PROJECT

CONCEPTUAL STORMWATER ASSESSMENT, PROPOSED SERVICE STATION SITE KINGS FOREST NEW SOUTH WALES

PREPARED FOR

PROJECT 28 PTY LTD

DATE

NOVEMBER 2016

GILBERT SUTHERLAND

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CLIENT CONTACT Michael Geale
CLIENT REFERENCE –

SYNOPSIS This report describes the stormwater assessment undertaken for the proposed service station development located on Tweed Coast Road, New South Wales, to ensure that stormwater runoff from the development meets Tweed Shire Council's requirements.

REVISION HISTORY

REVISION #	DATE	EDITION BY	APPROVED BY
1	10/2016	B. Wills, C. Anderson, N. Sutherland	N. Sutherland & L. Varcoe
2	11/2016	B. Wills, C. Anderson, N. Sutherland	N. Sutherland & L. Varcoe
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DISTRIBUTION

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Distribution	1	2	3	4	5	6	7	8	9	10
Project 28	1	1	1							
G&S library & file	2	2	2							

SUMMARY

Project 28 Pty Ltd commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare a Conceptual Stormwater Assessment (SWA) for the proposed service station development on Tweed Coast Road, Kings Forest, New South Wales. This report outlines the stormwater management measures required to ensure the commercial development satisfies Tweed Shire Council's (TSC) stormwater runoff objectives and planning/building requirements.

A comparison of the estimated water quality of the development, with and without the constructed treatment measures in place, was carried out using the MUSIC computer model Version 6. This comparison indicates that, provided the proposed water quality management measures are maintained, the quality of runoff from the proposed development will achieve TSC's specified objectives.

This report provides a conceptual design further design and detail will be provided during detailed design phase ensuring TSC's objectives are addressed.

Careful management will be required to ensure that the projected quality levels are maintained through the lifetime of the development. These details will be considered in the Site Based Management Plan (SBMP).

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LIST OF DRAWINGS

DRAWING NO.	DESCRIPTION
11728.101	Site location
11728.102	Proposed development layout
11728.103	Proposed stormwater management strategy

GLOSSARY

TERM	MEANING
Australian Height Datum (AHD)	National reference for relative height measurement in Australia.
Average Recurrence Interval (ARI)	The average or expected length of time between exceedances of a given variable, such as rainfall.
Catchment	The area above a given point which contributes to the runoff.
Clay	Very fine-grained sediment or soil (often defined as having a particle size less than 0.002 mm, or 2 microns, in diameter).
Ephemeral	A stream that flows briefly only in direct response to precipitation in the immediate locality and the channel of which is at all times above the watertable.
Erosion	The process by which material (such as rock or soil) is worn away or removed (as by wind or water).
Intermittent	A stream in which the flow is seasonal, usually in response to rainfall in the immediate area (see ephemeral).
Loam	Medium-textured soil composed of approximately 10% to 25% clay, 25% to 50% silt and less than 50% sand.
pH	The degree of acidity or alkalinity measured on a scale of 1 to 14 with 7 as neutral. From 0 to 7 is acidic; from 7 to 14 is alkaline.
Sand	Sediment composed of particles within the size range 63 microns to 2 millimetres.
Scouring	The action of removing sediment from stream banks, particle by particle. This is a more destructive process than collapse when viewed over time due to incremental effects.
Sediment	Unconsolidated, fine-grained material (typically derived from the weathering of rocks), that is transported by water and settles on the floor of seas, rivers streams and other bodies of water.
Silt	Sediment having particles finer than sand and coarser than clay (i.e. 2 to 63 microns).

TERM	MEANING
Sub-catchment	A smaller area within a catchment drained by one or more tributaries of the main water body.
Suspended Solids (SS)	The concentration of filterable particles in water (retained on a 1.2μm filter) and reported by volume (mg/L).
Total Nitrogen (TN)	Total nitrogen is the sum of the nitrogen present in all nitrogen-containing components in the water column. The nutrients, nitrogen and phosphorus are essential for plant growth. High concentrations indicate potential for excessive weed and algal growth.
Total Phosphorus (TP)	Total phosphorus is the sum of the phosphorus present in all phosphorus-containing components in the water column. The nutrients, nitrogen and phosphorus are essential for plant growth. High concentrations indicate potential for excessive weed and algal growth.
Turbidity	A measure of the cloudiness of water, which is determined by the amount of light scattered by suspended particles.

