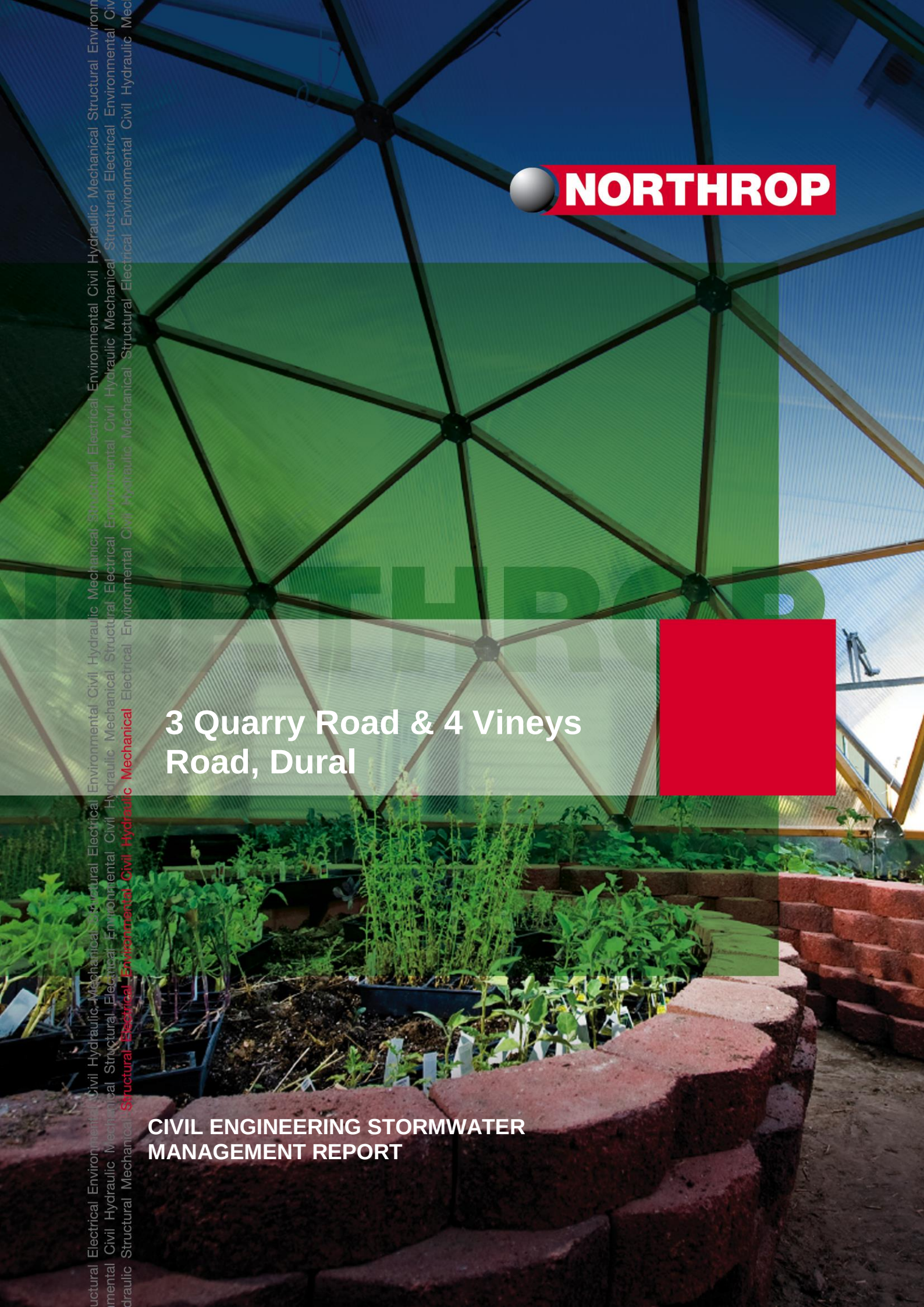

NORTHROP

3 Quarry Road & 4 Vineys Road, Dural

CIVIL ENGINEERING STORMWATER MANAGEMENT REPORT

NORTHROP

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Document Control

Prepared for

Project Name	3 Quarry Road & 4 Vineys Road, Dural
File Reference	172490
Date	25/06/2018

Document Control

S170938-DA02–A Stormwater Management Strategy Report

Rev	Description	Prepared by	Reviewed by	Issue Date	Client App	Approval Date
A	Draft Issue	NN	JG	12/04/18		
B	Final Issue	NN	JG	25/06/18		

Contents

1. Introduction

Northrop Consulting Engineers Pty Ltd (Northrop) have been engaged by Thelem Consulting to prepare civil engineering design and documentation in support of a Development Application (DA) submission to Hornsby Shire Council for the proposed aged care and independent living units at 3 Quarry Road & 4 Vineys Road, Dural.

This report covers the proposed earthworks and stormwater drainage strategy including:

- Erosion and Sediment control;
- Stormwater Detention; and
- Water Sensitive Urban Design.

2. Related Reports and Documents

This report is to be read in conjunction with the following reports and documents:

a. Development Application Documentation prepared by Northrop (refer Appendix A):

- 172490-DA01-C01.01 Cover Sheet, Drawing Schedule and Locality Plan
- 172490-DA01-C01.11 General Arrangement Plan
- 172490-DA01-C02.01 Specification Notes
- 172490-DA01-C03.01 Concept Sediment and Soil Erosion Control Plan
- 172490-DA01-C03.11 Sediment and Soil Erosion Control Details
- 172490-DA01-C04.01 Concept Siteworks and Stormwater Management Plan-Sheet 1
- 172490-DA01-C04.02 Concept Siteworks and Stormwater Management Plan-Sheet 2
- 172490-DA01-C04.03 Concept Siteworks and Stormwater Management Plan-Sheet 3
- 172490-DA01-C05.01 Concept Culvert Design
- 172490-DA01-C05.11 Culvert Longitudinal Section
- 172490-DA01-C05.12 Culvert Cross Section
- 172490-DA01-C06.01 Details- Sheet 01
- 172490-DA01-C06.02 Details- Sheet 02
- 172490-DA01-C06.03 Details- Sheet 03
- 172490-DA01-C07.01 Catchment Plan

b. Hornsby Shire Council Pre-DA meeting held on the 26th February, 2018. (PI/12/2018)
c. Hornsby Development Control Plan 2013
d. Hornsby Shire Council- Development Design Specification 0074- Stormwater Drainage (Design)

3. The Development Site

3.1. Site Description

3 Quarry Road & 4 Vineys Road is situated on the eastern side of Old Northern Road. The subject site is within Hornsby Shire Council local government area.

The site is approximately 2.96 hectares and is situated:

- East of Old Northern Road;
- Entry from Quarry Road and Vineys Road

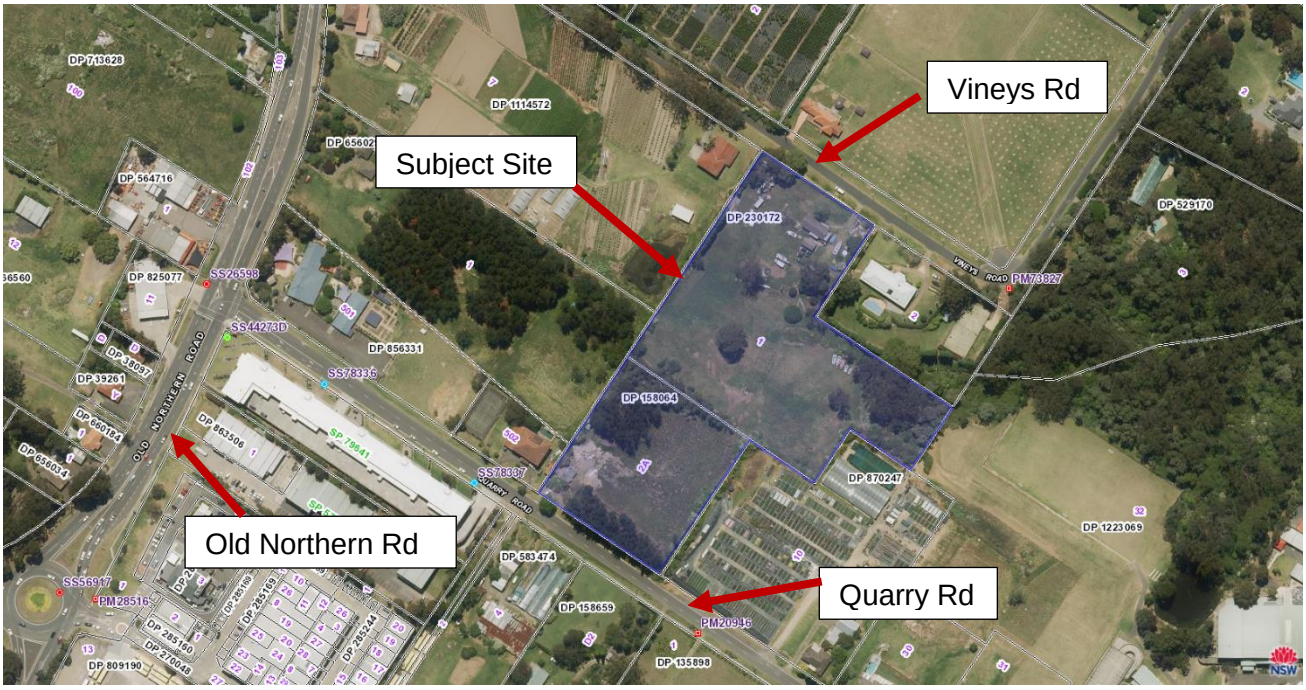

Figure 1 - Site Locality (Six Maps)

3.2. Proposed Development

The proposed development will involve the construction of an aged care facilities with independent living units with basement car parking, wellness centre and landscape areas.

Refer to the architectural drawings prepared by Marchese Partners and Northrop's civil drawing package for more detailed site description.

The site falls towards the middle of the subject site then has a gradual slope towards the eastern boundary (catchment area of 2.96 ha which is equal to the site area) will be directed to the eastern boundary of the site via an internal pit and pipe stormwater drainage network. The development will comprise of roof catchments, hardstand catchments (car parking & footpaths) and landscaped areas.

A portion of the roof catchment will be directed to rainwater reuse tanks. Any overflow from the rainwater tank will be discharged to the pit and pipe network. The rainwater tank will pre-treat captured runoff. Other pre-treatment strategies include uses of surface trash traps at each surface inlet pit. All surface runoff will be treated by a proprietary filtration system which is located within the on-site detention tank located between the wellness centre and building G before discharging to the eastern boundary bushland.

On-site stormwater detention is provided within the site, in accordance with Council requirements for the site. Stormwater quantity control is provided and is located within the on-site detention tank.

4. Erosion and Sediment Control

The objectives of the erosion and sediment control for the development site are to ensure:

- Adequate erosion and sediment control measures are applied prior to the commencement of construction and are maintained throughout construction; and
- Construction site runoff is appropriately treated in accordance with the requirements of Hornsby Shire Council.

As part of the works, the erosion and sedimentation control will be constructed in accordance with Council requirements and the NSW Department of Housing Manual, "Managing Urban Stormwater Soil & Construction" 2004 prior to any earthworks commencing on site. The Concept Sediment and erosion control measures are documented in Northrop's Development Application drawing 172490-DA00-C03.11.

4.1. Sediment Basin

A concept sediment basin has been designed to capture site runoff during construction and have been located towards the eastern part of the site, in the lowest practical point. The construction of the basins will be done in stages to enable maximum runoff capture assisted by the diversion of swales to capture and direct runoff to the basins.

Calculations to determine concept design basin sizes have been based on available geotechnical information regarding soil types and through the use of the Soils and Construction Volume 1 Manual.

To ensure the sediment basins are working effectively they are to be maintained throughout the construction works. Maintenance includes water to be removed by pumping to reach the minimum storage volume at the lower level of the settling zone. The settling zone will be identified by pegs to clearly show the level at which design storage capacity is available.

The pumped water from the sediment basins will be reused to irrigate areas of hydromulch and for dust control during construction.

Overflow weirs are to be provided to control overland flows for rainfall events in excess of the design criteria which is to cater for a storm event up to and including the 100 year ARI storm event.

Below is a summarised concept sediment basin sizing table.

Table 1 - Concept Sediment Basin Volumes

Basin	Catchment Area (Ha)	Volume Required (m^3)	Volume Provided (m^3)
East	2.96	932	933

4.2. Construction Measures

Construction measures prior to any earthworks commencing on site have been implemented generally in accordance to the Design Certificate drawings. The measures shown on the drawings are intended to be a minimum treatment only as the contractor will be required to modify the erosion and sedimentation control measures to suit the construction program, sequencing and techniques. These measures will include:

- A site fence is to be temporarily constructed around the site with a security fence surrounding the site office area and the proposed sediment basins as required;
- Sediment fencing downstream and surrounding disturbed areas, including any topsoil stockpiles;
- Installation for silt arrestors to collect site runoff and retain suspended particles;
- Dust control measures which includes covering stockpiles, maintain site fences and watering exposed areas;
- Placement of hay bales or mesh and gravel filters around and along proposed catch drains and around stormwater inlets pits; and
- The construction of temporary sediment basins as noted above in Section 4.1

5. Stormwater Management Objectives and Controls

5.1 Development Control Plan Objectives

The stormwater strategy for the 3 Quarry Road & 4 Vineys Road, Dural has been developed in accordance with the Water Sensitive Urban Design and Development Design Specification 0074, supplied by Hornsby Shire Council.

Hornsby Shire Council's Development Design Specification (Ref. 1.1) states the following objectives:

(a) To retain major creeks, streams and watercourses in a condition that minimises interference to stormwater flows especially those from major storms.
(b) To minimise the exposure of people and property to stormwater inundation.
(c) To minimise erosion and sedimentation problems.
(d) To protect and enhance the environmental quality and social well-being of residents.
(e) To ensure that supportive, preventative and remedial measures are consistent with Council's principles, goals and objectives.
(f) To protect the natural environment against degradation from changes to stormwater runoff patterns and the transportation of pollutants.

5.2 Stormwater Management Controls

The proposed stormwater management strategy implements the use of an on-site detention reduce the site discharge. The peak 100 year ARI post development discharges are restricted to 5 year ARI pre development discharges.

A water quality treatment strategy proposed for 3 Quarry Road & 4 Vineys Road, Dural has been designed to achieve the objectives (stated above) and controls as outlined below:

Controls are as follows:

- Rainwater tanks, installed during building construction;
- Proprietary GPT units upstream of each pits and on each stormwater discharge point to trunk drainage channels;
- Water quality cartridges installed during building construction

Stormwater quantity and quality management measures will be discussed in sections 6 and 7 of this report respectively.

5.3 Proposed Box Culvert

The subject site is in-cooperating two 1400wide x 600 high box culvert to convey overland flow & overflow from the existing site located on the upstream property. An inlet pit will be design to capture maximum flow before discharging downstream via the twin culvert via junction pits and rock headwall.

The proposed box culvert is located below the basement level 2 and 3 respectively. The proposed on-site detention outlet is connected to the box culvert (Refer to drawing DAC04.03).

6. Stormwater Quantity Management

6.1 Existing Catchment

The existing catchment for the 3 Quarry Road & Vineys Road is approximately 2.96ha in size. The area generally drains towards the centre of the site, with the site low point located in the eastern boundary. The run off from the 3 Quarry Road & Vineys Road area drains towards the centre and rear of the site and eventuates towards the bushlands.

High level site investigation has concluded that the road drainage on Quarry Road converges on the southern boundary of the subjec rges via an existing 450 RCP through our site. The location is the existing pipe is to l located during the detail design stage.

Figure 2 below shows the pre-development catchment plan for the subject site.

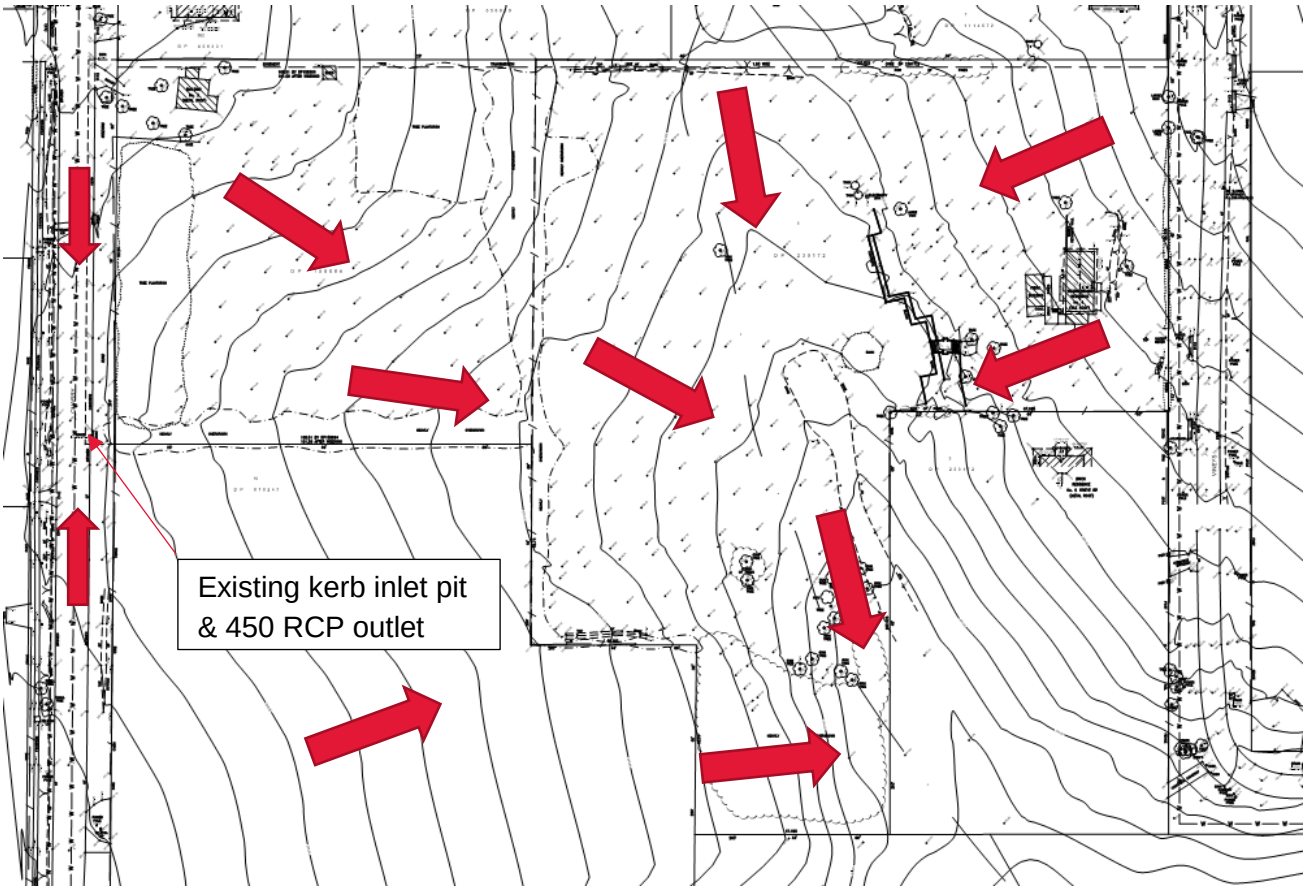

Figure 2 - Pre-Development Catchment Plan

Permissible site discharge rates (PSD) for each storm event were calculated as the proposed on-site detention tank is designed to restrict post development peak discharges from the site, to predevelopment levels for the 5 year and 100 year ARI storms events.

6.2 Stormwater Quantity Management Strategy

The stormwater quantity management strategy has been designed so that the run off from the various catchments will discharge to the external stormwater drainage network where it will be discharging into the precinct based detention tank. Approx. 0.217 ha of the site by-passes the on-site detention tank. The proposed site has been divided into catchments which can be referred in figure 4.

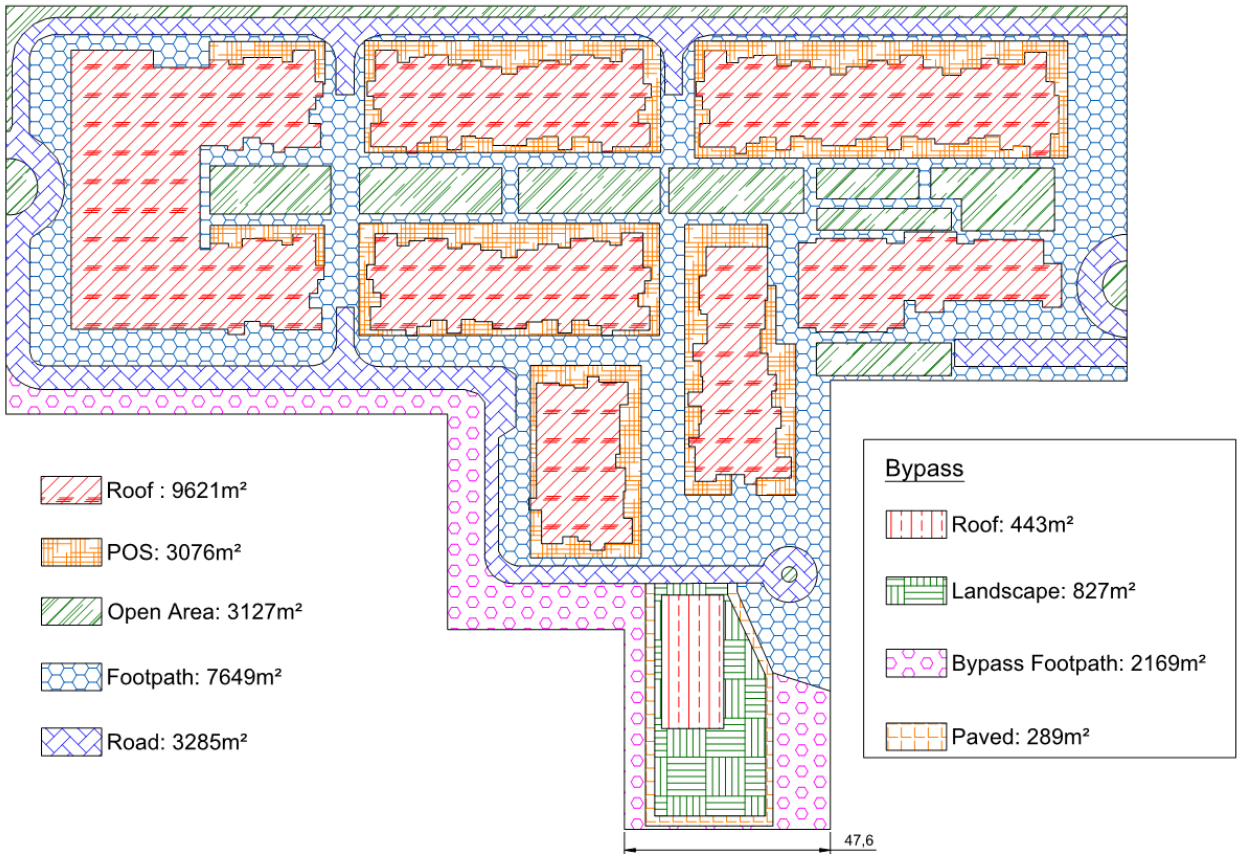

Figure 3 - Catchment Areas

6.3 Hydrological Modelling

The Hydrology of the existing catchment and on-site detention size were modelled using DRAINS software. The existing slopes of the catchments were calculated based on site survey prepared by Higgins Surveyors (refer Appendix B).

