Stormwater Management Report

United Cinemas, Gregory Hills

80218030 - 17 - 0444

Prepared for

Planet Warriewood Ltd Mustaca Family Trust

7 December 2017

Cardno

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1 Introduction

Cardno (NSW/ACT) Pty Ltd has been commissioned by Planet Warriewood Pty Ltd to report on the stormwater management strategy for the proposed cinema and commercial development at Lot 601 within Central Hills Business Park, Gregory Hills. This report has been prepared in support of a Development Application to be lodged with Camden Council.

The stormwater management for the proposed cinema and commercial development has been designed in accordance with Central Hills Business Park stormwater management strategy, Camden Council Engineering Design Specification and includes:

- On-site detention tank to control the quantity of post-development stormwater runoff;
- Stormwater treatment train to control the quality of the stormwater runoff; and
- Pit and pipe drainage network to convey runoff from 10% AEP storm event.

1.1 External Reports/Studies

This report shall be read in conjunction with the following documents;

a) Lot 601 Central Hills Business Park, Development Application Civil Engineering Assessment prepared by Cardno, August 2012;

b) Central Hills Business Park, Stage 3 and 6 Construction Certificate Stormwater Management Plan prepared by Cardno, September 2011;

c) Camden Council Engineering Design Specification; and

d) Civil Engineering drawings prepared by Cardno (80218030-SK001 to 80218030-SK003).

2 The Development Site

2.1 Existing Catchment and Drainage

The proposed development is located within Lot 601 of the Central Hills Business Park. A development application for a commercial development for the site was submitted to Council in 2012. Subsequently, the southern section of the lot has been developed with a number of retail shops and carparking. The stormwater runoff from the existing development on the southern section of the site drains to the on-site detention tank located in the south eastern corner of the site before discharging into the existing stormwater drainage network in Rodeo Road.

The northern section of the site has total site area of 4.1ha and the proposed development site has an area of 2.79ha. The location of the proposed development site is shown in **Figure 2-1**. The site has a 1% fall towards Lasso Road and Central Hills Drive, grass cover has been laid on the site for sediment and erosion control since the completion of the bulk earthwork.

Figure 2-1 Site Location

2.2 Proposed Development and Drainage Network

The proposed commercial development is located within the north western section of Lot 601 and is bounded by:

- Lasso Road to the north and west;
- Future commercial development to the east; and
- Existing carpark and Steer Road to the south.

The site will consist of a cinema, commercial space, a multi-level carpark and also includes:

a) New site entries from Steer Road and Lasso Road to the proposed loading docks and carpark; and

b) An on-site detention tank with stormwater treatment devices in the north eastern corner of the development site.

Generally, the stormwater runoff from the proposed development site will be drained to the proposed OSD tank for stormwater treatment and to ensure the post-development stormwater peak flows do not exceed the pre-development peak flows. In order to provide a smooth interface between the proposed development and the existing levels in Lasso Road, the landscaping area will bypass the proposed OSD tank and sheet flow across the site boundary onto Lasso Road. The development site is divided into 4 sub-catchments based on the land use and the proposed grading of the site. Figure 2-2 presents the post-development catchment plan.

