27 Bellevue Ave Avalon Beach

Stormwater Management Report (Including Water Sensitive Urban Design)

Project: 27 Bellevue Ave Avalon Beach

Prepared for: Construct by Design Pty Ltd

Reference:	5281
Revision:	02
Date:	16th March 2021

Document prepared by:

M+G Consulting
Level 3, 50 Berry St
North Sydney, NSW 2060
T: +61 2 8666 7888

Contents

List of figures

List of tables

1.0 Introduction

1.1 Preface

M+G Consulting has been commissioned by Construct by Design Pty Ltd to prepare a Stormwater Management Report (including Water Sensitive Urban Design) and associated civil engineering design drawings for the development application submission to Northern Beaches Council for the proposed Seniors Housing development at 27 Bellevue Ave Avalon Beach.

The proposed works include the demolition of existing structures and the construction of a new two storey development containing four (4) apartments and associated car parking. The details of the works involved are shown on the architectural drawings by SHED Architects.

The following engineering works form part of the proposed development:

- Earthworks for building basements, associated pathways, parking facilities and bioretention basins, including the clearing of existing vegetation (where approved).
- Construction of new retaining walls, pavements and apartment structures.
- New stormwater drainage for the works to comply with the design requirements contained in the Pittwater 21 DCP – Section B5 – Water Management.
- New water quality measures for the works to comply with the suggested design criteria in the Australian Runoff Quality – A Guide to Water Sensitive Urban Design (Engineers Australia, 2006)

A stormwater management strategy has been detailed in this report to be implemented during the construction stage (short term) and after the completion of construction works (long term) for the proposed development. This report explores the stormwater management strategy by discussing the following key considerations:

- Sediment and erosion control: to manage stormwater runoff and prevent detriment to receiving waters downstream;
- Stormwater quantity control: to manage post-development flows in accordance with the relevant guidelines listed in this report; and
- Stormwater quality control: to manage pollutant levels in post-development runoff as part of the Water Sensitive Urban Design (WSUD) requirements for the development.

The following information and documents were utilised in this investigation:

- Concept Civil Engineering Drawings by M+G;
- Concept Architectural Plans by SHED Architects;
- Australian Standard AS/NZS 3500.3-2015 *Plumbing and Drainage: Part 3 Stormwater Drainage;*
- Survey Plans by Bee & Lethbridge Ref Job No. 21192, DWG No. 21192B Sheets 1 & 2 dated 03-07-2020
- Geotechnical Investigations by Crozier Geotechnical Consultants: Project No. 2019-151 dated 25-09-2019;
- Pittwater 21 DCP – Section B5 – Water Management;
- Stormwater NSW – *Guidelines for the maintenance of stormwater treatment measures* (2020);
- NSW Government Local Land Services Greater Sydney – *NSW Music Modelling Guidelines* (2015); and
- Landcom - *Managing Urban Stormwater: Soils and Construction 4th Edition* (2004);
- Landcom – *Soils and Construction – Volume 1, Chapter 5*;
- Urban Stormwater – Best Practice Environmental Management Guidelines (CSIOR, 1999);
- "Australian Runoff Quality – *A Guide to Water Sensitive Urban Design*", Engineers Australia (2006);
- "Australian Rainfall and Runoff – *A Guide to Flood Estimation*", Institute of Engineers, Australia (2016);
- Sydney Catchment Management Authority – *DRAFT NSW MUSIC Modelling Guidelines* (August 2010); and
- NSW Government Water Quality and River Flow Environmental Objectives.

To prevent any adverse effects on receiving environments, the stormwater management strategy has been designed to safely attenuate flows throughout the site. The proposed strategy will ensure that flows discharging from the site are within the acceptable limits outlined in the relevant guidelines whilst also reducing pollutant levels present in post-development runoff via proposed water treatment elements.

1.2 General Instructions

The information contained in this report is to be read in conjunction with documentation, such as engineering drawings, plans, specifications and the like, that is issued relating to the project.

The contractor is to ensure that all soil and water management works, including sediment and erosion control, shall be completed as per the instructions outlined in this report and constructed in accordance with the guidelines contained in the document *"Managing Urban Stormwater – Soils and Construction, 4th Edition* (2004)" by Landcom.

2.0 Existing Site

The site is located at 27 Bellevue Ave Avalon Beach (Lot 33 in DP11462), which is within the Northern Beaches Council (LGA). It is bound by a dwelling to the north, Bellevue Ave to the west, Sanders Ln to the south and Wickham Ln to the east. The site currently exists as a residential lot. The site falls from an approx. RL21.9-20.8m to RL6.6-8.75m (AHD) falling from the western to the eastern boundary (parallel to Sanders Ln).

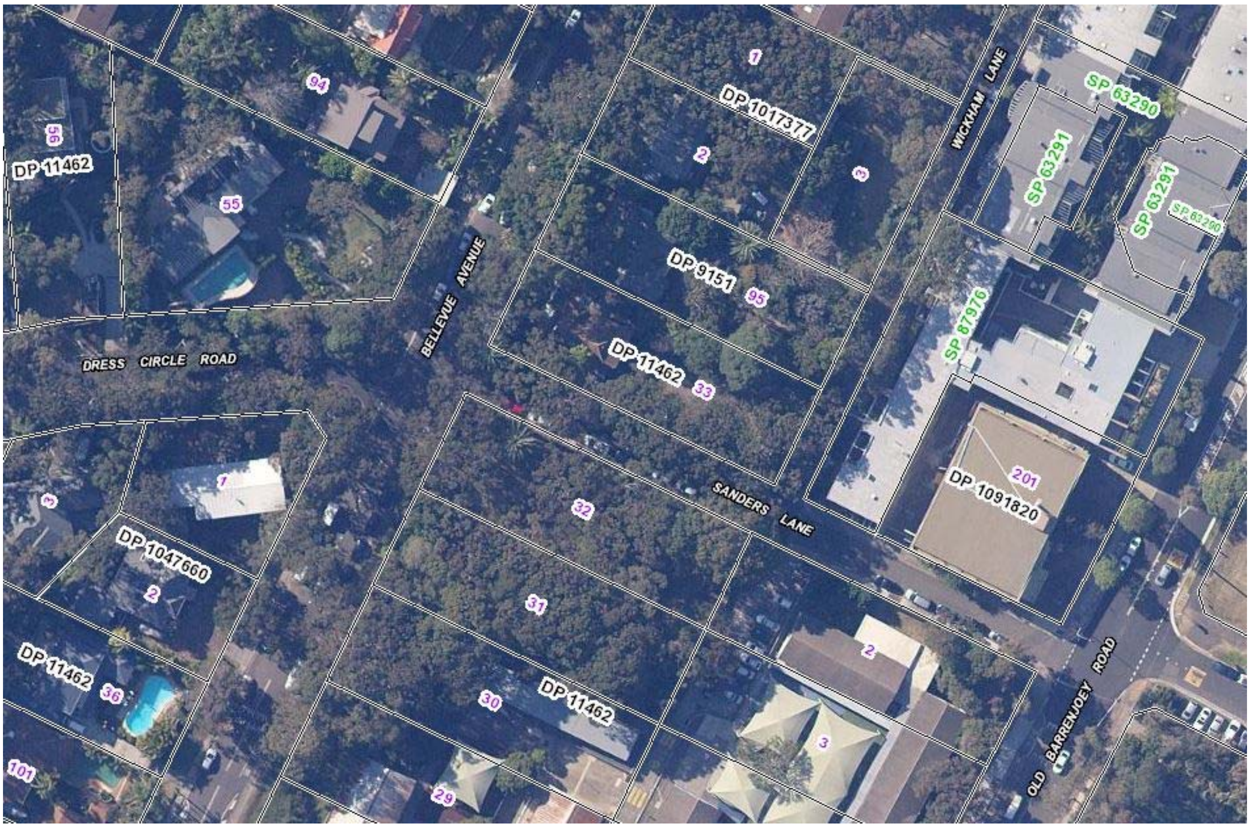


Fig. 1 - Aerial Photo of Existing Site (Source: SIX Maps)

The proposed development includes the redevelopment of the site including construction of a new Seniors Housing development, comprising of a two-storey development containing four (4) apartments and associated car parking.

3.0 Construction Soil and Water Management

3.1 General

Prior to any earthworks commencing on site, soil and water management control measures will need to be put in place generally in accordance with *Managing Urban Stormwater – Soils and Construction, 4th Edition* (2004) by Landcom. Please refer to drawings 5281-C02-1 and 5281-C03-01.

The contractor will be responsible to attain all necessary licenses, permits or approvals prior to the commencement of the works.

The contractor will be responsible for the implementation and maintenance of the Erosion and Sediment Control measure used during construction of the works.

The temporary measures contained in this report are to be implemented and maintained throughout the construction phase of the project, until such a time when permanent measures can be put in place. Soil and water management requirements are not limited to the advice contained in this report and as such this document outlines the minimum requirements that are to be implemented by the contractor. The final design and implementation of all maintenance works is the sole responsibility of the contractor. Further assessment of the permanent stormwater management controls outlined in this report are required. This may require some revision to the measures, which is to be confirmed during the detailed design stage of the project.

3.2 During wet weather construction

Soil and water management measures are to be incorporated into the construction works during wet weather construction works. These include, but are not limited, to:

- All plant and equipment are to be relocated away from edges of batters and edges of excavations.
- Construct temporary earth V-drains to direct surface water away from top of batters, edges of excavations batters and temporary shoring
- Inspect all batters and temporary shoring and undertake remedial works as required.
- Inspect all erosion and sediment control measures and repair as necessary.
- Check to ensure that sufficient supply of flocculant is on site for water treatment prior to discharge from site.
- Ensure all vehicle access tracks are in good condition. Undertake repairs and top with gravel/ballast as required.

4.0 Stormwater Design

4.1 Requirements and Guidelines

The proposed stormwater drainage elements have been designed in accordance with the following:

- Pittwater 21 DCP – Section B5 – Water Management; and
- Australian Standard AS/NZS 3500.3-2015 *Plumbing and Drainage: Part 3 Stormwater Drainage.*

The Water Sensitive Urban Design (WSUD) for the proposed development has been designed to comply with the following Control Plans, Australian Standards, Report and Guidelines:

- Urban Stormwater – Best Practice Environmental Management Guidelines (CSIOR, 1999); and
- Australian Runoff Quality – A Guide to Water Sensitive Urban Design", Engineers Australia (2006).

4.2 Stormwater Design Objectives

The objective of the Stormwater Management Plan outlined below is to:

- Prevent or minimise adverse social and environmental impacts from stormwater runoff originating from the proposed development.
- Achieve acceptable levels of stormwater runoff quality and quantity.

The Stormwater Management Plan aims to identify Stormwater Quantity and Quality Best Management Practice for the site and demonstrate that water quantity and quality impacts will be minimised in receiving waters.

The Stormwater Management Plan examines the site in two sections - the operational phase and the construction phase. The operational phase addresses the treatment of contaminated runoff from the developed site by a combination of manufactured products and natural methods before discharging into receiving waters, whilst the construction phase of the Stormwater Management Plan addresses erosion and sediment control to prevent contamination of water sources by stormwater runoff during construction of the site.

5.0 Stormwater Quantity Control

5.1 Introduction

An analysis on the effect of the upstream contributing areas and overland flow paths was conducted. The objective of this analysis was to ensure that any adverse effect on stormwater discharge from the proposed development was mitigated and attenuated the post-development flows to the pre-existing conditions.

"DRAINS" software by Watercom Pty Ltd was used to assess the performance of the proposed stormwater drainage system. A Horton-ILSAX model was used to assess the design performance.

5.2 Stormwater Drainage Design Parameters

The table below provides a summary of all the parameters used and assumptions made in our assessment on the proposed stormwater drainage system:

Parameter	Assumption or Information Source
IFD Data	Pittwater 21 DCP Appendix 11 – Stormwater Management Technical Data (Table 5b)
Sub-Catchment fraction imperviousness	DRAINS default values: Supplementary (Roof Surfaces) – 358.2m^2 Paved (Pavements & Footpaths) – 328.5m^2 Grassed (Landscaped Areas) – 527.0m^2
Flow velocity estimates	DRAINS outputs
Manning's 'n' roughness values	DRAINS default values
Flow contraction and expansion coefficients	DRAINS default values
Structure hydraulic head loss coefficients	
Other hydraulic head losses	

Table 1 - Parameters and Assumptions in DRAINS Model

2

5.2 Proposed Drainage System

The proposed stormwater drainage system for the development has been designed to capture runoff from impermeable surfaces including roofs and pavements. The proposed new works involve approximately 391m^2 of new impervious surfaces. New in-ground stormwater drainage lines to drain the new facility are proposed to route through a subfloor OSD tank located below a non-habitable balcony floor space before discharging via an orifice-controlled flow to Wickham Ln to the East. Roofed surfaces drain to rainwater tanks, with overflows routing through bio-retention systems prior to draining to the OSD tank to reduce the pollutant loading on the flows discharging from the site.