In order to initialise the DRAINS model, the upstream catchments volumes were determined. At the external drainage, a catchment volume of 1350L/s was adopted. This is based on the upstream catchment and the survey of the road drainage levels.

A stormwater analysis of the network drainage system for a 5 and 100 year ARI indicated the Flow Depth and Velocity were all in accordance with council requirements.

Figure 4 and 5 illustrates the DRAINS model for the subject site.

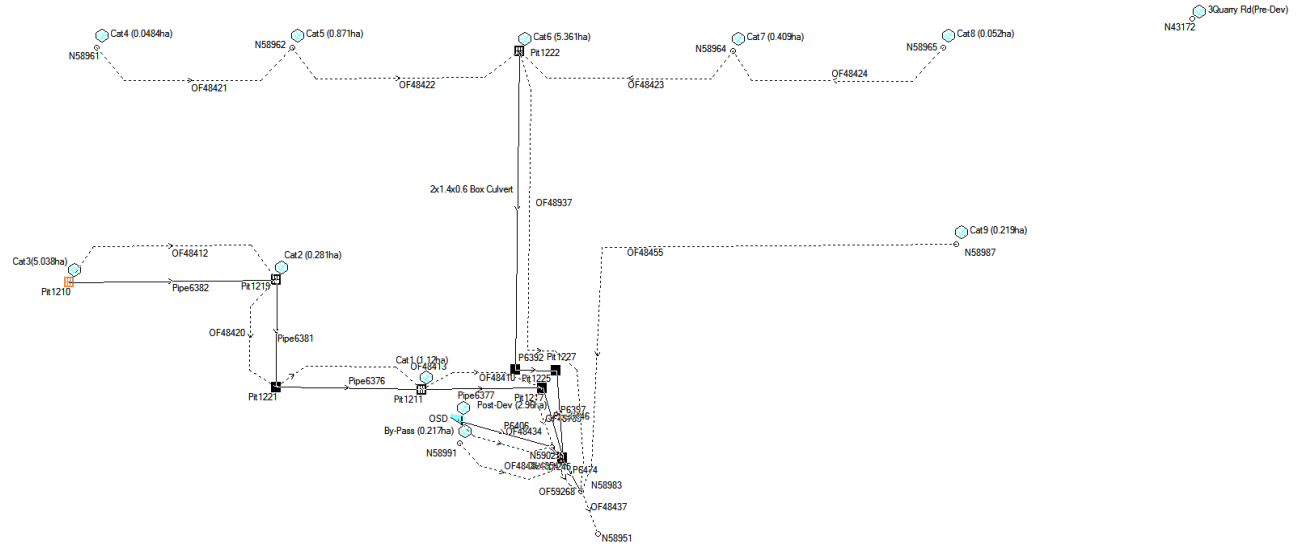

Figure 4 – DRAINS Model- Overview

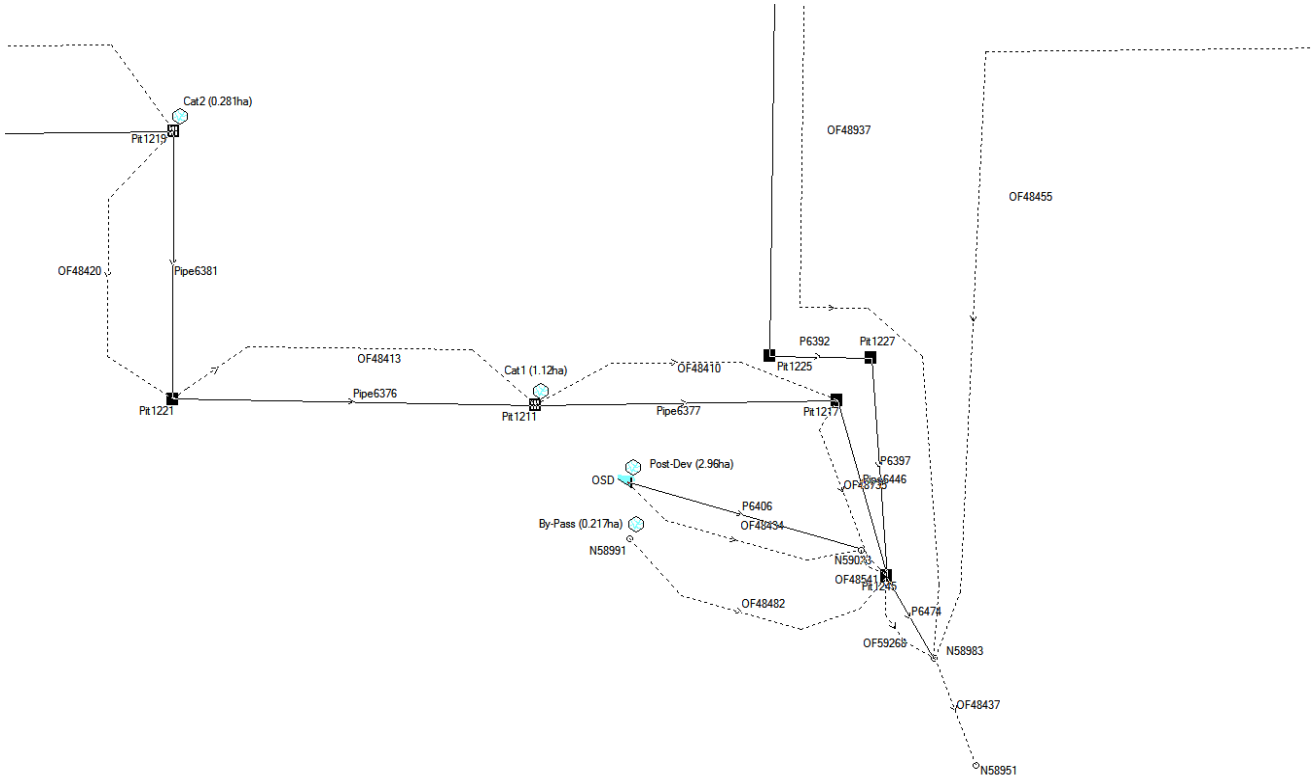

Figure 5 – DRAINS Model- Inset

The hydrological modelling includes the upstream catchment from the roadway, existing dam overflow and overland flow from adjacent properties and the subject site. The on-site detention volume and discharge are designed to collect the post development 100 year flows and to limit the discharge to the pre-development 5 year flow. The volume of the on-site detention tank is 380m3 with the PSD =790 L/s.

Figure 6 & 7 shows the pre-development 5 year flowrates.

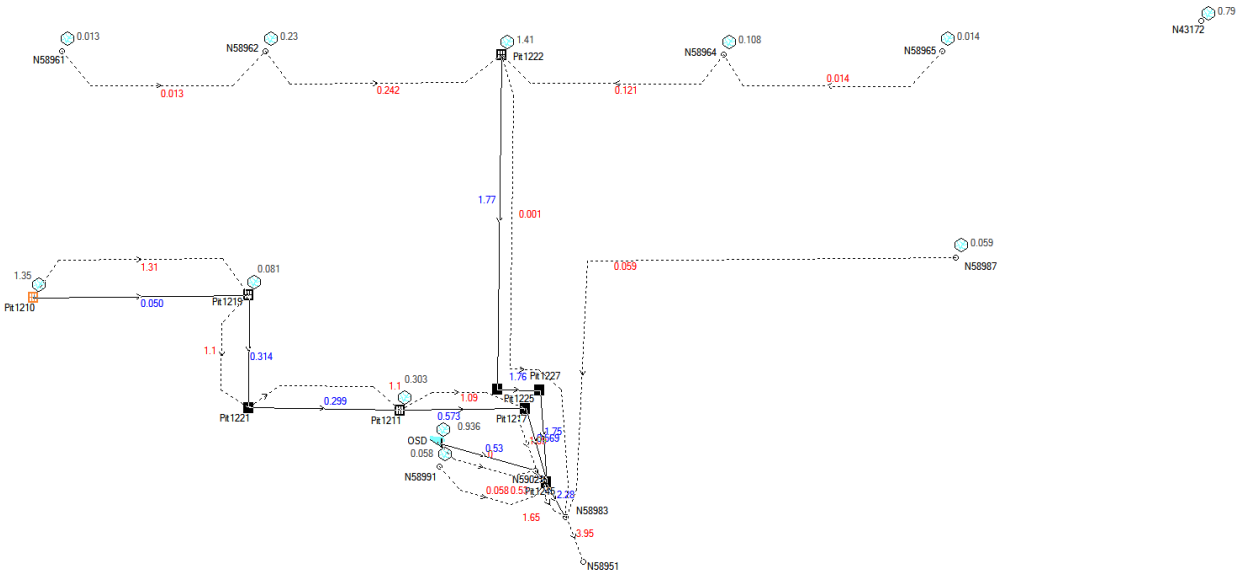

Figure 6 – DRAINS Model (Pre- Development 5 year)

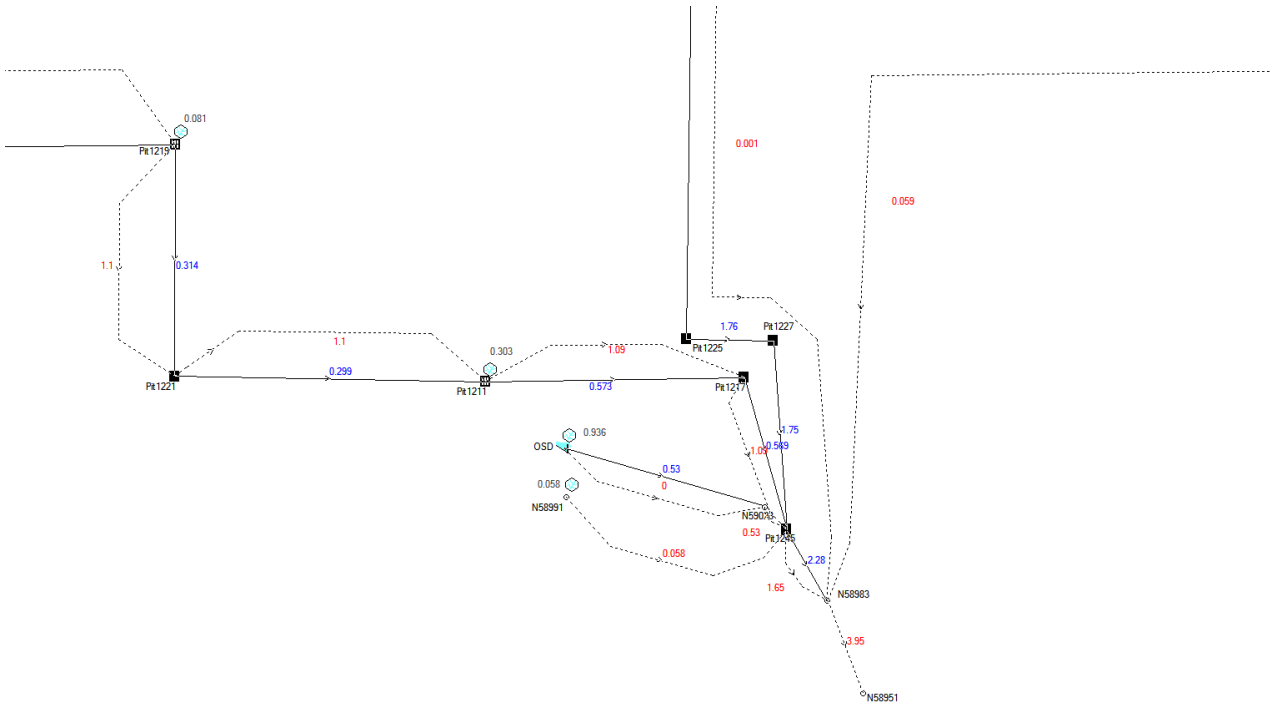

Figure 7 – DRAINS Model- Inset (Pre- Development 5 years)

Figure 8 & 9 shows the flowrates for the post-development 100 year ARI.

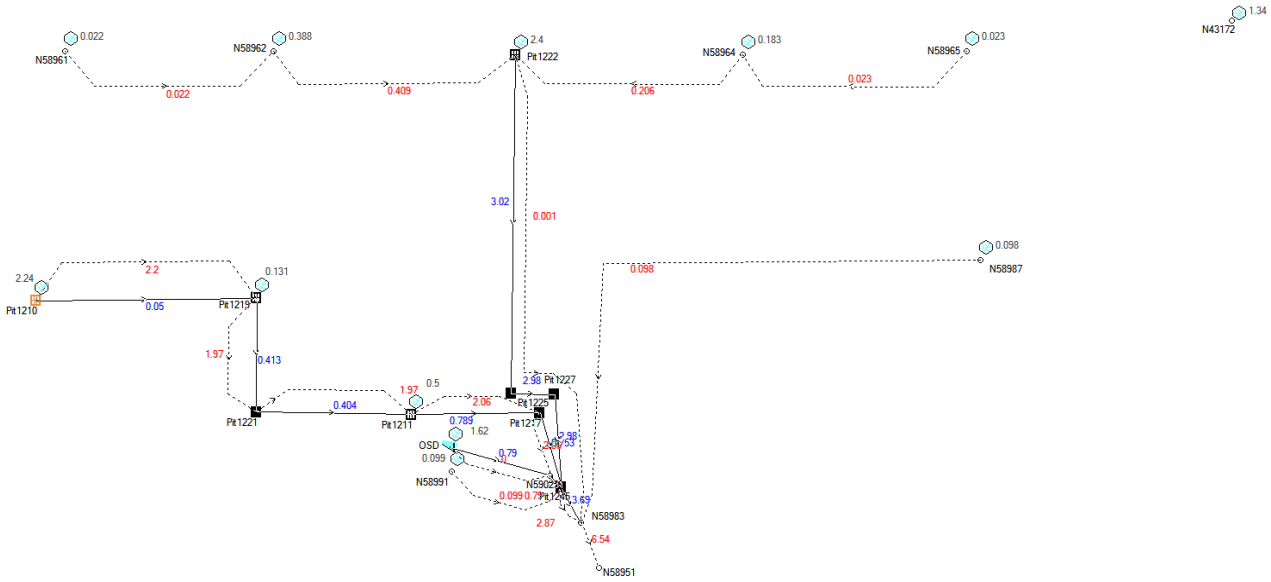

Figure 8 – DRAINS Model (Post- Development 100 years)

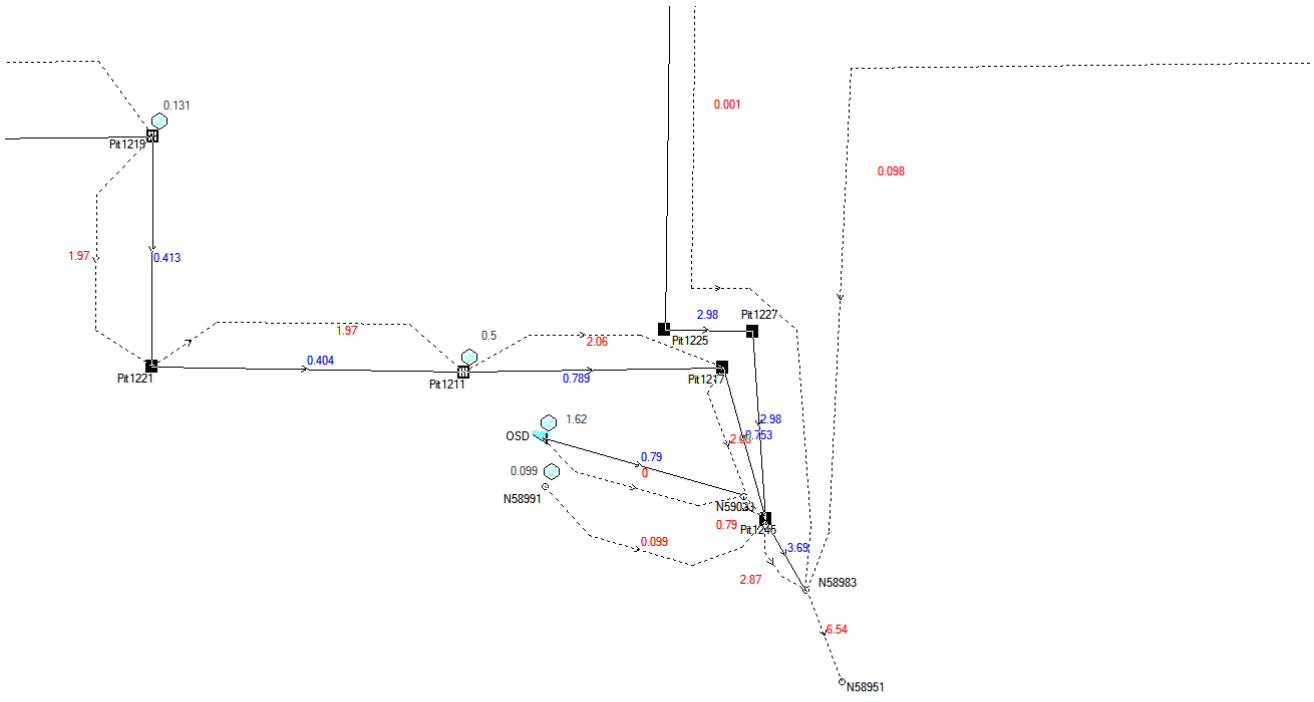

Figure 9 – DRAINS Model- Inset (Post- Development 100 years)

6.4 Adopted Water Quality Objectives

The main objectives for stormwater quality are indicated in Hornsby council's WSUD Reference Guidance 2015 and are presented in Table 3 below:

Table 2 - Water Quality Targets

Pollutant	% Reduction Post-Development Average Annual Load Reduction
Gross Pollutants	90
Total Suspended Solids (TSS)	80
Total Phosphorous (TP)	60
Total Nitrogen (TN)	45

6.5 Stormwater Quality Management Scheme

The stormwater treatment train has two stages of treatment; pit inlet filter baskets (trash baskets) that will provide pre-treatment by capturing gross pollutants and the coarser suspended solids. The primary treatments are provided by a bio-retention swale and proprietary filter cartridge in the downstream catchment that will remove nutrients such as nitrogen and phosphorous.

6.6 Rainwater Tanks

The rainwater tank will collect a portion of roof water from the development which will pass through a first flush system prior to capture. The rainwater tank will be located adjacent to the on-site detention tank.

The collected water will be used for toilet flushing only. The tank will be equipped with the following:

- Solid access lid and step irons;
- High level overflow to external stormwater drainage network;
- Duty and standby pump configured for alternative operation;
- Backup fuel generator;
- Mains water top-up; and
- Associated float valves and control panels.

Results pending based on BASIX Report.

6.7 Rainfall Data

For the analysis of the MUSIC modelling, historical rainfall records were obtained from the Bureau of Meteorology for Station No. 66062 Sydney. The MUSIC analysis was undertaken using a 6 min time step for year 1981 to 1985 of historical data.

The mean annual rainfall for the modelled data was 1240mm.

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

METHODOLOGY

The water quality modelling software MUSIC v6 was used to analyse the performance of the treatment train. *Figure* below shows the MUSIC node and link diagram used to describe the proposed treatment train. The model has been built to assess the adequacy of the Stormwater treatment measure proposed and to ensure that the quality of stormwater meets the objectives prior to stormwater runoff leaving the site.

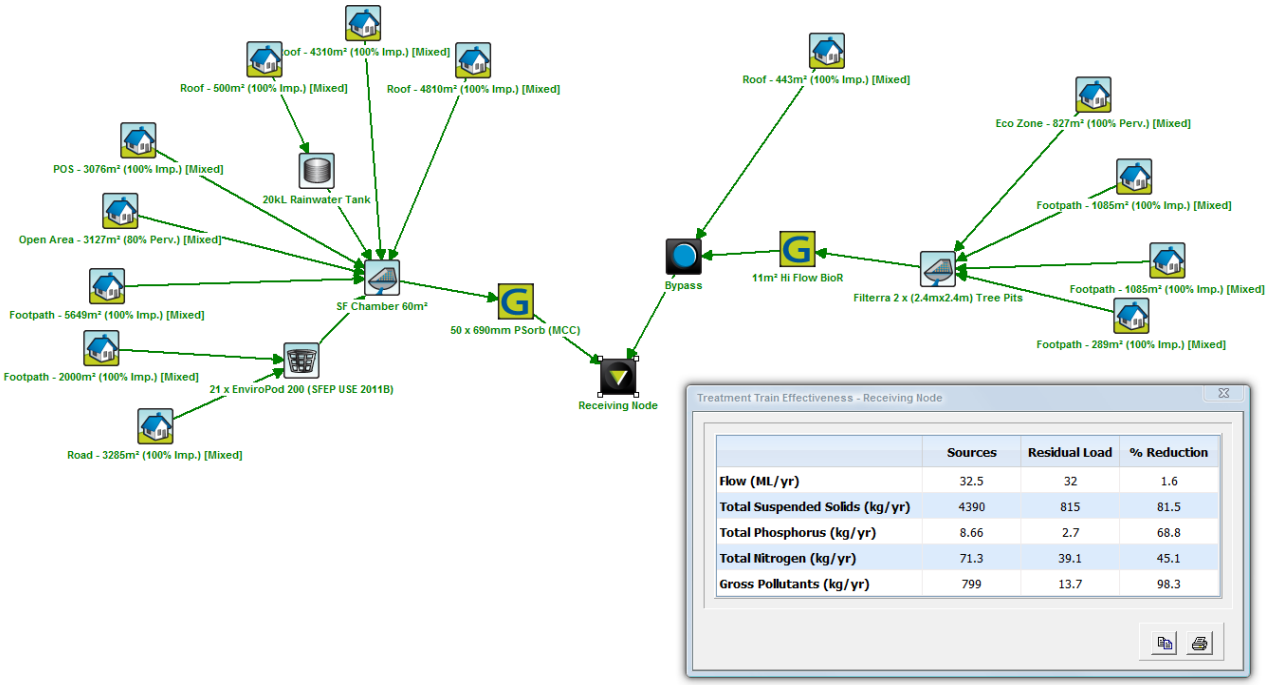

Figure 10 - MUSIC Link and Node Diagram

The following rainfall and runoff parameters shown in Table have been utilised.