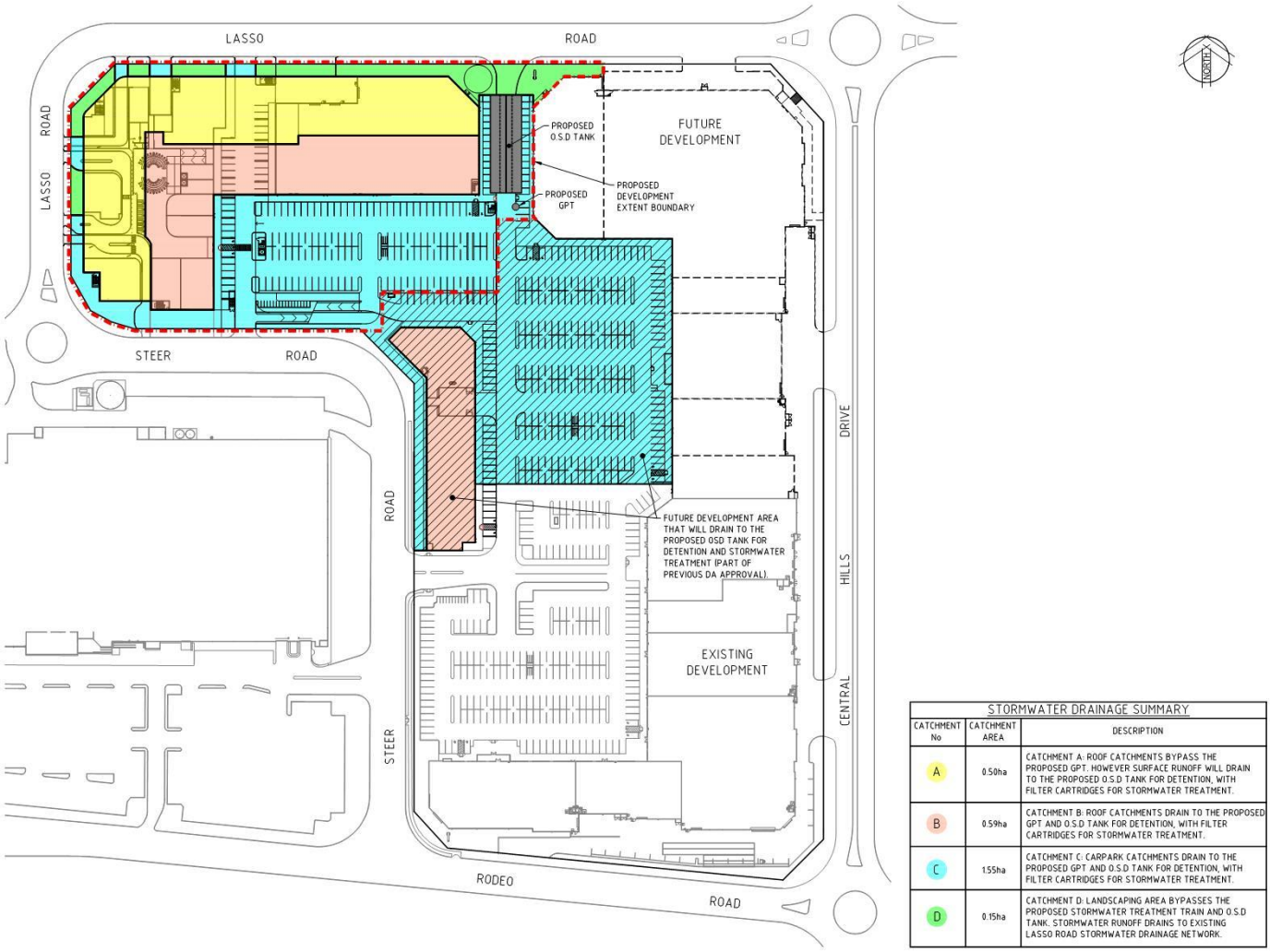

Figure 2-2 Post Development Catchment Plan

Table 2-1 outlines relationship between the catchments and the proposed OSD/WSUD basins.

Table 2-1 Catchment Characteristics

Catchments	Area (ha)	Comment
A	0.50	Roof water will drain to the OSD tank. The tank will control the runoff to match existing conditions and provide water treatment to meet council's water quality targets.
B	0.59	Roof water will drain to the GPT and OSD tank. The tank will control the runoff to match existing conditions and provide water treatment to meet council's water quality targets.
C	1.55	Stormwater runoff from the carpark and multi-deck carpark will be conveyed to the proposed GPT and OSD tank for stormwater treatment. The tank will control the runoff to match existing conditions and provide water treatment to meet council's water quality targets.
D	0.15	Landscaping area along the frontage of Lasso Road, bypasses the proposed stormwater treatment train and OSD tank.

3 Stormwater Quality

3.1 Adopted Water Quality Objectives

The main objectives of stormwater quality as indicated in the Camden Council Engineering Design Specification are shown in **Table 3-1**.

Table 3-1 Stormwater Quality Objectives

Pollutants	Treatment Retention Criteria
Gross Pollutants	90
Total Suspended Solids	85
Total Phosphorus	65
Total Nitrogen	45

3.2 Stormwater Quality Management Scheme

The stormwater treatment train has two stages of treatment; a gross pollutant trap (GPT) will provide primary treatment by capturing gross pollutants and coarse sediments. The secondary treatment is provided by filter cartridge devices located in the OSD tank to remove nutrients such as nitrogen and phosphorous.

GPT devices are designed primarily to capture solid particles. However, some nutrients attach to the suspended solids, the wet sediment sump have a benefit in removing a small portion of nutrients.

Underground GPTs are preferable from an urban design perspective as they offer better amenity and visual impact compared to trash racks or end-of-pipe nets. In addition, re-suspension of pollutants is more likely in open GPTs.

3.3 Rainfall Data

For the analysis of the MUSIC modelling, the historical rainfall records were obtained from the Bureau of Meteorology for Station No. 67035 at Liverpool (nearest station with 6minutes data). The MUSIC analysis was undertaken using a 6 min time step for year 1969 – 1979 historical data.

The mean annual rainfall for the analysed period is 778mm in Camden and the local mean annual rainfall in Camden is 743mm.

The Evapotranspiration values have been entered from the default data provided by the MUSIC software for the Sydney area.

3.4 Methodology

MUSIC v6.2 was used to analyse the performance of the stormwater treatment train. **Figure 3-1** shows the MUSIC node and link diagram to describe the treatment train.