1 Introduction

Project 28 Pty Ltd commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare a Conceptual Stormwater Assessment (SWA) in support of the proposed service station development on Tweed Coast Road, Kings Forest, NSW. The subject site and proposed development are described in Section 2.

The purpose of this report is to detail the method and results of the modelling undertaken to ensure that Tweed Shire Council's (TSC) stormwater objectives are addressed. This included quantifying the efficiency of the proposed stormwater quality improvement devices and management measures for the development.

This report is divided into sections detailing the physical site characteristics, the proposed development, a description and assessment of the modelled stormwater runoff quality and recommendations for managing stormwater discharge from the site.

Qualified G&S staff have utilised the MUSIC Version 6 computer model to identify the likely changes to annual stormwater quality runoff from the site as a result of the proposed development.

2 Site description and proposal

2.1 Location

The proposed site is located on Tweed Coast Road in Kings Forest, NSW and is formally described as Lot 7 on DP875447. For the purposes of this report, the subject site is referred to as 'the site'. The location of the site is shown on Drawing no. 11728.101 (Appendix 1).

2.2 Pre-developed site description

For stormwater assessment purposes, the site's pre-developed state is considered rural in nature, being undeveloped and covered mostly by grass species with a few trees and shrubs.

2.3 Post-developed site description

The proposed development of the site involves the construction of a service station and food and drink premises. The proposed development area of 1.09 ha (shown on Drawing No. 11728.102 in Appendix 1) consists of a multiuse service station, station shop, fast food tenancies, eating areas, car parks and a car wash and dog wash facility. This development includes the construction and/or installation of the following components:

- Site earthworks
- Roads
- Water reticulation mains
- Underground fuel storage
- Underground electricity distribution cables
- Telecommunication cables
- Other ancillary services
- Landscaping.

2.4 Receiving environment

In its current state, the site is relatively flat in nature with sporadic minor depressions throughout. These minor depressions allow infiltration into the sandy soils.

Following development, treated stormwater runoff would be directed to the lawful point of discharge (discussed in Section 5), and ultimately to Cudgen Creek. Other than the changes to surface runoff within the development footprint, the remainder of the site will continue to discharge runoff in the same manner as currently occurs.

No water quality monitoring has been carried out by G&S to establish background water quality levels on the site.

2.5 Water quality objectives

The water quality objectives for site runoff were identified according to the TSC's *Development Design Specification D7 – Stormwater Quality,* Version 1.4. Those guidelines specify that the site's proposed permanent water quality control measures need to achieve reductions in the mean annual pollutant loads estimated to be generated by the site, after completion of the proposed development, at a minimum of:

- 80% for Total Suspended Sediment,
- 60% for Total Phosphorus,
- 45% for Total Nitrogen, and
- 90% for Gross Pollutants (>5mm).

3 Stormwater quality assessment methods

To assess the likely impacts of the proposed development on water quality, the CRC for Catchment Hydrology's Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Version 6 computer model was used.

MUSIC is a water resources package with components for generating surface and subsurface runoff, non-point source pollutant export and pollutant transporting and routing. It is specifically designed for the analysis of the effects of planned land use changes and for the evaluation of best management practice stormwater quality improvement devices. The input data requirements are described below.

3.1 Modeling undertaken

The MUSIC model was used to form a basic model for the stormwater treatment system simulating the proposed developed site after completion of the construction phase.

The scenarios modelled were as follows:

- Developed untreated case.
- Developed treated case.

Descriptions of the site sub-catchments are included in Section 3.5. Details of the stormwater treatment methods currently implemented and the results of the MUSIC modelling are provided in Section 4.

3.2 Metrological data

In accordance with the TSC's *Development Design Specification D7 – Stormwater Quality,* Version 1.4, May 2015, the Tweed Standard Rainfall Data set was obtained from TSC's website. The six-minute time-step pluviometer records dated from 16/10/1973 to 30/06/1984. The average annual rainfall for this period was 1,697 mm.