Table 3 - Rainfall Runoff Parameters

Parameter	Recommended Values
Rainfall Threshold (mm/day)	1.5
Soil Storage Capacity (mm)	170
Initial Storage (% of Capacity)	30
Field Capacity (mm)	70
Infiltration Capacity Coefficient – a	180
Infiltration Capacity Exponent – b	3.0
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 information provided in "Using MUSIC in Sydney's Drinking Water Catchment", Sydney Catchment Authority, 2012. The parameters are listed in Table below:

Table 4 - Water Quality Parameters for MUSIC Source Nodes

Land- Use Category		Log TSS (mg/L)		Log TP (mg/L)		Log TN (mg/L)	
		Storm Flow	Base flow	Storm Flow	Base Flow	Storm Flow	Base Flow
Roof Areas	Mean	1.30	1.20	-0.89	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Open Area	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	019	0.19	0.12
Footpath	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Road	Mean	2.43	1.20	-0.30	-0.85	0.34	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Eco Zone	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
POS	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12

6.8 Model Results

The results of the analysis showed the treatment train will achieve the water quality targets set out in Council's DCP. Table 5 below display the effectiveness of the treatment train for the primary and secondary treatment.

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.

Table 5 - MUSIC Model Results

Pollutant	Before Treatment	After Treatment	% Reduction	% Objective	Compliance
Total Suspended Solids (kg/yr)	4490	838	81.5	80	OK
Total Phosphorus (kg/yr)	8.63	2.69	68.8	65	OK
Total Nitrogen (kg/yr)	70.2	38.3	45.1	45	OK
Gross Pollutants (kg/yr)	783	13.7	98.3	90	OK

6.9 Proposed Stormwater Treatment Train

In order to achieve the reduction targets the following treatment devices are required as part of the treatment train:

- Filterra

A total of two (2) Filterra are to be introduced to the design as a major filter device located at the end of the treatment train. Stormwater runoff enters the Filterra system through a kerb-inlet opening and flows through a specially designed filter media mixture contained in a landscaped modular container. The biofiltration media captures and immobilises pollutants; some of these pollutants are then decomposed, volatilised and incorporated into the biomass of the Filterra system's micro/macro fauna and fora. The review conducted by University of Western Sydney (UWS) recommended the use of the following parameters for modelling in Brisbane City Council which have been accepted.

  - TSS 96%
  - TN 39%
  - TP 64%

- Stormwater360 Enviropod 200 Inserts

Enviropod 200 inserts will be used as a pre-treatment for stormwater runoff to capture litter and coarse sediment surface flows on the site. Enviropod inserts are to be installed on all surface inlet pits across the site. The following capture rates have been adopted for the MUSIC model, based on information provided by Stormwater360:

  - TSS 54%
  - TN 21%
  - TP 30%
  - Litter 100%

- 690mm PSorb

Stormfilter cartridges will be used as a primary-treatment for stormwater runoff to capture fine sediment from surface flows on the site. Stormfilters are to be installed within the water quality chamber in the on-site detention tank. The following capture rates have been adopted for the MUSIC model, based on information provided by Stormwater360:

  - TSS 93.4%
  - TN 55.9%
  - TP 86.1%

- 20kL Rainwater Tank

Refer to **Appendix B and D** for the location and size of the proposed located systems and information relating to the proposed WSUD products.

7 Conclusion

Based on preliminary investigations, analyses and designs, it is anticipated that there will be no significant issues associated with 3 Quarry Road & 4 Vineys Road, Dural.

The Water Management Plan herein, proposes a series of individual elements arranged in a treatment train consisting of on-lot treatment, street level treatment and precinct based public domain infrastructure treatment measures. Suggested structural elements for the development include:

- Stormwater pit filter inserts
- Proprietary filter cartridge systems downstream
- Rainwater reuse tank - 20,000L Tank.

The stormwater assessment report has been prepared and conform to the requirements of the Hornsby Shire Council's Development Control Plan (DCP) 2013 and Development Design Specification 0074- Stormwater Drainage (Design), 2016.

Appendix A – Civil Engineering Plans

3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

CIVIL ENGINEERING WORKS
DEVELOPMENT APPLICATION

SOURCE : NEARMAP.COM.AU (©2018)

DRAWING SCHEDULE	
DRG No.	DRAWING TITLE
DAC01.01	COVER SHEET, DRAWING SCHEDULE AND LOCALITY PLAN
DAC01.11	GENERAL ARRANGMENT PLAN
DAC02.01	SPECIFICATION NOTES
DAC03.01	CONCEPT SEDIMENT AND SOIL EROSION CONTROL PLAN
DAC03.11	CONCEPT SEDIMENT AND SOIL EROSION CONTROL DETAILS
DAC04.01	CONCEPT SITEWORKS AND STORMWATER MANAGEMENT PLAN - SHEET 01
DAC04.02	CONCEPT SITEWORKS AND STORMWATER MANAGEMENT PLAN - SHEET 02
DAC04.03	CONCEPT SITEWORKS AND STORMWATER MANAGEMENT PLAN - SHEET 03
DAC05.01	CONCEPT CULVERT DESIGN
DAC05.11	CULVERT LONGITUDINAL SECTION
DAC05.21	CULVERT CROSS SECTION - SHEET 01
DAC05.22	CULVERT CROSS SECTION - SHEET 02
DAC06.01	DETAIL - SHEET 01
DAC06.02	DETAIL - SHEET 02
DAC06.03	DETAIL - SHEET 03
DAC07.01	CATCHMENT PLAN

DRAWN: C. PASKE
DESIGNED: N. NAICKER
JOB MANAGER: J. GILLIGAN
VERIFIER:

NOT FOR CONSTRUCTION

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
0	REVISION IN PROGRESS	CP	-	NN	12.04.18
1	ISSUED FOR REVIEW	CP	-	NN	03.05.18
2	ISSUED FOR INFORMATION	CP	-	JG	19.06.18

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ARCHITECT
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PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

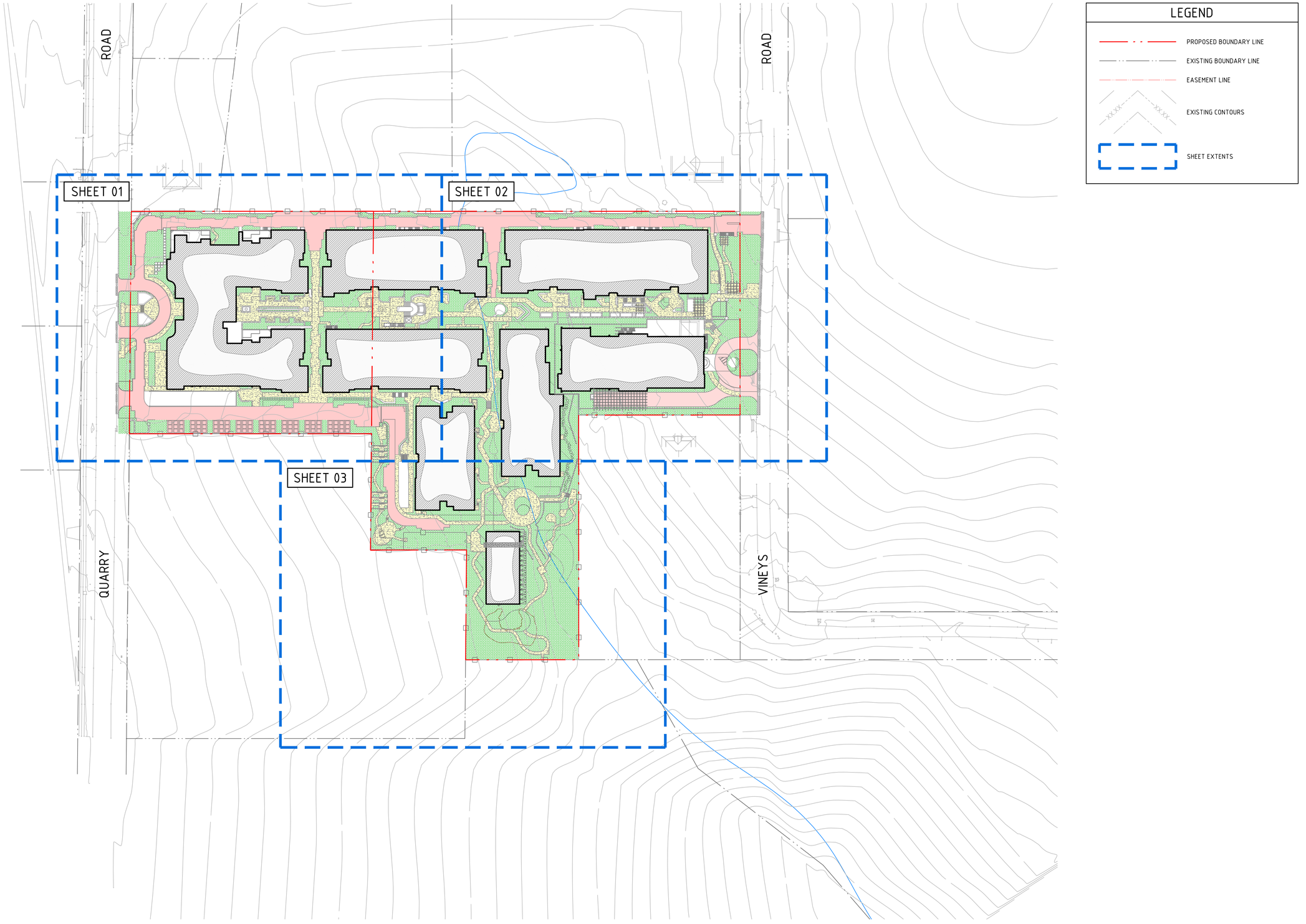
COVER SHEET, DRAWING SCHEDULE AND LOCALITY PLAN

JOB NUMBER **172490**

DRAWING NUMBER **DAC01.01**

REVISION **2**

DRAWING SHEET SIZE = A1



LEGEND

- PROPOSED BOUNDARY LINE
- EXISTING BOUNDARY LINE
- EASEMENT LINE
- EXISTING CONTOURS
- SHEET EXTENTS

DRAWN: C. PASKE
DESIGNED: N. NAICKER
JOB MANAGER: J. GILLIGAN
VERIFIER:

NOT FOR CONSTRUCTION

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
0	REVISION IN PROGRESS	CP	-	NN	12.04.18
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PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

GENERAL ARRANGMENT PLAN

JOB NUMBER **172490**
DRAWING NUMBER **DAC01.11**
REVISION **2**
DRAWING SHEET SIZE = A1

NOTE: ALL CIVIL ENGINEERING CONSTRUCTION WORKS TO BE CARRIED OUT IN ACCORDANCE WITH HORSNBY SHIRE COUNCIL DEVELOPMENT GUIDELINES .THE AFOREMENTIONED GUIDELINES INCLUSIVE OF ALL SPECIFICATIONS TAKE PRECEDENCE OVER NOTES PROVIDED BELOW.

STORMWATER DRAINAGE

1. ALL DRAINAGE LINES SHALL BE UPVC (CLASS SN4) SEWER GRADE DRAINAGE PIPE, U.N.O.
2. ALL DRAINAGE LINES SHALL BE LAID AT 1% MIN. FALL, UNO.
3. ALL LEVELS ARE AUSTRALIAN HEIGHT DATUM (AHD).
4. ALL DOWNPIPES GUTTERS TO BE DESIGNED IN ACCORDANCE WITH AS/NZS 3500.3.2 – 2003 'STORMWATER' DRAINAGE.
5. THE STORMWATER DRAINAGE DESIGN HAS BEEN CARRIED OUT IN ACCORDANCE WITH AS/NZS 3500.3.2-2003 'STORMWATER' DRAINAGE.
6. ANY VARIATIONS TO THE NOMINATED LEVELS SHALL BE REFERRED TO ENGINEER IMMEDIATELY.
7. SUBSOIL DRAINAGE SHALL BE PROVIDED TO ALL RETAINING WALLS & EMBANKMENTS, WITH THE LINES FEEDING INTO THE STORMWATER DRAINAGE SYSTEM.
8. ALL GRATES TO BE GALVANISED STEEL WITH HINGES AND CHILD PROOF LOCK.
9. ALL GRATES TO BE HEEL SAFE WITHIN AGED CARE DEVELOPMENTS.
10. THE STORMWATER DRAINAGE IS DESIGNED IN ACCORDANCE WITH HORNSBY SHIRE COUNCIL DEVELOPMENT DESIGN SPECIFICATION 0074 STOMRWATER DRAINAGE DESIGN, JULY 2016.

RAINWATER RE-USE

1. PROVIDE RAINWATER RE-USE SYSTEM TO SUPPLY WATER FOR TOILET FLUSHING.
2. GUTTER GUARD TO BE INSTALLED ON ALL EAVES GUTTERS.
3. A PERMANENT SIGN IS TO BE LOCATED IN THE VICINITY OF THE TANK STATING THE WATER IS "NON POTABLE WATER" WITH APPROPRIATE HAZARD IDENTIFICATION.
4. PIPEWORK USED FOR RAINWATER SERVICES SHALL BE COLOURED LILAC IN ACCORDANCE WITH AS1345.
5. ALL VALVES AND APERTURES SHALL BE CLEARLY AND PERMANENTLY LABELLED WITH SAFETY SIGNS TO COMPLY WITH AS1319.
6. RAINWATER TANK RETICULATION SYSTEM AND MAINS WATER BYPASS ARRANGEMENT TO BE INSTALLED IN ACCORDANCE WITH AS/NZS 3500.1.2-2003 AND THE NSW CODE OF PRACTICE : PLUMBING AND DRAINING.
7. A FIRST FLUSH FILTRATION DEVICE IS TO BE PROVIDED AT RAINWATER TANK.

GENERAL NOTES

THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER CONSULTANTS' DRAWINGS AND SPECIFICATIONS AND WITH OTHER SUCH WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT. ANY DISCREPANCY SHALL BE REFERRED TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.

ALL DIMENSIONS ARE IN MILLIMETRES & ALL LEVELS ARE IN METRES, UNO (UNLESS NOTED OTHERWISE).

NO DIMENSION SHALL BE OBTAINED BY SCALING THE DRAWINGS.

ALL LEVELS AND SETTING OUT DIMENSIONS SHOWN ON THE DRAWINGS SHALL BE CHECKED ON SITE PRIOR TO THE COMMENCEMENT OF THE WORK.

DETAIL SURVEY DATA WAS SUPPLIED BY HIGGINS SURVEYORS, DRAWING DATED 22/12/2016.

EXISTING SERVICES WHERE SHOWN HAVE BEEN PLOTTED FROM SUPPLIED DATA AND SUCH THEIR ACCURACY CAN NOT BE GUARANTEED. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ESTABLISH THE LEVEL OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF WORK.

ON COMPLETION OF STORMWATER INSTALLATION, ALL DISTURBED AREAS MUST BE RESTORED TO ORIGINAL CONDITION, INCLUDING KERBS, FOOTPATHS, CONCRETE AREAS, GRAVEL AND GRASSED AREAS AND ROAD PAVEMENTS, UNLESS DIRECTED OTHERWISE.

ALL STORMWATER MANAGEMENT MEASURES SHOWN ON THIS DRAWING HAVE BEEN PREPARED FOR DEVELOPMENT APPLICATION PURPOSES TO DEMONSTRATE FEASIBILITY. ALL MEASURES WILL BE SUBJECT TO DETAIL DESIGN AT THE CONSTRUCTION CERTIFICATE STAGE AND MAY BE SUBJECT TO VARIATION PROVIDED THAT THE DESIGN INTENT IS MAINTAINED.

DESIGN SUMMARY

CATCHMENT CALCULATIONS:

	PRE-DEVELOPMENT	POST-DEVELOPMENT
TOTAL AREA	29,695.90m²	29,695.90m²
IMPERVIOUS AREA	555.03m² (1.9%)	20,399.79m² (68.7%)
PERVIOUS AREA	29140.87m² (98.1%)	9,296.11m² (31.3%)

SITE DISCHARGE CALCULATIONS:

	5 YEAR ARI	100 YEAR ARI
PRE-DEVELOPMENT	790 L/s	1340 L/s
POST-DEVELOPMENT	530 L/s	790 L/s

ON-SITE DETENTION:

DESIGN BASIS:
- PRE TO POST DEVELOPMENT CONDITIONS USING 'DRAINS'.

EMAIL 'NNAICKER@NORTHROP.COM.AU' FOR 'DRAINS' FILE.

PRE-DEVELOPED RUNOFF CALCULATED USING THE RATIONAL METHOD IN ACCORDANCE WITH HORNSBY SHIRE COUNCIL'S 'POLICY FOR STORMWATER MANAGEMENT'.

A= CATCHMENT AREA (m^2)= 29695.90 m^2
I_{100}= 265 mm/hr
Tc= 6.6 MINUTES
PRE-DEVELOPED 5YR RUNOFF = 790 L/s
POST-DEVELOPED RUNOFF CALCULATED USING 'DRAINS'
POST-DEVELOPED 100YR RUNOFF = 790 L/s

STORMWATER DRAINAGE REQUIREMENTS HAVE BEEN CALCULATED IN ACCORDANCE WITH HORNSBY SHIRE COUNCIL.

BYPASS AREA / (PERCENTAGE) = 2170.75m² (7.3%)

ON-SITE DETENTION STORAGE PROVIDED = 650m^3

ON-SITE DETENTION SUMMARY:
- BELOW GROUND BLOCK WORK TANK

TOP WATER LEVEL = RL196.32
OVERFLOW LEVEL = RL197.00
ORIFICE CENTERLINE = RL194.65
ORIFICE DIAMETER = Φ572mm

RAINWATER RE-USE:

IN ACCORDANCE WITH BASIX/COUNCIL REQUIREMENTS.
RAINWATER RE-USE STORAGE REQUIRED = 20m^3
RAINWATER RE-USE STORAGE PROVIDED = 20m^3

RAINWATER RE-USE TO BE USED FOR THE FOLLOWING;
- IRRIGATION

STORMWATER MANAGEMENT REQUIREMENTS HAVE BEEN CALCULATED IN ACCORDANCE WITH HORNSBY SHIRE COUNCIL DEVELOPMENT DESIGN SPECIFICAION 0074 STORMWATER DRAINAGE (DESIGN, JULY 2016).

WATER QUALITY:

MUSIC MODEL SUMMARY (EMAIL 'NNAICKER@NORTHROP.COM.AU' FOR 'MUSIC' FILE)

MUSIC MODEL SUMMARY:

SOURCE NODE	CATCHMENT	AREA
URBAN	ROOF AREA (TOTAL)	9620m²
URBAN	OPEN SPACE	2507.6m²
URBAN	GROUND TO OSD	8274.4m²
URBAN	DRIVEWAY	3285m²
		TOTAL 23687m²

TREATMENT NODES:

- RAINWATER RE-USE TANK
- ON-SITE DETENTION TANK
- STORMWATER 360 'STORMFILTER' CARTRIDGE
- VEGETATIVE SWALE

TREATMENT STANDARDS:

POLLUTANT	REDUCTION STANDARDS	REDUCTION ACHIEVED
GROSS POLLUTANTS	90%	98.3%
TOTAL SUSPENDED SOLIDS	80%	81.5%
TOTAL PHOSPHORUS	65%	68.8%
TOTAL NITROGEN	45%	45.1%

MUSIC MODEL PARAMETERS IN ACCORDANCE WITH HORNSBY SHIRE COUNCILS MUSIC MODELLING VERSION 6.3.0

MUSIC MODEL PARAMETERS IN ACCORDANCE WITH THE DRAFT NSW MUSIC MODELLING GUIDELINES REF: R.B17048.001.01 DATED AUGUST 2010.