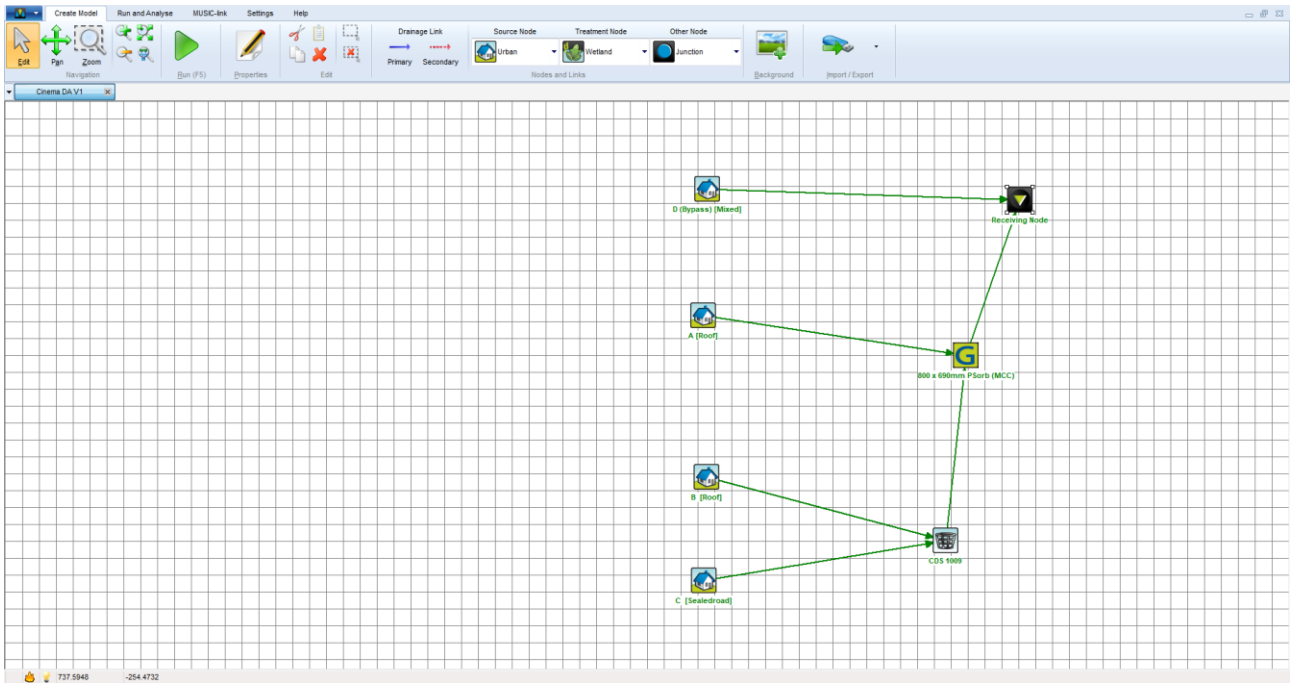

Figure 3-1 MUSIC Node and Link diagram

Based on latest architectural drawings, the proposed development has a fraction of imperviousness of 90%. The proposed development site was modelled with the following land use categories:

- Roof catchments (Catchment A and B) – 100% impervious;
- Carparks (Catchment C – sealed road) – 90% impervious; and
- Landscaping (Catchment D – commercial) – 10% impervious.

Based on geotechnical investigations in the surrounding area, the soil is likely to be brown silty clay, therefore, the rainfall and runoff parameters shown in **Table 3-2** were used.

Table 3-2 Rainfall Runoff Parameters (Ref: NSW MUSIC Modelling Guidelines)

Parameters	Values
Rainfall Threshold (mm/day)	1
Soil Storage Capacity (mm)	54
Initial Storage (% of Capacity)	25
Field Capacity (mm)	51
Infiltration Capacity Coefficient	180
Infiltration Capacity Coefficient	3
Initial Depth (mm)	10
Daily Recharge rate (%)	25
Daily Baseflow Rate (%)	25
Daily Deep Seepage Rate (%)	0

The pollutant concentration parameters used in the model were based on the findings from Fletcher et al, 2004 for residential area. The parameters are listed below in Table 3-3.

Table 3-3 Base Flow and Storm Flow Concentration Parameters for NSW (Fletcher et al, 2004) (Source: Modelling Guideline For New South Wales)

	Concentration (mg/L – log10)					
	Total Suspended Solids		Total Phosphorus		Total Nitrogen	
Commercial use	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Base Flow	1.20	0.17	-0.85	0.19	0.11	0.12
Storm Flow	2.15	0.32	-0.60	0.25	0.30	0.19
Roof catchment						
Base Flow	N/A	N/A	N/A	N/A	N/A	N/A
Storm Flow	1.3	0.32	-0.89	0.25	0.30	0.19
Carpark – Sealed Road						
Base Flow	1.2	0.17	-0.85	0.19	0.11	0.12
Storm Flow	2.15	0.32	-0.60	0.25	0.30	0.19

GPTs were modelled as a Rocla CDS unit with the efficiency outlined below:

- Total Suspended Solids (TSS) – 70%
- Total Nitrogen (TN) – 0%
- Total Phosphorus (TP) – 0%
- Gross Pollutants – 98%

Secondary stormwater treatment will be provided by filter cartridges similar to Stormwater 360 StormFilter with PhosphoSorb Filter Media. The cartridges will be installed inside the proposed OSD tank. The treatment efficiency for each cartridge is outlined below:

- Total Suspended Solids (TSS) – 94%
- Total Nitrogen (TN) – 46%
- Total Phosphorus (TP) – 86%

Each filter cartridge has a treatable flow rate of 1.1L/s

3.5 Model Results

The results of the analysis showed the treatment train will require 70 Stormwater 360 StormFilter cartridges to achieve the water quality targets set out in Table 3-1. Table 3-4 displays the effectiveness of the treatment train for the proposed development.

