WOOD & GRIEVE ENGINEERS

Allambie Heights Village – Project 2

Prepared for:

Allambie Heights Village Ltd

Date:
14 February 2020

Prepared by:

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Project No.38509-CI-RE_001
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Revision

Site Address:	181 Allambie Road, Allambie Heights, NSW
Real Property Description:	Lot 2615 DP752038
Proposed Development:	Senior Living Development
Client:	Allambie Heights Village Ltd
Local Authority	Northern Beaches Council
Authority Reference #:	N/A
Wood & Grieve Reference:	38509-CI-RE_001

Ian Harris BEng (Hons)
For and on behalf of
Wood & Grieve Engineers

REVISION	DATE	COMMENT	APPROVED BY
A	01.06.18	DA Issue	**IH**
B	18.06.18	DA Issue	**IH**
C	14.02.20	Updated DA Issue	**IH**

Contents

1. Introduction

Wood & Grieve Engineers have been commissioned by Allambie Heights Village Ltd to prepare this Stormwater Management Plan (SMP) in support of the Development Application for the proposed development at 181 Allambie Road, Allambie Heights, NSW. The sites real address is Lot 2615 DP752038.

This SMP outlines the conceptual DA level stormwater design for the proposed development of a senior living development on the site.

This SMP demonstrates the application of Water Sensitive Urban Design (WSUD) principles and illustrates that the proposed development complies with the Mid-Coast Council Standards and Guidelines for stormwater, Australian Rainfall and Runoff, Australian Standards and best engineering practise.

The purpose of this SMP is to evaluate the quantity and quality of stormwater associated with the proposed development plan so as to demonstrate to Council that an appropriate stormwater management strategy has been adopted.

The SMP specifically addresses the following items for both the construction and operational phases of the development:

- Stormwater runoff volumes and detention (Stormwater Quantity);
- Stormwater quality treatment measures (Stormwater Quality);
- Erosion and Sedimentation Control.

The following will be achieved with the correct application of this SMP report:

- Appropriate standards to be maintained on all aspects of stormwater within the site,
- Pollution control to be maintained,
- Establishment of a unified, clear and concise stormwater management strategy.

2. Existing Site Characteristics

2.1 Property Detail

Address:	181 Allambie Road, Allambie Heights, NSW
Real Property Description:	Lot 2615 DP752038
Total Site Area:	37,176m² (3.718Ha)

The proposed development can be seen on the concept design drawings in Appendix A of this report.

The proposed development will consist of a seniors living development including residences and a pool building.

As can be seen in the site location aerial photo below, the site is located west of Allambie Road and north of Martin Luther Place.

The area of the site to be developed is currently undeveloped. There are existing seniors living buildings to the east of the development area within the extent of the site.

Figure 1: Site Location Plan (Source: Nearmaps 2018)

Existing Site Characteristics

2.2 Topography

The area in consideration is currently undeveloped and is currently vegetated over its majority. There is a current bitumen road intersecting the development area. Topographic survey confirms the site falls from the north to south from approximately RL130m AHD to RL120m AHD.

Figure 2: Site Topography (Source: CMS Surveyors 2017)

2.3 Existing Stormwater Discharge

Visual inspection of the site and the detailed site topographic survey confirm that there is currently no in ground drainage infrastructure on the area of the site being considered for development. Stormwater runoff from this area of the site runs as overland flow towards the northern edge of the bitumen road where it is collected and conveyed towards a headwall and culvert running under the road. This headwall discharges into a vegetated swale which conveys flows towards the southern boundary of the site.

There is an existing waterway running north to south through the site to the west of the proposed development area. This waterway will not be impacted by the proposed development.

There is evidence of in ground drainage for the existing buildings located on the eastern portion of the site. This stormwater network appears to drain towards Allambie Road.

3. Local Authority Requirements

Northern Beaches Council set the design requirements for any new stormwater management system associated with new development in their Water Management Policy PL850. A summary of the key requirements for the development of the Stormwater management system for this development are summarized below.

3.1 On Site Detention Requirements

Council's policy states:

(a) OSD is required for the following developments:

i. single residential dwellings where the total existing and proposed impervious areas exceed 40% of the total site area (OSD will not be required for alterations and additions or where the total site area is 450m^2 or less)

ii. new residential flat buildings/multi-residential unit dwellings

iii. commercial developments

iv. industrial developments

v. subdivisions resulting in the creation of three (3) lots or more

vi. subdivisions resulting in the creation of two (2) lots or more, OSD will be required where the post developed impervious area of the new lots exceed 40% of the site area of the new lots. This requirement also applies to newly created lots with existing dwellings to be retained

vii. Alterations and additions to existing residential flat buildings/multi-residential unit dwellings, commercial developments and industrial developments, OSD is applicable to the extent of the new works only.

(b) Development requiring OSD must comply with Council's Onsite Stormwater Detention Technical Specification.

(c) A positive covenant and Restriction As to User must be registered on the title for the OSD system to ensure regular maintenance and operation.

(d) Council will not permit the use of "Drainage Cell" type products for onsite detention storage as access for maintenance or removal of silt/debris is limited.

(e) Council will allow the volume of rainwater reuse in single residential dwellings to be credited against the calculated OSD storage volume as determined by Council's Onsite Stormwater Detention Technical Specification.

Reference to the Onsite Stormwater Detention Technical Specification states:

"The general requirement of Council's OSD Specification is to ensure that the site's stormwater runoff after any development does not exceed the runoff prior to the development"

The specification continues to state:

> The post-development runoff is to be determined based on the post-development impervious area for all storm durations for the 5 year, 20 year, and 100 year ARI storm events. The OSD system(s) must be designed to restrict these flows to the calculated pre-development discharge rates. Hence the 5 year ARI post-development runoff must not exceed the 5 year ARI pre-development discharge, the 20 year ARI post-development runoff must not exceed the 20 year ARI pre-development discharge, and the 100 year ARI post-development runoff must not exceed the 100 year ARI pre-development discharge.

3.2 Discharge

For site which cannot directly connect to council drainage infrastructure council set discharge requirements in their Stormwater Drainage From Low Level Properties Technical Specification document.

This document states that direct connection to watercourses should be avoided and On-Site Absorption should be considered. The specification gives the following advice on the design of On-site Absorption.

“The absorption pit is to be designed for an Average Recurrence Interval (ARI) storm of 50 years using DRAINS computer software based on the infiltration rate that can be maintained in the long term. An overflow mechanism in the form of a level spreader must be provided for all storms greater than the 50 year ARI storm, up to and including the 100 year ARI storm. The overflow mechanism is required to minimise overland flow disturbance to the lower property.”

3.3 Water Pollutant Reduction Targets

Council's Water Management Policy states "Stormwater treatment measures are required to ensure the development does not impact on the receiving waters."

The policy outlines the following requirements for water quality treatment.

Table 4 – General Stormwater Quality Requirements

Pollutant	Performance Requirements
Total Phosphorous	65% reduction in the post development mean annual load[1]
Total Nitrogen	45% reduction in the post development mean annual load[1]
Total Suspended Solids	85% reduction in the post development mean annual load[1]
Gross Pollutants	90% reduction in the post development mean annual load[1] (for pollutants greater than 5mm in diameter)
pH	6.5 - 8.5
Hydrology	The post-development peak discharge must not exceed the pre-development peak discharge for flows up to the 2 year ARI

Note:

[1]The percentage reduction in the post development mean annual loads are relative to the loads from the proposed development without treatment applied.

4. Flood Impact Assessment

When considering a new development it is important to assess the impact of existing flooding on the proposed development and also the impact of the proposed development on existing or potential flooding both upstream and downstream of the development.

4.1 Existing Flooding

Referring to Council's online flood mapping indicates that the site is not affected by flooding.

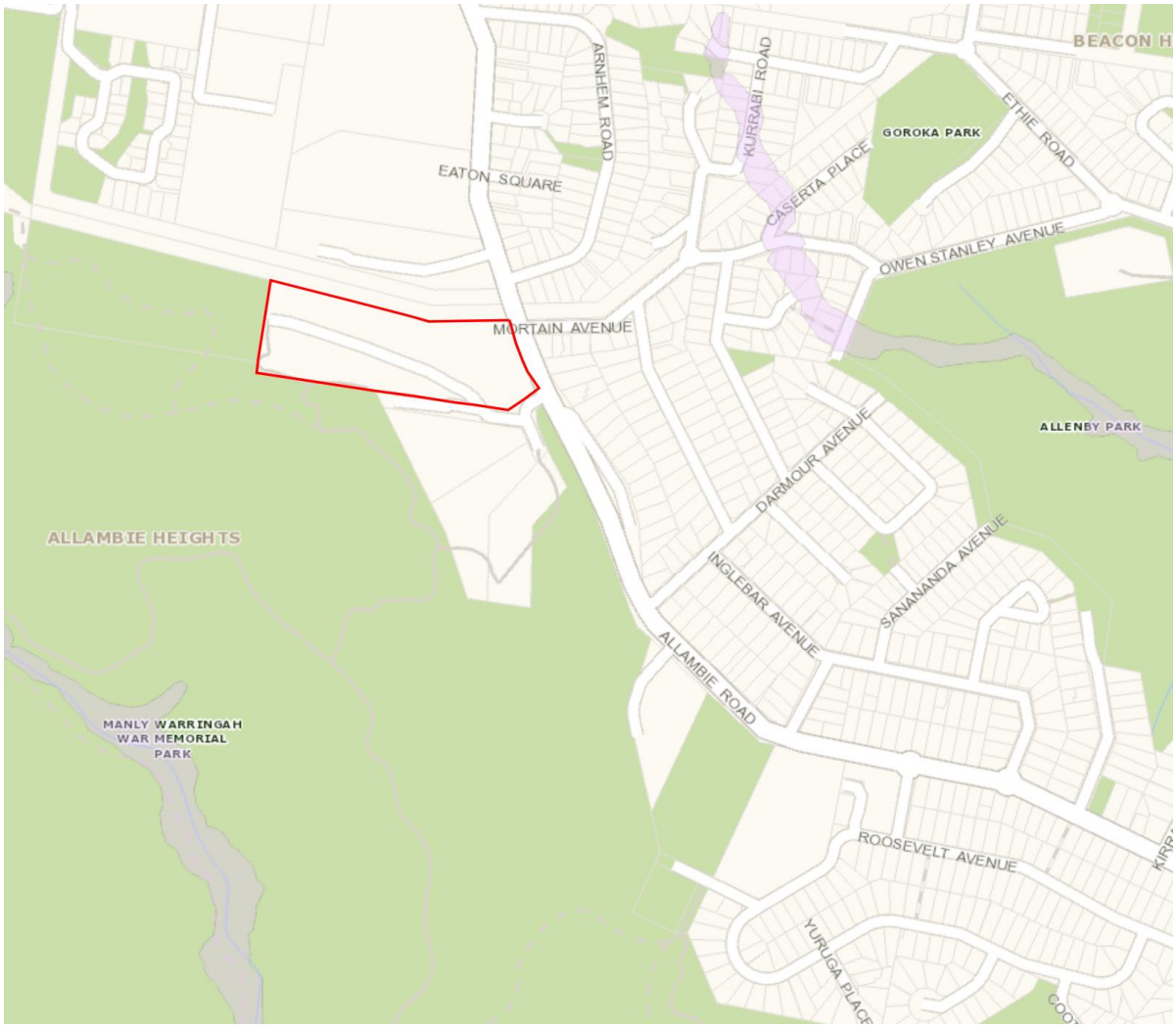

Figure 3: Low Flood Risk Planning Precinct (Source: Northern Beaches Planning Maps, 2018)

4.1.1 Flood Impacts

As the site is not affected by regional flooding no flood mitigation measures are proposed to deal with regional flooding. Measures will however be incorporated into the design to minimise the risk of local or nuisance flooding to or because of the development. These will include grading external areas to ensure positive stormwater runoff in a controlled manner and the provision of on-site detention to ensure there are no adverse downstream impacts caused by the development.

5. Stormwater Conveyance

This section of the report discusses the systems proposed to allow for stormwater to be conveyed across the site to the legal point of discharge.

5.1 Roof Drainage

All roof areas will be drained through a conventional downpipe system. The drainage system will be designed in accordance with AS3500.3:2003 to convey the 50 year design storm runoff from the roof to the proposed in ground drainage network. Flows in excess of the design flows will surcharge the roof drainage system and discharge onto the surrounding ground where it will then be conveyed overland in a controlled manner.

5.2 Infiltration Discharge

Discharge from the site will be via infiltration into the ground water. The base of the raingardens will allow runoff to discharge into the ground. Geotechnical investigations have been undertaken for the site and confirm that the existing geology on the site would allow for an infiltration rate of 0.01mm/hr, this rate has been used to calculate the area required to allow the runoff to discharge.

The infiltration system has been designed to discharge runoff occurring from a 100 year design storm, a peak discharge flow of 283L/s.

6. Stormwater Attenuation

Stormwater detention for the site will be provided to attenuate the post development discharge rates back to the pre-development rates. A DRAINS model has been produced to assess the volume of storage required for the development. This model confirms that 100m³ is required to attenuate the discharge flows.

The stormwater detention will be achieved by providing an underground tank situated below the proposed community building. The location and arrangement of the tank is indicated in the concept drawing in Appendix A of this report.

Discharge rates will be attenuated by providing an orifice plate over the discharge pipe which will restrict the flows discharging to the legal point of discharge. The sizing of this orifice plate has been undertaken using the DRAINS model for the development. The model has confirmed that the orifice plate will have a diameter of 190mm.

The table below summarises the discharge flows from the site.

Development Scenario	% Impermeable	Discharge Flow Rates (L/s)		
		5 Year Design Storm	20 Year Design Storm	100 Year Design Storm
Pre-Development	10	328	463	595
Post – Development	60	278	359	584

Table 1: Site Discharge Flows

Output from the DRAINS model is included in Appendix B of this report.

7. Water Quality Treatment

As discussed in section 3.2 of this report Northern Beaches Council have set targets for the reduction of water borne pollution being conveyed from the site through the stormwater drainage system.

This section of the report demonstrates the Stormwater Quality Improvement Devices (SQID's) to be implemented and the Pollutant Export Modelling undertaken to demonstrate the effectiveness of the treatment system in achieving the reduction targets set by council.

7.1 Potential Pollutants

There are a wide range of potential stormwater pollutant sources which occur from urbanised catchments, many which can be managed through appropriate stormwater quality treatment. Typical urban pollutants may include:

- Atmospheric deposition
- Erosion (including that from subdivision and building activities)
- Litter and debris
- Traffic emissions and vehicle wear
- Animal droppings
- Pesticides and fertilisers
- Application, storage and wash-off of car oil, detergents and other household and commercial solvents and chemicals
- Solids accumulation and growth in stormwater systems
- Weathering of buildings

These pollutants in urban stormwater can be placed into various categories as follows. The pollutants underlined below are able to be readily modelled:

- Suspended Solids
- Litter
- Nutrients such as Nitrogen and Phosphorous
- Biological oxygen demand (BOD) and chemical oxygen demand (COD) materials
- Micro-organisms
- Toxic organics
- Trace metals
- Oils and surfactants

While only the key pollutants underlined above will be examined within the modelling, the stormwater Quality Improvement Devices implemented are expected to assist in reducing a wide range of pollutants. For example, heavy metals are commonly associated with, and bound to fine sediments. Thus reducing the discharge of fine sediment during the construction and operational phases will also reduce the discharge of heavy metals to existing stormwater systems.

7.2 Pollutant Reduction System

In order to achieve the pollutant reduction targets specified in section 3.3 of this report a series of treatment devices are proposed with together form a treatment train. The diagram below shows the proposed treatment train for this development.

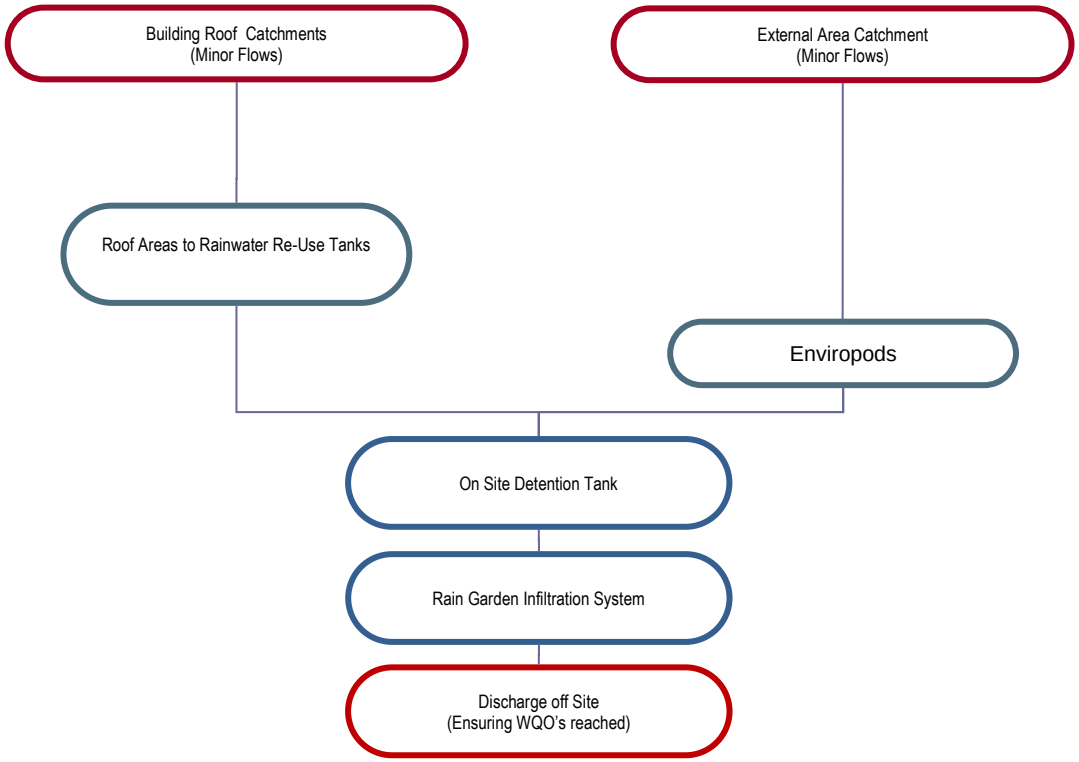

Figure 4: Proposed Water Quality Treatment Train

Further discussion on each element of this treatment train is provided below.

7.2.1 Rainwater Tanks

As shown in the proposed treatment train, the roof water from the building will drain to rainwater tanks and will be used for irrigation. The use of rainwater tanks will allow for a reduction of TSS by the settling of particles over time and through the screening of water before it enters the tank.

A 130Kl tank is proposed for the development.

7.2.2 EnviroPod Pit Inlet Trap (or approved equivalent)

EnviroPod's (or other similar approved equivalents) provide effective removal of TSS and gross pollutants. EnviroPod's are a filter cage system which are inserted into roadway gully pits to filter and remove pollutants before the water enters the piped drainage system. It is proposed to placed EnviroPod filters within every pit in the roadway.

The MUSIC modelling parameters for this device are set by the manufacturer, Stormwater 360.

Parameters	TSS	TP	TN	GP
Input (mg/L)	100	10	50	14.8
Output (mg/L)	53	10	50	0
Reduction (%)	47	0	0	100

Figure 5: EnviroPod Pit Inlet Trap (Source: Stormwater 360)

7.2.3 Rain Garden

Bio-retention systems are vegetated areas where stormwater is passed through densely planted filter media (loamy sand) allowing the plants to absorb the collected and stored nutrients. Bio-retention basins utilise temporary ponding above the vegetated surface to increase the volume of stored water for treatment. Bio-retention systems can take a number of forms but all have common features including the extended detention depth above the media surface, the filter media and a low level drainage media and subsoil system. These are shown in the figure below.

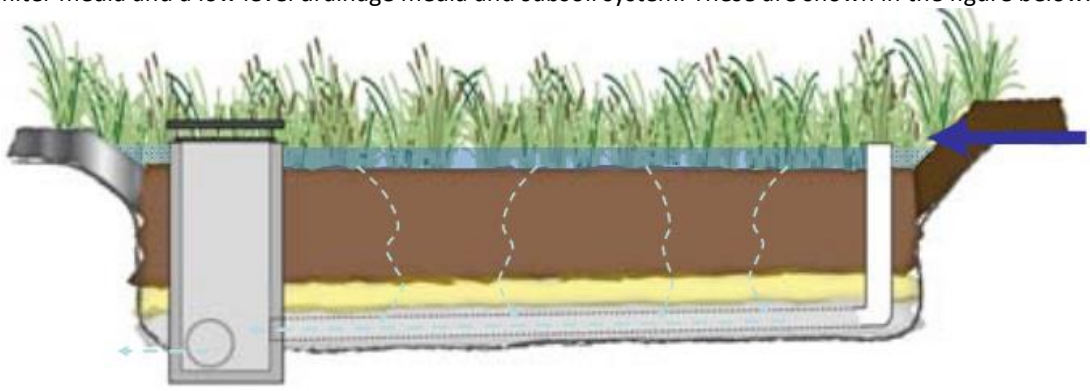

Figure 6: Typical Section of a generic Bio-retention system (Source: Water by Design)

7.3 Pollutant Reduction Modelling

In order to demonstrate that the proposed treatment train meets the required reduction targets, pollutant reduction modelling is proposed using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Software program Version 5.0 by eWater CRC. Pollutant export rates are currently only available for Total Suspended Solids (TSS), Total Nitrogen (TN), Total Phosphorous (TP) and Gross Pollutants (GP). Therefore only quantitative modelling for TSS, TN, TP & GP has been undertaken using MUSIC.

Modelling has only been undertaken on the post-development proposal with SQID's installed so as to demonstrate the percentage reduction for each pollutant type.

7.3.1 MUSIC Program Setup

This section explains the setup of the MUSIC model with the detailed pollutant reduction calculations being included in the MUSIC results in Appendix C.

For Music Modelling (using MUSIC 6.2.1) the following parameters have been used:

Table 2: MUSIC modelling parameters

Model Parameters	
Meteorological Data:	Sydney
Evaporation Data:	Period: 1959
Time Step:	6 minute

Table 3: Catchment modelling parameters

Node Description	**Area (Ha)**	**Percentage Impervious (%) / Area Impervious (Ha)**		**Land Use Rainfall and Pollutant Parameters**
Building Roof Catchment	0.364	100	0.364	Urban Residential
External Areas	0.160	100	0.160	Urban Residential
Bypass Area	0.243	0	0	Revegitated
	Total: 0.767Ha	Effective FI 68%		

7.3.2 MUSIC Results & Parameters

MUSIC Model

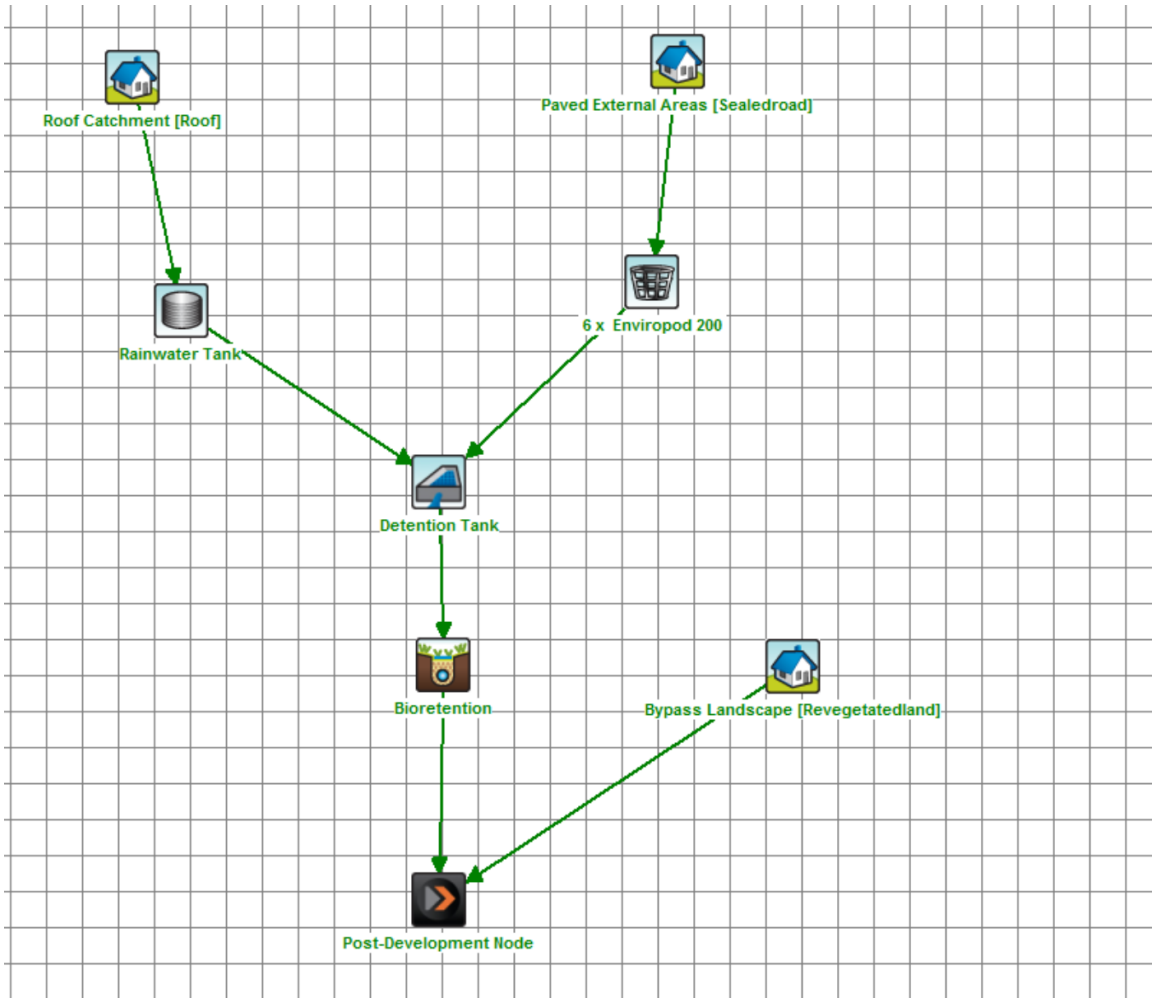

Figure 7 MUSIC Model

MUSIC Output

	Sources	Residual Load	% Reduction
Flow (ML/yr)	8.18	5.54	32.4
Total Suspended Solids (kg/yr)	956	120	87.5
Total Phosphorus (kg/yr)	2.13	0.452	78.8
Total Nitrogen (kg/yr)	17.6	6.27	64.4
Gross Pollutants (kg/yr)	171	0	100

Figure 8 MUSIC Results

MUSIC Runoff Generation Parameters

The following properties have been used in the MUSIC Modelling based on the Land Use Rainfall and Pollutant Parameters.