The average monthly potential areal evapotranspiration values used were also in accordance with TSC's *Development Design Specification D7* with an average annual evapotranspiration of 1,363 mm.

3.3 Runoff parameters

Relevant parameters for the land uses were sourced from Table 3.7 of *Water by Design* 'MUSIC Modelling Guidelines, Version 1.0 – 2010' and are presented in Table 3.3.1.

Table 3.3.1 Rainfall-Runoff parameters

Parameter	Commercial
Impervious Area Properties	
Rainfall Threshold (mm/day)	1
Pervious Area Properties	
Soil Storage Capacity (mm)	18
Initial Storage (% of Capacity)	10
Field Capacity (mm)	80
Infiltration Capacity Coefficient - a	243
Infiltration Capacity Exponent - b	0.6
Groundwater Properties	
Initial Depth (mm)	50
Daily Recharge Rate (%)	0
Daily Baseflow Rate (%)	31
Daily Deep Seepage Rate (%)	0

3.4 Water quality parameters

The water quality parameters modeled were:

- Total Suspended Sediment (TSS)
- Total Phosphorus (TP)
- Total Nitrogen (TN)
- Gross Pollutants (GP)

The sediment and nutrient export characteristics were adopted from Tables 3.8 and 3.9 of *Water by Design* 'MUSIC Modelling Guidelines, Version 1.0 – 2010' and are presented in Table 3.4.1 (on the following page).

It should be noted that the rainfall to runoff model and the pollutant export expressions have not been calibrated for local catchments. This means the modeling results cannot be expected to

Table 3.4.1 Pollutant Export Parameters (Log_{10}mg/L)

Land use	Parameter	Suspended Solids		Total Phosphorus		Total Nitrogen	
		Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow
Commercial Roof	Mean	N/A	1.30	N/A	-0.89	N/A	0.37
	Std Deviation	N/A	0.38	N/A	0.34	N/A	0.34
Commercial Roads	Mean	0.78	2.43	-0.60	-0.30	0.32	0.37
	Std Deviation	0.39	0.38	0.50	0.34	0.30	0.34
Commercial Balance	Mean	0.78	2.16	-0.60	-0.39	0.32	0.37
	Std Deviation	0.39	0.38	0.50	0.34	0.30	0.34

produce accurate assessments of the amount of pollutants likely to be exported from the proposed development. However, the results do provide useful assessments, which enable comparisons of the effectiveness of various stormwater management strategies.

3.5 Developed untreated case

MUSIC modeling was carried out for those areas within the site that will be disturbed by the proposed development and will contribute runoff to the stormwater treatment devices.

In this concept stage the development footprint has been considered as a single catchment and modelled with a commercial land use. Table 3.5.1 below details the adopted catchment parameters.

Table 3.5.1 Catchment parameters

	Area (ha)	Percent Impervious
Proposed Development		
Commercial Roof	0.203	100%
Commercial Roads	0.552	95%
Commercial Balance	0.341	20%

Impervious areas, where available, have been directly measured based on plans supplied by Push Architecture (shown in the G&S Drawing No. 11728.102). Where specific measurements weren't available, imperviousness assumptions have been made, as per Tables 3.5 and 3.6 of *Water by Design* 'MUSIC Modelling Guidelines, Version 1.0 – 2010'. Modelled catchments are shown on Drawing No. 11728.103 (drawing included in Appendix 1).

Stormwater is to be isolated from entering the forecourt of the service station complex (the bunded, undercover area where fuel dispensing occurs), by firstly a roof preventing rainfall ingress and secondly a bund. These are standard practices for new service stations and are described more fully in 'Information Sheet 3, Environmental Action for Service Stations'[1]. Water that is generated within the bunded forecourt area, together with any liquid wastes, spills or potentially contaminated runoff, would be treated separately as outlined in the SBMP. Similarly, any rain falling on the dog wash facility area would be isolated from the stormwater system. Instead, that water would combine with wastewater from the facility and be treated and disposed of separately, as detailed in the SBMP. Accordingly, the dog wash area was excluded from the catchment area for the purposes of this assessment.

