BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
ABN 26 134 067 842

Elf Farm Supplies Pty Ltd

Stormwater Management Report

112 Mulgrave Road, Mulgrave

October 2018

PLANNING
PROJECT MANAGEMENT
ENGINEERING
CERTIFICATION

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Project No.	SY070166
Author	JT/GL/GJ
Checked	GJ
Approved	GJ

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3	Re-Issue	02.07.18	Addressed DoP comments
4	Re-Issue	22.08.18	Addressed Further comments
5	Re Issue	23.10.18	Add disc to approved – kept basin approval

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SUSTAINABLE CERTIFICATION ISO 9001: 2015 Endorsed Quality Management System
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SYDNEY
Suite 603, Level 6, 12 Century Circuit
Norwest Business Park NSW 2153
P (02) 9659 0005 F (02) 9659 0006
E sydney@brs.com.au

CENTRAL COAST
Studio 5, 78 York Street
East Gosford NSW 2250
P (02) 4325 5255
E coast@brs.com.au

HUNTER
Unit 1, 17 Babilla Close
Beresfield NSW 2322
P (02) 4966 8388 F (02) 4966 1399
E hunter@brs.com.au

brs.com.au

TABLE OF CONTENTS

1 Introduction 4
2 Site Location and Development Proposal 5
2.1 Site Location 5
2.2 Proposal 5
2.3 Altered catchment Areas 5
3 Discharge Requirements 7
3.1 General 7
3.2 Drains Model 7
3.3 Results 8
4 Water Quality & Maintenance Management 10
4.1 Proposed Catchment 10
4.2 Council Requirements 10
4.3 General 10
4.3.1 North-East Sub-catchment (Basin 1) 10
4.3.2 North-west Sub-catchment (Basin 2) 11
4.3.3 South Sub-catchment 11
4.3.4 West and South-west Sub-catchment (Proposed Basin 3) 11
4.4 Pre-Development Model 11
4.5 Post Development Model 11
4.6 Treatment Node Requirements 14
4.6.1 Sedimentation Basins 14
4.6.2 Bio-retention Basins 14
4.6.3 Ponds 15
4.6.4 Results 15
4.7 Maintenance Management 15
5 Recommendations 16
6 References 17

Attachment A – Catchment Plan

1 Introduction

This report has been prepared to detail the results of an analysis undertaken to assess the impacts of an expansion of the mushroom composting facility at 112 Mulgrave Road, Mulgrave. Previous designs by Barker Ryan Stewart were approved as part of the original works in 2010. Since then several modifications were made to the approval which had little impact on the operation of the drainage system however a drainage line was constructed with a discharge point different to that of the approved plans. For this reason some further design work has been undertaken to ensure that the drainage system is compliant with the original approval.

In considering the stormwater management at the site, this investigation considered the following:

- The pre-development and post development site conditions.
- The basins installed on the site as part of the development proposal.
- Additional basins constructed on site to accommodate the altered construction works
- Councils On-Site Stormwater Detention requirements for development within the Hawkesbury.
- Water Quality management required on the site.
- The approved plans prepared by BRS dated 19 November 2010.

2 Site Location and Development Proposal

2.1 Site Location

The site of the proposed development is described as Lot 13 and 14 in DP 1138749. This lot is known as 108 and 112 Mulgrave Road, Mulgrave.

2.2 Proposal

The site is an existing mushroom substrate farm which is currently in the process of being expanded. In 2010 Barker Ryan Stewart designed the stormwater system associated with the expansion. The project was approved for construction in 2012, but the majority of works did not immediately proceed. In 2016 approval was given for modifications to the previously approved expansion, referred to as MOD 1. The MOD 1 changes were inconsequential to the proposed stormwater system. These changes incorporated;

- Slight changes to the position and size of the new building located at the north of the site with no change in the overall impervious area associated with the building and surrounding hardstand,
- The repositioning of some of the internal drainage lines that cater for roof and pavement runoff from the above mentioned relocated building,
- A new air biofilter located at the south west of the site that will contain any rainfall falling into it, and
- Changes to the size and extent of the building located in between the new air biofilter and the existing pre wet shed. This building has not increased the impervious area of the site, only changed it from hardstand area to roof which has not impacted on the OSD requirements and has no negative impacts on the proposed water quality requirements.

Major construction work commenced following the 2016 MOD 1 approval. During construction drainage from part of the site has been redirected from the northwest catchment to the western catchment. This occurred when the roof drainage line shown on 2010 plans as draining the northern end of the pre wet shed and an area of hardstand was connected into the existing drainage line that services the conveyor building, offices and part of the roof of the main building and so drained into the existing basin area located just north of the overflow dam (the western catchment).
A further application to modify the project approval has been submitted, referred to as MOD 3. This application incorporates:

- Filling an area at the south east of the site to expand the open air bale storage. The filled area will be added to the northeast catchment, and
- Formalising the change to drainage made during MOD 1 construction. This will increase the size of the western catchment and reduce the size of the northwest catchment, accordingly modifications to the basins associated with these catchments are proposed.

2.3 Altered catchment Areas

The following changes in catchment area are noted and have been used for the re-analysis,

South catchment

Previously assessed roof area	4,470m2
Proposed roof area	4,470m2

Northeast catchment

Previously assessed catchment area	36,320m2
Increase in permeable surface (bale store)	1,800m2
Proposed catchment area	38,120m2

Northwest Catchment

Previously assessed catchment area	35,380m2
Decrease in roof area - now in W catchment	2,710m2
Decrease in hardstand area – now in W catchment	620m2
Proposed Catchment area	32,050m2

West Catchment area

Previously assessed catchment area	10,790m2
Increase in catchment area due to basin	6,520m2
Increase in roof area from NW catchment	2,710m2
Increase in hardstand area from NW catchment	620m2
Increase in roof from area SW catchment	6,230m2
Proposed catchment area	26,870m2

Southwest Catchment Area (Bypass area)

Previously assessed catchment area	16,760m2
Decrease in area due to air bio filter	5,290m2
Decrease in area now draining to West catchment	6,230m2
Proposed catchment area	5,240m2

As the roof area draining to the south has not altered no further analysis has been undertaken.

For the Northwest catchment, the area has changed and so the outlet configurations will need to be altered to ensure that the post development flows will not be greater than the respective pre-developed cases. In this case, a discharge control pit and outlet orifice will need to be recalculated to account for the altered catchment area. In addition, a sedimentation and bio-retention pond will be required to be implemented at the base of the basin. As the catchment area draining to basin 2 has reduced, so will the required bio basin surface area. The previous report nominated an area of bio basin of 600 square metres.

For the Northeast catchment, the existing basin is to be checked to ensure that pre-development flows are maintained due to the small increase in catchment area draining to it and to ensure that the proposed sedimentation and bio-retention pond are adequate for water quantity purposes.