Table 4: Recommended MUSIC Runoff Generation Parameters

Parameter	Urban Residential
Rainfall Threshold (mm)	1.0
Soil Capacity (mm)	120
Initial Storage (%)	25
Field Capacity	80
Infiltration Capacity Coefficient a	200
Infiltration Capacity Coefficient b	1.00
Initial Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Drainage Rate (%)	5
Daily Deep Seepage Rate (%)	0

MUSIC Concentration Parameters

Table 5: MUSIC Concentration Parameters for Parramatta Catchments

Land-use Type	Parameters	TSS Log10 mg/L		TP Log10 mg/L		TN Log10 mg/L	
		Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow
Roof Catchment	Mean	1.1	1.3	-0.82	-0.89	0.32	0.30
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19
External Areas	Mean	1.2	2.43	-0.85	-0.3	0.11	0.34
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19
Vegetated Bypass	Mean	1.15	1.95	-1.22	-0.66	-0.05	0.30
	STD Dev	0.17	0.32	0.19	0.25	0.12	0.19

7.3.3 Pollutant Reduction Results

A number of management measures have been considered with a focus on reducing polluted runoff volumes from the site. The WSUD principals proposed for stormwater treatment includes the following SQID's:

- Rainwater Tank
- Detention Tank
- Gross Pollutant Traps
- Raingarden

The effectiveness of the treatment devices proposed in the above section has been modelled using MUSIC with the overall treatment train efficiency results shown in Table 6 below.

Table 6: Treatment Train Efficiencies

Indicator	Total Site Reduction	Site Targets	Target Achieved
Gross Pollutants	100%	90%	Yes
Total Suspended Solids (TSS)	87.5%	85%	Yes
Total Phosphorus (TP)	78.8%	60%	Yes
Total Nitrogen (TN)	64.4%	45%	Yes

From the results presented above it can be seen that the proposed SQID's mean that the stormwater quality treatment meets with the reduction targets set for the development.

8. Erosion & Sedimentation Control

Landcom have published a design guide entitled "Managing Urban Stormwater - Soils and Construction" which is regarded as the standard to which erosion and sedimentation control should be designed to within NSW. Northern Beaches Council specifies compliance with the Landcom design guide in there Design Guidelines Subdivision/Developments.

The control of erosion and sedimentation describes the measures incorporated during and following construction of a new development to prevent the pollution and degradation of the downstream watercourse.

A Soil and Water Management Plan has prepared as part of the development application documentation and is included in Appendix A of this report.

Common control measures adopted are:

- Sedimentation fences;
- Sedimentation basins;
- Stormwater drainage inlet protection;
- Overland flow diversion swales;
- Shaker Grids and wash downs for vehicles leaving the construction site;
- Dust control measures.

The maintenance of these control measures throughout their intended lifespan will ensure that the risk of erosion and sedimentation pollution of the downstream watercourse will be minimized.

Appendix A – Civil Drawings

CIVIL ENGINEERING WORKS

SHEET LIST TABLE	
Sheet Number	Sheet Title
CI-000-01	COVER SHEET
CI-007-01	SPECIFICATION NOTES - SHEET 1 OF 2
CI-007-02	SPECIFICATION NOTES - SHEET 2 OF 2
CI-050-01	GENERAL ARRANGEMENT PLAN
CI-060-01	SITEWORKS PLAN
CI-070-01	SEDIMENTATION & EROSION CONTROL PLAN
CI-402-01	ROADS LONGSECTIONS
CI-403-01	TYPICAL ROAD SECTIONS
CI-405-01	MC01 - ROAD CROSS SECTIONS - SHEET 1 OF 4
CI-405-02	MC01 - ROAD CROSS SECTIONS - SHEET 2 OF 4
CI-405-03	MC01 - ROAD CROSS SECTIONS - SHEET 3 OF 4
CI-405-04	MC01 - ROAD CROSS SECTIONS - SHEET 4 OF 4
CI-405-11	MC02 - ROAD CROSS SCETIONS - SHEET 1 OF 5
CI-405-12	MC02 - ROAD CROSS SCETIONS - SHEET 2 OF 5
CI-405-13	MC02 - ROAD CROSS SCETIONS - SHEET 3 OF 5
CI-405-14	MC02 - ROAD CROSS SCETIONS - SHEET 4 OF 5
CI-405-15	MC02 - ROAD CROSS SCETIONS - SHEET 5 OF 5
CI-406-01	ROADS DETAILS
CI-440-01	PAVEMENT PLAN
CI-480-01	SIGNAGE & LINEMARKING PLAN
CI-500-01	STORMWATER DRAINAGE CATCHMENT PLAN
CI-520-01	STORMWATER MANAGEMENT PLAN
CI-526-01	STORMWATER MANAGEMENT DETAILS

JACKSON TEECE
Architecture

JACKSON TEECE	181 ALLAMBIE ROAD, ALAMBIE HEIGHTS	WOOD & GRIEVE ENGINEERS	38509	CI-000-01	C
CLIENT	PROJECT		PROJECT No	DRAWING No	REV

1 EARTHWORKS

1.1 GENERAL

1.1.1 Extent of Contract

This specification is for the carrying out of all earthworks indicated on the drawings. It is the Contractor's responsibility to assess the nature of the soil being cut or filled and to select plant which will achieve the specified results. The Contractor shall also make his own assessment of the quantities of earthworks to be carried out, including the accuracy of existing contours and any effect on the levels of the in-situ material due to the operations selected by the Contractor.

1.1.2 Standards

Earthworks shall be completed in accordance with:

- Local Authority Standards and Specifications
- AS 3798-1996 Guidelines on Earthworks for Commercial and Residential Developments
- AS 1289 Methods of Testing Soils for Engineering Purposes
- AS 2870-1996 Residential Slabs and Footings – Construction
- AS 1726-1993 Geotechnical Site Investigations.

1.1.3 Existing Services

The Contractor shall familiarise himself and all personnel on Site, under his direction, with the location of all existing services on and adjacent to the Site and he shall be responsible for the cost of repairing any damage caused to existing services. This repair work shall be carried out by the relevant Authority and shall be arranged by the Contractor.

1.1.4 Disturbance to Private Properties

The Contractor shall not cause any damage to, and shall take reasonable precautions to avoid excessive disturbance to any private property due to dust, vibration, noise, etc., resulting from these works. The Contractor shall not enter onto private property without the written consent of the land owner.

1.1.5 Natural or Existing Vegetation

In areas not requiring earthworks, access for machines shall not be permitted. Any unauthorised disturbance shall be remediated to the full satisfaction of the Local Authority or relevant government department and all costs borne by the Contractor.

1.2 EARTHWORKS GEOTECHNICAL CERTIFICATION

Where applicable, all cut and fill operations are to be undertaken in accordance with the recommendations of the Geotechnical Report supplied with this tender as amended throughout the Contract under the instruction and supervision of the Geotechnical Consultant to achieve Level One Certification. The Geotechnical Consultant is to be engaged to provide a full time inspection and testing service on all earthworks and is to establish the location and frequency of sampling and testing of the earthworks operations to allow certification.
Where no Geotechnical Consultant or report has been established prior to Tender, the Contractor is to engage his own Geotechnical Consultant to supervise and certify all earthworks operations as directed by the drawings and the Local Authority requirements.

1.3 QUALITY ASSURANCE – EARTHWORKS

The Contractor shall produce, and submit to the Superintendent, verified records to confirm that the specification requirements have been achieved as follows:

	Item	Test/Record	Frequency
a)	Topsoil stripping	Contractor's Certificate	1 per project
b)	Finished Earthworks levels	Surveyed as-constructed drawing showing finished contours	1 per project
c)	Compaction - bulk fill	Compaction Certificate	As directed by the Local Authority and/or Geotechnical Testing Authority
d)	Compaction - method specification	Contractor's Certificate confirming roller, passes, water used etc	As directed by the Local Authority and/or Geotechnical Testing Authority
NB.	Compaction tests should be adequately distributed so as to give a good representation of the whole area, including additional testing within 2 metres of corners and edges of earthworked area.		
e)	Stabilisation (Hydromulch):		
	Mix details	Supplier's Certificate	1 per mix
	Application rate	Supplier's Certificate	1 per project
f)	Retaining Walls:		
	Independent Certification (Design)	Independent Structural Certification of Retaining Wall Design to suit in-situ soils	1 per wall type per location
	Foundation Compaction	Compaction Certificate	As directed by the Local Authority and/or Geotechnical Testing Authority
	Backfill Compaction	Compaction Certificate	As directed by the Local Authority and/or Geotechnical Testing Authority
	Finished Walls	As-constructed profiles with tolerances and locations	1 per 30m length of wall

The Contractor is to utilise and submit the standard Quality Assurance forms as contained in Appendix 2 to demonstrate the above quality assurance items.

1.4 CLEARING

Clearing must be approved by the Superintendent, the Arborist and the Specialist Fauna Consultant (where applicable) prior to clearing works commencing. The Contractor is to confirm whether all permits and requirements are in place prior to commencing clearing.
Clearing and grubbing shall be carried out in accordance with the appropriate Local Authority Specification for Clearing and Grubbing and Earthworks. The extent of clearing and grubbing shall be as shown on the approved earthworks plan, VMP or Landscaping drawings (where applicable). Written confirmation from the Local Authority is required confirming any variation from these documents before commencement of any works. Clearing works shall not commence until all approved landscaping plans and vegetation management plans are available on site. If there are any discrepancies between these plans, any trees in question shall be retained until advised in writing by the Local Authority, via the Superintendent.
As a minimum the clearing shall consist of removal from the area designated in the drawings of all trees, standing or fallen, and other vegetation, boulders and rubbish and shall include the grubbing out of all stumps and tree roots to a depth of 600mm below the natural surface or 400mm below the finished cut surface, whichever is the lower, and disposing of all spoils resulting from the clearing and grubbing. Any holes left after grubbing shall be filled and compacted to the same density as that of the surrounding undisturbed soil.
As little as possible of the surface soil shall be removed during clearing operations.
The Contractor shall take precautions to minimise damage to growing trees and shrubs, fences and other improvements outside the designated areas, and any damage shall be made good. Trees that are shown as being retained on the approved drawings, Vegetation Management Plan or identified on site shall not be damaged in any way during construction. Any costs required for any remedial works to damaged trees will be the responsibility of the Contractor.
The spoils of all clearing and grubbing operations shall be removed from the Site. No spoils of clearing and grubbing shall be pushed beyond the limits of the site, or burnt.
The tender shall include the provision of temporary fencing as shown on tender drawings.

1.5 RUBBISH MATERIAL

Rubbish material such as concrete, bricks, any other building waste or material which is deemed unsuitable for use as fill shall be considered "Unsuitable Material" for the duration of the contract. Removal of any rubbish material which is visible from a site inspection at the time of tendering shall form part of the contract works. The Contractor shall allow for the removal and dumping of this material off site within their tender.
In cases where rubbish material is left by others after the close of tenders, or is discovered during excavations and could not reasonably have been expected at the time of tendering, the material shall be removed from site as directed by the Superintendent and shall form a variation to the Contract.

1.6 MULCHING / CHIPPING

All tree trunks, branches and stumps smaller than or equal to 400mm in diameter, including leafy material, shall be mulched (unless noted otherwise) and neatly stockpiled in a site to be determined by the Superintendent.
Mulched material shall be generally 75mm maximum length and 15mm maximum diameter and shall be that material passing a 100mm maximum screen.
Chipping of logs between 200mm and 400mm diameter is acceptable (subject to Superintendent approval) however the chipped and mulched material shall be stockpiled in separate heaps.
All mulch and chippings are the property of the Principal and processed mulch/chippings shall not be used for any other purpose, nor removed from the site without specific approval from the Superintendent.
The intent of these works and this specification is to maximise the volume of mulch/chippings for use on stabilising fill batters and the contractor shall undertake all works accordingly.
Due to the risk of self-combustion, stockpiles are to be placed in areas away from bushland and assets, preferably on cleared land. Where this cannot be achieved, sufficient firebreaks should be created such that stockpiles are accessible to water carts from all sides of the stockpile.
Where practical, stockpiles shall be positioned where they will be in passing view of workers to assist in monitoring.
The tops of stockpiles shall be struck flat and are to be thinned out to a height not exceeding 2m.
Water carts are not to be driven over stockpiles as they may cause burnt material to collapse under the weight of the machine.
In the event of a small fire or smoke arising from a stockpile, the heap shall be smothered with sand or water. Where the fire or smoke persists, the stockpile shall be thinned out and sand or water shall be reapplied until under control.
Where a stockpile is in close proximity to water access, a pipe with sprinkler shall be attached to the top of the heap.

1.7 STRIPPING OF TOPSOIL

The existing topsoil shall be stripped from all areas to be earthworked, prior to the commencement of the earthworks, and stockpiled on site.
Topsoil is defined as the layer of surface material containing humus, roots, plants and organic material exceeding one percent by weight.
The Contractor shall allow in his Tender the cost to remove and dispose of excess topsoil offsite.

1.8 CUTTING TO DESIGN LEVELS ***AMEND***

Following the removal of topsoil and proof rolling (if specified by the Geotechnical Certifier), areas shown to be cut shall be cut to achieve the levels shown on the drawings.
Any areas which are over excavated shall be refilled to the design levels shown on the drawings. Any refilling shall be placed as specified in "Filling to Design Levels" section below.
Where no fill is to be applied, cut surfaces shall be finished by further proof rolling as directed by the Geotechnical Certifier.
Any area in which rock is excavated within a future lot area, the rock shall be over-excavated to a minimum depth of 600mm below finished level and suitably crushed and replaced (where achievable) or replaced with compacted structural fill as directed by the Geotechnical Certifier.
The Contractor shall make reasonable efforts to ascertain whether any rock exists within 600mm of the surface by test pitting or other methods.

1.9 FILLING TO DESIGN LEVELS

Fill material shall be placed as directed by the Geotechnical Certifier, which shall be varied to suit the material being placed, and the method of compaction.
The Contractor shall assess the fill quantities required within the earthworks area and allow to import any shortfall of fill. All associated costs shall be included in the tender.
Each layer of fill material shall be compacted in accordance with the Local Authority standards and specifications, and as directed by the Geotechnical Certifier. As a minimum, compaction shall achieve a minimum density ratio of 95% as obtained in test AS 1289.5.4.1 with maximum dry density determined in accordance with AS 1289.5.2.1 (modified compactive effort).
The Contractor is to have any material, which is proposed to be re-utilised in trenches or earthworked areas, tested to determine characteristics to allow suitable compaction to be achieved.
The Contractor is to ensure that all materials are placed in layers and at a moisture content as directed by the Geotechnical Certifier to achieve the desired compaction.

1.10 EXCESS SPOIL

Where after the completion of earthworks there is excess spoil it shall be placed on site as shown on the drawings. Where no direction is given on the drawings, all excess spoil shall be removed from the site at the Contractor's expense.

1.11 TOPSOIL

1.11.1 Re-spreading Topsoil

The topsoil for respreading shall be assessed and blended on site to comprise not more than 20 percent by weight of vegetable and humus material, not more than 20 percent below the 75 micron sieve size and a maximum soil particle size of 50mm. The topsoil shall be free of vegetation pieces larger than 200mm in any one direction. Topsoil shall be spread uniformly to a thickness not less than 50mm and not more than 100mm. The Contractor shall allow in his tender for the removal of all excess topsoil from site. The Contractor is to seek direction from the Superintendent prior to the removal of excess topsoil from the site.

1.12 TOLERANCES

The completed earthworks levels shall be within plus 100mm or minus 0mm of the design levels without retaining walls shown on the drawings. Where retaining walls exist or will exist in the future, the earthworks tolerance shall be within plus 50mm or minus 0mm of the design levels shown on the drawings. The design levels are the levels on the completed earthworks including respread topsoil.

1.13 TESTING BY AN INDEPENDENT GEOTECHNICAL CERTIFIER

Earthworks shall be progressively tested in accordance with the Local Authority standards and specifications to an independent Level One Geotechnical Certification (unless specified otherwise) as defined in Appendix B of AS3798-1996, to demonstrate that the specified relative compaction has been achieved.
Field density testing shall be completed and certified by an independent NATA registered laboratory. The laboratory shall calibrate field density testing apparatus against laboratory tests. Field density tests may consist of sand replacement to AS 1289.5.3.1 or nuclear density tests to AS 1289.5.8.4 to 5.8.9.
The Contractor shall allow for the independent Geotechnical Certifier to provide a testing and inspection supervision service on all earthworks suitable to the level of geotechnical certification required. The Geotechnical Certifier shall establish the type, number and frequency of the testing regime appropriate for the works involved.
General fill shall be tested by means of sand replacement or nuclear density tests.
The frequency of testing shall be as listed in the clause "Quality Assurance - Earthworks" of this specification.
All costs for this testing shall be incorporated in the tender.
Additional tests may be directed by the Superintendent and the Contractor shall arrange for the performance of such tests. Where the results of such tests indicate that the specified densities have been achieved, the cost of the tests will be paid by the Principal through a Provisional Sum for testing.
The results of all tests shall be recorded on the appropriate forms as included in this specification.

1.14 EARTHWORKS AS-CONSTRUCTED INFORMATION

On the completion of the following stages of earthworks, the Contractor shall provide a detailed survey pick-up of As-Constructed levels over the earthworked area using an Engineering Surveyor:

- Over excavation surface levels (on top of rock) prior to the placement of structural fill, and
- On the finished earthworked surface level.

Practical completion will not be granted until this information has been provided to the satisfaction of the Superintendent.

1.15 STABILISATION

1.15.1 Stabilisation by Topsoil and Seeding

Surface stabilisation shall be carried out with a minimum 50mm and maximum 100mm layer of seeded topsoil across all disturbed areas as specified in the drawings (unless otherwise noted). Where the Contractor has insufficient topsoil to achieve this minimum topsoil thickness the Contractor shall obtain the Superintendent's direction before proceeding further.

1.15.2 Hydromulching

Hydromulching shall be applied (unless noted otherwise) by a Sub-contractor specialising in this work as directed by the contract and drawings. The Contractor shall obtain the Sub-Contractor's recommendations and submit these to the Superintendent.
In the absence of specialist advice, hydromulching shall consist of a mixture of 1,200kg to 1,400kg newspaper, 200 litres of stabiliser (eg Gluon 240) and 10,000 litres of water. The hydromulch shall be thoroughly mixed and applied by pressurised spray at the rate of 40kl to 50kl per hectare.

Prior to spraying the hydromulch, if specified by the Superintendent, the area shall be fertilised with Superphosphate at the rate of 200kg per hectare. Seed shall be included in the hydromulch mix as follows:

Cereal Rye	100kg per hectare
Wimmera or Merredin Rye	20kg per hectare
Serena, Circle Valley or Rose Clover	20kg per hectare

1.16 FINISH

All finished surfaces shall be graded to the finished presentation stage prior to hydromulching, including:

- Rolling the finished earthworks prior to topsoil spreading
- Evenly graded changes between design levels and contours
- All wheel tracks and other disturbances levelled out
- Removal of all debris or rock pieces greater than 100mm in any direction from the surface
- Removal of all spoil heaps
- Rolling or smudge boarding the finished topsoil surface.

1.17 RETAINING WALLS

1.17.1 General

The Contractor shall allow for the co-ordination and engagement of a suitably qualified structural and geotechnical consultant to provide the detailed design and construction certification of the retaining walls to suit the in-situ site soil conditions, applicable surcharge loading for the wall location and the general application of the wall.
The Contractor shall fully supervise and coordinate the construction of all retaining walls within the Contract. The Contractor shall co-ordinate the wall certifier to ensure full design and construction certification can be submitted during and at the completion of the works in accordance with the Local Authority or Building Certifier requirements. Failure to submit certification will result in the wall being removed and replaced at the Contractor's expense to the satisfaction of the Superintendent.
Any discrepancies between the drawings, specification and current or preferred work practices shall be brought to the attention of the Superintendent prior to closing of Tenders.
Where retaining walls form part of the Contract works, any general arrangement or structural details shown on the construction drawings shall be treated as preliminary only, unless specifically noted otherwise.
For all proposed standard or proprietary product walls (eg Concrib, Besser Block, Concrete Sleeper etc) the design specification, materials, preparation, installation, backfill and workmanship is to be in accordance with the manufacturer's specification and certification requirements.

1.17.2 Retaining Wall Building License

The Contractor shall obtain a Building License from the relevant Local Authority in accordance with the Preliminaries section of this specification as required by the Authority.

1.17.3 Setting Out for Constructing Retaining Walls

The Contractor shall allow in his tender for all costs associated with engaging the Licensed Surveyor to set out and check the location of all retaining walls prior to and at the end of construction. Such cost shall be borne by the Contractor.

1.17.4 Subsoil Drainage Lines Behind Retaining Walls

All retaining walls are to have appropriate granular drainage backing material with a subsoil drainage line installed in accordance with the relevant Authority requirements. All subsoil lines are to grade at a minimum of 1:200 and be connected to the closest stormwater drainage pit or daylighted with appropriate scour protection in a location which does not result in nuisance flows or the potential for long term blockage.

1.17.5 Safety Fencing

Wall heights of 1m and over shall have a safety fence installed along the back of the wall. The fence as a minimum shall include star-iron pickets hammered securely into the ground with two strands of sighter-wire and high visibility plastic mesh. Fence height shall be minimum 1.2m in height. Star-iron pickets are to be installed with plastic protective caps.

1.17.6 Retaining Wall As-Constructed Requirements

The Contractor shall produce As-Constructed profiles of wall cross sections for actual heights and widths and As-Constructed plans of wall positions. The Contractor shall mark up the retaining wall sections to illustrate any changes that occurred during construction.
The As-Constructed information shall be signed and certified as accurate and correct by the Contractor's certifier and Surveyor before being submitted to the Superintendent for approval. Costs to provide As-Constructed information shall be part of the Contractor's tender.
The Contractor shall provide compaction test certificates to all retaining wall foundation and backfill in accordance with Quality Assurance and Testing provisions of this specification.
The Contractor shall submit foundation compaction test results prior to construction of walls commencing or before subsequent backfill layers as appropriate. The Superintendent may request additional testing in accordance with the Provisional Sum section of this specification.

1.17.7 Tolerances

For all walls the level at the top of the wall shall be no more than -0mm to +50mm overall from the design level.
Wall faces shall not deviate from the design as shown.
Walls shall at all times be contained within the designated site or lot boundary including all footings and drainage backing layers.

1.17.8 Fees and Charges

The Contractor shall apply for all building licenses and obtain approvals to carry out the work as required by the Local Authority.
The Contractor shall pay all fees associated with building licenses and approvals.

2 FOOTPATHS

2.1 GENERAL

All footpath works shall be constructed in accordance with the drawings and the relevant Local Authority specification and will be subject to inspection and the approval of the relevant Local Authority and the Superintendent.
In relation to the footpaths portion of the specification, the term Local Authority will be taken to mean the Local Shire Council or the Local Main Roads Department where applicable to the works being undertaken. The term footpath in this specification will be deemed to cover all pathways, cycleways or the like designated on the tender drawings.
Any instructions from the Local Authority pertaining to the works shall be issued by that Authority to the Superintendent.
The extent of footpaths to be constructed is as shown on the drawings.
Footpaths may not be constructed until after all utility services, drainage, sewerage, major verge clearing and kerbing have been completed.

2.2 CLEARING

The footpath alignment shall be cleared for the full width of the footway reserve or as noted on the drawings.
Clearing shall be carried out in accordance with the "Clearing" clause in the Earthworks section.

2.3 SUB-GRADE

The entire width of the proposed footpath shall be cut or filled as necessary.
After excavation or filling, compacting, trimming and boxing out, the finished surface of the footpath sub-grade shall conform to the shape and dimensions shown in the drawings.
Sub-grade is to be compacted to not less than 95% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1-2003) to a minimum depth below the surface of 300mm.
All filling shall be placed in generally horizontal layers not exceeding 250mm and compacted prior to the placing of further material.
Where required by the Local Authority a sand bed of clean sand, free from roots, clay or any deleterious matter shall be placed and compacted to the designed footpath width. The bedding shall be compacted in accordance with the relevant Local Authority standard or to not less than 90% of the maximum dry density obtained in the modified maximum dry density compaction tests (AS 1289.5.2.1-2003).

2.4 CAST IN-SITU CONCRETE PATHS

2.4.1 Dimensions

The footpath shall be constructed with a cross-fall as allocated by the relevant Local Authority towards the kerb unless otherwise noted on the drawings. The finished thickness of the slab to be a minimum of 100mm or as specified by the Local Authority. The width of the path shall be as shown on the drawings.

2.4.2 Construction

Where the path is constructed in the road reserve, the longitudinal profile of the path shall be the same as the longitudinal profile of the adjacent kerbing. Elsewhere, the path longitudinal profile will be such as to achieve a uniform smooth grading and alignment, and generally conform to the surrounding finished ground or as shown on the drawings.
No concrete shall be poured until the sand bedding and or subgrade has been approved by the Superintendent.

2.4.3 Concrete

The concrete used in this construction shall conform to AS 3600 and be provided by an approved pre-mixed concrete supplier, conforming with AS 1379. Each batch provided shall be supported with evidence of strength slump, aggregate size, etc.
The concrete strength aggregate size and slump should be as specified by the Local Authority.
The concrete, when placed, must be well tamped to remove all voids and to work fines to the surface for trowelling.

2.4.4 Contraction and Expansion Joints

Contraction and expansion joints in footpaths shall be constructed in accordance with the Local Authority specifications, or when silent, the following shall apply:

- Contraction joints are to be placed at 2m intervals.
- Expansion joints are to be placed at every third contraction joint and to the surround of all utility manholes or covers and against the back of kerb (where applicable).

All joints shall be aligned with joints in the kerbing where the path is against the back of kerb.

2.4.5 Finish

A brushed finish shall be provided to the surface of the slab with joints and edges polished in accordance with the Local Authority specifications.
The alignment of the edge of the path is to be straight and true to line. Deviations from alignment or from specified width will not be accepted. The path shall be parallel with the kerbing in vertical and horizontal alignment.