Table 3-4 Summary of Post-Development Model Results and Objectives Levels for the proposed development

Pollutants	Before Treatment	After treatment	% Reduction	% Objective
Total Suspended Solids (kg/yr)	3880	584	85	85
Total Phosphorous (kg/yr)	7.3	1.9	74	65
Total Nitrogen (kg/yr)	44.4	23.6	47	45
Gross Pollutant (kg/yr)	510	18.4	96	90

The water quality model created using MUSIC software provides an indication of the pollutant removal rates expected when a treatment train of water quality measures is applied to the proposed layout of the development. It is suggested however, that to keep in mind that the model is limited to concept analysis and the detailed size and removal rates for the different treatment components will be developed at the detailed design of the development.

4 Stormwater Quantity

4.1 Methodology

The hydrology and OSD basin size was modelled using DRAINS software with ILSAX hydrological model. Two models have been developed; a pre-development model was established to assess the permissible site discharge (PSD) based on flows from the existing, undeveloped site. A post-development model was established to estimate the OSD volume required for the proposed development. The hydrological parameters are shown in Table 4-1.

Table 4-1 Hydrological Loss Model for DRAINS

Parameter	Values
Paved area depression storage (mm)	1
Grassed area depression storage (mm)	5
Soil Type	3
Antecedent Moisture Condition	3

The slope of the pre-development site is 1% based on the survey data. The time of concentration for the pre-development condition was calculated by kinematic wave equation with a roughness value of 0.15 (Open space with vegetation).

The time of concentration for the post developed catchment is 5 minutes. The adopted fraction of imperviousness for the proposed development is 90%. The model used the 2016 Intensity-Frequency-Duration (IFD) rainfall data downloaded from the Bureau of Meteorology.

The proposed OSD tank were designed with the flow controls as shown in Table 4-2.

Table 4-2 WSUD/OSD Basin flow control measures

Basin Control	Measures
Primary outlet	140mm diameter orifice
Secondary Control Pit	2.7m wide Internal weir at RL99.90 surrounding a 400mm diameter orifice
Emergency overflow	900 x 900 grate at the top of the tank, stormwater then flow to Lasso Road stormwater drainage network

4.2 DRAINS Model Results

The modelling results presented in Table 4-3 demonstrates the OSD tank will limit the post-development runoff to match existing peak flows for all storms up to and including 1% AEP event.

Table 4-3 Modelling Results for the Proposed OSD/WSUD Basin

Storm Event	PSD(m^3/s)	Total outflow (m^3/s)	Water Level (m)	Storage (m^3)
0.2EY (2 year ARI)	0.054	0.05	99.19	620
0.5EY (5 year ARI)	0.12	0.06	99.57	820
20% AEP	0.26	0.25	100.02	1055
1% AEP	0.48	0.44	100.14	1120

The OSD storage volume requirement for the proposed development is 1120m^3. The modelling result shows the proposed OSD tank are capable to limit the post development peak flows to pre-development conditions.

5 Conclusion

The proposed stormwater drainage strategy generally meets the requirements set out in the Camden Council Engineering Design Specification.

The proposed WSUD/OSD tank ensures post developed peak flows are no greater than the pre-developed peak flow for storm events up to and including the 1% AEP.

The gross pollutant trap and stormwater filter cartridges will provide sufficient pollutant removal to satisfy the water quality objectives.

APPENDIX

A

STORMWATER MANAGEMENT PLANS

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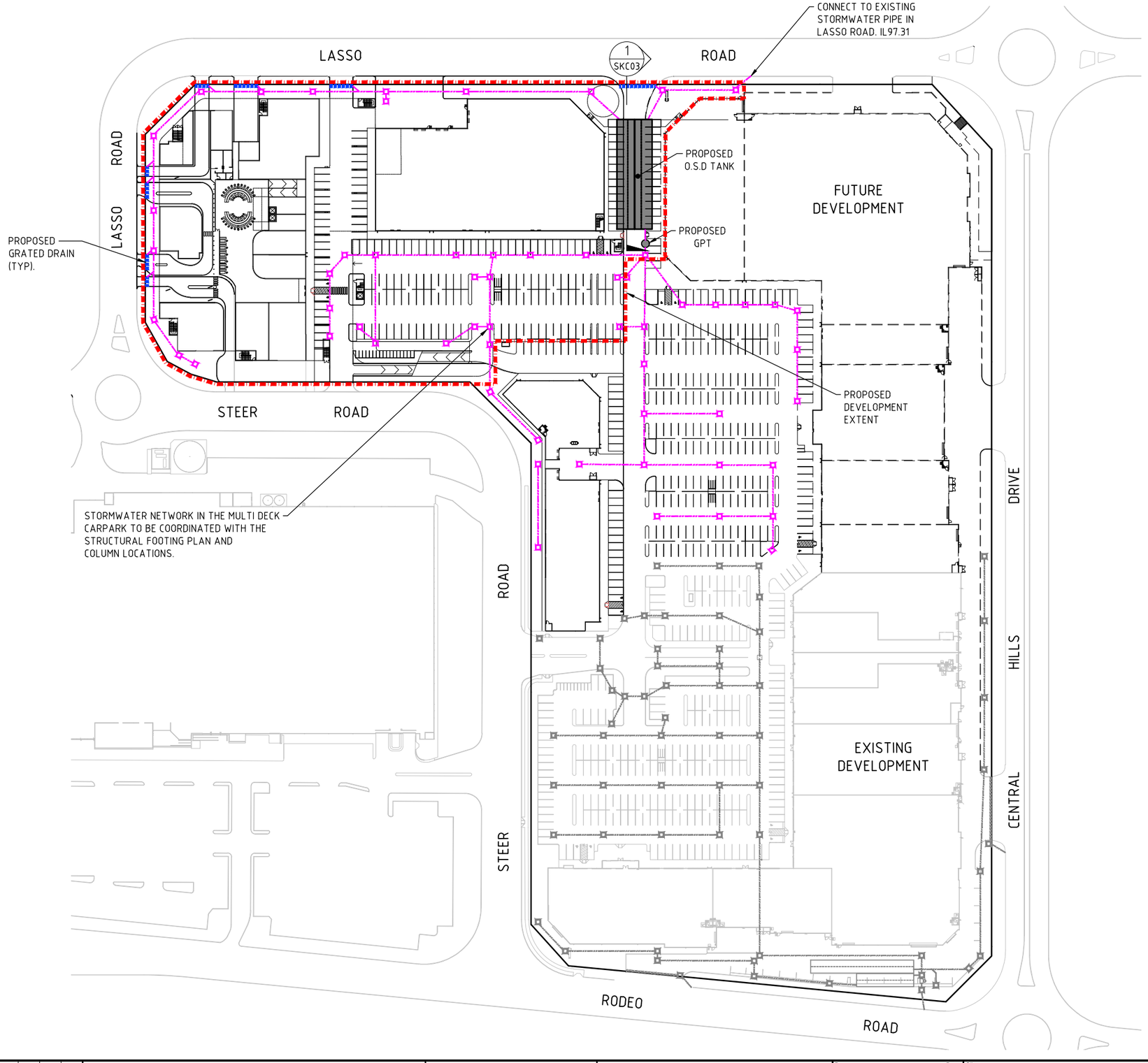