In the case of the western catchment, a discharge control pit with orifice plate, outlet pipe through the basin wall and an overflow spillway to allow for the larger storm events. Water quality treatment will also be required in the form of a sedimentation and bio-retention pond on its base. The existing design also requires a GPT to be installed on this line as no other water quality measures were required, however now that the catchment has been altered then this is proposed to be replaced with a bio basin and pond system.

In addition to the above, a Rocla water level controller device is to be installed downstream of all three basins for any stormwater susceptible to contamination. This is as per the EPA's latest requirements and is additional to the approved design and will work to provide an isolation valve to allow shutoff of stormwater discharge from the site in the event of a spillage of fuel or other hazardous liquids. This will allow holding of the contaminated water within the basin's until being disposed of safely.

3 Discharge Requirements

3.1 General

The discharge rates for each subcatchment and the sizing of the on-site detention system have been calculated using the design rainfall events in AR&R. The rainfall intensities used are from Councils Engineering Design Guidelines. The modelling has been undertaken using the software DRAINS.

3.2 Drains Model

The existing pre-developed DRAINS model set up as part of the development application for the expansion of the site was used as the basis for the pre-development flows that are not to be exceeded. This model was set up to reflect the site prior to the site's expansion and the results of the model are shown below in Section 3.3. A copy of the model is shown below,

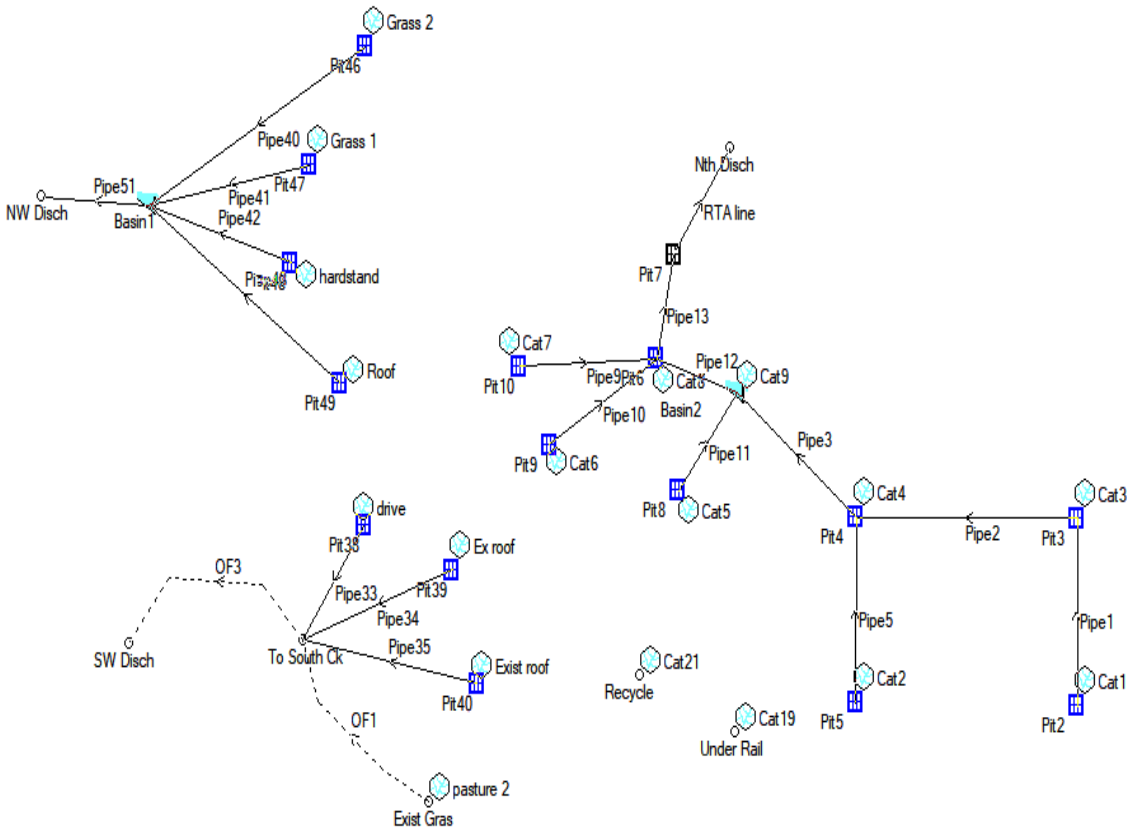


Figure 3.1 – Existing DRAINS model layout

The post development model also set up and submitted as part of the application process has been modified to reflect the changes that have occurred on the site, taking into consideration the varying impervious areas, roof areas and drainage construction. To ensure that the post development discharge remained at or below the pre-development model, an orifice plate was incorporated into the basin outlet and varied in size until the peak discharge rate for all storm events from the 1-year ARI up to the

100 year ARI complied. A copy of the model is shown below. Note: the volumes determined within each basin do not include the extended detention storage for the water quality treatment ponds at the base.