2.4.6 Protection

Barricade, warning signs and lights shall be erected to prevent damage of the footpath from vehicles and pedestrians for not less than 24 hours after completion or if rainfall during the curing period is apparent.
The Contractor is responsible for protection of the path against damage of any kind during the period of setting and curing of the concrete.

2.4.7 Clean Up and Backfilling

All cement droppings, slurry, etc. and surplus materials to be removed from site.
All formwork, pegs, stakes, etc. shall be removed after the curing of the path has been completed.
After removal of the formwork, and acceptance of the path by the Superintendent and the Local Authority, the path shall be backfilled with topsoil. Backfilling shall be compacted to not less than 90% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1-2003) and shaped level with the top of path.

3 STORMWATER DRAINAGE

3.1 GENERAL

All stormwater works shall be constructed in accordance with the tender drawings and the relevant Local Authority Specification and standard drawings, and will be subject to inspections and approval of the relevant Local Authority and the Superintendent. Any discrepancy between the Local Authority standards and those shown on the tender drawings shall be referred to the Superintendent prior to construction.
In relation to the stormwater portion of the specification, the term Local Authority will be taken to mean the Local Shire Council or the Local Main Roads Department where applicable to the works being undertaken.
Where works are not municipal works, all works shall be constructed in accordance with the tender drawings and AS 3500.3.
Any instructions from the Authority pertaining to the works shall be issued by that Authority to the Superintendent.
The Contractor shall provide a minimum of 48 hours notice, to the Superintendent so a joint audit inspection of each stage of construction can be arranged with the Local Authority. The Contractor shall also attend. Each stage shall be inspected prior to commencing the next or following stage. The Contractor shall rectify any areas considered unacceptable due to poor workmanship or materials and this shall be reinspected prior to continuing with the next stage of work.
Joint audit inspections with the Contractor, the Superintendent and a Local Authority Representative shall be actioned on the following basis:

- When the stormwater pipes and other structures have been laid to final line and level and prior to backfilling of the trenches; and
- After junction pits, gullies and other structures have been constructed and the backfilling of trenches completed.

Quality Assurance – Drainage
Prior to commencing on the next stage of the works, the Contractor shall produce and submit to the Superintendent certified records to confirm that the Local Authority specifications and requirements have been achieved. Where the Local Authority specifications are silent, the following minimum testing regime shall be applied:

Item as Specified	Test/Record	Frequency
Materials Specification	Supplier's Certificate	1 per delivery
Drain set-out	Contractor's Survey record	1 per drain line
Drain Construction	Survey as-constructed details (as per standard form - see Appendix 2) Invert levels Access chamber locations Access chamber cover levels Bedding details Gully locations Gully type/level Pipe size/type	1 per drain line
Drain Testing	CCTV Testing	1 per drain line
Backfill	Contractor's Certificate	1 per drain line
Compaction	Compaction Certificate (as per standard form – See Appendix 2)	3 tests per drain line per layer (incl trench base) and adjacent to chambers.

The contractor shall note on the record where any item fails to meet the specified requirements, including the planned remedial action to be taken.

3.2 TOLERANCES

The Local Authority standards are to be used to establish the allowable tolerance in relation to Stormwater Drainage works. Where the Local Authority standards are silent, the following construction tolerances shall be achieved by the Contractor:

Grades steeper than 1:500	± 10% of design grade and ± 20mm of design invert level
Grades flatter than 1:500	up to 10% steeper, but not less than 5% flatter than design grade and ± 10mm of design invert levels

The horizontal deviation of any piped or box culverted drain shall not exceed 25mm from the true alignment. There shall be no obvious sharp changes of direction.

3.3 MATERIALS

3.3.1 Australian Standards

All workmanship and materials used in the works shall conform to the current Local Authority standards where such standard exists. Where such standard does not exist, the current Australian Standard shall apply.

3.4 SETTING OUT

3.4.1 General

The drawings show centre lines, grades, lengths, diameters, invert levels at entry and exit of drains and the location of access chambers.
The distances shown between access chambers are mostly scaled measurements and are for the Contractor's guidance only. In all instances access chambers are to be constructed in the locations shown. Centre lines and invert levels are to be strictly adhered to and no alterations shall be made except on the written authority of the Superintendent.

3.4.2 Setting out of Drainage Lines and Structures

All set out shall be undertaken by an Engineering Surveyor, arranged for by the Contractor at his expense.
The centre of each access chamber shall be pegged and at least two reference stakes placed offset from the access chamber centreline.
The Contractor's Engineering Surveyor shall provide the Contractor's Foreman with a copy of his survey record for each drain. The record shall indicate all reference pegs, offset pegs, RLs of dumpy pegs, access chamber to access chamber distance, and the distance to house connections (where applicable). Records shall be retained by the Foreman on Site and shall be available for inspection by the Superintendent.

3.5 EXCAVATION

3.5.1 General

Tenderers must form their own opinion, and take what tests on site they consider necessary to ascertain what the nature of the ground is, sub-surface strata and ground water levels.
Clearing, topsoil and stabilisation shall be carried out in accordance with the Earthworks section of this specification.

3.5.2 Rock Excavation

The Contractor is to allow in his tender for all excavation works including the removal of all rock.
Rock for the purpose of variations is as defined in the Preliminaries section of this specification.
Blasting shall be undertaken as specified below.

3.5.3 Dewatering

The Contractor shall allow within his Tender the cost of all dewatering and any additional construction costs due to wet ground conditions.
In the event of water being encountered, the Contractor shall make adequate provision to ensure that the excavation is kept free from water during the process of concrete pouring and for a period of at least 24 hours after the concrete pour. No bedding or pipes shall be laid in water and trenches are to be kept free from water until refill is commenced.

3.5.4 Trench Excavation

Trenches are to be cut to line and gradient. The line of cut for each side of the trench shall be marked out on the surface before excavation commences.
The trench widths shall be kept to a minimum consistent with the bed width requirements and the requirements of adequate working space and timbering.
Tunnelling shall be only carried out where directed by the Superintendent, and the Contractor shall submit details of tunnelling method prior to commencement for the approval of the Superintendent.
Should the bed of the trench be over excavated, then the over-excavated volume shall be replaced in accordance with the Earthworks section of this specification.
All trench excavation shall be made in a safe manner with all trenches either being shored or battered back to achieve this. The Contractor shall comply with the Construction Safety section of this specification.
Trenches shall be kept free from water, debris and falling earth.
The final trimming of the bottom 150mm of trench excavation should not be carried out until immediately prior to concreting or placement of pipe bedding. Excavation must be completed for a minimum of 10 metres length ahead of pipe laying.

3.5.5 Drainage Structure Excavation

Excavation for all drainage structures must be made to the correct depth and of sufficient dimension to allow the base and walls to be constructed as needed.

The Contractor shall be responsible for safety at all times.

3.5.6 Blasting

Blasting shall be only carried out with the approval of the Superintendent and prior to any blasting, the Superintendent and the Contractor shall inspect all necessary safety precautions. Handling, safety precautions and storage of explosives shall be in accordance with the requirements of the Mines Regulation Act 1946, the Explosives and Dangerous Goods Act 1961, AS 2187 Part 1 1984 and AS 2187 Part 2, Rules for the Storage and Handling of Explosives, AS 2188, Magazines for Handling of Explosives and such other precautions as the Superintendent may require.
Blasting shall only be carried out by a person holding a current permit.

3.5.7 Excavation in Existing Roadways, Footpaths etc.

Excavation is to be kept to a minimum in existing roadways, footpaths and other paved areas, ensuring that damage to such structures is kept to a minimum. The Local Authority shall be notified and that Authority's approval received prior to commencing work in roadways and footpaths.

3.5.8 Measurement of Excavation

Measurement of excavation for the purpose of costing variations shall be in accordance with the minimum trench dimensions shown on the drawings, and measurement shall comply with AS 1181 "Method of Measurement of Civil Engineering Works."

3.5.9 Obstruction to Traffic

Excavation material shall be deposited in an area causing the least interference to vehicular and pedestrian traffic.
At all times when the works are left unattended, all excavation in public areas shall be fenced off with warning signs and lighting and the Contractor shall ensure that they remain in a safe condition.
These safety precautions shall be subject to the approval of the Superintendent.

3.6 DRAIN CONSTRUCTION

3.6.1 Pipe Setting

All pipes shall be set in a straight line between access chambers or between access chambers and headwalls. On inspection by the Superintendent, any pipe not placed in a straight line shall be replaced at the cost of the Contractor.
Pipes shall be set in an upstream direction unless otherwise approved by the Superintendent.
All pipes are to be jointed in accordance with the relevant Australian Standards and manufacturer's specification.

3.6.2 RC Concrete Pipe Jointing

Spigot and socket pipes shall be jointed with the spigot fully home in the socket and rubber ring joint. Pipes shall be laid such that the sockets face upstream.

3.6.3 PVC Pipe Jointing

PVC pipes shall be jointed with the spigot fully home in the socket and the joint solvent cemented. The solvent cement used shall be the product recommended by the pipe manufacturer. The solvent cement shall be applied using a clean brush to both surfaces of the joint after these surfaces have been cleaned.

3.6.4 Pipe Bedding

All pipes shall be bedded in accordance with the relevant Local Authority specifications. Pipes constructed in dry sand conditions shall be bedded on a shaped trench base. Pipes constructed in wet ground conditions shall be bedded in accordance with the Local Authority standards, or where silent, on a minimum 100mm crushed rock bedding.

3.7 DRAINAGE STRUCTURES

All drainage structures shall be constructed in accordance with the relevant Local Authority standards.

3.8 STEP IRONS

Step irons shall be placed in all drainage structures in accordance with the relevant Local Authority specifications.

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DRAWN:	CPO
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APPROVED FOR TENDER:	RET 04.03.19
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JACKSON TEECE
Architecture

ARCHITECT/CLIENT

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

SPECIFICATION NOTES - SHEET 1 OF 2

PROJECT TITLE

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WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-007-01	C
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3.9 ROCK PITCHING

Rocks shall generally weigh in excess of 10 Kg each and the greatest dimension of any rock shall not exceed 1.5 times its least dimension.

Rock shall be hard, sound and durable, shall be set on a sand bed in a close fitting pattern and watered and rammed into position. Where no mortar is specified, all rock pitching should be placed on geofabric for the full extent.

Where specified as mortared rock pitching, the joints between stones shall be raked clean for their full depth and filled with a 3 parts sand to 1 part Portland Cement mortar. All rocks are to be securely positioned with adequate mortar to ensure that will not loosen or break away. Thickness of mortar between rocks to be a minimum as listed below:

- Half the depth of the proposed rocks for rocks between 150mm and 300mm in diameter;
- One third the depth of the proposed rocks for rocks larger than 300mm up to 600mm in diameter;
- Absolute minimum of 75mm for smaller rocks.

Mortared rock pitching is to be placed around all headwalls (to front and sides) regardless of whether they are upstream or downstream structures. Where no extent is shown, rock pitching in front of outlet headwall structures is to extend a minimum distance as determined by the applicable Main Roads specifications. Where no key is shown on headwall structures, mortared rock pitching is to be placed below the headwall for a minimum of 400mm length.

4.1 BACKFILLING

4.1.1 General

Backfilling of pipe trenches shall not be carried out until mains have been measured by the Superintendent.

The fact of any such work being backfilled does not relieve the Contractor in any way of his responsibilities and he may be called upon to uncover and repair such work, at his own cost, any pipeline declared by the Superintendent as unsatisfactory at any time until the end of the defects period. Any such repair work shall be subject to retesting at the Contractor's cost.

Backfilling of all pipes shall be in accordance with Local Authority standards. Where these standards are silent, then the following sections shall apply.

4.1.2 Plain Pipes

Structural fill shall be used for backfilling to a height of 300mm above the top of pipes and shall be compacted by means of an approved mechanical or a pneumatic tamper to not less than a density ratio of 90% as obtained in AS 1289.5.4.1 (modified compactive effort).

Care shall be taken so as not to disturb the pipe. Backfilling of the remainder of the trench shall be in accordance with the Earthworks section of this specification.

4.1.3 Perforated Pipes

Selected 10mm filter aggregate shall be used for bedding and backfilling to the pipe and shall be not less than 150mm thickness below and above the pipe and for the full width of the trench which shall be not less than 150mm either side of the pipe. The remainder of the trench shall be backfilled in accordance with the Earthworks section of this specification.

4.1.4 Restoration of Existing Streets and Laneways

After refilling, trenches in existing road reserves or laneways are to be maintained in a safe condition for traffic and pedestrians.

The final surface treatment shall be to the standard of the Local Authority and the Contractor shall obtain a letter from the Local Authority, indicating its approval of the final surface treatment, and submit a copy of this letter to the Superintendent.

4.2 TESTING OF TRENCH BACKFILL DENSITY

The trench backfill density shall be tested in accordance with the Earthworks and Quality Assurance – Drainage sections of this specification.

Trench compaction tests are to be taken on each layer of backfill as specified in the relevant Local Authority guidelines, and all certification forwarded to the Superintendent. Compaction is to conform to the relevant Authority Standards but where these are silent, shall be compacted at its optimum moisture content to a density of not less than 95% of the maximum modified dry density in accordance with modified maximum dry density tests (AS 1289.5.2.1-2003).

4.3 TESTING REGIME

All testing of drainage works is to be undertaken in accordance with the Local Authority specifications including any required CCTV testing.

The Contractor shall supply all equipment, labour and materials necessary for testing of the drainage in accordance with the Local Authority specifications.

4.4 AS-CONSTRUCTED SURVEY AND DOCUMENTATION

4.4.1 Survey

Using the Contractor's quality assurance measure up (see Quality Assurance - Drainage), the As-Constructed survey shall be carried out and the results recorded by the Contractor's Engineering Surveyor. The costs of all As-Constructed information requirements are to be incorporated into the Contractor's tender.

The As-Constructed requirements are as per the Preliminaries section of this specification.

The survey shall include all invert levels at access chambers, gully pits, headwalls and endwalls, centre to centre distance of pits, distances from centre of pits to headwalls or endwalls, size of pipes, types of pipes and bedding, location of pits in relation to adjacent boundaries, reduced levels of access chamber and entry pit covers.

4.4.2 Certification of As-Constructed Information

These drawings when completed shall be signed and certified as accurate and correct by the Engineering Surveyor and Contractor before submitting to the Superintendent who will then forward onto the Local Authority for their approval.

1.1.3 Acceptance

Acceptance of the works will follow the satisfactory completion of the works, authority inspection and acceptance of As-Constructed documentation.

1.5 CLEANING UP

Any damage done by the Contractor or his employees to buildings, fences, services, driveways etc. shall be immediately made good to the approval of the Superintendent.

During the period of the Contract, the Contractor shall clean up the construction site and remove all surplus construction material and debris from the site. At the completion of the Contract the Site shall be clean and tidy, all excavations filled flush with the natural ground level, and all excess material removed.

The Contractor shall immediately reinstate any subsidence over trenches occurring at any time during the defects liability period.

REV	DESCRIPTION	DRAWN	APP'D	DATE
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C	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... ../../..

JACKSON TEECE
Architecture

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181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

SPECIFICATION NOTES - SHEET 2 OF 2

TITLE

38509-CI-007-02.dwg

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-007-02	C
SCALE @ A1	PROJECT No	DRAWING No	REV

14/02/2020 12:35:47 PM

LEGEND

- PROPOSED SITE BOUNDARY
- PROPOSED BUILDING
- PROPOSED JUNCTION PIT
- PROPOSED GRATED PIT
- PROPOSED KERB INLET PIT
- ON SITE DETENTION TANK
- PROPOSED ASPHALT PAVEMENT
- PROPOSED CONCRETE FOOTPATH
- ROAD REINFORCED TURF.REFER TO LANDSCAPE ARCHITECT FOR DETAILS. FOR EMERGENCY ACCESS ONLY.
- TREE PROTECTION ZONE

BUILDING A

BUILDING B

BUILDING C

MC01

MC02

1:250 5 0 5 10 A1
1:500 A3

REV	DESCRIPTION	DRAWN	APP'D	DATE
C	ISSUED FOR TENDER	CPO	RET	13.03.19
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... /../../..

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181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

GENERAL ARRANGEMENT PLAN

TITLE

38509-CI-050-01.dwg

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-050-01	D
SCALE @ A1	PROJECT No	DRAWING No	REV

14/02/2020 12:36:51 PM

LEGEND

- PROPOSED SITE BOUNDARY
- PROPOSED BUILDING
- PROPOSED STORMWATER PIPE
- PROPOSED JUNCTION PIT
- PROPOSED GRATED PIT
- PROPOSED KERB INLET PIT
- ON SITE DETENTION TANK
- PROPOSED ASPHALT PAVEMENT
- PROPOSED CONCRETE FOOTPATH
- ROAD REINFORCED TURF.REFER TO LANDSCAPE ARCHITECT FOR DETAILS. FOR EMERGENCY ACCESS ONLY.
- TREE PROTECTION ZONE

EXISTING TREE TO BE RETAINED. NO TRENCHING OR EARTHWORKS IN CUT WITHIN THE TREE PROTECTION ZONE.

CONSTRUCT BERM TO DIVERT FLOWS FROM UPSTREAM CATCHMENT TOWARDS THE PROPOSED DISH DRAIN AT THE TOP OF THE PROPOSED NEW RETAINING WALL.

TRANSITION FROM KERB ONLY TO FLUSH KERB OVER 1.0m.

MAKE SMOOTH JOIN WITH EXISTING.

FFL: 130.000m

FFL: 127.050m

FFL: 127.050m

FFL: 125.200m

MC02

MC01

TRANSITION FROM K&G-1 TO K&G-2 THROUGH KERB RETURN.

MAKE SMOOTH JOIN WITH EXISTING.

TRANSITION FROM K&G-1 TO K&G-2 THROUGH KERB RETURN.

TRANSITION FROM KERB AND GUTTER TO FLUSH KERB OVER 1.5m.

LOCALISED BATTER DOWN TO MATCH INTO EXISTING FROM FOOTPATH. ARBORIST TO BE PRESENT ON SITE DURING FORMWORK TO ENSURE PROTECTION OF ADJACENT TREES.

LOCALLY GRADE FOOT PATH TO PROVIDE 1.2m LONG LANDING (2.5% MAX. GRADE IN EACH DIRECTION) BEFORE CARPARK.

SAW CUT Ex. PAVEMENT 600mm FROM FACE OF PROPOSED DISH DRAIN.

MAKE SMOOTH JOIN WITH EXISTING.

1:250 5 0 5 10 A1
1:500 A3

REV	DESCRIPTION	DRAWN	APP'D	DATE
E	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
D	ISSUED FOR TENDER	CPO	RET	25.03.19
C	ISSUED FOR TENDER	CPO	RET	13.03.19
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... /../../..

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181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW
PROJECT

SITEWORKS PLAN
TITLE

38509-CI-060-01.dwg
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WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-060-01	D
SCALE @ A1	PROJECT No	DRAWING No	REV

NOTE:
REFER DRAWING CI-076-01 FOR EROSION AND SEDIMENT CONTROL DETAILS

REV	DESCRIPTION	DRAWN	APPD	DATE
C	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
B	ISSUED FOR TENDER	CPO	RET	05.03.19
A	ISSUED FOR DA APPROVAL	CPO	IAH	01.06.18

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... JJJ...

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181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW
PROJECT

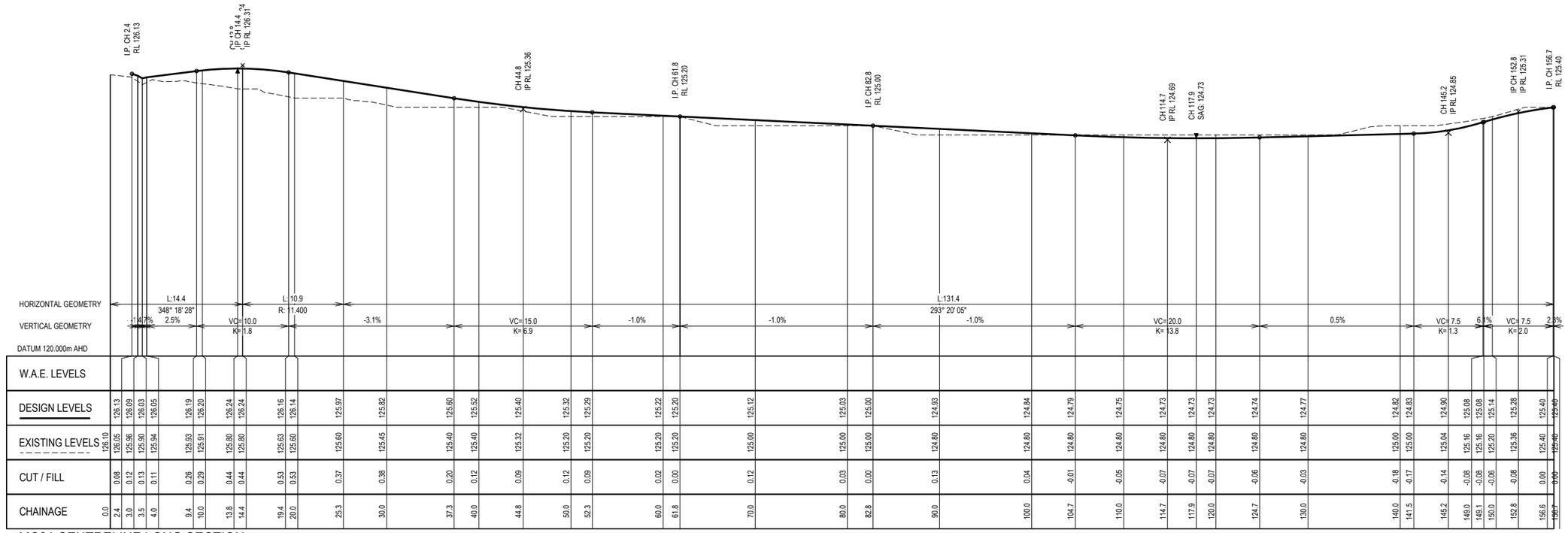
SEDIMENTATION & EROSION CONTROL PLAN
TITLE

38509-CI-070-01.dwg
14/02/2020 12:38:08 PM

WOOD & GRIEVE ENGINEERS

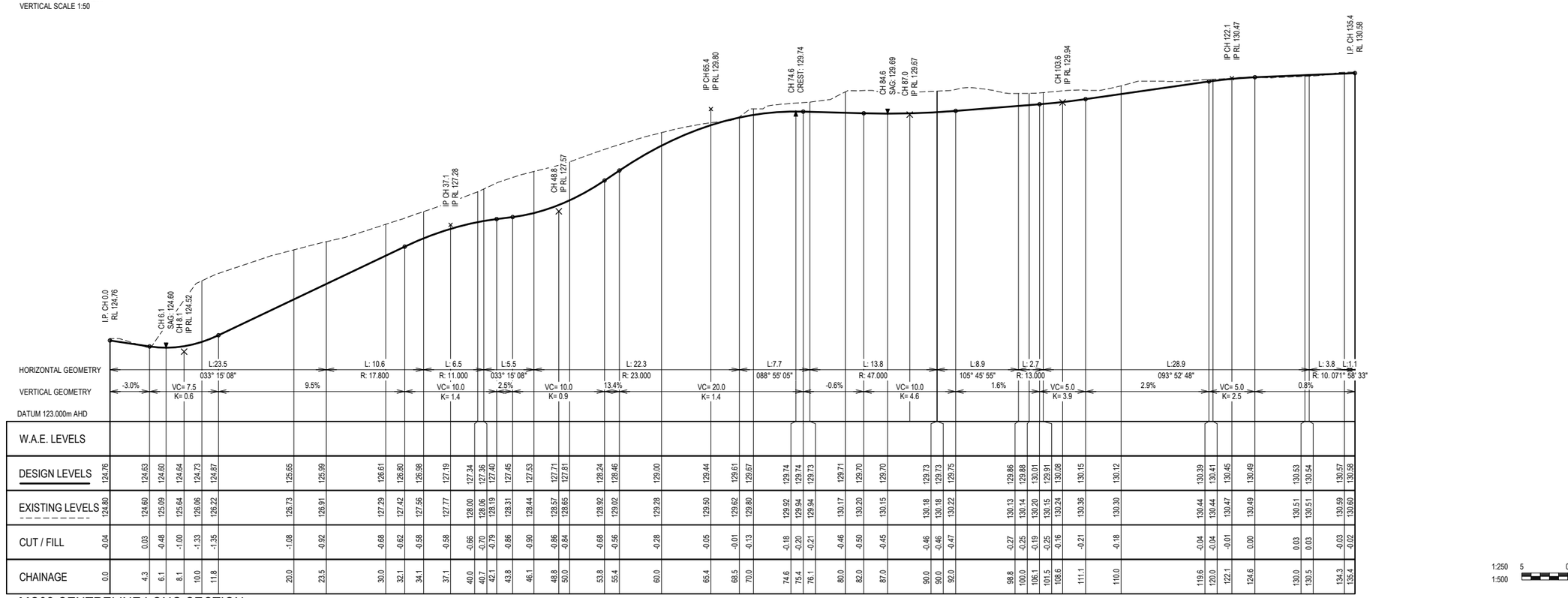
FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-070-01	C
SCALE @ A1	PROJECT No	DRAWING No	REV



MC01 CENTRELINE LONG SECTION

HORIZONTAL SCALE 1:250
VERTICAL SCALE 1:50



MC02 CENTRELINE LONG SECTION

HORIZONTAL SCALE 1:250
VERTICAL SCALE 1:50

1:250 5 0 5 10 A1
1:500 HORIZONTAL A3

1:50 1 0.5 0 1 2 A1
1:100 VERTICAL A3

REV	DESCRIPTION	DRAWN	APP'D	DATE
C	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	

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181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW
PROJECT