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01	16.10.17	FOR INFORMATION	PL		

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Checked	PL	Date OCT'17
Designed	PL	Date OCT'17
Verified		Date
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Client: PLANET WARRIEWOOD LTD
Project: UNITED CINEMAS GREGORY HILLS
Title: CONCEPT STORMWATER LAYOUT PLAN

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

DATUM	DATE	Scale	Size
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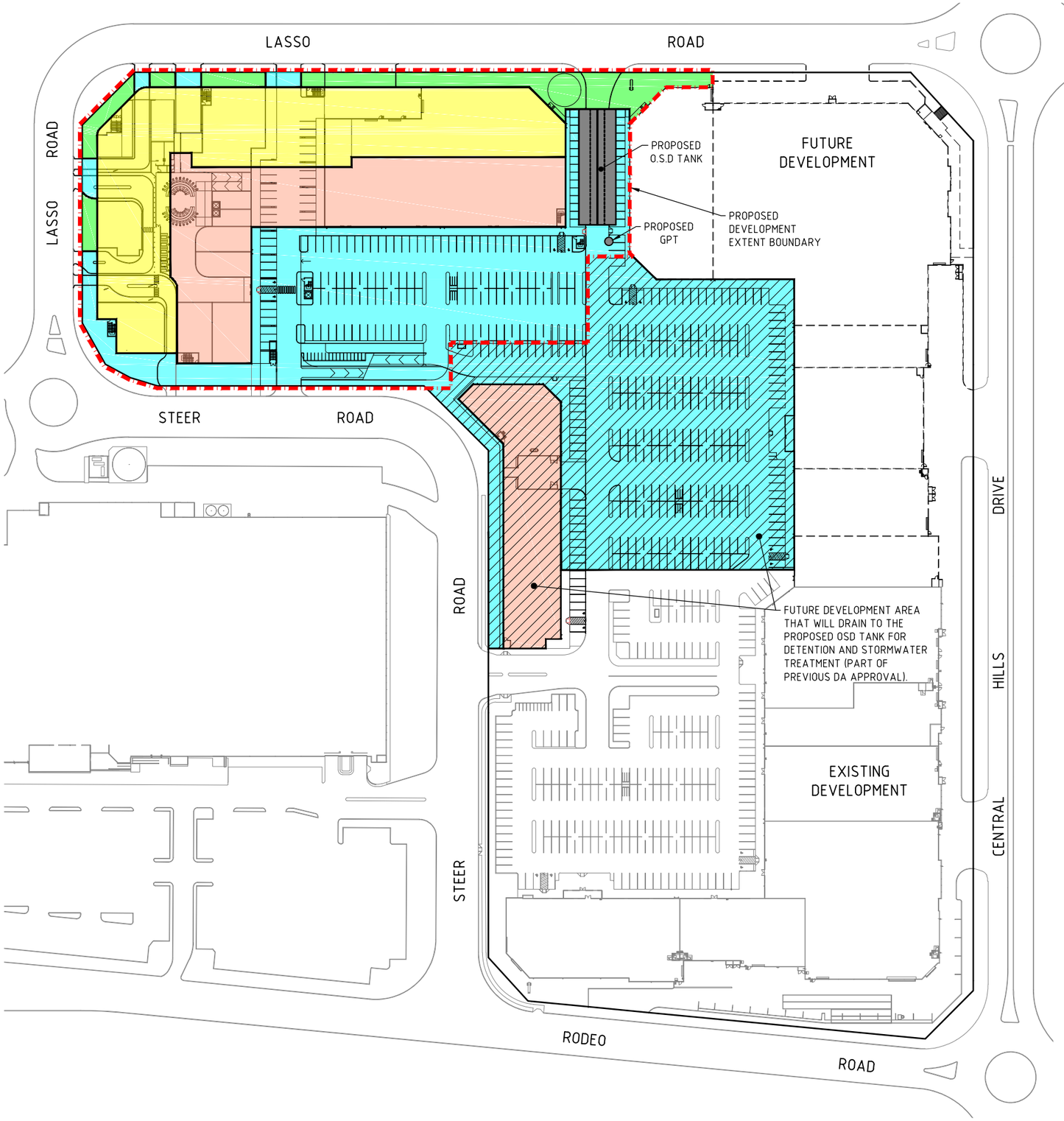
Drawing Number: 80218030 - SKC01
Revision: 02