VERIFIER:
JOB MANAGER: J GILLIGAN
DESIGNED: N NAICKER
DRAWN: C PASKE

NOT FOR CONSTRUCTION

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
0	REVISION IN PROGRESS	CP	-	NN	12.04.18
1	ISSUED FOR REVIEW	CP	-	NN	03.05.18
2	ISSUED FOR INFORMATION	CP	-	JG	19.06.18

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ARCHITECT
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Level 11 345 George Street, Sydney NSW 2000
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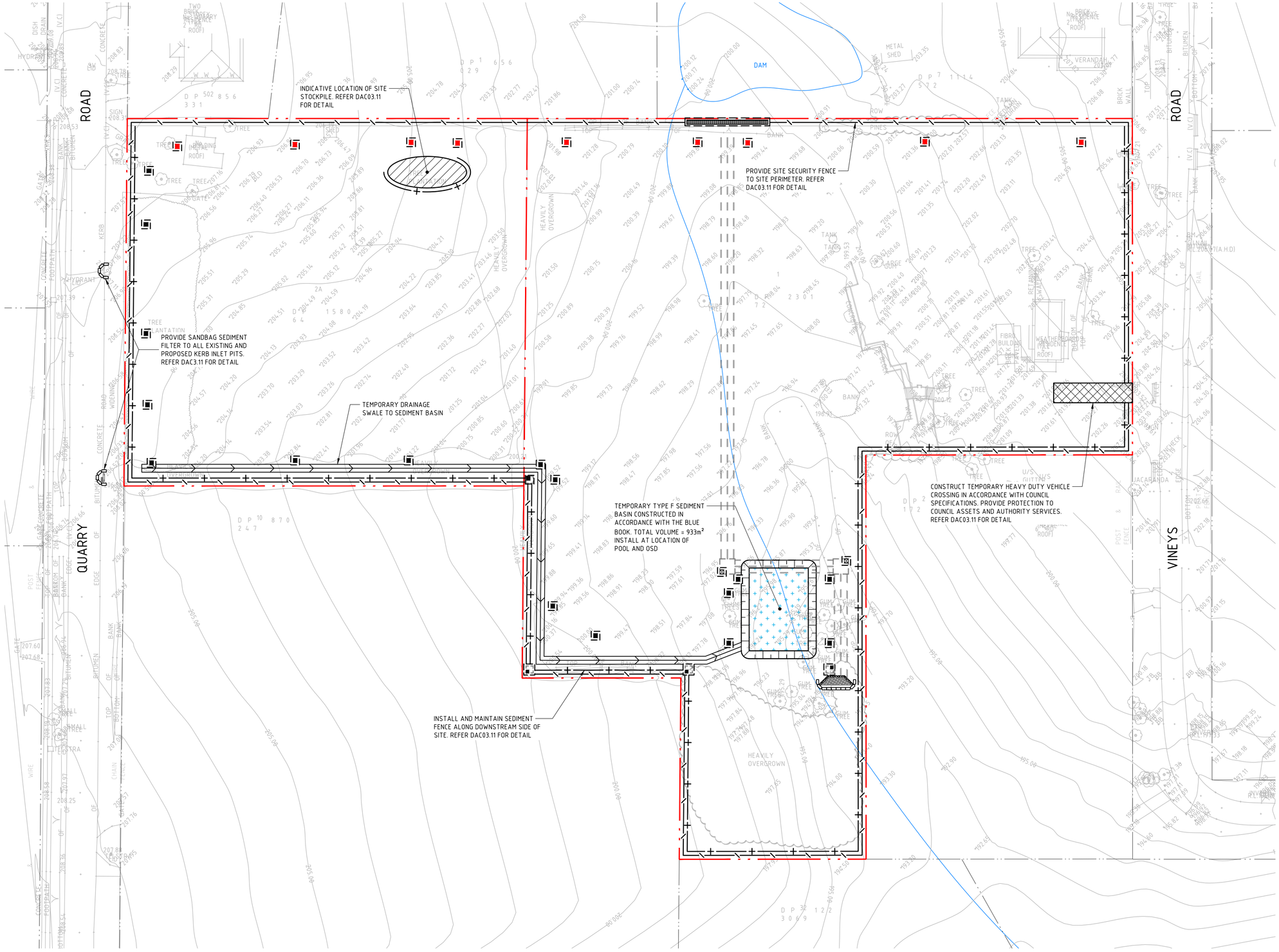
Email sydney@northrop.com.au ABN 81 094 433 100

PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

SPECIFICATION NOTES

JOB NUMBER **172490**
DRAWING NUMBER **DAC02.01**
REVISION **2**
DRAWING SHEET SIZE = A1



LEGEND

- PROPOSED BOUNDARY LINE
- EXISTING BOUNDARY LINE
- EASEMENT LINE
- EXISTING CONTOURS
- SEDIMENT FENCE
- SECURITY FENCE
- SANDBAG SEDIMENT FILTER
- DROP INLET SEDIMENT TRAP
- DRAINAGE SWALE
- DIVERSION MOUND
- DIVERSION DRAIN (CLEAN)
- DIVERSION DRAIN (DIRTY)
- STABILISED SITE ACCESS
- STOCKPILE
- SEDIMENT BASIN

DRAWN: C. PASKE
DESIGNED: N. NAICKER
JOB MANAGER: J. GILLIGAN
VERIFIER:

NOT FOR CONSTRUCTION

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
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SCALE 1:500@A1 0 5 10 15 20 25m

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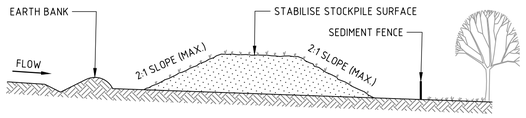
PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

CONCEPT SEDIMENT AND SOIL EROSION CONTROL PLAN

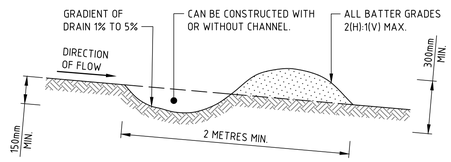
JOB NUMBER **172490**
DRAWING NUMBER **DAC03.01**
REVISION **2**
DRAWING SHEET SIZE = A1



CONSTRUCTION NOTES

1. PLACE STOCKPILES MORE THAN 2m (PREFERABLY 5m) FROM EXISTING VEGETATION, CONCENTRATED WATER FLOW, ROADS AND HAZARD AREAS.
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT, ELONGATED MOUNDS.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2m IN HEIGHT.
4. WHERE THEY ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE FOLLOWING THE APPROVED ESCP OR SWMP TO REDUCE THE C-FACTOR TO LESS THAN 0.10.
5. CONSTRUCT EARTH BANKS (STANDARD DRAWING 5-5) ON THE UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES AND SEDIMENT FENCES (STANDARD DRAWING 6-8) 1 TO 2m DOWNSLOPE.

STOCKPILES (SD 4-1)

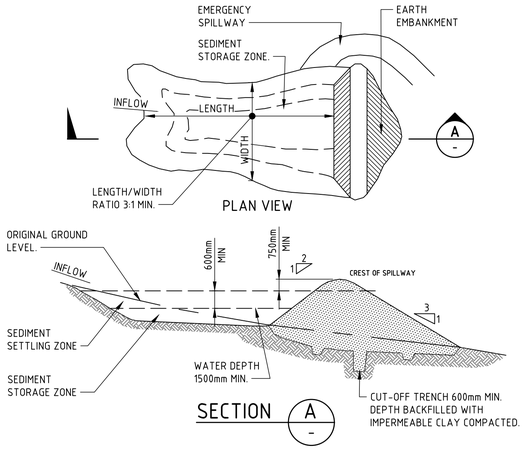


CONSTRUCTION NOTES

1. BUILD WITH GRADIENTS BETWEEN 1 AND 5 PERCENT.
2. AVOID REMOVING TREES AND SHRUBS IF POSSIBLE - WORK AROUND THEM.
3. ENSURE THE STRUCTURES ARE FREE OF PROJECTIONS OR OTHER IRREGULARITIES THAT COULD IMPEDE WATER FLOW.
4. BUILD THE DRAINS WITH CIRCULAR, PARABOLIC OR TRAPEZOIDAL CROSS SECTIONS, NOT V SHAPED.
5. ENSURE THE BANKS ARE PROPERLY COMPACTED TO PREVENT FAILURE.
6. COMPLETE PERMANENT OR TEMPORARY STABILISATION WITHIN 10 DAYS OF CONSTRUCTION.

NOTE: ONLY TO BE USED AS TEMPORARY BANK
WHERE MAXIMUM UPSLOPE LENGTH IS 80 METRES.

EARTH BANK - LOW FLOW (SD 5-5)

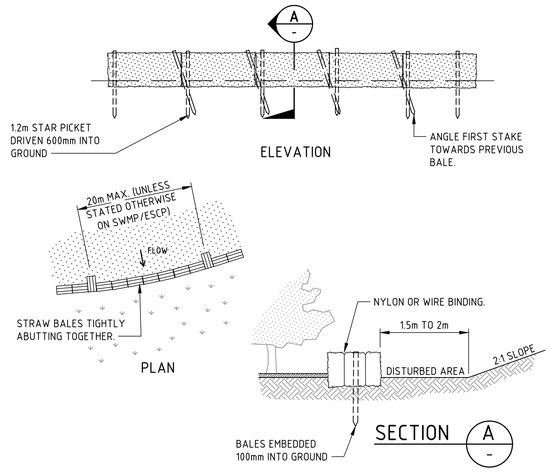


CONSTRUCTION NOTES

1. REMOVE ALL VEGETATION AND TOPSOIL FROM UNDER THE DAM WALL AND FROM WITHIN THE STORAGE AREA.
2. CONSTRUCT A CUT-OFF TRENCH 500mm DEEP AND 1200mm WIDE ALONG THE CENTRELINE OF THE EMBANKMENT EXTENDING TO A POINT ON THE GULLY WALL LEVEL WITH THE RISER CREST.
3. MAINTAIN THE TRENCH FREE OF WATER AND RECOMPACT THE MATERIALS WITH EQUIPMENT AS SPECIFIED IN THE SWMP TO 95 PER CENT STANDARD PROCTOR DENSITY.
4. SELECT FILL FOLLOWING THE SWMP THAT IS FREE OF ROOTS, WOOD, ROCK, LARGE STONE OR FOREIGN MATERIAL.
5. PREPARE THE SITE UNDER THE EMBANKMENT BY RIPPING TO AT LEAST 100mm TO HELP BOND COMPACTED FILL TO THE EXISTING SUBSTRATE.
6. SPREAD THE FILL IN 100mm TO 150mm LAYERS AND COMPACT IT AT OPTIMUM MOISTURE CONTENT FOLLOWING THE SWMP.
7. CONSTRUCT THE EMERGENCY SPILLWAY.
8. REHABILITATE THE STRUCTURE FOLLOWING THE SWMP.

(APPLIES TO 'TYPE D' AND 'TYPE F' SOILS ONLY)

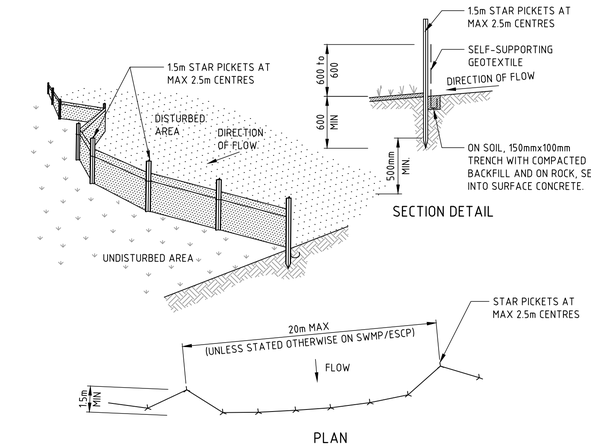
EARTH BASIN - WET (SD 6-4)



CONSTRUCTION NOTES

1. CONSTRUCT THE STRAW BALE FILTER AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE.
2. PLACE BALES LENGTHWISE IN A ROW WITH ENDS TIGHTLY ABUTTING. USE STRAW TO FILL ANY GAPS BETWEEN BALES. STRAWS ARE TO BE PLACED PARALLEL TO GROUND.
3. ENSURE THAT THE MAXIMUM HEIGHT OF THE FILTER IS ONE BALE.
4. EMBED EACH BALE IN THE GROUND 75mm TO 100mm AND ANCHOR WITH TWO 1.2 METRE STAR PICKETS OR STAKES. ANGLE THE FIRST STAR PICKET OR STAKE IN EACH BALE TOWARDS THE PREVIOUSLY LAID BALE. DRIVE THEM 600mm INTO THE GROUND AND, IF POSSIBLE, FLUSH WITH THE TOP OF THE BALES. WHERE STAR PICKETS ARE USED AND THEY PROTRUDE ABOVE THE BALES, ENSURE THEY ARE FITTED WITH SAFETY CAPS.
5. WHERE A STRAW BALE FILTER IS CONSTRUCTED DOWNSLOPE FROM A DISTURBED BATTER, ENSURE THE BALES ARE PLACED 1 TO 2 METRES DOWNSLOPE FROM THE TOE.
6. ESTABLISH A MAINTENANCE PROGRAM THAT ENSURES THE INTEGRITY OF THE BALES IS RETAINED - THEY COULD REQUIRE REPLACEMENT EACH TWO TO FOUR MONTHS.

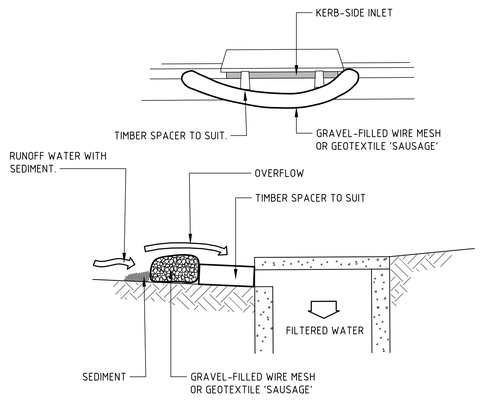
STRAW BALE FILTER (SD 6-7)



CONSTRUCTION NOTES

1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10-YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND AT 2.5 METRE INTERVALS (MAX) AT THE DOWNSLOPE EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.

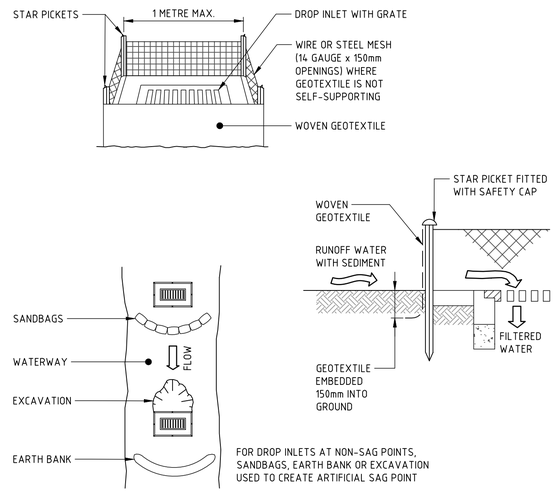
SEDIMENT FENCE (SD 6-8)



CONSTRUCTION NOTES

1. INSTALL FILTERS TO KERB INLETS ONLY AT SAG POINTS.
2. FABRICATE A SLEEVE MADE FROM GEOTEXTILE OR WIRE MESH LONGER THAN THE LENGTH OF THE INLET PIT AND FILL IT WITH 25mm TO 50mm GRAVEL.
3. FORM AN ELLIPTICAL CROSS-SECTION ABOUT 150mm HIGH x 400mm WIDE.
4. PLACE THE FILTER AT THE OPENING LEAVING AT LEAST A 100mm SPACE BETWEEN IT AND THE KERB INLET. MAINTAIN THE OPENING WITH SPACER BLOCKS.
5. FORM A SEAL WITH THE KERB TO PREVENT SEDIMENT BYPASSING THE FILTER.
6. SANDBAGS FILLED WITH GRAVEL CAN SUBSTITUTE FOR THE MESH OR GEOTEXTILE PROVIDING THEY ARE PLACED SO THAT THEY FIRMLY ABUT EACH OTHER AND SEDIMENT-LADEN WATERS CANNOT PASS BETWEEN.

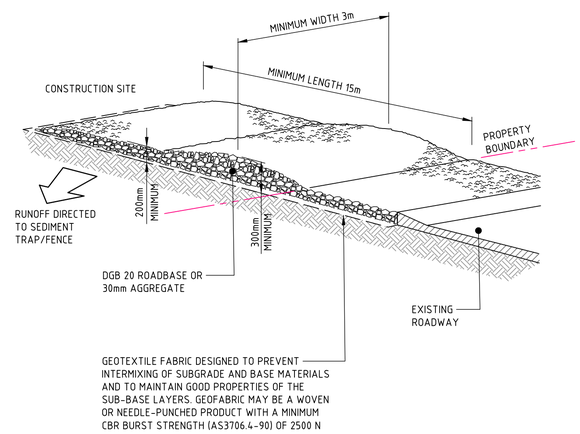
MESH AND GRAVEL INLET FILTER (SD 6-11)



CONSTRUCTION NOTES

1. FABRICATE A SEDIMENT BARRIER MADE FROM GEOTEXTILE OR STRAW BALES.
2. FOLLOW STANDARD DRAWING 6-7 AND STANDARD DRAWING 6-8 FOR INSTALLATION PROCEDURES FOR THE STRAW BALES OR GEOFABRIC. REDUCE THE PICKET SPACING TO 1 METRE CENTRES.
3. IN WATERWAYS, ARTIFICIAL SAG POINTS CAN BE CREATED WITH SANDBAGS OR EARTH BANKS AS SHOWN IN THE DRAWING.
4. DO NOT COVER THE INLET WITH GEOTEXTILE UNLESS THE DESIGN IS ADEQUATE TO ALLOW FOR ALL WATERS TO BYPASS IT.

GEOTEXTILE INLET FILTER (SD 6-12)



CONSTRUCTION NOTES

1. STRIP THE TOPSOIL, LEVEL THE SITE AND COMPACT THE SUBGRADE.
2. COVER THE AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
3. CONSTRUCT A 200mm THICK PAD OVER THE GEOTEXTILE USING ROAD BASE OR 30mm AGGREGATE.
4. ENSURE THE STRUCTURE IS AT LEAST 15 METRES LONG OR TO BUILDING ALIGNMENT AND AT LEAST 3 METRES WIDE.
5. WHERE A SEDIMENT FENCE JOINS ONTO THE STABILISED ACCESS, CONSTRUCT A HUMP IN THE STABILISED ACCESS TO DIVERT WATER TO THE SEDIMENT FENCE.

STABILISED SITE ACCESS (SD 6-14)

DESIGNED: N. NAICKER
DRAWN: C. PASKE
JOB MANAGER: J. GILLIGAN
VERIFIER:

NOT FOR CONSTRUCTION

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
0	REVISION IN PROGRESS	CP	-	NN	12.04.18
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PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION
CONCEPT SEDIMENT AND SOIL EROSION CONTROL DETAILS

JOB NUMBER **172490**
DRAWING NUMBER **DAC03.11**
REVISION **2**
DRAWING SHEET SIZE = A1

STORMWATER PITS ON PODIUM SLAB BY HYDRAULIC ENGINEER SIZED TO CONVEY 1:100 YEAR ARI STORM EVENT. TO CONNECT WITH ONSITE STORMWATER DETENTION TANK.

QUARRY ROAD

BUILDING A
FFL206.10
FFL203.00

BUILDING A
FFL206.10

BUILDING A
FFL203.00

BUILDING B
FFL203.00

BUILDING B
FFL199.90

BUILDING E
FFL203.00

BUILDING E
FFL199.90

BUILDING F
FFL199.00

TW208.10 TW208.00 TW209.00 TW209.00 TW207.20 TW207.20 TW205.60 TW204.60 TW203.10 TW207.40 TW206.60

RW

RL206.00 RL206.50 RL205.30 RL203.46 RL203.00 RL203.00 RL202.50 RL202.50 RL201.84 RL206.10 RL206.10 RL206.10 RL203.00 RL203.00 RL203.00 RL203.00 RL203.00 RL199 RL199.90 RL203.00 RL203.00 RL203.00 RL203.00 RL199.90 RL202.95 RL201.70 RL200.90 RL199.00

IL204.66 IL204.66 IL204.60 IL204.46 IL204.37 IL204.31 IL204.19 IL203.94 IL201.66 IL201.52 IL196.29 IL196.25

Ø375 RCP Ø375 RCP Ø450 RCP Ø450 RCP Ø525 RCP Ø525 RCP Ø600 RCP Ø600 RCP Ø1200 RCP Ø675 RCP

1:4 SLOPE

PROPOSED Ø1200 RCP STORMWATER PIPE ROUTE AND LOCATION TO BE CONFIRMED

FOR CONTINUATION REFER TO SHEET 02

FOR CONTINUATION REFER TO SHEET 03

LEGEND

- PROPOSED BOUNDARY LINE
- EXISTING BOUNDARY LINE
- EASEMENT LINE
- REDUNDANT BOUNDARY LINE
- PROPOSED KERB
- EXISTING KERB
- FUTURE KERB
- SAWCUT AND PAVEMENT INFILL
- KO — KERB ONLY
- KG — KERB AND GUTTER
- VC — VEHICULAR CROSSING
- KR — KERB RAMP
- CE — CONCRETE EDGING
- MTE — MATCH TO EXISTING
- × eRL.XX.XX — PROPOSED SPOT HEIGHT
- • RL.XX.XX — EXISTING SPOT HEIGHT
- FFLXX.XX — PROPOSED FINISHED FLOOR LEVEL
- X.X — DIRECTION OF GRADE
- BATTERS
- XX.XX — CONTOURS
- EXISTING CONTOURS
- V-SHAPED CHANNEL
- STORMWATER PIPE
- PROPOSED GRATED INLET PIT. CONNECTION OF STORMWATER PITS BY HYDRAULIC ENGINEER. TO CONNECT TO ON-SITE STORMWATER DETENTION TANK
- EXISTING DRAINAGE STRUCTURE
- NEW DRAINAGE STRUCTURE
- •B — BOLLARD
- RW — RETAINING WALL - TYPE 1
- MC01 — CONTROL LINE
- PAVEMENT
- FOOTPATH
- LANDSCAPING

NOTE:

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DRAWN: C. PASKE
DESIGNED: N. NAICKER
JOB MANAGER: J. GILLIGAN
VERIFIER:

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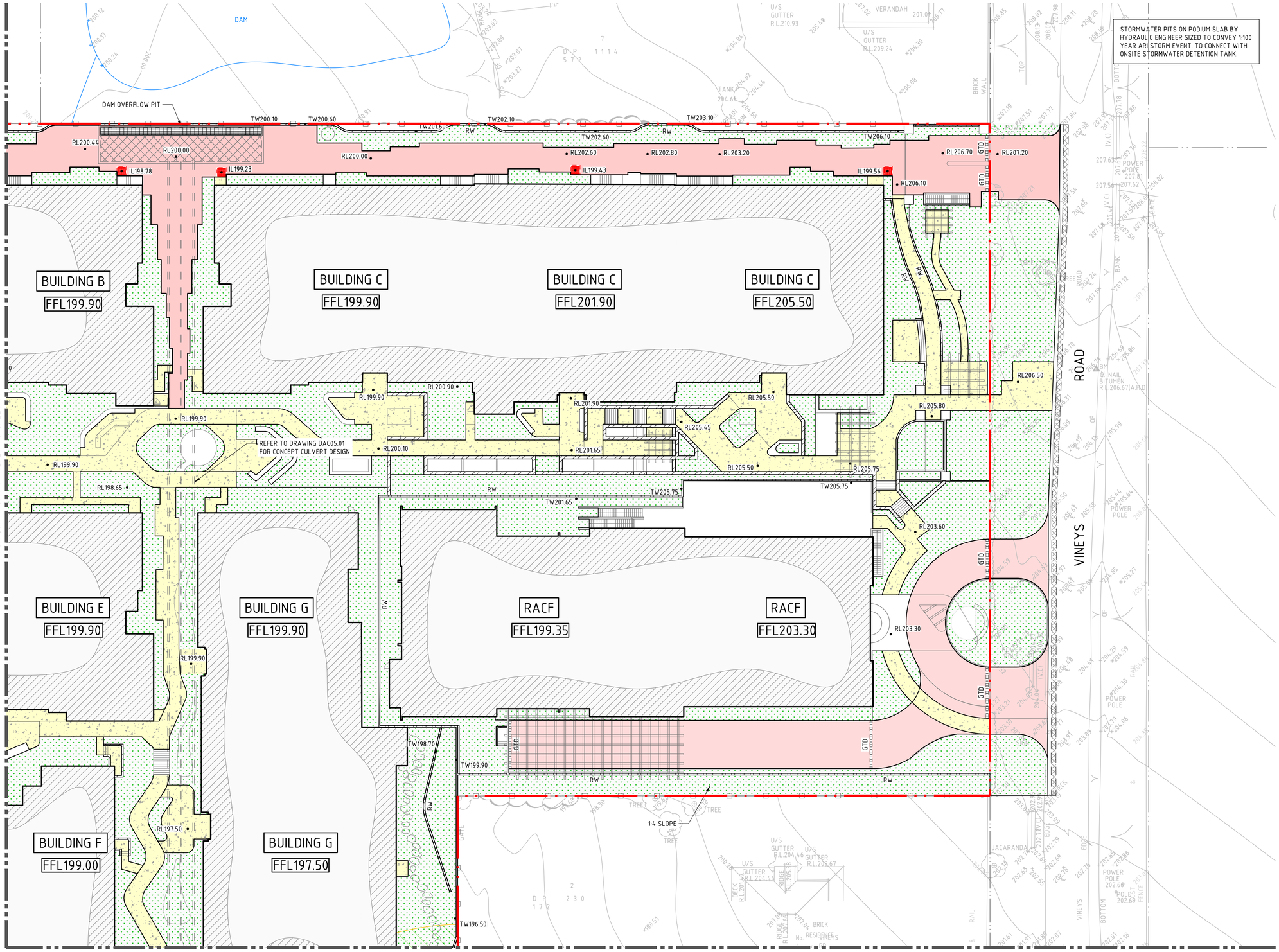
PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

CONCEPT SITEWORKS AND STORMWATER MANAGEMENT PLAN - SHEET 01

JOB NUMBER **172490**
DRAWING NUMBER **DAC04.01**
REVISION **2**
DRAWING SHEET SIZE = A1



LEGEND

- PROPOSED BOUNDARY LINE
- EXISTING BOUNDARY LINE
- EASEMENT LINE
- REDUNDANT BOUNDARY LINE
- PROPOSED KERB
- EXISTING KERB
- FUTURE KERB
- SAWCUT AND PAVEMENT INFILL
- KO — KERB ONLY
- KG — KERB AND GUTTER
- VC — VEHICULAR CROSSING
- KR — KERB RAMP
- CE — CONCRETE EDGING
- MTE — MATCH TO EXISTING
- × eRL XX.XX — PROPOSED SPOT HEIGHT
- • RL XX.XX — EXISTING SPOT HEIGHT
- FFL XX.XX — PROPOSED FINISHED FLOOR LEVEL
- X.X — DIRECTION OF GRADE
- BATTERS
- XX.XX — CONTOURS
- EXISTING CONTOURS
- V-SHAPED CHANNEL
- STORMWATER PIPE
- PROPOSED GRATED INLET PIT. CONNECTION OF STORMWATER PITS BY HYDRAULIC ENGINEER. TO CONNECT TO ON-SITE STORMWATER DETENTION TANK
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VERIFIER:
JOB MANAGER: J. GILLIGAN
DESIGNED: N. NAICKER
DRAWN: C. PASKE

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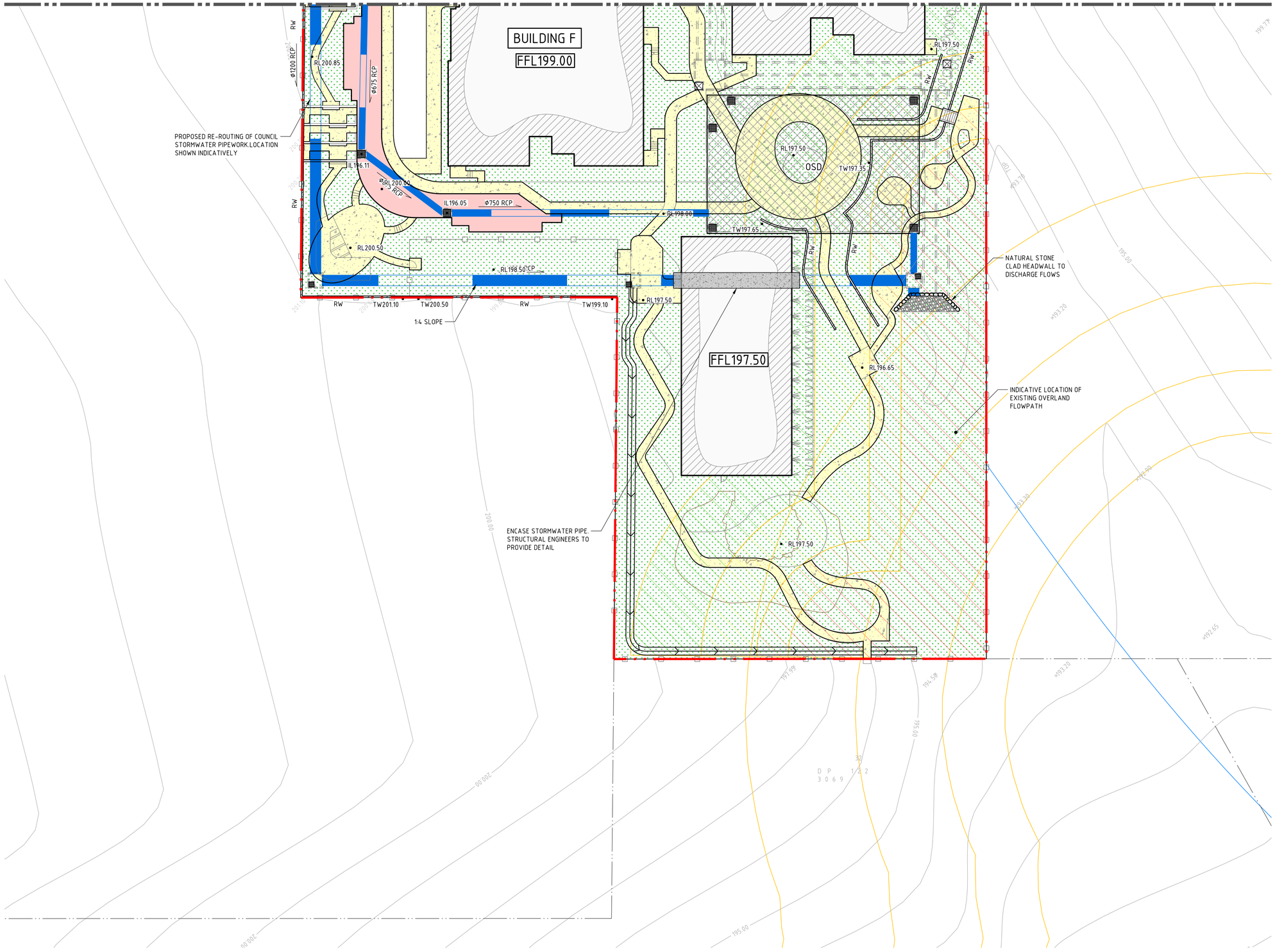
PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

CONCEPT SITEWORKS AND STORMWATER MANAGEMENT PLAN - SHEET 02

JOB NUMBER **172490**
DRAWING NUMBER **DAC04.02**
REVISION **2**
DRAWING SHEET SIZE = A1

FOR CONTINUATION REFER TO SHEET 01 & 02



LEGEND

- PROPOSED BOUNDARY LINE
- EXISTING BOUNDARY LINE
- EASEMENT LINE
- REDUNDANT BOUNDARY LINE
- PROPOSED KERB
- EXISTING KERB
- FUTURE KERB
- SAWCUT AND PAVEMENT INFILL
- KO — KERB ONLY
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- VC — VEHICULAR CROSSING
- KR — KERB RAMP
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- MTE — MATCH TO EXISTING
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- • RL XX.XX — EXISTING SPOT HEIGHT
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- X.X — DIRECTION OF GRADE
- BATTERS
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PROJECT: **3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL**

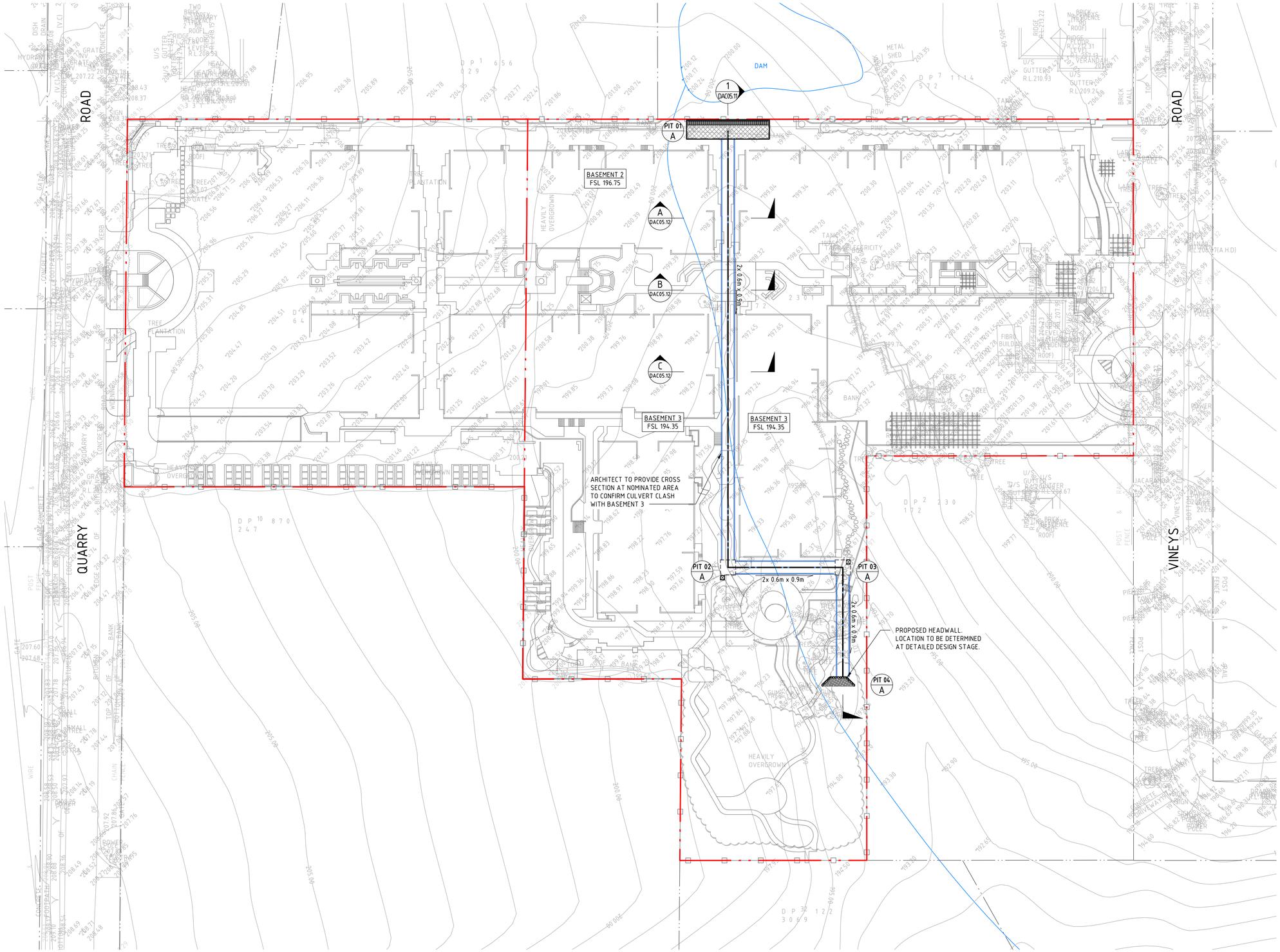
DRAWING TITLE: **CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION**

CONCEPT SITEWORKS AND STORMWATER MANAGEMENT PLAN - SHEET 03

JOB NUMBER: **172490**

DRAWING NUMBER: **DAC04.03** REVISION: **2**

DRAWING SHEET SIZE = A1



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DESIGNED: N. NAICKER
JOB MANAGER: J. GILLIGAN
VERIFIER:

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SCALE 1:500@A1
0 5 10 15 20 25m

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PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

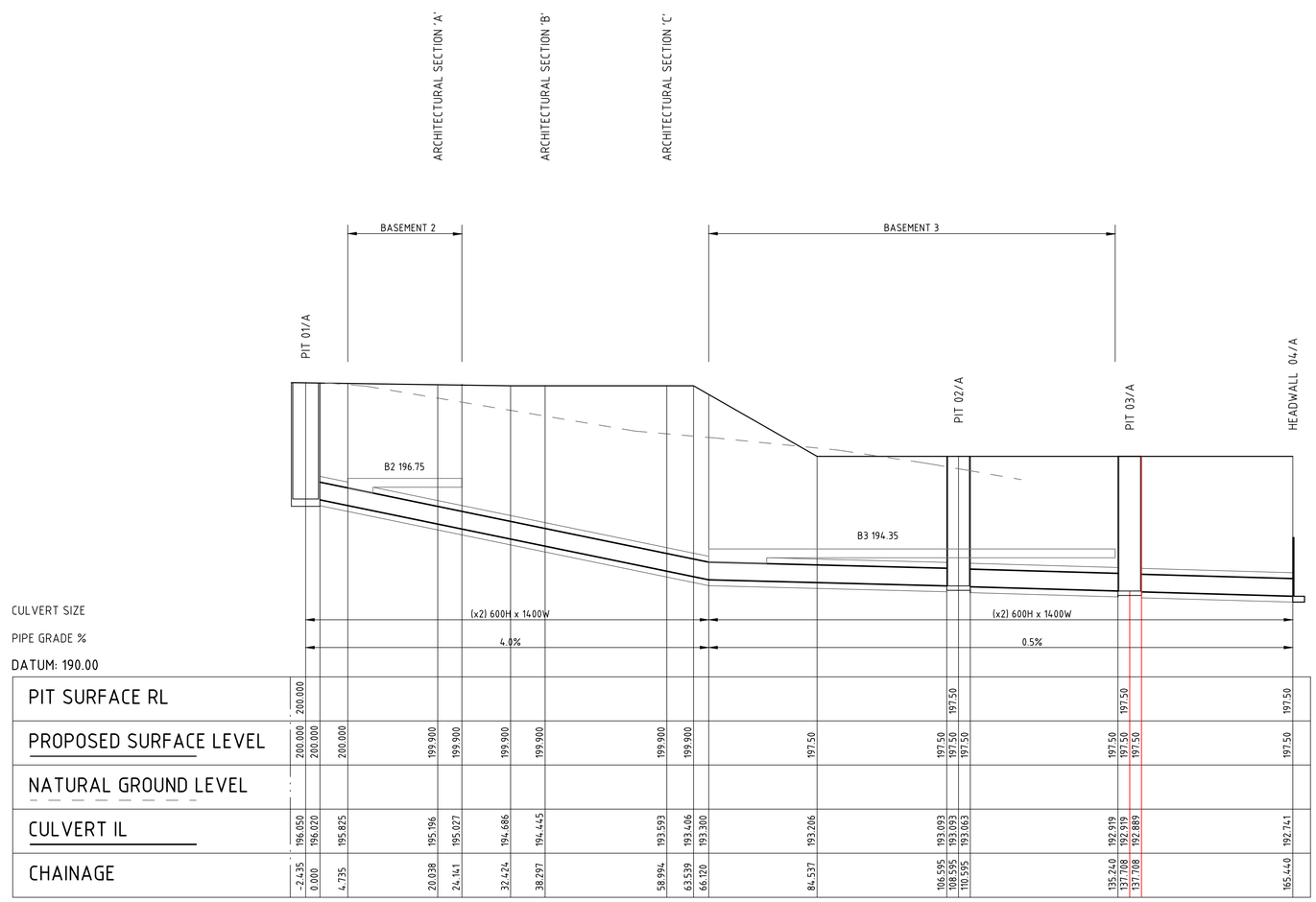
CONCEPT CULVERT DESIGN

JOB NUMBER **172490**

DRAWING NUMBER **DAC05.01**

REVISION **2**

DRAWING SHEET SIZE = A1



LONGITUDINAL SECTION

1 / DAC05.01

VERTICAL SCALE 1:10
HORIZONTAL SCALE 1:100

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DESIGNED: N. NAICKER
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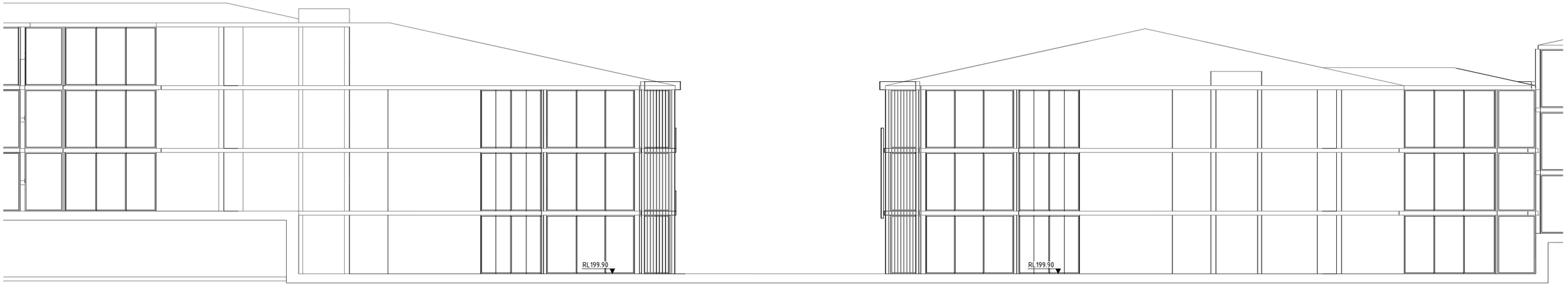
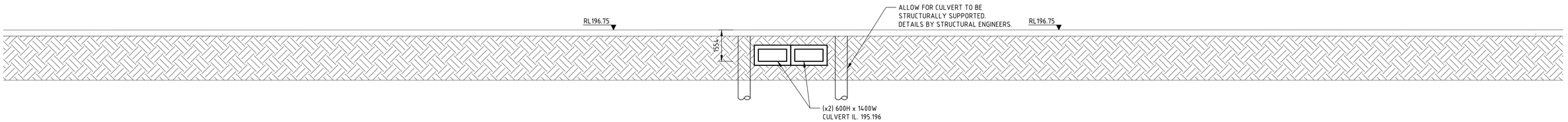
DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