It should be noted that a small additional road area was included in the MUSIC model to cater for the area underneath the roofed forecourt area but external of the waste/spill treatment bund. Conservative assumptions of a 5m high roof and an overhang of 10° were used as per the

[1] Department of Environment and Climate Change (DECC), New South Wales, October 2008. ISBN 9781742320106.

Department of Environment and Climate change NSW *Environmental Action for Service Stations,* October 2008.

3.6 Developed treated case

The same parameters as above were modelled under the same rainfall conditions in a developed state with the proposed water quality treatment measures included.

A vegetated bio-retention basin was nominated to treat the runoff from the site before it is discharged into the stormwater network. The bio-retention basin has been designed in accordance with QUDM and TSC guidelines. Operating characteristics of the basins are set out in Table 3.6.1. A conceptual location for the bio-retention basin is shown on Drawing No. 11728.103 (included in Appendix 1).

Table 3.6.1 Bio-retention basin parameters

Parameter	Basin
Inlet Properties	
Low Flow Bypass (m^3/s)	0.0
High Flow Bypass (m^3/s)	100.0
Storage Properties	
Extended Detention Depth (m)	0.3
Surface Area (m^2)	105
Infiltration Properties	
Filter Area (m^2)	105
Filter Depth (m)	0.50
TN Content of Filter Media (mg/kg)	800
Orthophosphate Content of Filter Media (mg/kg)	50.0
Saturated Hydraulic Conductivity (mm/hr)	200.00
Outlet Properties	
Overflow Weir Width (m)	2.0

Note that in accordance with the Water by Design *Bio-retention Technical Design Guidelines*, October 2014, a coarse sediment removal device is not required for the development as its footprint covers an area of <2ha.

4 Stormwater quality assessment results

Water quality objectives have been outlined in Section 2.5, with additional details of the MUSIC modelling process, catchments, treatment measures and assumptions as described in Section 3.

4.1 Developed untreated results

Table 4.1.1 presents the average annual runoff volumes and quantities of suspended sediment, nitrogen and phosphorus predicted to be exported from each catchment in a developed state, with no treatment measures in place during the 10-year model simulation.

Table 4.1.1 Developed untreated case average annual loads

	Pollutant Loads (kg/year)			
	TSS	TP	TN	GP
Site Total	4220	8.44	49.2	299

4.2 Developed treated results

The modelled average annual runoff volumes and quantities of the suspended sediment, nitrogen and phosphorus predicted to be exported from those parts of the site that constitute the developed state catchment, with treatment measures in place during the 10-year model simulation are shown in Table 4.2.1.

Table 4.2.1 Developed treated case average annual loads

	Pollutant Loads (kg/year)			
	TSS	TP	TN	GP
Site Total	821	3.06	24.6	0

4.3 Comparative quality result analysis

As Table 4.3.1 demonstrates, the adopted water quality objectives have been achieved by the treatment devices proposed.

Table 4.3.1 Developed treated case pollutant load reduction statistics

	Pollutant Load Reductions (%)			
	TSS	TP	TN	GP
Target	80.0	60.0	45.0	90
Achieved	80.6	63.7	50	100

Based on the assessment and modelling described above, the proposed stormwater treatment train has the capacity to address the TSC's pollutant load reduction targets.

4.4 Water quality assessment summary

The design assessment carried out shows that the stormwater management infrastructure (bio-retention) for the proposed development addresses the TSC's operational phase performance criteria. Providing those treatment trains are installed and maintained in accordance with the recommended measures outlined in the SBMP, the assessment indicates the TSC's objectives will continue to be met.

5 Lawful point of discharge

5.1 Stormwater discharge

The proposed development drainage layout would direct stormwater runoff south to the proposed stormwater treatment device (bioretention basin). The treated water from the basin would then be discharged to the proposed piped local stormwater network, within the Tweed Coast Road reserve, as shown on Mortons Urban Solutions Drawing No. 12301-SK-060A (Appendix 2). The Tweed Coast Road and stormwater network will be upgraded as part of the Kings Forest Stage 1 works and will have sufficient capacity for the proposed service station.