ROADS LONGSECTIONS
TITLE

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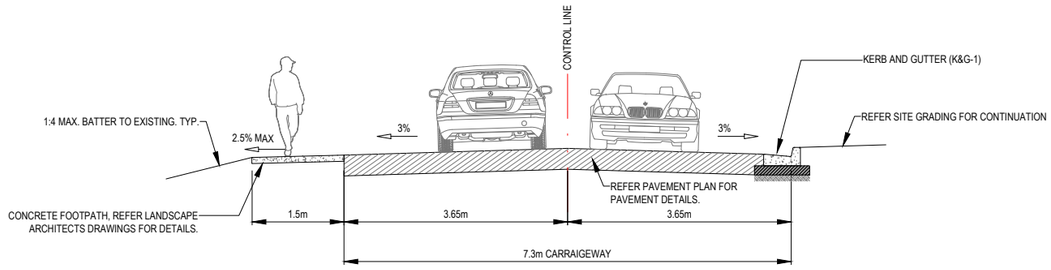
WOOD & GRIEVE ENGINEERS

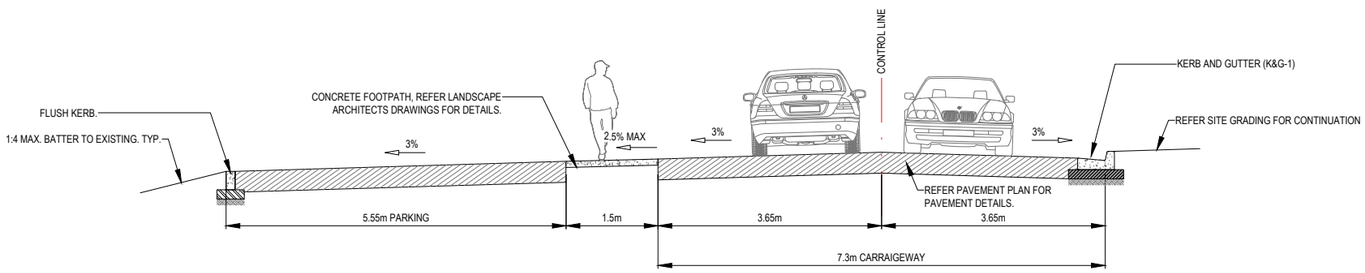
FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-402-01	C
SCALE @ A1	PROJECT No	DRAWING No	REV



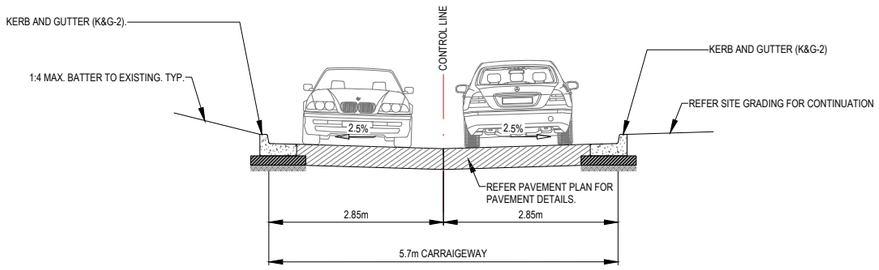
TYPICAL ROAD CROSS SECTION - MC01

(SCALE 1:50)



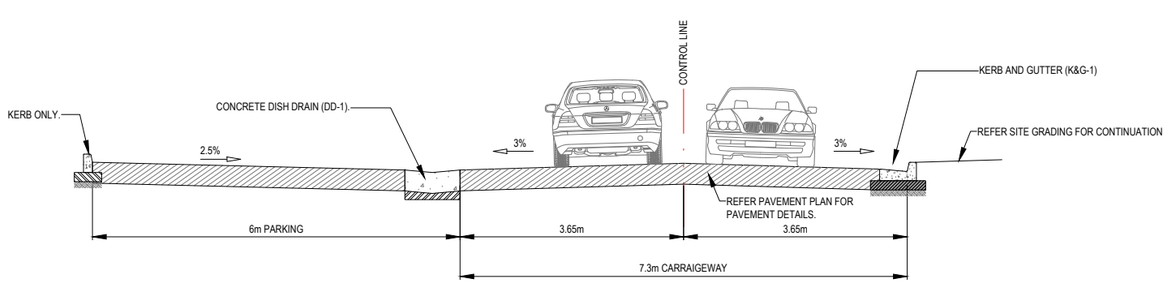
TYPICAL ROAD CROSS SECTION WITH PARKING - MC01 (AT SITE ENTRY)

(SCALE 1:50)



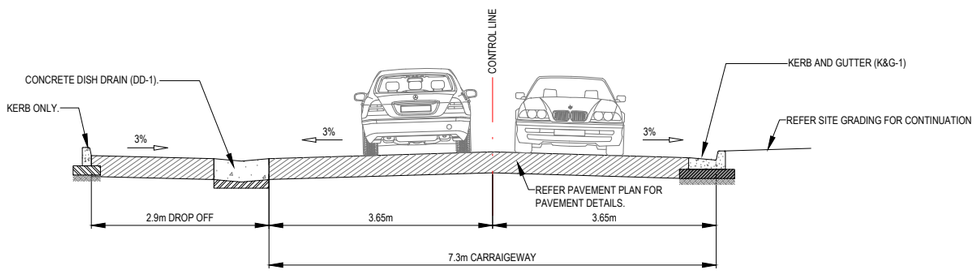
TYPICAL ROAD CROSS SECTION - MC02

(SCALE 1:50)



TYPICAL ROAD CROSS SECTION WITH PARKING - MC01 (AT BUILDING "C")

(SCALE 1:50)



TYPICAL ROAD CROSS SECTION WITH DROP OFF BAY - MC01 (AT BUILDING "C")

(SCALE 1:50)

1:50 1 0.5 0 1 2 A1
1:100 A3

REV	DESCRIPTION	DRAWN	APP'D	DATE
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C	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... ../../..

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181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

TYPICAL ROAD SECTIONS

TITLE

38509-CI-403-01.dwg

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-403-01	C
SCALE @ A1	PROJECT No	DRAWING No	REV

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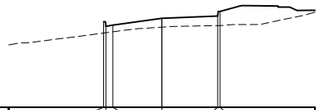
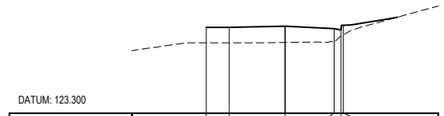


DATUM: 123.300

W.A.E. LEVELS													
DESIGN LEVELS			126.09	125.94	125.98		126.20			126.28	126.43		
EXISTING LEVELS			125.72	125.73	125.76		125.91			125.96	125.97		
CUT / FILL			0.37	0.21	0.22		0.29			0.31	0.46		
OFFSET			-3.80	-3.65	-3.20		0.00			3.65	3.80		

MC01 - CH 10.000



DATUM: 123.300

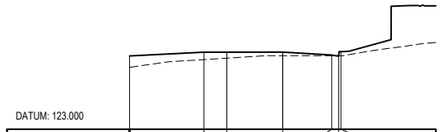
W.A.E. LEVELS													
DESIGN LEVELS			126.10	126.10		126.14			126.06	126.02	126.17		
EXISTING LEVELS			125.60	125.60		125.61			125.62	125.82	125.86		
CUT / FILL			0.50	0.50		0.53			0.44	0.20	0.31		
OFFSET			-5.15	-3.65		0.00			3.20	3.65	3.80		

MC01 - CH 19.834

DATUM: 123.300

W.A.E. LEVELS													
DESIGN LEVELS			125.95	125.95		125.97			125.88	125.84	125.99		
EXISTING LEVELS			125.60	125.60		125.60			125.60	125.61	125.65		
CUT / FILL			0.35	0.35		0.37			0.28	0.23	0.33		
OFFSET			-5.15	-3.65		0.00			3.20	3.65	3.80		

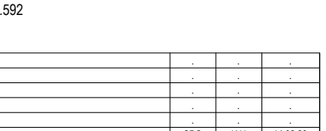
MC01 - CH 25.303



DATUM: 123.000

W.A.E. LEVELS													
DESIGN LEVELS		125.39		125.51	125.51		125.52		125.42	125.38	125.53		
EXISTING LEVELS		125.02		125.27	125.32		125.40		125.40	125.40	125.40		
CUT / FILL		0.38		0.24	0.19		0.12		0.02	-0.02	0.13		
OFFSET		-10.00		-5.15	-3.65		0.00		3.20	3.65	3.80		

MC01 - CH 40.000



DATUM: 123.200

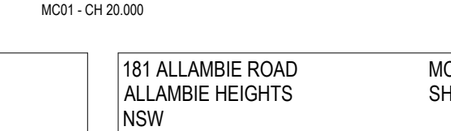
W.A.E. LEVELS													
DESIGN LEVELS			125.98	125.83	125.87		126.18			126.27	126.42		
EXISTING LEVELS			125.72	125.73	125.76		125.94			125.99	125.99		
CUT / FILL			0.26	0.10	0.11		0.25			0.28	0.43		
OFFSET			-3.80	-3.65	-3.20		0.00			3.65	3.80		

MC01 - CH 09.150

DATUM: 123.300

W.A.E. LEVELS													
DESIGN LEVELS			126.15	126.15		126.24			126.32	126.28	126.43		
EXISTING LEVELS			125.65	125.70		125.80			125.80	125.80	125.92		
CUT / FILL			0.50	0.45		0.44			0.52	0.48	0.50		
OFFSET			-5.15	-3.65		0.00			3.20	3.65	5.04		

MC01 - CH 15.000



DATUM: 123.300

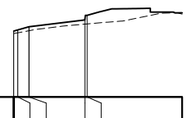
W.A.E. LEVELS													
DESIGN LEVELS			125.96	125.96		125.98			125.88	125.84	125.99		
EXISTING LEVELS			125.60	125.60		125.60			125.60	125.63	125.68		
CUT / FILL			0.36	0.36		0.38			0.28	0.21	0.32		
OFFSET			-5.15	-3.65		0.00			3.20	3.65	3.80		

MC01 - CH 25.000

DATUM: 123.000

W.A.E. LEVELS													
DESIGN LEVELS		125.53		125.66	125.66		125.67		125.57	125.53	125.68		
EXISTING LEVELS		125.09		125.36	125.40		125.40		125.40	125.40	125.40		
CUT / FILL		0.44		0.30	0.26		0.27		0.17	0.13	0.28		
OFFSET		-10.00		-5.15	-3.65		0.00		3.20	3.65	3.80		

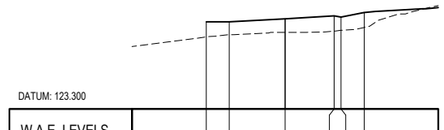
MC01 - CH 35.000



DATUM: 123.800

W.A.E. LEVELS													
DESIGN LEVELS		125.95	125.99	126.09			126.31		126.46				
EXISTING LEVELS		125.87	125.89	125.96			126.18		126.18				
CUT / FILL		0.08	0.09	0.13			0.14		0.28				
OFFSET		-1.00	-0.73	0.00			3.65		3.80				

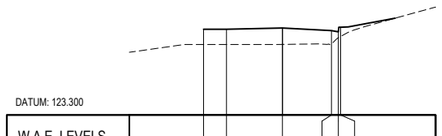
MC01 - CH 05.592



DATUM: 123.300

W.A.E. LEVELS													
DESIGN LEVELS			126.14	126.14		126.24			126.34	126.30	126.45		
EXISTING LEVELS			125.65	125.72		125.80			125.84	125.87	125.96		
CUT / FILL			0.49	0.42		0.44			0.50	0.43	0.49		
OFFSET			-5.15	-3.65		0.00			3.20	3.65	5.17		

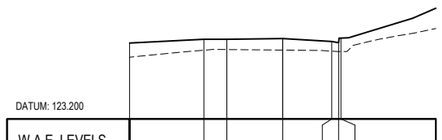
MC01 - CH 14.365



DATUM: 123.300

W.A.E. LEVELS													
DESIGN LEVELS			126.10	126.10		126.14			126.05	126.01	126.16		
EXISTING LEVELS			125.60	125.60		125.60			125.61	125.82	125.86		
CUT / FILL			0.50	0.50		0.53			0.44	0.19	0.30		
OFFSET			-5.15	-3.65		0.00			3.20	3.65	3.80		

MC01 - CH 20.000



DATUM: 123.200

W.A.E. LEVELS													
DESIGN LEVELS		125.68		125.80	125.80		125.82		125.73	125.69	125.84		
EXISTING LEVELS		125.61		125.44	125.47		125.45		125.41	125.40	125.40		
CUT / FILL		0.46		0.36	0.33		0.38		0.32	0.29	0.44		
OFFSET		-10.00		-5.15	-3.65		0.00		3.20	3.65	3.80		

MC01 - CH 30.000

1:200 2 0 2 4 6 8 10 A1
1:400 A3
HORIZONTAL

1:100 1 0 1 2 3 4 5 A1
1:200 A3
VERTICAL

REV	DESCRIPTION	DRAWN	APP'D	DATE
C	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... ../../..

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181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

MC01 - ROAD CROSS SECTIONS - SHEET 1 OF 4

TITLE

38509-CI-405-01.dwg

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-405-01	C
SCALE @ A1	PROJECT No	DRAWING No	REV

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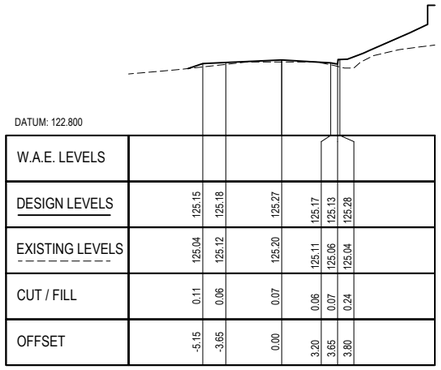
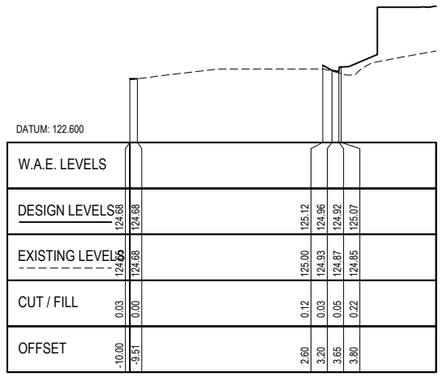


DATUM: 122.800

W.A.E. LEVELS								
DESIGN LEVELS		125.15	125.18	125.27	125.17	125.13	125.28	
EXISTING LEVELS		125.04	125.12	125.20	125.11	125.06	125.04	
CUT / FILL		0.11	0.06	0.07	0.06	0.07	0.24	
OFFSET		-5.15	-3.65	0.00	3.20	3.65	3.80	

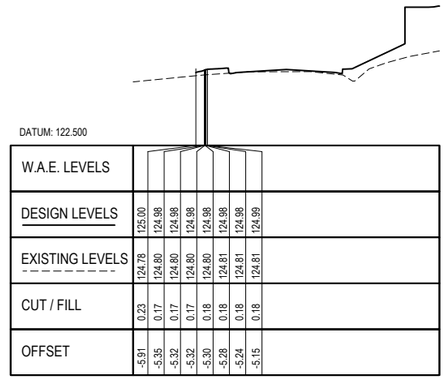
MC01 - CH 55.000



DATUM: 122.600

W.A.E. LEVELS								
DESIGN LEVELS	124.68	124.68				125.12	124.96	124.92	125.07
EXISTING LEVELS	124.68	124.68				125.00	124.93	124.87	124.85
CUT / FILL	0.03	0.00				0.12	0.03	0.05	0.22
OFFSET	-10.00	-9.51				2.60	3.20	3.65	3.80

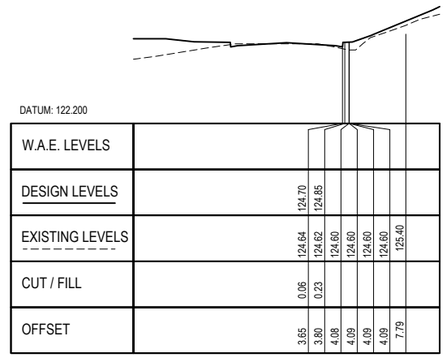
MC01 - CH 70.000



DATUM: 122.500

W.A.E. LEVELS								
DESIGN LEVELS	125.00	124.98	124.98	124.98	124.98	124.98	124.99	
EXISTING LEVELS	124.78	124.80	124.80	124.80	124.80	124.81	124.81	
CUT / FILL	0.23	0.17	0.17	0.17	0.18	0.18	0.18	
OFFSET	-5.91	-5.35	-5.32	-5.32	-5.30	-5.28	-5.24	-5.15	

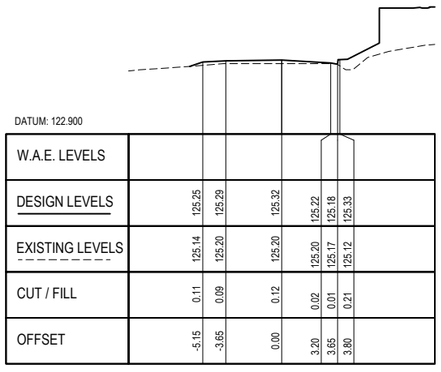
MC01 - CH 85.000



DATUM: 122.200

W.A.E. LEVELS								
DESIGN LEVELS			124.70	124.85				
EXISTING LEVELS			124.64	124.62	124.60	124.60	124.60	125.40
CUT / FILL			0.06	0.23				
OFFSET			3.65	3.80	4.08	4.09	4.09	7.79

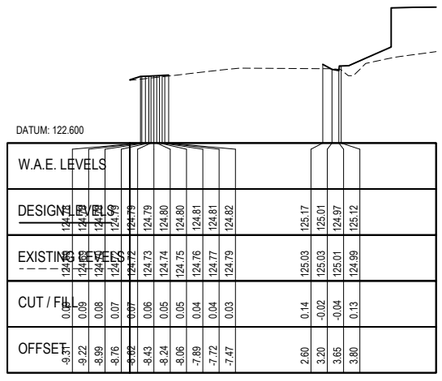
MC01 - CH 100.000



DATUM: 122.900

W.A.E. LEVELS								
DESIGN LEVELS		125.25	125.29	125.32	125.22	125.18	125.33	
EXISTING LEVELS		125.14	125.20	125.20	125.20	125.17	125.12	
CUT / FILL		0.11	0.09	0.12	0.02	0.01	0.21	
OFFSET		-5.15	-3.65	0.00	3.20	3.65	3.80	

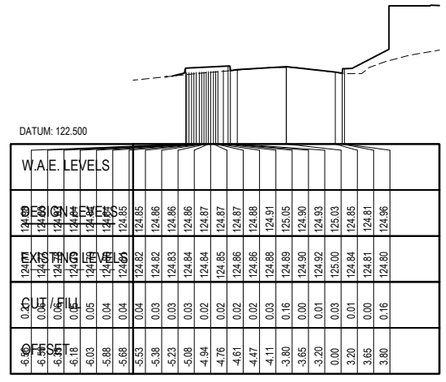
MC01 - CH 50.000



DATUM: 122.600

W.A.E. LEVELS								
DESIGN LEVELS	124.68	124.68	124.79	124.79	124.80	124.81	124.81	124.82		125.17	125.01	124.97	125.12
EXISTING LEVELS	124.68	124.68	124.79	124.72	124.73	124.74	124.75	124.76	124.77	124.79		125.03	125.03	125.01	124.99
CUT / FILL	0.03	0.00	0.00	0.07	0.06	0.05	0.05	0.04	0.04	0.03		0.14	-0.02	-0.04	0.13
OFFSET	-10.00	-9.51	-9.22	-8.99	-8.76	-8.52	-8.43	-8.24	-8.06	-7.89	-7.72	-7.47		2.60	3.20	3.65	3.80

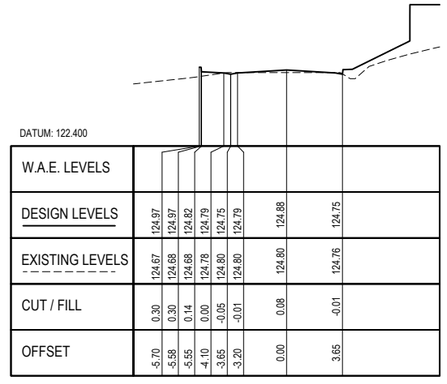
MC01 - CH 65.000



DATUM: 122.500

W.A.E. LEVELS								
DESIGN LEVELS	124.85	124.86	124.86	124.87	124.87	124.88	124.91	125.05	124.90	124.93	125.03	124.85	124.81	124.96
EXISTING LEVELS	124.82	124.82	124.83	124.84	124.85	124.86	124.88	124.89	124.90	124.92	125.00	124.84	124.81	124.80
CUT / FILL	0.03	0.04	0.03	0.03	0.02	0.02	0.03	0.16	0.00	0.01	0.03	0.01	0.00	0.16
OFFSET	-5.53	-5.38	-5.23	-5.08	-4.94	-4.76	-4.61	-4.47	-4.11	-3.80	-3.65	-3.20	0.00	3.20	3.65	3.80

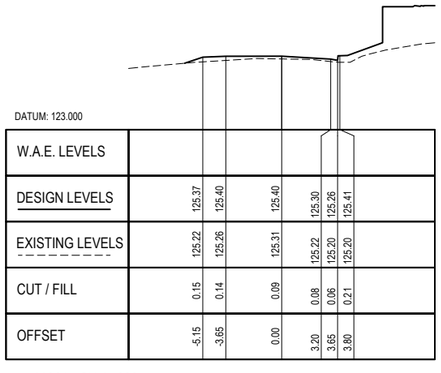
MC01 - CH 80.000



DATUM: 122.400

W.A.E. LEVELS								
DESIGN LEVELS	124.97	124.97	124.82	124.79	124.75	124.79		124.88		124.75
EXISTING LEVELS	124.67	124.68	124.68	124.78	124.80	124.80		124.80		124.76
CUT / FILL	0.30	0.30	0.14	0.00	-0.05	-0.01		0.08		-0.01
OFFSET	-5.70	-5.58	-5.55	-4.10	-3.65	-3.20		0.00		3.65

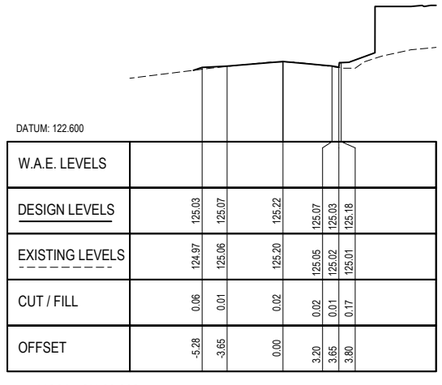
MC01 - CH 95.000



DATUM: 123.000

W.A.E. LEVELS								
DESIGN LEVELS		125.37	125.40	125.40	125.30	125.26	125.41	
EXISTING LEVELS		125.22	125.26	125.31	125.22	125.20	125.20	
CUT / FILL		0.15	0.14	0.09	0.08	0.06	0.21	
OFFSET		-5.15	-3.65	0.00	3.20	3.65	3.80	

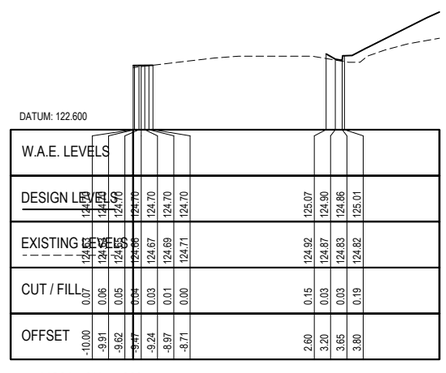
MC01 - CH 45.000



DATUM: 122.600

W.A.E. LEVELS								
DESIGN LEVELS			125.03	125.07	125.22	125.07	125.03	125.18	
EXISTING LEVELS			124.97	125.06	125.20	125.05	125.02	125.01	
CUT / FILL			0.06	0.01	0.02	0.02	0.01	0.17	
OFFSET			-5.28	-3.65	0.00	3.20	3.65	3.80	

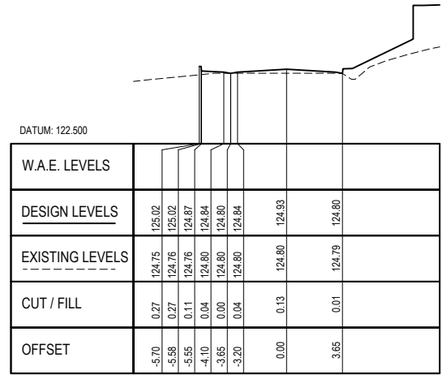
MC01 - CH 60.000



DATUM: 122.600

W.A.E. LEVELS								
DESIGN LEVELS	124.70	124.70	124.70	124.70		125.07	124.90	124.86	125.01
EXISTING LEVELS	124.70	124.70	124.67	124.69	124.71		124.87	124.83	124.82
CUT / FILL	0.00	0.00	0.03	0.01	0.00	0.15	0.03	0.03	0.19
OFFSET	-8.71	-8.97	-9.24	-9.47	-9.62	2.60	3.20	3.65	3.80

MC01 - CH 75.000



DATUM: 122.500

W.A.E. LEVELS								
DESIGN LEVELS		125.02	125.02	124.87	124.84	124.80	124.84		124.93		124.80
EXISTING LEVELS		124.75	124.76	124.76	124.80	124.80	124.80		124.80		124.79
CUT / FILL		0.27	0.27	0.11	0.04	0.00	0.04		0.13		0.01
OFFSET		-5.70	-5.58	-5.55	-4.10	-3.65	-3.20		0.00		3.65

MC01 - CH 90.000

1:200 2 0 2 4 6 8 10 A1
1:400 A3
HORIZONTAL

1:100 1 0 1 2 3 4 5 A1
1:200 A3
VERTICAL

REV	DESCRIPTION	DRAWN	APP'D	DATE
C	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... JJJ..

