

WATER SENSITIVE URBAN DESIGN STRATEGY REPORT

461-473 Pacific Highway, Asquith NSW 2077

Prepared for: Chinese Australian Services Society Limited

Document no: SY160802_WSUD Strategy Report_R04_200731

Issue no: 04



Revisions

Date	Revision/ Issue No.	Revision Description	Prepared By	Reviewed By	Approved By
07/03/18	01	Issue for Development Application	CR	MB	MB
18/10/19	02	Issue for Development Application	VG	MB	MB
22/07/20	03	Re-Issue for Council Approval	MB	-	MB
31/07/20	04	Re-Issue for Council Approval – Additional OSD and Easement Information	MB	-	MB

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1.0 INTRODUCTION

ACOR Consultants has been engaged by CASS Limited to prepare civil and stormwater design documentation in support of a Development Application for a proposed aged care facility at 461-473 Pacific Highway, Asquith.

The subject site is located within the Hornsby City Council local government area. The purpose of this report is to outline the basis of the design of the stormwater system and WSUD strategy, including the design of in-ground stormwater drainage network, on-site detention system and water quality treatment train details.

This report must be read in conjunction with the ACOR Civil DA Drawings enclosed as Appendix A to this report.

1.1 Criteria

The stormwater system has been designed to comply with the following standards and local authority requirements:

- a) Bureau of Meteorology IFD data – sourced from <http://www.bom.gov.au/>
- b) Australian Rainfall and Runoff 1987
- c) Site survey data
- d) Hornsby Development Control Plan (2013)
- e) Hornsby Development Design Specification 0074 – Stormwater Drainage (Design)
- f) Hornsby Development Design Specification 0075 – Control of Erosion and Sedimentation
- g) Hornsby WSUD Reference Guidelines

1.2 Scope of Report

The scope of this stormwater management report is limited to the subject site and the assessment of the following items;

- Internal stormwater network design – To determine sizing and performance of inlet pits, underground drainage network and overland flows.
- Relocation of Existing drainage easement to the northern boundary and increase capacity to cater for 100yr flows – to determine the required pipe size to satisfy council requirement to achieve piped flow of 100yr ARI generated by a 1.0-hectare external catchment from Pacific Highway
- Stormwater discharge to existing drainage easement – To consider an appropriate method of stormwater discharge into the stormwater easement pipe to meet Council permissible discharge rates.
- On-site detention – Including the design of an OSD system to achieve a permissible site discharge rate limited to the 5-year ARI storm for the pre-development site conditions for all storms up to the 20-year ARI storm.
- Overland flooding – How external overland flows will be managed within the public domain.
- Water Sensitive Urban Design Strategy – Identifying the WSUD strategy to be implemented to meet Hornsby Council stormwater quality targets.

2.0 EXISTING SITE CONDITIONS

2.1 Site Description

The existing site is comprised of seven residential single dwelling allotments, being the following parcels known as:

- Lot 1 DP 120748 (No. 473) Pacific Highway, Asquith;
- Lot 1 DP 1003107 (No. 471 Pacific Highway, Asquith;
- Lot 19 DP 1003192 (No. 469) Pacific Highway, Asquith;
- Lot 18 DP 1003192 (No. 467) Pacific Highway, Asquith;
- Lot 17 DP 1003192 (No. 465) Pacific Highway, Asquith;
- Lot 16 DP 1003192 (No. 463) Pacific Highway, Asquith; and
- Lot 15 DP 14476 (No. 461) Pacific Highway, Asquith.

The site is bounded by a residential townhouse development to the north which is subject of DA/279/2016 approved for construction (No. 475-477 Pacific Highway), Pacific Highway to the east, a vacant corner allotment to the south and Asquith Oval to the west.

The site has a moderate fall from east-to-west of approximately 6 percent.

The site has an area of 5,050m², with a frontage of 115m to Pacific Highway.

An existing 1.83m wide stormwater drainage easement traverses the site along the southern boundary of No. 471 Pacific Highway, which extends through Asquith Oval to Wall Avenue and Mills Avenue. The easement contains a 450mm diameter RCP stormwater pipe which conveys stormwater flows from the upstream Pacific Highway road catchment, Pacific Highway road verge and residential properties north of Rupert Street.

The Pacific Highway road verge along the subject site frontage generally grades from the edge of bitumen towards the site boundary. The road verge includes an existing table drain which collects and conveys stormwater from the upstream catchment to a sag point outside No 471 Pacific Highway. A surcharge inlet pit is located at the table drain sag point, which collects and conveys stormwater through the Council easement pipe towards Asquith Oval as described above.

Roads & Maritime Services NSW (RMS) has identified that the Pacific Highway frontage is subject to road widening for new kerb and gutter and road shoulder.



Figure 1. Existing Site Aerial Photograph

3.0 PROPOSED DEVELOPMENT

3.1 Site Characteristics

The proposed development will involve demolition of the existing structures on site and construction of a residential aged care facility (RACF) building to the south of the existing stormwater easement and independent living units (ILUs) to the north. The RACF and ILU buildings will incorporate residential rooms, office space, multipurpose rooms and a basement carpark, with a basement ramp into the carpark below.

Vehicular access will be provided through a driveway off Pacific Highway to facilitate a “left in, left out” arrangement for waste collection vehicles to enter and exit in a forward direction.

3.2 Stormwater Drainage System

Stormwater from all pervious and impervious surfaces within the proposed development will be collected by an in-ground pit and gravity pipe system.

Roof water will generally be collected by eaves gutters and downpipes before connecting into the in-ground site stormwater system shown on the civil DA drawings. Roof water from the proposed ILU building will be directed to a 10,000L capacity underground rainwater tank to satisfy BASIX commitments.

With the relocation of the existing stormwater easement to the northern boundary the OSD tank can be positioned to the west of the RACF building and basement carpark footprint.

Catchment plans (C14.01-C14.02) have been prepared to highlight the total flow generating areas within the site. The plans also highlight internal catchment areas bypassing the site due to surface grading at the boundary and external catchments being captured within the site which include minor catchment generated by the verge frontage and external catchment piped upstream by the development next door.

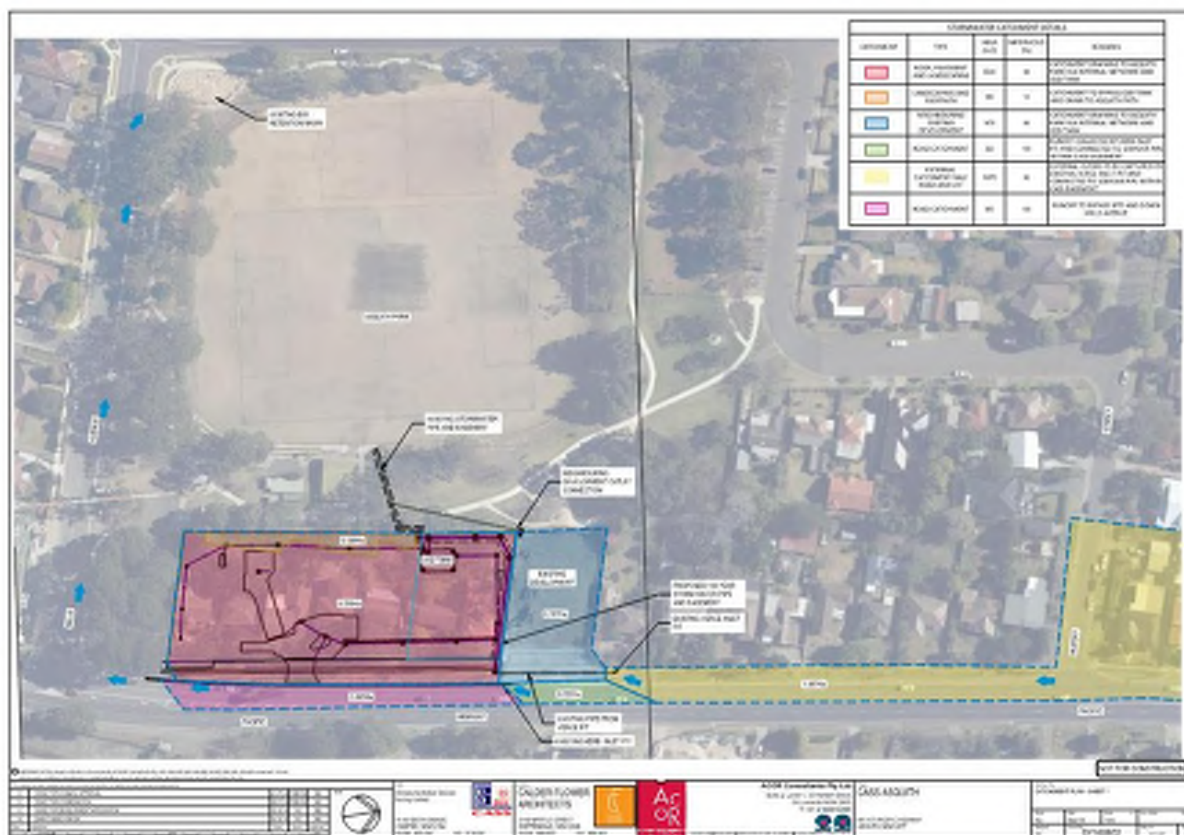


Figure 2. Site Catchment Plan Sheet 1

In the event of blockages within the proposed stormwater system, tailwater effects caused by the downstream stormwater easement pipe being at full capacity or storm events greater than the 20-year ARI critical design storm, provision for overland flows will be provided as follows:

- Overland flows along the eastern hardstand / driveway will be directed around the building envelope and to the proposed drainage easement where possible, which will allow conveyance of stormwater in a safe manner.
- Further defined overland flow paths are provided along the northern and southern boundaries to direct flows towards the natural flow path, being Asquith Oval to the west of the site.

3.3 Post-Development Flows

The proposed OSD system will store and release stormwater so that the re-development of the property limits stormwater discharge to the pre-development 5-year ARI storm for all storms up to the 20-year ARI storm.

This permissible site discharge will be achieved by a centralised OSD tank within the development to attenuate stormwater flows.

The OSD tank is located below ground, west of the RACF building and basement carpark footprint. The OSD tank has the capacity to detain 77m³ and includes a filtration chamber for WSUD requirements.

The proposed location of the OSD tank for the subject site will require removal of Tree 56, as the tree trunk and structural root zone will be located within the proposed tank structure.

The removal of Tree 56 is necessary, as alternative locations of the OSD tank along the western (downstream) boundary will have more substantial impacts to existing trees to be retained.

Similarly, the proposed position of the OSD tank is adjacent to the lawful point of discharge for the site. Moving the OSD tank further away from the lawful point of discharge would require additional inlet and outlet pipework to extend over tree protection zones, which would cause even greater impact to existing tree root systems.

Re-location the OSD tank to the hardstand area adjacent to the eastern (upstream) boundary has been considered, however the extent of bypass flows from lower landscaped and roof areas would cause the OSD tank volume to increase to an unfeasible volume to comply with Council's Stormwater Specification.

Further details of the OSD system design are shown on the civil design drawings enclosed as Appendix A.

Hydrological modelling for the subject site was undertaken using ILSAX modelling in DRAINS software. Full results of this model can be found on the civil design drawings and the supplied model (ref: SY160802_DA Site and Easement Drainage Model_200302).

The DRAINS model set-up and results have been enclosed as Appendix B to this report.

The following key model parameters have been adopted to provide accurate OSD modelling:

- The site sub-catchments have been accurately calculated (including bypass areas) to provide a detailed analysis of flows from each OSD tank. These OSD discharge rates have then been refined to ensure that the total post-development flows are less than the pre-development 5-year ARI site flows.
- The stormwater easement and external upstream contributing catchment has been incorporated into the site DRAINS model to accurately reflect any tailwater conditions applied to the internal stormwater network at the easement connection point.

A summary of the calculated 5-year ARI pre-development site flows and the post-development site flows for storm events up to and including the 20-year ARI are as follows:

Stormwater Discharge Summary

ARI Storm	Pre-Dev Catchment (L/s)	Post-Dev Catchment (L/s)
5 year	162	-
20 year	-	158

The above table indicates that the proposed OSD system attenuates total sub-catchment post-development flows to the 5-year ARI pre-development flows in accordance with Hornsby Council requirements.

3.4 Stormwater Easement

The alignment of the existing 1.83m wide stormwater easement will be relocated to the northern boundary of the site and will be increased to a 3.0m wide easement to accommodate a new 750mm diameter RCP pipeline. The pipeline will connect into the proposed road verge pipeline that will be constructed as part of the approved Townhouse development at No. 475-477 Pacific Highway. Flows within the road verge will then be conveyed through the piped system along the northern boundary and connected to the existing stormwater easement pit directly adjacent to the western site boundary (labelled Pit EX02/1 on ACOR drawing C13.01)

A 750mm clear internal diameter drainage easement pipeline has been proposed to satisfy *Hornsby Shire Council Stormwater Drainage (Design) Specification* requirements, specifically being that:

For pipe sizes up to and including 750mm nominal diameter the drainage system is to be assumed fully blocked.

For pipe sizes greater than 750mm nominal diameter the drainage system is to be assumed 50% blocked.

Incorporating a 750mm diameter pipeline into the easement design will allow the system to fully contain the 1 in 100-year storm flows for the upstream catchment at 50% pit and pipe blockage.

The proposed drainage easement pipeline will connect to the existing boundary stormwater pit, labelled as “Pit 04/7” which will be rebuilt to accept the proposed easement pipeline connection.

The drainage easement pipeline along the western boundary has been designed to provide “controlled surcharge” through a series of stormwater drainage pits, with the easement pipeline reducing in size gradually from 750mm diameter to the existing 450mm diameter pipeline size in Asquith Oval.

A direct connection of a 750mm diameter easement pipeline at the property boundary, into the existing 450mm diameter pipeline within Asquith Oval has been assessed as not preferable, as it will cause excessive surcharge of flows from one surface inlet pit.

An alternative to the pipes stepping down in size as currently shown on the drawings, would be to maintain a 750mm diameter pipeline between stormwater pits labelled as “Pit 04/3” and “Pit 04/7”, with temporary orifice plates attached to pit walls to control flows and surcharge at the nominated stormwater easement pits, until such time as the Asquith Oval stormwater system is upgraded.

Alternatively, the location of surcharge flows could be directed further downstream through upgrade of the Asquith Oval system adjacent to the western property boundary of the subject site as part of the development, however to date advice received from Council has been to limit drainage easement works within the subject site boundaries.

3.5 Overland Flooding

The subject site has been identified by Hornsby Shire Council as affected by overland flooding from the upstream external catchments. This is due to the pre-development scenario, which incorporates a localised sag point in the grassed table drain, which allows surcharge flows to drain into the subject site. The upstream catchment has been estimated to be approximately one hectare.

Notwithstanding the above, the proposed stormwater easement realignment and amplification works as described in Section 3.4 of this report will facilitate full piped drainage of 1 in 100-year overland flows from the upstream catchment, including a 50% blockage factor of the pit and piped system.

We reference pre-DA meeting minutes for this development, dated 17 March 2017, which identifies that the stormwater easement pipe traversing through the site is subject to a flood study to ensure proposed buildings are clear of the 100-year ARI flood contour. Based on the proposed drainage easement realignment and amplification, no overland surface flows will occur, and thus will negate a requirement for an overland flood study.

Subsequent to the above pre-DA requirement, Hornsby Council has requested an alternative design and analysis be undertaken based on a further, in-depth review of the surrounding site conditions. A copy of the correspondence received from Hornsby Council, dated 21 December 2017, is enclosed as Appendix C to this report.

The design and analysis requested from Hornsby Council on 21 December 2017 will require analysis for two scenarios, being the short and long term as follows:

- (a) *In the short term assuming that the subject site is the only development with kerb and gutter being constructed only fronting the development site.*

- i) *A grated gully pit shall be provided in the kerb and gutter alignment to collect flows from the road pavement and connecting to the existing Council pipe draining through the site. The pipe alignment shall be upgraded to minimise the hydraulic losses in the existing pipe bends.*
 - ii) *The Council pipe shall be analysed to ensure sufficient capacity to cater for the 20-year ARI flows.*
 - iii) *The existing table drain shall be removed in front of the development site and a new inlet pit constructed over the existing pipe upstream of the development to collect the existing flows in the table drain.*
 - iv) *The sag in the nature strip fronting the development site shall be removed with continuous grade to the intersection with Mills Avenue.*
 - v) *Calculations shall be provided to demonstrate that a minimum 300mm freeboard is provided at the front boundary alignment to direct the overland flow along the nature strip to Mills Avenue assuming the pipe is fully blocked. The overland flow shall analyse any surcharging of pits that may contribute to the overland flow. A minimum 300 mm freeboard is also required at the driveway locations.*
 - vi) *The cross fall in the footpath shall be graded away from the properties.*
- (b) *The long-term scenario where kerb and gutter is constructed along the full frontage up to Rupert Street.*
- i) *The table drain is completely removed with sufficient collection pits along the nature strip provided to capture runoff from the low-level footpath (if required).*
 - ii) *Design and analysis of the overland flow path with sufficient free board of 300mm along the property boundaries to contain the overland flow within the nature strip. A minimum 300mm freeboard is also required at the driveway locations.*
 - iii) *Council will require that any future developments upstream of the subject site to provide kerb and gutter and therefore the only contributing flows in the nature strip is generated along the footpath. This will require the junction pit in front of the subject site to have fully sealed bolt down lids.*

Subsequent to the above advice, we also acknowledge Council's further assessment of site constraints and coordination issues along the road verge for driveway access and its impact on overland flows. A copy of this correspondence from Council, dated 16 January 2018, is enclosed as Appendix D for reference.

A public domain design scheme has been developed in consultation with Hornsby Shire Council, as part of the design documents to be submitted for the subject site Development Application. We understand that the key design elements of the overall public domain design scheme along the subject site frontage, as well as future re-development of upstream properties to the north, is as follows:

- The grading of the road verge between road shoulder / back of kerb and property boundary alignments will fall towards the property boundary.
- A footpath with 2.5% crossfall will be provided for pedestrian access, which will also project through any proposed driveways.
- The existing grass table drain conveying flows from the upstream catchment will be filled and replaced with a piped system.
- As each property is progressively re-developed, introduction of new kerb and gutter along Pacific Highway and associated gully pit drainage will restrict the overland flows entering the road verge, thus facilitating a fully piped and sealed system within the road verge. This will minimise risk of overland flows surcharging and grated pit inlet openings due to system blockage.

- It is important to note that the provision of a fully piped and sealed road verge stormwater network is required, as an overland flow path has not been accommodated in the approved public domain plans for No. 475-477 Pacific Highway, thus rendering the provision of a surface overland flow path along the frontage of No. 461-473 Pacific Highway ineffective.

Thus a “site-specific” flood study for external flows travelling along the stormwater easement will not be relevant for the site.

Overland flows within the subject site, due to surcharge from roof gutters or the OSD tank, will be managed by a defined flow path along the site perimeters between building envelope and site boundary.

4.0 STORMWATER QUALITY MANAGEMENT

4.1 WSUD Objectives

Hornsby Shire Council stipulates the following water quality targets for pollution load reduction:

- 90% reduction in mean annual loads of total gross pollutants (TGP);
- 80% reduction in mean annual loads of total suspended solids (TSS);
- 60% reduction in mean annual loads of total phosphorus (TP); and,
- 45% reduction in mean annual loads of total nitrogen (TN).

4.2 Methodology and Modelling

A MUSIC model has been set up using the Hornsby Shire Council MUSIC-Link. The total site area has been modelled as a single, centralised water quality treatment device. The underground stormwater pit and pipe system will contain Enviropod litter baskets in each stormwater pit, as well as eleven (11) StormFilter cartridges within a chamber of the OSD tank to remove suspended solids and nutrients from the stormwater.

For a conservative approach the roof areas have been modelled as General Urban (Mixed) source nodes.

A portion of pervious area at the back of the site (along the Asquith Oval boundary) is to bypass the treatment system due to natural site grades. This bypass catchment has been included in the MUSIC model.

4.3 Catchments

A single internal site catchment has been determined for water quality treatment and detention storage. A small portion of area west of the buildings will bypass the stormwater network. The catchment plan C14.01-C14.02 presents the pervious and impervious break down of internal and external catchment areas.

4.4 Rainfall Data

Rainfall Data from Hornsby Shire Council MUSIC-Link was used.

4.5 Evapotranspiration Data

Evapotranspiration Data from Hornsby Shire Council MUSIC-Link was used.

4.6 Source Parameters

MUSIC Source Node Soil Properties

Soil Parameter	Value
Rainfall Threshold (mm/day)	0.3 for roof 1.5 for others
Soil Storage Capacity (mm)	170
Initial Storage (% of Capacity)	30
Field Capacity	70
Infiltration Capacity Coefficient – a	180
Infiltration Capacity Coefficient – b	3.0
Groundwater Initial Depth (mm)	10
Groundwater Daily Recharge Rate (%)	25
Groundwater Daily Base Flow (%)	25
Groundwater Daily Deep Seepage Rate (%)	0

4.7 Catchments Pollutant Mean Concentrations

Base Flow and Storm Flow Pollutant Event Mean Concentration Values

Land Use Category	Catchment Type	TSS (log 10)		TP (log 10)		TN (log 10)	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
General Urban	Base Flow	1.20	0.17	-0.85	0.19	0.11	0.12
	Storm Flow	2.15	0.32	-0.60	0.25	0.3	0.19
Roof Areas	Base Flow	N/A	N/A	N/A	N/A	N/A	N/A
	Storm Flow	1.30	0.32	-0.89	0.25	0.30	0.19

4.8 Treatment Train

The stormwater treatment train is to consist of:

- Primary Treatment: All rainfall runoff from hardstand and landscaped areas is directed into inlet pits fitted with a Stormwater360 Enviropod.
- Tertiary Treatment: All roof, hardstand and landscaped rainfall runoff (with the exception of the by-pass area shown on the catchment plan) will be piped to the OSD tank, fitted with 11x 460mm Stormwater360 StormFilter Cartridges.