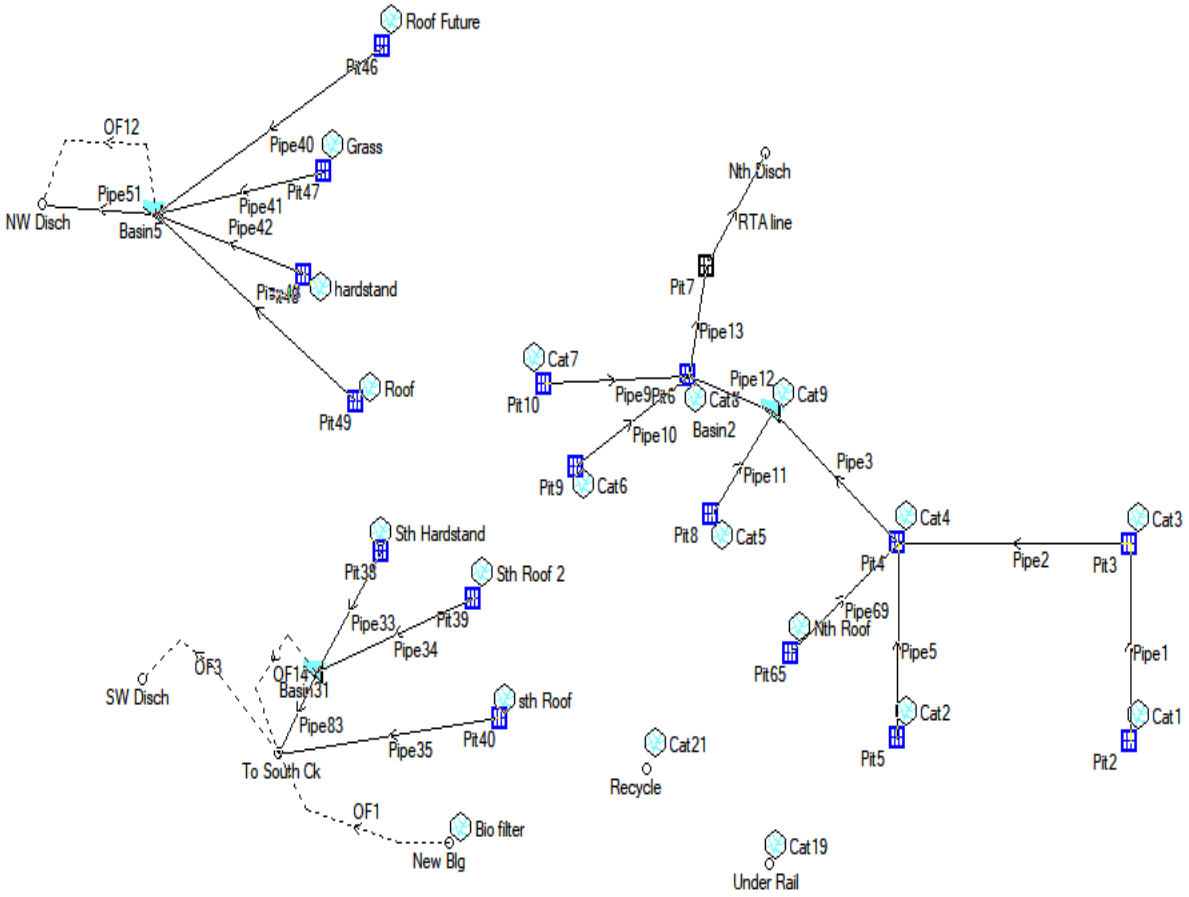


Figure 3.2 – Proposed DRAINS model layout

3.3 Results

It was found that

- The designed size and configuration of basin 1 is sufficient to cater for the onsite detention needs for the upgraded facility,
- The designed basin 2 is oversized due to the reduction in catchment area draining to it, so it is proposed to reduce the required volume, and
- Basin 3 is to be constructed to cater for the additional catchment now being directed to it by the alteration of the designed drainage system.

Table 3.1 – DRAINS modelling results

ARI	Pre-Developed Case (I/S)			Post Developed Case (I/S)		
	NW catchment	W and SW catchment	NE catchment	NW catchment	W and SW catchment	NE catchment
1	86	203	181	86	193	153
5	399	548	471	114	273	323
20	474	765	645	309	326	443
100	551	996	711	520	375	506

The results above in Table 3.1 show the pre-developed flows compared against the post developed flows once the orifice restrictions and basin volume are incorporated into the drainage systems.

The results show that with the discharge control pit restrictions in place that for the 1 year ARI rainfall event the post developed discharge is at least the same for each of the three catchments and that in events larger than this the post developed discharges are all less than the pre developed cases.

4 Water Quality & Maintenance Management

4.1 Proposed Catchment

The proposed development is required to meet the water quality targets set out in the Hawkesbury City Council Development Control Plan and State Government reduction ratios.

The site has been considered to be composed of 5 smaller sub-catchments denoted as North-east, North-west, West, South-west and South. Proposed treatment measures involve the use of sedimentation basins, bioretention basins, ponds and wetlands to meet the targets set out by Council.

The proposed development is documented within Attachment A.

4.2 Council Requirements

The Hawkesbury City Council Development Control Plan Appendix E – Civil Works Specification Part I states the minimum requirement for stormwater quality control "shall be that the average annual pollutant load discharged from the developed site shall be no greater than for existing conditions".

Given the complex nature of the development at this site it was considered necessary to undertake an analysis of the proposed development and compare it to the pre-developed conditions for the site, prior to the development of the substrate plant. It was considered that this area was primarily used as agricultural farm land given its location on the bank of South Creek and as evident by the current use of similar properties along the watercourse. As such, to satisfy the requirements of Council the pollutant load from the developed site shall be treated to better the pollutant load generated assuming the site is entirely agricultural farm land.

To determine compliance with this requirement, a full analysis of the water quality of the stormwater discharge leaving the site was undertaken using The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software modelling package Version 6.3 build 0.1908.

4.3 General

To determine compliance with Council's requirements, a full analysis of the water quality of the stormwater discharge leaving the site was undertaken using The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software modelling package.

The 6 minute rainfall data used within the model was obtained from pluviograph number 067033, located at the RAAF base in Richmond. The data from the period 1985 to 1995 was used to analyse the performance of water quality treatment train to achieve a long-term assessment of the expected water quality.

The analysis considered four catchments for the development with the use of the following treatment measures to improve the quality of stormwater discharge leaving the site:

4.3.1 North-East Sub-catchment (Basin 1)

- There is no change required to the previous approved design for this basin and associated water quality controls.

4.3.2 North-west Sub-catchment (Basin 2)

- As a result of the catchment area now draining to this basin being reduced in size, both the area of filter within the biobasin and the storage volume of the on site detention basin have been reduced in size. These changes have resulted in the bio basin being able to be placed within the OSD component of the basin, so bringing it into line with a more conventional OSD/bio basin configuration. The basin is to be constructed with the following;
- A 100m^2 sedimentation basin within the on-site detention basin will be constructed at the inlets into the basin to capture much of the sediment.
- A 180m^2 bio-retention area within the on-site detention basin downstream of the sedimentation basin will be constructed.

4.3.3 South Sub-catchment

- This catchment bypasses treatment measures and is discharged under the railway line towards the dam on the adjoining property prior to discharging towards South Creek. There is no change to this catchment.

4.3.4 West and South-west Sub-catchment (Proposed Basin 3)

- A 150m^2 sedimentation basin within the on-site detention basin will be constructed at the inlets into basins 3 to capture sediment from the first flush.
- A 180m^2 bio-retention area within each of the on-site detention basins downstream of the sedimentation basin will be constructed to treat the majority of nitrogen and phosphorous content within the stormwater discharge.

4.4 Pre-Development Model

The pre-developed scenario was modelled as a single agricultural source type node with an area equivalent to the developed area of the site. Table 3.1 on the following page shows the input values used for source nodes in the MUSIC model.

4.5 Post Development Model

The sub-catchments in the post-developed scenario were modelled with several source nodes that simulate the different pollutant load generating areas within each sub-catchment. These included roof, hardstand, gravel and pervious areas.

Table 4.1 on the following page shows the input values used for source nodes in the MUSIC model.