STORMWATER DRAINAGE SUMMARY

CATCHMENT No	CATCHMENT AREA	DESCRIPTION
A	0.50ha	CATCHMENT A: ROOF CATCHMENTS BYPASS THE PROPOSED GPT. HOWEVER SURFACE RUNOFF WILL DRAIN TO THE PROPOSED O.S.D TANK FOR DETENTION, WITH FILTER CARTRIDGES FOR STORMWATER TREATMENT.
B	0.59ha	CATCHMENT B: ROOF CATCHMENTS DRAIN TO THE PROPOSED GPT AND O.S.D TANK FOR DETENTION, WITH FILTER CARTRIDGES FOR STORMWATER TREATMENT.
C	1.55ha	CATCHMENT C: CARPARK CATCHMENTS DRAIN TO THE PROPOSED GPT AND O.S.D TANK FOR DETENTION, WITH FILTER CARTRIDGES FOR STORMWATER TREATMENT.
D	0.15ha	CATCHMENT D: LANDSCAPING AREA BYPASSES THE PROPOSED STORMWATER TREATMENT TRAIN AND O.S.D TANK. STORMWATER RUNOFF DRAINS TO EXISTING LASSO ROAD STORMWATER DRAINAGE NETWORK.

Rev.	Date	Description	Des.	Verif.	Appd.
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01	16.10.17	FOR INFORMATION	PL		

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SCALE 1:750 @A1

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Checked	PL	Date OCT'17
Designed	PL	Date OCT'17
Verified		Date
Approved		

Client: PLANET WARRIEWOOD LTD
Project: UNITED CINEMAS GREGORY HILLS
Title: CATCHMENT PLAN

Status: FOR INFORMATION ONLY
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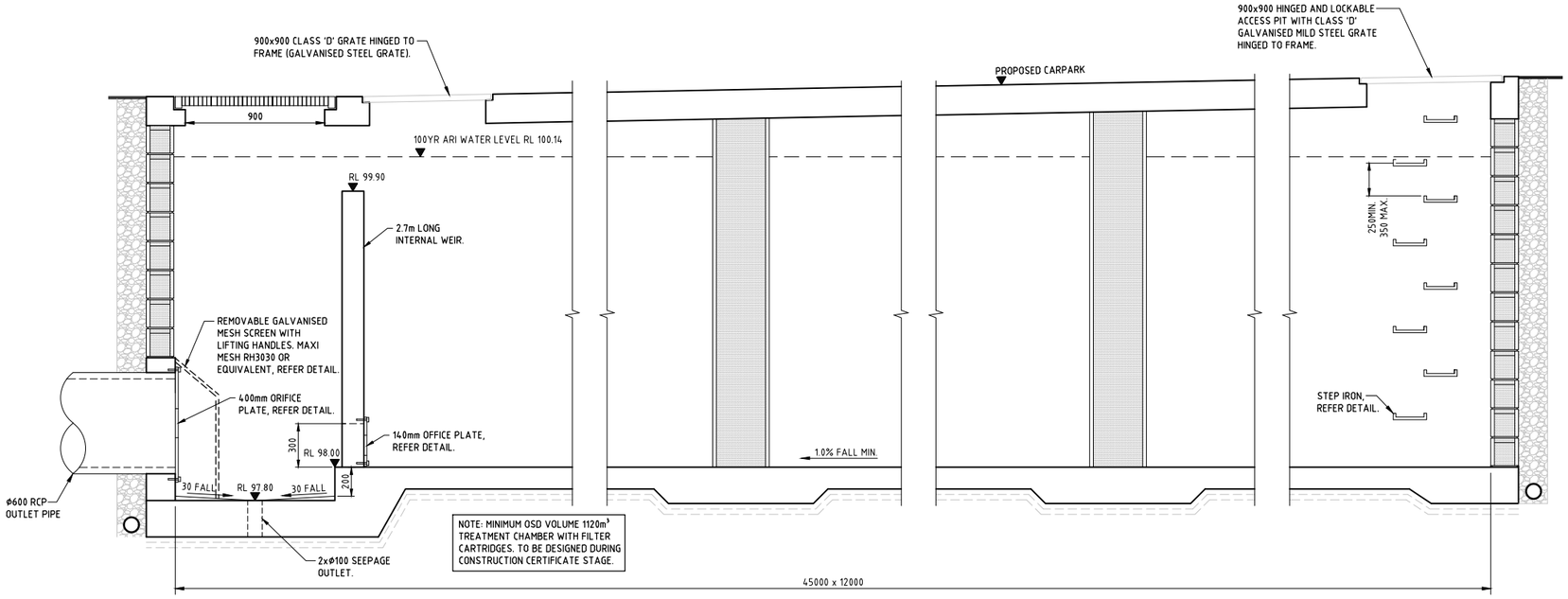