The approved Stormwater360 treatment node was used within MUSIC to model the treatment effectiveness achieved by the Enviropod and StormFilters. See Figure 3 below for the model set up.

4.9 Model Results

MUSIC Model Results

		Source Load	Residual Load	% Reduction Achieved	% Reduction Required
TSS	(kg/yr)	1010	109	89.2	80
TP	(kg/yr)	1.64	0.594	63.8	60
TN	(kg/yr)	12.3	6.73	45.3	45
Gross Pollutants	(kg/yr)	141	0.055	100	90

The MUSIC-link self-validation tool was used to ensure treatment train effectiveness met the requirements of Hornsby Shire Council, and a Hornsby Shire Council MUSIC-link PDF report was generated and is attached in Appendix F.

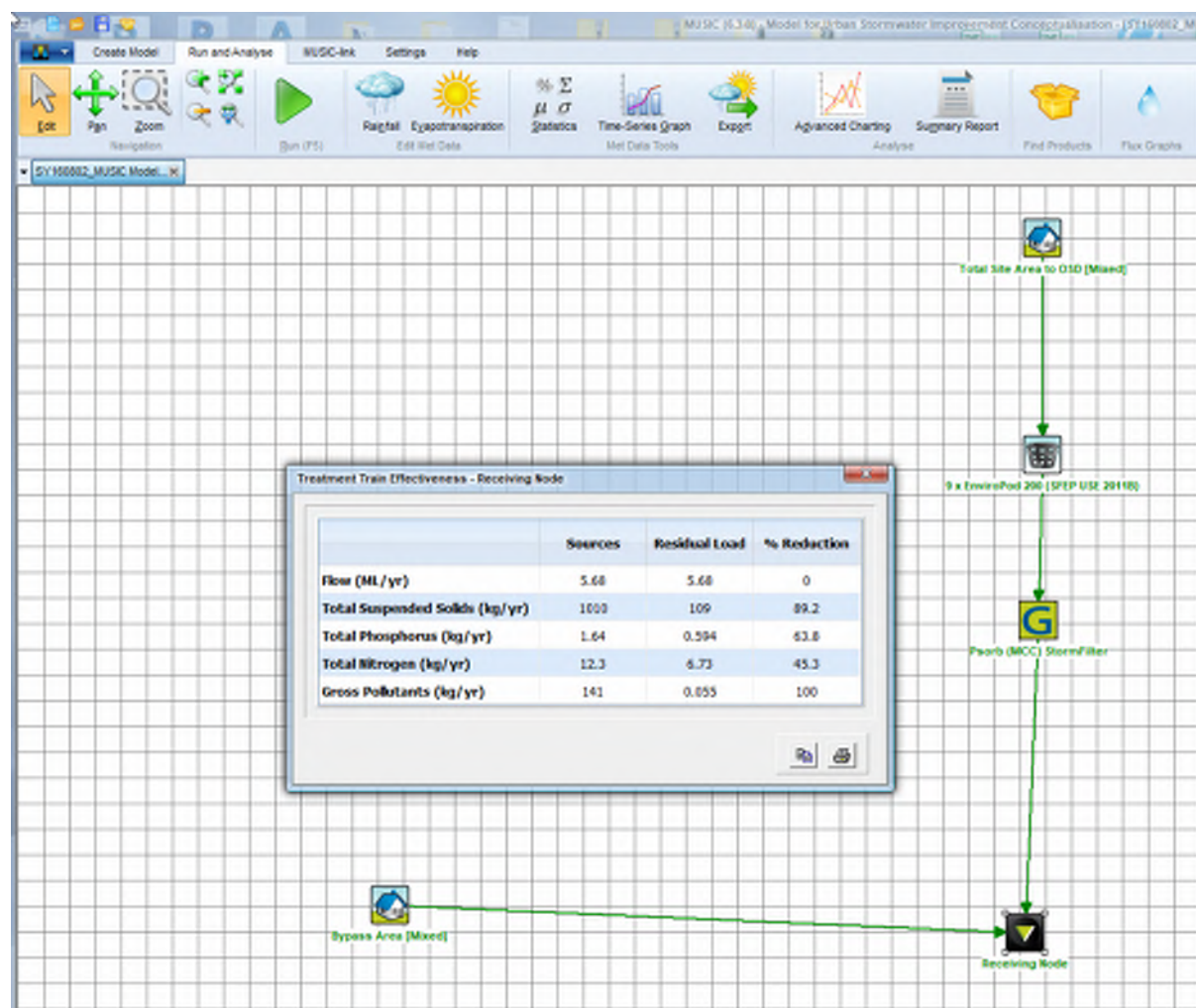


Figure 4 - MUSIC Model Set-up and Results

4.10 Maintenance

To ensure continued treatment effectiveness from the Stormwater360 Enviropod and StormFilter, maintenance is required in accordance with Stormwater360's maintenance specification.

The table below outlines the maintenance requirements and the full maintenance and operation specification is provided in Appendix E.

Maintenance Plan for Stormwater360 treatment devices

Treatment Device	Maintenance Required	Frequency
Enviropod	Monitor filter bag	After any moderate to extreme rainfall events.
	Empty filter bag	Once the material collected by the filter reaches no more than approximately half to two thirds of the total bag depth.
StormFilter	Minor maintenance/inspection	Twice a year
	Major maintenance/inspection	Once a year

A full maintenance specification will be supplied by the device manufacturer upon installation of the proposed system.

5.0 CONCLUSION

In summary the proposed design has considered and provides for appropriate stormwater detention, stormwater treatment and overland flooding / easement design considerations.

As such we confirm that the stormwater design meets the requirements set out by Hornsby Council.

Appendix A

ACOR Civil DA Drawings

CASS ASQUITH

461- 473 PACIFIC HIGHWAY ASQUITH, NSW 2077

CIVIL SERVICES - SITE WORKS

PAVEMENT LEGEND

PAVEMENT TYPE 01

VEHICULAR CROSSING DESIGN CBR = 5%

DESIGN FINISHED SURFACE LEVEL

200mm THICK CONCRETE
(f_c = 32MPa) WITH SL82 TOP
AND BOTTOM (50mm COVER)

20mm SAND BINDING LAYER
(IF REQUIRED)

COMPACTED SUBGRADE

PAVEMENT TYPE 02

DRIVEWAY PAVEMENT DESIGN CBR = 5%

DESIGN FINISHED SURFACE LEVEL

180mm THICK CONCRETE
(f_c = 32MPa) WITH SL82
CENTRAL (50mm COVER)

100mm COMPACTED THICKNESS
BASECOURSE

COMPACTED SUBGRADE

PAVEMENT TYPE 03

CONCRETE FOOTPATH

DESIGN FINISHED SURFACE LEVEL

100mm THICK N25 CONCRETE WITH
SL72 MESH CENTRALLY PLACED

50mm SAND BEDDING

COMPACTED SUBGRADE

CIVIL LEGEND PROPOSED

K&G

.....

KERB AND GUTTER

KO

.....

KERB ONLY

DD 900

.....

DISH DRAIN WITH WIDTH

• P56.20

.....

FINISHED SURFACE LEVEL

• EX56.20

.....

EXISTING SURFACE LEVEL

GRATED DRAIN

STORMWATER DRAINAGE STRUCTURE
WITH NUMBER

3000 uPVC

.....

STORMWATER DRAINAGE LINE WITH
PIPE SIZE AND CLASS

.....

OVERLAND FLOW PATH

SOIL EROSION AND SEDIMENT
CONTROL LEGEND

SEDIMENT CONTROL FENCE

INLET TRAP

TEMPORARY STABILISED
CONSTRUCTION EXIT

DRAWING LIST		
DWG No.	DESCRIPTION	REVISION
C11.01	COVER SHEET INDEX & LEGEND	G
C11.02	GENERAL NOTES	G
C11.05	DETAILS - SHEET 1	G
C11.06	DETAILS - SHEET 2	G
C11.07	DETAILS - SHEET 3	G
C11.08	DETAILS - SHEET 4	G
C12.01	PAVEMENT PLAN	H
C13.01	SITE WORKS PLAN	H
C13.02	SITE WORKS PLAN - DRAINAGE EASEMENT	NOT USED
C13.10	STORMWATER LONGITUDINAL SECTIONS - SHEET 1	F
C13.11	STORMWATER LONGITUDINAL SECTIONS - SHEET 2	F
C14.01	CATCHMENT PLAN - SHEET 1	F
C14.02	CATCHMENT PLAN - SHEET 2	F
C15.01	SOIL EROSION AND SEDIMENT CONTROL PLAN	G

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E	ISSUE FOR COORDINATION	08.07.20	ROB/VG	MB	
D	ISSUE FOR DEVELOPMENT APPLICATION	18.10.19	VG	MB	
Issue	Description	Date	Drawn	Approved	

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GENERAL NOTES

- THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL ARCHITECTURAL AND OTHER CONSULTANTS DRAWINGS AND SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED.
- ALL DIMENSIONS RELEVANT TO SETTING OUT AND OFF-SITE WORK SHALL BE VERIFIED BY THE CONTRACTOR BEFORE CONSTRUCTION
- DIMENSIONS SHALL NOT BE OBTAINED BY SCALING THE DRAWINGS.
- ALL DIMENSIONS ON DETAILS ARE IN MILLIMETRES UNLESS STATED OTHERWISE. ALL PLANS AND LEVELS ARE EXPRESSED IN METRES.
- DURING CONSTRUCTION THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURAL STABILITY OF THE WORKS AND ENSURE NO PARTS BE OVER STRESSED UNDER CONSTRUCTION ACTIVITIES.
- WORKMANSHIP AND MATERIALS ARE TO BE IN ACCORDANCE WITH THE RELEVANT CURRENT S.A.A. CODES INCLUDING ALL AMENDMENTS, AND THE LOCAL STATUTORY AUTHORITIES, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
- THE APPROVAL OF A SUBSTITUTION SHALL BE SOUGHT FROM THE ENGINEER BUT IS NOT AN AUTHORISATION FOR A VARIATION. ANY VARIATIONS INVOLVED MUST BE TAKEN UP WITH THE ARCHITECT OR PROJECT MANAGER BEFORE THE WORK COMMENCES.
- ANY DISCREPANCIES OR OMISSIONS SHALL BE REFERRED TO THE ENGINEER FOR A DECISION BEFORE PROCEEDING WITH THE WORK.
- THE BUILDER SHALL GIVE 48 HOURS NOTICE FOR ALL ENGINEERING INSPECTIONS.
- BUILDING FROM THESE DRAWINGS IS NOT TO COMMENCE UNTIL APPROVED BY THE LOCAL AUTHORITIES
- THE WORD 'ENGINEER' USED IN THESE NOTES REFER TO AN EMPLOYEE OR NOMINATED REPRESENTATIVE OF **ACOR CONSULTANTS PTY.LTD.**

EXISTING SERVICES AND FEATURES

- THE CONTRACTOR SHALL ALLOW FOR THE CAPPING OFF, EXCAVATION, REMOVAL AND DISPOSAL IF REQUIRED OF ALL EXISTING SERVICES IN AREAS AFFECTED BY WORKS WITHIN THE CONTRACT AREA, AS SHOWN ON THE DRAWINGS UNLESS DIRECTED OTHERWISE BY THE SUPERINTENDENT.
- THE CONTRACTOR SHALL ENSURE THAT AT ALL TIMES SERVICES TO ALL BUILDINGS NOT AFFECTED BY THE WORKS ARE NOT DISRUPTED.
- PRIOR TO COMMENCEMENT OF ANY WORKS THE CONTRACTOR SHALL GAIN WRITTEN APPROVAL OF HIS PROGRAMME FOR THE RELOCATION/CONSTRUCTION OF TEMPORARY SERVICES.
- EXISTING BUILDINGS, EXTERNAL STRUCTURES, AND TREES SHOWN ON THESE DRAWINGS ARE FEATURES EXISTING PRIOR TO ANY DEMOLITION WORKS.
- CONTRACTOR SHALL CONSTRUCT TEMPORARY SERVICES TO MAINTAIN EXISTING SUPPLY TO BUILDINGS REMAINING IN OPERATION DURING WORKS TO THE SATISFACTION AND APPROVAL OF THE SUPERINTENDENT. ONCE DIVERSION IS IS COMPLETE AND COMMISSIONED THE CONTRACTOR SHALL REMOVE ALL SUCH TEMPORARY SERVICES AND MAKE GOOD TO THE SATISFACTION OF THE SUPERINTENDENT.
- INTERRUPTION TO SUPPLY OF EXISTING SERVICES SHALL BE DONE SO AS NOT TO CAUSE ANY INCONVENIENCE TO THE PRINCIPAL. CONTRACTOR TO GAIN APPROVAL OF SUPERINTENDENT FOR TIME OF INTERRUPTION.

SUBGRADE PREPARATION

- REMOVE ALL TOPSOIL, VEGETABLE MATTER AND RUBBLE.
- PROOF ROLL NATURAL SURFACE.
- REMOVE ANY SOFT AREAS.
- PLACE APPROVED NON ORGANIC FILL WITH A MAXIMUM PARTICLE SIZE OF 75mm AND COMPACT IN 200mm MAX. THICK LAYERS. U.N.O.
- COMPACTION IS TO BE CARRIED OUT BY ROLLING AT OPTIMUM MOISTURE CONTENT TO OBTAIN A DENSITY EQUIVALENT TO 98% OF MAXIMUM DRY DENSITY WHEN TESTED BY THE STANDARD COMPACTION TEST. No. E1:1 FROM A.S. 1289.
- COMPACTION SHALL BE CARRIED OUT WITH A VIBRATING ROLLER WITH AT LEAST 10 TONNE STATIC WEIGHT.
- TESTING OF THE SUBGRADE SHALL BE CARRIED OUT BY AN APPROVED N.A.T.A. REGISTERED LABORATORY.

SITEWORKS NOTES

- ORIGIN OF LEVELS :- AUSTRALIAN HEIGHT DATUM (A.H.D.)
- CONTRACTOR MUST VERIFY ALL DIMENSIONS AND EXISTING LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORK.
- ALL WORK IS TO BE UNDERTAKEN IN ACCORDANCE WITH THE DETAILS SHOWN ON THE DRAWINGS, THE SPECIFICATIONS AND THE DIRECTIONS OF THE PRINCIPAL'S REPRESENTATIVE.
- EXISTING SERVICES HAVE BEEN PLOTTED FROM SUPPLIED DATA AND AS SUCH THEIR ACCURACY CANNOT BE GUARANTEED. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ESTABLISH THE LOCATION AND LEVEL OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF ANY WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE PRINCIPAL'S REPRESENTATIVE. CLEARANCES SHALL BE OBTAINED FROM THE RELEVANT SERVICE AUTHORITY.
- WHERE NEW WORKS ABUT EXISTING THE CONTRACTOR SHALL ENSURE THAT A SMOOTH EVEN PROFILE, FREE FROM ABRUPT CHANGES IS OBTAINED.
- THE CONTRACTOR SHALL ARRANGE ALL SURVEY SETOUT TO BE CARRIED OUT BY A REGISTERED SURVEYOR.
- CARE IS TO BE TAKEN WHEN EXCAVATING NEAR EXISTING SERVICES. NO MECHANICAL EXCAVATIONS ARE TO BE UNDERTAKEN OVER COMMUNICATIONS OR ELECTRICAL SERVICES. HAND EXCAVATE IN THESE AREAS.
- ALL SERVICE TRENCHES UNDER VEHICULAR PAVEMENTS SHALL BE BACKFILLED WITH AN APPROVED NON-NATURAL GRANULAR MATERIAL AND COMPACTED TO 98% STANDARD MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS.1289.5.1.1.
- ALL TRENCH BACKFILL MATERIAL SHALL BE COMPACTED TO THE SAME DENSITY AS THE ADJACENT MATERIAL.
- ON COMPLETION OF PIPE INSTALLATION ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL, INCLUDING KERBS, FOOTPATHS, CONCRETE AREAS, GRAVEL AND GRASSED AREAS AND ROAD PAVEMENTS.
- PROVIDE 12mm WIDE EXPANDING CORK JOINTS BETWEEN CONCRETE PAVEMENTS AND ALL BUILDINGS, WALLS, FOOTINGS, COLUMNS, KERBS, DISH DRAINS, GRATED DRAINS, BOLLARD FOOTINGS ETC
- CONTRACTOR TO OBTAIN ALL AUTHORITY APPROVALS.
- ALL BATTERS TO BE GRASSED LINED WITH MINIMUM 100 TOPSOIL AND APPROVED COUCH LAID AS TURF.
- MAKE SMOOTH TRANSITION TO EXISTING SERVICES AND MAKE GOOD.
- THE CONTRACTOR SHALL PROVIDE ALL TEMPORARY DIVERSION DRAINS AND MOUNDS TO ENSURE THAT AT ALL TIMES EXPOSED SURFACES ARE FREE DRAINING AND WHERE NECESSARY EXCAVATE SUMPS AND PROVIDE PUMPING EQUIPMENT TO DRAIN EXPOSED AREAS.
- THESE PLANS SHALL BE READ IN CONJUNCTION WITH APPROVED ARCHITECTURAL, STRUCTURAL, HYDRAULIC AND ELECTRICAL DRAWINGS AND SPECIFICATIONS.
- TRENCHES THROUGH EXISTING ROAD AND CONCRETE PAVEMENTS SHALL BE SAWCUT TO FULL DEPTH OF CONCRETE AND A MIN 50mm IN BITUMINOUS PAVING.
- ALL BRANCH GAS AND WATER SERVICES UNDER DRIVEWAYS AND BRICK PAVING SHALL BE LOCATED IN Ø80 uPVC SEWER GRADE CONDUITS EXTENDING A MIN OF 500mm PAST PAVING.
- ON COMPLETION OF WORKS ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL INCLUDING, BUT NOT LIMITED TO, KERBS, FOOTPATHS, CONCRETE AREAS, GRASS AND LANDSCAPED AREAS.

COMPACTION NOTES

- STRIP TOPSOIL TO EXPOSE NATURALLY OCCURRING MATERIAL AND STOCKPILE ON SITE FOR SELECTIVE RE-USE OR DISPOSE OFF-SITE AS DIRECTED BY THE SUPERINTENDENT.
- WHERE FILLING IS REQUIRED TO ACHIEVE DESIGN SUBGRADE PROOF ROLL EXPOSED NATURAL SURFACE WITH A MINIMUM OF TEN PASSES OF A VIBRATING ROLLER (MINIMUM STATIC WEIGHT OF 10 TONNES) IN THE PRESENCE OF THE SUPERINTENDENT. REFER TO SPECIFICATION FOR DETAILS.
- ALL SOFT, WET OR UNSUITABLE MATERIAL TO BE REMOVED AS DIRECTED BY THE SUPERINTENDENT AND REPLACED WITH APPROVED MATERIAL SATISFYING THE REQUIREMENTS LISTED BELOW.
- ALL FILL MATERIAL SHALL BE FROM A SOURCE APPROVED BY THE SUPERINTENDENT AND SHALL COMPLY WITH THE FOLLOWING :
 - FREE FROM ORGANIC, PERISHABLE AND CONTAMINATED MATTER
 - MAXIMUM PARTICLE SIZE 75MM
 - PLASTICITY INDEX BETWEEN 2% AND 15%
- ALL FILL MATERIAL SHALL BE PLACED IN MAXIMUM 200MM THICK LAYERS AND COMPACTED AT OPTIMUM MOISTURE CONTENT (+ OR - 2%) TO ACHIEVE A DRY DENSITY DETERMINED IN ACCORDANCE WITH AS 1289 E3.1 OF NOT LESS THAN THE FOLLOWING STANDARD MINIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 E1.1 :

LOCATION	STANDARD DRY DENSITY
UNDER BUILDING SLABS	98%
AREAS OF SERVICE TRENCHES	98%
EXTERNAL PAVED AREAS, ROADS AND CARPARKS	98%
LANDSCAPED AREAS	90%
- THE CONTRACTOR SHALL PROGRAM THE EARTHWORKS OPERATION SO THAT THE WORKING AREAS ARE ADEQUATELY DRAINED DURING THE PERIOD OF CONSTRUCTION. THE SURFACE SHALL BE GRADED AND SEALED OFF TO REMOVE DEPRESSIONS, ROLLER MARKS AND SIMILAR WHICH WOULD ALLOW WATER TO POND AND PENETRATE THE UNDERLYING MATERIAL. ANY DAMAGE RESULTING FROM THE CONTRACTOR NOT OBSERVING THESE REQUIREMENTS SHALL BE RECTIFIED BY THE CONTRACTOR AT THEIR COST.
- TESTING OF THE SUBGRADE SHALL BE CARRIED OUT BY AN APPROVED NATA REGISTERED LABORATORY AT THE CONTRACTORS EXPENSE.