Refer to Appendix A for concept stormwater drainage plan.

The proposed stormwater management system for the development includes:

- Pit and pipe drainage network to collect run off from the storm events.
- Two (2) bioretention systems used to improve water quality.
- One (1) subfloor 25m^3 OSD tank with a High Early Discharge (HED) chamber used to attenuate post-development flows to the pre-existing conditions. A high-level overflow pipe is also incorporated into the OSD design for storms in excess of the 1 in 100-year ARI.
- One (1) 3m^3 basement pump out pit (connecting to the OSD tank)
- 12000L of total storage provided in Rainwater Tanks. Tanks are proportioned to each roof based on surface area.

5.3 On-Site Stormwater Detention Requirements

Northern Beaches Council is the responsible body for determining the onsite stormwater detention (OSD) permissible site discharges and site storage required.

In accordance with the Pittwater 21 DCP – Section B5.7 – On-Site Stormwater Detention, the OSD tank has been sized to ensure that that the development does not increase stormwater discharge downstream of the land over and above that of the existing stormwater discharge conditions up to the 1% AEP storm event.

The stormwater discharge from the HED chamber onto the public roadway (Wickham Ln) has also been limited to a maximum flow rate of 30L/s for storms up to and including the 1% AEP storm event in accordance with Section B5.10 – Stormwater Discharge into Public Drainage System.

As per the requirements identified in Section B5.7 of the Pittwater 21 DCP, a total combined OSD volume of $25m^3$ provided by the subfloor OSD tank has been modelled to attenuate post development flows to pre-development conditions (refer to Appendix B for the Pre & Post-Development flow rates from the *DRAINS* outputs).

The pre & post-development site discharge flows for the site have been summarised in the table below:

Pre-Development:

- Impervious Areas = $296.5m^2$ (24.4%)
- Pervious Areas = $918.5m^2$ (75.6%)

Post-Development:

- Impervious Areas = $815.0m^2$ (67.1%)
- Pervious Areas = $400.0m^2$ (32.9%)

Total Site Area = $1215m^2$

(Refer to drawing 5281-C04-1 for pre and post development catchment plans)

STORM EVENT ANNUAL EXCEEDANCE PROBABILITY (ARI)	PRE-DEV FLOW RATES Q (m^3/s)	POST-DEV OSD OUTFLOW (KERB DISCHARGE) (m^3/s)	POST-DEV UNCONTROLLED FLOW (m^3/s)	POST-DEV TOTAL FLOW (m^3/s)
1 Year	0.023	0.020	0.003	**0.023** (eq)
2 Year	0.031	0.025	0.004	**0.029** (-0.002)
5 Year	0.042	0.029	0.005	**0.034** (-0.008)
10 Year	0.048	0.029	0.006	**0.035** (-0.013)
20 Year	0.056	0.029	0.007	**0.036** (-0.020)
50 Year	0.062	0.029	0.008	**0.037** (-0.025)
100 Year	0.070	0.029	0.009	**0.038** (-0.032)

Table 2 – Pre & Post-Development Flow Rates

It can be seen from the above results that the stormwater drainage system is capable of attenuating post-development flows to the pre-developed conditions for the storm events listed above in accordance with Section B5.7 and B5.10 of the Pittwater 21 DCP.

Refer Appendix B for the DRAINS outputs showing pre and post development flow rates for the listed ARIs.

6.0 Stormwater Quality Control

6.1 Introduction

The pollutant reduction targets specified in the Australian Runoff Quality – *A Guide to Water Sensitive Urban Design*", Engineers Australia (2006) are as per below:

Pollutant Type	Pollutant Reduction Target - Mean Annual Loads	Design Reduction (Ref Section 6.7)
Total Suspended Solids (TSS)	80%	82.4%
Total Phosphorus (TP)	45%	62.8%
Total Nitrogen (TN)	45%	45.2%
Gross Pollutants (size >5mm) (GP)	Not specified	92.8%

Table 3 – Pollutant Reduction Targets vs Design Pollutant Reduction Levels

6.2 Stormwater Quality Control Measures

To achieve the required water quality measures to satisfy the requirements contained in Pittwater 21 DCP – Section B5.9 Water Quality – Other than Low Density Residential, the following measures are to be implemented into the stormwater drainage works.

- Pre-screening of organic matter prior to the collection of rainwater;
- One (1) subfloor on-site detention tank; and
- Two (2) bioretention basins vegetated with a plant species having effective nutrient removal properties.

A combination of the bio-retention basins and OSD tank are used in the primary and secondary treatment of stormwater runoff. Details of these measures are shown on the Concept Stormwater Drainage Plan DRG 5281-C05-01.

6.3 MUSIC Modelling

"MUSIC" software by eWater Pty Ltd was used to assess the performance of the bioretention basins in achieving the pollution reduction targets outlined in Australian Runoff Quality – *A Guide to Water Sensitive Urban Design*", Engineers Australia (2006).

6.4 Bio-retention Basins

The proposed stormwater management strategy has adopted a series of bio-retention basins that will be integrated into the drainage network to treat runoff from roof surfaces (overflow from rainwater tanks). These systems will be aimed at reducing the pollutants present in these flows to the nominated targets outlined in section 6.1 of this report (ref Table 3).

Stormwater is routed to the bio-retention basins via overflows from the rainwater tanks directly capturing roof runoff and pipes capturing balcony runoff. The water is then filtered through a vegetated and biologically active media layer and is collected in slotted subsoil drainage pipes below the garden beds. The treated runoff collected in these drainage pipes then drain to an outlet pit, connecting back into the stormwater drainage network.

The benefits of these bio-retention basins include:

- Effective removal of fine and soluble pollutants;
- Effective removal of sediment and heavy metals;
- Effective removal of nutrients (Phosphorus & Nitrogen) and bacteria;
- Basin volumes assist in the management of stormwater quantity control.

Bioretention plant species are to be core functional bioretention plant species that are effective nutrient removal properties and are able to tolerate short periods of inundation punctuated by longer dry periods.

6.6 Treatment Train

The figure below depicts the treatment train used to assess the performance of the bio-retention basins for WSUD.

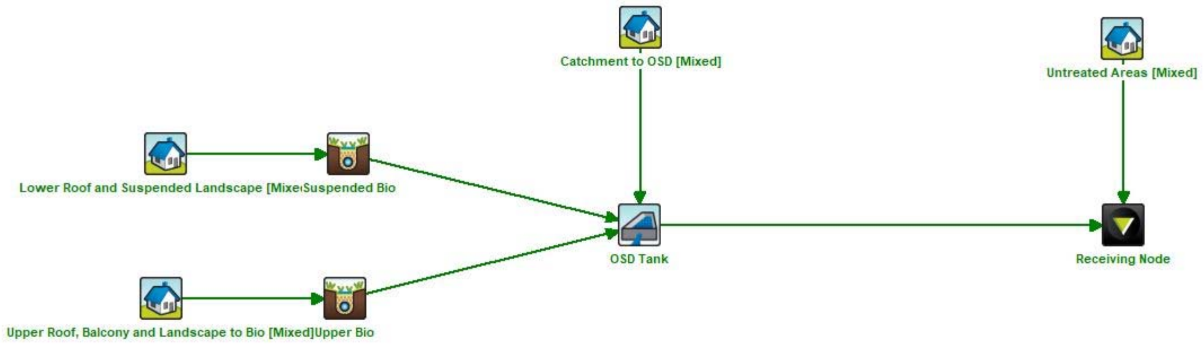


Fig. 2 - MUSIC Treatment Train

A proposed bioretention basin to the north will capture overflows from the northern rainwater tanks and the balconies set at higher RLs than the basin. Another bioretention basin is proposed to be constructed in a suspended landscaped area, collecting overflows from the southern rainwater tank. Both basins will then route to the OSD tank as well as catchment areas bypassing the bioretention basins. As such, the treatment train shown in the figure above has been adopted to assess the WSUD performance of the stormwater drainage system.

6.7 Results

The outputs obtained from the MUSIC modelling can be seen on the following page with a screenshot of the treatment train effectiveness at the receiving node. The pollutant loads that are shown in the results are expressed in ML/yr and the reduction rate is shown as a percentage in comparison to the untreated flows. These reductions can be compared to the targets that were previously summarised on Table 3.

Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	0.99	0.885	10.6
Total Suspended Solids (kg/yr)	181	32	82.4
Total Phosphorus (kg/yr)	0.384	0.143	62.8
Total Nitrogen (kg/yr)	2.78	1.52	45.2
Gross Pollutants (kg/yr)	23.7	1.71	92.8

Fig. 3 - MUSIC Treatment Train Effectiveness Results

It can be seen from the MUSIC results shown above that the proposed system will achieve the required pollutant reduction targets outlined in Australian Runoff Quality – *A Guide to Water Sensitive Urban Design*", Engineers Australia (2006). The integration of the bio-retention basins will ensure that the stormwater quality that is discharged from the site will not have an adverse effect on the water quality of the downstream receiving waters.

7.0 Maintenance Schedule

7.1 Construction soil and water management

The following inspection frequency and corrective action, to be undertaken by the main contractor, for the soil and water management measures during the construction works and during periods of wet weather is recommended to ensure that the system remains functional for the various ARI storm events that have been considered:

Construction Soil and Water Management Maintenance Schedule			
Maintenance Action	**Maintenance Requirements**	**Frequency**	**Responsibility**
Sediment Fences			
Sediment build-up	Remove any excessive silt/sediment/debris build-up	Weekly or after significant rainfall event	Main Contractor
Damage	Repair and/or replace damaged fences	Weekly or after significant rainfall event	Main Contractor
Mesh and Gravel Inlet Filters			
Sediment build-up	Remove any excessive silt/sediment/debris build-up. Ensure filters are positioned around pit inlets	Weekly or after significant rainfall event	Main Contractor
Geotextile and Straw Bale Filters			
Sediment build-up	Remove any excessive silt/sediment/debris build-up. Ensure filters are positioned around pit inlets	Weekly or after significant rainfall event	Main Contractor
Stabilised Site Entry and Roadways			
Sediment build-up/Debris/Mud	Clean site entry grate and remove all debris build-up. Replace water in tyre wash bay. Clean and sweep roads.	Daily and after rainfall events	Main Contractor
Sediment Pond			
Sediment Build-up	Remove any excessive silt/sediment/debris build-up. Ensure filters are positioned around pit inlets	Every 2 months	Main Contractor
Flocculation and Water Testing	Ensure water in sediment pond is flocculated and water quality tested prior to discharging from site	After and during rainfall events	Main Contractor

7.2 Stormwater and water quality

The following indicative maintenance schedule is proposed to ensure that the pollution control devices and stormwater drainage system remains functional for the various ARI storm events that have been considered:

Stormwater and Water Quality Maintenance Schedule			
Maintenance Action	**Maintenance Requirements**	**Frequency**	**Responsibility**
Stormwater Drainage System			
Inside of Pits	Remove grate and inspect condition of pit. Repair and replace as required. Remove any silt/sediment/debris build-up	Every 6 months	Maintenance Contractor
Outside of Pits	Clean grate and remove any silt/sediment/debris build-up	Every 4 months or after significant rainfall event	Maintenance Contractor
Stormwater Drainage System			
General inspection of pipes	Condition inspection stormwater pipes. Undertake any repairs as necessary	Every 6 months	Maintenance Contractor
Bio-Retention Basins			
All maintenance requirements for bio-retention basins and the frequency of these works should be carried out in accordance with *Stormwater NSW – GUIDELINES FOR THE MAINTENANCE OF STORMWATER TREATMENT MEASURES, January 2020.* Refer Appendix C for further details.			Maintenance Contractor
Landscaped Areas			
Erosion/loss of vegetation	Inspect turfed and landscaped for areas of exposed earth/rutting. Install mulch/turf/planting as required to rectify.	Every 6 months or after significant rainfall event	Maintenance Contractor
Weed Control	Remove weeds from root-ball. And replace effected areas with mulch/turf/planting as required to rectify	Every month	Maintenance Contractor

8.0 Conclusion

An in-depth assessment has been made to consider the overall impact of the proposed development on the existing infrastructure and natural environments in the vicinity of the site. The details and recommendations contained on this report, if followed, provides strategies and practices for the control of Soil and Water Management during and after the construction works.