6 Conclusions

This Stormwater Assessment considered the development proposal as described and determined the required sizing of the stormwater quality device and the location of the legal point of discharge to ensure that runoff from the proposed service station development would meet TSC's requirements.

The proposed stormwater quality management measures have been shown to meet the pollutant load reduction targets and hence TSC's performance criteria for water quality discharging from the site during the operational phase.

Careful management and maintenance will be required to ensure that the discharge objectives are maintained throughout the development's lifetime. These details are addressed in the SBMP.

7 Appendix 1 – Site drawings

ORIENTATION

SCALE 1:20,000

200 400 600 800 1000 metres

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LEGEND

Site Boundary

SOURCES

Satellite Image: Google Earth Pro, Accessed: 01/09/2016, Imagery Dated: 05/05/2016.
Site Boundary: Push Architecture, *Proposed Site Plan*, Drawing No. 1000 Issue O, Dated: 09/2016

PROJECT

PROPOSED SERVICE STATION, TWEED COAST RD, KINGS FOREST, NSW

CLIENT

PROJECT 28 PTY LTD

DRAWING

SITE LOCATION

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:20,000@A3	06/10/2016	BMW	CMA	11728	101	-

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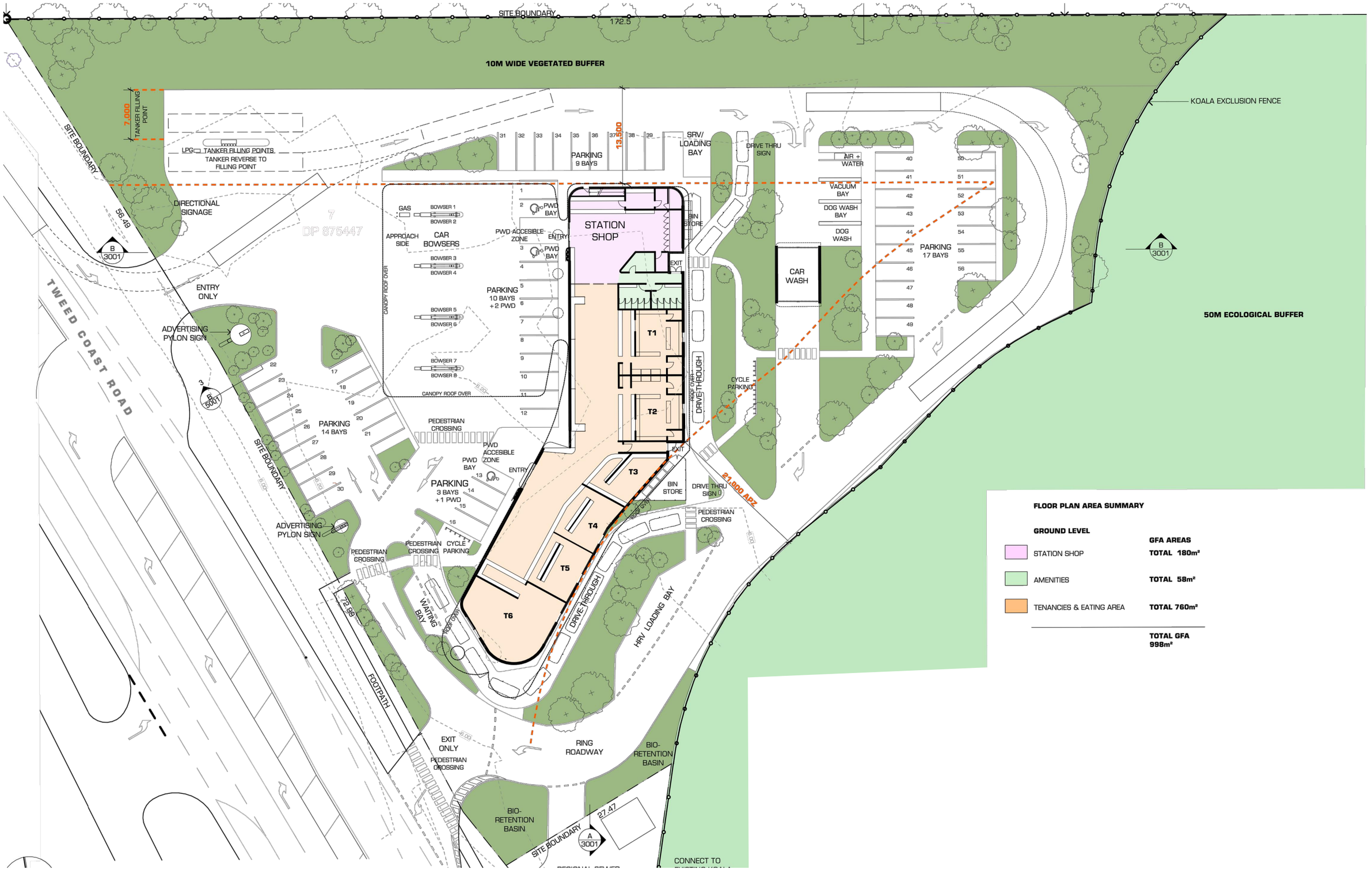