STORMWATER NOTES

- ALL 225 DIA. DRAINAGE PIPES AND LARGER SHALL BE CLASS "2" APPROVED SPIGOT AND SOCKET FRC OR RCP. PIPES WITH RUBBER RING JOINTS. (U.N.O.) ALL DOWNPIPE DRAINAGE LINES SHALL BE SEWER GRADE UPVC WITH SOLVENT WELD JOINTS. (U.N.O.)
- EQUIVALENT STRENGTH REINFORCED CONCRETE PIPES MAY BE USED.
- ALL PIPE JUNCTIONS UP TO AND INCLUDING 450 DIA. AND TAPERS SHALL BE VIA PURPOSE MADE FITTINGS.
- MINIMUM GRADE TO STORMWATER LINES TO BE 1%. (U.N.O.)
- CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORK.
- ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN A TRADESMAN-LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE A SMOOTH FINISH.
- PRECAST PITS SHALL NOT BE USED UNLESS WRITTEN APPROVAL IS OBTAINED FROM THE SUPERINTENDENT.
- WHERE TRENCHES ARE IN ROCK, THE PIPE SHALL BE BEDDED ON A MIN. 50MM CONCRETE BED (OR 75MM THICK BED OF 12MM BLUE METAL) UNDER THE BARREL OF THE PIPE. THE PIPE COLLAR AT NO POINT SHALL BEAR ON THE ROCK. IN OTHER THAN ROCK, PIPES SHALL BE LAID ON A 75MM THICK SAND BED. IN ALL CASES BACKFILL THE TRENCH WITH SAND TO 200MM ABOVE THE PIPE. WHERE THE PIPE IS UNDER PAVEMENTS BACKFILL REMAINDER OF TRENCH WITH SAND OR APPROVED GRANULAR BACKFILL COMPACTED IN 150MM LAYERS TO 98% STANDARD MAX. DRY DENSITY.
- BEDDING SHALL BE (U.N.O.) TYPE H1, IN ACCORDANCE WITH CURRENT RELEVANT AUSTRALIAN STANDARDS.
- WHERE STORMWATER LINES PASS UNDER FLOOR SLABS SEWER GRADE RUBBER RING JOINTS ARE TO BE USED.
- WHERE SUBSOIL DRAINAGE LINES PASS UNDER FLOOR SLABS AND VEHICULAR PAVEMENTS UNSLOTTED UPVC SEWER GRADE PIPE SHALL BE USED.
- PROVIDE 3.0M LENGTH OF 100 DIA. SUBSOIL DRAINAGE PIPE WRAPPED IN FABRIC SOCK, AT UPSTREAM END OF EACH PIT.

EROSION AND SEDIMENT CONTROL NOTES

GENERAL INSTRUCTIONS

- THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE ENGINEERING PLANS, AND ANY OTHER PLANS OR WRITTEN INSTRUCTIONS THAT MAY BE ISSUED AND RELATING TO DEVELOPMENT AT THE SUBJECT SITE.
- THE SITE SUPERINTENDENT WILL ENSURE THAT ALL SOIL AND WATER MANAGEMENT WORKS ARE LOCATED AS INSTRUCTED IN THIS SPECIFICATION.
- ALL BUILDERS AND SUB-CONTRACTORS WILL BE INFORMED OF THEIR RESPONSIBILITIES IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION TO DOWNSLOPE LANDS AND WATERWAYS.

CONSTRUCTION SEQUENCE

- THE SOIL EROSION POTENTIAL ON THIS SITE SHALL BE MINIMISED. HENCE WORKS SHALL BE UNDERTAKEN IN THE FOLLOWING SEQUENCE :
 - INSTALL SEDIMENT FENCES, TEMPORARY CONSTRUCTION EXIT AND SANDBAG KERB INLET SEDIMENT TRAP.
 - UNDERTAKE SITE DEVELOPMENT WORKS IN ACCORDANCE WITH THE ENGINEERING PLANS. PHASE DEVELOPMENT SO THAT LAND DISTURBANCE IS CONFINED TO AREAS OF WORKABLE SIZE.

EROSION CONTROL

- DURING WINDY CONDITIONS, LARGE, UNPROTECTED AREAS WILL BE KEPT MOIST (NOT WET) BY SPRINKLING WITH WATER TO KEEP DUST UNDER CONTROL.
- FINAL SITE LANDSCAPING WILL BE UNDERTAKEN AS SOON AS POSSIBLE AND WITHIN 20 WORKING DAYS FROM COMPLETION OF CONSTRUCTION ACTIVITIES.

FENCING

- STOCKPILES WILL NOT BE LOCATED WITHIN 2 METRES OF HAZARD AREAS, INCLUDING LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS SUCH AS WATERWAYS. WHERE THEY ARE BETWEEN 2 AND 5 METRES FROM SUCH AREAS, SPECIAL SEDIMENT CONTROL MEASURES SHOULD BE TAKEN TO MINIMISE POSSIBLE POLLUTION TO DOWNSLOPE WATERS, E.G. THROUGH INSTALLATION OF SEDIMENT FENCING.
- ANY SAND USED IN THE CONCRETE CURING PROCESS (SPREAD OVER THE SURFACE) WILL BE REMOVED AS SOON AS POSSIBLE AND WITHIN 10 WORKING DAYS FROM PLACEMENT.
- WATER WILL BE PREVENTED FROM ENTERING THE PERMANENT DRAINAGE SYSTEM UNLESS IT IS RELATIVELY SEDIMENT FREE, I.E. THE CATCHMENT AREA HAS BEEN PERMANENTLY LANDSCAPED AND/OR ANY LIKELY SEDIMENT HAS BEEN FILTERED THROUGH AN APPROVED STRUCTURE.
- TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES WILL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE REHABILITATED.

OTHER MATTERS

- ACCEPTABLE RECEPTORS WILL BE PROVIDED FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER.
- RECEPTORS FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER ARE TO BE EMPTIED AS NECESSARY. DISPOSAL OF WASTE SHALL BE IN A MANNER APPROVED BY THE SITE SUPERINTENDENT.

SITE INSPECTION & MAINTENANCE

- EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED AFTER RAINFALL EVENTS TO ENSURE THAT THEY OPERATE EFFECTIVELY. REPAIR AND OR MAINTENANCE SHALL BE UNDERTAKEN AS REQUIRED.

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D	ISSUE FOR DEVELOPMENT APPLICATION	18.10.19	VG	MB	
Issue	Description	Date	Drawn	Approved	

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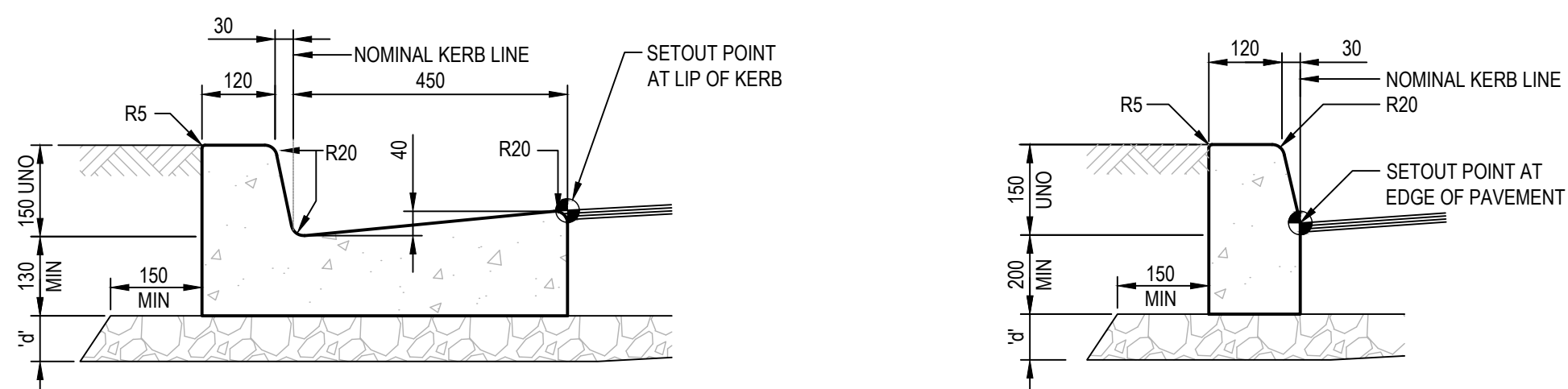
Drawing Title

GENERAL NOTES

Drawn	Date	Scale	A1	Q.A. Check	Date
JK	Jan-18	N/A			
Designed	Project No.	Dwg. No.	Issue		
MB	SY160802	C11.02	G		

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SCALE 1:10
NOTE:
'd' = SUBBASE THICKNESS TO MATCH DEPTH OF
PAVEMENT SUBBASE, BUT NOT LESS THAN 75

SCALE 1:10
NOTE:
'd' = SUBBASE THICKNESS TO MATCH DEPTH OF
PAVEMENT SUBBASE, BUT NOT LESS THAN 75

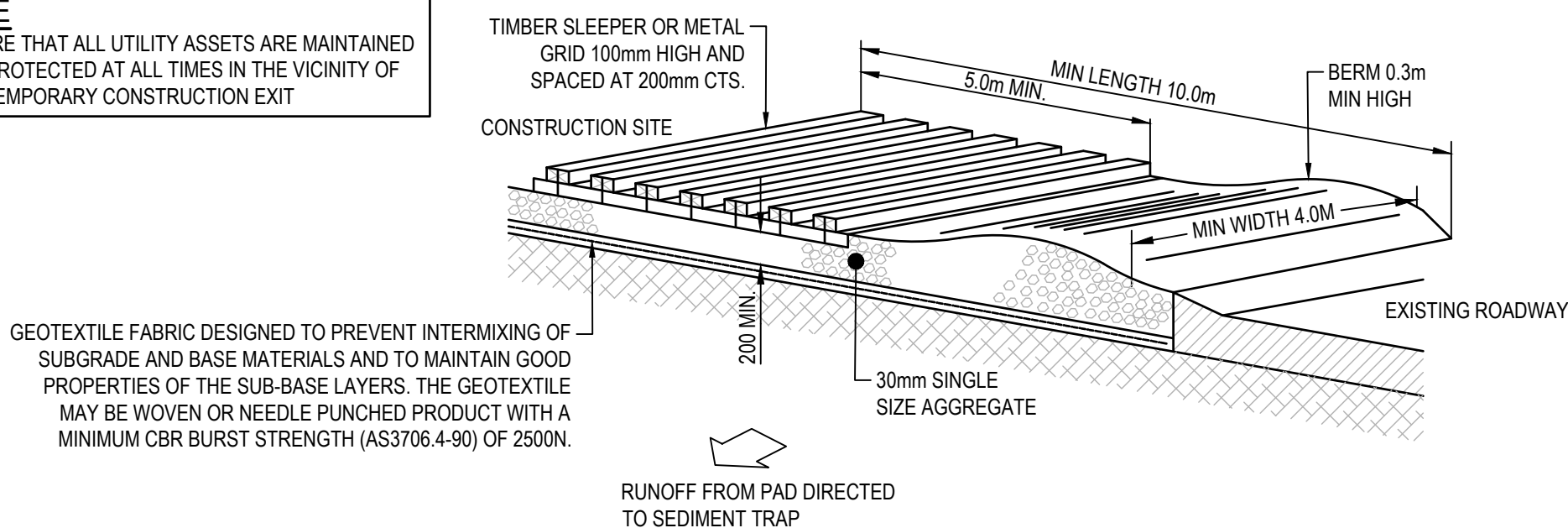


MINIMUM INTERNAL PIT DIMENSIONS		
"D"	"X"	"Y"
D ≤ 600	450	450*
D ≤ 900	600	600*
D ≤ 1200	600	900
D > 1200	900	900

NOTE
PITS DENOTED * SHALL BE USED ONLY WHERE SPECIFIED IN DRAINAGE SCHEDULE OR ON PLAN



NOTE
ENSURE THAT ALL UTILITY ASSETS ARE MAINTAINED AND PROTECTED AT ALL TIMES IN THE VICINITY OF THE TEMPORARY CONSTRUCTION EXIT



CONSTRUCTION NOTES

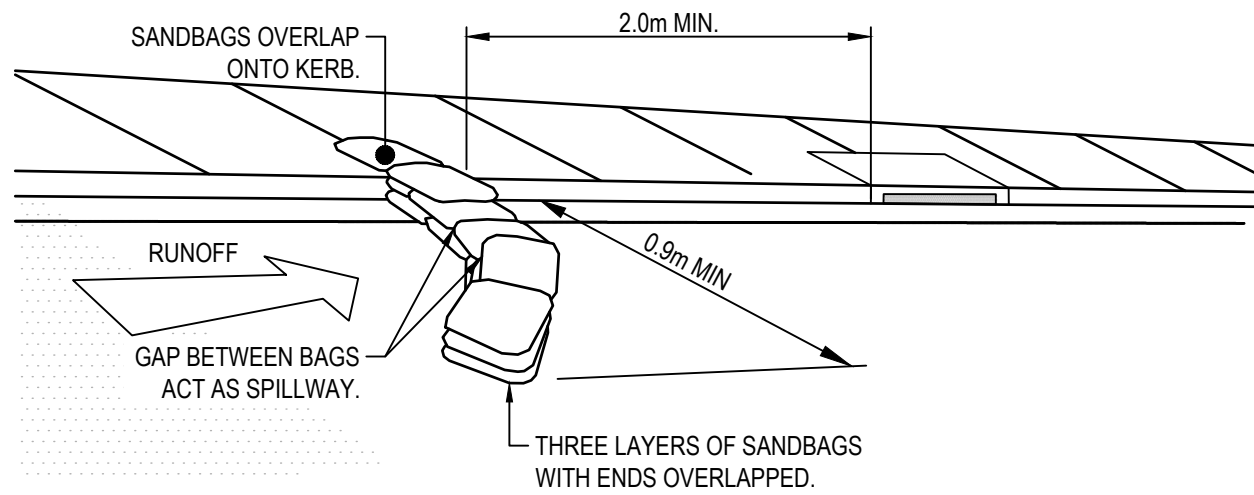
1. STRIP TOPSOIL AND LEVEL SITE.
2. COMPACT SUBGRADE.
3. COVER AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
4. CONSTRUCT 200mm THICK PAD OVER GEOTEXTILE USING 30mm SINGLE SIZE AGGREGATE.
5. CONSTRUCT HUMP IMMEDIATELY WITHIN BOUNDARY TO DIVERT WATER TO A SEDIMENT FENCE OR OTHER SEDIMENT TRAP WHERE THE SEDIMENT IS COLLECTED AND REMOVED.

MAINTENANCE NOTES

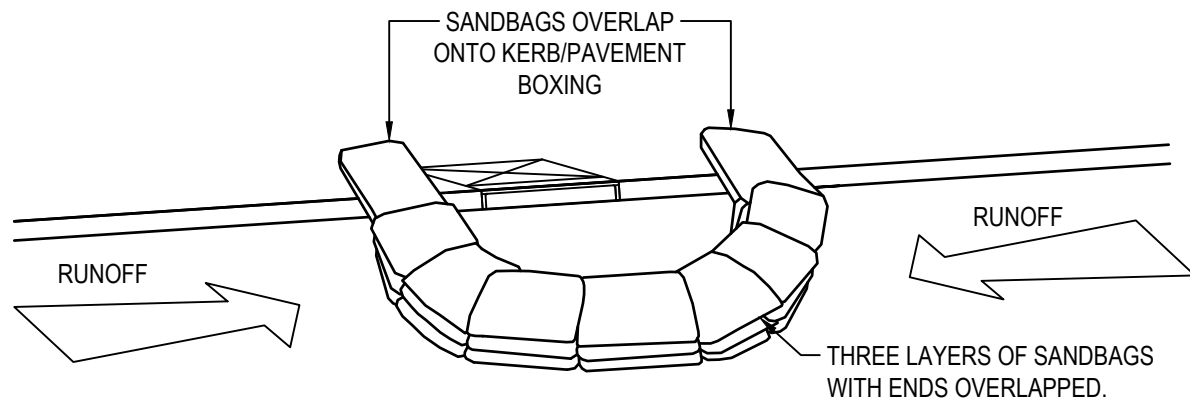
THE EXIT SHALL BE MAINTAINED IN A CONDITION WHICH PREVENTS TRACKING OR FLOWING OF SEDIMENT OFF THE CONSTRUCTION SITE. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL GRAVEL AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED OFF THE CONSTRUCTION SITE MUST BE REMOVED IMMEDIATELY.

TEMPORARY STABILISED CONSTRUCTION EXIT

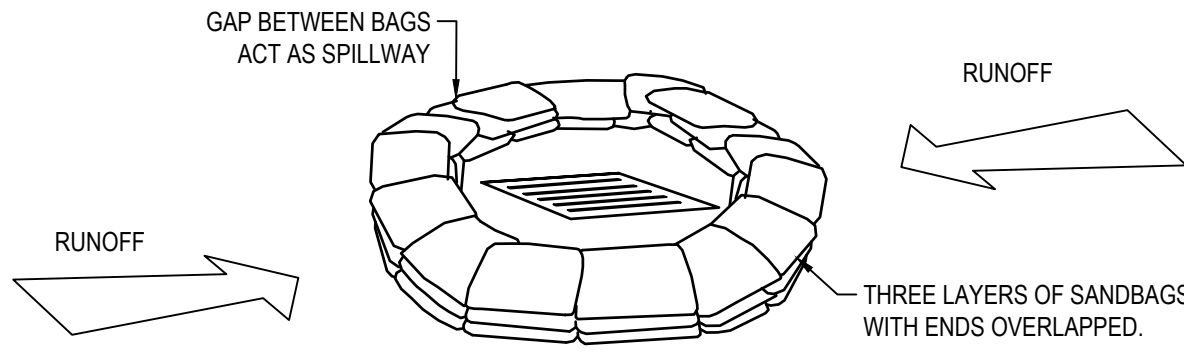
N.T.S.



SANDBAG SEDIMENT TRAP - AT ON GRADE PIT



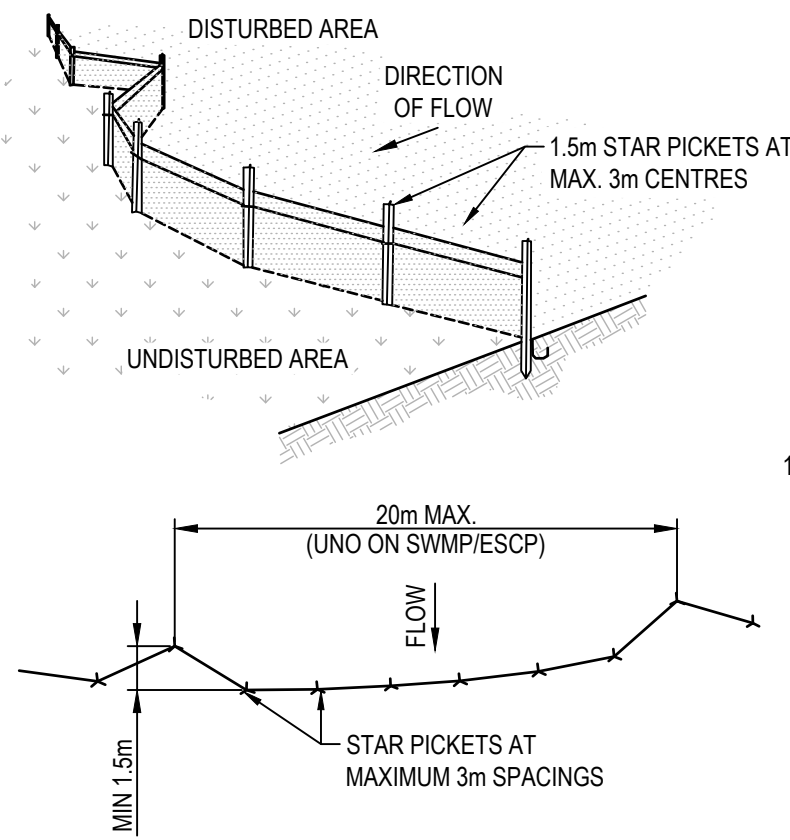
SANDBAG SEDIMENT TRAP - AT KERB SAG PIT



SANDBAG SEDIMENT TRAP - AT OTHER THAN KERB SAG PIT

SANDBAG SEDIMENT TRAP DETAILS

N.T.S.