Report prepared by	Report reviewed by
Nicholas Nishijima	Simon Matthews
M+G Consulting	M+G Consulting

Appendix A – Concept Stormwater Drainage Plan

FOR CIVIL & STORMWATER NOTES REFER DRAWING No. C01

STORMWATER DRAINAGE CONCEPT PLAN

SCALE 1:100

DRAINAGE NOTES:

1. FOR DRAINAGE NOTES REFER DWG. C01.

PIT SCHEDULE

PIT No.	SIZE	LID TYPE (TO AS.3996)
1	450 x 450	NOT USED
2	450 x 450	SURFACE INLET PIT FLUSH GRATE CLASS 'A'
3	450 x 450	SURFACE INLET PIT FLUSH GRATE CLASS 'D'
4	450 x 450	SURFACE INLET PIT FLUSH GRATE CLASS 'A'
5	900 x 900	SURFACE INLET PIT FLUSH GRATE CLASS 'A'
6	450 x 450	SURFACE INLET PIT FLUSH GRATE CLASS 'A'

PIT NOTES:

1. PITS DEEPER THAN 1000 TO HAVE STEP IRONS.
2. ALL GRATES TO BE CAST INTO NEW SLABS.
3. ALL OSD/PIT/TRENCH DRAIN LIDS AND GRATES TO BE TO AS 3996. REFER TO PLANS/SECTIONS FOR CLASS OF PIT/GRATE.
4. ALL PIT SURFACE LEVELS TO BE CONFIRMED ON SITE. ANY SIGNIFICANT VARIATIONS FROM PROVIDED SURFACE LEVELS, ENGINEER TO BE ADVISED FOR ANY CHANGES TO THE PIPE INVERT LEVELS.

NOTE A:

ALL EXCAVATION FOR INSTALLATION OF THE STORMWATER DRAINAGE SYSTEM IN THE VICINITY OF A TREE PROTECTION ZONE (TPZ) IS TO USE HAND EXCAVATION METHODS TO ENSURE NO DAMAGE TO EXISTING TREE ROOTS IN ACCORDANCE WITH ARBORIST REQUIREMENTS. ENGINEER TO BE ADVISED IF ANY ADJUSTMENTS ARE REQUIRED TO THE ALIGMENT OF THE STORMWATER DRAIN LINES TO COMPLY WITH THE ABOVE.

THIS DRAWING IS ISSUED FOR AUTHORITY APPROVAL ONLY

No.	REVISION	DATE	No.	REVISION	DATE
5	SWD AMENDED FOR T21 & T33	06-09-21			
4	OSD TANK LOCATION REVISED	18-08-21			
3	GENERALLY REVISED, OSD RELOCATED	16-03-21	7	MINOR REVISIONS	23-09-21
2	ISSUED FOR AUTHORITY APPROVAL	08-09-20	6	BIO-RETENTION BASIN LOCATION	14-09-21
1	ISSUED FOR COORDINATION	28-08-20		REVISED	

ARCHITECT

T +612 9360 7570
ABN 75155117516

PROJECT

27 BELLEVUE AVENUE
AVALON

CLIENT

CONSTRUCT BY DESIGN

M+G Consulting
M & G CONSULTING ENGINEERS PTY LTD
ABN 65 094 064 990
Level 3
50 Berry Street
North Sydney NSW 2060
(PO Box 1656 North Sydney NSW 2059)
Tel: +61 (0)2 8666 7888
Fax: +61 (0)2 8666 7878
Email:cad@mg.com.au

TITLE

STORMWATER DRAINAGE CONCEPT PLAN

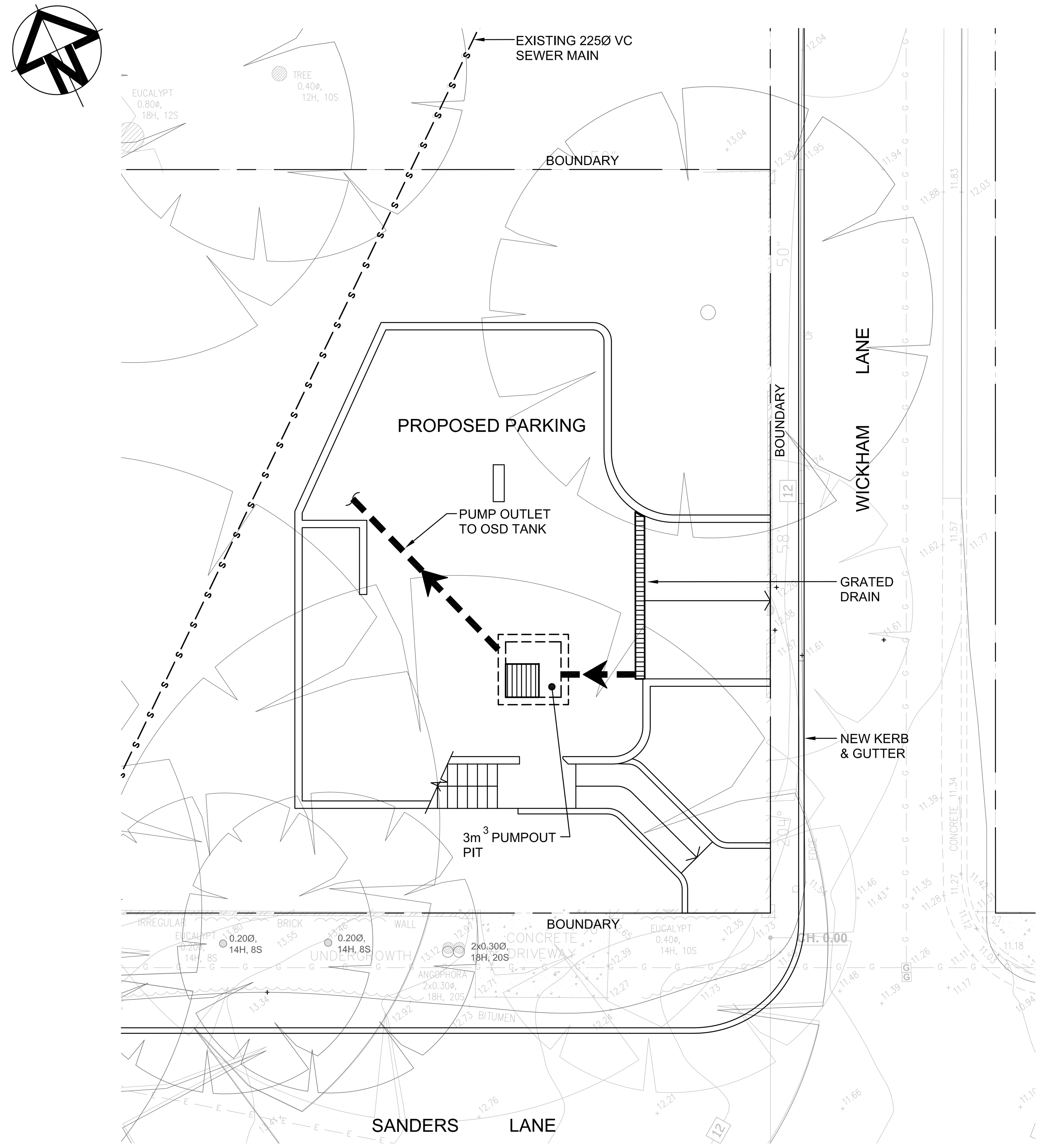
DRAWN	DESIGNED	REVIEWED	DATE	SCALE
JDW	NN	SM	AUG 2020	AS SHOWN

JOB No.	DRAWING No.	ISSUE
5281	C05	7

203

A1

FOR CIVIL & STORMWATER NOTES REFER DRAWING No. C01

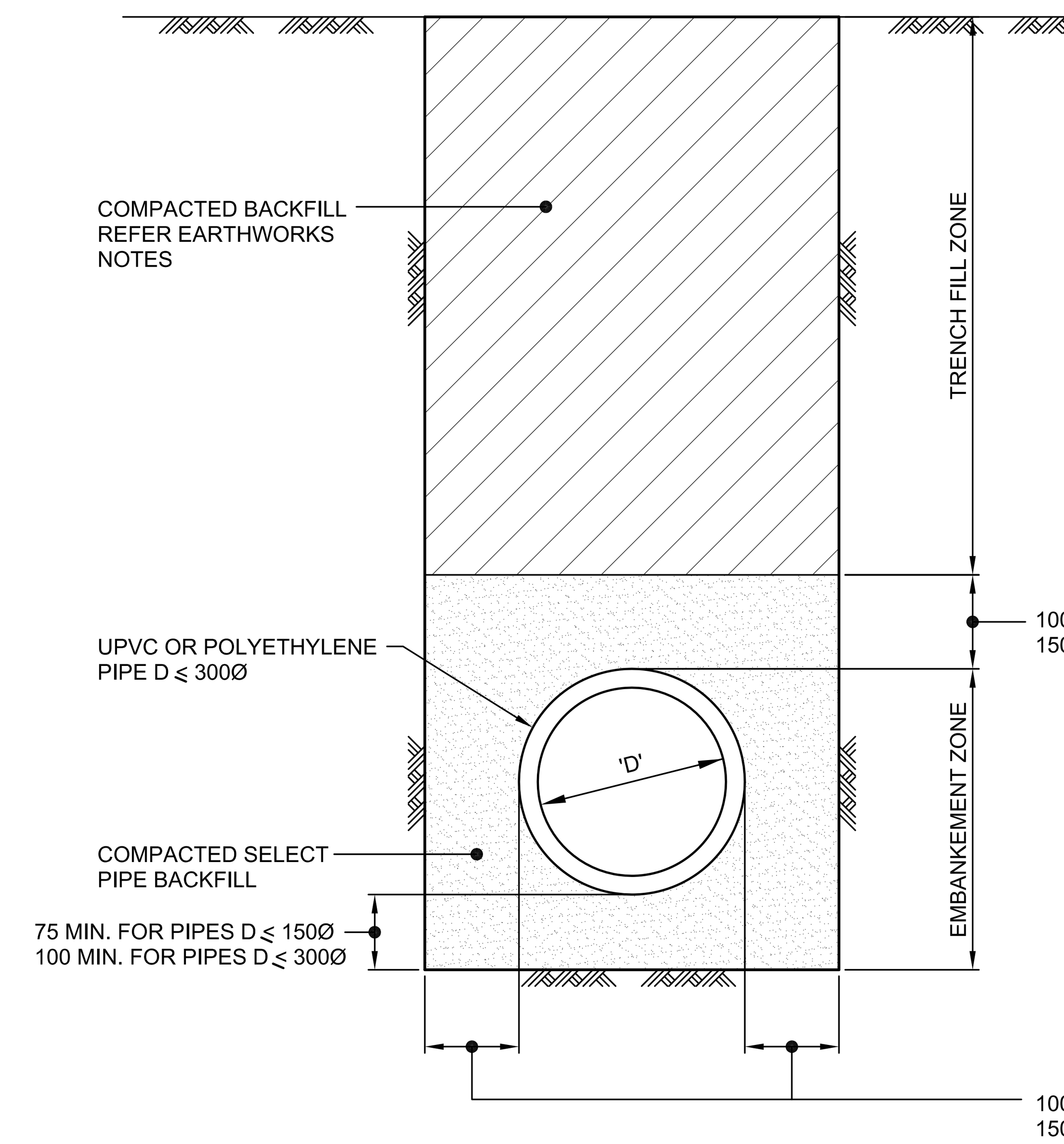


LOWER PARKING STORMWATER DRAINAGE PLAN

SCALE 1:100

DRAINAGE NOTES:

1. FOR DRAINAGE NOTES REFER DWG. C01.



UPVC OR POLYETHYLENE PIPE TRENCH DETAIL FOR PIPES LESS THAN OR EQUAL TO 300Ø

NTS

NOTE:

NOT FOR PIPES WITHIN ROAD RESERVE. REFER DRAWING C05 FOR DETAILS OF PIPES WITHIN ROAD RESERVE.