JACKSON TEECE
Architecture

ARCHITECT/CLIENT

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

MC01 - ROAD CROSS SECTIONS - SHEET 2 OF 4

TITLE

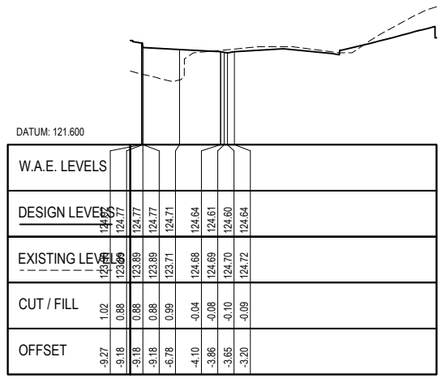
WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-405-02	C
SCALE @ A1	PROJECT No	DRAWING No	REV

38509-CI-405-01.dwg

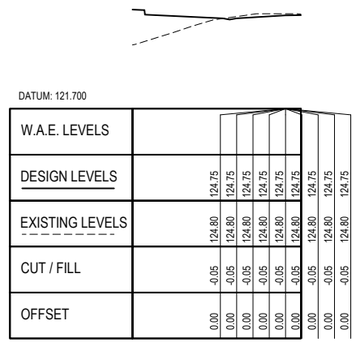
14/02/2020 12:39:13 PM



DATUM: 121.600

W.A.E. LEVELS										
DESIGN LEVELS	124.77	124.77	124.77	124.77	124.71	124.64	124.61	124.60	124.64	
EXISTING LEVELS	123.75	123.89	123.89	123.89	123.71	124.68	124.69	124.70	124.72	
CUT / FILL	1.02	0.88	0.88	0.88	0.99	-0.04	-0.08	-0.10	-0.09	
OFFSET	-9.27	-9.18	-9.18	-9.18	-6.78	-4.10	-3.86	-3.65	-3.20	

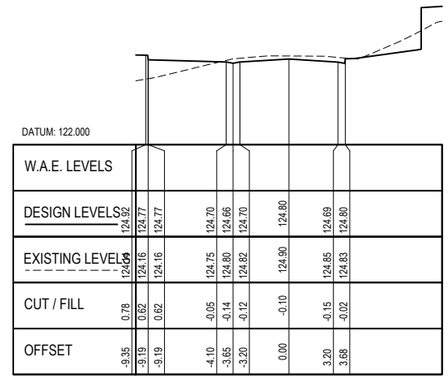
MC01 - CH 114.472



DATUM: 121.700

W.A.E. LEVELS										
DESIGN LEVELS						124.75	124.75	124.75	124.75	124.75	124.75	124.75	124.75
EXISTING LEVELS						124.80	124.80	124.80	124.80	124.80	124.80	124.80	124.80
CUT / FILL						-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
OFFSET						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

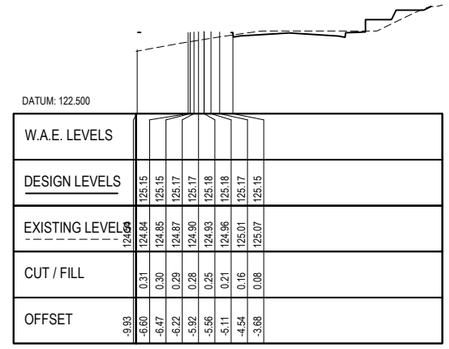
MC01 - CH 125.000



DATUM: 122.000

W.A.E. LEVELS										
DESIGN LEVELS	124.92	124.77	124.77		124.70	124.66	124.70	124.80	124.69	124.80
EXISTING LEVELS	124.14	124.16	124.16		124.75	124.80	124.82	124.90	124.85	124.83
CUT / FILL	0.78	0.62	0.62		-0.05	-0.14	-0.12	-0.10	-0.15	-0.02
OFFSET	-9.35	-9.19	-9.19		-4.10	-3.65	-3.20	0.00	3.20	3.68

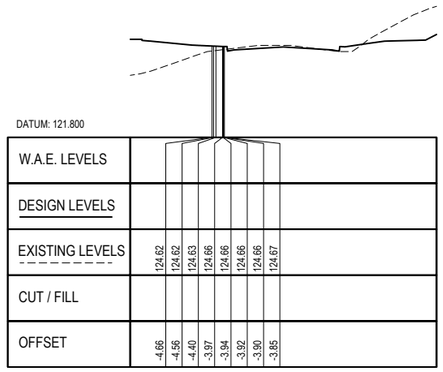
MC01 - CH 135.125



DATUM: 122.500

W.A.E. LEVELS										
DESIGN LEVELS	125.15	125.15	125.17	125.17	125.18	125.18	125.17	125.15		
EXISTING LEVELS	124.84	124.85	124.87	124.90	124.93	124.96	125.01	125.07		
CUT / FILL	0.31	0.30	0.29	0.28	0.25	0.21	0.16	0.08		
OFFSET	-5.60	-6.47	-8.22	-5.92	-5.66	-5.11	-4.54	-3.68		

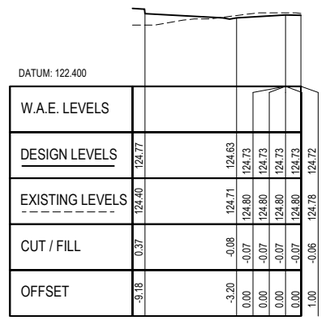
MC01 - CH 150.000



DATUM: 121.800

W.A.E. LEVELS										
DESIGN LEVELS										
EXISTING LEVELS	124.62	124.62	124.63	124.66	124.66	124.66	124.66	124.67		
CUT / FILL										
OFFSET	-4.66	-4.58	-4.40	-3.97	-3.94	-3.92	-3.90	-3.85		

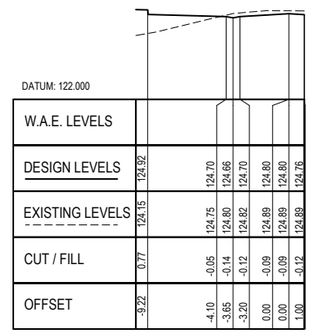
MC01 - CH 110.000



DATUM: 122.400

W.A.E. LEVELS										
DESIGN LEVELS	124.77			124.63	124.73	124.73	124.73	124.72		
EXISTING LEVELS	124.40			124.71	124.80	124.80	124.80	124.78		
CUT / FILL	0.37			-0.08	-0.07	-0.07	-0.07	-0.06		
OFFSET	-9.18			-3.20	0.00	0.00	0.00	1.00		

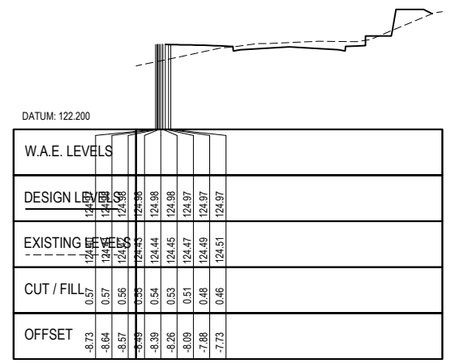
MC01 - CH 120.000



DATUM: 122.000

W.A.E. LEVELS										
DESIGN LEVELS	124.92			124.70	124.66	124.70	124.80	124.80	124.76	
EXISTING LEVELS	124.15			124.75	124.80	124.82	124.89	124.89	124.89	
CUT / FILL	0.77			-0.05	-0.14	-0.12	-0.09	-0.09	-0.12	
OFFSET	-9.22			-4.10	-3.65	-3.20	0.00	0.00	1.00	

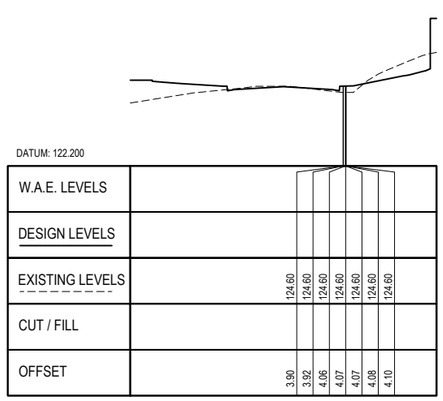
MC01 - CH 135.000



DATUM: 122.200

W.A.E. LEVELS										
DESIGN LEVELS	124.98	124.98	124.98	124.98	124.97	124.97	124.97			
EXISTING LEVELS	124.43	124.44	124.45	124.47	124.49	124.51				
CUT / FILL	0.55	0.54	0.53	0.51	0.48	0.46				
OFFSET	-8.73	-8.39	-8.26	-8.09	-7.88	-7.73				

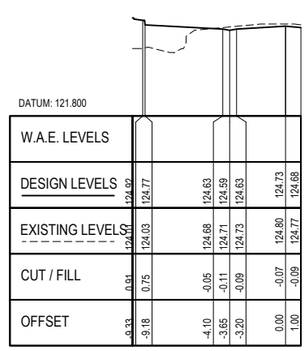
MC01 - CH 145.000



DATUM: 122.200

W.A.E. LEVELS										
DESIGN LEVELS										
EXISTING LEVELS	124.60	124.60	124.60	124.60	124.60	124.60				
CUT / FILL										
OFFSET	3.90	3.92	4.06	4.07	4.07	4.08	4.10			

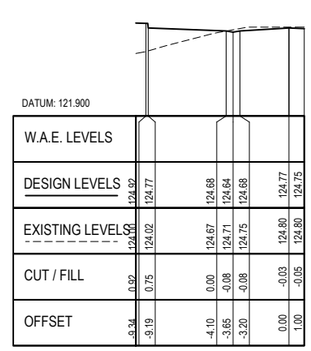
MC01 - CH 105.000



DATUM: 121.800

W.A.E. LEVELS										
DESIGN LEVELS	124.92	124.77		124.63	124.59	124.63		124.73	124.68	
EXISTING LEVELS	124.91	124.03		124.68	124.71	124.73		124.80	124.77	
CUT / FILL	0.01	0.75		-0.05	-0.11	-0.09		-0.07	-0.09	
OFFSET	-9.33	-9.18		-4.10	-3.65	-3.20		0.00	1.00	

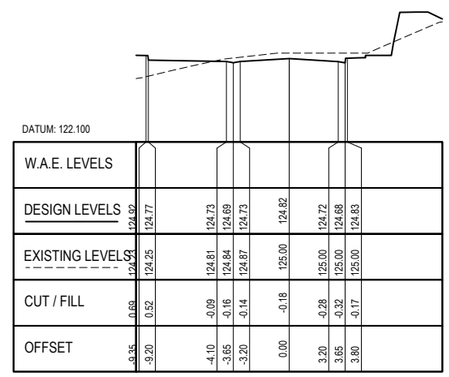
MC01 - CH 115.000



DATUM: 121.900

W.A.E. LEVELS										
DESIGN LEVELS	124.92	124.77		124.68	124.64	124.68		124.77	124.75	
EXISTING LEVELS	124.92	124.02		124.67	124.71	124.75		124.80	124.80	
CUT / FILL	0.00	0.75		0.00	-0.08	-0.08		-0.03	-0.05	
OFFSET	-9.34	-9.19		-4.10	-3.65	-3.20		0.00	1.00	

MC01 - CH 130.000



DATUM: 122.100

W.A.E. LEVELS										
DESIGN LEVELS	124.92	124.77		124.73	124.69	124.73		124.72	124.68	124.83	
EXISTING LEVELS	124.25			124.81	124.84	124.87	125.00	125.00	125.00	125.00	
CUT / FILL	0.67	0.52		-0.09	-0.16	-0.14	-0.18	-0.28	-0.32	-0.17	
OFFSET	-9.35	-9.20		-4.10	-3.65	-3.20	0.00	3.20	3.65	3.80	

MC01 - CH 140.000

1:200 2 0 2 4 6 8 10 A1
1:400 A3
HORIZONTAL

1:100 1 0 1 2 3 4 5 A1
1:200 A3
VERTICAL

REV	DESCRIPTION	DRAWN	APP'D	DATE
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.		.	.	.
C	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... /../..

JACKSON TEECE
Architecture

ARCHITECT/CLIENT

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

MC01 - ROAD CROSS SECTIONS - SHEET 3 OF 4

TITLE

38509-CI-405-01.dwg

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-405-03	C
SCALE @ A1	PROJECT No	DRAWING No	REV

14/02/2020 12:39:18 PM

DATUM: 122.600

W.A.E. LEVELS							
DESIGN LEVELS	125.38	125.27	125.40	125.40	125.36	125.51	
EXISTING LEVELS	125.24	125.27	125.40	125.40	125.40	125.40	125.72
CUT / FILL	0.14	0.00	0.00	0.00	-0.04	0.11	
OFFSET	-3.68	-3.20	0.00	3.20	3.65	3.68	10.00

MC01 - CH 156.675

DATUM: 122.600

W.A.E. LEVELS									
DESIGN LEVELS	125.36	125.35	125.38	125.34	125.49	125.49			
EXISTING LEVELS	125.21	125.40	125.40	125.40	125.40	125.40	125.40	125.40	125.45
CUT / FILL	0.14	-0.05	-0.02	-0.06	0.09	0.09			
OFFSET	-3.68	0.00	3.20	3.65	3.68	3.80	4.95	5.02	6.38

MC01 - CH 155.000

1:200 2 0 2 4 6 8 10 A1
1:400 A3
HORIZONTAL

1:100 1 0 1 2 3 4 5 A1
1:200 A3
VERTICAL

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C	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

CPO
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IAH 01.06.18
RET 04.03.19
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JACKSON TEECE
Architecture

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

MC01 - ROAD CROSS SECTIONS -
SHEET 4 OF 4

WOOD & GRIEVE ENGINEERS

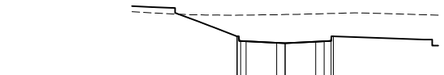
FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN | 38509 | CI-405-04 | C

DATUM: 123.000

W.A.E. LEVELS								
DESIGN LEVELS	125.28	125.13	125.12	125.06	125.12	125.08	125.23	
EXISTING LEVELS	126.39	126.38	126.38	126.35	126.33	126.33	126.33	
CUT / FILL	-1.10	-1.25	-1.26	-1.29	-1.21	-1.25	-1.10	
OFFSET	-3.15	-3.00	-2.55	0.00	2.55	3.00	3.15	

MC02 - CH 13.750



DATUM: 123.800

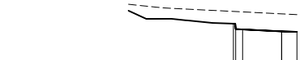
W.A.E. LEVELS												
DESIGN LEVELS	126.18	126.18	126.03	126.02	125.97	125.96	126.01	126.02	126.03	126.18		
EXISTING LEVELS	126.87	126.87	126.87	126.87	126.88	126.89	126.91	126.92	126.93	126.93		
CUT / FILL	-0.69	-0.69	-0.84	-0.85	-0.92	-0.94	-0.91	-0.90	-0.90	-0.75		
OFFSET	-3.15	-3.12	-2.90	-2.55	-0.55	0.00	2.00	2.55	3.00	3.15		

MC02 - CH 23.163

DATUM: 124.400

W.A.E. LEVELS								
DESIGN LEVELS	126.72	126.57	126.56	126.49	126.49			
EXISTING LEVELS	127.22	127.21	127.21	127.21	127.22			
CUT / FILL	-0.50	-0.65	-0.65	-0.72	-0.73			
OFFSET	-3.15	-3.00	-2.55	0.00	1.00			

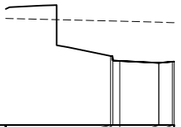
MC02 - CH 28.823



DATUM: 125.000

W.A.E. LEVELS								
DESIGN LEVELS	127.30	127.13	127.11	127.05	127.04			
EXISTING LEVELS	127.70	127.70	127.69	127.62	127.60			
CUT / FILL	-0.40	-0.57	-0.57	-0.57	-0.56			
OFFSET	-3.15	-3.00	-2.55	0.00	1.00			

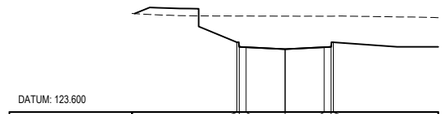
MC02 - CH 35.000



DATUM: 122.700

W.A.E. LEVELS								
DESIGN LEVELS	124.95	124.80	124.79	124.73	124.77			
EXISTING LEVELS	126.10	126.10	126.09	126.06	126.04			
CUT / FILL	-1.15	-1.29	-1.30	-1.33	-1.28			
OFFSET	-3.15	-3.00	-2.55	0.00	0.89			

MC02 - CH 10.000



DATUM: 123.600

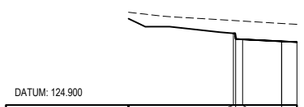
W.A.E. LEVELS								
DESIGN LEVELS	125.88	125.73	125.72	125.65	125.72	125.73	125.88	
EXISTING LEVELS	126.73	126.73	126.74	126.73	126.73	126.73	126.73	
CUT / FILL	-0.86	-1.01	-1.02	-1.08	-1.01	-1.00	-0.85	
OFFSET	-3.15	-3.00	-2.55	0.00	2.55	3.00	3.15	

MC02 - CH 20.000

DATUM: 124.100

W.A.E. LEVELS								
DESIGN LEVELS	126.35	126.20	126.19	126.13	126.15			
EXISTING LEVELS	126.95	126.95	126.95	126.98	126.99			
CUT / FILL	-0.59	-0.74	-0.76	-0.85	-0.84			
OFFSET	-3.15	-3.00	-2.55	0.00	1.00			

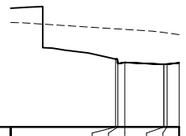
MC02 - CH 25.000



DATUM: 124.900

W.A.E. LEVELS								
DESIGN LEVELS	127.24	127.06	127.05	126.98	126.96			
EXISTING LEVELS	127.66	127.66	127.64	127.56	127.54			
CUT / FILL	-0.42	-0.60	-0.60	-0.58	-0.58			
OFFSET	-3.15	-3.00	-2.55	0.00	1.00			

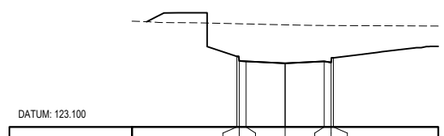
MC02 - CH 34.119



DATUM: 122.600

W.A.E. LEVELS								
DESIGN LEVELS	124.81	124.66	124.70	124.64	124.65	124.69		
EXISTING LEVELS	125.80	125.80	125.78	125.68	125.67	125.61		
CUT / FILL	-0.99	-1.13	-1.08	-1.04	-1.02	-0.92		
OFFSET	-3.15	-3.00	-2.55	0.00	0.21	1.00		

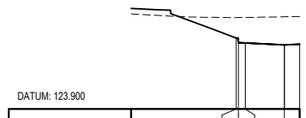
MC02 - CH 08.223



DATUM: 123.100

W.A.E. LEVELS								
DESIGN LEVELS	125.40	125.25	125.24	125.18	125.24	125.20	125.35	
EXISTING LEVELS	126.47	126.47	126.46	126.43	126.41	126.41	126.41	
CUT / FILL	-1.07	-1.21	-1.22	-1.26	-1.17	-1.21	-1.06	
OFFSET	-3.15	-3.00	-2.55	0.00	2.55	3.00	3.15	

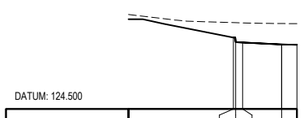
MC02 - CH 15.000



DATUM: 123.900

W.A.E. LEVELS								
DESIGN LEVELS	126.21	126.06	126.05	125.99	126.01			
EXISTING LEVELS	126.88	126.89	126.89	126.91	126.92			
CUT / FILL	-0.67	-0.82	-0.83	-0.92	-0.90			
OFFSET	-3.15	-3.00	-2.55	0.00	1.00			

MC02 - CH 23.527



DATUM: 124.500

W.A.E. LEVELS								
DESIGN LEVELS	126.83	126.68	126.67	126.61	126.60			
EXISTING LEVELS	127.32	127.32	127.31	127.29	127.29			
CUT / FILL	-0.49	-0.64	-0.64	-0.68	-0.69			
OFFSET	-3.15	-3.00	-2.55	0.00	1.00			

MC02 - CH 30.000

1:200 2 0 2 4 6 8 10 A1
1:400 A3

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JACKSON TEECE
Architecture

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

MC02 - ROAD CROSS SCETIONS - SHEET 1 OF 5

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-405-11	C

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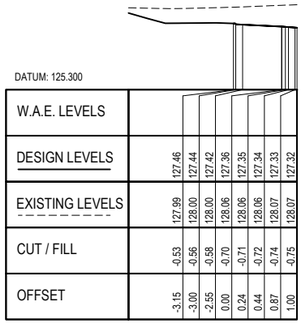
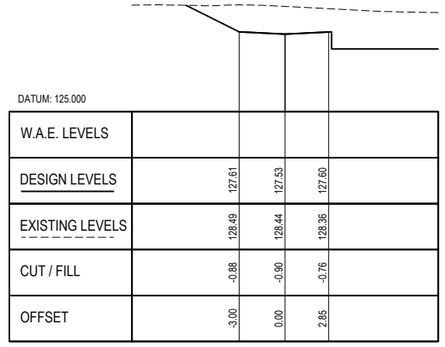


DATUM: 125.300

W.A.E. LEVELS									
DESIGN LEVELS	127.46	127.44	127.42	127.36	127.35	127.34	127.33	127.32	
EXISTING LEVELS	127.99	128.00	128.00	128.06	128.06	128.06	128.07	128.07	
CUT / FILL	-0.53	-0.56	-0.58	-0.70	-0.71	-0.72	-0.74	-0.75	
OFFSET	-3.15	-3.00	-2.55	0.00	0.24	0.44	0.87	1.00	

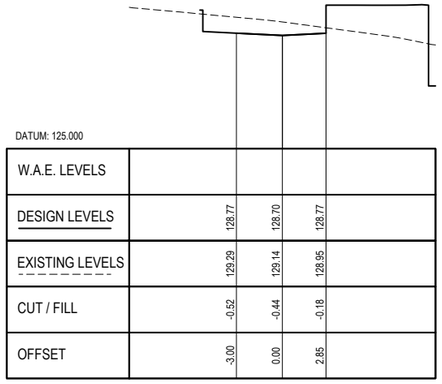
MC02 - CH 40.664



DATUM: 125.000

W.A.E. LEVELS				
DESIGN LEVELS	127.61	127.53	127.60	
EXISTING LEVELS	128.49	128.44	128.36	
CUT / FILL	-0.88	-0.90	-0.76	
OFFSET	-3.00	0.00	2.85	

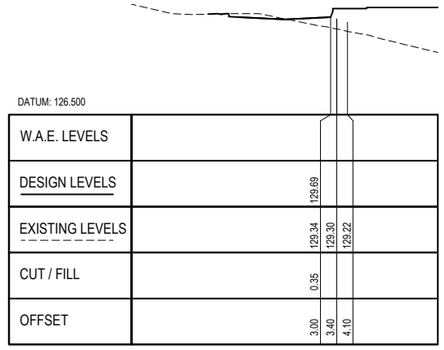
MC02 - CH 46.125



DATUM: 125.000

W.A.E. LEVELS				
DESIGN LEVELS	128.77	128.70	128.77	
EXISTING LEVELS	129.29	129.14	128.95	
CUT / FILL	-0.52	-0.44	-0.18	
OFFSET	-3.00	0.00	2.85	

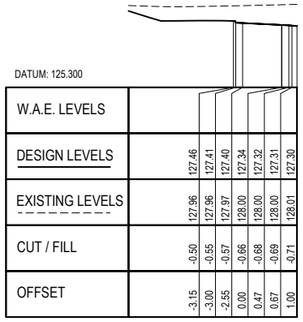
MC02 - CH 57.297



DATUM: 126.500

W.A.E. LEVELS				
DESIGN LEVELS	129.69			
EXISTING LEVELS	129.34	129.30	129.22	
CUT / FILL	0.35			
OFFSET	3.00	3.40	4.10	

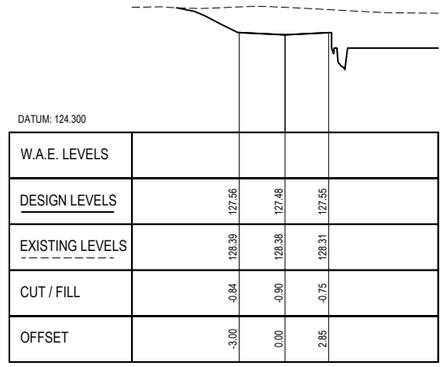
MC02 - CH 68.470



DATUM: 125.300

W.A.E. LEVELS									
DESIGN LEVELS	127.46	127.41	127.40	127.34	127.32	127.31	127.30		
EXISTING LEVELS	127.96	127.96	127.97	128.00	128.00	128.00	128.01		
CUT / FILL	-0.50	-0.55	-0.57	-0.66	-0.68	-0.69	-0.71		
OFFSET	-3.15	-3.00	-2.55	0.00	0.47	0.67	1.00		

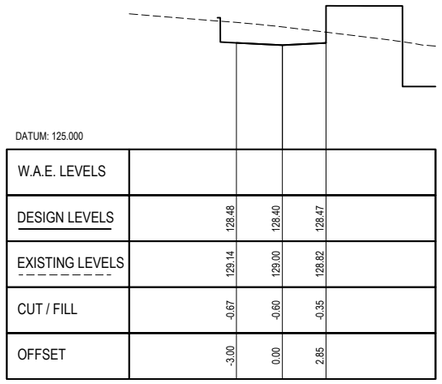
MC02 - CH 40.000



DATUM: 124.300

W.A.E. LEVELS				
DESIGN LEVELS	127.56	127.48	127.55	
EXISTING LEVELS	128.39	128.38	128.31	
CUT / FILL	-0.84	-0.90	-0.75	
OFFSET	-3.00	0.00	2.85	

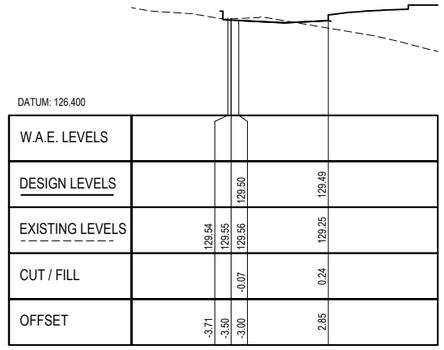
MC02 - CH 45.000



DATUM: 125.000

W.A.E. LEVELS				
DESIGN LEVELS	128.48	128.40	128.47	
EXISTING LEVELS	129.14	129.00	128.82	
CUT / FILL	-0.67	-0.60	-0.35	
OFFSET	-3.00	0.00	2.85	

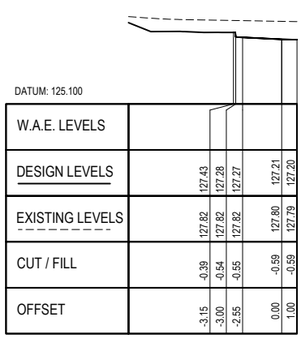
MC02 - CH 55.000



DATUM: 126.400

W.A.E. LEVELS									
DESIGN LEVELS			129.50		129.49				
EXISTING LEVELS	129.54	129.55	129.56		129.25				
CUT / FILL			-0.07		0.24				
OFFSET	-3.71	-3.50	-3.00		2.85				