PLAN

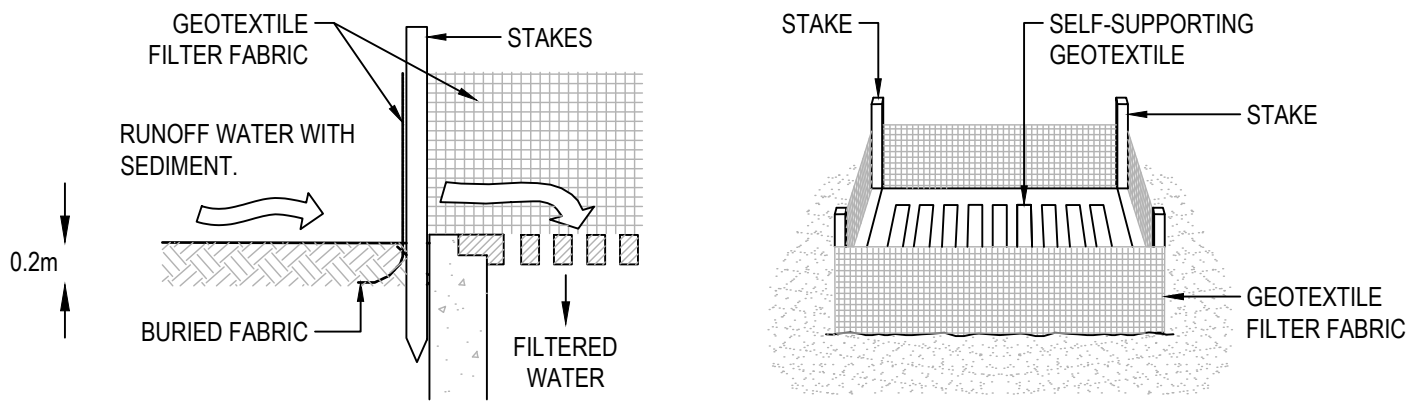
SECTION DETAIL

CONSTRUCTION NOTES

1. CONSTRUCT SEDIMENT FENCE AS CLOSE AS POSSIBLE TO PARALLEL TO THE CONTOURS OF THE SITE.
2. DRIVE 1.5m LONG STAR PICKETS INTO GROUND, 3 METRES APART.
3. DIG A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
4. BACKFILL TRENCH OVER BASE OF FABRIC.
5. FIX SELF-SUPPORTING GEOTEXTILE TO UPSLOPE SIDE OF POSTS WITH WIRE TIES OR AS RECOMMENDED BY GEOTEXTILE MANUFACTURER.
6. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.

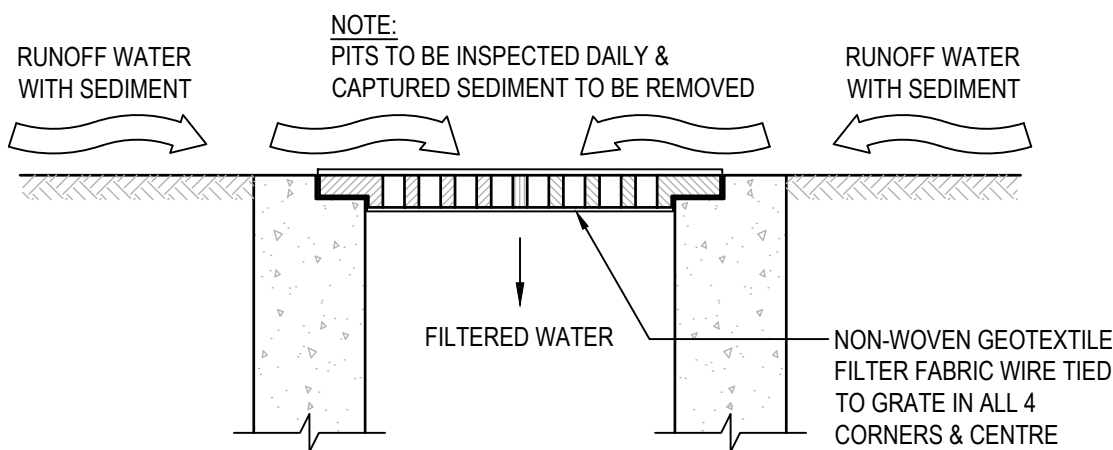
SEDIMENT CONTROL FENCE

N.T.S.



GEOTEXTILE FILTER FABRIC DROP INLET SEDIMENT TRAP.

N.T.S.



INLET TRAP

N.T.S.

NOTE

TO BE USED IN PAVED AREAS WHERE TRAFFIC ACCESS IS REQUIRED

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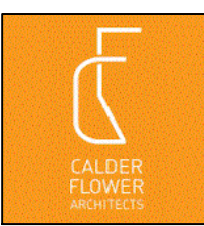
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D	ISSUE FOR DEVELOPMENT APPLICATION	18.10.19	VG MB
Issue	Description	Date	Drawn Approved

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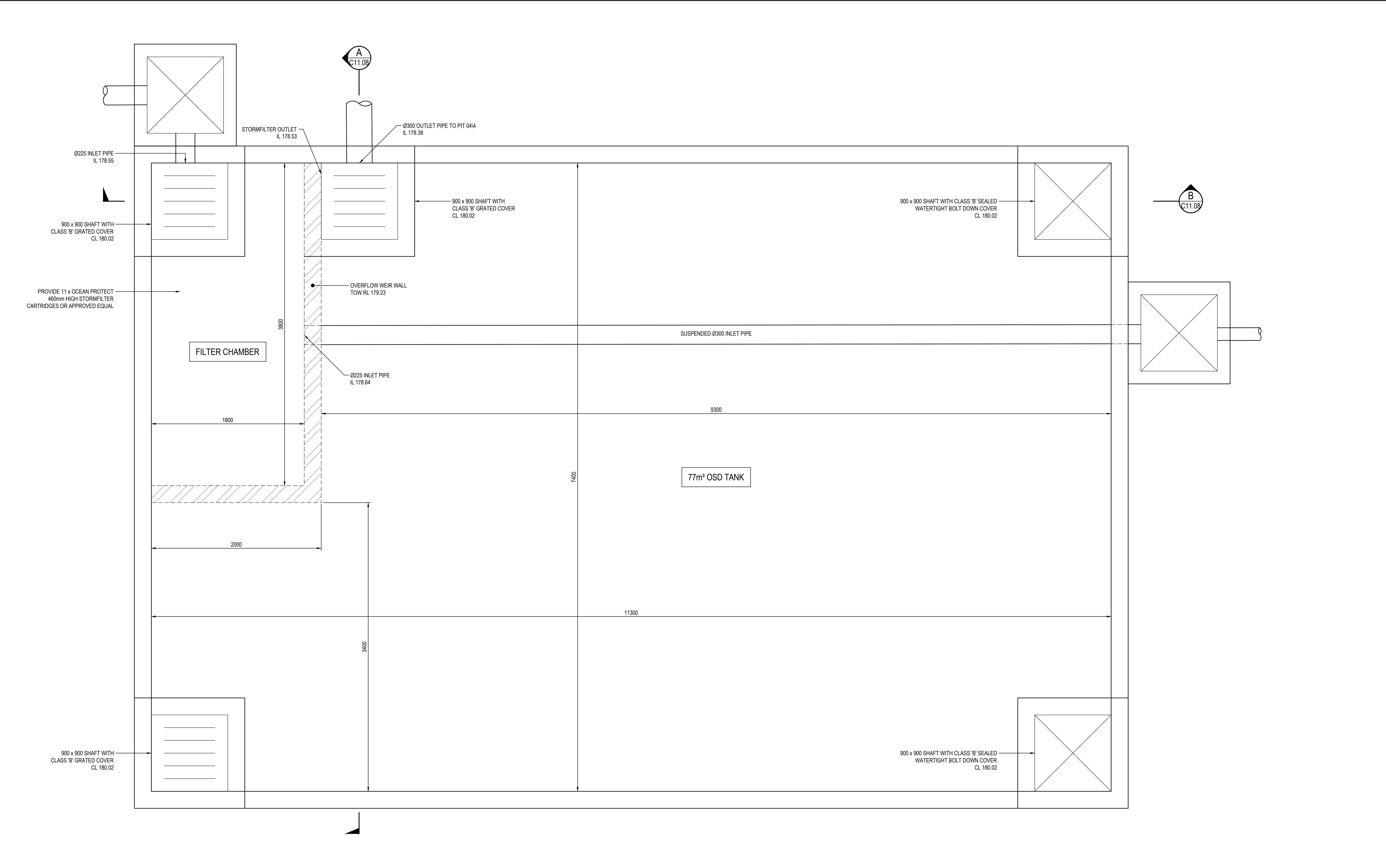
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Drawing Title
DETAILS - SHEET 2

Drawn	Date	Scale	A1	Q.A. Check	Date
JK	Jan-18	AS SHOWN			
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MB	SY160802	C11.06	G		

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Issue	Description	Date	Drawn	Approved	
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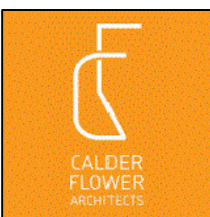
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Project
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Drawing Title
DETAILS - SHEET 3

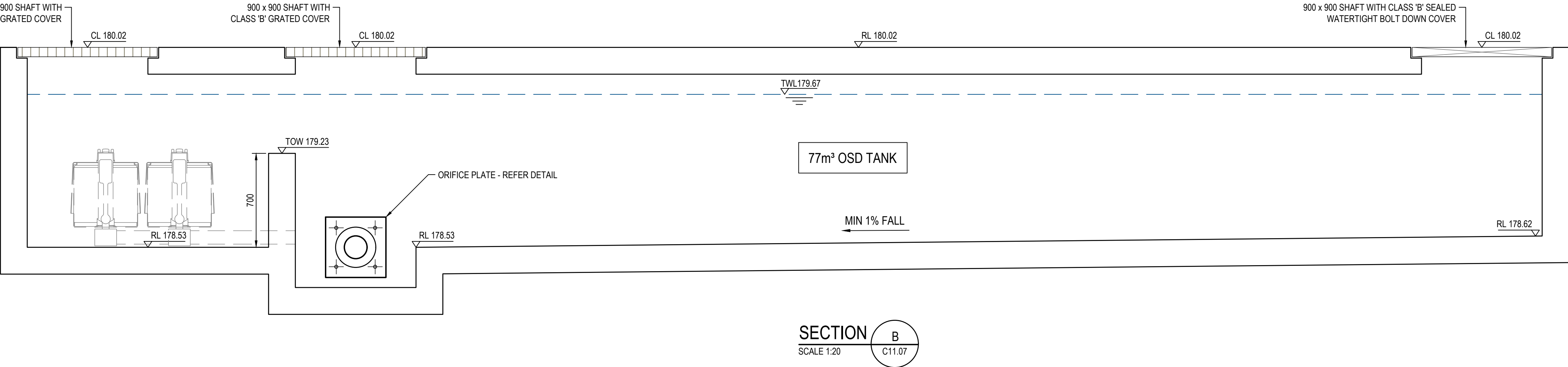
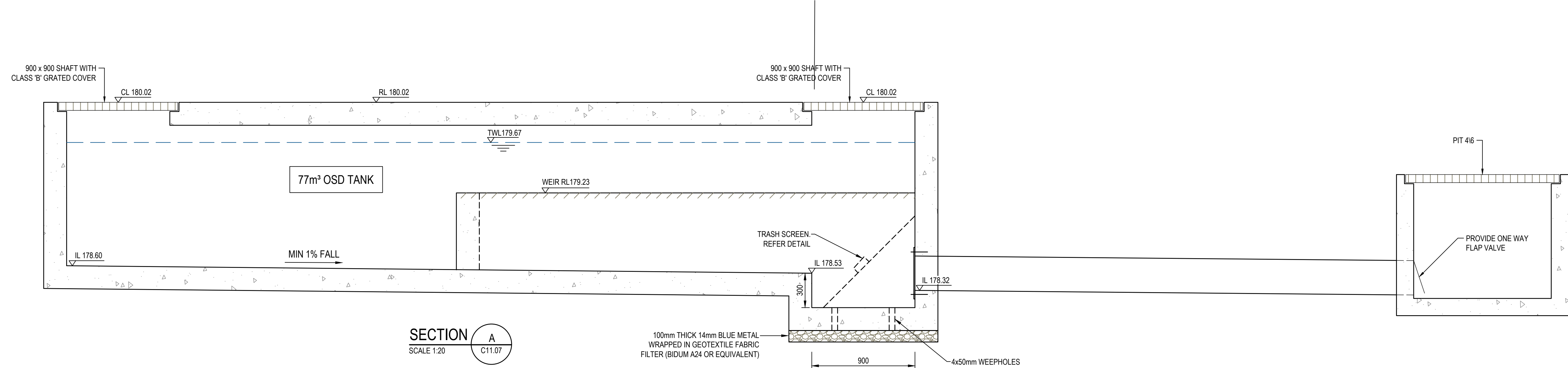
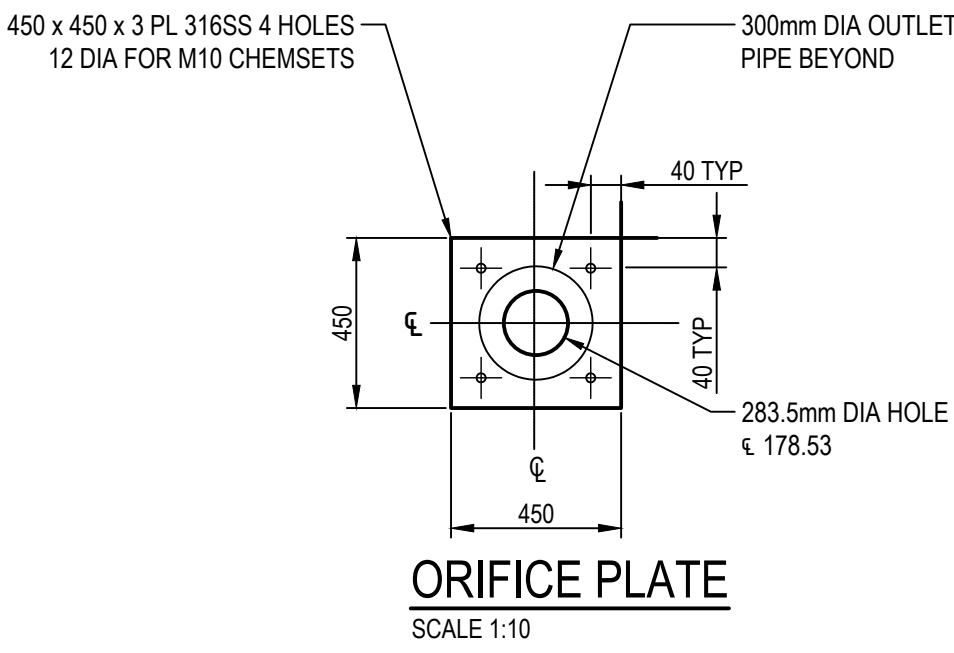
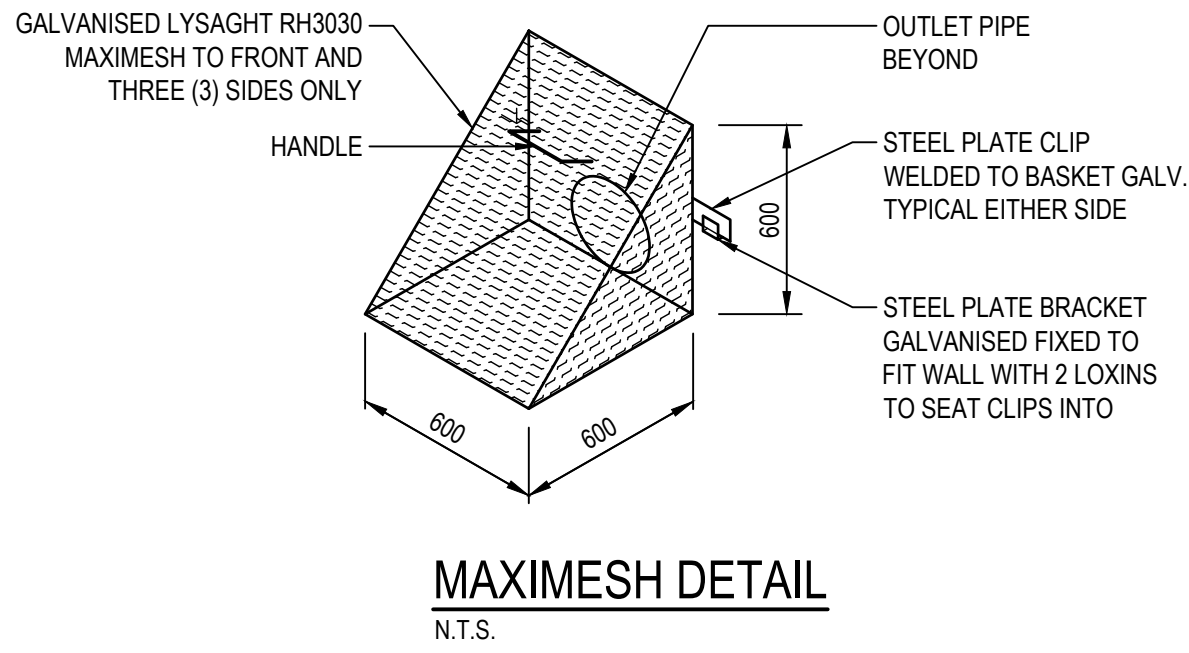
Drawn JK	Date Jan-18	Scale AS SHOWN	A1	Q.A. Check	Date
Designed MB	Project No. SY160802	Dwg. No. C11.07	Issue G		

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DESIGN CRITERIA OSD TANK	
TOTAL SITE AREA =	5545.0m²
DESIGN METHOD =	ILSAX
PRE-DEVELOPED IMPERVIOUS AREA =	38%
POST-DEVELOPED IMPERVIOUS AREA =	90.0%
5 YEAR ARI PRE DEVELOPED FLOWS (l/s) =	Q ₅ = 162
20 YEAR ARI POST DEVELOPED FLOWS (l/s) =	Q ₂₀ = 160
FLOWS BYPASSING OSD (l/s) =	Q ₂₀ = 14
PORTION OF SITE THROUGH OSD SYSTEM =	95%
STORAGE VOLUME REQUIRED =	72.0m³
STORAGE VOLUME PROVIDED =	76.8m³

OSD TABLE	
VOLUME	77.0m³
SURFACE AREA	75.6m²
AVERAGE DEPTH	1.05m



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D	ISSUE FOR DEVELOPMENT APPLICATION	18.10.19	VG	MB
Issue	Description	Date	Drawn	Approved

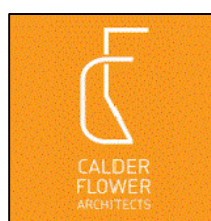
Client
Chinese Australian Services
Society Limited

44-48 SIXTH AVENUE
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FAX : 9718 6357

Architect
CALDER FLOWER ARCHITECTS
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Project
CASS ASQUITH
461-473 PACIFIC HIGHWAY
ASQUITH, NSW 2077

Drawing Title DETAILS - SHEET 4					
Drawn JK	Date Jan-18	Scale AS SHOWN	A1	Q.A. Check	Date
Designed MB	Project No. SY160802	Dwg. No. C11.08	Issue G		

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P:\2016\160802\Cass\DWG\C11.08.dwg 1:10000 21/04/21 10:08:09

PAVEMENT LEGEND

PAVEMENT TYPE 01
VEHICULAR CROSSING DESIGN CBR = 5%

DESIGN FINISHED SURFACE LEVEL

200mm THICK CONCRETE
(f_c = 32MPa) WITH SL82 TOP
AND BOTTOM (50mm COVER)

20mm SAND BINDING LAYER
(IF REQUIRED)

COMPACTED SUBGRADE

PAVEMENT TYPE 02
DRIVEWAY PAVEMENT DESIGN CBR = 5%

DESIGN FINISHED SURFACE LEVEL

180mm THICK CONCRETE
(f_c = 32MPa) WITH SL82
CENTRAL (50mm COVER)

100mm COMPACTED THICKNESS
BASECOURSE

COMPACTED SUBGRADE

PAVEMENT TYPE 03
CONCRETE FOOTPATH

DESIGN FINISHED SURFACE LEVEL

100mm THICK N25 CONCRETE WITH
SL72 MESH CENTRALLY PLACED

50mm SAND BEDDING

COMPACTED SUBGRADE

PAVEMENT TYPE 03
PERMEABLE PAVING OVER TREE ROOTS TO
LANDSCAPE ARCHITECT'S SPECIFICATIONS

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F	ISSUE FOR COORDINATION	08.07.20	ROB/VG MB
E	ISSUE FOR DEVELOPMENT APPLICATION - (ARCHITECTURAL UPDATE)	29.10.19	DW MB
Issue	Description	Date	Drawn Approved

Client

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Project

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ASQUITH, NSW 2077

Drawing Title PAVEMENT PLAN			
Drawn JK	Date Jan-18	Scale 1:200	A1
Designed MB	Project No. SY160802	Dwg. No. C12.01	Issue H