FLOOR PLAN AREA SUMMARY

GROUND LEVEL

	GFA AREAS
STATION SHOP	**TOTAL 180m²**
AMENITIES	**TOTAL 58m²**
TENANCIES & EATING AREA	**TOTAL 760m²**
	TOTAL GFA 998m²

ORIENTATION

SCALE 1:500

5 10 15 20 25 metres

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LEGEND

Note: For additional Legend entries please see the drawing space.

SOURCES

Proposed Development Layout: Push Architecture, *Proposed Site Plan*, Drawing No. 1000 Issue P1, Dated: 11/2016

PROJECT
PROPOSED SERVICE STATION, TWEED COAST RD, KINGS FOREST, NSW

CLIENT
PROJECT 28 PTY LTD

DRAWING
PROPOSED DEVELOPMENT LAYOUT

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:500@A3	22/11/2016	BMW/AJS	CMA	11728	102	-

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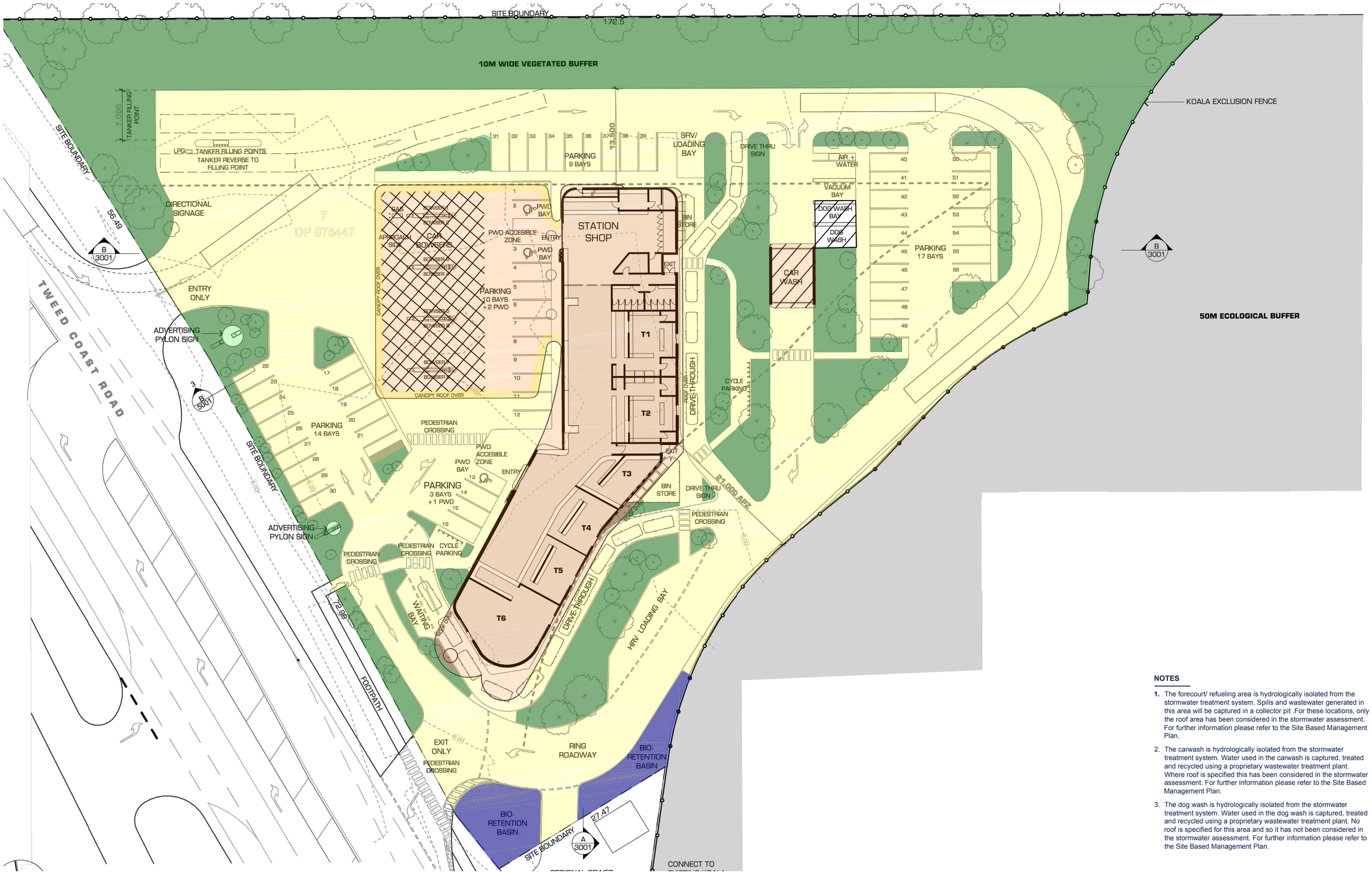