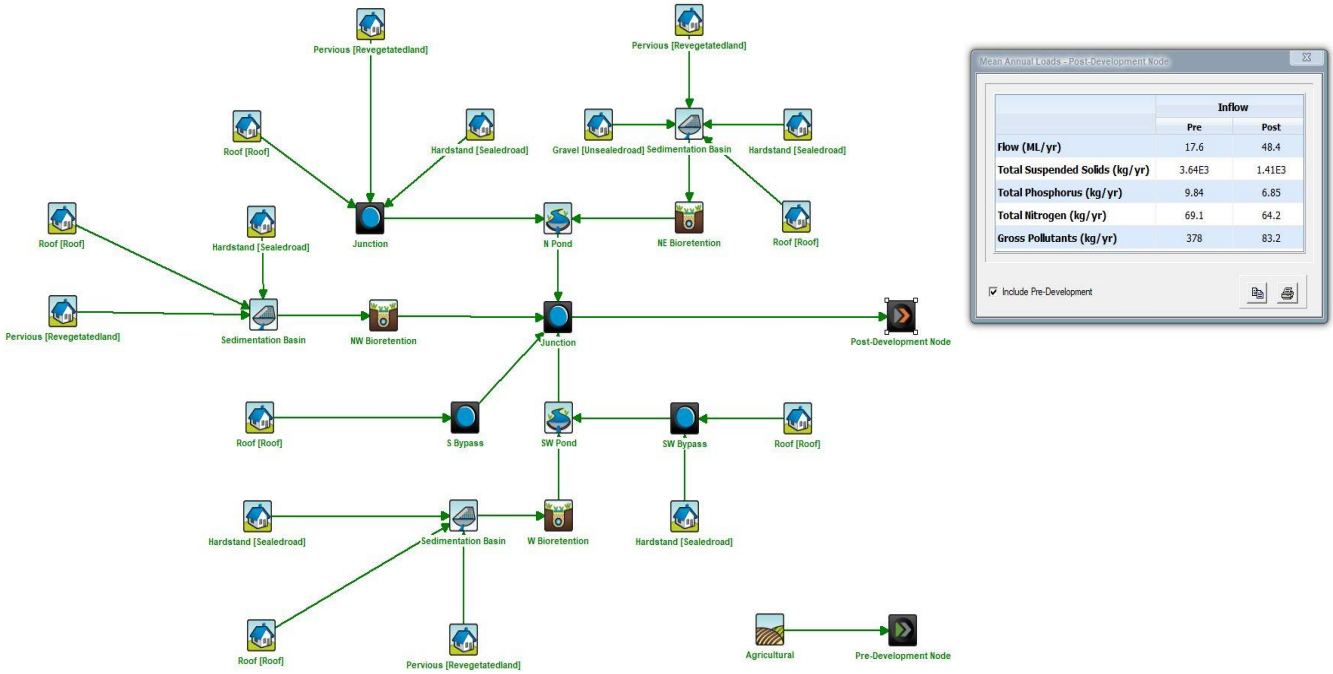
Table 4.1 Input Parameters MUSIC Model

Data Type	Input Data				
	Hardstand	**Roof**	**Pervious**	**Gravel**	**Agricultural**
Rainfall Runoff Parameters					
Rainfall Threshold (mm/day)	1.0	1.0	1.0	1.0	1.0
Soil Storage Capacity (mm)	200	200	200	200	200
Initial Storage(%)	30	30	30	30	30
Field Capacity	170	170	170	170	170
Infiltration Capacity Factor (mm)	200	200	200	200	200
Infiltration Capacity Exponent	1.0	1.0	1.0	1.0	1.0
Stormwater Pollutants					
Base Flow					
TSS - μ	1.20	1.10	1.15	1.2	1.4
TSS – σ	0.17	0.17	0.17	0.17	0.13
TP - μ	-0.85	-0.82	-1.22	-0.85	-0.88
TP – σ	0.19	0.19	0.19	0.19	0.13
TN - μ	0.11	0.32	-0.05	0.11	0.074
TN – σ	0.12	0.12	0.12	0.12	0.13
Stormflow					
TSS - μ	2.43	1.3	1.95	3.0	2.3
TSS – σ	0.32	0.32	0.32	0.32	0.31
TP - μ	-0.30	-0.89	-0.66	-0.3	-0.27
TP – σ	0.25	0.25	0.25	0.25	0.3
TN - μ	0.34	0.30	0.30	0.34	0.59
TN – σ	0.19	0.19	0.19	0.19	0.26

Table 4.2 MUSIC Sub-Catchment Areas

North-east	Area (ha)	Imp (%)
Roof	0.173	100
Hardstand	0.351	100
Gravel	0.804	100
Pervious	1.261	0
Sub total:	**2.589**	
North-east (Bypass to wetland)	**Area (ha)**	**Imp (%)**
Roof	0.424	100
Hardstand	0.134	100
Pervious	0.481	0
Sub total:	**1.039**	
North-west	**Area (ha)**	**Imp (%)**
Roof	1.151	100
Hardstand	0.622	100
Pervious	1.432	0
Sub total:	**3.205**	
South (Bypass)	**Area (ha)**	**Imp (%)**
Roof	0.389	100
Sub total:	**0.389**	
South-west (Bypass to pond)	**Area (ha)**	**Imp (%)**
Roof	0.427	100
Hardstand	0.097	100
Sub total:	**0.524**	
West	**Area (ha)**	**Imp (%)**
Roof	1.255	100
Hardstand	0.238	100
Pervious	0.652	0
Sub total:	**2.145**	
Total Area	**9.912**	

Pre-developed Agriculture	Area (ha)	Imp (%)
Agricultural	9.912	10
Sub total:	**9.912**	
Total Area	**9.912**	



	Inflow	
	Pre	Post
Flow (ML/yr)	17.6	48.4
Total Suspended Solids (kg/yr)	3.64E3	1.41E3
Total Phosphorus (kg/yr)	9.84	6.85
Total Nitrogen (kg/yr)	69.1	64.2
Gross Pollutants (kg/yr)	378	83.2

Figure 4.1 – MUSIC Model Layout

4.6 Treatment Node Requirements

4.6.1 Sedimentation Basins

Runoff generated by the proposed development will be drained to the basins via a conventional pit and pipe system. These basins are designed to remove a majority of the sediment from stormwater discharging from the site.

The sediment basins shall have a minimum 1m depth of permanent pool and an extended detention depth of 0.5m. Each sedimentation basin is to have an outlet with an anti-vortex device and trash rack and sized as specified in the attached drawings.

4.6.2 Bio-retention Basins

The bioretention basins are located downstream of the sedimentation basins. The filter medium is to be at least 400mm deep and the maximum extended detention depth is 300mm for all basins. The basin is to be lined with an impermeable liner to exclude infiltration into the surrounding soil.

The bioretention basins are to be planted with suitable species in accordance with *Stormwater Biofiltration Systems Adoption Guidelines* by Facility for Advancing Water Biofiltration, Monash University (June 2009).

The filter medium was modelled with the following specifications:

- Saturated Hydraulic Conductivity of 100mm/hr;
- TN Content of 800mg/kg;
- Orthophosphate content of 55mg/kg;

4.6.3 Ponds

Runoff generated by the proposed development will be drained to the existing ponds prior to discharge into the downstream watercourse.

The ponds shall have a minimum 1m depth of permanent pool and an extended detention depth of 0.5m. Each pond is to have an outlet with an anti-vortex device and trash rack and sized as specified in the attached drawings.

4.6.4 Results

The water quality model was simulated for 6-minute rainfall intervals.

Table 3.3 below shows the mean annual pollutant loads generated from the site in the pre-development and post development scenario. It is demonstrated that with the use of the specified treatment measures that the pollutants are reduced below the pre-developed scenario. It also shows the treatment train removal rates for the development with and without the treatment measures in place. A copy of the MUSIC layout can be found in Appendix B.