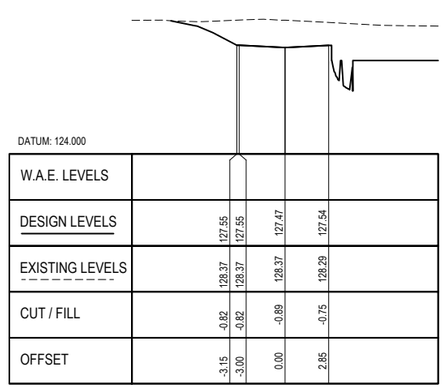
MC02 - CH 65.000



DATUM: 125.100

W.A.E. LEVELS									
DESIGN LEVELS	127.43	127.28	127.27			127.21	127.20		
EXISTING LEVELS	127.82	127.82	127.82			127.80	127.79		
CUT / FILL	-0.39	-0.54	-0.55			-0.59	-0.59		
OFFSET	-3.15	-3.00	-2.55			0.00	1.00		

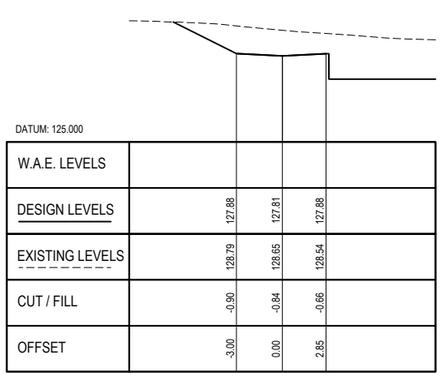
MC02 - CH 37.391



DATUM: 124.000

W.A.E. LEVELS				
DESIGN LEVELS	127.55	127.55	127.47	127.54
EXISTING LEVELS	128.37	128.37	128.37	128.29
CUT / FILL	-0.82	-0.82	-0.89	-0.75
OFFSET	-3.15	-3.00	0.00	2.85

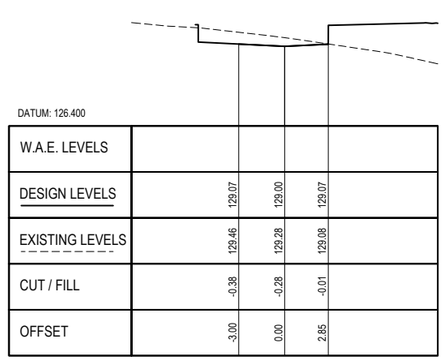
MC02 - CH 44.739



DATUM: 125.000

W.A.E. LEVELS				
DESIGN LEVELS	127.88	127.81	127.88	
EXISTING LEVELS	128.79	128.65	128.54	
CUT / FILL	-0.90	-0.84	-0.66	
OFFSET	-3.00	0.00	2.85	

MC02 - CH 50.000



DATUM: 126.400

W.A.E. LEVELS				
DESIGN LEVELS	129.07	129.00	129.07	
EXISTING LEVELS	129.46	129.28	129.08	
CUT / FILL	-0.38	-0.28	-0.01	
OFFSET	-3.00	0.00	2.85	

MC02 - CH 60.000

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1:400 A3

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C	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

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	RET 04.03.19
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JACKSON TEECE
Architecture

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

MC02 - ROAD CROSS SCETIONS - SHEET 2 OF 5

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

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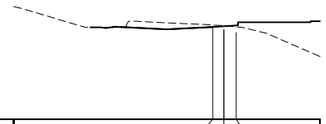
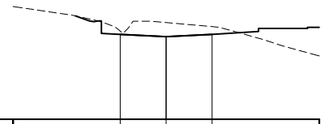


DATUM: 126.800

W.A.E. LEVELS			
DESIGN LEVELS	129.81		
EXISTING LEVELS	129.87	129.85	129.82
CUT / FILL	-0.06		
OFFSET	3.00	3.73	4.53

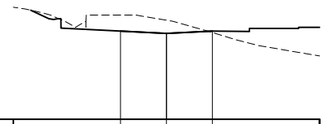
MC02 - CH 76.139



DATUM: 127.000

W.A.E. LEVELS			
DESIGN LEVELS	129.77	129.70	129.77
EXISTING LEVELS	129.88	130.16	130.02
CUT / FILL	-0.11	-0.46	-0.25
OFFSET	-3.00	0.00	3.00

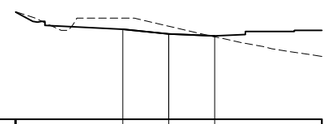
MC02 - CH 85.000



DATUM: 127.000

W.A.E. LEVELS			
DESIGN LEVELS	129.88	129.80	129.88
EXISTING LEVELS	130.40	130.23	129.83
CUT / FILL	-0.52	-0.43	0.04
OFFSET	-3.00	0.00	3.00

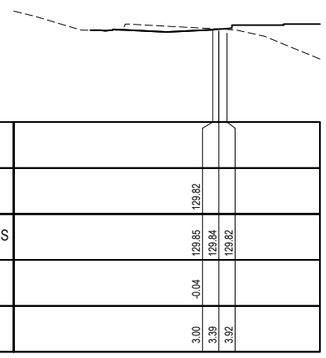
MC02 - CH 95.000



DATUM: 127.100

W.A.E. LEVELS			
DESIGN LEVELS	130.04	129.88	129.82
EXISTING LEVELS	130.40	130.14	129.79
CUT / FILL	-0.36	-0.25	0.03
OFFSET	-3.00	0.00	3.00

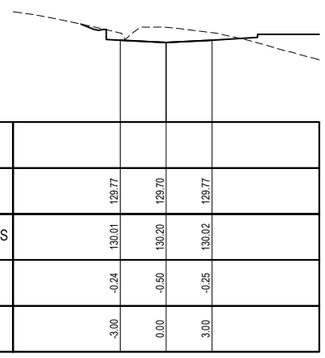
MC02 - CH 100.183



DATUM: 126.800

W.A.E. LEVELS			
DESIGN LEVELS	129.82		
EXISTING LEVELS	129.85	129.84	129.82
CUT / FILL	-0.04		
OFFSET	3.00	3.39	3.92

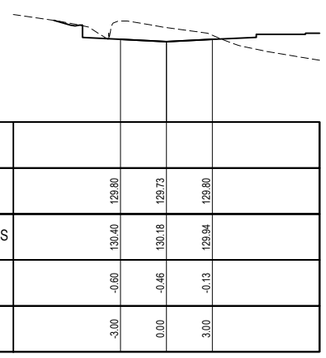
MC02 - CH 75.000



DATUM: 127.100

W.A.E. LEVELS			
DESIGN LEVELS	129.77	129.70	129.77
EXISTING LEVELS	130.01	130.20	130.02
CUT / FILL	-0.24	-0.50	-0.25
OFFSET	-3.00	0.00	3.00

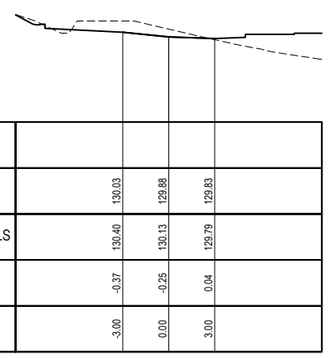
MC02 - CH 83.049



DATUM: 127.100

W.A.E. LEVELS			
DESIGN LEVELS	129.80	129.73	129.80
EXISTING LEVELS	130.40	130.18	129.94
CUT / FILL	-0.60	-0.46	-0.13
OFFSET	-3.00	0.00	3.00

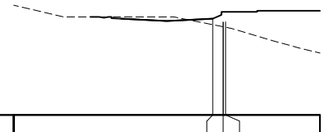
MC02 - CH 90.000



DATUM: 127.100

W.A.E. LEVELS			
DESIGN LEVELS	130.03	129.88	129.83
EXISTING LEVELS	130.40	130.13	129.79
CUT / FILL	-0.37	-0.25	0.04
OFFSET	-3.00	0.00	3.00

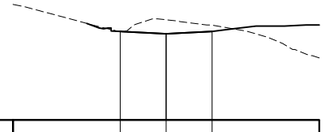
MC02 - CH 100.000



DATUM: 126.600

W.A.E. LEVELS			
DESIGN LEVELS	129.74		
EXISTING LEVELS	129.55	129.48	129.46
CUT / FILL	0.20		
OFFSET	3.00	3.68	3.84

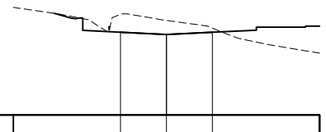
MC02 - CH 70.000



DATUM: 126.900

W.A.E. LEVELS			
DESIGN LEVELS	129.79	129.71	129.79
EXISTING LEVELS	129.80	130.17	130.00
CUT / FILL	-0.01	-0.46	-0.21
OFFSET	-3.00	0.00	3.00

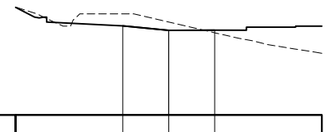
MC02 - CH 80.000



DATUM: 127.100

W.A.E. LEVELS			
DESIGN LEVELS	129.80	129.73	129.80
EXISTING LEVELS	130.38	130.18	129.94
CUT / FILL	-0.58	-0.46	-0.14
OFFSET	-3.00	0.00	3.00

MC02 - CH 89.959



DATUM: 127.100

W.A.E. LEVELS			
DESIGN LEVELS	130.01	129.86	129.67
EXISTING LEVELS	130.40	130.13	129.78
CUT / FILL	-0.39	-0.27	0.09
OFFSET	-3.00	0.00	3.00

MC02 - CH 98.834

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1:400 A3

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JACKSON TEECE
Architecture

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

MC02 - ROAD CROSS SCETIONS - SHEET 3 OF 5

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-405-13	C

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DATUM: 127.800

W.A.E. LEVELS								
DESIGN LEVELS	130.63	130.48		130.12	130.04	130.00	130.15	
EXISTING LEVELS	130.43	130.42		130.30	130.20	130.18	130.17	
CUT / FILL	0.20	0.06		-0.18	-0.16	-0.18	-0.02	
OFFSET	-8.55	-8.40		0.00	2.40	2.85	3.00	

MC02 - CH 110.000

DATUM: 128.100

W.A.E. LEVELS								
DESIGN LEVELS	130.64	130.49		130.41	130.39	130.32		
EXISTING LEVELS	130.20	130.20		130.44	130.43	130.42		
CUT / FILL	0.44	0.29		-0.04	-0.05	-0.10		
OFFSET	-8.55	-8.40		0.00	0.33	1.00		

MC02 - CH 120.000

DATUM: 127.900

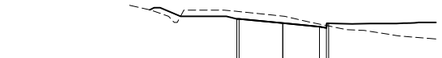
W.A.E. LEVELS								
DESIGN LEVELS	130.71	130.71		130.53	130.46	130.61		
EXISTING LEVELS	130.71	130.71		130.51	130.40	130.38		
CUT / FILL	0.00	0.00		0.03	0.06	0.23		
OFFSET	-8.55	-8.40		0.00	2.85	3.00		

MC02 - CH 130.000

DATUM: 127.900

W.A.E. LEVELS								
DESIGN LEVELS								
EXISTING LEVELS								
CUT / FILL								
OFFSET								

MC02 - CH 134.293



DATUM: 127.400

W.A.E. LEVELS								
DESIGN LEVELS	130.11	130.11		129.98	129.86	129.82	129.97	
EXISTING LEVELS	130.36	130.35		130.21	129.94	129.90	129.88	
CUT / FILL	-0.25	-0.24		-0.23	-0.08	-0.08	0.09	
OFFSET	-3.00	-2.85		0.00	2.40	2.85	3.00	

MC02 - CH 105.000

DATUM: 127.900

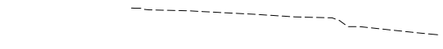
W.A.E. LEVELS								
DESIGN LEVELS	130.64	130.49		130.26	130.23			
EXISTING LEVELS	130.42	130.32		130.39	130.35			
CUT / FILL	0.22	0.17		-0.13	-0.12			
OFFSET	-8.55	-8.40		0.00	1.00			

MC02 - CH 115.000

DATUM: 127.900

W.A.E. LEVELS								
DESIGN LEVELS	130.66	130.66		130.52	130.45	130.60	130.60	
EXISTING LEVELS	130.67	130.66		130.50	130.35	130.34	130.34	
CUT / FILL	-0.01	0.00		0.02	0.10	0.26	0.26	
OFFSET	-8.55	-8.40		0.00	2.85	3.00	3.00	

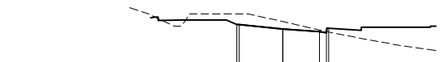
MC02 - CH 128.556



DATUM: 127.900

W.A.E. LEVELS								
DESIGN LEVELS								
EXISTING LEVELS								
CUT / FILL								
OFFSET								

MC02 - CH 132.382



DATUM: 127.200

W.A.E. LEVELS								
DESIGN LEVELS	130.05	130.05		129.91	129.82	129.78	129.93	
EXISTING LEVELS	130.40	130.40		130.15	129.87	129.82	129.81	
CUT / FILL	-0.35	-0.35		-0.25	-0.05	-0.04	0.13	
OFFSET	-3.00	-2.85		0.00	2.40	2.85	3.00	

MC02 - CH 101.531

DATUM: 127.900

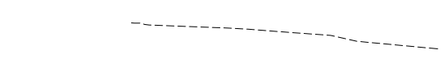
W.A.E. LEVELS								
DESIGN LEVELS	130.63	130.48	130.47	130.17	130.09	130.05	130.20	
EXISTING LEVELS	130.63	130.43	130.41	130.18	130.40	130.28	130.25	130.24
CUT / FILL	0.20	0.20	0.07	0.29	-0.23	-0.19	-0.20	-0.03
OFFSET	-8.55	-8.55	-8.40	-8.07	0.00	2.40	2.85	3.00

MC02 - CH 111.756

DATUM: 128.400

W.A.E. LEVELS								
DESIGN LEVELS	130.53	130.53		130.49	130.47	130.46	130.44	
EXISTING LEVELS	130.50	130.51		130.49	130.47	130.46	130.45	
CUT / FILL	0.03	0.03		0.00	0.00	0.00	-0.01	
OFFSET	-8.55	-8.40		0.00	0.32	0.54	1.00	

MC02 - CH 125.000



DATUM: 127.900

W.A.E. LEVELS								
DESIGN LEVELS								
EXISTING LEVELS								
CUT / FILL								
OFFSET								

MC02 - CH 130.470

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1:400 A3

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A	ISSUED FOR TENDER	CPO	RET	05.03.19

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JACKSON TEECE
Architecture

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

MC02 - ROAD CROSS SCETIONS - SHEET 4 OF 5

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-405-14	C

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DATUM: 127.900

W.A.E. LEVELS	
DESIGN LEVELS	
EXISTING LEVELS	
CUT / FILL	
OFFSET	

MC02 - CH 135.440

DATUM: 127.900

W.A.E. LEVELS	
DESIGN LEVELS	
EXISTING LEVELS	
CUT / FILL	
OFFSET	

MC02 - CH 135.000

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JACKSON TEECE
Architecture

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

MC02 - ROAD CROSS SCETIONS - SHEET 5 OF 5

WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

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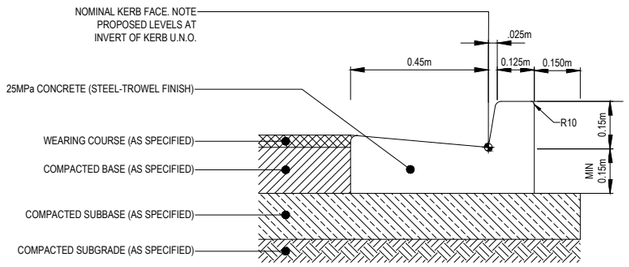
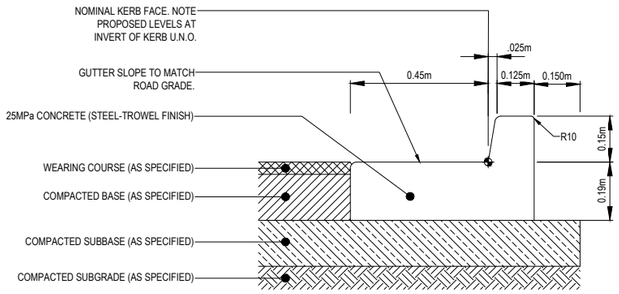


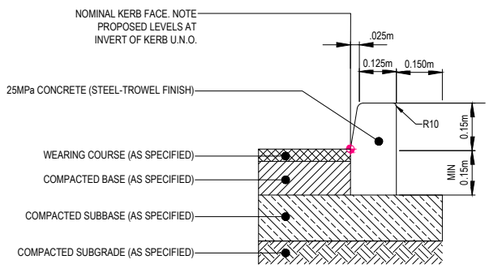
KERB AND GUTTER (K&G-1)

(SCALE 1:10)



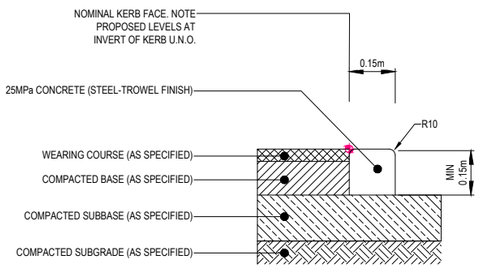
KERB AND GUTTER (K&G-2)

(SCALE 1:10)



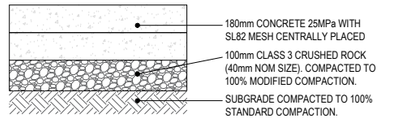
KERB ONLY (KO)

(SCALE 1:10)



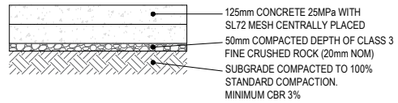
FLUSH KERB (FK)

(SCALE 1:10)



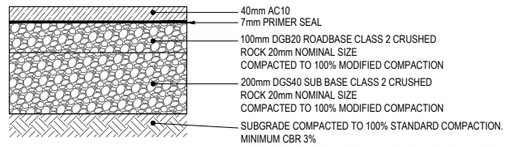
CONCRETE PAVEMENT DETAIL

(SCALE 1:10)



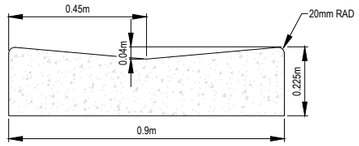
CONCRETE FOOTPATH DETAIL

(SCALE 1:10)



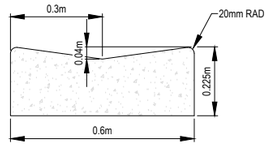
ASPHALT PAVEMENT DETAIL

(SCALE 1:10)



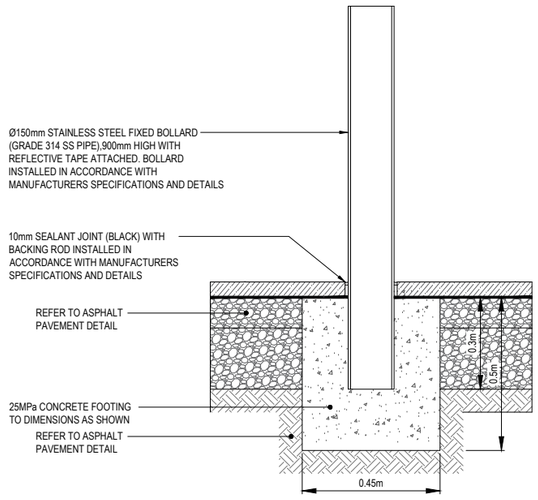
DISH DRAIN DETAIL (DD-1)

(SCALE 1:10)



DISH DRAIN DETAIL (DD-2)

(SCALE 1:10)



TYPICAL BOLLARD DETAIL

(SCALE 1:10)

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1:20 A3

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A	ISSUED FOR TENDER	CPO	RET	05.03.19

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VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... /../..

JACKSON TEECE
Architecture

ARCHITECT/CLIENT

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

ROADS DETAILS

PROJECT TITLE

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WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-406-01	C
SCALE @ A1	PROJECT No	DRAWING No	REV

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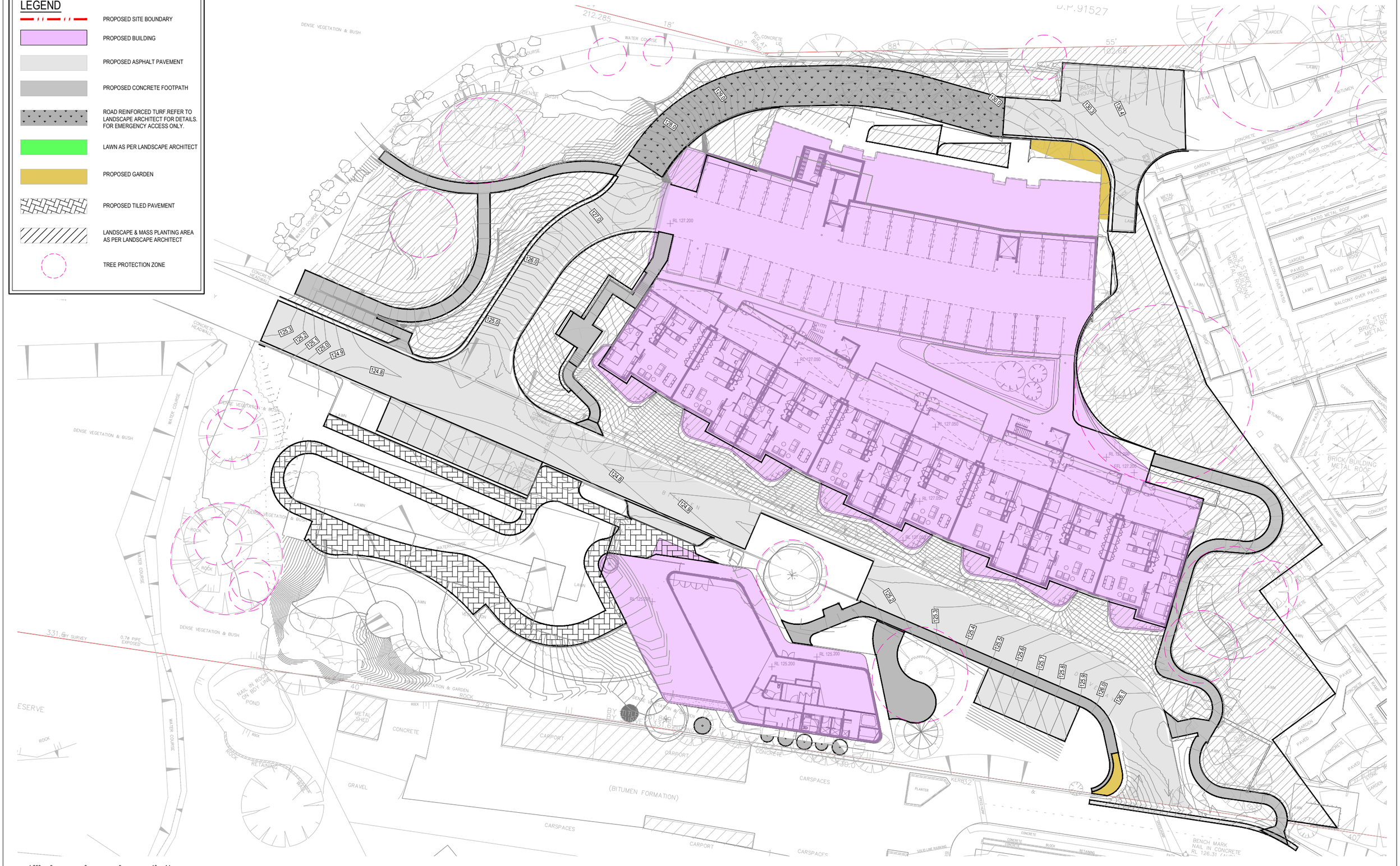
LEGEND

- PROPOSED SITE BOUNDARY
- PROPOSED BUILDING
- PROPOSED ASPHALT PAVEMENT
- PROPOSED CONCRETE FOOTPATH
- ROAD REINFORCED TURF.REFER TO LANDSCAPE ARCHITECT FOR DETAILS. FOR EMERGENCY ACCESS ONLY.
- LAWN AS PER LANDSCAPE ARCHITECT
- PROPOSED GARDEN
- PROPOSED TILED PAVEMENT
- LANDSCAPE & MASS PLANTING AREA AS PER LANDSCAPE ARCHITECT
- TREE PROTECTION ZONE



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REV	DESCRIPTION	DRAWN	APP'D	DATE
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A	ISSUED FOR TENDER	CPO	RET	05.03.19

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JACKSON TEECE
Architecture

ARCHITECT/CLIENT

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

PAVEMENT PLAN

TITLE

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WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-440-01	C
SCALE @ A1	PROJECT No	DRAWING No	REV

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NOTES:

1. LINE MARKING AND SIGNAGE TO BE IN ACCORDANCE WITH AS1742 - MANUAL FOR UNIFORM TRAFFIC CONTROL DEVICES AND THE RTA (NSW ROADS AND TRAFFIC AUTHORITY) GUIDE TO DELINEATION.