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SCHEDULE OF STORMWATER DRAINAGE STRUCTURES			
PIT NAME	PIT TYPE	PIT DEPTH	COMMENTS
01\1	GRATED DRAIN	0.35	
01\2	KERB INLET PIT - 1.8m LINTEL	0.69	PROVIDE ENVIROPOD FILTER
01\3	GRATED SURFACE INLET PIT 600 x 900	1.14	PROVIDE ENVIROPOD FILTER
01\4	GRATED SURFACE INLET PIT 900 x 900	0.78	PROVIDE ENVIROPOD FILTER
01\5	GRATED SURFACE INLET PIT 900 x 900	1.26	PROVIDE ENVIROPOD FILTER
01\6	GRATED SURFACE INLET PIT 900 x 900	1.78	PROVIDE ENVIROPOD FILTER
01\7	900 x 900 SEALED JUNCTION PIT	2.21	
01\8	900 x 900 SEALED JUNCTION PIT	2.22	
01\9	GRATED SURFACE INLET PIT 900 x 900	1.40	
01\10	900 x 900 SEALED JUNCTION PIT	1.21	
01\11	900 x 900 SEALED JUNCTION PIT	1.12	
01\12	900 x 900 SEALED JUNCTION PIT	1.21	
01\13	FILTER CHAMBER		FILTER CHAMBER
01\14	OSD TANK		OSD TANK
03\1	GRATED DRAIN	0.24	
04\1	900 x 900 SEALED JUNCTION PIT	1.38	
04\2	1200 x 1200 SEALED JUNCTION PIT	1.71	
04\3	GRATED SURFACE INLET PIT 1200 x 1200	1.41	
04\4	GRATED SURFACE INLET PIT 1200 x 1200	1.27	
04\5	GRATED SURFACE INLET PIT 1200 x 1200	1.13	
04\6	GRATED SURFACE INLET PIT 900 x 900	1.09	
06\1	GRATED SURFACE INLET PIT 600 x 600	0.59	
06\2	GRATED SURFACE INLET PIT 600 x 600	0.59	
06\3	GRATED SURFACE INLET PIT 600 x 600	0.56	
06\4	GRATED SURFACE INLET PIT 600 x 600	0.56	
06\5	600 x 600 SEALED JUNCTION PIT	0.59	
06\6	600 x 900 SEALED JUNCTION PIT	0.88	
06\7	900 x 900 SEALED JUNCTION PIT	1.03	
07\1	GRATED SURFACE INLET PIT 900 x 900	0.35	PROVIDE ENVIROPOD FILTER

MINIMUM BASEMENT PUMP-OUT TANK STORAGE VOLUME TO BE 38.1m³ BASED ON THE FOLLOWING CALCULATIONS:

SURFACE AREA RUNOFF DRAINING TO BASEMENT = 232m²

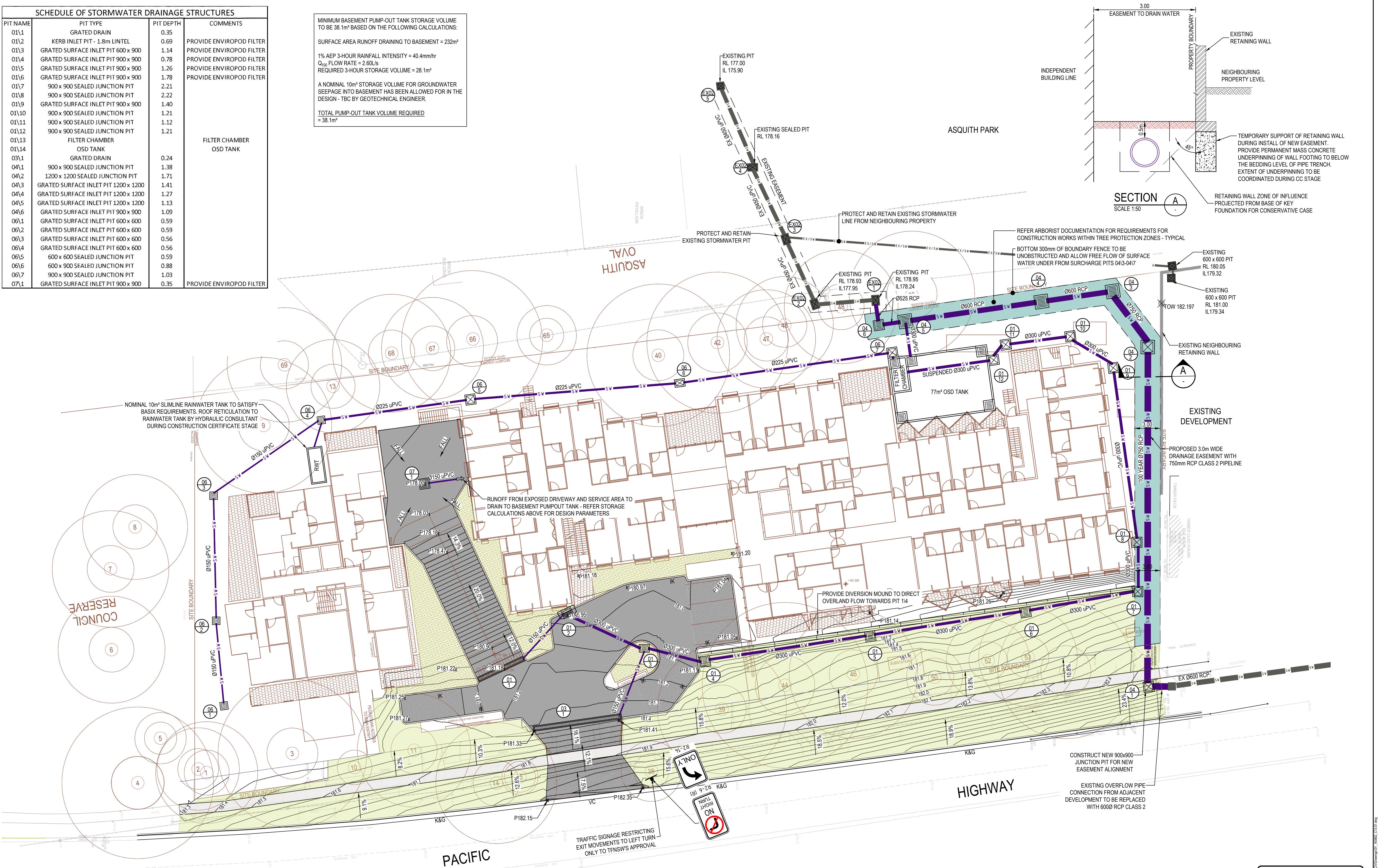
1% AEP 3-HOUR RAINFALL INTENSITY = 40.4mm/hr

Q₁₀₀ FLOW RATE = 2.60L/s

REQUIRED 3-HOUR STORAGE VOLUME = 28.1m³

A NOMINAL 10m³ STORAGE VOLUME FOR GROUNDWATER SEEPAGE INTO BASEMENT HAS BEEN ALLOWED FOR IN THE DESIGN - TBC BY GEOTECHNICAL ENGINEER.

TOTAL PUMP-OUT TANK VOLUME REQUIRED = 38.1m³



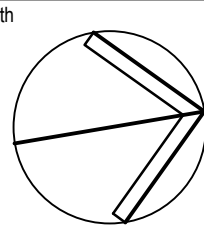
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Issue		Description	Date	Drawn	Approved
J	ISSUE FOR COUNCIL APPROVAL- DRIVEWAY SIGNAGE ADDED		30.07.20	DK	MB
H	ISSUE FOR COUNCIL APPROVAL		29.07.20	ROB/VG	MB
G	ISSUE FOR COUNCIL APPROVAL		21.07.20	ROB/VG	MB
F	ISSUE FOR COORDINATION		08.07.20	ROB/VG	MB

1cm at full scale

70mm

20mm



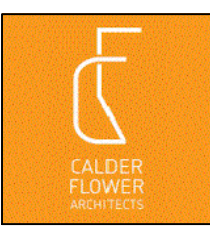
Client
Chinese Australian Services Society Limited

44-48 SIXTH AVENUE
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Architect
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2/140 MYRTLE STREET
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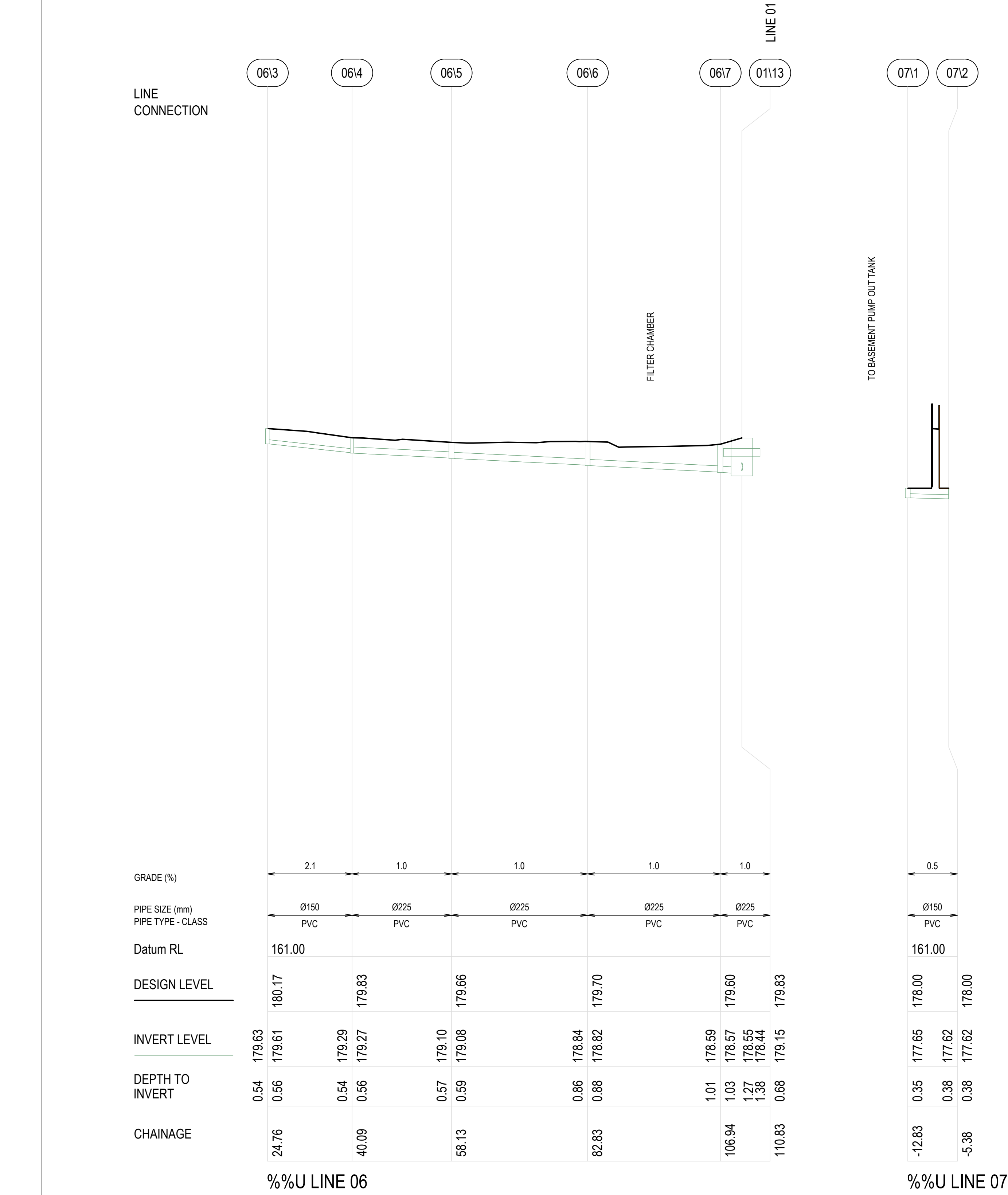
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Project
CASS ASQUITH

461-473 PACIFIC HIGHWAY
ASQUITH, NSW 2077

Drawing Title
SITE WORKS PLAN

Drawn	Date	Scale	A1	Q.A. Check	Date
JK	Jan-18	1:200			
Designed	Project No.	Dwg. No.	Issue		
MB	SY160802	C13.01	J		



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C	ISSUE FOR DEVELOPMENT APPLICATION	18.10.19	VG	MB	
Issue	Description	Date	Drawn	Approved	
					

Client
Chinese Australian Services
Society Limited

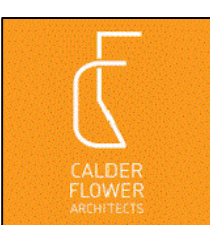
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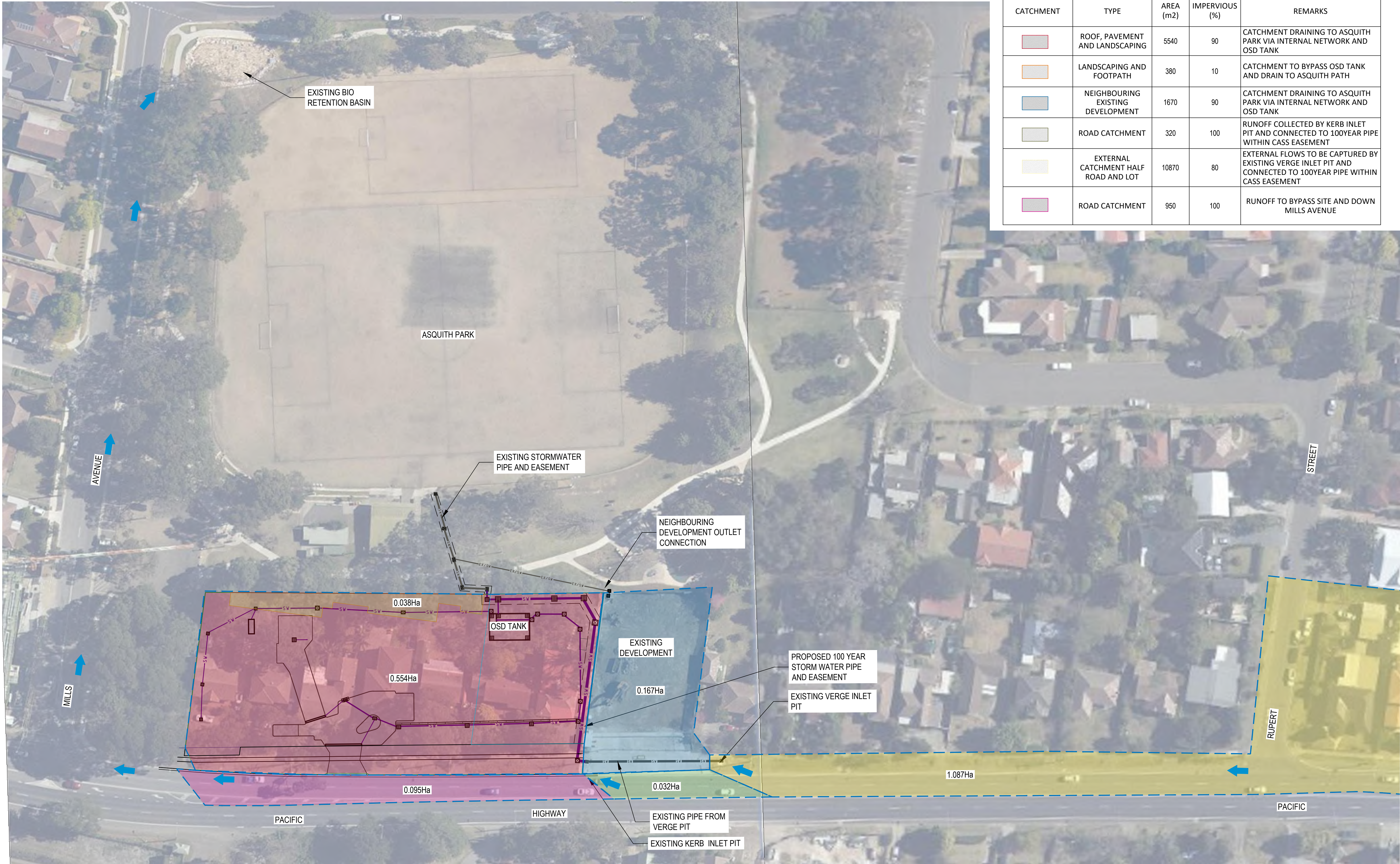
Project
CASS ASQUITH

461-473 PACIFIC HIGHWAY
ASQUITH, NSW 2077

Drawing Title STORMWATER LONGITUDINAL SECTIONS - SHEET 2					
Drawn VG	Date Sep-19	Scale AS SHOWN	A1	Q.A. Check	Date
Designed VG	Project No. SY160802	Dwg. No. C13.11	Issue F		

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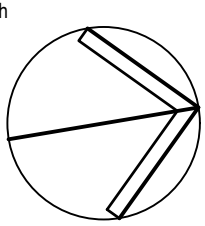
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STORMWATER CATCHMENT DETAILS				
CATCHMENT	TYPE	AREA (m2)	IMPERVIOUS (%)	REMARKS
	ROOF, PAVEMENT AND LANDSCAPING	5540	90	CATCHMENT DRAINING TO ASQUITH PARK VIA INTERNAL NETWORK AND OSD TANK
	LANDSCAPING AND FOOTPATH	380	10	CATCHMENT TO BYPASS OSD TANK AND DRAIN TO ASQUITH PATH
	NEIGHBOURING EXISTING DEVELOPMENT	1670	90	CATCHMENT DRAINING TO ASQUITH PARK VIA INTERNAL NETWORK AND OSD TANK
	ROAD CATCHMENT	320	100	RUNOFF COLLECTED BY KERB INLET PIT AND CONNECTED TO 100YEAR PIPE WITHIN CASS EASEMENT
	EXTERNAL CATCHMENT HALF ROAD AND LOT	10870	80	EXTERNAL FLOWS TO BE CAPTURED BY EXISTING VERGE INLET PIT AND CONNECTED TO 100YEAR PIPE WITHIN CASS EASEMENT
	ROAD CATCHMENT	950	100	RUNOFF TO BYPASS SITE AND DOWN MILLS AVENUE

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D	ISSUE FOR COORDINATION	08.07.20	ROB/VG	MB
C	ISSUE FOR DEVELOPMENT APPLICATION	18.10.19	VG	MB
Issue	Description	Date	Drawn	Approved



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Project
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Drawing Title
CATCHEMENT PLAN - SHEET 1

Drawn VG	Date Sep-19	Scale 1:500	A1	Q.A. Check	Date
Designed VG	Project No. SY160802	Dwg. No. C14.01	Issue F		

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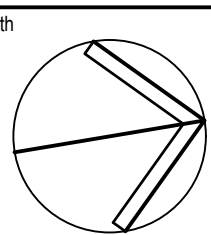
STORMWATER CATCHMENT DETAILS				
CATCHMENT	TYPE	AREA (m2)	IMPERVIOUS (%)	REMARKS
	ROOF, PAVEMENT AND LANDSCAPING	5540	90	CATCHMENT DRAINING TO ASQUITH PARK VIA INTERNAL NETWORK AND OSD TANK
	LANDSCAPING AND FOOTPATH	380	10	CATCHMENT TO BYPASS OSD TANK AND DRAIN TO ASQUITH PATH
	NEIGHBOURING EXISTING DEVELOPMENT	1670	90	CATCHMENT DRAINING TO ASQUITH PARK VIA INTERNAL NETWORK AND OSD TANK
	ROAD CATCHMENT	320	100	RUNOFF COLLECTED BY KERB INLET PIT AND CONNECTED TO 100YEAR PIPE WITHIN CASS EASEMENT
	EXTERNAL CATCHMENT HALF ROAD AND LOT	10870	80	EXTERNAL FLOWS TO BE CAPTURED BY EXISTING VERGE INLET PIT AND CONNECTED TO 100YEAR PIPE WITHIN CASS EASEMENT
	ROAD CATCHMENT	950	100	RUNOFF TO BYPASS SITE AND DOWN MILLS AVENUE

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Issue	Description	Date	Drawn	Approved

1 0 10m at full scale 20m



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Project
CASS ASQUITH

461-473 PACIFIC HIGHWAY
ASQUITH, NSW 2077

Drawing Title
CATCHMENT PLAN - SHEET 2

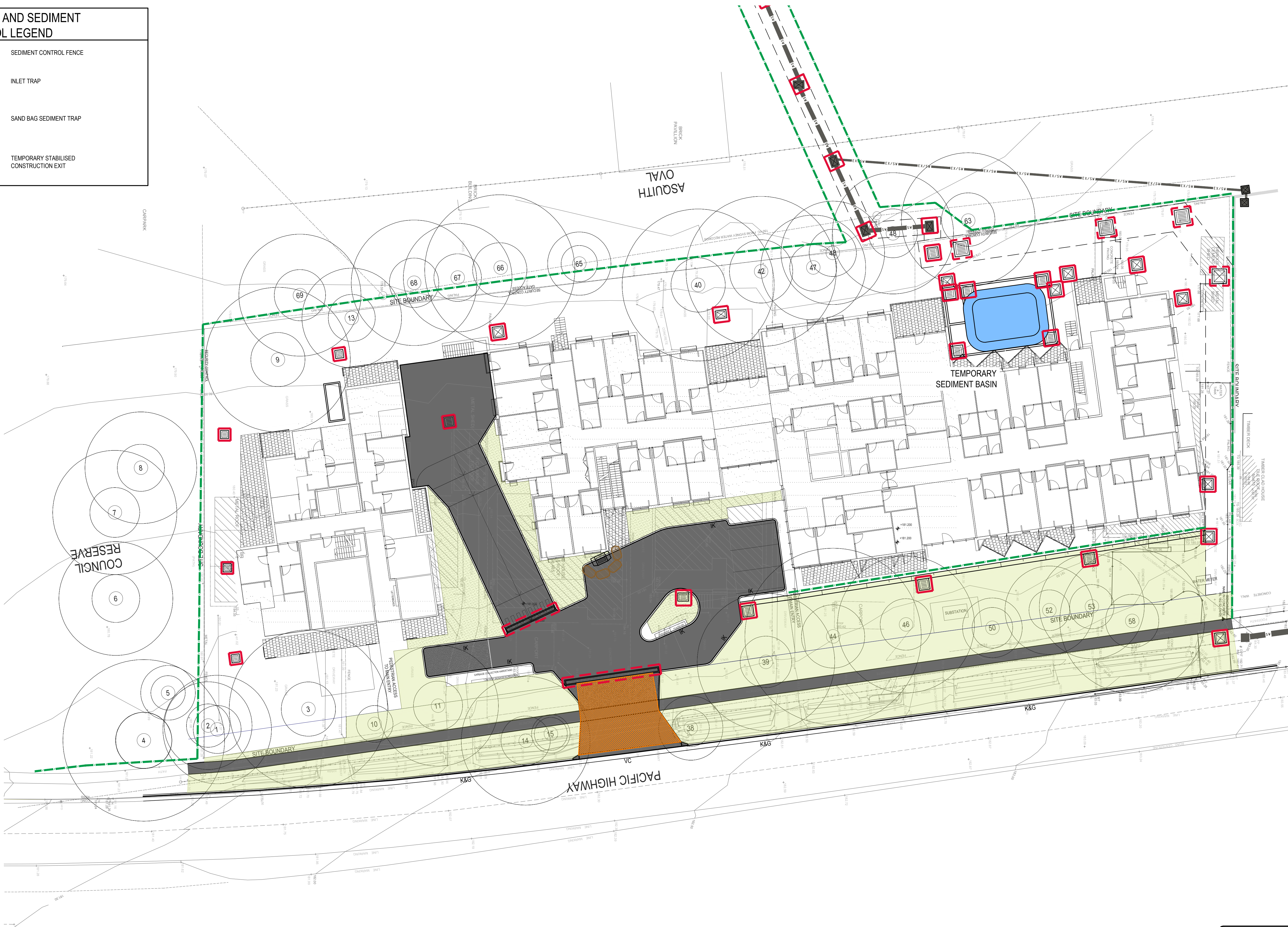
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Designed VG	Project No. SY160802	Dwg. No. C14.02	Issue F		