Table 4.3 Water Quality Pollutant Mean Annual Loads

Pollutant	Pre-development (kg/yr)	Post Development (kg/yr)	Removal Efficiency Rates
Total Suspended Solids	3,710	917	93
Total Phosphorus	9.90	5.3	65.6
Total Nitrogen	68.0	46.8	58.7
Gross Pollutants	378	197	84.1

4.7 Maintenance Management

To ensure the system functions efficiently over the long term, it will be necessary to carry out regular maintenance on the stormwater system and the water quality treatment measures.

The maintenance of the sedimentation basins, bioretention basins and ponds will include regular inspections and be in accordance to a maintenance schedule. This will include but is not limited to the clean out of sediment accumulated within the basins, clearing of trash racks and care/management of plants within the bioretention basin. The maintenance schedule will set out the frequency of the maintenance inspections, the maintenance to be performed and who should undertake them.

In addition, during construction, erosion sediment control devices will have to be put in place to protect the riparian buffer zone and the bio-retention basin. The construction of the basin and infiltration system should not be commenced until the majority of the construction has been completed. This will prevent the bio-retention system from clogging with construction sediment and silt.

5 Recommendations

The investigations undertaken in preparing this report have shown that the stormwater generated from the proposed development can be adequately managed through some minor upgrading measures within the existing basins.

The upgrading measures include:

- Reducing and reconfiguring basin 2 so the bio filter, OSD and sedimentation basins are incorporated into one structure.
- The informal basin located to the sites south west will need to be formalised with the inclusion of a discharge control pit, bio filter and sedimentation basin, and
- Installation of a downstream isolation valve (Rocla water level controller) into each of the three basins to allow holding of contaminated water in the event of a spill as per EPA requirements.

The MUSIC model results conceptually show that the post-development pollutant load is no greater than the pre-developed pollutant load and therefore meets Council's requirements and show that there is an improvement in the water quality discharging from the site in the post development case. These improvements result from the treatment processes provided by a combination of sedimentation basins, bioretention basins and ponds.

The DRAINS results show that the development will not increase peak discharge flows from the site for all rainfall events from the 1 year up to the 100 year ARI events.

6 References

The Institution of Engineers Australia, 1987, "*Australian Rainfall and Runoff : A guide to Flood estimation*", The Institution of Engineers Australia, Canberra

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Sydney Catchment Authority, Penrith, "*Using MUSIC in Sydney's Drinking Water Catchment*", Sydney Catchment Authority, December 2012

Facility for Advancing Water Biofiltration (FAWB), Monash University, 2009, "*Stormwater Biofiltration Systems Adoption Guidelines*", June 2009

Music Development Team CRC for Catchment Hydrology, 2005, "Music User Guide", CRC for Catchment Hydrology, Australia, www.toolkit.net.au/music

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ATTACHMENT A

Civil Engineering Drawings

REVISION E

HAWKESBURY CITY COUNCIL
PROPOSED RESIDENTIAL DEVELOPMENT
108 & 112 MULGRAVE RD, MULGRAVE
DRIVEWAY & DRAINAGE PLANS

Prepared for: ELF FARM SUPPLIES PTY LTD

HAWKESBURY CITY COUNCIL'S WORKS
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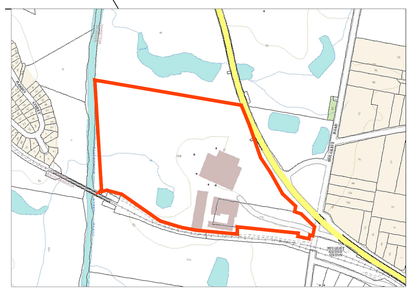
LOCATION OF WORKS



LOCALITY SKETCH
NOT TO SCALE

SHEET INDEX

SHEET No.	DESCRIPTION
COVER SHEET	COVER SHEET - GENERAL NOTES, SHEET INDEX AND LEGEND
2	SITE PLAN
3	BASIN 1 WORKS PLAN & DETAIL
4	NORTH EAST WATER QUALITY DESIGN
5	BASIN 2 WORKS PLAN & DETAIL
6	BASIN 3 WORKS PLAN & DETAIL
7	STORMWATER DETAILS
8	CATCHMENT PLAN - EXISTING APPROVAL
9	CATCHMENT PLAN - PROPOSED WORKS (MOD 3)

LEGEND

- PROPOSED DRAINAGE LINE
- EXISTING DRAINAGE LINE
- NATURAL SURFACE CONTOUR
- EXISTING HEADWALL
- PROPOSED HEADWALL
- GRATED SURFACE INLET PIT
- SEALED PIT

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION
SYDNEY
P: 02 9659 0005
CENTRAL COAST
P: 02 4325 5255
HUNTER
P: 02 4966 8388
ABN: 26 134 067 842
barkerryanstewart.com.au
mail@barkerryanstewart.com.au

NORTH

NOTE:
1. BASIN 1 AND 3 HAVE SUFFICIENT STORAGE FOR THEIR OSD REQUIREMENTS BUT REQUIRE THE OUTLETS TO BE RECONFIGURED TO ENSURE DISCHARGE RATES ARE AS PER COUNCIL REQUIREMENTS.
2. BASIN 2 NEEDS TO HAVE AN INCREASED STORAGE AREA AND A RECONFIGURED OUTLET TO COMPLY.
3. BASIN 1,2 AND 3 ALL REQUIRE ADDITIONAL WATER QUALITY TREATMENT MEASURES.
4. CATCH DRAINS NEED TO BE CONSTRUCTED AS SHOWN TO ENSURE OSD AND WATER QUALITY TARGETS ARE SATISFIED.
5. INSTALL A ROCLA WATER LEVEL CONTROLLER DOWNSTREAM OF ALL BASIN OUTLET PIPES TO ALLOW SHUTOFF OF STORMWATER.

ASIN 2 TO BE CONSTRUCTED
RALLY IN ACCARDANCE WITH
APPROVED DESIGN BUT TO
PORATE A BIO BASIN WITHIN
TRUCTURE INSTEAD OF AS A
SEPARATE STRUCTURE.
REFER TO 5

CTED IN
ET 6 TO
RECTED
CHMENT

EXISTING REED BED TO BE INCREASED
(MIN AREA 450m2)
IN ACCORDANCE WITH EXISTING APPROVED DESIGN
(REFER TO SHEET 4)

INSTALL ROCLA WATER LEVEL CONTROLLER PIT

(BASIN 1 TO BE CONSTRUCTED IN ACCORDANCE WITH APPROVED DESIGN
(REFER TO SHEET 3)