NOTES

1. The forecourt/ refueling area is hydrologically isolated from the stormwater treatment system. Spills and wastewater generated in this area will be captured in a collector pit .For these locations, only the roof area has been considered in the stormwater assessment. For further information please refer to the Site Based Management Plan.
2. The carwash is hydrologically isolated from the stormwater treatment system. Water used in the carwash is captured, treated and recycled using a proprietary wastewater treatment plant. Where roof is specified this has been considered in the stormwater assessment. For further information please refer to the Site Based Management Plan.
3. The dog wash is hydrologically isolated from the stormwater treatment system. Water used in the dog wash is captured, treated and recycled using a proprietary wastewater treatment plant. No roof is specified for this area and so it has not been considered in the stormwater assessment. For further information please refer to the Site Based Management Plan.

ORIENTATION

SCALE 1:500

5 10 15 20 25 metres

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LEGEND

- MUSIC Modelled Land Use - Commercial Road
- MUSIC Modelled Land Use - Commercial Roof
- MUSIC Modelled Land Use - Commercial Balance
- Proposed Basin Location
- Forecourt/Refueling Area
- Dog Wash and Carwash

SOURCES

Proposed Development Layout: Push Architecture, *Proposed Site Plan*, Drawing No. 1000 Issue P1, Dated: 11/2016

PROJECT

PROPOSED SERVICE STATION, TWEED COAST RD, KINGS FOREST, NSW

CLIENT

PROJECT 28 PTY LTD

DRAWING

PROPOSED STORMWATER MANAGEMENT STRATEGY

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:500@A3	22/11/2016	BMW/AJS	CMA	11728	103	-