NOTES:

1. TRENCH AND BACKFILL TO BE IN ACCORDANCE WITH AS/NZS 2566.2
2. EMBANKMENT ZONE:
   SELECT FILL TO BE IN ACCORDANCE WITH AS/NZS 2566.2
   ACCEPTABLE MATERIALS ARE:
   5-7mm CRUSHED ROCK
   GRADING SPECIFICATION

SIEVE SIZE (mm)	9.5	6.7	4.75	2.36	1.18
% PASSING BY MASS	100	85-100	30-85	0-30	0-5

COMPACTED TO 70% DENSITY INDEX (AS 1289.5.6.1)

OR

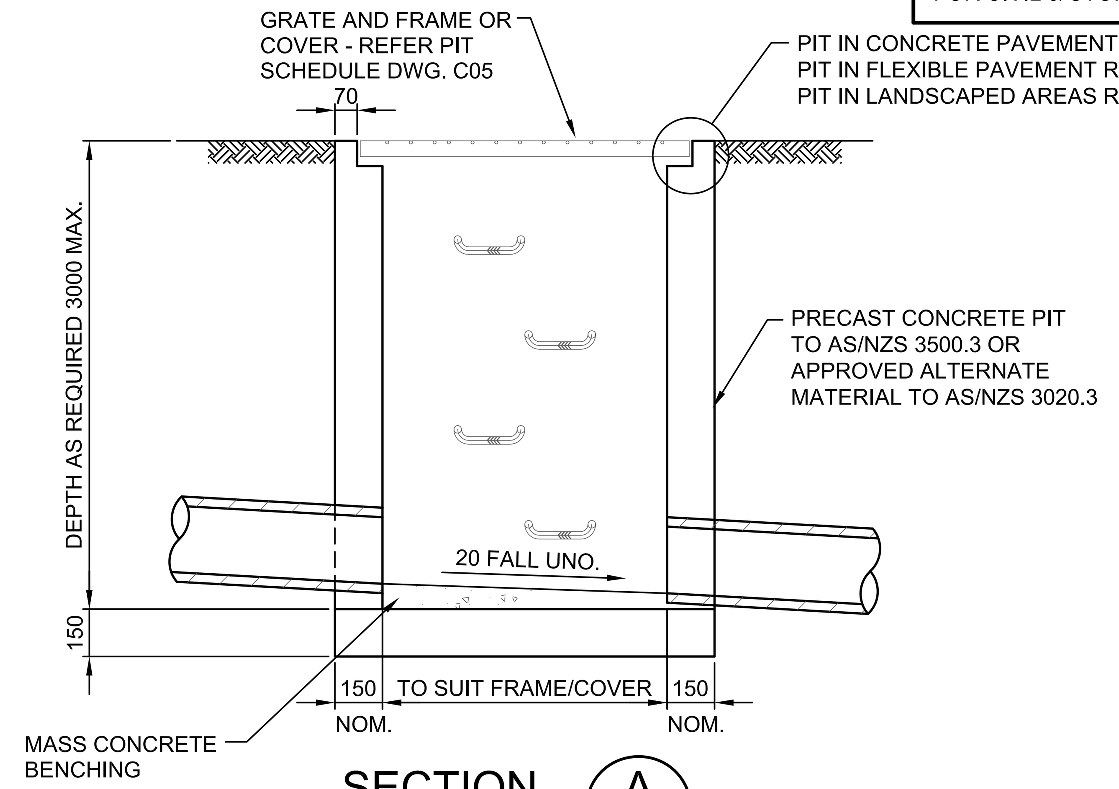
APPROVED SAND MATERIAL
GRADING SPECIFICATION

SIEVE SIZE (mm)	4.75	2.36	1.18	0.6	0.3	0.15	0.075
% PASSING BY MASS	100	90-100	85-100	70-100	50-100	0-40	0-5

COMPACTED TO 70% DENSITY INDEX (AS 1289.5.6.1)

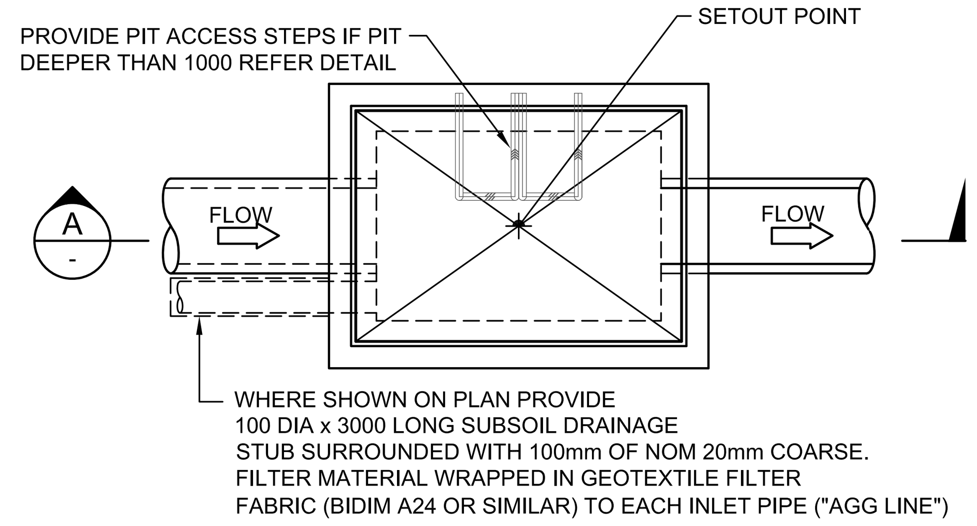
OR

OTHER SUITABLE MATERIAL TO AS/NZS 2566.2 COMPACTED TO AS/NZS 2566.2 REQUIREMENTS



SECTION A

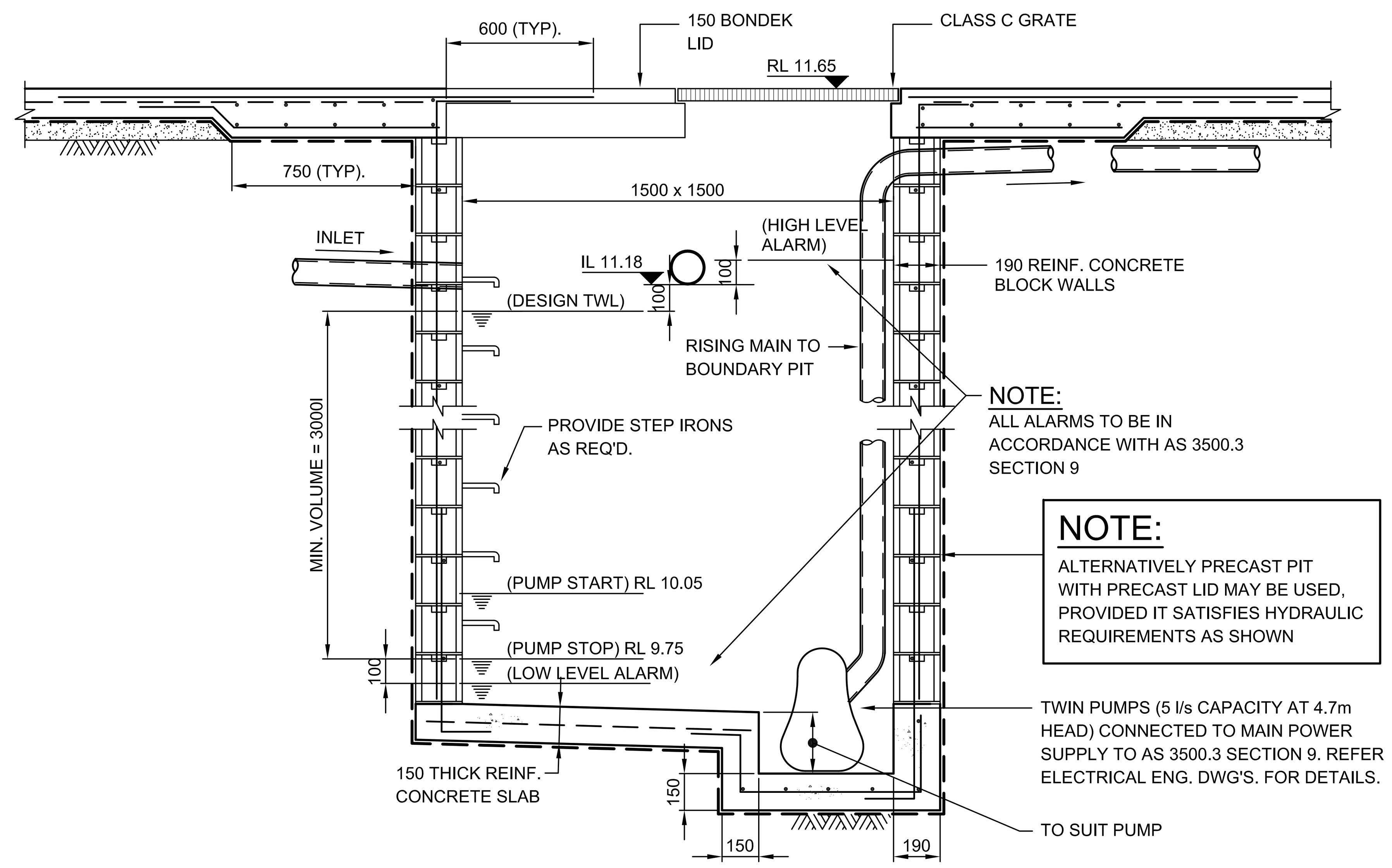
SCALE 1:20



PLAN

SURFACE PIT DETAIL

SCALE 1:20



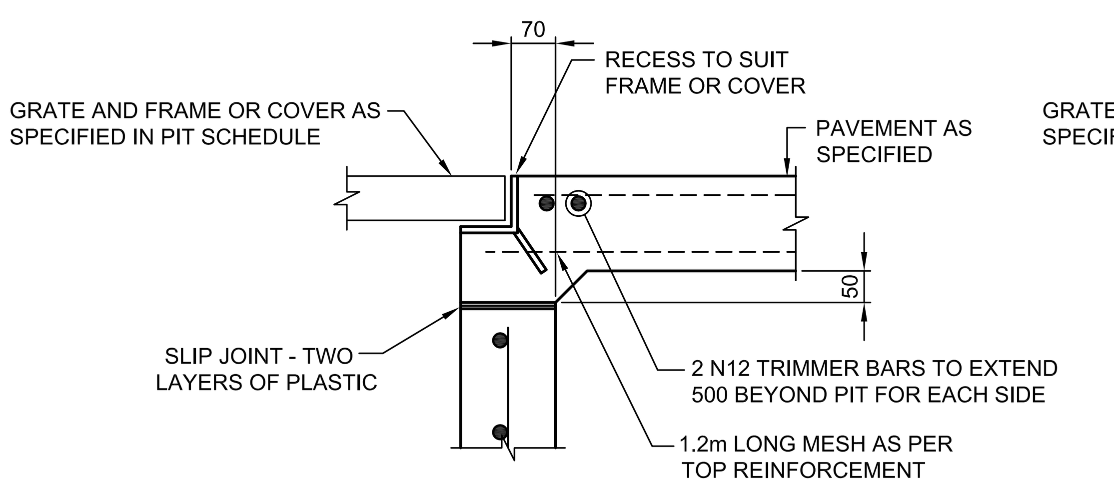
NOTE:

ALTERNATIVELY PRECAST PIT WITH PRECAST LID MAY BE USED, PROVIDED IT SATISFIES HYDRAULIC REQUIREMENTS AS SHOWN

SUBSOIL DRAINAGE PUMPOUT PIT DETAIL

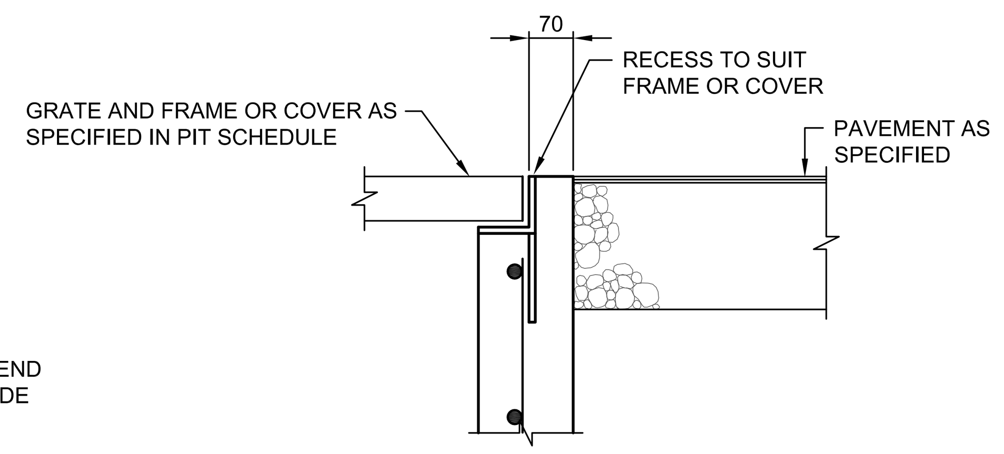
(DESIGNED FOR 1 :20 YR ARI)

NTS



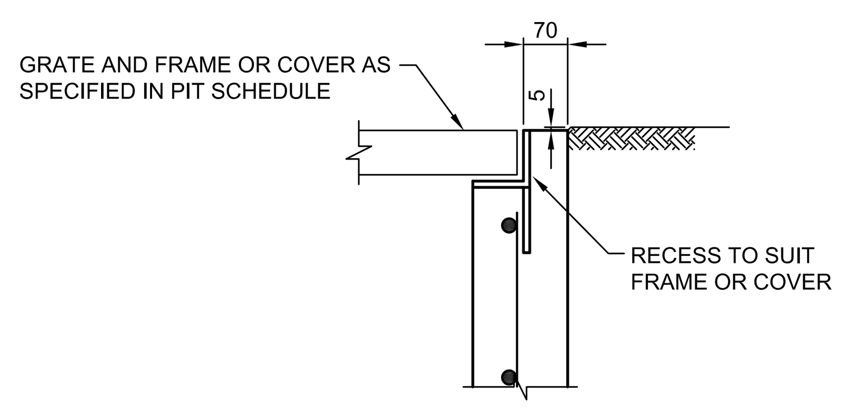
DETAIL B

SCALE 1:10



DETAIL C

SCALE 1:10



DETAIL D

SCALE 1:10

THIS DRAWING IS ISSUED FOR AUTHORITY APPROVAL ONLY

No.	REVISION	DATE	No.	REVISION	DATE
2	MINOR REVISIONS	23-09-21			
1	ISSUED FOR AUTHORITY APPROVAL	08-09-20			

ARCHITECT

T +612 9360 7570
ABN 75155117516

SHED

PROJECT

27 BELLEVUE AVENUE
AVALON

CLIENT

CONSTRUCT BY DESIGN

M+G Consulting
M & G CONSULTING ENGINEERS PTY LTD
ABN 65 094 064 990
Level 3
50 Berry Street
North Sydney NSW 2060
(PO Box 1656 North Sydney NSW 2059)
Tel: +61 (0)2 8666 7888
Fax: +61 (0)2 8666 7878
Email:cad@mg.com.au

TITLE LWR. PARKING STORMWATER DRAINAGE CONCEPT PLAN AND DRAINAGE DETAILS SHT 1

DRAWN	DESIGNED	REVIEWED	DATE	SCALE
JDW	NN	SM	AUG 2020	AS SHOWN

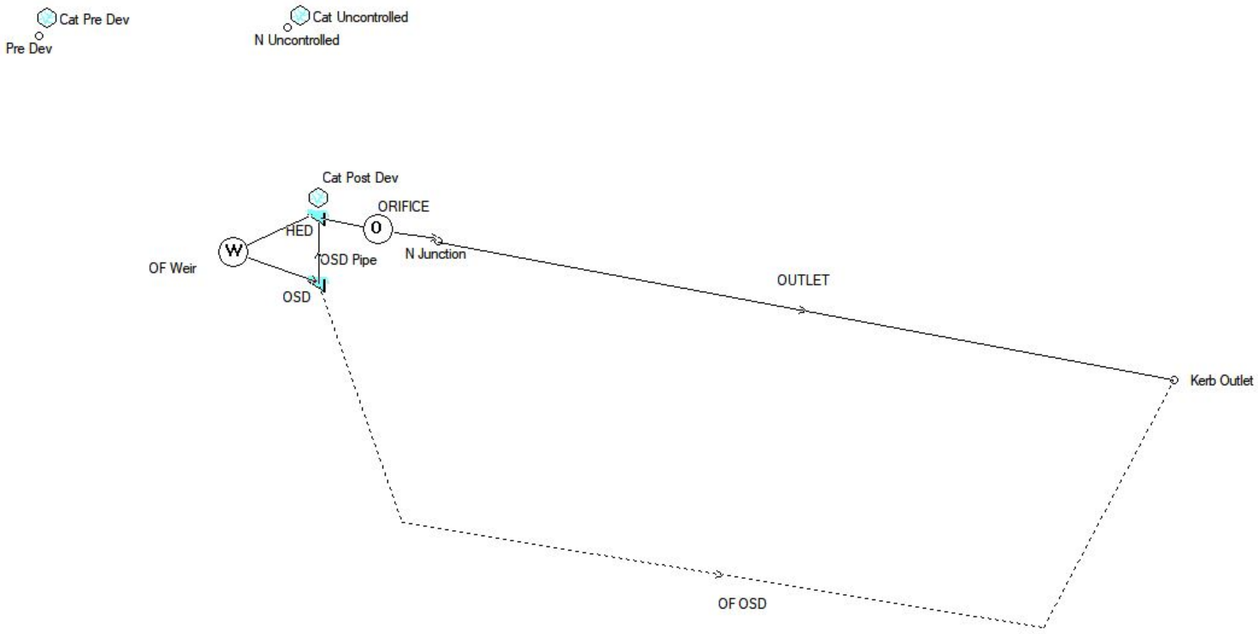
JOB No.	DRAWING No.	ISSUE
5281	C06	2

204

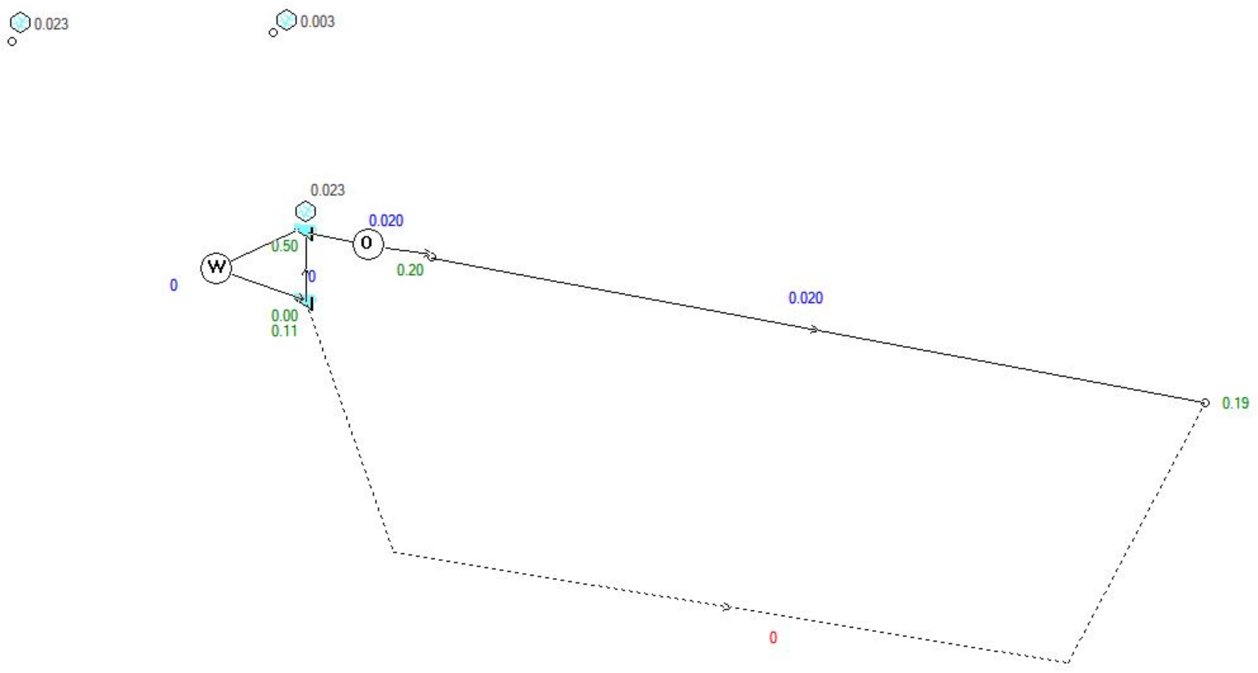
A1

Appendix B - DRAINS Results

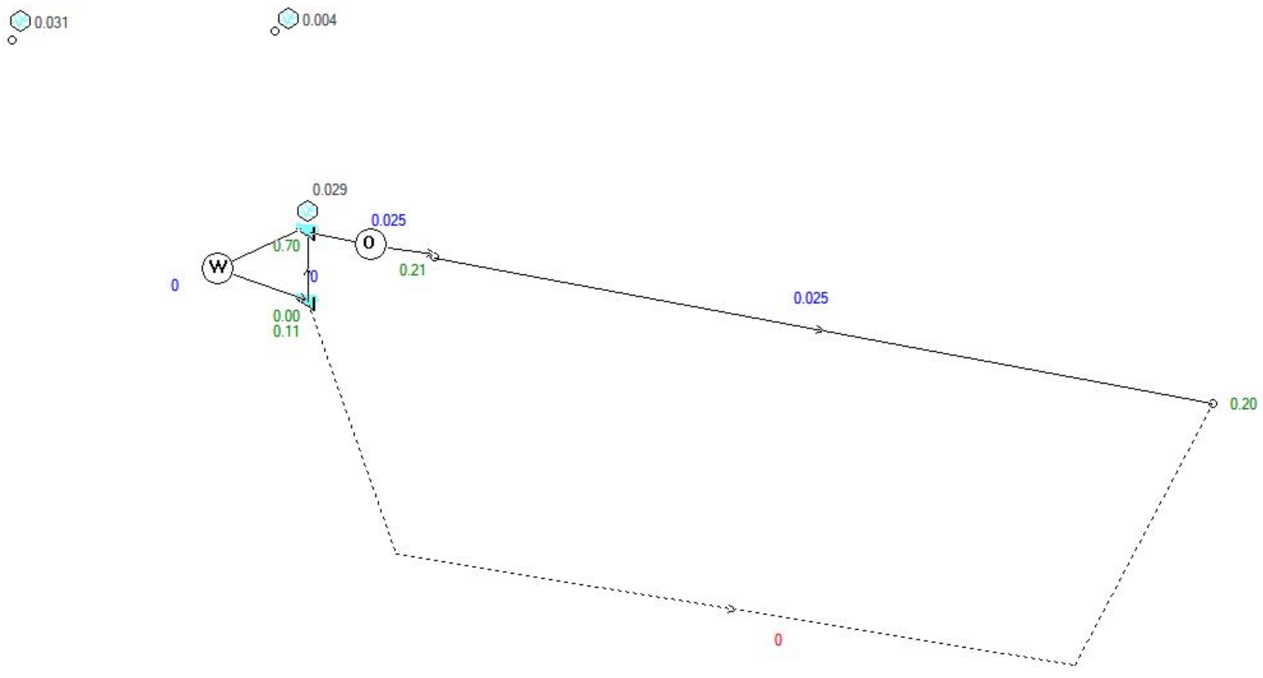
DRAINS Model (OSD Assessment)