AREA TO BE FILLED

BASIN 1
BASIN 2
BASIN 3

RU4 ZONE
IN2 ZONE

PART LOT 13
DP 1138749
LOT 14
DP 1138749

HAWKESBURY
VALLEY
WAY

INTERNAL
BASIN

DAM

PHASE 1/3 BUILDING
METAL SHED
WORKSHOP
OFFICE BUILDING
PRE-WET SHED

BLACKTOWN
RICHMOND
RAILWAY

20 0 20 40 60 80 100
METRES
1:1000

E	BARKER RYAN STEWART TOTAL PROJECT SOLUTIONS PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION	SYDNEY P: 02 9659 0005 CENTRAL COAST P: 02 4325 5255 HUNTER P: 02 4966 8388 ABN: 26 134 067 842 barkerryanstewart.com.au mail@barkerryanstewart.com.au	Client: ELF FARM SUPPLIES PTY LTD	108 - 112 MULGRAVE RD, MULGRAVE LOT 13 & 14 in DP 1138749 PROPOSED DRAINAGE WORKS SITE PLAN	Designed: JT Drawn: GJR / MB Checked: GJR Scales: Plan 1:1000 Horiz. Vert. X-Sect. Datum: A.H.D.	Plan No. 07166E20_CA01 File Ref. 07166E20_CA.dwg REV. E SHEET 2 OF 9 SHEETS
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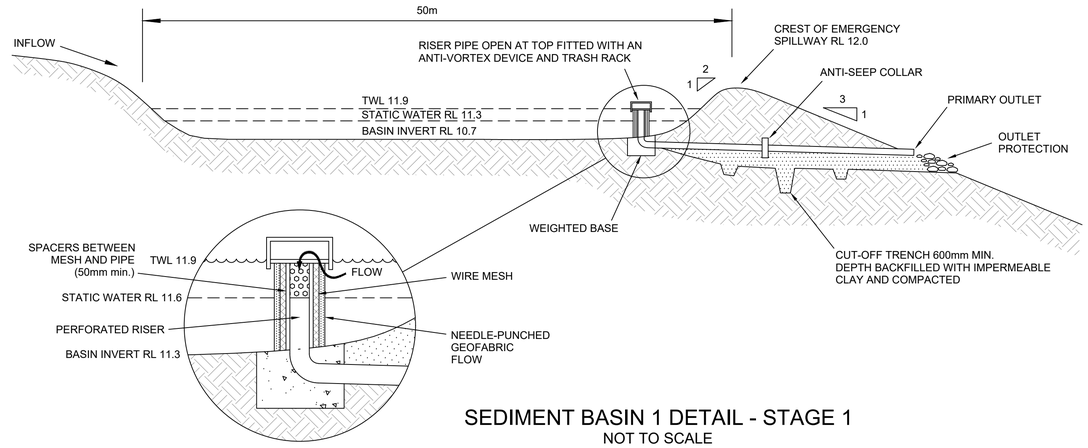
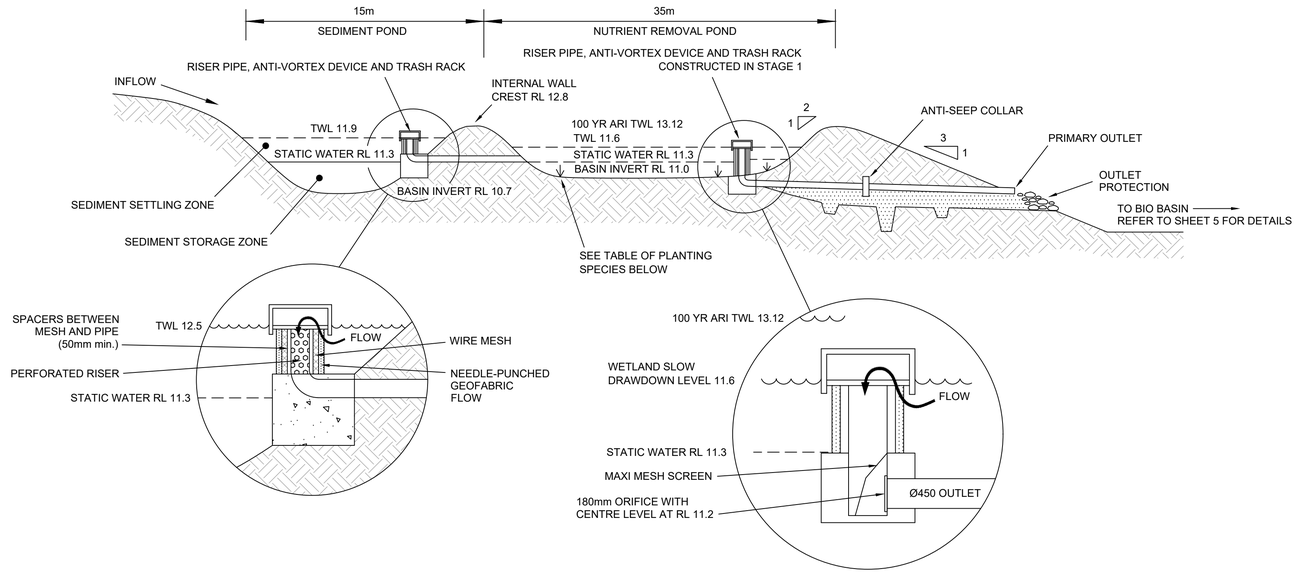