ABBREVIATIONS:

BB - DOUBLE BARRIER LINE
PX - PEDESTRIAN CROSSING (2.5m WIDE)
TF - STOP LINE

REV	DESCRIPTION	DRAWN	APP'D	DATE
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B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	IAH	05.03.19

DRAWN:	CPO
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JACKSON TEECE
Architecture
ARCHITECT/CLIENT

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW
PROJECT

SIGNAGE & LINEMARKING PLAN
TITLE

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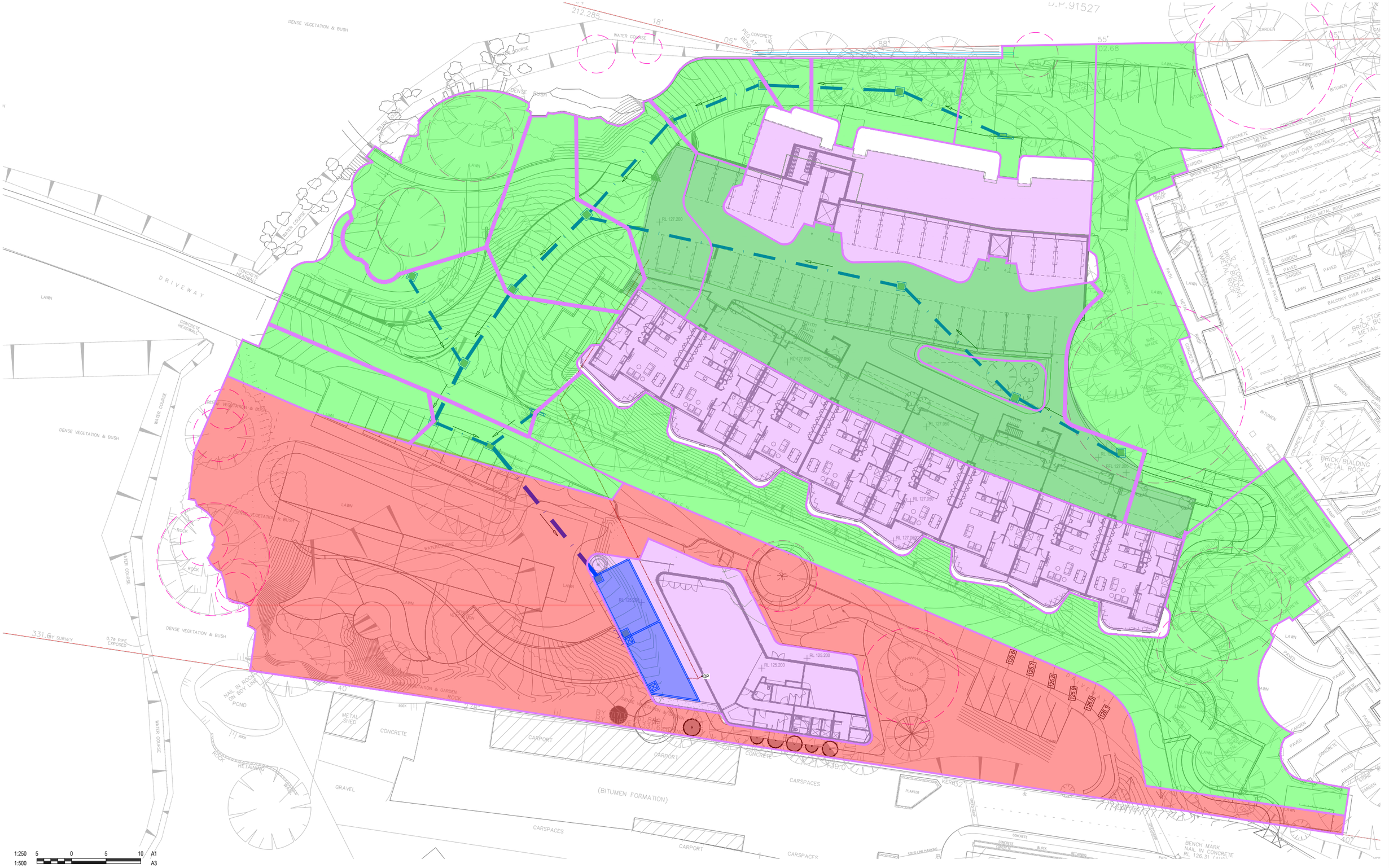
WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-480-01	C
SCALE @ A1	PROJECT No	DRAWING No	REV



REV	DESCRIPTION	DRAWN	APP'D	DATE
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D	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
C	ISSUED FOR TENDER	CPO	RET	13.03.19
B	ISSUED FOR TENDER	CPO	RET	11.03.19
A	ISSUED FOR TENDER	CPO	RET	05.03.19

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... /../../..

JACKSON TEECE
Architecture

ARCHITECT/CLIENT

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

STORMWATER DRAINAGE
CATCHMENT PLAN

TITLE

38509-CI-500-01.dwg

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WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-500-01	D
SCALE @ A1	PROJECT No	DRAWING No	REV

LEGEND

- PROPOSED SITE BOUNDARY
- PROPOSED BUILDING
- PROPOSED STORMWATER PIPE
- PROPOSED JUNCTION PIT
- PROPOSED GRATED PIT
- PROPOSED KERB INLET PIT
- ON SITE DETENTION TANK
- CONCRETE HEADWALL
- PROPOSED RAINWATER PIPE (RW)
- PROPOSED SWALE
- PROPOSED DOWNPIPE (DP)
- TREE PROTECTION ZONE

MAKE SMOOTH CONNECTION WITH EXISTING DISH DRAIN

EXISTING DISH DRAIN TO BE RELOCATED BEHIND PROPOSED PARKING AND RETAINING WALL AS SHOWN. EXISTING DISH DRAIN SIZE AND TYPE TO BE CONFIRMED AND MATCHED TO PROPOSED RELOCATION.

PROPOSED BUND TO CONVEY OVERLAND FLOW FROM NORTH TO PROPOSED DISH DRAIN RELOCATION.

A.3 900 x 900 SURFACE INLET SL129.550 IL 128.300

A.2 900 x 900 SURFACE INLET SL129.700 IL 128.500

A.4 900 x 900 SURFACE INLET SL128.100 IL 127.100

A.1 900 x 450 KERB INLET SL129.700 IL 128.700

A.5 900 x 900 SURFACE INLET SL127.000 IL 125.270

A.6 900 x 900 SURFACE INLET SL125.550 IL 124.500

D.1 900 x 900 SURFACE INLET SL126.700 IL 125.750

B.3 900 x 900 SURFACE INLET SL127.060 IL 125.730

B.2 900 x 900 SURFACE INLET SL127.500 IL 126.01

B.1 900 x 900 SURFACE INLET SL127.150 IL 126.150

A.7 900 x 900 SURFACE INLET SL124.650 IL 123.550

C.1 900 x 450 KERB INLET SL124.550 IL 123.550

A.8 900 x 600 SURFACE INLET SL124.650 IL 123.350

C.2 900 x 600 SURFACE INLET SL124.600 IL 123.260

Ø225 RCP; Ø300 RCP; Ø375 RCP; Ø450 RCP; Ø600 RCP

SURFACE DRAINAGE LINE. DISCHARGE TO ON SITE DETENTION TANK

RAINWATER DRAINAGE LINE FOR ROOF DRAINAGE ONLY. DISCHARGE TO RAINWATER REUSE TANK.

125m³ ON SITE DETENTION TANK. DISCHARGE TO BIO-FILTRATION SYSTEM

LEVEL SPREADER AT TANK OUTLET TO PREVENT SCOURING OF RAINGARDEN.

RAIN GARDEN REFER CI-526-01 FOR DETAILS

130kL RAINWATER TANK FOR LANDSCAPE IRRIGATION OVERFLOW TO DETENTION TANK

1:250 1:500 — 5 0 5 10 — A1 A3

REV	DESCRIPTION	DRAWN	APP'D	DATE
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E	ISSUED FOR APPROVAL	CPO	IAH	14.02.20
D	ISSUED FOR TENDER	CPO	RET	13.03.19
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B	ISSUED FOR TENDER	CPO	RET	05.03.19
A	ISSUED FOR DA APPROVAL	CPO	IAH	01.06.18

DRAWN:	CPO
DESIGNED:	GLE
VERIFIED:	IAH 01.06.18
APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... JJJ..

JACKSON TEECE
Architecture

ARCHITECT/CLIENT

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

STORMWATER MANAGEMENT PLAN

TITLE

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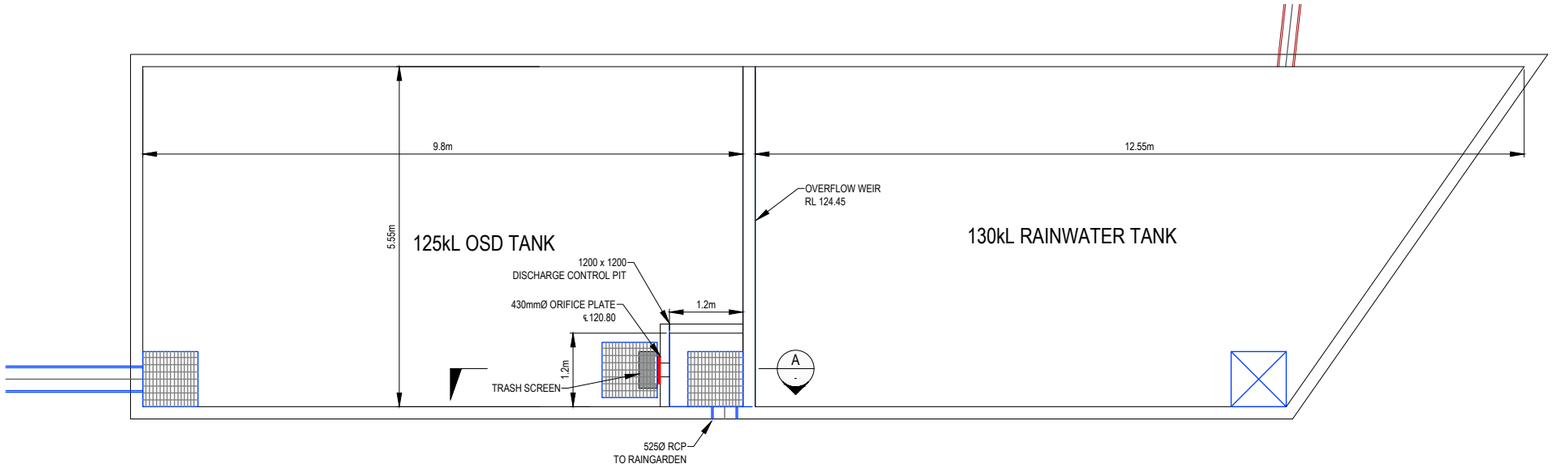
WOOD & GRIEVE ENGINEERS

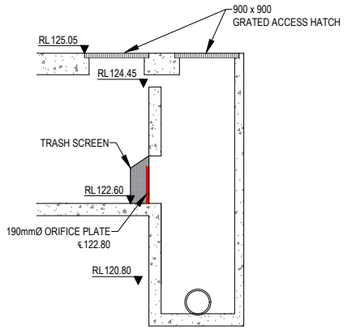
FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-520-01	E
SCALE @ A1	PROJECT No	DRAWING No	REV



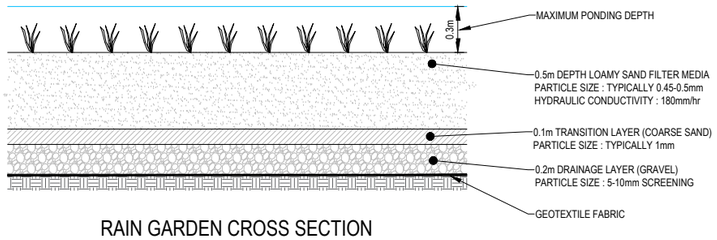
ON SITE DETENTION & RAINWATER TANK PLAN

SCALE 1:50



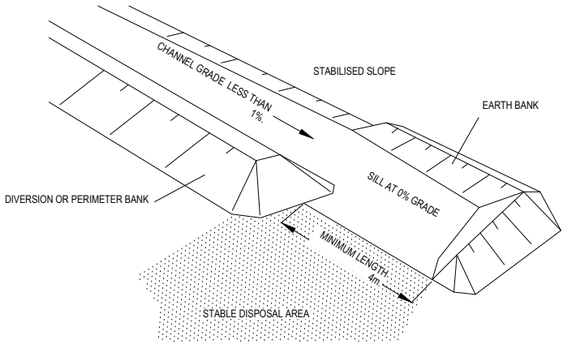
ON SITE DETENTION DISCHARGE CONTROL PIT SECTION

SCALE 1:50

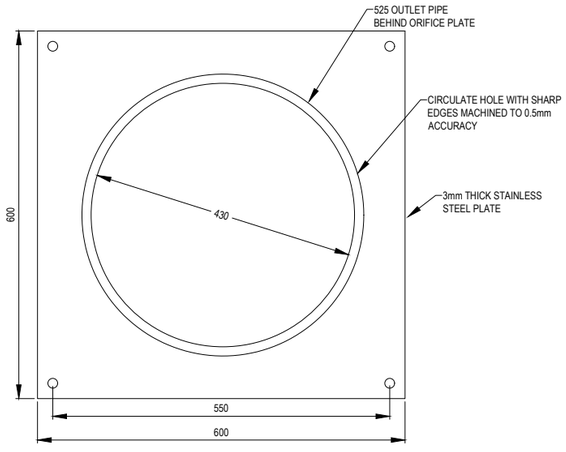


RAIN GARDEN CROSS SECTION

SCALE 1:20

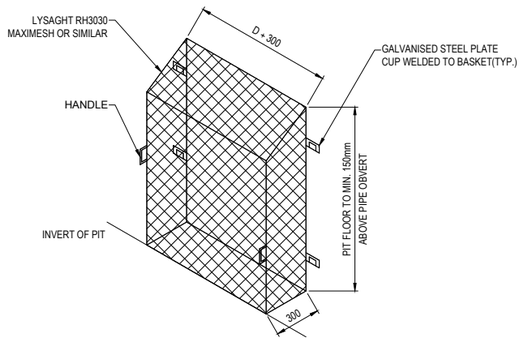


LEVEL SPREADER (OR SILL)
N.T.S



ORIFICE PLATE DETAIL

SCALE 1:5



SCREEN MESH DETAIL

N.T.S.

1:5 0.1 0 0.1 0.2 A1
1:10 A3

1:50 1 0.5 0 1 2 A1
1:100 A3

1:100 1 0 1 2 3 4 5 A1
1:200 A3

REV	DESCRIPTION	DRAWN	APP'D	DATE
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DRAWN:	CPO
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APPROVED FOR TENDER:	RET 04.03.19
APPROVED FOR CONSTRUCTION:	... /../..

JACKSON TEECE
Architecture

ARCHITECT/CLIENT

181 ALLAMBIE ROAD
ALLAMBIE HEIGHTS
NSW

PROJECT

STORMWATER MANAGEMENT
DETAILS

TITLE

38509-CI-526-01.dwg

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WOOD & GRIEVE ENGINEERS

FOR APPROVAL
NOT FOR CONSTRUCTION

AS SHOWN	38509	CI-526-01	E
SCALE @ A1	PROJECT No	DRAWING No	REV

Appendix B – DRAINS Output

Appendix B – DRAINS Output

5 Year Model Output

DRAINS results prepared from Version 2018.01

PIT / NODE DETAILS Version 8

Name	Max HGL	HGL	Max Pond Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Max Surface Freeboard (m)	Max Pond (cu.m/s)	Min	Overflow	Constraint
A.1	125.99	127.22	0.004	0.1	1.21	0.000	Inlet Capacity		
A.2	125.73	127.22	0.004	0.1	1.47	0.000	Inlet Capacity		
A.3	125.52		0.002		1.32	0.000	None		
A.4	124.64		0.004		1.19	0.000	None		
A.5	124.13		0.004		1.17	0.000	None		
A.6	123.46	124.56	0.004	0.2	1.08	0.000	Inlet Capacity		
Roof	124.86		0.163						
RWT	124.57		0.000						
B.1	124.16	125.04	0.032	0.5	0.84	0.000	Inlet Capacity		

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm	
PreDev Catchment	0.328	0.045	0.292	5.00	8.00	8.00	AR&R 5 year, 2 hours storm, average 35.5 mm/h, Zone 1	
A.1 Catch	0.004	0.004	0.000	5.00	6.00	6.00	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1	
A.2 Catch	0.004	0.004	0.000	5.00	6.00	6.00	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1	
A.3 Catch	0.002	0.002	0.000	5.00	6.00	6.00	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1	
A.4 Catch	0.004	0.004	0.000	5.00	6.00	6.00	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1	
A.5 Catch	0.004	0.004	0.000	5.00	6.00	6.00	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1	
A.6 Catch	0.004	0.004	0.000	5.00	6.00	6.00	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1	
Roof Catch	0.163	0.163	0.000	5.00	6.00	6.00	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1	
Bypass Catch	0.168	0.045	0.131	5.00	8.00	8.00	AR&R 5 year, 2 hours storm, average 35.5 mm/h, Zone 1	
B.1 Catch	0.032	0.000	0.032	5.00	8.00	8.00	AR&R 5 year, 2 hours storm, average 35.5 mm/h, Zone 1	

Outflow Volumes for Total Catchment (0.63 impervious + 1.48 pervious = 2.11 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 5 year, 5 minutes storm, average 162 mm/h, Zone 1	285.12	116.50 (40.9%)	78.88 (92.6%)	37.62 (18.8%)
AR&R 5 year, 10 minutes storm, average 126 mm/h, Zone 1	443.52	230.73 (52.0%)	126.20 (95.2%)	104.53 (33.6%)
AR&R 5 year, 15 minutes storm, average 107 mm/h, Zone 1	564.96	317.95 (56.3%)	162.48 (96.3%)	155.47 (39.2%)

Appendix B – DRAINS Output

AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1	661.76	386.06 (58.3%)	191.40 (96.8%)	194.65 (41.9%)
AR&R 5 year, 30 minutes storm, average 77.0 mm/h, Zone 1	813.12	469.34 (57.7%)	236.63 (97.4%)	232.72 (40.8%)
AR&R 5 year, 45 minutes storm, average 62.0 mm/h, Zone 1	982.08	573.00 (58.3%)	287.11 (97.8%)	285.90 (41.5%)
AR&R 5 year, 1 hour storm, average 54.0 mm/h, Zone 1	1140.48	672.96 (59.0%)	334.43 (98.1%)	338.53 (42.3%)
AR&R 5 year, 1.5 hours storm, average 42.2 mm/h, Zone 1	1336.90	772.76 (57.8%)	393.11 (98.4%)	379.64 (40.5%)
AR&R 5 year, 2 hours storm, average 35.5 mm/h, Zone 1	1499.52	861.59 (57.5%)	441.70 (98.6%)	419.89 (39.9%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
1.000	0.004	0.71	125.972	125.729	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1
1.001	0.009	1.42	125.702	125.515	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1
1.002	0.011	1.51	125.482	124.640	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1
1.003	0.015	1.72	124.600	124.127	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1
1.004	0.019	1.78	124.082	123.459	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1
1.005	0.055	0.96	123.439	123.443	AR&R 5 year, 1.5 hours storm, average 42.2 mm/h, Zone 1
1.006	0.110	2.76	121.387	121.205	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1
2.000	0.164	2.32	124.864	124.573	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1
2.001	0.164	2.36	124.573	124.286	AR&R 5 year, 20 minutes storm, average 94.0 mm/h, Zone 1
3.000	0.032	2.33	124.093	123.459	AR&R 5 year, 2 hours storm, average 35.5 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S		Max Q D/S		Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF2	0	0	-999.0000		0	0	0			
OF5	0	0	0.000	0	0	0	0			
OF10	0	0	0.000	0	0	0	0			
OF21	0	0	-0.000	0	0	0	0			
OF27	0	0	0.000	0	0	0	0			
OF32	0	0	0.000	0	0	0	0			
OF36	0	0	0.000	0	0	0	0			
OF35	0	0	0.000	0	0	0	0			
OF39	0.168	0.168	0.000	0.095	0.09	5.03	0.92	AR&R 5 year, 2 hours storm, average 35.5 mm/h, Zone 1		
OF41	0	0	0.000	0	0	0	0			

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
OSD Tank		123.44	38.7	0.110	0.110	0.000
Bio	120.98	0.0	0.000	0.000	0.000	

CONTINUITY CHECK for AR&R 5 year, 2 hours storm, average 35.5 mm/h, Zone 1

Node	Inflow	Outflow	Storage Change	Difference

Appendix B – DRAINS Output

	(cu.m)	(cu.m)	(cu.m)	%	
DS.1	343.38	343.38	0.00	0.0	
A.1	7.00	7.02	0.00	-0.3	
A.2	14.02	14.12	0.00	-0.7	
A.3	17.62	17.57	0.00	0.3	
A.4	24.57	24.59	0.00	-0.1	
A.5	31.59	31.61	0.00	-0.1	
A.6	68.48	68.40	0.00	0.1	
OSD Tank		323.34	323.34	0.00	-0.0
Bio	323.34	323.34	0.00	0.0	
Roof	254.80	254.92	0.00	-0.0	
RWT	254.92	254.94	0.00	-0.0	
N42	195.15	195.15	0.00	0.0	
Bypass	195.15	195.15	0.00	0.0	
B.1	29.77	29.87	0.00	-0.3	

Run Log for 38509 run at 16:34:05 on 30/5/2018
No water upwelling from any pit. Freeboard was adequate at all pits.
The maximum flow in these overflow routes is unsafe: OF39

20 Year Design Output
DRAINS results prepared from Version 2018.01

PIT / NODE DETAILS Version 8

Name	Max HGL	HGL	Max Pond Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Max Surface (m)	Freeboard	Max Pond (cu.m/s)	Min	Overflow	Constraint
A.1	126.00	127.22	0.006	0.1	1.20	0.000	Inlet Capacity			
A.2	125.74	127.22	0.006	0.1	1.46	0.000	Inlet Capacity			
A.3	125.53		0.003		1.31	0.000	None			
A.4	124.65		0.006		1.17	0.000	None			
A.5	124.14		0.006		1.16	0.000	None			
A.6	124.07	124.56	0.006	0.3	0.47	0.000	Inlet Capacity			
Roof	125.27		0.214							
RWT	124.78		0.000							
B.1	124.19	125.05	0.046	0.6	0.81	0.000	Inlet Capacity			

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm		
PreDev Catchment			0.463	0.060	0.414	5.00	8.00	8.00	AR&R 20 year, 2 hours storm, average 47.4 mm/h, Zone 1
A.1 Catch		0.006	0.006	0.000	5.00	6.00	6.00	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1	
A.2 Catch		0.006	0.006	0.000	5.00	6.00	6.00	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1	
A.3 Catch		0.003	0.003	0.000	5.00	6.00	6.00	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1	
A.4 Catch		0.006	0.006	0.000	5.00	6.00	6.00	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1	
A.5 Catch		0.006	0.006	0.000	5.00	6.00	6.00	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1	

Appendix B – DRAINS Output

A.6 Catch	0.006	0.006	0.000	5.00	6.00	6.00	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1
Roof Catch	0.214	0.214	0.000	5.00	6.00	6.00	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1
Bypass Catch	0.235	0.061	0.186	5.00	8.00	8.00	AR&R 20 year, 2 hours storm, average 47.4 mm/h, Zone 1
B.1 Catch	0.046	0.000	0.046	5.00	8.00	8.00	AR&R 20 year, 2 hours storm, average 47.4 mm/h, Zone 1

Outflow Volumes for Total Catchment (0.63 impervious + 1.48 pervious = 2.11 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 20 year, 5 minutes storm, average 208 mm/h, Zone 1	366.08	195.13 (53.3%)	103.06 (94.2%)	92.07 (35.9%)
AR&R 20 year, 10 minutes storm, average 164 mm/h, Zone 1	577.28	361.57 (62.6%)	166.16 (96.3%)	195.41 (48.3%)
AR&R 20 year, 15 minutes storm, average 139 mm/h, Zone 1	733.92	482.26 (65.7%)	212.96 (97.1%)	269.30 (52.3%)
AR&R 20 year, 20 minutes storm, average 123 mm/h, Zone 1	865.92	585.53 (67.6%)	252.40 (97.6%)	333.13 (54.9%)
AR&R 20 year, 30 minutes storm, average 102 mm/h, Zone 1	1077.12	728.70 (67.7%)	315.50 (98.0%)	413.20 (54.7%)
AR&R 20 year, 45 minutes storm, average 83.0 mm/h, Zone 1	1314.72	896.76 (68.2%)	386.49 (98.4%)	510.27 (55.3%)
AR&R 20 year, 1 hour storm, average 72.0 mm/h, Zone 1	1520.64	1044.01 (68.7%)	448.01 (98.6%)	596.00 (55.9%)
AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1	1774.06	1200.35 (67.7%)	523.73 (98.8%)	676.63 (54.4%)
AR&R 20 year, 2 hours storm, average 47.4 mm/h, Zone 1	2002.21	1349.32 (67.4%)	591.89 (98.9%)	757.43 (53.9%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
1.000	0.006	0.77	125.979	125.741	AR&R 20 year, 20 minutes storm, average 123 mm/h, Zone 1
1.001	0.012	1.52	125.709	125.526	AR&R 20 year, 20 minutes storm, average 123 mm/h, Zone 1
1.002	0.014	1.63	125.488	124.654	AR&R 20 year, 20 minutes storm, average 123 mm/h, Zone 1
1.003	0.019	1.87	124.607	124.143	AR&R 20 year, 20 minutes storm, average 123 mm/h, Zone 1
1.004	0.025	1.92	124.091	124.066	AR&R 20 year, 20 minutes storm, average 123 mm/h, Zone 1
1.005	0.068	0.43	124.060	124.057	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1
1.006	0.124	3.11	121.447	121.205	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1
2.000	0.215	3.03	125.274	124.780	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1
2.001	0.215	3.04	124.780	124.300	AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1
3.000	0.046	2.58	124.106	124.066	AR&R 20 year, 2 hours storm, average 47.4 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF2	0	-999.0000	0	0	0			
OF5	0	0.000 0	0	0	0			

OF10	0	0	0.000	0	0	0	0	
OF21	0	0	-0.000	0	0	0	0	
OF27	0	0	0.000	0	0	0	0	
OF32	0	0	0.000	0	0	0	0	
OF36	0	0	0.000	0	0	0	0	
OF35	0	0	0.000	0	0	0	0	
OF39	0.235	0.235	0.000	0.105	0.10	5.80	0.99	AR&R 20 year, 2 hours storm, average 47.4 mm/h, Zone 1
OF41	0	0	0.000	0	0	0	0	

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
OSD Tank		124.06	80.2	0.124	0.124	0.000
Bio	120.98	0.0	0.000	0.000	0.000	

CONTINUITY CHECK for AR&R 20 year, 1.5 hours storm, average 56.0 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	%	Difference
DS.1	521.86	521.86	0.00	0.0	
A.1	8.30	8.32	0.00	-0.2	
A.2	16.62	16.64	0.00	-0.2	
A.3	20.79	20.82	0.00	-0.2	
A.4	29.12	29.15	0.00	-0.1	
A.5	37.45	37.40	0.00	0.1	
A.6	93.72	94.39	0.00	-0.7	
OSD Tank		396.63	396.62	0.00	-0.0
Bio	396.62	396.62	0.00	0.0	
Roof	302.12	302.21	0.00	-0.0	
RWT	302.21	302.24	0.00	-0.0	
N42	282.76	282.76	0.00	0.0	
Bypass	282.76	282.76	0.00	0.0	
B.1	47.97	48.03	0.00	-0.1	