SECTION 1
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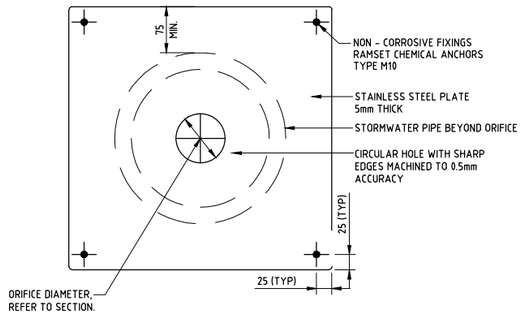

ORIFICE PLATE DETAIL
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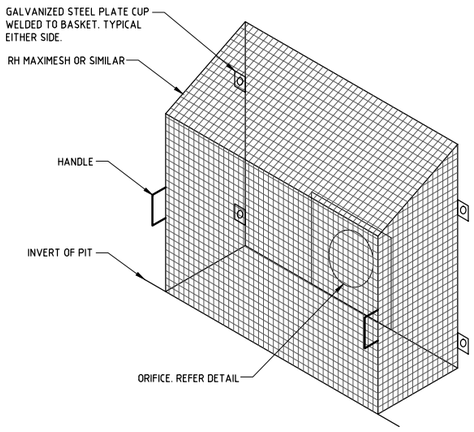
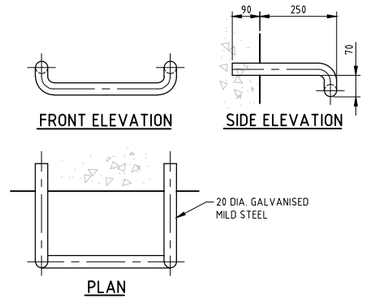
NOTE:
1. ORIFICE DIAMETER TO BE ENGRAVED ON THE PLATE SURFACE.
2. ORIFICE TO BE EPOXY SEALED AROUND OUTER EDGES.



TRASH SCREEN DETAIL
SCALE 1:10

NOTE:
1. TRASH SCREEN DIMENSION TO BE ADJUSTED TO PROVIDE 150mm MIN CLEAR SPACE AROUND ORIFICE PLATE.



STEP IRON DETAIL
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01	16.10.17	FOR INFORMATION	PL		

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SCALE 1:10 @A1
0 0.5 1 1.5 2m
SCALE 1:20 @A1

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Project: UNITED CINEMAS GREGORY HILLS
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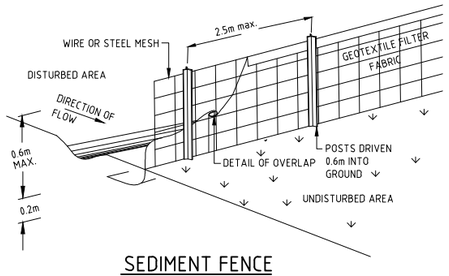

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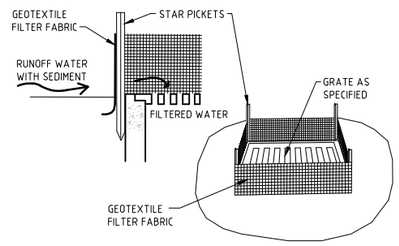

GEOTEXTILE FILTER PIT SURROUND
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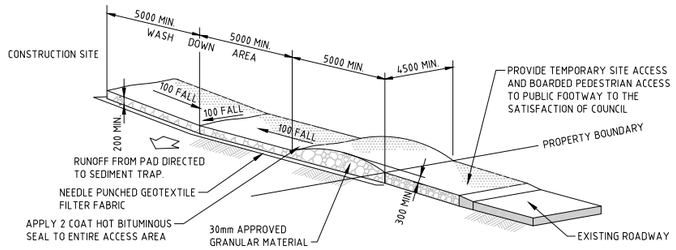

STABILISED SITE ACCESS AND TRUCK WASH DOWN AREA
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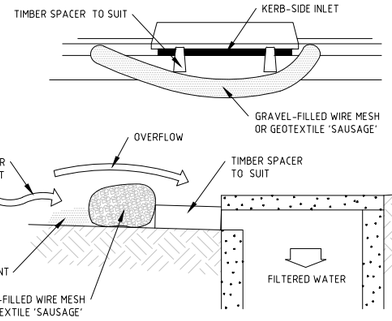

MESH AND GRAVEL INLET FILTER
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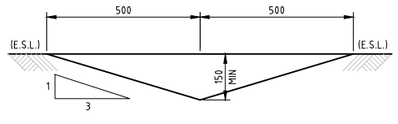