SEDIMENT BASIN 1 DETAIL - STAGE 1
NOT TO SCALE



SEDIMENT BASIN 1 DETAIL - STAGE 2
NOT TO SCALE

E	BARKER RYAN STEWART TOTAL PROJECT SOLUTIONS PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION	SYDNEY P: 02 9659 0005 CENTRAL COAST P: 02 4325 5255 HUNTER P: 02 4966 8388 ABN: 26 134 067 842 barkerryanstewart.com.au mail@barkerryanstewart.com.au	Client: ELF FARM SUPPLIES PTY LTD	108 - 112 MULGRAVE RD, MULGRAVE LOT 13 & 14 in DP 1138749 PROPOSED DRAINAGE WORKS BASIN 1 WORKS DETAILS	Designed: JT Drawn: GJR / MB Checked: GJR Scales: Plan NTS Horiz. Vert. X-Sect. Datum: A.H.D.	Plan No. 07166E20_CA02 File Ref. 07166E20_CA.dwg REV. E SHEET 3 OF 9 SHEETS
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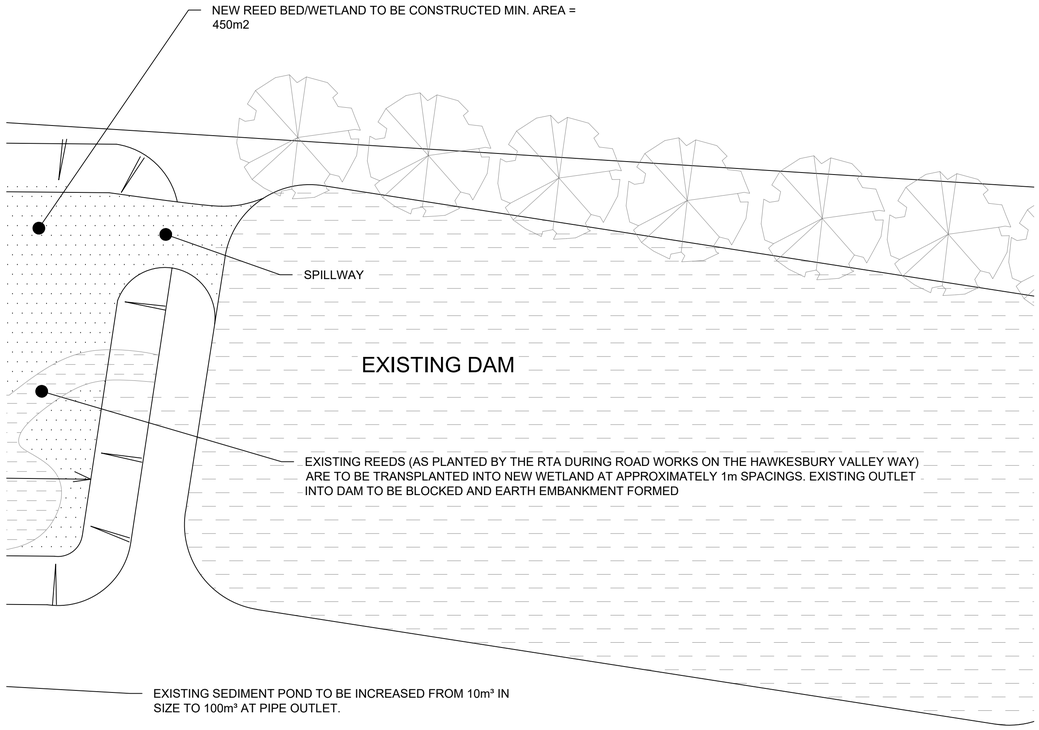
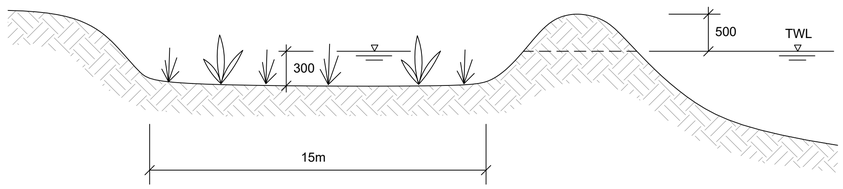


PLAN
SCALE 1:250



REED BED/WETLAND SECTION
NOT TO SCALE

5 0 5 10 15 20 25 1:250
METRES

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION
SYDNEY
P: 02 9659 0005
CENTRAL COAST
P: 02 4325 5255
HUNTER
P: 02 4966 8388
ABN: 26 134 067 842
barkerryanstewart.com.au
mail@barkerryanstewart.com.au

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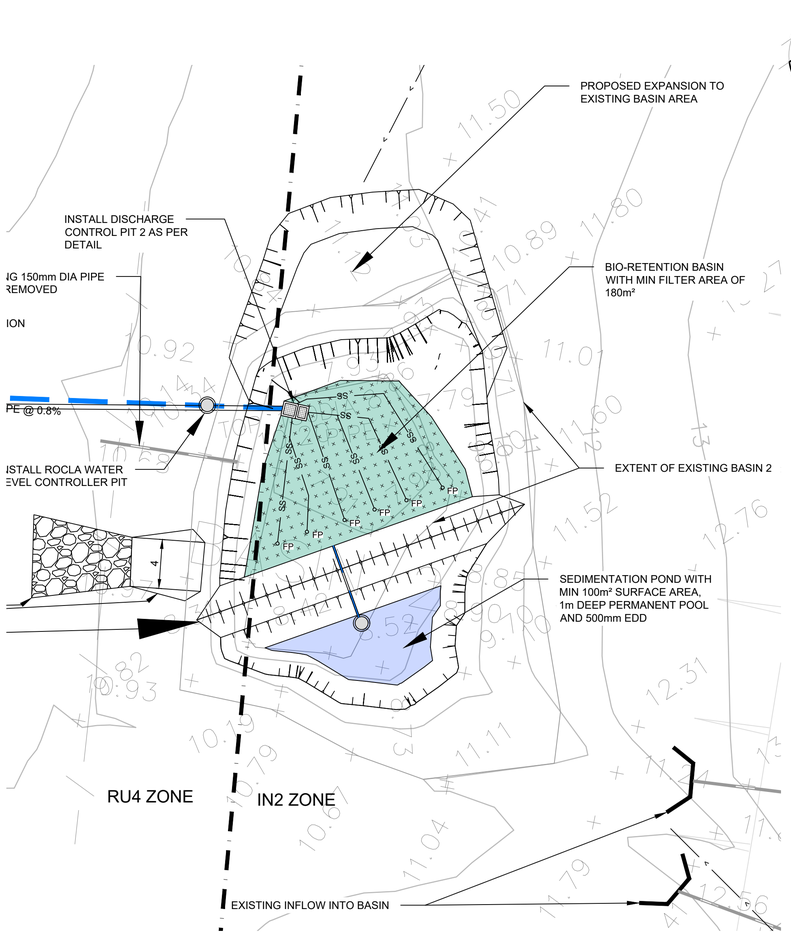
Client:
ELF FARM SUPPLIES PTY LTD