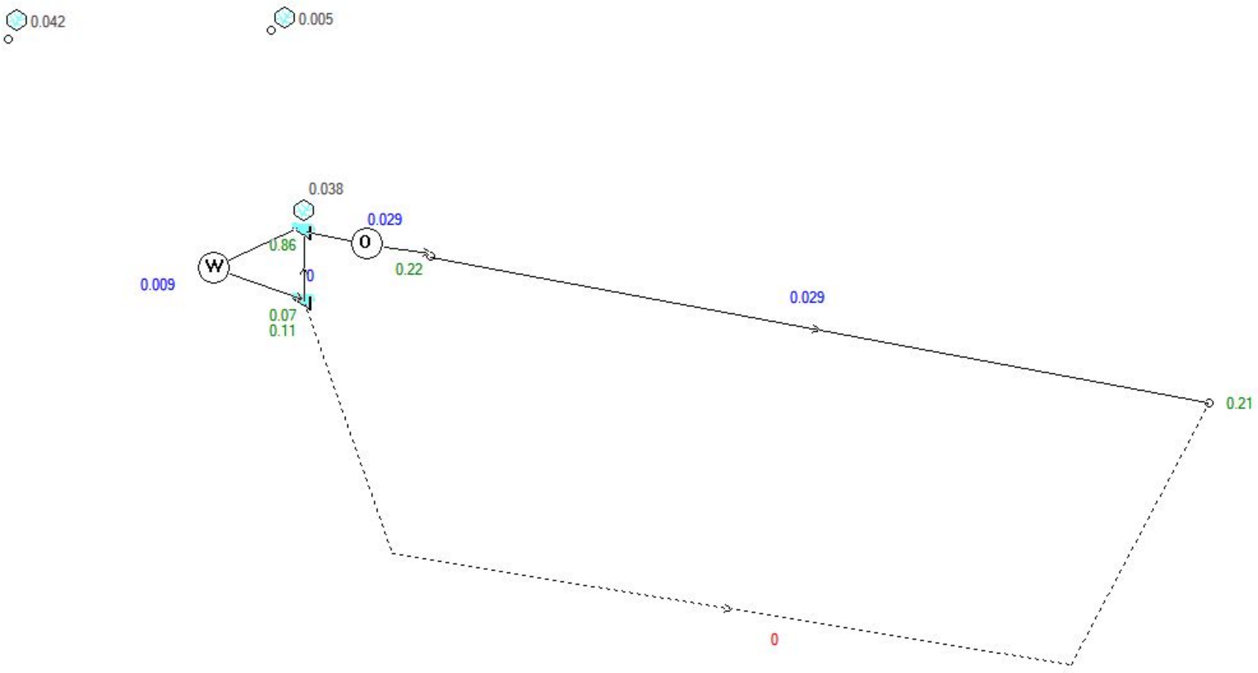
1 Year ARI



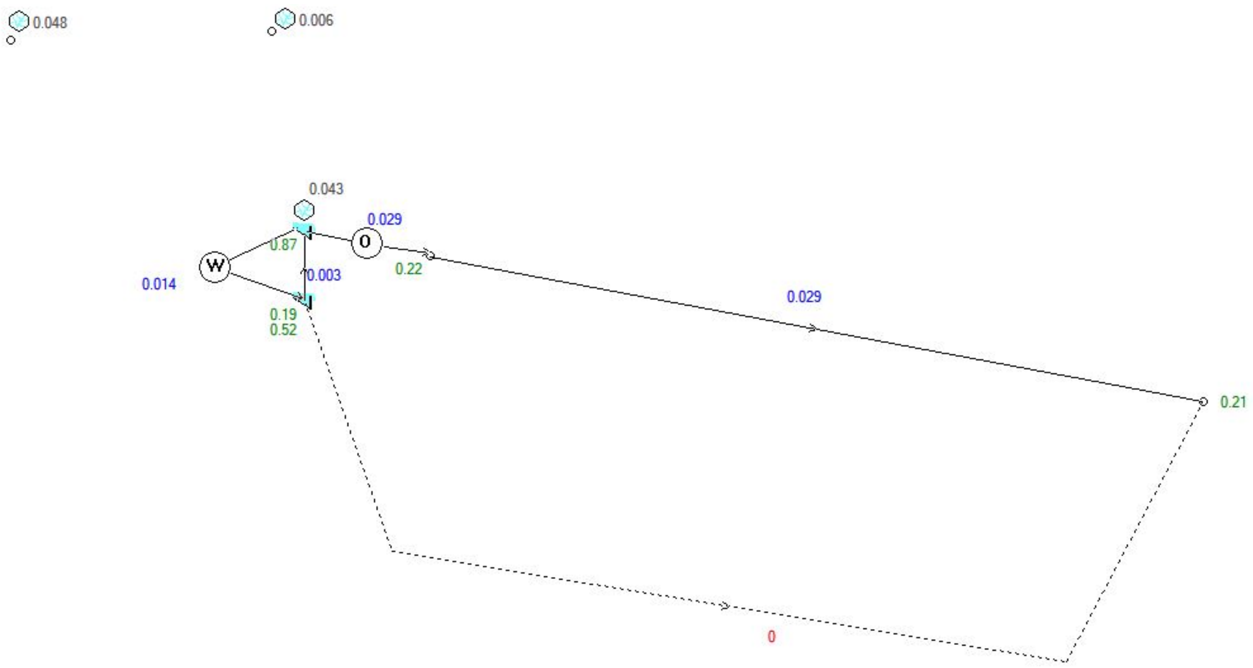
2 Year ARI



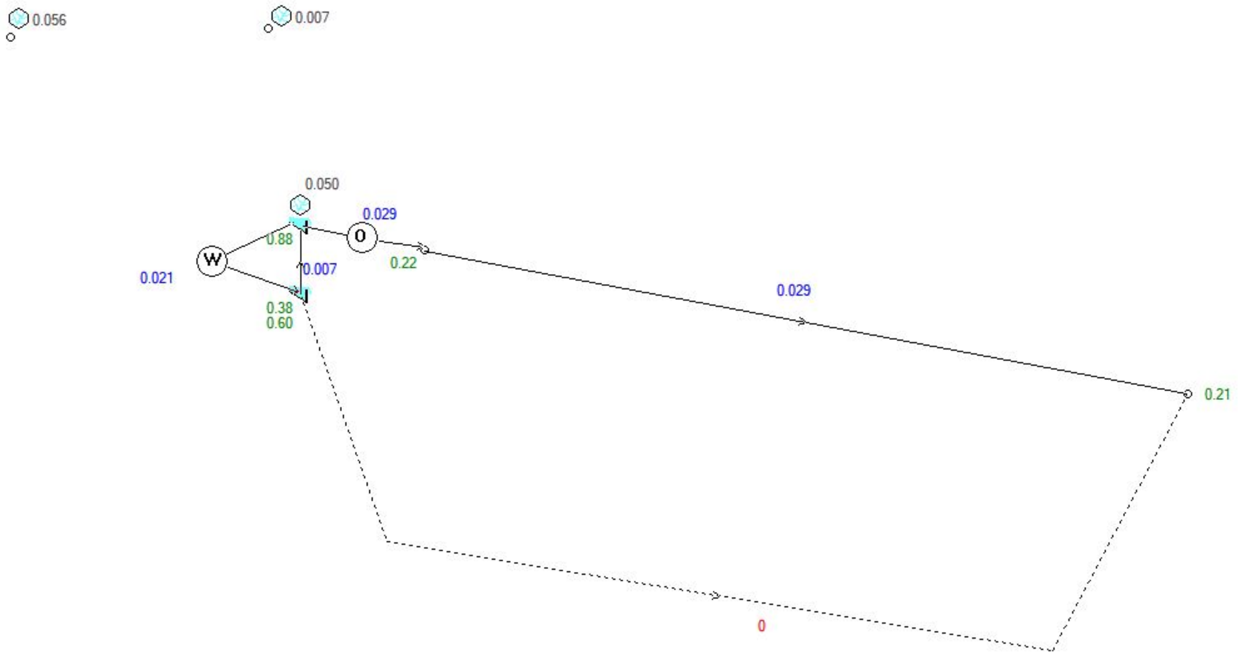
5 Year ARI



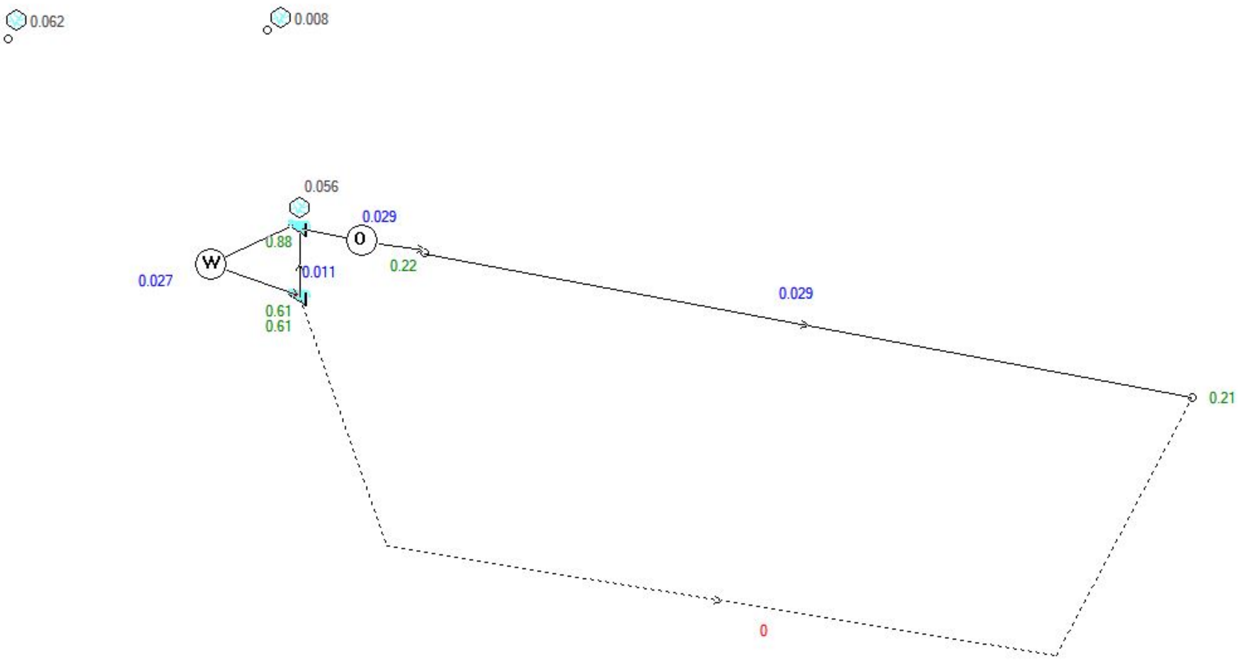
10 Year ARI



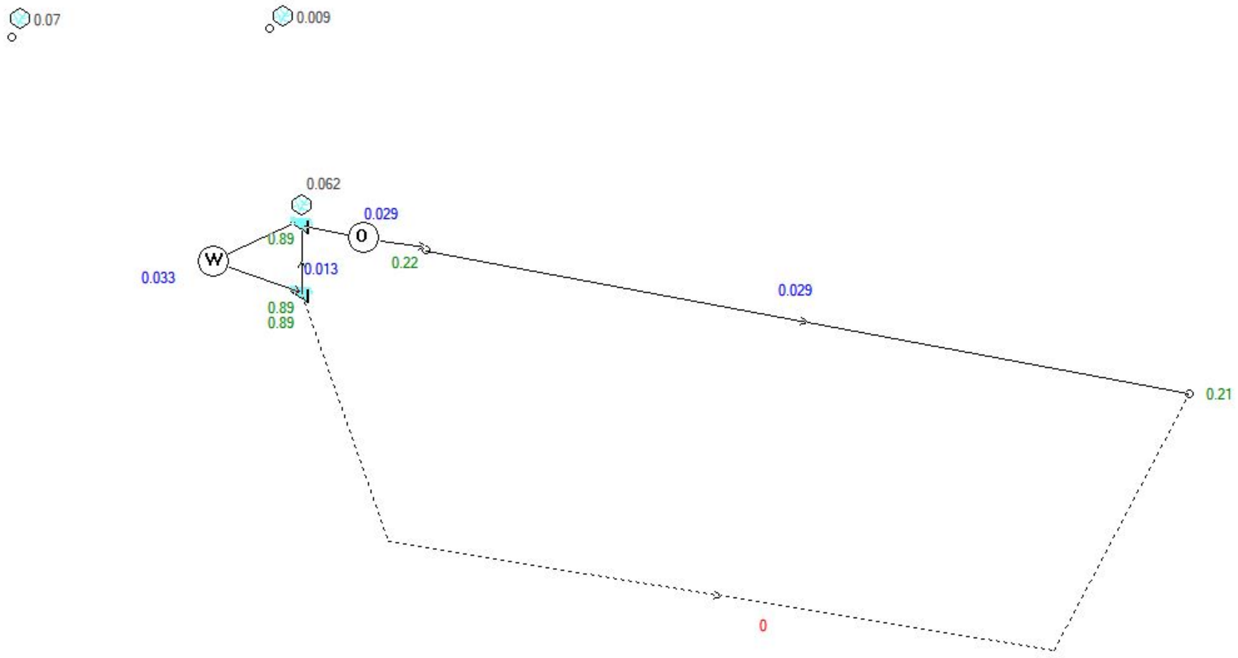
20 Year ARI



50 Year ARI



100 Year ARI



Appendix C – Bio-Retention Basin Maintenance

5.11 Bio-Filtration/Bio Retention/ Raingardens

5.11.1 Key Considerations for Inspections, Regular Maintenance and Comprehensive Maintenance

Inspections	Key considerations
Inspection frequency	• Bioretention treatments should be inspected regularly after completion of seeding/planting until the vegetation is established. In the first year of operation inspections should occur on a monthly basis and following significant storm events to evaluate an appropriate inspection frequency for a particular site. • Typically an average inspection frequency of 1 to 2 months following stabilisation of vegetation would be appropriate. The inspections could coincide with a regular maintenance activity (e.g. grass cutting, weeding, litter removal, etc). • Quarterly inspections are recommended for established systems.
Inspection tasks	*Vegetation/Grass* • The most important maintenance consideration for bioretention measures is preserving vegetation cover (>80%). • Plants should be inspected monthly during the first year of establishment and then quarterly. Any dead or unhealthy plants should be scheduled for either treatment or removal/replacement. • Grass should be inspected regularly during the first year to identify areas of poor growth that require maintenance. • Weed growth should be inspected monthly during the first year to identify appropriate maintenance methods for preventing or controlling the growth. *Filter media* • Media within bioretention measures should be inspected visually for any signs of erosion or formation of rills or blockages. • The inlet(s) to a bioretention measure should be inspected, preferably during wet weather, to confirm that flow is being dispersed evenly at these locations. The remainder of the measure should be inspected to confirm that flow is not being channelised forming erosion rills, or bypassing, or overtopping. • The side slopes should be inspected for erosion, particularly at locations where concentrated flows enter laterally into the bioretention measure. • Sediment deposits should be monitored and removed where concentrations occur. *Miscellaneous* • In many systems, there is an underflow or filtrate collection system, commonly a slotted pipe. Annually this should be inspected or rodded or jetted to ensure there are no blockages. • Mulch should be inspected to determine the presence of any significant voids and to determine an appropriate interval for topping up the mulch layer. • Litter, rocks/sediment and organic debris should be identified and removed.

Maintenance—Regular	**Key considerations**
Key design elements to consider for maintenance	• Inspection of openings at the end of perforated pipes needs to be part of the initial design. This allows maintenance workers to check sediment build-up and water ponding during dry weather. • Ensure access is available for the equipment required for maintenance. • Provide pre-treatment measures to remove litter, organic debris and coarse sediment. Especially for large solutions. • Provide raised edge strips around the bioretention measure to reduce edge trimming requirements. • Use only grasses and vegetation suitable for the local soil and climatic conditions. Ensure that grass/vegetation is able to withstand flow velocities under design storm event conditions and high flow bypass. Consider providing a subsurface reservoir of water under drainage layer to support plants during dry spells. • Sub-soil drainage pipes in bioretention basins/rain gardens should not be surrounded by a geotextile sock to minimise the potential for clogging within the pipe. The sock itself blocks and causes more problems than in solves. • Provide some redundancy in subsoil drainage to avoid rebuilding. • Consider check dams along bioretention swales with a gradient of less than 4% to minimise the potential for erosion. • Provide side slopes less than 4(H):1(V) to make mowing easier. • Sometimes, these systems should not be commissioned during construction periods or while site surfaces are being stabilised, and where high sediment loads are expected.
Maintenance costs	• The maintenance cost for mature systems is approximately similar to swales—$2.50/m² for grassed systems and $1.50/m² for vegetated systems using native vegetation (Fletcher et al., 2003). Similar to grassed swales, maintenance costs during the initial two-year vegetation establishment period (estimated at $9.00/m²/yr) may be higher than vegetated systems. But this relates only to removal of litter and vegetation management. • If doing hydraulic conductivity testing, allow $2,000–4,000/yr
Maintenance frequency	• Evaluation of an appropriate maintenance frequency can be determined in the first year of operation by observing: — vegetation cover; — decomposition rate of mulch; — damage to vegetation; — erosion; — the presence of erosion rills; — volume of litter; — organic debris and sediment; and — weed growth. It is likely that as vegetation becomes established and/or the catchment is re-developed/stabilised, that maintenance frequency will reduce. • Requirements for plant and soil maintenance should be assessed during regular inspections. The maintenance frequency is likely to be more regular during the one to two year period following construction. • The maintenance frequency after stabilisation would primarily be dependent on aesthetics and seasonal influences, with grass cutting and weeding required either fortnightly or monthly (depending on the species) during spring and summer. Less frequent grass cutting and weeding (typically every 2 to 3 months), would be required during autumn and winter where other factors (e.g. aesthetics, litter removal, erosion, vegetation damage) may control the maintenance frequency. In some climates grass cutting may not be required during autumn and winter for some species of grass.