Run Log for 38509 run at 16:35:07 on 30/5/2018
No water upwelling from any pit. Freeboard was adequate at all pits.
The maximum flow in these overflow routes is unsafe: OF39

100 Year Design Output
DRAINS results prepared from Version 2018.01

PIT / NODE DETAILS Version 8

Name	Max HGL	HGL	Max Pond Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Max Surface Freeboard (m)	Max Pond (cu.m/s)	Min	Overflow	Constraint
A.1	126.01	127.22	0.007	0.1	1.19	0.000	Inlet Capacity		
A.2	125.75	127.22	0.007	0.1	1.45	0.000	Inlet Capacity		
A.3	125.54		0.004		1.30	0.000	None		
A.4	124.74		0.007		1.09	0.000	None		
A.5	124.80		0.007		0.50	0.000	None		
A.6	124.69	124.69	0.007	4.1	0.00	0.000	Outlet System		
Roof	126.21		0.266						
RWT	125.48		0.000						

Appendix B – DRAINS Output

B.1	124.75	125.06	0.059	0.7	0.25	0.000	Inlet Capacity

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
PreDev Catchment		0.595	0.074	0.534	5.00	8.00	8.00 AR&R 100 year, 2 hours storm, average 63.0 mm/h, Zone 1
A.1 Catch	0.007	0.007	0.000	5.00	6.00	6.00	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
A.2 Catch	0.007	0.007	0.000	5.00	6.00	6.00	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
A.3 Catch	0.004	0.004	0.000	5.00	6.00	6.00	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
A.4 Catch	0.007	0.007	0.000	5.00	6.00	6.00	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
A.5 Catch	0.007	0.007	0.000	5.00	6.00	6.00	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
A.6 Catch	0.007	0.007	0.000	5.00	6.00	6.00	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
Roof Catch	0.266	0.266	0.000	5.00	6.00	6.00	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
Bypass Catch	0.301	0.075	0.239	5.00	8.00	8.00	AR&R 100 year, 2 hours storm, average 63.0 mm/h, Zone 1
B.1 Catch	0.059	0.000	0.059	5.00	8.00	8.00	AR&R 100 year, 2 hours storm, average 63.0 mm/h, Zone 1

Outflow Volumes for Total Catchment (0.63 impervious + 1.48 pervious = 2.11 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 269 mm/h, Zone 1	473.44	300.67 (63.5%)	135.14 (95.5%)	165.53 (49.9%)
AR&R 100 year, 10 minutes storm, average 213 mm/h, Zone 1	749.76	531.43 (70.9%)	217.69 (97.2%)	313.73 (59.7%)
AR&R 100 year, 15 minutes storm, average 182 mm/h, Zone 1	960.96	704.71 (73.3%)	280.80 (97.8%)	423.92 (62.9%)
AR&R 100 year, 20 minutes storm, average 161 mm/h, Zone 1	1133.44	844.50 (74.5%)	332.33 (98.1%)	512.18 (64.4%)
AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1	1415.04	1059.69 (74.9%)	416.46 (98.5%)	643.23 (64.8%)
AR&R 100 year, 45 minutes storm, average 111 mm/h, Zone 1	1758.22	1329.37 (75.6%)	518.99 (98.8%)	810.38 (65.7%)
AR&R 100 year, 1 hour storm, average 96.0 mm/h, Zone 1	2027.52	1540.20 (76.0%)	599.45 (99.0%)	940.75 (66.2%)
AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1	2376.00	1794.24 (75.5%)	703.57 (99.1%)	1090.67 (65.5%)
AR&R 100 year, 2 hours storm, average 63.0 mm/h, Zone 1	2661.16	2002.06 (75.2%)	788.76 (99.2%)	1213.30 (65.0%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
1.000	0.007	0.83	125.985	125.751	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1

1.001	0.015	1.68	125.713	125.537	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
1.002	0.017	1.75	125.494	124.736	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
1.003	0.031	0.63	124.721	124.798	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
1.004	0.037	0.34	124.796	124.690	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
1.005	0.090	0.57	125.095	125.149	AR&R 100 year, 20 minutes storm, average 161 mm/h, Zone 1
1.006	0.136	3.42	121.541	121.205	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
2.000	0.265	3.75	126.213	125.477	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
2.001	0.264	3.74	125.476	125.149	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1
3.000	0.063	0.57	124.726	124.690	AR&R 100 year, 2 hours storm, average 63.0 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S		Max Q D/S		Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF2	0	0	0.000	0	0	0	0			
OF5	0	0	0.000	0	0	0	0			
OF10	0	0	0.000	0	0	0	0			
OF21	0	0	0.000	0	0	0	0			
OF27	0	0	0.000	0	0	0	0			
OF32	0	0	0.000	0	0	0	0			
OF36	0.147	0.147	0.000	0.060	0.05	4.00	0.82	AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1		
OF35	0	0	0.000	0	0	0	0			
OF39	0.301	0.301	0.000	0.114	0.12	6.44	1.04	AR&R 100 year, 2 hours storm, average 63.0 mm/h, Zone 1		
OF41	0	0	0.000	0	0	0	0			

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
OSD Tank		125.15	104.4	0.283	0.136	0.147
Bio	120.98	0.0	0.000	0.000	0.000	

CONTINUITY CHECK for AR&R 100 year, 1.5 hours storm, average 75.0 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	%	Difference
DS.1	817.66	817.66	0.00	0.0	
A.1	11.15	11.14	0.00	0.1	
A.2	22.29	22.28	0.00	0.0	
A.3	27.85	27.82	0.00	0.1	
A.4	38.97	38.90	0.00	0.2	
A.5	50.05	50.35	0.00	-0.6	
A.6	139.05	135.35	0.00	2.7	
OSD Tank		542.15	542.14	0.00	-0.0
Bio	542.14	542.14	0.00	0.0	
Roof	405.86	406.28	0.00	-0.1	
RWT	406.28	406.80	0.00	-0.1	
N42	432.07	432.07	0.00	0.0	
Bypass	432.07	432.07	0.00	0.0	
B.1	77.33	77.56	0.00	-0.3	

Appendix B – DRAINS Output

Run Log for 38509 run at 16:35:49 on 30/5/2018

The maximum water level in these storages exceeds the maximum elevation you specified: OSD Tank.
DRAINS has extrapolated the Elevation vs Storage table to a higher Elevation. Please provide accurate values for higher elevations.
No water upwelling from any pit.
Freeboard was less than 0.15m at A.6
Flows were safe in all overflow routes.

Appendix C – MUSIC Model Results

Appendix C – MUSIC Model Results

Source nodes
Location,Roof Catchment,Paved External Areas,Bypass Landscape
ID,1,5,8
Node Type,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode
Zoning Surface Type,Roof,Sealedroad,Revegetatedland
Total Area (ha),0.364,0.16,0.243
Area Impervious (ha),0.364,0.159397014925373,0
Area Pervious (ha),0,0.000602985074626861,0.243
Field Capacity (mm),80,80,80
Pervious Area Infiltration Capacity coefficient - a,200,200,200
Pervious Area Infiltration Capacity exponent - b,1,1,1
Impervious Area Rainfall Threshold (mm/day),1,1,1
Pervious Area Soil Storage Capacity (mm),120,120,120
Pervious Area Soil Initial Storage (% of Capacity),25,25,25
Groundwater Initial Depth (mm),10,10,10
Groundwater Daily Recharge Rate (%),25,25,25
Groundwater Daily Baseflow Rate (%),5,5,5
Groundwater Daily Deep Seepage Rate (%),0,0,0
Stormflow Total Suspended Solids Mean (log mg/L),1.3,2.43,1.95
Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.32,0.32,0.32
Stormflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic
Stormflow Total Suspended Solids Serial Correlation,0,0,0
Stormflow Total Phosphorus Mean (log mg/L),-0.89,-0.3,-0.66
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.25,0.25,0.25
Stormflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic
Stormflow Total Phosphorus Serial Correlation,0,0,0
Stormflow Total Nitrogen Mean (log mg/L),0.3,0.34,0.3
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.19,0.19,0.19
Stormflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic
Stormflow Total Nitrogen Serial Correlation,0,0,0
Baseflow Total Suspended Solids Mean (log mg/L),1.1,1.2,1.15
Baseflow Total Suspended Solids Standard Deviation (log mg/L),0.17,0.17,0.17
Baseflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic
Baseflow Total Suspended Solids Serial Correlation,0,0,0
Baseflow Total Phosphorus Mean (log mg/L),-0.82,-0.85,-1.22
Baseflow Total Phosphorus Standard Deviation (log mg/L),0.19,0.19,0.19
Baseflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic
Baseflow Total Phosphorus Serial Correlation,0,0,0
Baseflow Total Nitrogen Mean (log mg/L),0.32,0.11,-0.05
Baseflow Total Nitrogen Standard Deviation (log mg/L),0.12,0.12,0.12
Baseflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic
Baseflow Total Nitrogen Serial Correlation,0,0,0
Flow based constituent generation - enabled,Off,Off,Off
Flow based constituent generation - flow file, , ,
Flow based constituent generation - base flow column, , ,
Flow based constituent generation - pervious flow column, , ,
Flow based constituent generation - impervious flow column, , ,
Flow based constituent generation - unit, , ,
OUT - Mean Annual Flow (ML/yr),4.91,2.16,1.12
OUT - TSS Mean Annual Load (kg/yr),128,755,66.8
OUT - TP Mean Annual Load (kg/yr),0.750,1.24,0.164
OUT - TN Mean Annual Load (kg/yr),10.6,5.23,1.80
OUT - Gross Pollutant Mean Annual Load (kg/yr),119,52.2,0.00
Rain In (ML/yr),5.42212,2.38335,3.61971

Appendix C – MUSIC Model Results

ET Loss (ML/yr),0.514048,0.225955,2.50116
Deep Seepage Loss (ML/yr),0,0,0
Baseflow Out (ML/yr),0,0,0.591647
Imp. Stormflow Out (ML/yr),4.90808,2.1574,0
Perv. Stormflow Out (ML/yr),0,0,0.526913
Total Stormflow Out (ML/yr),4.90808,2.1574,0.526913
Total Outflow (ML/yr),4.90808,2.1574,1.11856
Change in Soil Storage (ML/yr),0,0,-7E-6
TSS Baseflow Out (kg/yr),0,0,9.05422
TSS Total Stormflow Out (kg/yr),127.962,755.393,57.7569
TSS Total Outflow (kg/yr),127.962,755.393,66.8111
TP Baseflow Out (kg/yr),0,0,0.039014
TP Total Stormflow Out (kg/yr),0.750111,1.24375,0.124487
TP Total Outflow (kg/yr),0.750111,1.24375,0.163501
TN Baseflow Out (kg/yr),0,0,0.54805
TN Total Stormflow Out (kg/yr),10.6426,5.23226,1.24862
TN Total Outflow (kg/yr),10.6426,5.23226,1.79667
GP Total Outflow (kg/yr),118.765,52.2044,0

No Imported Data Source nodes

USTM treatment nodes
Location,Rainwater Tank,Bioretention,Detention Tank
ID,2,4,6
Node Type,RainWaterTankNode,BioRetentionNodeV4,DetentionBasinNode
Lo-flow bypass rate (cum/sec),0,0,0
Hi-flow bypass rate (cum/sec),100,100,100
Inlet pond volume,0, ,0
Area (sqm),87.5,100,67.5
Initial Volume (m^3),0, ,
Extended detention depth (m),0.2,0.2,1.5
Number of Rainwater tanks,1, ,
Permanent Pool Volume (cubic metres),130, ,2
Proportion vegetated,0, ,0
Equivalent Pipe Diameter (mm),100, ,1
Overflow weir width (m),10,2,0.3
Notional Detention Time (hrs),0.467, ,9.86E3
Orifice Discharge Coefficient,0.6, ,0.6
Weir Coefficient,1.7,1.7,1.7
Number of CSTR Cells,2,3,1
Total Suspended Solids - k (m/yr),400,8000,8000
Total Suspended Solids - C* (mg/L),12,20,20
Total Suspended Solids - C** (mg/L),12, ,20
Total Phosphorus - k (m/yr),300,6000,6000
Total Phosphorus - C* (mg/L),0.13,0.13,0.13
Total Phosphorus - C** (mg/L),0.13, ,0.13
Total Nitrogen - k (m/yr),40,500,500
Total Nitrogen - C* (mg/L),1.4,1.4,1.4
Total Nitrogen - C** (mg/L),1.4, ,1.4
Threshold Hydraulic Loading for C** (m/yr),3500, ,3500
Horizontal Flow Coefficient, ,3,
Reuse Enabled,On,Off,Off
Max drawdown height (m),1.48571428571429, ,
Annual Demand Enabled,Off,Off,Off

Appendix C – MUSIC Model Results

Annual Demand Value (ML/year), , ,
Annual Demand Distribution, , ,
Annual Demand Monthly Distribution: Jan, , ,
Annual Demand Monthly Distribution: Feb, , ,
Annual Demand Monthly Distribution: Mar, , ,
Annual Demand Monthly Distribution: Apr, , ,
Annual Demand Monthly Distribution: May, , ,
Annual Demand Monthly Distribution: Jun, , ,
Annual Demand Monthly Distribution: Jul, , ,
Annual Demand Monthly Distribution: Aug, , ,
Annual Demand Monthly Distribution: Sep, , ,
Annual Demand Monthly Distribution: Oct, , ,
Annual Demand Monthly Distribution: Nov, , ,
Annual Demand Monthly Distribution: Dec, , ,
Daily Demand Enabled,On,Off,Off
Daily Demand Value (ML/day),0.0063, ,
Custom Demand Enabled,Off,Off,Off
Custom Demand Time Series File, , ,
Custom Demand Time Series Units, , ,
Filter area (sqm), ,100,
Filter perimeter (m), ,14,
Filter depth (m), ,0.5,
Filter Median Particle Diameter (mm), , ,
Saturated Hydraulic Conductivity (mm/hr), ,100,
Infiltration Media Porosity, ,0.35,
Length (m), , ,
Bed slope, , ,
Base Width (m), , ,
Top width (m), , ,
Vegetation height (m), , ,
Vegetation Type, ,Vegetated with Effective Nutrient Removal Plants,
Total Nitrogen Content in Filter (mg/kg), ,600,
Orthophosphate Content in Filter (mg/kg), ,30,
Is Base Lined?, ,No,
Is Underdrain Present?, ,Yes,
Is Submerged Zone Present?, ,No,
Submerged Zone Depth (m), , ,
B for Media Soil Texture,-9999,13,-9999
Proportion of upstream impervious area treated, , ,
Exfiltration Rate (mm/hr),0,0,0
Evaporative Loss as % of PET,0,100,100
Depth in metres below the drain pipe, , ,
TSS A Coefficient, , ,
TSS B Coefficient, , ,
TP A Coefficient, , ,
TP B Coefficient, , ,
TN A Coefficient, , ,
TN B Coefficient, , ,
Sfc, ,0.61,
S*, ,0.37,
Sw, ,0.11,
Sh, ,0.05,
Emax (m/day), ,0.008,
Ew (m/day), ,0.001,

Appendix C – MUSIC Model Results

IN - Mean Annual Flow (ML/yr),4.91,4.64,4.82
IN - TSS Mean Annual Load (kg/yr),128,157,399
IN - TP Mean Annual Load (kg/yr),0.750,0.748,1.25
IN - TN Mean Annual Load (kg/yr),10.6,8.25,10.0
IN - Gross Pollutant Mean Annual Load (kg/yr),119,0.00,0.00
OUT - Mean Annual Flow (ML/yr),2.67,4.42,4.64
OUT - TSS Mean Annual Load (kg/yr),51.7,50.5,157
OUT - TP Mean Annual Load (kg/yr),0.378,0.298,0.748
OUT - TN Mean Annual Load (kg/yr),5.50,4.69,8.25
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,0.00,0.00
Flow In (ML/yr),4.90804,4.64089,4.82458
ET Loss (ML/yr),0,0.221265,0.0850746
Infiltration Loss (ML/yr),0,0,0
Low Flow Bypass Out (ML/yr),0,0,0
High Flow Bypass Out (ML/yr),0,0,0
Orifice / Filter Out (ML/yr),2.13987,2.86636,0.0786461
Weir Out (ML/yr),0.527306,1.55131,4.55943
Transfer Function Out (ML/yr),0,0,0
Reuse Supplied (ML/yr),2.23943,0,0
Reuse Requested (ML/yr),2.29794,0,0
% Reuse Demand Met,97.4538,0,0
% Load Reduction,45.657,4.80989,3.8657
TSS Flow In (kg/yr),127.962,156.689,399.228
TSS ET Loss (kg/yr),0,0,0
TSS Infiltration Loss (kg/yr),0,0,0
TSS Low Flow Bypass Out (kg/yr),0,0,0
TSS High Flow Bypass Out (kg/yr),0,0,0
TSS Orifice / Filter Out (kg/yr),41.1785,7.39103,1.60655
TSS Weir Out (kg/yr),10.5687,43.125,155.164
TSS Transfer Function Out (kg/yr),0,0,0
TSS Reuse Supplied (kg/yr),28.9992,0,0
TSS Reuse Requested (kg/yr),0,0,0
TSS % Reuse Demand Met,0,0,0
TSS % Load Reduction,59.5605,67.7603,60.7316
TP Flow In (kg/yr),0.750111,0.748307,1.24828
TP ET Loss (kg/yr),0,0,0
TP Infiltration Loss (kg/yr),0,0,0
TP Low Flow Bypass Out (kg/yr),0,0,0
TP High Flow Bypass Out (kg/yr),0,0,0
TP Orifice / Filter Out (kg/yr),0.306375,0.067488,0.0103158
TP Weir Out (kg/yr),0.0712789,0.23063,0.737966
TP Transfer Function Out (kg/yr),0,0,0
TP Reuse Supplied (kg/yr),0.295559,0,0
TP Reuse Requested (kg/yr),0,0,0
TP % Reuse Demand Met,0,0,0
TP % Load Reduction,49.6536,60.161,40.055
TN Flow In (kg/yr),10.6426,8.2494,10.0477
TN ET Loss (kg/yr),0,0,0
TN Infiltration Loss (kg/yr),0,0,0
TN Low Flow Bypass Out (kg/yr),0,0,0
TN High Flow Bypass Out (kg/yr),0,0,0
TN Orifice / Filter Out (kg/yr),4.38103,1.84889,0.113912
TN Weir Out (kg/yr),1.11458,2.84082,8.13815
TN Transfer Function Out (kg/yr),0,0,0

Appendix C – MUSIC Model Results

TN Reuse Supplied (kg/yr),3.872,0,0
TN Reuse Requested (kg/yr),0,0,0
TN % Reuse Demand Met,0,0,0
TN % Load Reduction,48.3621,43.1509,17.8711
GP Flow In (kg/yr),118.765,0,0
GP ET Loss (kg/yr),0,0,0
GP Infiltration Loss (kg/yr),0,0,0
GP Low Flow Bypass Out (kg/yr),0,0,0
GP High Flow Bypass Out (kg/yr),0,0,0
GP Orifice / Filter Out (kg/yr),0,0,0
GP Weir Out (kg/yr),0,0,0
GP Transfer Function Out (kg/yr),0,0,0
GP Reuse Supplied (kg/yr),0,0,0
GP Reuse Requested (kg/yr),0,0,0
GP % Reuse Demand Met,0,0,0
GP % Load Reduction,100,100,100
PET Scaling Factor, ,2.1,

Generic treatment nodes
Location, 6 x Enviropod 200
ID,7
Node Type,GPTNode
Lo-flow bypass rate (cum/sec),0
Hi-flow bypass rate (cum/sec),0.12
Flow Transfer Function
Input (cum/sec),0
Output (cum/sec),0
Input (cum/sec),10
Output (cum/sec),10
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Input (cum/sec),
Output (cum/sec),
Gross Pollutant Transfer Function
Enabled,True
Input (kg/ML),0
Output (kg/ML),0
Input (kg/ML),14.780776740251
Output (kg/ML),0
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),

Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Input (kg/ML),
Output (kg/ML),
Total Nitrogen Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),10
Output (mg/L),8.7
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Total Phosphorus Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),10
Output (mg/L),7
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),

Output (mg/L),
Input (mg/L),
Output (mg/L),
Total Suspended Solids Transfer Function
Enabled,True
Input (mg/L),0
Output (mg/L),0
Input (mg/L),100
Output (mg/L),46
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
Input (mg/L),
Output (mg/L),
TSS Flow based Efficiency Enabled,Off
TSS Flow based Efficiency,
TP Flow based Efficiency Enabled,Off
TP Flow based Efficiency,
TN Flow based Efficiency Enabled,Off
TN Flow based Efficiency,
GP Flow based Efficiency Enabled,Off
GP Flow based Efficiency,
IN - Mean Annual Flow (ML/yr),2.16
IN - TSS Mean Annual Load (kg/yr),755
IN - TP Mean Annual Load (kg/yr),1.24
IN - TN Mean Annual Load (kg/yr),5.23
IN - Gross Pollutant Mean Annual Load (kg/yr),52.2
OUT - Mean Annual Flow (ML/yr),2.16
OUT - TSS Mean Annual Load (kg/yr),347
OUT - TP Mean Annual Load (kg/yr),0.871
OUT - TN Mean Annual Load (kg/yr),4.55
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00
Flow In (ML/yr),2.15738
ET Loss (ML/yr),0
Infiltration Loss (ML/yr),0
Low Flow Bypass Out (ML/yr),0
High Flow Bypass Out (ML/yr),0
Orifice / Filter Out (ML/yr),0
Weir Out (ML/yr),0
Transfer Function Out (ML/yr),2.15738
Reuse Supplied (ML/yr),0
Reuse Requested (ML/yr),0
% Reuse Demand Met,0

Appendix C – MUSIC Model Results

% Load Reduction,0
TSS Flow In (kg/yr),755.392
TSS ET Loss (kg/yr),0
TSS Infiltration Loss (kg/yr),0
TSS Low Flow Bypass Out (kg/yr),0
TSS High Flow Bypass Out (kg/yr),0
TSS Orifice / Filter Out (kg/yr),0
TSS Weir Out (kg/yr),0
TSS Transfer Function Out (kg/yr),347.48
TSS Reuse Supplied (kg/yr),0
TSS Reuse Requested (kg/yr),0
TSS % Reuse Demand Met,0
TSS % Load Reduction,54
TP Flow In (kg/yr),1.24375
TP ET Loss (kg/yr),0
TP Infiltration Loss (kg/yr),0
TP Low Flow Bypass Out (kg/yr),0
TP High Flow Bypass Out (kg/yr),0
TP Orifice / Filter Out (kg/yr),0
TP Weir Out (kg/yr),0
TP Transfer Function Out (kg/yr),0.870622
TP Reuse Supplied (kg/yr),0
TP Reuse Requested (kg/yr),0
TP % Reuse Demand Met,0
TP % Load Reduction,30
TN Flow In (kg/yr),5.23226
TN ET Loss (kg/yr),0
TN Infiltration Loss (kg/yr),0
TN Low Flow Bypass Out (kg/yr),0
TN High Flow Bypass Out (kg/yr),0
TN Orifice / Filter Out (kg/yr),0
TN Weir Out (kg/yr),0
TN Transfer Function Out (kg/yr),4.55207
TN Reuse Supplied (kg/yr),0
TN Reuse Requested (kg/yr),0
TN % Reuse Demand Met,0
TN % Load Reduction,13
GP Flow In (kg/yr),52.2045
GP ET Loss (kg/yr),0
GP Infiltration Loss (kg/yr),0
GP Low Flow Bypass Out (kg/yr),0
GP High Flow Bypass Out (kg/yr),0
GP Orifice / Filter Out (kg/yr),0
GP Weir Out (kg/yr),0
GP Transfer Function Out (kg/yr),0
GP Reuse Supplied (kg/yr),0
GP Reuse Requested (kg/yr),0
GP % Reuse Demand Met,0
GP % Load Reduction,100

Other nodes
Location,Post-Development Node
ID,3
Node Type,PostDevelopmentNode

Appendix C – MUSIC Model Results

IN - Mean Annual Flow (ML/yr),5.54
IN - TSS Mean Annual Load (kg/yr),117
IN - TP Mean Annual Load (kg/yr),0.462
IN - TN Mean Annual Load (kg/yr),6.49
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00
OUT - Mean Annual Flow (ML/yr),5.54
OUT - TSS Mean Annual Load (kg/yr),117
OUT - TP Mean Annual Load (kg/yr),0.462
OUT - TN Mean Annual Load (kg/yr),6.49
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00
% Load Reduction,32.4
TSS % Load Reduction,87.7
TN % Load Reduction,63.3
TP % Load Reduction,78.6
GP % Load Reduction,100

Links
Location,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link
Source node ID,1,4,2,6,5,7,8
Target node ID,2,3,6,4,7,6,3
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed
Muskingum K, , , , , , ,
Muskingum theta, , , , , , ,
IN - Mean Annual Flow (ML/yr),4.91,4.42,2.67,4.64,2.16,2.16,1.12
IN - TSS Mean Annual Load (kg/yr),128,50.5,51.7,157,755,347,66.8
IN - TP Mean Annual Load (kg/yr),0.750,0.298,0.378,0.748,1.24,0.871,0.164
IN - TN Mean Annual Load (kg/yr),10.6,4.69,5.50,8.25,5.23,4.55,1.80
IN - Gross Pollutant Mean Annual Load (kg/yr),119,0.00,0.00,0.00,52.2,0.00,0.00
OUT - Mean Annual Flow (ML/yr),4.91,4.42,2.67,4.64,2.16,2.16,1.12
OUT - TSS Mean Annual Load (kg/yr),128,50.5,51.7,157,755,347,66.8
OUT - TP Mean Annual Load (kg/yr),0.750,0.298,0.378,0.748,1.24,0.871,0.164
OUT - TN Mean Annual Load (kg/yr),10.6,4.69,5.50,8.25,5.23,4.55,1.80
OUT - Gross Pollutant Mean Annual Load (kg/yr),119,0.00,0.00,0.00,52.2,0.00,0.00

Catchment Details
Catchment Name,38509 - ALLAMBIE HEIGHTS MUSIC
Timestep,6 Minutes
Start Date,1/01/1959
End Date,31/12/1959 11:54:00 PM
Rainfall Station, 66062 SYDNEY
ET Station,Monthly User Defined
Mean Annual Rainfall (mm), 1490
Mean Annual ET (mm), 1260