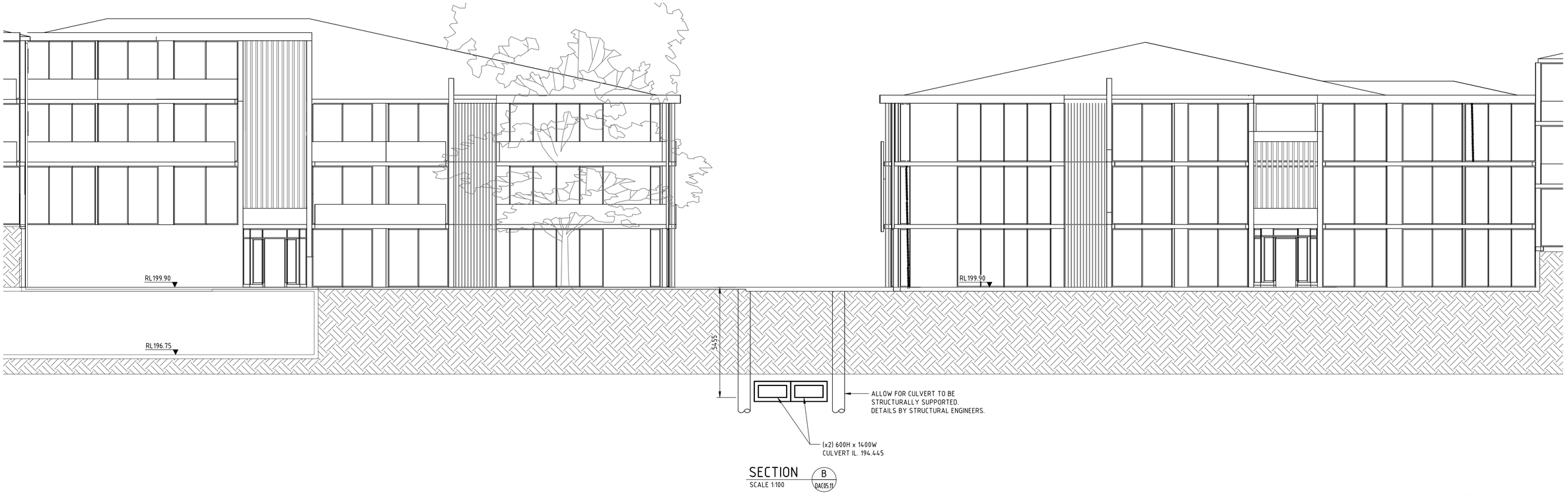
CULVERT LONGITUDINAL SECTION

JOB NUMBER **172490**
DRAWING NUMBER **DAC05.11**
REVISION **2**
DRAWING SHEET SIZE = A1





SECTION A
SCALE 1:100 DAC05.11



SECTION B
SCALE 1:100 DAC05.11

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DESIGNED: N. NAICKER
JOB MANAGER: J. GILLIGAN
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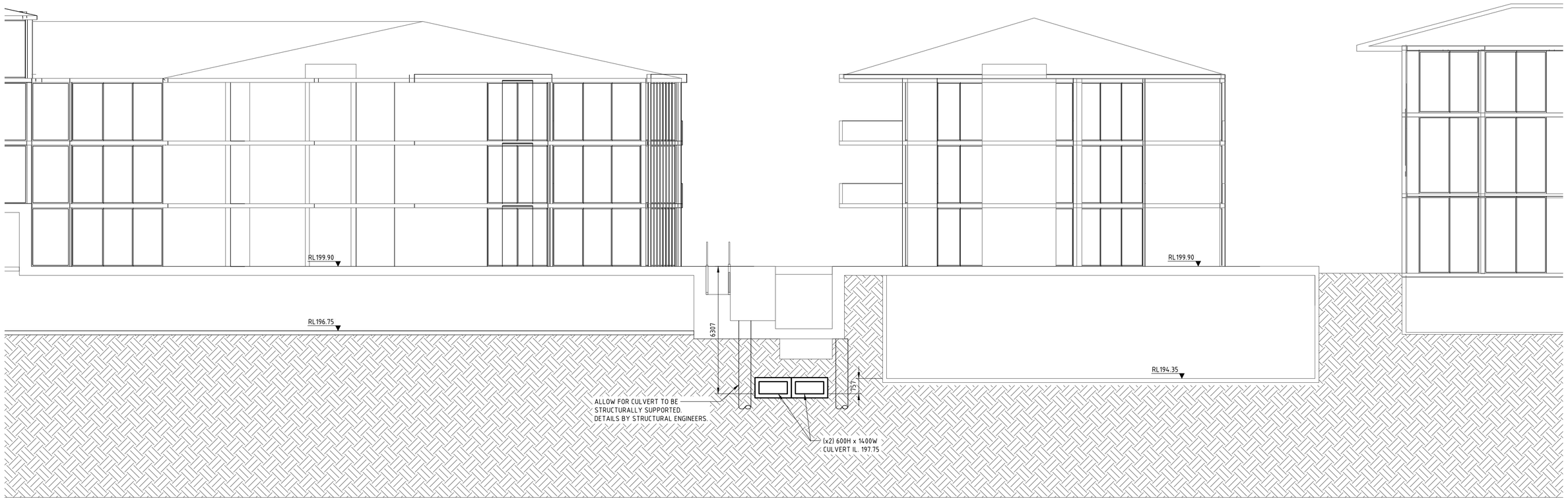
PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

CULVERT CROSS SECTION - SHEET 01

JOB NUMBER **172490**
DRAWING NUMBER **DAC05.21**
REVISION **2**
DRAWING SHEET SIZE = A1



SECTION C
SCALE 1:100
DAC05.11

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DESIGNED: N. NAICKER
JOB MANAGER: J. GILLIGAN
VERIFIER:

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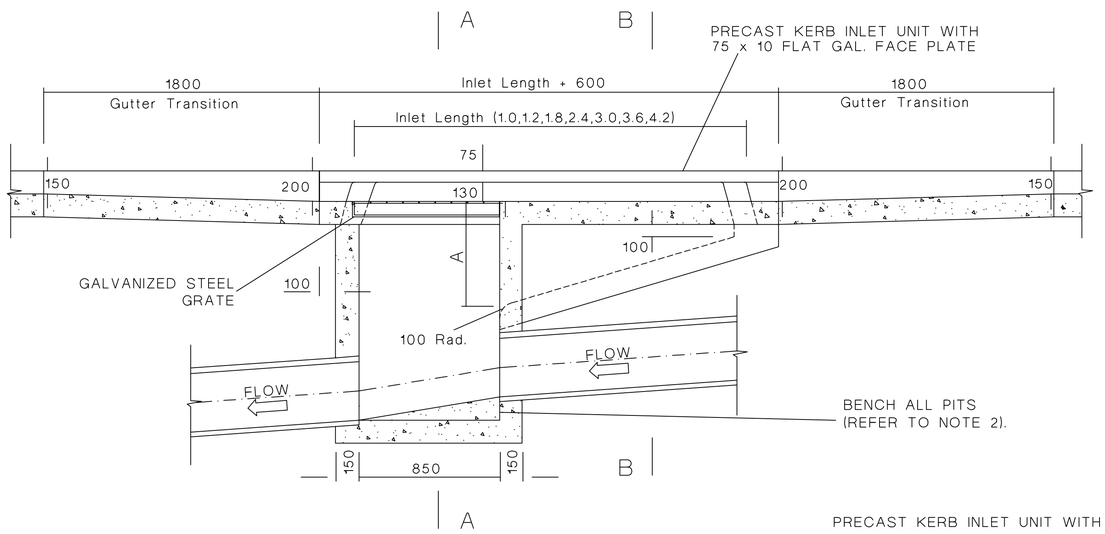
DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

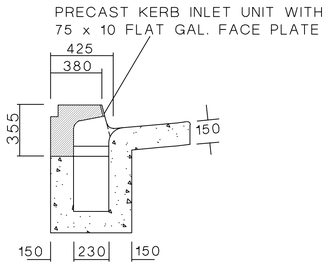
CULVERT CROSS SECTION - SHEET 02

JOB NUMBER **172490**
DRAWING NUMBER **DAC05.22**
REVISION **2**
DRAWING SHEET SIZE = A1

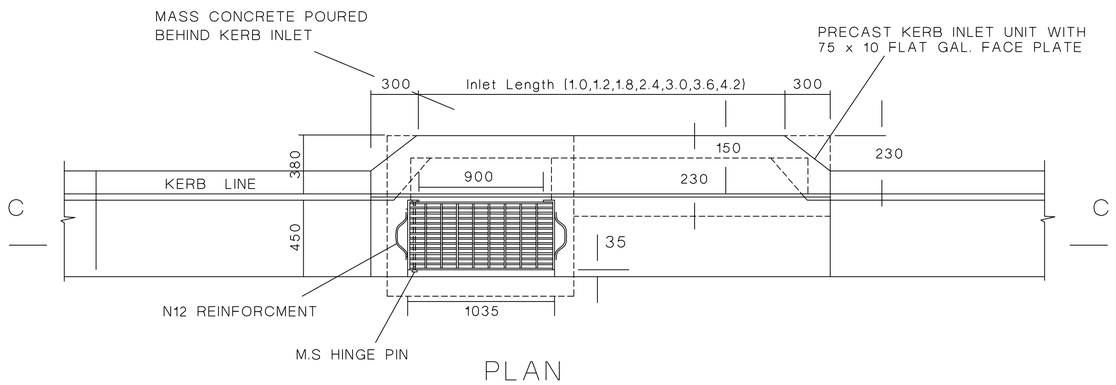


SECTION C-C

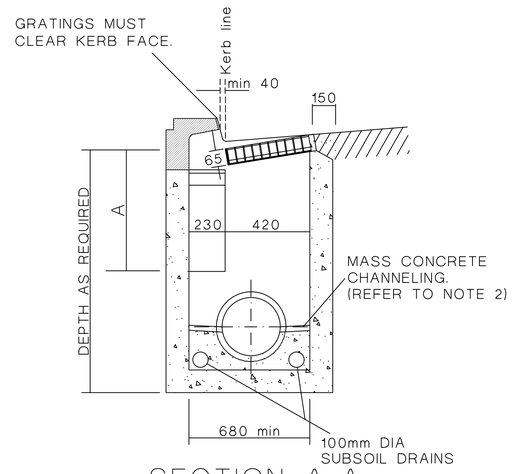
DIMENSION A (mm)	INLET LENGTH (m)
250	UP TO 1.8
300	2.4
350	3.0
400	3.6
450	4.2



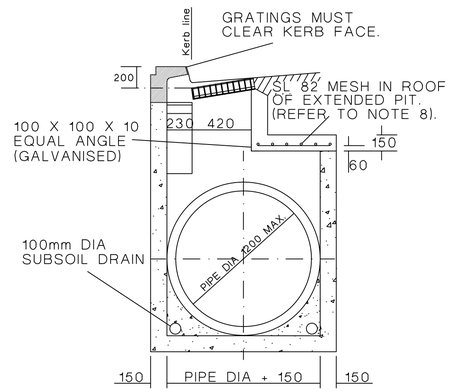
SECTION B-B



PLAN



SECTION A-A
(PIPES UP TO 525)



SECTION A-A
(PIPES > 525)

NOTES:

1. COMPRESSIVE STRENGTH OF CONCRETE AT 28 DAYS TO BE 20MPa.
2. TOP OF BENCHING TO BE 1/2 OF OUTLET PIPE DIAMETER.
3. 100 DIA. SUBSOIL DRAINAGE PIPE 3m LONG WRAPPED IN FABRIC SOCK TO BE PROVIDED AT INVERT LEVEL EITHER SIDE OF INLET PIPES.
4. PROVIDE STEP IRONS WHERE PIT IS DEEPER THAN 1.0m AT 450 CENTRES.
5. FOR PIT DEPTHS GREATER THAN 3.0m SEPARATE DESIGN IS REQUIRED.
6. PROVIDE HOT DIPPED GALVANIZED FABRICATED STEEL GULLY GRATE AND FRAME OF CLASS D. GRATE AND FRAME MUST COMPLY WITH AS3996-2006. OUTSIDE EDGE OF THE FRAME TO BE FLUSH WITH THE LIP OF THE GUTTER.
7. ALL GRATES TO HAVE LOCKING CLIP.
8. WHERE CHAMBER WIDTH EXCEEDS 1.2m, ROOF REINFORCEMENT TO BE DESIGNED BY A CHARTERED PROFESSIONAL.

DRAWN: C. PASKE
DESIGNED: N. NAICKER
JOB MANAGER: J. GILLIGAN
VERIFIER:

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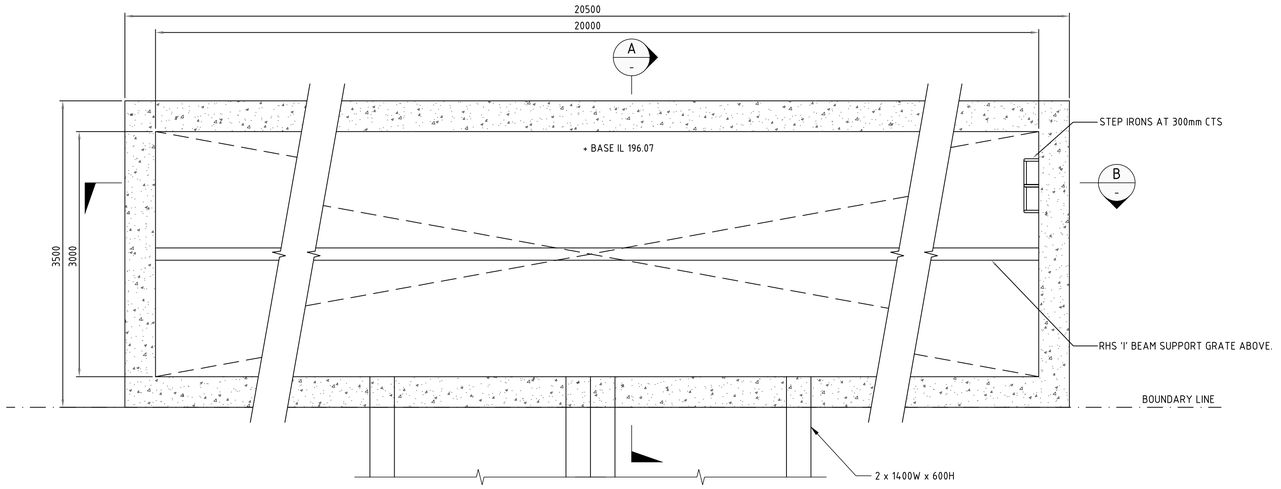
PROJECT: **3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL**

DRAWING TITLE: **CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION**

DETAIL - SHEET 01

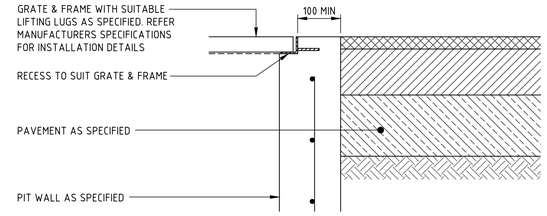
JOB NUMBER: **172490**
DRAWING NUMBER: **DAC06.01**
REVISION: **2**
DRAWING SHEET SIZE = A1



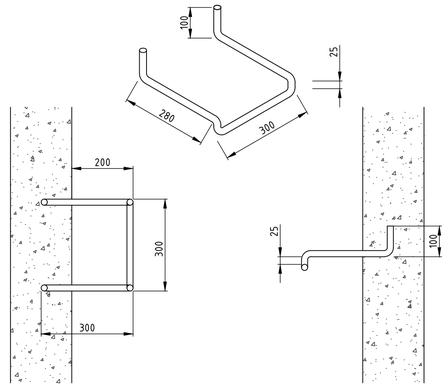
INLET ACCESS CHAMBER DETAIL

NOT TO SCALE

1 / FIG 6



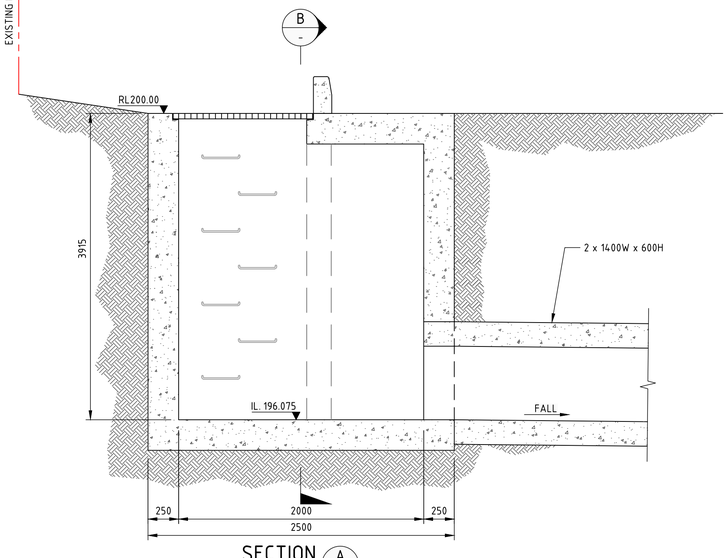
PIT INTERFACE - DETAIL 'A'



STEP IRON DETAIL

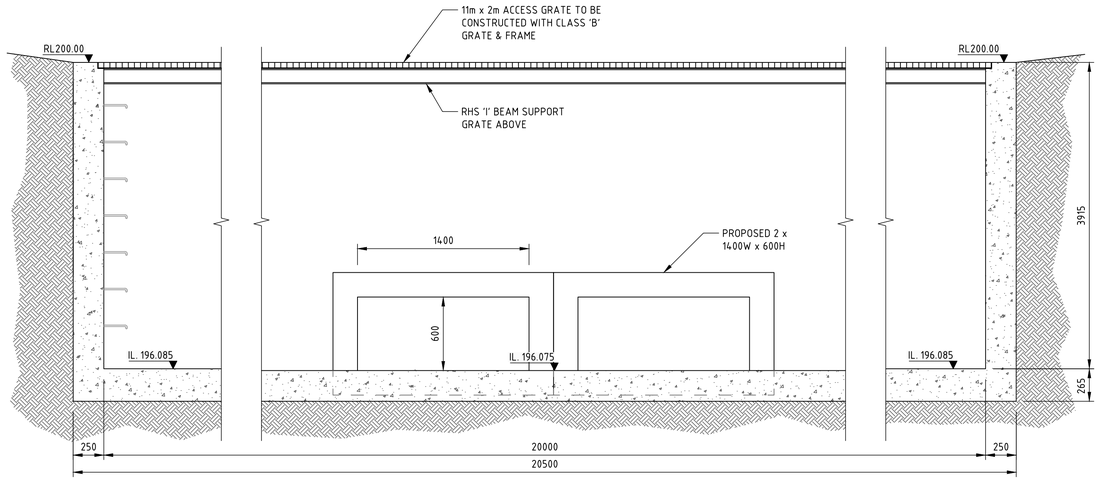
STEP IRON OF 20mm GALVANISED STEEL MADE TO SHAPE AND DIMENSIONS AS SHOWN, PLACED AT 300 CENTRES AND STAGGERED HORIZONTALLY FOR ALL PITS DEEPER THAN 1.0m. THE USE OF PROPRIETARY STEP IRONS ARE ACCEPTABLE PROVIDED THE PRODUCT IS IN ACCORDANCE WITH AUSTRALIAN STANDARDS

EXISTING BOUNDARY



SECTION A

NOT TO SCALE



SECTION B

NOT TO SCALE

DESIGNED: N. NAICKER
DRAWN: C. PASKE
JOB MANAGER: J. GILLIGAN
VERIFIER:

NOT FOR CONSTRUCTION

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NORTHROP
Sydney
Level 11 345 George Street, Sydney NSW 2000
Ph (02) 9241 4188 Fax (02) 9241 4324
Email sydney@northrop.com.au ABN 81 094 433 100

PROJECT: **3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL**

DRAWING TITLE: **CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION**

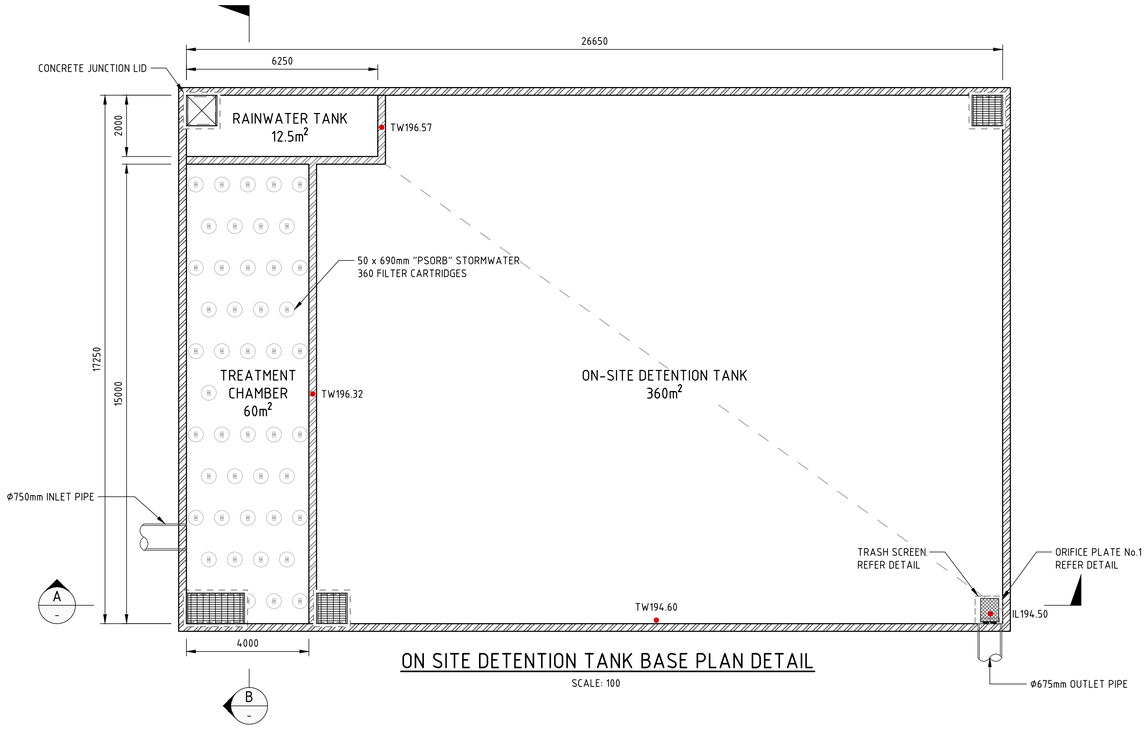
DETAIL - SHEET 02

JOB NUMBER: **172490**

DRAWING NUMBER: **DAC06.02**

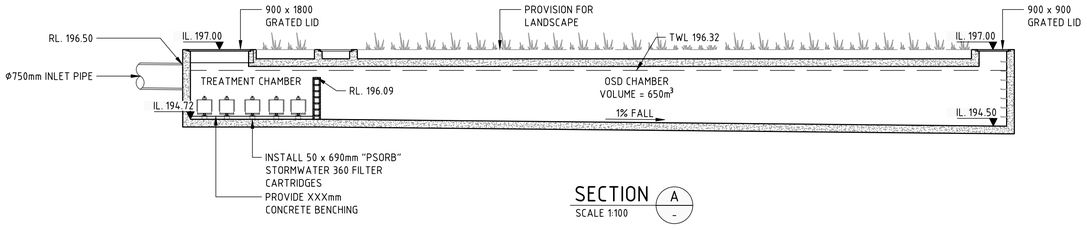
REVISION: **2**

DRAWING SHEET SIZE = A1



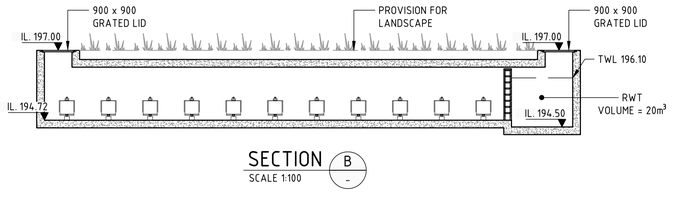
ON SITE DETENTION TANK BASE PLAN DETAIL

SCALE: 100



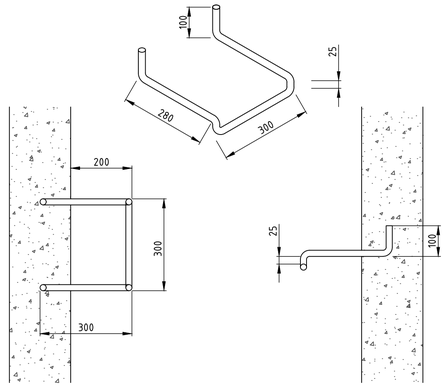
SECTION A

SCALE 1:100



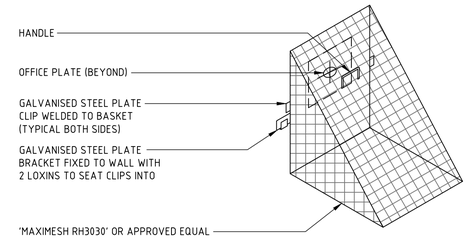
SECTION B

SCALE 1:100

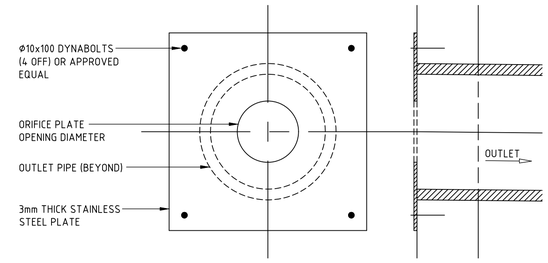


STEP IRON DETAIL

STEP IRON OF 20mm GALVANISED STEEL MADE TO SHAPE AND DIMENSIONS AS SHOWN, PLACED AT 300 CENTRES AND STAGGERED HORIZONTALLY FOR ALL PITS DEEPER THAN 1.0m. THE USE OF PROPRIETARY STEP IRONS ARE ACCEPTABLE PROVIDED THE PRODUCT IS IN ACCORDANCE WITH AUSTRALIAN STANDARDS