Maintenance tasks

- During the initial 1–2 year establishment period for a bioretention measure, regular watering, mulching, weeding, soil treatment, removal and replacement of dead/diseased vegetation
- Pre-treatment measures should be cleaned to minimise the potential for the bioretention measure to be excessively loaded with sediment, litter and organic debris.
- Diseased or poorly growing vegetation should be inspected by a horticulturalist (or similarly qualified individual) to establish a treatment approach or provide recommendations on suitable replacement species.
- Mulching should be undertaken periodically to fill in voids observed
- The species of vegetation selected for the bioretention measure should be appropriate for the local environmental conditions and should not require additional watering or improved drainage to maintain the plants once established. During extended dry periods, plants may benefit from the addition of water crystals or gels.
- Weeds should be removed manually by hand if the weed coverage is localised. If the weed is more widespread options include spot spraying of herbicides approved for use within an aquatic environments is recommended.
- Removal of sediment from the forebay manually or with a machine will be required.
- Accumulated sediment on the filter media may require manual removal using rakes and shovels.
- Flow spreaders (level spreaders, check dams or benches), if present within the bioretention measures, should be cleared of any debris. Accumulated sediment within these controls, if present, should be removed. Structural integrity of the flow spreaders should be inspected and repaired if defects are found.
- Matter such as grass clippings, organics debris and sediments removed from bioretention measures should be managed to prevent pollution to waterways further downstream. Clippings and organic debris should be composted in a designated area outside the bioretention measure.
- Minimise the load of grass clippings that could enter downstream waterways during maintenance.
- If blockages are suspected, a test of hydraulic conductivity using the FAWB method should be undertaken to ensure infiltration stays within an acceptable range (typically 100 mm/hr to 500 mm/hr). Low infiltration may require removal and replacement of the top 50 mm to 100 mm of filter media. The infiltration rate will be on the *Data Sheet*.

Maintenance—Annual/Comprehensive | **Key considerations**

Cleaning/maintenance methods

- Budget and plan for an annual cleaning.
- Ensure mowers with catchers to cut grass in open grassed areas within the bioretention measure are used, and line and edge trimmers in other areas.
- Remove concentrated areas of loose sediment, litter and organic debris via suction truck where suitable access is available.
- Manually remove weeds and deposited matter using rakes, spades, shovels, hoes and pitchforks.
- Use high-pressure jets or hoses to flush sub-soil systems.
- Remove concentrated deposits of organic debris and sediment using portable vacuum/mulching units.
- A vehicle to transport organic waste from the site is necessary.
- Sub-soil drainage lines (if provided) should be flushed through inspection/flushing points if available.
- Mulching typically would need to be topped up on an annual cycle prior to warmer months, with mulch replaced every 2 to 3 years during dry periods.

Appendix D – Existing Site Survey

NOTES:

1) CAUTION: SHOULD ANY DEVELOPMENT OR CONSTRUCTION BE PLANNED ON OR NEAR THE BOUNDARIES, THE BOUNDARIES SHOULD BE CLEARLY MARKED ON SITE.

2) A FIELD SURVEY OF THE BOUNDARIES HAS BEEN CONDUCTED. AREA AND DIMENSIONS HAVE BEEN SURVEYED FROM PLANS MADE AVAILABLE AT LAND REGISTRY SERVICES.

3) ORIGIN OF LEVELS ON A.H.D. IS TAKEN FROM S.S.M. 11115 RL 17.06 A.H.D.

4) TREE SPREADS ARE DIAGRAMMATIC ONLY AND ARE NOT SYMMETRICAL.

5) UNDERGROUND (NON VISIBLE) SERVICE LINES HAVE BEEN SHOWN FROM "DIAL BEFORE YOU DIG" SERVICE AUTHORITY RECORDS & ARE DIAGRAMMATIC ONLY IN REGARD TO THEIR POSITION & WIDTH UNLESS STATED OTHERWISE.

6) BEARINGS SHOWN ARE ON M.G.A.-(MAP GRID of AUSTRALIA).

7) CONTOUR INTERVAL 0.5 METRE.

8) CONTOURS ARE INDICATIVE OF GROUND FORM ONLY. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.

INVESTIGATION OF "DIAL BEFORE YOU DIG" UNDERGROUND SERVICES HAS BEEN MADE. DETECTION OF UNDERGROUND SERVICES IS NOT AN INTEGRAL PART OF THIS SURVEY. ALL RELEVANT AUTHORITIES SHOULD BE NOTIFIED PRIOR TO ANY EXCAVATION ON OR NEAR THE SITE

DEVELOPERS & EXCAVATORS MAY BE HELD FINANCIALLY RESPONSIBLE BY THE ASSET OWNER SHOULD THEY DAMAGE UNDERGROUND NETWORKS.

CARELESS DIGGING CAN:
- CAUSE DEATH OR SERIOUS INJURY TO WORKERS AND THE GENERAL PUBLIC
- INCONVENIENCE USERS OF ELECTRICITY, GAS, WATER AND COMMUNICATIONS
- LEAD TO CRIMINAL PROSECUTION AND DAMAGES CLAIMS
- CAUSE EXPENSIVE FINANCIAL LOSSES TO BUSINESS
- CUT OFF EMERGENCY SERVICES
- DELAY PROJECT COMPLETION TIMES WHILE THE DAMAGE IS REPAIRED

MINIMISE YOUR RISK AND DIAL BEFORE YOU DIG.
TEL. 1100

Bee & Lethbridge
Quality Surveying & Development Solutions

Bee & Lethbridge Pty Ltd
Suite 2, 14 Starkey Street,
PO Box. 330, Forestville, NSW 2087
Phone: 9451 6757
Email: survey@beeleth.com.au
ABN: 13 003 194 447
www.beeleth.com.au

COPLAND C. LETHBRIDGE
REGISTERED SURVEYOR N.S.W.
IDENTIFICATION No. SU001470

LEGEND

TREE 0.10ø, 5H, 4S	DENOTES APPROX. 0.1øm DIAMETER OF TREE DENOTES APPROX. 5m HEIGHT OF TREE DENOTES APPROX. 4m SPREAD OF TREE	
GUTTER	DENOTES TOP OF GUTTER	
	DENOTES PATH OF TRAVEL	

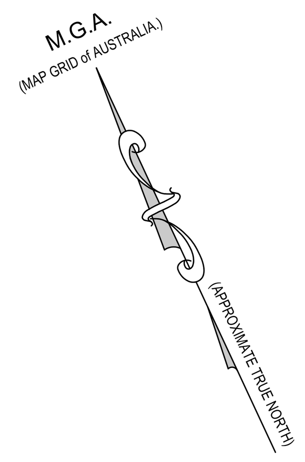
OVERHEAD ELECTRIC LINES
BOARDS SEWER
TELECOMMUNICATION LINES
GAS LINES
STORM WATER LINES