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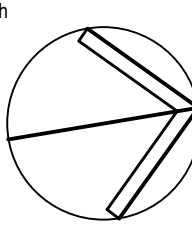
SOIL EROSION AND SEDIMENT CONTROL LEGEND

- SEDIMENT CONTROL FENCE
- INLET TRAP
- SAND BAG SEDIMENT TRAP
- TEMPORARY STABILISED CONSTRUCTION EXIT



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E	ISSUE FOR COORDINATION	08.07.20	ROB/VG MB
D	ISSUE FOR DEVELOPMENT APPLICATION	18.10.19	VG MB
Issue	Description	Date	Drawn Approved



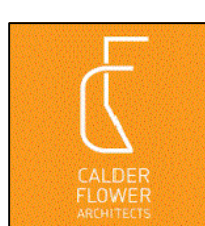
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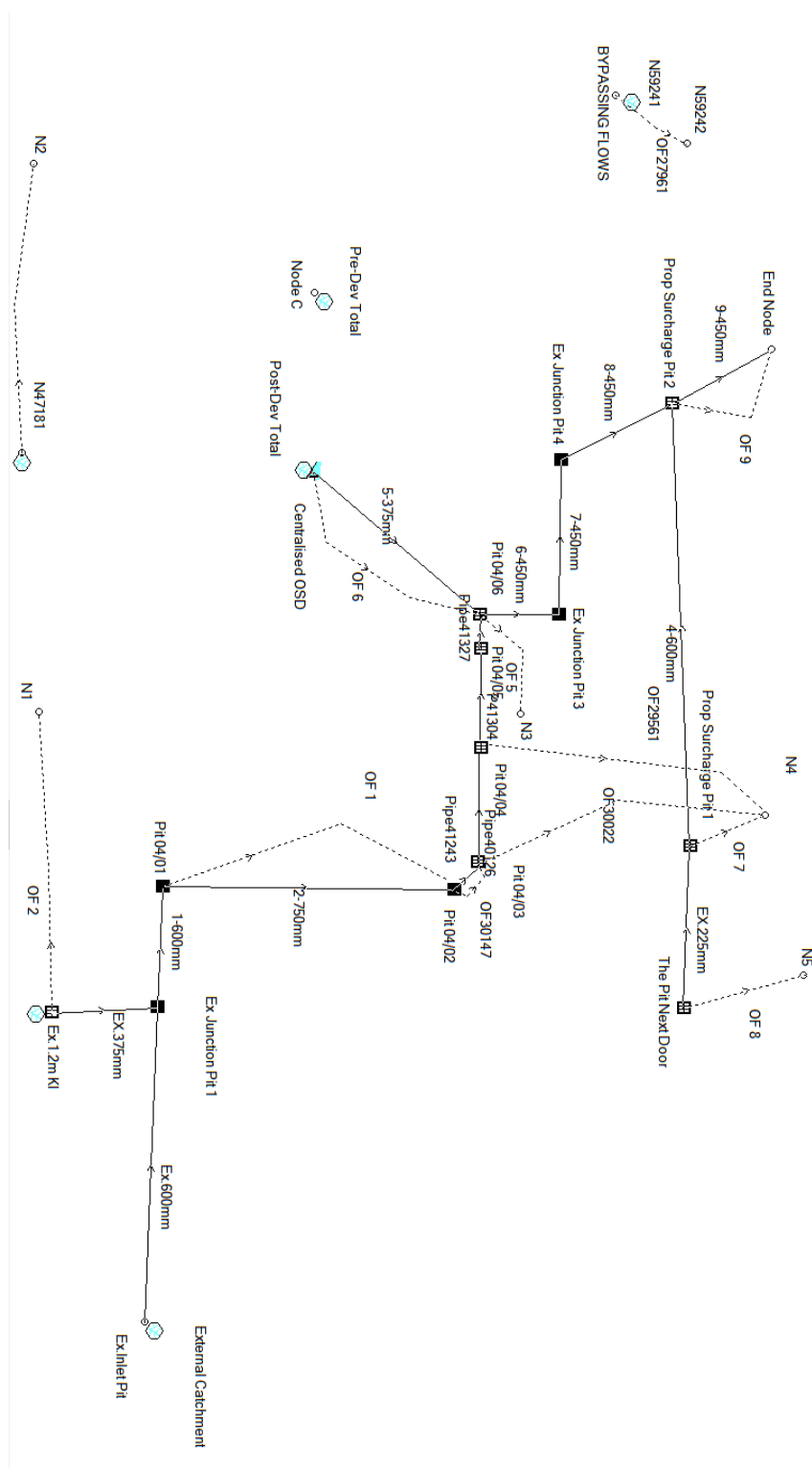
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ASQUITH, NSW 2077

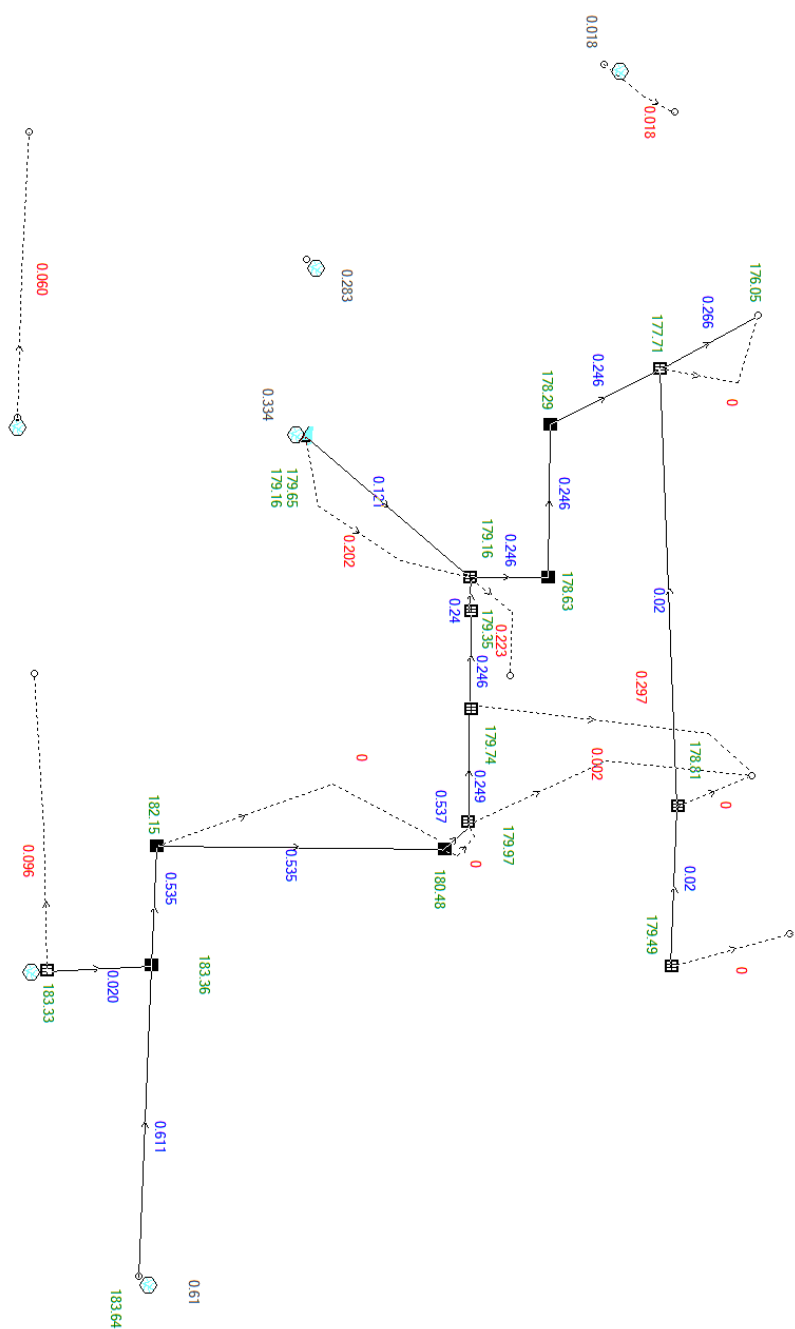
Drawing Title SOIL EROSION AND SEDIMENT CONTROL PLAN			
Drawn JK	Date Jan-18	Scale A1	Q.A. Check Date
Designed MB	Project No. SY160802	Dwg. No. C15.01	Issue G

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Appendix B

DRAINS Model Set-Up and 1% AEP Results





Appendix C

Hornsby Council Letter dated 21 December 2017

Matthew Buttarelli - ACOR

From: Erin Dethridge <edethridge@urbis.com.au>
Sent: Thursday, 21 December 2017 1:30 PM
To: Matthew Buttarelli - ACOR; Bradley Martin - ACOR
Cc: Paul Myers
Subject: RE: Seniors Living - 461-473 Pacific Highway, Asquith

Follow Up Flag: Follow up
Flag Status: Completed

Hi Matthew,

We have received the below response from Council for your information.

Can you please review and let us know if you have any concerns with Council's requirements?

Kind regards,

Erin

From: Garry Mahony [mailto:GMahony@Hornsby.nsw.gov.au]
Sent: Thursday, 21 December 2017 8:47 AM
To: Erin Dethridge <edethridge@urbis.com.au>
Cc: Paul Myers <PM@calderflower.com.au>
Subject: RE: Seniors Living - 461-473 Pacific Highway, Asquith

Hi Erin,

Council will require the following information to be submitted for the design and analysis of civil road and drainage works in the Pacific Highway road reserve in support of a development application for a Seniors Living Development at the above address.

1. The design and analysis shall be undertaken for two scenarios being:
 - (a) In the short term assuming that the subject site is the only development with kerb and gutter being constructed only fronting the development site.
 - i) A grated gully pit shall be provided in the kerb and gutter alignment to collect flows from the road pavement and connecting to the existing Council pipe draining through the site. The pipe alignment shall be upgraded to minimise the hydraulic losses in the existing pipe bends.
 - ii) The Council pipe shall be analysed to ensure sufficient capacity to cater for the 20 year ARI flows.
 - iii) The existing table drain shall be removed in front of the development site and a new inlet pit constructed over the existing pipe upstream of the development to collect the existing flows in the table drain.
 - iv) The sag in the nature strip fronting the development site shall be removed with continuous grade to the intersection with Mills Avenue.
 - v) Calculations shall be provided to demonstrate that a minimum 300mm freeboard is provided at the front boundary alignment to direct the overland flow along the nature strip to Mills Avenue assuming the pipe is fully blocked. The overland flow shall analyse any surcharging of pits that may contribute to the overland flow. A minimum 300 mm freeboard is also required at the driveway locations.

- vi) The cross fall in the footpath shall be graded away from the properties.
- (b) The long term scenario where kerb and gutter is constructed along the full frontage up to Rupert Street.
 - i) The table drain is completely removed with sufficient collection pits along the nature strip provided to capture runoff from the low level footpath (if required).
 - ii) Design and analysis of the overland flow path with sufficient free board of 300mm along the property boundaries to contain the overland flow within the nature strip. A minimum 300mm freeboard is also required at the driveway locations.
 - iii) Council will require that any future developments upstream of the subject site to provide kerb and gutter and therefore the only contributing flows in the nature strip is generated along the footpath. This will require the junction pit in front of the subject site to have fully sealed bolt down lids.

2. I refer to the information provided by the Project Engineer and provide the following comments

- (a) The analysis by the Project Engineer has assumed that kerb and gutter will be constructed upstream of the development site to isolate the road catchment flows with the road carriageway. This would be considered the long term scenario with the design and analysis to demonstrate that there would be no surcharging of any pits in the nature strip.
- (b) The short term scenario shall be analysed by the Project Engineer as per the above requirements.

3. The design and construction of the kerb and gutter, proposed drainage system in the new kerb alignment and the drainage system under the table drain is the responsibility of the RMS to maintain. It is recommended that the RMS be consulted for their comments prior to finalising the design.

If you would like to discuss any aspect of this matter please do not hesitate to contact me on 9847 6868

Regards

Garry Mahony

Senior Town Planner | Development Assessment | Hornsby Shire Council

p 02 9847 6868 **m** 0438 777 572

e gmahony@hornsby.nsw.gov.au | **w** hornsby.nsw.gov.au | **f** [facebook.com/HornsbyCouncil](https://www.facebook.com/HornsbyCouncil)

Council acknowledges the traditional owners of the lands of Hornsby Shire, the Darug and Guringai people.

From: Erin Dethridge [<mailto:edethridge@urbis.com.au>]

Sent: Monday, 18 December 2017 3:01 PM

To: Garry Mahony

Cc: Paul Myers

Subject: RE: Seniors Living - 461-473 Pacific Highway, Asquith

Hi Garry,

Further to my recent email, we were hoping to follow the comments from Council's engineer. We had expected to receive the comments by now.

We look forward to hearing from you at your earliest convenience.

Kind regards,

Erin

Appendix D

Hornsby Council Letter dated 16 January 2018

Matthew Buttarelli - ACOR

From: Peter Clare <PCLare@Hornsby.nsw.gov.au>
Sent: Tuesday, 16 January 2018 3:51 PM
To: Matthew Buttarelli - ACOR
Cc: Garry Mahony; Erin Dethridge; Donald Maseh; Paul Myers; Caesar Su; Andrew Lam; Chris Fraser
Subject: RE: Seniors Living - 461-473 Pacific Highway, Asquith

Hi Matthew,

I have discussed this with Garry Mahony and have done a little bit of research of this site and adjoining developments. The issue of vehicular access and street drainage issues are to be considered complex and varied.

As you may be aware Andrew Lam is the engineer looking after your project and Chris Fraser is the engineer looking after the development of the adjoining development site to the north of your site. Both these engineers have an in depth knowledge of the issues.

However both Andrew and Chris are on Annual Leave at the moment but are due back to work on the 29th and 30th of January respectively.

Considering the above it is considered prudent for both Andrew and Chris to be involved in this meeting and possibly a representative of the RMS.

Once Andrew and Chris have returned I will brief them and they will contact you.

Peter Clare

Development Engineer | Development Assessment | Hornsby Shire Council

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Council acknowledges the traditional owners of the lands of Hornsby Shire, the Darug and Guringai people.

From: Matthew Buttarelli - ACOR [mailto:MButtarelli@acor.com.au]
Sent: Tuesday, 16 January 2018 3:06 PM
To: Peter Clare
Cc: Garry Mahony; Erin Dethridge; Donald Maseh; Paul Myers; Caesar Su
Subject: RE: Seniors Living - 461-473 Pacific Highway, Asquith

Hi Peter,

Following up on previous correspondence, have you had any progress with confirming a meeting time and date with Council's engineer? We would still be available to have this meeting next Monday (22nd January) if this works with Council.

Feel free to give me a call to discuss.

Thanks,

Matthew Buttarelli | Civil Engineer



ENGINEERS | MANAGERS | INFRASTRUCTURE PLANNERS | DEVELOPMENT CONSULTANTS

ACOR Consultants Pty Ltd

Appendix E

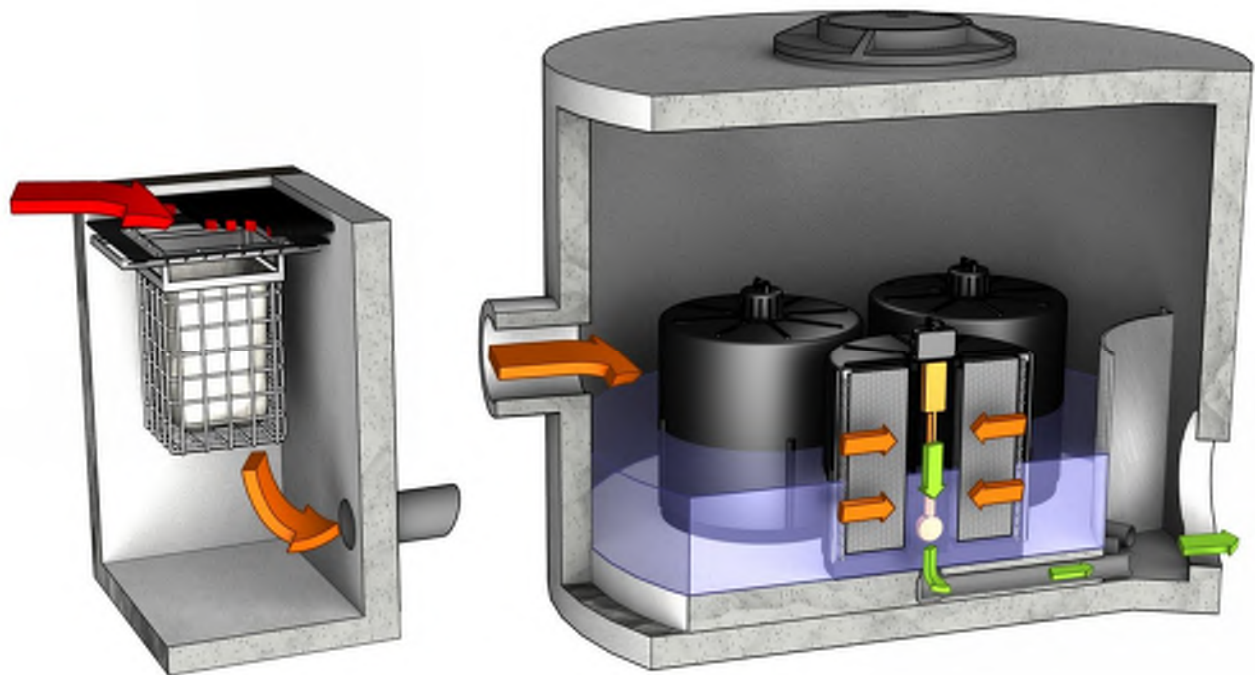
Stormwater Quality Improvement Device Maintenance and Operation Schedule

StormFilter / EnviroPod

SFEP Treatment Train

Operations and Maintenance

For: _____



Note: This guideline should be used as a part of the site stormwater management plan and is to be read in conjunction with the site specific Maintenance Schedule.



Client: _____

Contact: _____ Phone: _____

Engineer: _____

Contact: _____ Phone: _____

Address of Device: _____

Items: SFEP Treatment Train

1		
1		
2		

Frequency of Inspections and Maintenance:

	<i>Inspections (time/year)</i>	<i>Major Maintenance</i>
<i>EnviroPods</i>	2 (and after major storm)	3-4 months
<i>StormFilters</i>	1 (after 25mm rain event)	12 months

Maintenance Estimate Annual Cost:

<i>StormFilters:</i>		
<i>EnviroPods:</i>		

Treatment Train Specifications

Performance Specification

The stormwater filtration treatment train shall consist of ____ x 200 micron gully pit basket/s and ____ x 460/690mm passive, siphon-actuated, radial flow, self cleaning media filtration cartridge system/s operating at a specific flow rate of not more than 1.5L/s/m².

The gully pit basket system shall consist of the following components;

- Removable 200 micron Nylon monofilament Precision woven Filtration Bag;
- Fixed Galvanised Mesh Cage (no greater than 80mm x 80mm) around the Filtration Bag;
- Recycled modified ABS plastic to seal the unit into the pit; and
- By-pass mechanism above the Filter with no moving parts.
- System rigidly fixed to the walls of the pit.

The media filtration system shall be located within the following structure.

- Manhole;
- DownPipe;
- Linear;
- Vault;
- Large Box; and
- Detention.

Regardless of the system type, the media filtration system shall consist of the following components;

- Inlet energy dissipation;
- Cartridge section;
- Outlet section to bypass storm flows and convey treated stormwater;
- Access Lids in roof slab for access to Cartridges;
- Siphon actuated cartridges filled with proprietary ZPG™ filter media;
- Specific flow rate of each individual cartridge limited not to exceed 1.5L/s/m²;
- Air Lock Cap complete with one way Air Valve Flap;
- Outer Hood complete with Scrubbing Regulators;
- Automated high-energy turbulence on the screen face (only) at the end of storm flows to flush pollutants from the cartridge;
- Centre Drainage Tube complete with Buoyancy Float;
- Individual Cartridge Flow Restrictor Disc; and
- ¼ Turn Bayonet Fittings; and
- Under drain manifold to convey treated stormwater to the receiving environment.