TRASH SCREEN DETAIL



ORIFICE PLATE DETAIL

- ORIFICE PLATE No 1 - Ø572

VERIFIER:
JOB MANAGER: J GILLIGAN
DESIGNED: N NAICKER
DRAWN: C PASKE

NOT FOR CONSTRUCTION

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
0	REVISION IN PROGRESS	CP	-	NN	12.04.18
1	ISSUED FOR REVIEW	CP	-	NN	03.05.18
2	ISSUED FOR INFORMATION	CP	-	JG	19.06.18

CLIENT
thelem CONSULTING
DRAWING NOT TO BE USED FOR CONSTRUCTION UNLESS VERIFICATION SIGNATURE HAS BEEN ADDED

ARCHITECT
marchesepartners

ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE COMMENCING WORK.
NORTHROP ACCEPTS NO RESPONSIBILITY FOR THE USABILITY, COMPLETENESS OR SCALE OF DRAWINGS TRANSFERRED ELECTRONICALLY.
THIS DRAWING MAY HAVE BEEN PREPARED USING COLOUR, AND MAY BE INCOMPLETE IF COPIED TO BLACK & WHITE

SCALE VARIES

NORTHROP
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PROJECT
3 QUARRY ROAD AND 4 VINEYS ROAD, DURAL

DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

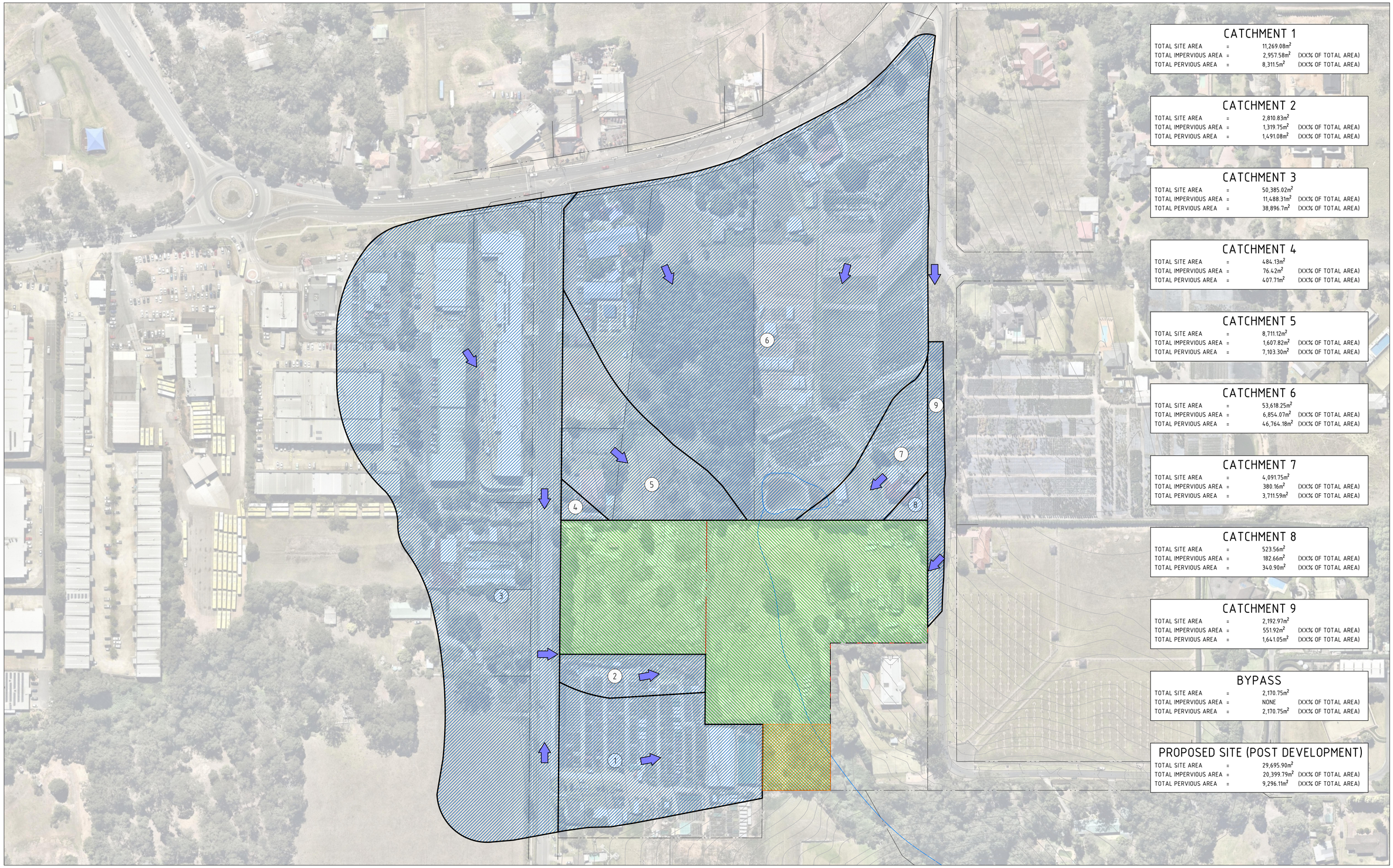
DETAIL - SHEET 03

JOB NUMBER **172490**

DRAWING NUMBER **DAC06.03**

REVISION **2**

DRAWING SHEET SIZE = A1



CATCHMENT 1

TOTAL SITE AREA	=	11,269.08m²	
TOTAL IMPERVIOUS AREA	=	2,957.58m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	8,311.5m²	(XX% OF TOTAL AREA)

CATCHMENT 2

TOTAL SITE AREA	=	2,810.83m²	
TOTAL IMPERVIOUS AREA	=	1,319.75m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	1,491.08m²	(XX% OF TOTAL AREA)

CATCHMENT 3

TOTAL SITE AREA	=	50,385.02m²	
TOTAL IMPERVIOUS AREA	=	11,488.31m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	38,896.7m²	(XX% OF TOTAL AREA)

CATCHMENT 4

TOTAL SITE AREA	=	484.13m²	
TOTAL IMPERVIOUS AREA	=	76.42m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	407.71m²	(XX% OF TOTAL AREA)

CATCHMENT 5

TOTAL SITE AREA	=	8,711.12m²	
TOTAL IMPERVIOUS AREA	=	1,607.82m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	7,103.30m²	(XX% OF TOTAL AREA)

CATCHMENT 6

TOTAL SITE AREA	=	53,618.25m²	
TOTAL IMPERVIOUS AREA	=	6,854.07m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	46,764.18m²	(XX% OF TOTAL AREA)

CATCHMENT 7

TOTAL SITE AREA	=	4,091.75m²	
TOTAL IMPERVIOUS AREA	=	380.16m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	3,711.59m²	(XX% OF TOTAL AREA)

CATCHMENT 8

TOTAL SITE AREA	=	523.56m²	
TOTAL IMPERVIOUS AREA	=	182.66m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	340.90m²	(XX% OF TOTAL AREA)

CATCHMENT 9

TOTAL SITE AREA	=	2,192.97m²	
TOTAL IMPERVIOUS AREA	=	551.92m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	1,641.05m²	(XX% OF TOTAL AREA)

BYPASS

TOTAL SITE AREA	=	2,170.75m²	
TOTAL IMPERVIOUS AREA	=	NONE	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	2,170.75m²	(XX% OF TOTAL AREA)

PROPOSED SITE (POST DEVELOPMENT)

TOTAL SITE AREA	=	29,695.90m²	
TOTAL IMPERVIOUS AREA	=	20,399.79m²	(XX% OF TOTAL AREA)
TOTAL PERVIOUS AREA	=	9,296.11m²	(XX% OF TOTAL AREA)

DRAWN: C.PASKE DESIGNED: N.NAICKER JOB MANAGER: J.GILLIGAN VERIFIER:

NOT FOR CONSTRUCTION

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE
0	REVISION IN PROGRESS	CP	-	NN	12.04.18
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SCALE 1:500@ A1 0 5 10 15 20 25m

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DRAWING TITLE
CIVIL ENGINEERING WORKS DEVELOPMENT APPLICATION

CATCHMENT PLAN

JOB NUMBER **172490**

DRAWING NUMBER **DAC07.01**

REVISION **2**

DRAWING SHEET SIZE = A1

Appendix B – Site Survey Plan

SEE SHEET 7

SEE SHEET 6

SEE SHEET 5

TWO STOREY BRICK RESIDENCE No. 2 QUARRY RD (TILE ROOF)

BRICK RESIDENCE No. 2 VINEYS RD (TILE ROOF)

BRICK RESIDENCE No. 6 VINEYS RD (METAL ROOF)

BRICK RESIDENCE No. 4 VINEYS RD (TILE ROOF)

FIBRO BUILDING

BUILDING No. 1 (METAL ROOF)

DAM

TANK

ELECTRICITY KIOSK

TREE PLANTATION

HEAVILY OVERGROWN

EASEMENT TRANSMISSION 1.83 WIDE

108.51 BY DP158064
101.50 AFTER WIDENING

VIDE DP 230172

QUARRY ROAD

VINEYS ROAD

DRIVEWAY

WIDENING

ASET @ 90°

NO INVESTIGATION OF UNDERGROUND SERVICES HAVE BEEN MADE. ALL RELEVANT AUTHORITIES SHOULD BE NOTIFIED PRIOR TO ANY EXCAVATION ON OR NEAR THE SITE

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

CARELESS DIGGING CAN:
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- CAUSE EXPENSIVE FINANCIAL LOSSES TO BUSINESS
- CUT OFF EMERGENCY SERVICES
- DELAY PROJECT COMPLETION TIMES WHILE THE DAMAGE IS REPAIRED

MINIMISE YOUR RISK & DIAL BEFORE YOU DIG
TELEPHONE: 1100

NOTES:

1) TITLE BEARINGS AND DIMENSIONS ARE SHOWN. BOUNDARY REDEFINITION HAS NOT BEEN UNDERTAKEN.
2) ORIGIN OF LEVELS: PM 20946 R.L 206.961(A.H.D.) (L.I.C 2016)
3) SITE COMPRISES LOT 2A D.P. 158064
   LOT 1 D.P. 230172
4) SITE AREA 2.968 ha BY TITLE DIMENSIONS.
5) UNDERGROUND SERVICES HAVE NOT BEEN INVESTIGATED.
6) (G) DENOTES GUTTER LEVEL.
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9) CONTOUR INTERVALS: MAJORS 1.0m
   MINORS 0.5m

—— O —— APPROXIMATE LINE OF OPTUS CABLE
—— S —— APPROXIMATE LINE OF SEWER LINE
—— W —— APPROXIMATE LINE OF WATER MAINS LINE

ISSUE	DATE	AMENDMENT
A	16-1-17	FINAL ISSUE OF PLAN

TITLE: PLAN SHOWING SELECTED DETAIL & LEVELS OVER No.3 QUARRY ROAD & 4 VINEYS RD, DURAL

LGA:	HORNSBY	REFERENCE:	17431
CLIENT :	H INVESTMENTS	DATE: 22-12-16	SHEET
SCALE (AT A0) 1:400	DATUM : AHD	SURVEYOR: RH	1

Higgins Surveyors
PROPERTY & DEVELOPMENTS CONSULTANTS
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QVB SYDNEY 1230
PH +61 2 9264 8044
FAX +61 2 9267 5468
admin@higginssurveyors.com.au

TWO STOREY
BRICK RESIDENCE
No. 2 *QUARRY RD*
(TILE ROOF)

RIDGE R.L.212.84
US GUTTER R.211.51
US GUTTER R.211.29
FLOOR LEVEL R.L.208.53
RIDGE R.L.212.15
HEAD R.L.214.51 SILL R.L.213.13
HEAD R.L.214.51 SILL R.L.213.13
HEAD R.L.210.99 SILL R.L.209.61
HEAD R.L.210.99 SILL R.L.209.61
HEAD R.L.210.99 SILL R.L.209.61
US GUTTER R.L.214.71

502

D P 856331

D P 656029

D P 158064

D P 230172

10

D P 870247

EASEMENT FOR TRANSMISSION 46' WIDE

108.51 BY DP158064
101.50 AFTER WIDENING

BUILDING No. 3 (METAL ROOF)

SHED

TREE PLANTATION

HEAVILY OVERGROWN

DAM

TANK

ELECTRICITY BOX

GUM TREE

BANK

QUARRY ROAD

WIDENING

CONCRETE FOOTPATH

BITUMEN

KERB

GRATE INV. R.L.206.84

GRATE INV. R.L.207.22

GRATE INV. R.L.206.04

GRATE INV. R.L.206.29

HYDRANT LID

POWER POLE

SIGN

GATE

FENCE

WIRE

TOP OF BANK

EDGE OF BITUMEN

93.24

153.525

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—— S —— APPROXIMATE LINE OF SEWER LINE
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CARELESS DIGGING CAN:
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- CAUSE EXPENSIVE FINANCIAL LOSSES TO BUSINESS
- CUT OFF EMERGENCY SERVICES
- DELAY PROJECT COMPLETION TIMES WHILE THE DAMAGE IS REPAIRED

MINIMISE YOUR RISK & DIAL BEFORE YOU DIG TELEPHONE: 1100

ISSUE	DATE	AMENDMENT
A	16-1-17	FINAL ISSUE OF PLAN

TITLE: PLAN SHOWING SELECTED DETAIL & LEVELS OVER No.3 QUARRY ROAD & 4 VINEYS RD, DURAL

LGA:	HORNSBY	REFERENCE:	17431
CLIENT :	H INVESTMENTS	DATE: 22-12-16	SHEET 2
SCALE (AT A0) 1:200	DATUM : AHD	SURVEYOR: RH	

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MINIMISE YOUR RISK & DIAL BEFORE YOU DIG TELEPHONE: 1100

D P 656029 — D P 1114572 — D P 230172 — D P 230172 — D P 230172

ROW OF PINES — 153.525 (VIDE DP 230172) — 67.665

ROAD — VINEYS — TRANSMISSION LINE — 1.83 WIDE — DAM — METAL SHED — TREE PLANTATION — HEAVILY OVERGROWN — BANK — GATE — FENCE — HEDGE — RAIL — POST — EDGE — TOP — BOTTOM — BITUMEN — WALL — CONCRETE — BLOCK — TIMBER RETAINING WALL — TANK — ELECTRICITY BOX — GUM TREE — LARGE GUM — LARGE TREE — TREE — POWER POLE — SIGN — WATER METER — JACARANDA

BRICK RESIDENCE No. 2 *VINEYS RD* (TILE ROOF)
RIDGE R.L.212.31
FLOOR LEVEL R.L.207.13
VERANDAH
U/S GUTTER R.L.210.93
U/S GUTTER R.L.209.24

FIBRO BUILDING — PAVED — CONC. 201.80 — BRICK

WEATHERBOARD RESIDENCE No. 4 (TILE ROOF)
RIDGE R.L.207.09
FLOOR LEVEL R.L.203.67
U/S GUTTER R.L.206.30
U/S GUTTER R.L.203.23

BRICK RESIDENCE No. 6 *VINEYS RD* (METAL ROOF)
RIDGE R.L.207.46
U/S GUTTER R.L.204.46
U/S GUTTER R.L.207.07
U/S GUTTER R.L.204.44

BM G.I.NAIL IN BITUMEN R.L.206.67(A.H.D)

SEE SHEET

ISSUE	DATE	AMENDMENT
A	16-1-17	FINAL ISSUE OF PLAN

TITLE: PLAN SHOWING SELECTED DETAIL & LEVELS OVER No.3 QUARRY ROAD & 4 VINEYS RD, DURAL

LGA: HORNSBY — REFERENCE: 17431

CLIENT : H INVESTMENTS — DATE: 22-12-16 — SHEET 3

SCALE (AT A0) 1:200 — DATUM : AHD — SURVEYOR: RH

Higgins Surveyors
PROPERTY & DEVELOPMENTS CONSULTANTS
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LEVEL 3, SUITE 3.05
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admin@higginssurveyors.com.au

SEE SHEET 2

SHEET 2

SEE SHEET 3

SHEET 3

SEE SHEET 4

SHEET 4

SEE SHEET 1

SHEET 1

10

D P 870247

108.51 BY DP158064
101.50 AFTER WIDENING
46' 30"

HEAVILY OVERGROWN

00"
200.00
18'
48.74
294'
203' 44' 00"
40.285

TOP OF BANK

2

D P 230172

ROW OF PINES

67.665
23' 44'

BRICK RESIDENCE
No. 6 *VINEYS RD*
(METAL ROAD)

U/S GUTTER R.L.204.46
U/S GUTTER R.L.204.43
U/S GUTTER R.L.204.44
RIDGE R.L.207.58
RIDGE R.L.207.04
TK CONC. R.L.201.78

BRICK BLOCK

TANK

BANK

GATE

TREE

GUM TREE

CLUMP OF TREES

GUM

00"
200.00
45'
102.525
293'

HEAVILY OVERGROWN

00"
200.00
45'
47.405
294'
203' 44' 00"

32

D P 1223069

T I N W M

ABT 9°30'

206.00

195.00

200.00

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CLIENT : H INVESTMENTS | DATE: 22-12-16 | SHEET 4

SCALE (AT A0) 1:200 | DATUM : AHD | SURVEYOR: RH

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FAX +61 2 9267 5468
admin@higginssurveyors.com.au

SEE SHEET 6

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6) (G) DENOTES GUTTER LEVEL.
7) TREE NAMES SHOWN CONSTITUTE OUR OPINION ONLY. IF TREE SPECIES IDENTIFICATION IS IMPORTANT FOR DESIGN OR HERITAGE REASONS THEY SHOULD BE DETERMINED BY A QUALIFIED ARBORIST.
8) CAUTION: SHOULD ANY DEVELOPMENT OR CONSTRUCTION BE PLANNED ON OR NEAR THE BOUNDARIES, THE BOUNDARIES SHOULD BE CLEARLY MARKED ON SITE
9) CONTOUR INTERVALS: MAJORS 1.0m
   MINORS 0.5m

—— O —— APPROXIMATE LINE OF OPTUS CABLE
—— S —— APPROXIMATE LINE OF SEWER LINE
—— W —— APPROXIMATE LINE OF WATER MAINS LINE

NO INVESTIGATION OF UNDERGROUND SERVICES HAVE BEEN MADE. ALL RELEVANT AUTHORITIES SHOULD BE NOTIFIED PRIOR TO ANY EXCAVATION ON OR NEAR THE SITE

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

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

MINIMISE YOUR RISK & DIAL BEFORE YOU DIG
TELEPHONE: 1100

ISSUE	DATE	AMENDMENT
A	16-1-17	FINAL ISSUE OF PLAN

TITLE: PLAN SHOWING SELECTED DETAIL & LEVELS OVER No.3 QUARRY ROAD & 4 VINEYS RD, DURAL

LGA: HORNSBY		REFERENCE: 17431	
CLIENT : H INVESTMENTS		DATE: 22-12-16	SHEET 5
SCALE (AT A0) 1:400	DATUM : AHD	SURVEYOR: RH	