TEMPORARY CATCH DRAIN (MIN. FALL 1%)
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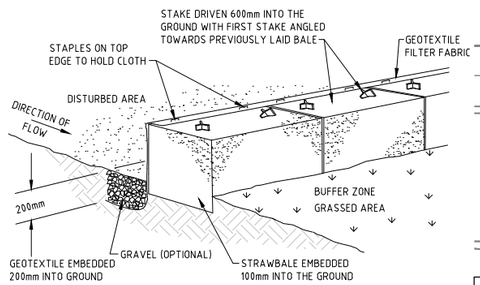

STRAWBALE AND GEOTEXTILE SEDIMENT FILTER
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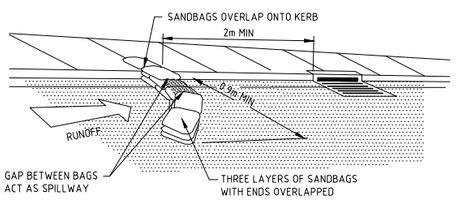

SANDBAG SEDIMENT TRAP FOR KERB INLET ON GRADE
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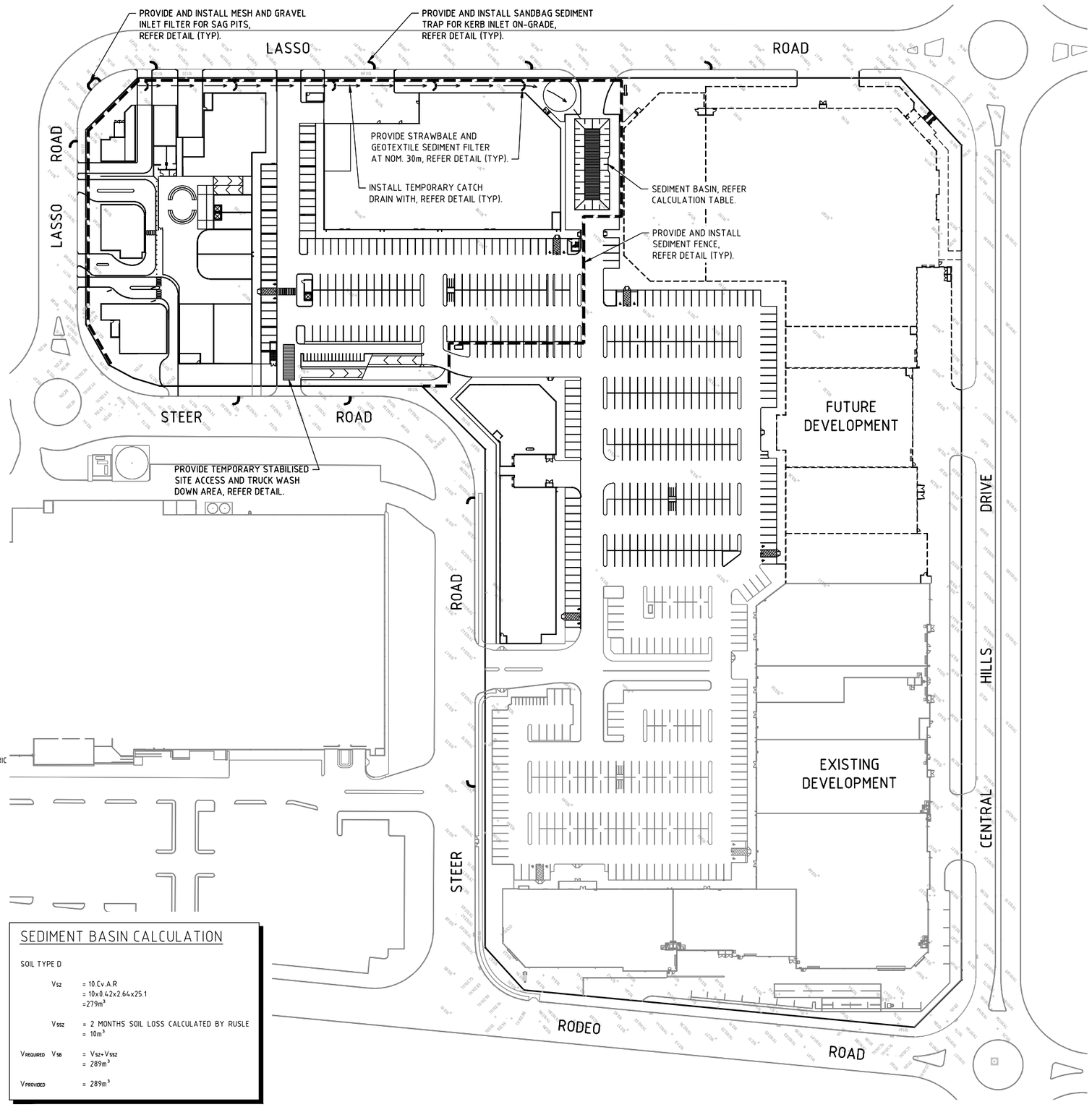

SEDIMENT BASIN CALCULATION

SOIL TYPE D

V_{SZ} = 10.Cv.A.R
= 10x0.42x2.64x25.1
= 279m³

V_{SSZ} = 2 MONTHS SOIL LOSS CALCULATED BY RUSLE
= 10m³

$V_{REQUIRED}$ V_{SB} = V_{SZ}+V_{SSZ}
= 289m³

$V_{PROVIDED}$ = 289m³

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01	05.12.17	DA ISSUE	MKH		

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SCALE 1:750 @A1

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