The components of any proposed the treatment train or technology, including a gully pit basket upstream of a radial flow cartridge filtration system, must be evaluated for a range of pollutants and these performance expectations must comply with current best practice guidelines, ie Water by Design “MUSIC Modeling Guidelines version 1.0 2010” for South East Queensland. In short, the performance evaluation of any system must show;

- 1. Any reduction efficiencies are justified by rigorous scientific testing as determined by an independent peer reviewer and the results further peer reviewed and published in a credible scientific journal. Any potential or perceived conflicts of interest should be disclosed within the published article.**
- 2. Published article providing insight into the pollutant composition (eg. soluble vs particulate for nitrogen) and the mean concentration of inflow and outflow to compare to local and or regional conditions.**
- 3. Performance evaluation undertaken in dry weather conditions OR a method to take into account any potential leaching of nutrients that may occur in the system(s).**

4. Evaluation is conducted using full-scale systems with details of treatable flow rates sampled and how they correlate to discrete removal efficiencies and comparisons to the designed treatable flow rates of the device. A comparison should also be made to the climatic conditions especially where un-restricted filters are used.

Maintenance Overview

The primary purpose of the Stormwater Treatment Train is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the system to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance must be performed in accordance with the Treatment Trains Operation & Maintenance Guidelines.

1. INTRODUCTION

The following report details the recommended methods for cleaning and maintaining the Enviropod Stormwater Gully Pit Insert. The aspects associated with cleaning included in this manual are methods for grate removal, filter bag cleaning, unit inspection, filter bag rejuvenation and the re-installation of the filter bags. This plan should be used in conjunction with the appropriate traffic management plans and site safety plans produced for each project. Other Stormwater360 (IES) documents which IES staff should use in conjunction with this report include the IES Employee Health and Safety Manual. It is recommended that contractors develop their own health and safety plans for activities to ensure that the workers are placed in a safe work environment.



Enviropod filter in service.

Each stormwater treatment device must be inspected and maintained regularly to ensure it is working properly throughout the estimated design life. During each inspection and clean, details of the mass, volume and type of material observed should be recorded to provide ongoing data for future management plan revisions and the optimisation of the maintenance frequency. It is essential that maintenance (including inspections, recording and reporting) be carried out in a systematic manner and is carried out by qualified and experienced personnel. It is also advisable that the treatment device owner has a nominated person responsible for overseeing the management process.

Maintenance is an essential component of stormwater management enabling ongoing at source control of stormwater pollution. Maintenance will also prevent failures such as structural failure (e.g. prevents blocked outlets) or aesthetic failure (e.g. debris accumulation). All stormwater treatment devices require maintenance to ensure the ongoing performance of the system.

This document consists primarily of the processes and tasks associated with the hand maintenance and inductor maintenance procedures. It does not include detail of the traffic management requirements or occupational health and safety requirements. Contractors or IES staff should utilise their own Employee Health and Safety Manual, which details the policies and procedures for safe work.

2. Health and Safety

Cleaning of Enviropod filters and Stormfilters is a specialist activity. Material collected can be harmful if not handled correctly. Sediments may contain heavy metals and carcinogenic substances as well as harmful objects such as broken glass and syringes. It is essential that Occupational Safety and Health guidelines are followed at all times, and that the following steps are carried out to ensure safe and successful maintenance operations.

In addition to the hazards associated with the cleaning handling of material in the filter bags, there also hazards associated with traffic at the work site, the removal of the grate, pedestrians and other non-worker personnel, and general work place hazards associated with working outdoors.

The procedures indicated in the Operations section of this manual are recommend as the safest and most efficient manner in conducting the maintenance of Enviropod Units (Section 3), however contractors and cleaning staff may vary the procedure in response to the site conditions, varying work practices or general preferences in the cleaning techniques. Please note that procedures outlined in this manual are not exhaustive, and that any changes should still comply with general safe work practices.

2.1 Personnel Health and Safety

All contractors and staff shall comply with all current Health and Safety Legislation and take all practicable steps to:

- Comply with all applicable laws, regulations and standards.
- Ensure that all employees, contractors and visitors are informed of and understand their obligations in respect of current Health and Safety Legislation.
- Ensure that employees understand and accept their responsibility to practice and promote a safe and healthy work environment.

All relevant precautions must be taken to prevent contact with sediment and litter when maintaining filters. The following personal protective equipment (PPE) safety equipment should be worn:

- Puncture resistant gloves.
- Steel capped safety boots.
- Fluorescent safety vest.
- Overalls or similar skin protection.
- Safety apron. (if necessary)*
- Eye protection. (if necessary)*

*Higher personal safety conditions may be required when maintaining units that may contain more hazardous material, for example pits where syringes have be observed or pits located in areas associated with such activities.

2.2 Traffic Control

All stormwater collection pits are typically situated either in/on roads and car parks or adjacent to roads in the footpath or swales. Traffic control requirements at each of these locations is typically the same, with most of the state and local road authorities requiring the same controls implemented whether the work is to be conducted on the road or on the road reserve.

As traffic requirements vary based on the road usage and the specific road configuration, traffic control plans should be prepared for each site. Given that maintenance is typically a quick process, the contractor should liaise with the relevant road authority to determine the specific road safety requirements for each location to ensure that on site workers can conduct the cleaning operations safely and efficiently, while complying with all laws and regulations.

NSW RTA working on roads safety manual indicates the signage requirements, placement of barricades or witches hats and the positioning of traffic control personnel. In addition to standard safety requirements IES

recommends that the maintenance vehicle be used to increase safety, through shielding the work area from oncoming traffic.

Plate 1 indicates the vehicle placed to shield the work area with cones placed around the vehicle. Plate 2 indicates at head on view, note the vehicle is positioned to allow access to the drive, whilst still blocking the pit from on-coming traffic. The vehicle has a flashing light on the roof and the hazard lights switched on.



Plate 1 Vehicle positioned near pit, preventing traffic from passing close to the pit.



Plate 1 Head-on view, indicating the placement of the vehicle near the pit.

2.3 Confined Spaces

Confined spaces poses a serious safety hazard for all personnel, however during the normal maintenance procedures there should be no reason to enter a confined space. All maintenance procedures are able to be conducted from the surface. Confined space entry procedures are not included as part of this manual, for IES employees confined space entry procedures are included as part of the IES Safety Manual. It is recommend

that all contractors evaluate their own needs for confined space entry and compliance with Occupation Health and Safety regulations.

When repairs or maintenance activities cannot be conducted from the surface, the contractor/cleaner should evaluate the need to enter the confined space, considering all alternative options. Where there is a need to proceed in a confined space, only staff with current confined space training shall operate in a confined space. Appropriate measures and controls shall be put in place to meet confined space entry requirements. Safety equipment must be worn where deemed necessary and where gas or oxygen hazard occurs, staff trained in its use will only use BA gear. **Non-trained staff must not go into confined spaces.**

3. Operations

This section details the specific activities required to clean the Enviropod units. Please note it has been written for use by someone who has never encountered a stormwater pit or an Enviropod unit, providing a step by step process for each of the cleaning stages.

3.1 Maintenance & Monitoring of Enviropod filters

To ensure that the unit performs optimally, the material collected by the filter bag should be emptied when the level of material is no more than approximately **half to two thirds** of the total bag depth or when there is evidence of material overflow. Although the bag has greater storage area, it is recommended that it is not left to fill completely prior to emptying, for the following reasons; the bags are capable of retaining a heavy mass of material (in excess of 50kg); material near the top of the bag can be resuspended during high to extreme rainfall events; and blockage of the overflow sections can occur, when material is allowed to build up above the filter bag.

It is also recommended that additional monitoring should be conducted following moderate to extreme rainfall events, in particular, when preceding months have had little to no rainfall. This monitoring is considered necessary to accommodate for higher volumes of runoff generated during major rainfall events, an anticipated greater accumulation of surface contamination during low rainfall periods and to ensure that the units have not been damaged due to high pipe velocities.

3.2 Stormwater Pit Cover Removal

3.2.1 Hinged Pit Grates

To open a hinged pit grate follow the following steps:

1. Insert the lifting hooks beneath the grate. (Position indicated in Plate 2)
2. Check hinge point is not damaged and debris is not caught in the hinge area.
3. Note many cast iron hinges are not hinged securely (to enable the removal of the grate). This may result in the pit grate not being able to sit in an open position. Additionally the hinge pins may also be damaged or corroded, which may allow for the pit grate to fall into pit. Such pit grates can be removed using the method indicated below for non-hinged grates.
4. Fully open pit grate, ensuring that the grate will stay in the open position without any external forces applied. Grates which do not remain open without being held should be removed or secured during cleaning or maintenance activities. Plate 3 and Plate 4 indicate the grate being opened and grate resting freely in the open position, respectively.



Plate 2 Lifting the grate



Plate 3 Opening Grate



Plate 4 Fully open grate



Plate 5 Lowering grate

3.2.2 *Non-Hinged Pit Grates*

To remove a non-hinged pit grate:

1. Place lifting hooks beneath grate, where possible in the four corners of the grate (Plate 6). Concrete lids may have Gatic lifting points, a key arrangement or holes in the lid, as such special equipment, such as Gatic lifters may be required.
2. Position each person either side of the grate. (Plate 7)
3. Lift the grate, ensuring that good heavy lifting posture is used at all times.
4. Place the grate on an angle on the gutter, to allow for the lifting hooks to be removed. (Plate 8)
5. For extremely heavy one piece grates and concrete Gatic covers, insert the lifters in place and slide the lids back. Note some lids may still require two people. (Picture required)



Plate 6 Insert hook near edge of grate



Plate 7 Position each lifter either side of the grate



Plate 8 Lift grate and move grate to one side



Plate 9 Lift grate above the support frame



Plate 10 Reinstated non hinged grate

3.3 Cleaning Methods

One of the following methods of maintenance should be used for the servicing of these Enviropod Filters:

- Hand Maintenance.

3.3.1 Cleaning using Inductor Truck

The following steps indicate a safe and efficient method to clean the Enviropod using an Inductor:

1. Open gully pit. (See Section **Error! Reference source not found.**)
2. Place the inductor hose over the material collected in the filter bag and switch on the inductor.
3. Using the inductor hose suck all of the sediment, organic leaf material, litter etc., collected in the filter bag
4. Allow the filter bag to be sucked up into the inductor hose for a few seconds to allow for the filter mesh pores to be cleaned. Care is to be taken by the operator not to damage the filter, i.e. ensure that there are no sharp edges on the inductor hose.

5. If material has built up around the overflows, use the inductor hose to clear the accumulated material.
6. Remove filter bag from the pit.
7. Sediment retained in the gully pit grate is to be removed.
8. Back opening channels are to be cleared of any debris to ensure flow is not hindered. Debris can be collected using the inductor truck.
9. All gully pit waste is to be removed from the pit.
10. Check the Enviropod unit. (See Section 0)
11. Check filter bag. (See Section 0)
12. Reinstall filter bag and gully pit lids.



Plate 11 Cleaning an Enviropod using the inductor method

Gully pit sediments under no circumstances are to be backwashed into the gully pit.

3.3.2 Hand Maintenance

The following steps indicate a safe and efficient method to clean the Enviropod manually by hand:

1. Open gully pit. (See Section **Error! Reference source not found.**)
2. Place the lifting hooks in the lifting loops of the filter bag. (See Plate 12)
3. For extremely heavy and overfilled bags either use a hydraulic lifting arm to lift the bag, or remove excess material using a shovel or similar piece of equipment. IES prefers the use of a post hole shovel, due to the reduced strain on the back when digging and the ability of the shovel to grab material vertically. (Insert Picture)
4. Lift the bag vertically off the supporting frame, ensuring that no undue pressure is placed on the filter bag. (See Plate 13)
5. Lift the bag clear of the stormwater pit. (See Plate 14)
6. Position the bag over the truck or other collection vehicle, taking hold of the loops at the base of the bag. (See Plate 15 and Plate 16)
7. Lift and empty the filter bag by holding the bottom lifting loops only. (See Plate 17)
8. Completely empty the filter bag. (See Plate 18)
9. Brush the filter bag with a stiff brush to remove bound sediment from the filter pores. (See Plate 19)
10. Check the filter bag. (See Section 0)
11. Check the Enviropod unit. (See Section 0)
12. Reinstall filter bag, ensuring bag is installed the correct way. (See Plate 20 and Plate 21)

13. Reinstate gully pit lids. (See Plate 22 and Plate 23)



Plate 12 Place the lifting hooks through the bag loops



Plate 13 Lift the bag from the cage and support frame



Plate 14 Lift the bag from the stormwater pit



Plate 15 Lift the bag onto the collection vehicle



Plate 16 Grab the bottom lifting loops



Plate 17 Lifting the bottom bag loops empty the filter bag



Plate 18 Completely empty the contents of



Plate 19 Brush the pores filter bag with a

the filter bag

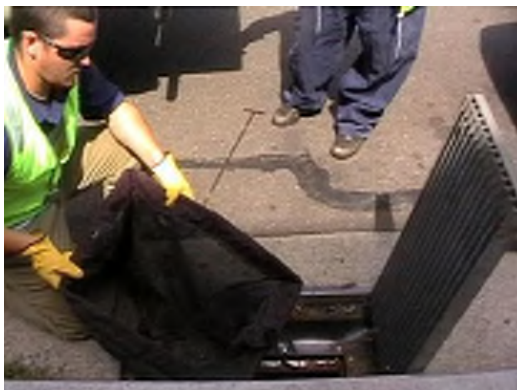


Plate 20 Reinstall filter bag

stiff brush



Plate 21 Ensure that the unit is positioned correctly, with the lifting loops on the inside



Plate 22 Correctly installed filter bag



Plate 23 Installed filter bag and sealed pit

3.4 Unit Inspection

After the Enviropod filter bag is removed, emptied and cleaned, the following should be checked to ensure that the unit has not been damaged:

- All connections and joints should be checked and broken rivets replaced (See Plate 24);
- The plastic pit seals should be inspected for unit movement or damage (See Plate 30); and
- The cage should be inspected for damage or movement (See Plate 31).

The overflow diversion channels, and the area between the Enviropod cage and pit wall should also be inspected for the accumulation of debris. Any observed debris should be removed and disposed of off-site. Accumulated material within the outlet pipe may need to be flushed.

Note: If the units are not cleaned regularly the mobilisation of material collected in the Enviropod unit may occur, as such cleaning of the units in accordance with this management plan is required. As this plan is based on observations and data collected during the monitoring period, ongoing adjustment of the cleaning frequency is generally required to improve the overall efficiency in the removal of collected material and prevent material overflow.



Plate 24 Check seals are pushed against the pit walls

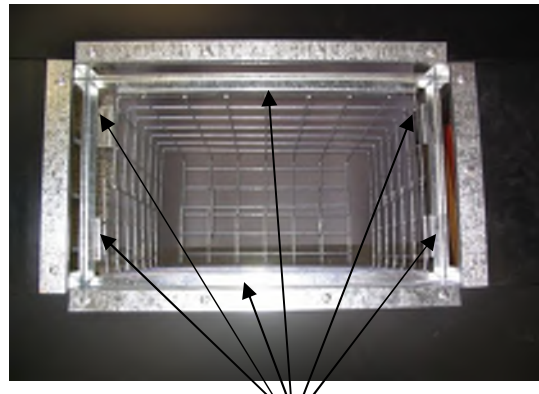


Plate 25 Check joining rivets (two piece unit shown above)

3.5 Filter Bag Inspection and Rejuvenation

Following the emptying and cleaning of the filter bags, the filter bag should be inspected to evaluate the bag condition. Given the nature of stormwater the filter bag from some Enviropod units can become considerably clogged with fine sediment. Filters can also be damaged by various objects in stormwater as well as fauna. Sharp objects such as sticks combined with high velocity water and a large mass in the filter bag can cause small tears in the filter material. Animals such as rats have also been known to chew through fine mesh filter bags located in gully pits near takeaway food outlets.

3.5.1 Clogged Filters

Clogged filter bags can be clean using several different methods. If the bag cleaning techniques described in the general maintenance sections above are not able to clean the filter bags the following options should be considered:

- Using a stiff brush and a bucket of soapy water scrub the filter bag surface.
- Remove filter bags from the pit and wash the bags using a high pressure water spray. Care has to be taken to not transfer the contamination elsewhere. Waste water from the process should be collected of and disposed of correctly.
- Remove the filter bags from the pits and the support rings and wash the bags in an industrial washing machine.

The final option presented above typically results in the bags appearing like new, with no visible stain or pore clogging within the filter mesh.



Plate 26 Slightly clogged filter bag, indicated by the brown stain on in the centre of the bag



Plate 27 A clean used filter bag

3.5.2 Damaged Filters

Damaged filters can often be repaired, provided the damage is small. Small tears in the fabric may occur do to several reasons, however the overall strength & structure of the nylon fabric typically prevents small tears becoming much larger. Although the bag is unlikely to tear further care must be used when clean torn bags as not to spill the collected material into the pit.

Small tears maybe repaired by either sewing the tear back together, with additional fabric to increase the strength of the stitching, or by sewing a patch of the filter material onto the filter bag. The filter bags may need to be replaced if large tears are present, as the filter bag is no longer able to function as intended.

3.6 Disposal of Material

All gully pit wastes from the site are to be taken off site and disposed of at a transfer station or similar approved disposal site. Stormwater Sediments can contain Lead, Copper, Zinc, Mercury, hydrocarbons and PCBs, which are harmful to both humans and the receiving environment. Appropriate sampling and laboratory analysis may be required to classify the material as suitable for reuse, or disposal under appropriate local guidelines.

4. Emergency Procedures

4.1 Spill Procedures

In the event of a spill discharging into any gully pit all sediment is to be extracted and the filter bags are to be removed and replaced with rejuvenated filter bags. Normal operation procedures apply to additional cleaning as a result of spills.

4.2 Blockages

In the unlikely event of surface flooding around a gully pit fitted with an Enviropod the following steps should be carried out:

Check Enviropod over flow bypass. The Enviropod filter has been designed with an overflow mechanism built into the filter box. If surface flooding still exists check the overflow slots underneath the rubber seal. If debris is lodged in the overflow slots these can be easily cleared by hand or steel rod.

If overflow is clear and surface flooding still exists remove Enviropod and check outlet pipe for blockages.

Removal of the Enviropod may be difficult if the filter is clogged and the Enviropod is holding water. If the filter is clogged, brush the side walls of the filter with a yard broom or similar. This will dislodge particles trapped at the interface allowing contained water to flow through the filter.

If the outlet pipe is blocked, it is likely that a gully sucker truck will be required to unblock it. Debris should be removed from the Enviropod with the gully sucker truck before removal of the Enviropod filter.

If a gully sucker truck is not available and the Enviropod needs to be removed by hand, follow the steps below:

- Remove excess debris by hand or brush the side of the filter.
- Lift and place filter ring through the filter box and into cage.
- Remove Filter box.
- Lift cage containing filter bag and ring out of the pit.
- Unblock outlet pipe.

SECTION 1

1.1 DESCRIPTION

StormFilter is a passive, flow-through stormwater filtration system. It consists of vaults that house rechargeable cartridges filled with a variety of filter media. The filter systems are installed in-line with storm drains. The StormFilter works by passing stormwater through media-filled cartridges, which trap particulates and adsorb materials such as dissolved metals and hydrocarbons. After being filtered through the media, the treated stormwater flows into a collection pipe or discharges into an open channel drainage way. StormFilter is offered in three different configurations: cast-in-place, precast and linear. The precast and linear models utilize pre-manufactured vaults. The cast-in-place units are customized for larger flows and may be either covered or uncovered underground units.

1.2 OPERATION

1.2.1 Purpose

The StormFilter is a passive stormwater filtration system designed to improve the quality of stormwater runoff from the urban environment before it enters receiving waterways.

Through independent third party studies, it has been demonstrated that the StormFilter is highly effective for treatment of first flush flows and flow-paced flows during the latter part of a storm. In general, StormFilter's efficiency is highest when pollutant concentrations are highest. The primary target pollutants for removal are: sediments (TSS), soluble metals, soluble phosphorus, nitrates, and oil and grease.

1.2.2 Sizing

The StormFilter® is typically sized to treat the peak flow of a water quality design storm as it passes through the filter. The peak flow is determined by calculations based on the contributing watershed hydrology and using a design storm magnitude. The design storm is usually based on the regulatory requirements set by the local stormwater management agency. The particular size of a StormFilter is determined by the number of filter cartridges (see Figure 4) required to treat the peak stormwater flow. Each cartridge is designed to treat a peak flow of 1 Litre/second. For example: a peak design stormwater flow rate of 10L/s would require that 10 cartridges be used in the treatment vault.

Because of the highly porous nature of the granular filter media, the flow through a newly installed cartridge is restricted to 1L/s, using a restrictor disc, to ensure adequate pollutant-media contact time.

1.2.3 Basic Function

The StormFilter is designed to siphon stormwater runoff through a filter cartridge containing media. The variety of media available can be designed to act as a mechanical filter to remove sediments, as an ion exchanger to remove dissolved heavy metals, and as an absorber to remove oils and greases.