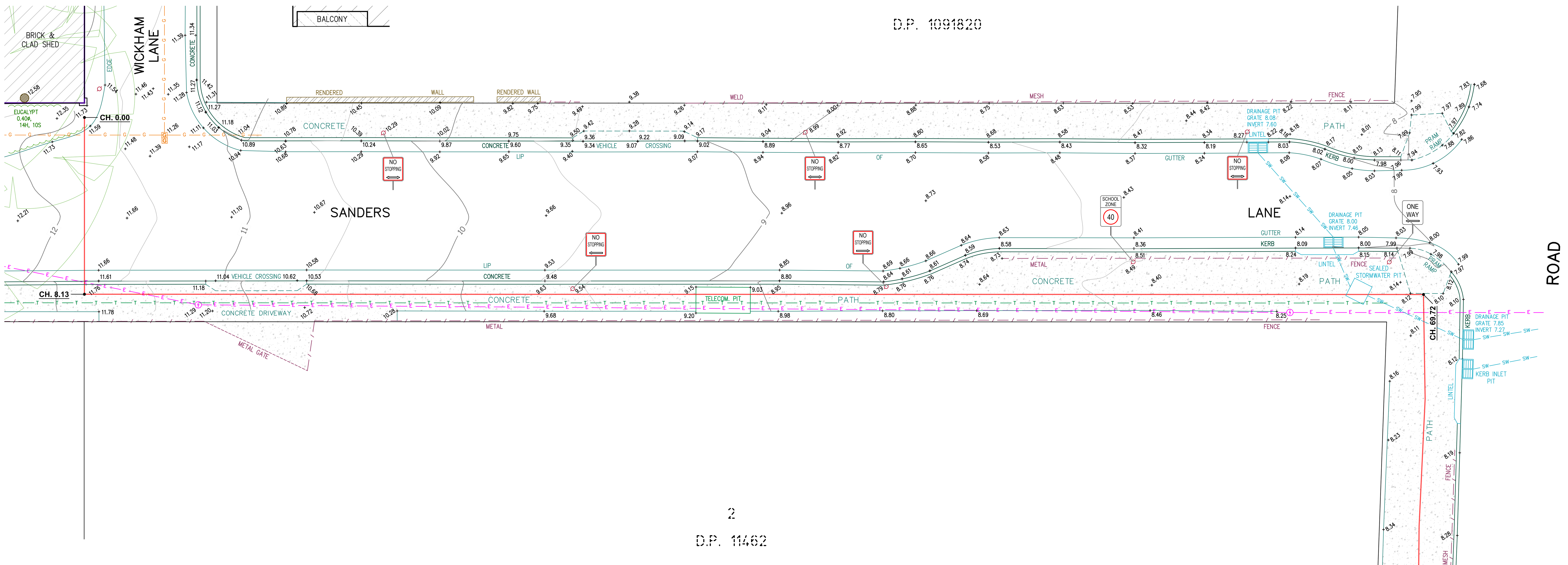
POWER POLE
INSPECTION CAP
TELECOM. PILLAR
TELECOM. PIT
SIGN
TAP
GAS METER
GAS LID

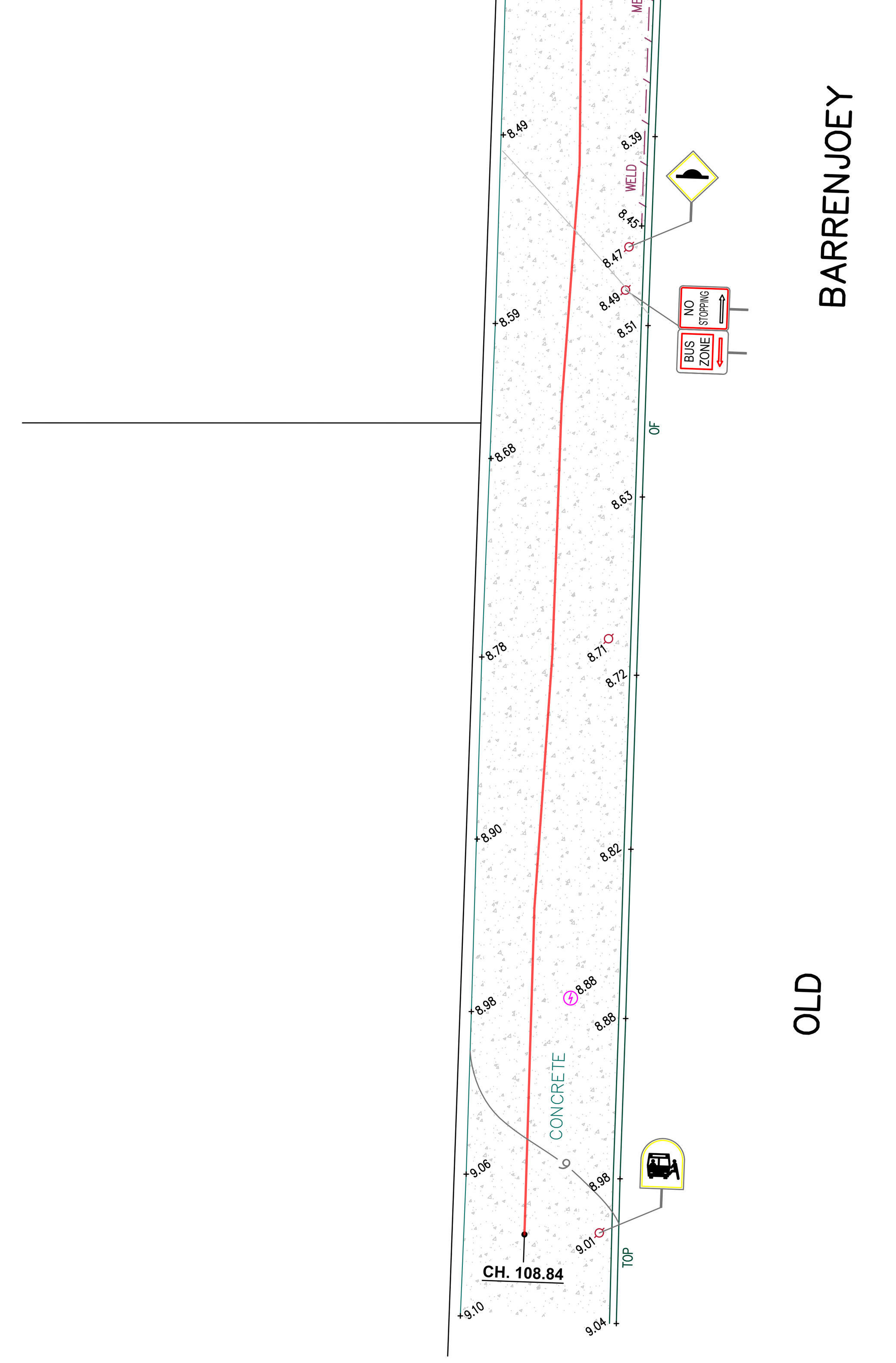
PLAN SHOWING BOUNDARIES, RELATIVE HEIGHTS & PHYSICAL FEATURES OVER LOT 33 IN D.P. 11462 KNOWN AS No. 27 BELLEVUE AVENUE, AVALON BEACH.

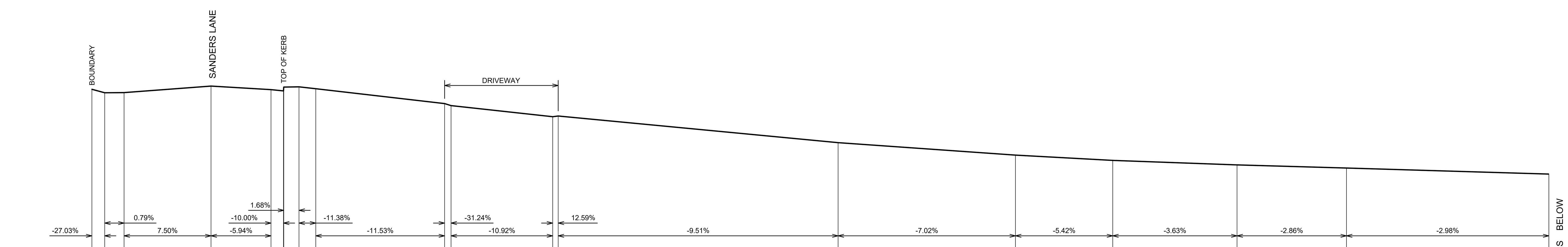
L.G.A.: NORTHERN BEACHES

CLIENT	Mr S. & Mrs J. THOMPSON					REF No.	21192
PROPERTY	No. 27 BELLEVUE AVENUE, AVALON BEACH						
DATUM	A.H.D.	SCALE	1:100 @ B1	DATE	12/08/2021	SHEET No.	1 of 4
SURVEYED	C.L./G.C./B.W.	DRAWN	R.M.	DWG No.	21192C	REV No.	015







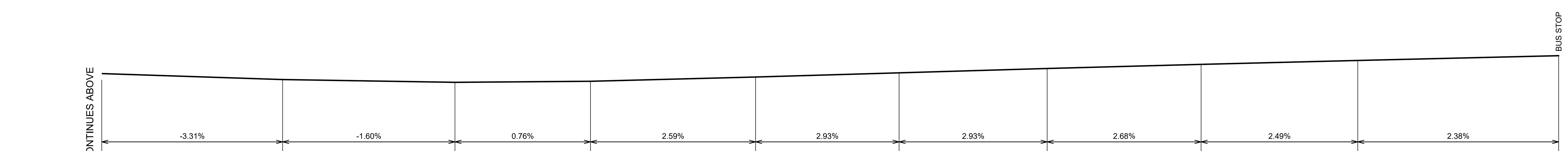


DATUM RL. 5.00

SURFACE	11.75	11.61	11.62	11.88	11.74	11.69	11.84	11.85	11.77	11.19	11.11	10.67	10.70	9.66	9.17	8.96	8.78	8.66	8.42
CHAINAGE	0.00	0.50	1.26	4.68	7.03	7.52	7.53	8.13	8.79	13.85	14.10	18.09	18.30	29.29	36.25	40.07	44.95	49.25	57.19

LONG SECTION

HORIZONTAL 1:100 VERTICAL 1:100



DATUM RL. 5.00

SURFACE	8.42	8.21	8.11	8.15	8.30	8.45	8.60	8.75	8.89	9.06
CHAINAGE	57.19	63.61	69.72	74.52	80.37	85.46	90.71	96.17	101.72	108.84

LONG SECTION

HORIZONTAL 1:100 VERTICAL 1:100

0 1 2 3 4 5 10 METRES

SCALE 1:100

Bee & Lethbridge

Quality Surveying & Development Solutions

Bee & Lethbridge Pty Ltd
Suite 2, 14 Starkey Street,
PO Box. 330, Forestville, NSW 2087
Phone: 9451 6757 Fax: 9975 3535
Email: survey@beeleth.com.au
ABN: 13 003 194 447
www.beeleth.com.au

COPLAND C. LETHBRIDGE
REGISTERED SURVEYOR N.S.W.
IDENTIFICATION No. SU001470

LEGEND

TREE 0.10Ø, 5H, 4S — DENOTES APPROX. 0.1Ø DIAMETER OF TREE, DENOTES APPROX. 5m HEIGHT OF TREE, DENOTES APPROX. 4m SPREAD OF TREE

GUTTER — DENOTES TOP OF GUTTER

OVERHEAD ELECTRIC LINES
BOARDS SEWER
TELECOMMUNICATION LINES
GAS LINES
STORM WATER LINES

POWER POLE
INSPECTION CAP
TELECOM. PILLAR
TELECOM. PIT
SIGN
TAP
GAS METER
GAS LID

PLAN SHOWING LONG SECTION, BOUNDARIES, RELATIVE HEIGHTS & SELECTED PHYSICAL FEATURES OVER PART OF SANDERS LANE & OLD BARRENJOEY ROAD, AVALON.

L.G.A.: NORTHERN BEACHES

CLIENT	Mr S. & Mrs J. THOMPSON	REF No.	21192
PROPERTY	No. 27 BELLEVUE AVENUE, AVALON		
DATUM	A.H.D.	SCALE	1:100 @ B1
DATE	03/07/2020	SHEET No.	2 of 2
SURVEYED	C.L./G.C./B.W.	DRAWN	R.M.
DWG No.	21192B	REV No.	0