality elements. Geotechnical conditions / constraints and associated retaining wall structural design have not been considered and would need to be addressed during the detailed design phase.

7 REFERENCES

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- Duncan, H.P., 1999, *Urban Stormwater Quality: A Statistical Overview*, Cooperative Research Centre for Catchment Hydrology, Melbourne, Australia
- eWater, 2018, *Pluviograph Rainfall Data Tool* [Online]. Available: https://ewater.org.au/products/music/related-tools/pluviograph-rainfall-data-tool/ [Accessed: 5th December 2018]
- Port Macquarie-Hastings Council, 2004, *Development Design Specification: D5 Stormwater Drainage Design*
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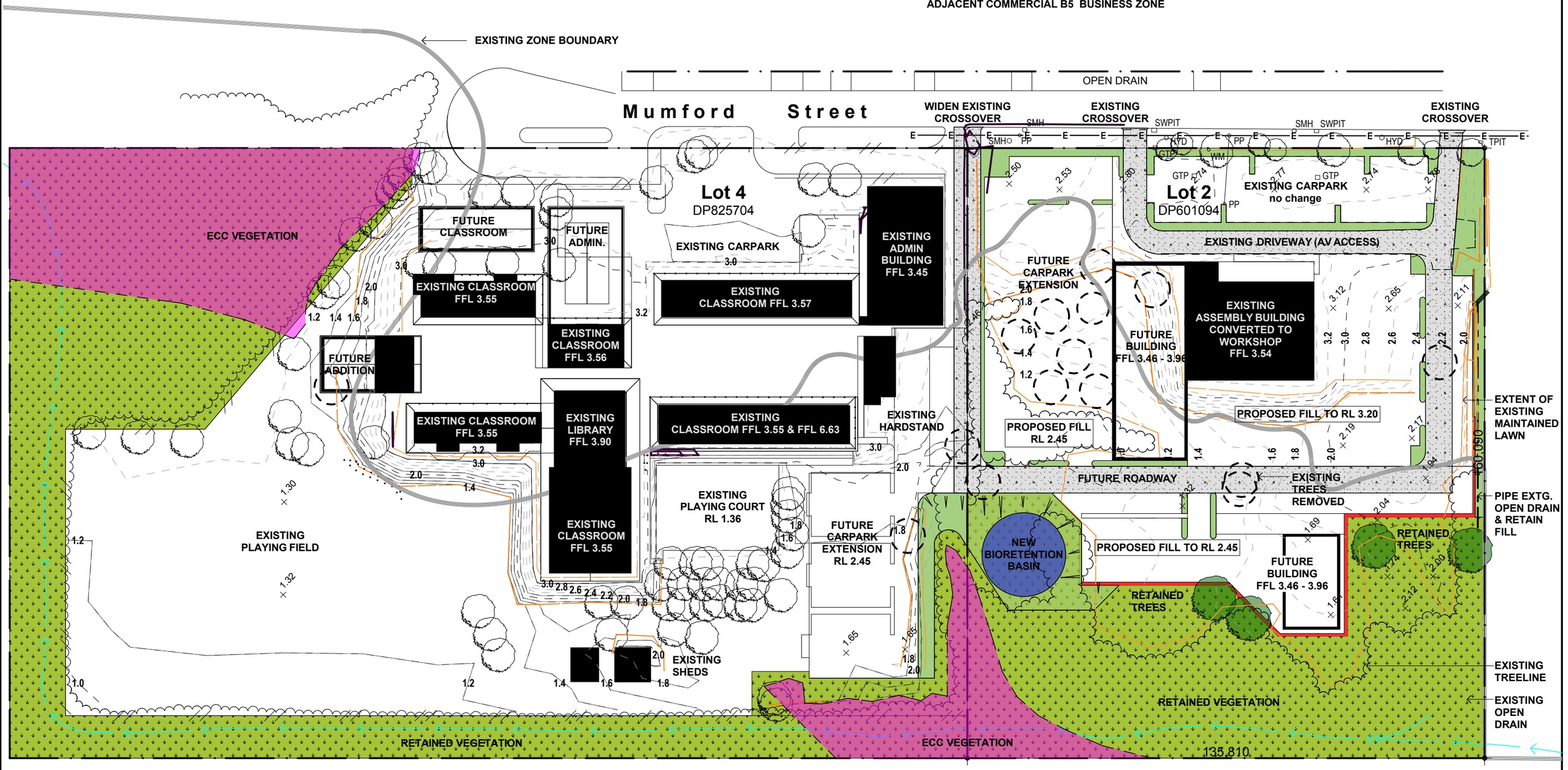
- Water by Design, 2014, *Bioretention Technical Design Guidelines*.

Appendix A

Site Plan

Source: AB3D Building Design



Site Plan

Proposed Rezoning
Lot 2 DP601094 & Lot 4 DP825704
Mumford Street PORT MACQUARIE

A B 3 D
Building Design
0438 499629 ab3d@bigpond.com

Site Plan
Scale 1:1000
Date 3/12/2018
Drawing No
A01 'C'