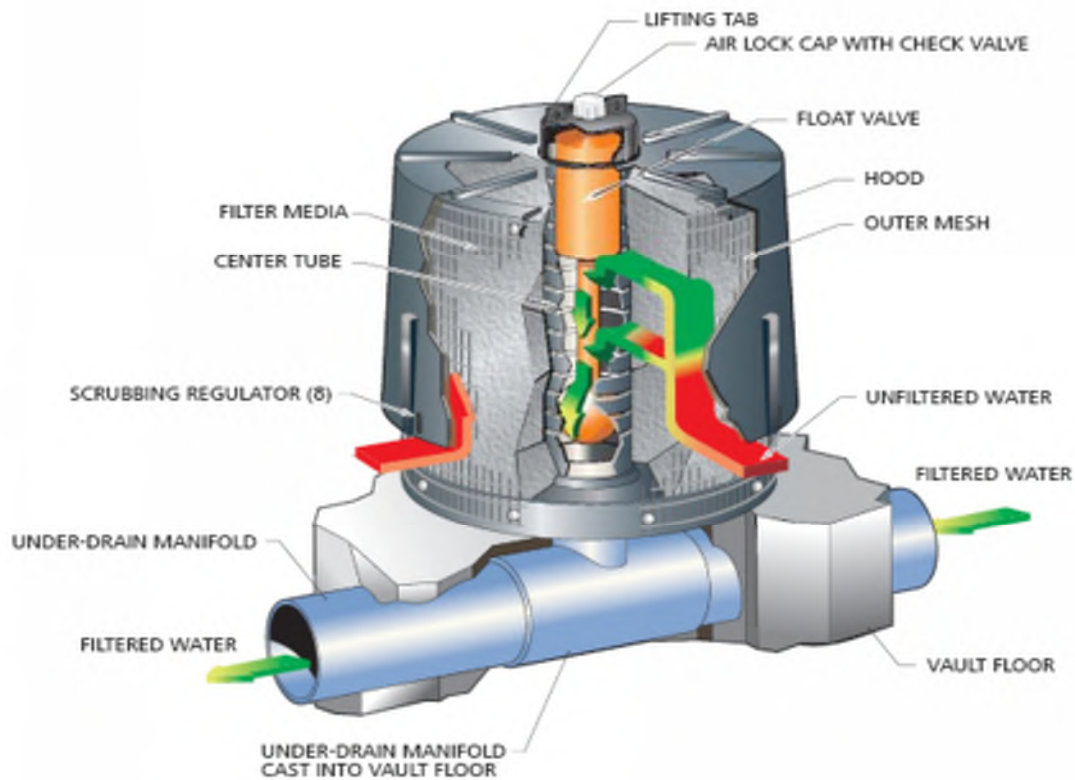


Figure 4. Filter Cartridge

1.2.4 Priming System Function

The treated stormwater collects in the centre tube of the cartridge, which is equipped with a self-priming siphon system. Figure 1 illustrates this system. The key component of the system is the plastic float. The float consists of a ball located at the base leading up to a larger portion, which provides increased buoyancy. Initially the ball rests in a seat effectively closing off the port to the drainage manifold.

As a result, the filter fills the centre drainage tube until the water level has risen high enough to purge the air from the filter cartridges and displaces the float. At a water depth of 22 inches the float pulls loose and allows the filtered water to drain out through the manifold. This effectively "primes" a siphon within the drainage tube and greatly increases the potential across the filter. The priming system increases StormFilter's ability to be loaded with sediment. A related feature is the cartridge "hood". This hood maintains the siphon effect by preventing air from being drawn into the cartridge until the external water level drops below the bottom of the hood.

Cartridges are connected to the manifold with a plastic connector. Since some media used is potentially buoyant, a threaded connector affixed to the manifold with compression bolts is necessary to ensure the cartridge isn't lifted out of place. For the heavier leaf media, a slip connector is used.

StormFilter is also equipped with flow spreaders that trap floating debris and surface films, even during overflow conditions. Depending on individual site characteristics, some systems are equipped with high and/or low flow bypasses. High flow bypasses are installed when the calculated peak storm event generates a flow that overcomes the overflow capacity of the system. This is especially important for precast systems. Low flow bypasses are sometimes installed to bypass continuous inflows caused by ground water seepage, which usually do not require treatment. All StormFilter units are designed with an overflow. The overflow operates when the inflow rate is greater than the infiltration capacity of the filter media.

1.2.5 Maintenance Overview

The primary purpose of the StormFilter is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. To assist the owner with maintenance issues, Stormwater360 provides detailed Operation & Maintenance Guidelines with each unit.

Stormwater360 can provide maintenance services completely, or in part. Available services include tracking of installed systems, advising the system's owner of maintenance needs, and notification of the regulatory agency once the system has been maintained.

Maintenance is usually performed in the dryer periods to rejuvenate the filter media and prepare the system for the next rainy period. Maintenance activities can also be required in the event of a chemical spill or excessive sediment loading due to site erosion or extreme storms. It is good practice to inspect the system after severe storm events.

END OF SECTION 1

SECTION 2

RECOMMENDED MAINTENANCE AND EXPECTED PERFORMANCE

2.1 TYPES OF MAINTENANCE

Presently, procedures have been developed for two levels of maintenance: Inspection/minor maintenance and major maintenance. Inspection/minor maintenance activities are combined since the minor maintenance does not require special equipment and typically little or no materials are in need of disposal. Inspection/minor maintenance typically involves opening the flow restricting valves (to pre-set levels) and cleanup of vegetation and debris. Major maintenance typically includes cartridge recharging. Major maintenance may involve disposal of materials that require consideration of regulatory guidelines. Depending on the particular unit configuration and equipment used, major maintenance may require an understanding of OSHA rules. Table 1 summarizes the primary activities associated with StormFilter maintenance.

Table 1: StormFilter

Facility Component Requiring Maintenance	Maintenance Activity	When Maintenance Activity Is Required	Expected Facility Performance After Maintaining
StormFilter® Cartridges and Containment Structure	Trash and Debris Removal	Floatable objects or other trash is present in the filter. Remove to avoid hindrance of filtration and eliminate unsightly debris and trash.	Permanent removal from storm system.
	Cartridge Replacement and Sediment Removal	1. Media has been contaminated by high levels of pollutants, such as after a spill.	1. New media is able to effectively treat stormwater.
Drainage System Piping	Flushing With Water	Drainage system is obstructed by debris or sediment.	Outflow is not restricted.

2.2 MAINTENANCE ACTIVITIES

2.2.1 Maintenance Activity Timing

Two scheduled inspections/maintenance activities should take place during the year. During the minor maintenance activities (routine inspection, debris removal), the type of major maintenance required is determined and, if required for disposal, samples of the sediments and media are obtained. The next scheduled date is to perform major maintenance activities (replacement of the filter cartridges and associated sediment removal). In addition to the scheduled activities, it is important to check the condition of the filter after major storms to check for damage caused by high flows and to check for high sediment accumulation, which may be caused by localised erosion in the drainage area. It may be necessary to adjust maintenance activity scheduling depending on the actual operating conditions encountered by the system.

2.2.2 Maintenance Activity Frequency

The primary factor controlling timing of maintenance for the StormFilter is sedimentation. A properly functioning system will remove solids from water by trapping these particulates within the porous structure of the media. The flow through the system will naturally decrease as more and more solids are trapped. Eventually the flow through a system will be low enough to require replacement of the cartridges. Sediment should be removed from upstream trapping devices on an as needed basis to prevent material from being re-suspended and discharged to the system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction should be inspected and maintained more often than those in fully established areas. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after large storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual filter.

2.3 MAINTENANCE CREW REQUIREMENTS

Table 4 lists the anticipated crew requirements for maintenance operations. Removal of water and sediments during major maintenance activities can be accomplished using either a pump and water truck or a vacuum truck. All applicable safety (OH & S) and disposal regulations should be followed. A general description of the maintenance activities follows.

Table 4: ANTICIPATED CREW REQUIREMENTS

	Inspection/Minor Maintenance	Major Maintenance: Sediment Removal	Major Maintenance: Cartridge Replacement
Labourer	1		1
Skilled Worker	1	1	1
Vacuum/Water Truck Operator		1	0/1
Total	2*	2*	2/3*
Special Requirements	Knowledge of Proper StormFilter Function	Knowledge of Disposal Requirements	Knowledge of Cartridge Removal and Installation Procedures

* May require OH & S trained person if/when vault entry occurs.

2.4 MAINTENANCE METHODS

2.4.1 Minor Maintenance/Inspection (Twice A Year)

Minor maintenance typically will involve the steps below, however if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

Steps for Minor Maintenance

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the doors to the vault and allow the system to air out for 5-10 minutes.
5. **Without entering the vault**, inspect the inside of the unit, including components.
6. Take notes about the external and internal condition. This includes inspecting pit penetrations, walls, lids, ladders & grates etc.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault in the forebay (or pre-treatment bay), and on top of the internal components. If flow is occurring, note the level of water and estimate the flow rate per drainage pipe. Record all observations.
8. Remove large loose debris and trash using a pole with a grapple or net on the end.
9. Close and fasten the door, and remove safety equipment.

10. Finally, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.

2.4.2 Major Maintenance Inspection (Once a Year)

The primary goal of the major maintenance inspection is to assess the condition of the cartridges relative to the level of sediment loading. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present and very little flow will be discharging from the drainage pipes. It is likely that the cartridges need to be replaced. Major maintenance inspection will typically involve the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

Steps for Pre-Major Maintenance Inspection

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the doors to the vault and allow the vault to air out for 5-10 minutes.
5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
6. Take notes about the external and internal condition.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
8. Remove large loose debris and trash using a pole with a grapple or net on the end.
9. If the visit is during a storm, make the flow observations discussed above.
10. Close and fasten the door, and remove safety equipment.
11. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
12. Review the condition reports from the previous minor and major maintenance visits and schedule for cartridge replacement if needed.

2.4.3 Major Maintenance: Sediment Removal & Cartridge Replacement (& Emergency)

Major maintenance/filter cartridge replacement typically involves the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.** Depending on the configuration of the particular system, a worker may be required to enter the vault to perform some tasks. If vault entry is required, OH & S rules for general confined space entry must be strictly adhered to. Filter cartridge replacement should occur during dry weather and it may be necessary to plug the filter inlet pipe if base flows exist. Standing water present in the vault should be regarded as polluted and contained during this operation by temporarily capping the manifold connectors.

Steps For Cartridge Replacement Maintenance

1. Depending on the particular unit, one or two utility workers and a hauling truck operator will deliver the replacement cartridges to the site. Information concerning how to obtain the replacement cartridges is available from Stormwater360.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the doors to the vault and allow the system to air out for 5-10 minutes.
5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
6. Make notes about the external and internal condition.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
8. Remove large loose debris and trash using a pole with a grapple or net on the end.
9. Ensuring safe working procedures are met, off load the replacement cartridges (16-39kgs each) and set aside.
10. Remove the top cap (threaded), upper seal and float from the cartridge. Repeat procedure for every cartridge within StormFilter vault. Place items in a large plastic container to be lifted from the vault.
Note: * Confined space entry may be required on StormFilter systems. In this case, please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 immediately.
11. Using a cordless drill and 8mm hex head, remove the three screws located around the top perimeter of the cartridge hood. Place screws in the large plastic container and, once full or completed, remove plastic container from vault.
12. Move the Vacuum truck near the StormFilter vault on the down wide side. Be sure that the Vacuum truck is not too close to the vault so as the fumes will not enter the vault. Make sure that the last 500mm of the nozzle is approx. 100-125mm in outside diameter.

13. Feed vacuum nozzle into cartridge bay and start vacuum truck. Remove cartridge hood and place nozzle directly onto filter media. Completely remove media from each cartridge and repeat process for every cartridge in vault.
14. Once completed unthread cartridges from vault floor and place hood back on cartridges
15. Using the appropriate lifting cap, attach the cable and remove the cartridge (up to 10kgs. each) from the vault. Personnel standing under suspended cartridges is strictly prohibited. Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless maintenance activities are being performed by Stormwater360 and damage is not related to discharges to the system.
16. Set the used cartridge aside or load onto the hauling truck.
17. Repeat steps 14 to 15 once all cartridges have been removed.
18. Remove deposited sediment from the floor of the vault and, if large amounts are present, from the forebay. This can be accomplished by using the Vacuum truck
15. Once the sediments are removed, it is necessary to assess the condition of the vault, particularly the manifold and the connectors. These are short sections of 2-inch schedule 50 PVC, or threaded schedule 80 PVC that should protrude above the floor of the vault. If required, apply a light coating of FDA approved silicon grease to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe. Replace any damaged connectors.
16. Using the boom, crane, or tripod, lower and install the new cartridges (typically 16-17kgs. for perlite cartridges). Once again, take care not to damage connections.
17. Close and fasten the door, and remove safety equipment.
18. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.
19. Finally, dispose of the residual materials in accordance with applicable regulations. Make arrangements to return the used cartridges to Stormwater360.

2.4.4 Related Maintenance Activities (Performed on an as-needed basis)

StormFilter units are often just one of many components in a more comprehensive stormwater drainage and treatment system. The entire system may include catch basins, detention vaults, sedimentation vaults and manholes, detention/retention ponds, swales, artificial wetlands, and other miscellaneous components. In order for maintenance of the StormFilter to be successful, it is imperative that all other components be

properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities. In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil and grease loading, and discharges of inappropriate materials.

2.5 TYPICAL EQUIPMENT REQUIRED FOR MAINTENANCE ACTIVITIES

Typical equipment required for conducting maintenance is shown in Table 5. Some of the materials listed are suggestions rather than requirements. It should be noted that there is more than one way to accomplish some tasks. Owners with available labour and equipment resources may desire to use alternative methods. However, it is advisable that guidance from Stormwater360 be obtained prior to using alternative techniques.

Table 5: MAINTENANCE EQUIPMENT REQUIREMENTS

Maintenance Equipment Required		
Minor Maintenance	Pre-Major Maintenance Inspection	Major Maintenance Cartridge Replacement
Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.	Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.	Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.
Work Clothes: Rubber boots, overalls, and gloves.	Work Clothes: Rubber boots, overalls, and gloves.	Work Clothes: Rubber boots, overalls, and gloves.
Door Bolt, Wrench, proprietary lifters (e.g. Gatic) and Miscellaneous Tools.	Door Bolt, Wrench, proprietary lifters (e.g. Gatic) and Miscellaneous Tools.	Door Bolt, Wrench, Pentasocket and Miscellaneous Tools.
Tape Measure	Tape Measure	Tape Measure
Flashlight	Flashlight	Flashlight
Grapple or Net Pole	Grapple or Net Pole	Grapple or Net Pole
Record Keeping Forms	Record Keeping Forms	Record Keeping Forms
Trash/Debris Container	Trash/Debris Container	Vacuum Truck
		Replacement Cartridges
		Cartridge Hauling Truck
		Crane, Tripod and Hoist, or Other Lifting Device (150kg minimum capacity)
		Shovels
		Extra 50mm PVC cartridge connectors
		Spare Flow Restrictor disks
		Trash/Debris Container
		Vault Inlet Pipe Plug
		Dolly
		PVC Pipe Cutter
		Ladder
		Cartridge Installation and Removal Sling

* Confined space equipment may be required for vault entry. This equipment must be used by personnel with the appropriate OH & S training. This equipment typically includes: Atmospheric testing devices, atmospheric purging and ventilating devices, and entry, exit, and rescue assisting devices.

2.6 MATERIAL DISPOSAL

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in a manner that will not allow the material to affect surface or ground water. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads. Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. It is not appropriate to discharge these materials back to the stormwater drainage system. Part of arranging for maintenance to occur should include coordination of disposal of solids (landfill coordination) and liquids (municipal vacuum truck decant facility, local wastewater treatment plant, on-site treatment and discharge). Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals. Disposal methods or reuse of the media contained in the cartridges will be determined by Stormwater360. If the material has been contaminated with any unusual substance, the cost of special handling and disposal will be the responsibility of the owner.

Enviropod Service Receipt

Site:
Contractor:
Location:
Year:

Job Number:
Receipt Number:
Week Serviced:

Service Frequency:
Enviropods on Site:

Enviropods Cleaned:
Bags Checked:
Frames and Seals Checked:
Overflows Checked
Tonnage:

If Damaged, Action:
If Damaged, Action:
If Blocked, Cleaned:

Comments

This service has been performed in accordance with Enviropod Management Plan (EMP) for above site. Please file this receipt with EMP and keep on site for compliance inspections.

Signature:

Position:

EnviroPod Maintenance Form

NOTE: See maps for detailed location.

Bag:

Client:

Date:

Project:

ENVIROPOD Sites										
Pir No.	Map No.	Location	Bag Size	Date	% Organics	% Litter	% Sediment	Fulness - F. 1/2, 1/3 or D	Notes	Grate
1										
2										
3										
4										
5										
6										
7										
8										
9										
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Sample StormFilter Minor Maintenance Inspection Data Sheet

Date: _____ **Location:** _____

System Size: _____ **TYPE:** **Cast-In-Place** **Precast** **Linear**

Personnel: _____

System Observations

Media Months in Service: _____

Oil and Grease in Forebay: _____

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged? (Yes _____ No _____) How Deep? _____

StormFilter Minor Maintenance Activities (check off if done and give description)

Remove Trash and Debris: _____

Minor Structural Repairs: _____

Drainage Area Report

Excessive Oil and Grease Loading (Yes _____ No _____) Source: _____

Sediment Accumulation on Pavement (Yes _____ No _____) Source: _____

Erosion of Landscaped Areas (Yes _____ No _____) Source: _____

Items Needing Further Work: _____

Comments: _____

Sample StormFilter Major Maintenance Inspection Data Sheet

It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present, very little flow will be discharging from the drainage pipes, and it is likely that the cartridges need to be replaced during major maintenance.

Date: _____ **Location:** _____

System Size: _____ **TYPE:** **Cast-In-Place** **Precast** **Linear**

Personnel: _____

System Observations

Media Months in Service: _____

Oil and Grease in Forebay: _____

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged? (Yes _____ No _____) How Deep? _____

Drainage Area Report

Excessive Oil and Grease Loading (Yes _____ No _____) Source: _____

Sediment Accumulation on Pavement (Yes _____ No _____) Source: _____

Erosion of Landscaped Areas (Yes _____ No _____) Source: _____

Comments: _____

Review the condition reports from the previous minor and major maintenance visits.

Sample StormFilter Major Maintenance/Cartridge Replacement Data Sheet

Date: _____ Location: _____

System Size: _____ TYPE: Cast-In-Place Precast Linear

Personnel: _____

List Safety Procedures and Equipment Used: _____

System Observations

Media Months in Service: _____

Oil and Grease in Forebay: _____

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Drainage Area Report

Excessive Oil and Grease Loading (Yes _____ No _____) Source: _____

Sediment Accumulation on Pavement (Yes _____ No _____) Source: _____

Erosion of Landscaped Areas (Yes _____ No _____) Source: _____

StormFilter Cartridge Replacement Maintenance Activities (check off it done and give description)

Remove Trash and Debris (Yes _____ No _____) Details: _____

Replace Cartridges (Yes _____ No _____) Details: _____

Sediment Removed (Yes _____ No _____) Details: _____

Quantity of Sediment Removed (estimate?): _____

Minor Structural Repairs (Yes _____ No _____) Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes/Problems: _____

Appendix F

MUSIC-Link Report

MUSIC-*link* Report

Project Details		Company Details	
Project:	SY160802 CASS Asquith	Company:	ACOR Consultants Pty Ltd
Report Export Date:	18/10/2019	Contact:	Matthew Buttarelli
Catchment Name:	SY160802_MUSIC Model UPDATED DA	Address:	33 Herbert Street, ST LEONARDS
Catchment Area:	0.569ha	Phone:	94385098
Impervious Area*:	88.06%	Email:	mbuttarelli@acor.com.au
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1981 - 31/12/1985 11:54:00 PM		
Mean Annual Rainfall:	1240mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.32		
Study Area:	Hornsby Shire Council (Quality)		
Scenario:	Hornsby Shire Council (Quality)		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Receiving Node	Reduction	Node Type	Number	Node Type	Number
Flow	0%	Generic Node	1	Urban Source Node	2
TSS	88.7%	GPT Node	1		
TP	64.4%				
TN	45.3%				
GP	100%				

Comments

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	9 x EnviroPod 200 (SFEP USE 2011B)	Hi-flow bypass rate (cum/sec)	None	99	0.18
Receiving	Receiving Node	% Load Reduction	None	None	0
Receiving	Receiving Node	GP % Load Reduction	90	None	100
Receiving	Receiving Node	TN % Load Reduction	45	None	45.3
Receiving	Receiving Node	TP % Load Reduction	60	None	64.4
Receiving	Receiving Node	TSS % Load Reduction	80	None	88.7
Urban	Bypass Area	Area Impervious (ha)	None	None	0
Urban	Bypass Area	Area Pervious (ha)	None	None	0.015
Urban	Bypass Area	Total Area (ha)	None	None	0.015
Urban	Total Site Area to OSD	Area Impervious (ha)	None	None	0.501
Urban	Total Site Area to OSD	Area Pervious (ha)	None	None	0.052
Urban	Total Site Area to OSD	Total Area (ha)	None	None	0.554

Only certain parameters are reported when they pass validation