Higgins Surveyors
PROPERTY & DEVELOPMENTS CONSULTANTS
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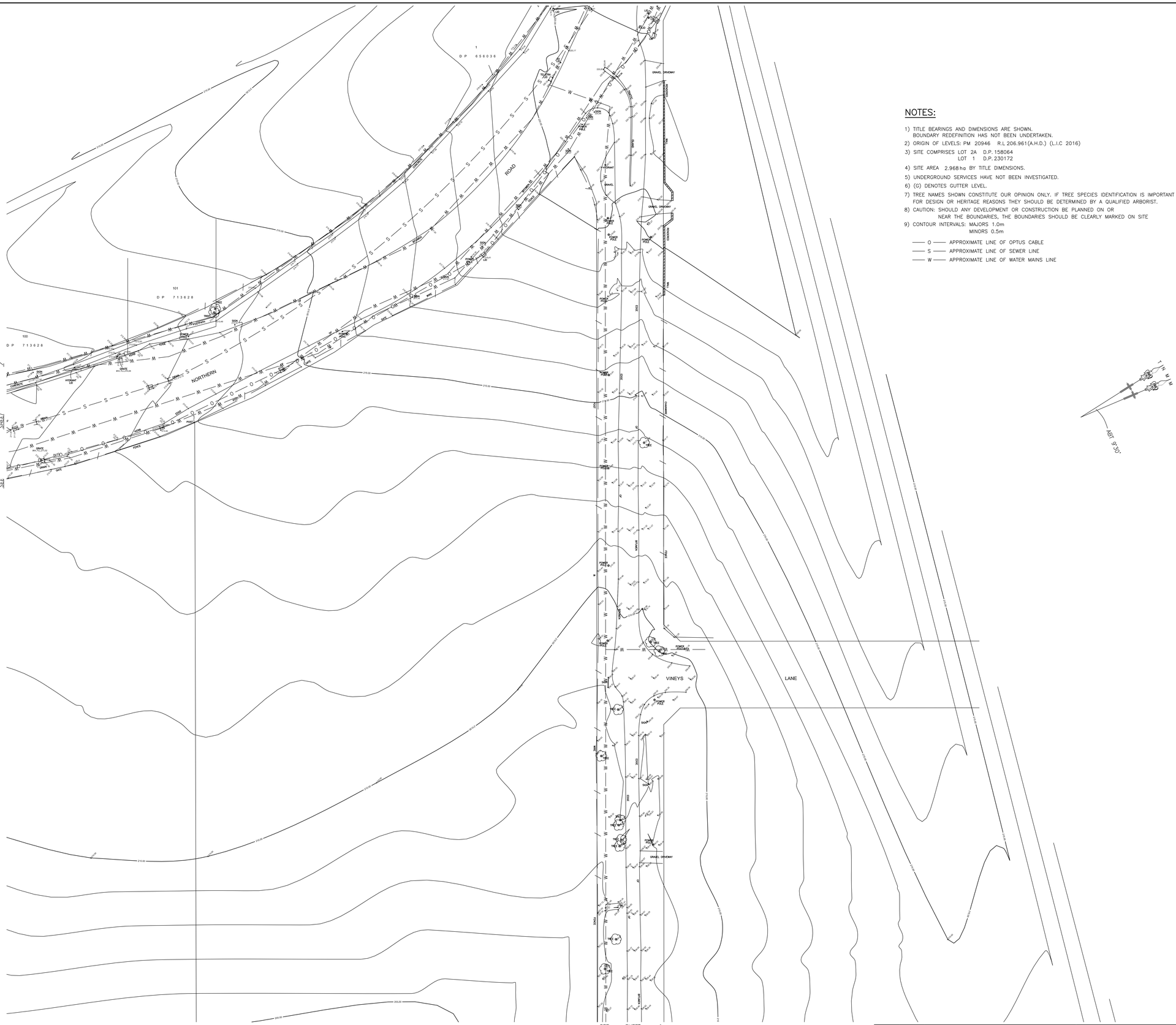
admin@higginssurveyors.com.au



NOTES:

1) TITLE BEARINGS AND DIMENSIONS ARE SHOWN.
   BOUNDARY REDEFINITION HAS NOT BEEN UNDERTAKEN.
2) ORIGIN OF LEVELS: PM 20946 R.L 206.961(A.H.D.) (L.I.C 2016)
3) SITE COMPRISES LOT 2A D.P. 158064
   LOT 1 D.P. 230172
4) SITE AREA 2.968 ha BY TITLE DIMENSIONS.
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LGA: HORNSBY | REFERENCE: 17431
CLIENT : H INVESTMENTS | DATE: 22-12-16 | SHEET
SCALE (AT A0) 1:400 | DATUM : AHD | SURVEYOR: RH | 6

Higgins Surveyors
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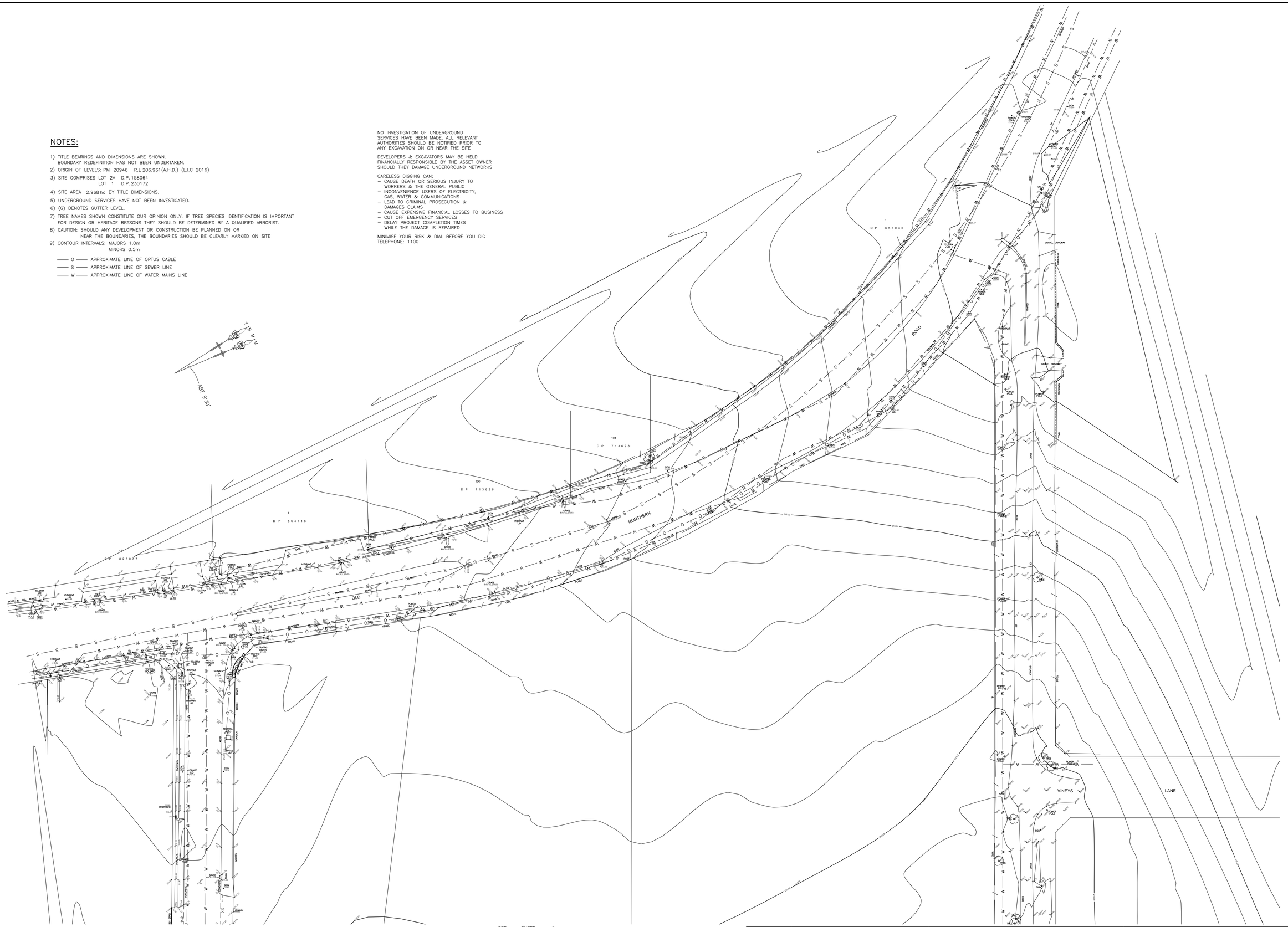

SEE SHEET 1

ISSUE	DATE	AMENDMENT
A	16-1-17	FINAL ISSUE OF PLAN

TITLE: PLAN SHOWING SELECTED DETAIL & LEVELS OVER No. 3 QUARRY ROAD & 4 VINEYS RD, DURAL

LGA: HORNSBY | REFERENCE: 17431

CLIENT : H INVESTMENTS | DATE: 22-12-16 | SHEET 7

SCALE (AT A0) 1:400 | DATUM : AHD | SURVEYOR: RH

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Appendix C – Maintenance Schedule

Operations and maintenance

StormFilter® EnviroPod Treatment Train

Stormwater360
AUSTRALIA

Device details			
Location of Device			
GPS Coord	N:	E:	D P Number:
Relevant Council			
Company			
Contact		Email	Ph
Engineer			
Contact		Email	Ph

SFEP Treatment
1 ddd
2

Frequency of Inspection/Maintenance		
	Inspections (time/year)	Major Maintenance
StormFilter		
EnviroPod		

Maintenance Estimated Annual Cost
StormFilter
EnviroPod
TOTAL

Contents

Maintaining the EnviroPod® Stormwater Gully Pit Insert

Maintenance is as integral to every stormwater management system as it is to any other item of machinery or equipment.

The primary purpose of the EnviroPod® Stormwater Gully Pit insert is to filter out and remove pollutants from entering our waterways. To ensure that the EnviroPod® continues to function effectively, it is important that the pollutants it captures are periodically removed, and the filtration components properly cleaned.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site, as well as the occurrence of events such as chemical spills or excessive sediment loading due to site erosion or extreme storms. Similarly, the system should be inspected after all major storm events.

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/m^2.

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
- 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
- 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/m^2
- 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
- ¼ Turn Bayonet Fittings
- Under drain manifold to convey treated stormwater to the receiving environment.

Components of any proposes treatment train or technology

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, i.e. 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 (e.g. 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 and Maintenance Guidelines.

Introduction

This manual has been designed to assist you with cleaning and maintaining the EnviroPod Stormwater Gully Pit Insert, using the methods recommended by the manufacturer.

The cleaning process and methods described cover all aspects of the system, including:

- Removing the grate
- Cleaning the filter bag
- Inspecting the unit
- Rejuvenating the filter bag
- Re-installing the filter bags.

The manual should be used in conjunction with your site's traffic management and safety plans, as well as other appropriate Stormwater360 (IES) documents such as the IES Employee Health and Safety Manual. We also recommend that maintenance and cleaning contractors, or device owners, develop their own site-specific health and safety activity plans to ensure a safe work environment.

Please note: This manual consists primarily of the processes and tasks associated with the hand maintenance and inductor maintenance procedures. It does not include details of the site's traffic management 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.

Why cleaning and maintenance are so vitally important

Adhering to the inspection and maintenance schedule of each stormwater treatment device is essential to ensuring that it works properly throughout its estimated design life.

During each inspection and clean, details of the mass, volume and type of material that has been collected by the device should be recorded. This data will assist with the revision of future management plans and help determine maintenance interval frequency. It's also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner. To ensure consistency, we recommend that one person be responsible for overseeing the management of the maintenance and cleaning process.

Maintenance of your stormwater management system is essential to ensuring ongoing at-source control of stormwater pollution. Maintenance also helps prevent structural failures (e.g. prevents blocked outlets) and aesthetic failures (e.g. debris build up).

Health and safety

The EnviroPod has been designed to trap and retain pollutants in stormwater runoff, helping to maintain the quality of water entering our aquatic ecosystems. Depending on the nature of your site, pollutants can range from organic material such as leaves and sticks through to debris such as broken glass, syringes or other potentially harmful materials.

Access to gully pits containing EnviroPods may require removing heavy protective grates, while cleaning such pits may entail working in confined spaces. For these reasons, all aspects of maintaining and cleaning your EnviroPod require careful adherence to Occupational Health and Safety (OH&S) guidelines. Doing so will ensure that all maintenance personnel are adequately protected and have been properly trained before taking part in any specialist activities. The same level of care needs to be taken to protect non-work personnel in and around the site, while appropriate traffic control measures must be put in place where collection pits are situated in, or adjacent to, roadways or car parks.

* The procedures indicated in the Operations section of this manual are recommended as the safest and most efficient manner of conducting the maintenance of EnviroPod units (Section 2), 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 made should always comply with general safe work practices.

Cleaning of EnviroPod filters and StormFilters is a specialist activity. The material collected by the devices can be harmful, and needs to be handled correctly. For example, 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 dangers associated with the cleaning and handling of material in the filter bags, precaution needs to be taken with activities such as removing the grate as well as with managing the traffic, pedestrians and other non-worker personnel at the site. The general workplace hazards associated with working outdoors also need to be taken into account.

2.1 Personnel health and safety

All contractors and staff must comply with all current workplace 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 workplace health and safety legislation
- Ensure that employees understand and accept their responsibility to practice and promote a safe and healthy work environment.

* Take proper care. Pollutants can range from organic materials such as leaves and sticks through to debris such as broken glass, syringes or other potentially harmful materials.

While cleaning and maintaining filters, all relevant precautions must be taken to prevent contact with sediment and litter. This includes wearing the following personal protective and safety equipment:

- 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 been observed or pits located in areas associated with such activities.

2.2 Traffic control

Stormwater collection pits are typically situated either in or on roads and car parks, or adjacent to roads in a footpath or swale. Traffic control requirements across all such locations differ with most of the state and local road authorities requiring the same controls to be implemented whether the work is to be conducted on the road or on the road reserve.

As traffic requirements differ depending on road usage and the specific road configuration, separate 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.

State government publications such as the NSW RMS *Traffic Control at Work Sites* safety manual outline the signage requirements, placement of barricades or witches hats and the positioning of traffic control personnel that's required when working on public roads. For increased safety, IES recommends that the maintenance vehicle be used to shield the work area from oncoming traffic.

Photo 1 shows the maintenance vehicle with cones placed around and positioned to shield the work area. **Photo 2** shows the 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.

2.3 Confined spaces

Confined space entry procedures are not included as part of this manual. For IES employees these procedures are included as part of the IES Safety Manual. It is recommended that all contractors evaluate their own needs for confined space entry and compliance with Occupational Health and Safety regulations.

When repairs or maintenance activities cannot be conducted from the surface, and there is a need to enter and work in a confined space, only staff with current confined space training are permitted to operate in a confined space. Appropriate measures and controls must be put in place to meet confined space entry requirements. At all times the necessary safety equipment must be worn, and where gas or oxygen hazards occur, only staff trained in its use will use breathing apparatus gear. **Non-trained staff must not go into confined spaces.**

* Confined spaces pose a serious safety hazard for all personnel; however during the normal maintenance procedures there should be no reason to enter a confined space and all maintenance procedures are able to be conducted from the surface.

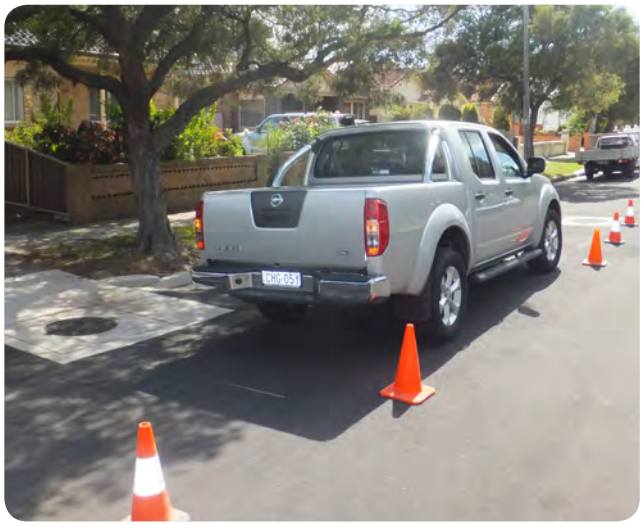

Photo 1 Vehicle positioned near pit, preventing traffic from passing close to the pit.

Photo 2 Head-on view, indicating the placement of the vehicle near the pit.

Operations

EnviroPod units need to be regularly inspected to determine whether they require maintenance or cleaning. This process involves several steps, and may require two or more maintenance personnel working together, as well the use of specialised equipment such as a hydraulic lifting arm or an inductor truck with a vacuum hose.

As gully pit grates are usually quite heavy, it is important that correct lifting procedures are adopted, and that the area surrounding the opened pit is shielded from access to non-work personnel.

If inspection reveals that the filter bag needs to be emptied and rejuvenated, the entire unit should also be examined to ensure that all connections and joints are sound. Any material that has accumulated in the overflow diversion channels or outlet pipes also needs to be removed, with those areas then being flushed. Where required, filter bags may need to be cleaned or repaired, and all waste material must be disposed of according to local guidelines at either an approved disposal site or transfer station.

This section outlines the procedures for cleaning the EnviroPod units. It has been written so that someone who has never previously encountered a stormwater pit or an EnviroPod unit can carry out such maintenance by simply following the outlined steps.

3.1 Maintenance and monitoring of EnviroPod filters

To ensure that each EnviroPod unit achieves optimal performance, 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. While the bag has a greater storage capacity, 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), which will make them more difficult to lift and empty
- material near the top of the bag can be re-suspended during high to extreme rainfall events
- 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 is conducted following moderate to extreme rainfall events, especially when preceding months have had little or no rainfall. This increased frequency of monitoring is necessary as there is a greater accumulation of surface contamination during low rainfall periods, which will then enter the unit with the higher volumes of runoff generated during a major rainfall event. It is also important 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

These are the steps for opening a hinged pit grate:

1. Insert the lifting hooks beneath the grate. (Position indicated in **Photo 3**)
2. Check hinge point is not damaged and debris is not caught in the hinge area.
3. Fully open pit grate, ensuring that the grate will stay in the open position without any external forces applied. Grates that do not remain open without being held should be removed or secured during cleaning or maintenance activities. **Photo 4** indicates the grate being opened and grate resting freely in the open position, respectively.

Please 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 the grate to fall into the pit. Such pit grates can be removed using the method indicated below for non-hinged grates.

Photo 3 Lifting the grate

Photo 4 Fully open grate

Photo 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 (see **Photo 6**). Concrete lids may have Gatic lifting points, a key arrangement or holes in the lid, which may require special equipment such as Gatic lifters
2. Position each person either side of the grate (see **Photo 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 (see **Photo 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

Photo 6 Insert hook near edge of grate

Photo 7 Position each lifter either side of the grate

Photo 8 Lift grate and move grate to one side

Photo 9 Lift grate above the support frame

Photo 10 Reinstated non hinged grate

3.3 Cleaning methods

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

3.3.1 Cleaning using an inductor truck

Follow these steps to safely and efficiently clean the EnviroPod using an inductor truck:

1. Open gully pit (See Section 3.2)
2. Place the inductor hose over the material collected in the filter bag and switch on the inductor
3. Using the inductor hose, suck out 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 that there are no sharp edges on the inductor hose that can damage the filter bag
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. This debris can also be collected using the inductor truck
9. All gully pit waste is to be removed from the pit
10. Check the EnviroPod unit (Section 3.4)
11. Check filter bag (Section 3.4)
12. Reinstate filter bag and gully pit lids

Photo 11 Cleaning an EnviroPod using the inductor method

3.3.2 Hand maintenance

To clean the EnviroPod manually by hand, follow these steps:

1. Open gully pit (See Section 1)
2. Place the lifting hooks in the lifting loops of the filter bag (See **Photo 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
4. Lift the bag vertically off the supporting frame, ensuring that no undue pressure is placed on the filter bag. (See **Photo 13**)
5. Lift the bag clear of the stormwater pit (See **Photo 14**)
6. Position the bag over the truck or other collection vehicle, taking hold of the loops at the base of the bag (See **Photo 15** and **Photo 16**)
7. Lift and empty the filter bag by holding the bottom lifting loops only (See **Photo 17**)
8. Completely empty the filter bag (See **Photo 18**)
9. Brush the filter bag with a stiff brush to remove bound sediment from the filter pores
10. Check the EnviroPod unit (Section 3.4)
11. Check the filter bag (Section 3.5)
12. Reinstate filter bag, ensuring bag is installed the correct way (See **Photo 19** and **Photo 20**)
13. Reinstate gully pit lids (See **Photo 21** and **Photo 22**)

Photo 12 Place the lifting hooks through the bag loops

Photo 13 Lift the bag from the cage and support frame

Photo 14 Lift the bag from the stormwater pit

Photo 15 Lift the bag onto the collection vehicle

Photo 16 Grab the bottom lifting loops

Photo 17 Lifting the bottom bag loops empty the filter bag

Photo 18 Completely empty the contents of the filter bag

Photo 19 Reinstall filter bag

Photo 20 Ensure that the unit is positioned correctly, with the lifting loops on the inside

Photo 21 Correctly installed filter bag

Photo 22 Installed filter bag and sealed pit

Please note: Under no circumstances are gully pit sediments to be backwashed into the gully pit.

Photo 23 Check seals are pushed against the pit walls

Photo 24 Check joining rivets (two piece unit shown above)

3.4 Unit inspection

After the EnviroPod filter bag has been 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 **Photo 23**)
- The plastic pit seals should be inspected for unit movement or damage (See **Photo 24**)
- The cage should be inspected for damage or movement.

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

If spare parts are required, Stormwater360 is able to provide these at a cost to the owner of the EnviroPod unit, although these parts may also be obtained from other suppliers.

Please 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.

3.5 Filter bag inspection and rejuvenation

After the filter bags have been emptied and cleaned, they should be inspected to evaluate their condition. Given the nature of stormwater, the filter bag may become considerably clogged with fine sediment or damaged by various objects in stormwater as well as fauna. Sharp material 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 cleaned using several different methods. If the techniques described in the general maintenance sections above do not adequately 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, taking care not to transfer the contamination elsewhere. Wastewater from the process should be collected and disposed of correctly.
- Remove the filter bags from the pits and the support rings and wash the bags in an industrial washing machine.

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

Photo 25 Slightly clogged filter bag, indicated by the brown stain on in the centre of the bag

Photo 26 A clean used filter bag

3.5.2 Damaged filters

Damaged filter bags can often be repaired, provided the damage is small. Small tears in the fabric may occur due to several reasons, however the overall strength and 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 cleaning torn bags so as not to spill the collected material into the pit.

Small tears may be 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. If large tears are present, the filter bag may need to be replaced as it is no longer able to function as intended.

3.6 Disposal of material

All gully pit wastes 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.

Emergency procedures

Spills and blockages can have an immediate impact on the performance of a stormwater management system, and can potentially result in serious damage to built infrastructure as well as the surrounding waterways and wetlands.

In these types of emergencies, it is important to act quickly to remediate the problem by removing affected sediment or clearing the cause of the blockage, so that the system can resume normal and effective functioning as soon as possible.

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:

1. Check EnviroPod overflow 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 it can be easily cleared by hand or a steel rod.
2. If overflow is clear and surface flooding still exists remove EnviroPod and check outlet pipe for blockages.
3. 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 sidewalls 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.
4. 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:

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