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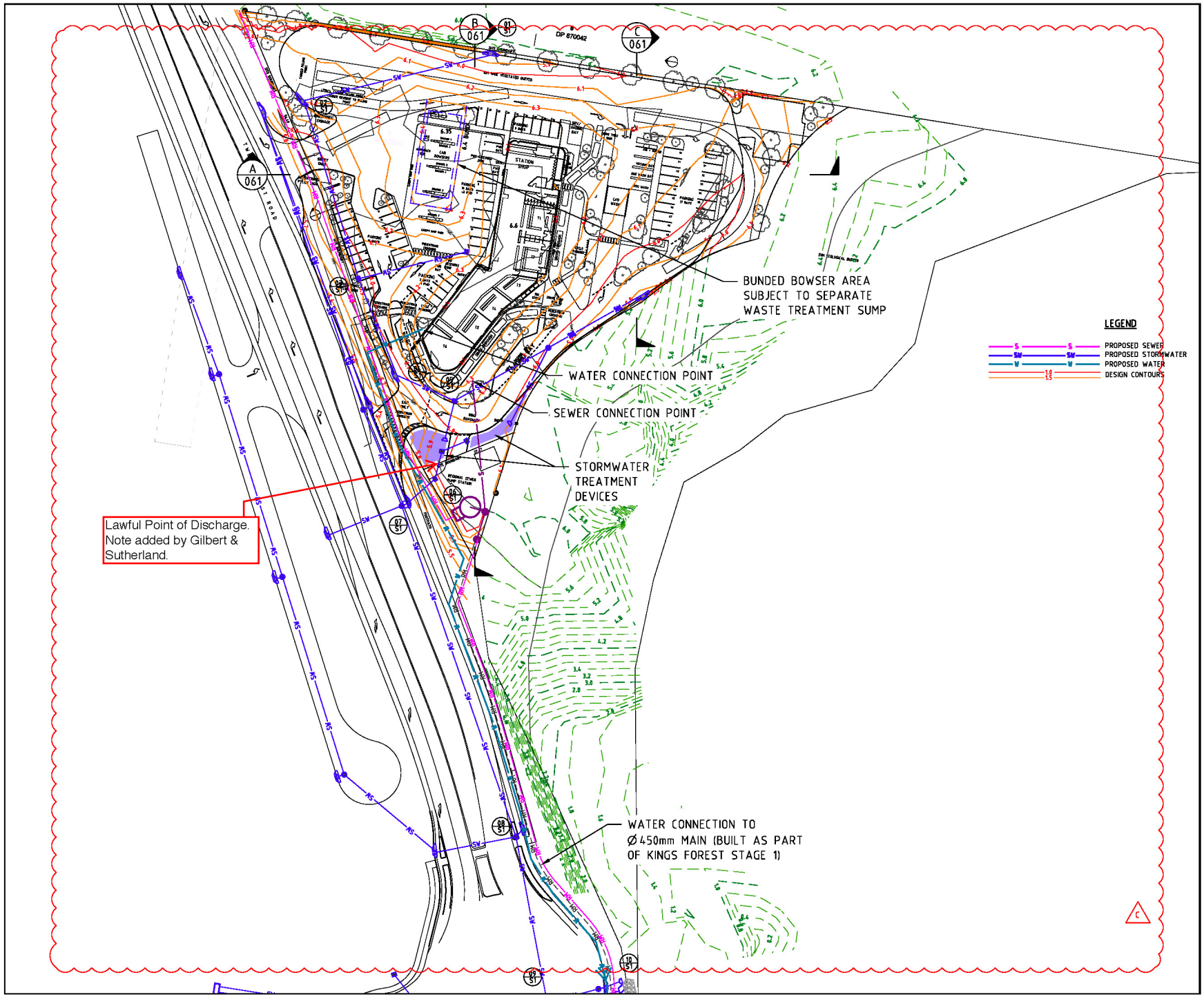
8 Appendix 2 – Reference drawing



PROJECT NAME

KINGS FOREST

CONCEPT PLANNING

CLIENT

PROJECT 28 PTY LTD

NORTH

0 5 10 15 20 25m

Scale 1:500 – A1 (1:1000 – A3)

ISSUES	DATE
TENDER	
COUNCIL	
CONSTRUCTION	

PRE	DATE	AMENDMENT
C	25-11-16	STORMWATER TREATMENT AREA & LEGEND ADDED
B	06-05-15	SHEET LAYOUT CHANGED
A	16-12-14	COUNCIL ISSUE

ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH 001-NOTES AND 002-LEGEND

ASSOCIATED CONSULTANTS

DRAWING TITLE

KINGS FOREST
PRECINCT 1
GRADING PLAN

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DESIGNED	RB	DRAWN	RB
APPROVED		DATE	16-12-14

DRAWING NUMBER 12301-SK-060A

AMEND. C