108 - 112 MULGRAVE RD, MULGRAVE
LOT 13 & 14 in DP 1138749
PROPOSED DRAINAGE WORKS
NORTH EAST WATER QUALITY DESIGN

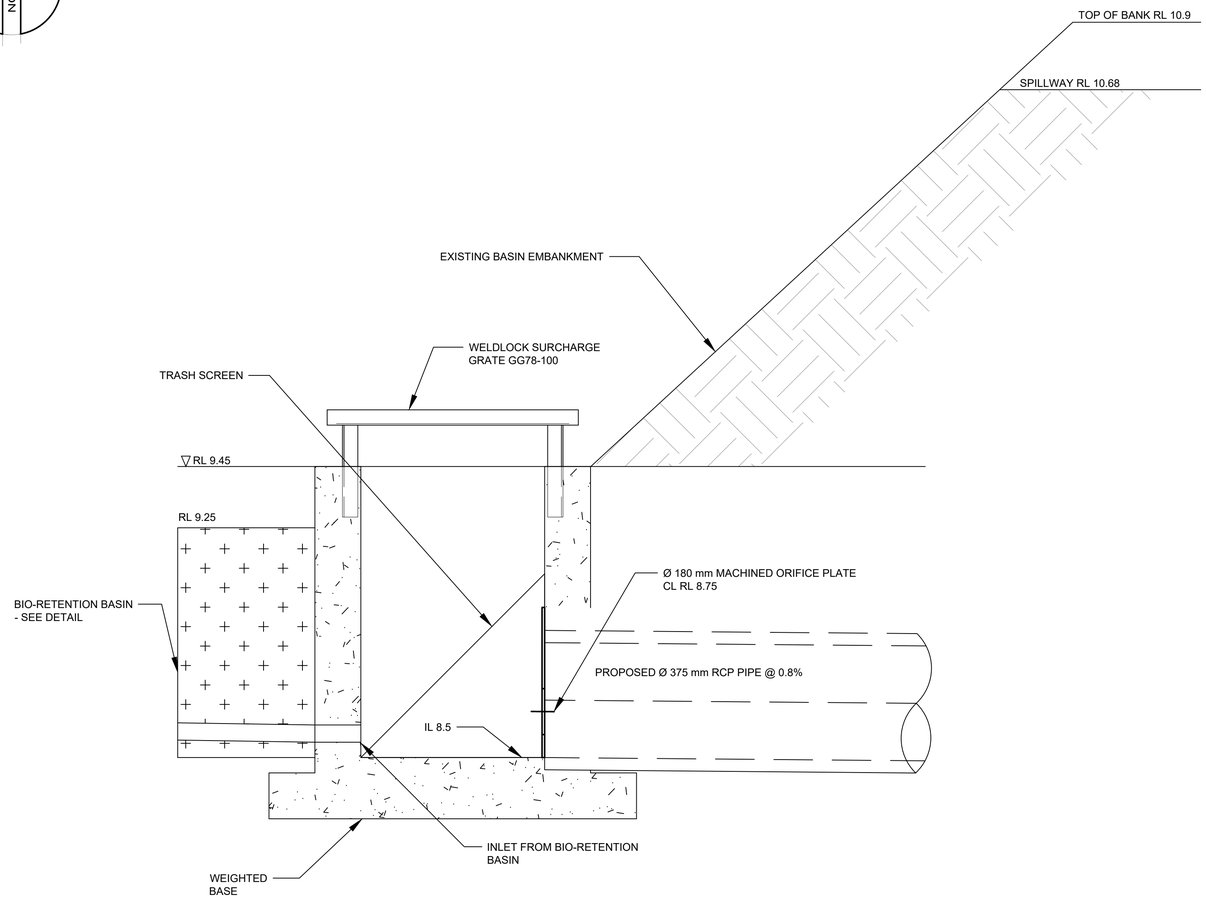
Designed: JT
Drawn: GJR / MB
Checked: GJR
Scales: Plan 1:250
Horiz.
Vert.
X-Sect.
Datum: A.H.D.

Plan No.
07166E20_CA03
File Ref. 07166E20_CA.dwg
REV. E
SHEET 4 OF 9 SHEETS



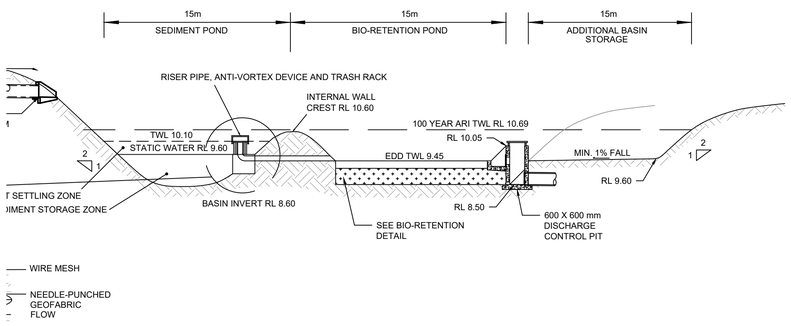
BASIN 2 SITE PLAN

1:250 SCALE



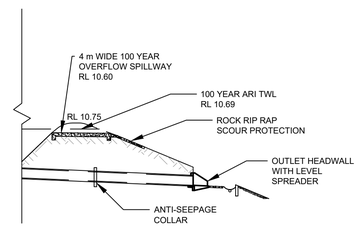
DISCHARGE CONTROL PIT 2 DETAIL

1:100 SCALE



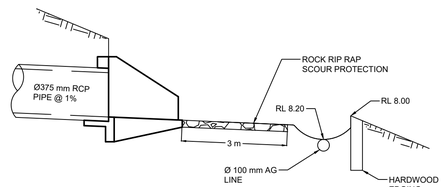
BASIN 2 SECTION DETAIL

NOT TO SCALE



BASIN 2 SPILLWAY DETAIL

NOT TO SCALE



LEVEL SPREADER OUTLET DETAIL

NOT TO SCALE

2 0 2 4 6 8 10 METRES 1:100

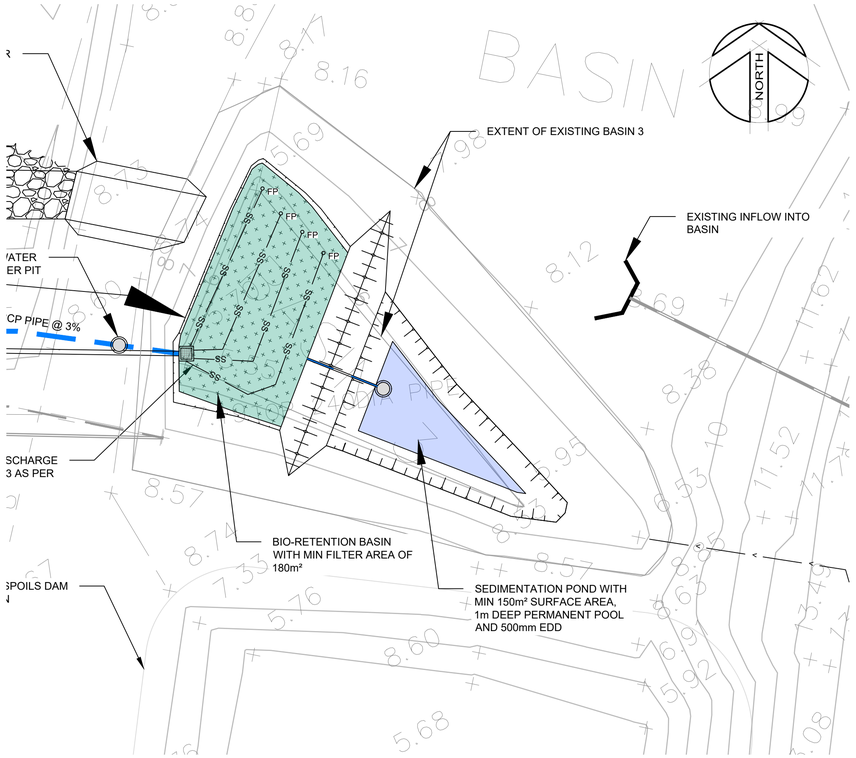
5 0 5 10 15 20 25 METRES 1:250

E	18	BARKER RYAN STEWART TOTAL PROJECT SOLUTIONS PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION	SYDNEY P: 02 9659 0005 CENTRAL COAST P: 02 4325 5255 HUNTER P: 02 4966 8388 ABN: 26 134 067 842 barkerryanstewart.com.au mail@barkerryanstewart.com.au	Client: ELF FARM SUPPLIES PTY LTD	108 - 112 MULGRAVE RD, MULGRAVE LOT 13 & 14 in DP 1138749 PROPOSED DRAINAGE WORKS BASIN 2 WORKS PLAN & DETAILS
D	18				
C	18				
B	18				
A	18				

Designed: JT
Drawn: GJR / MB
Checked: GJR

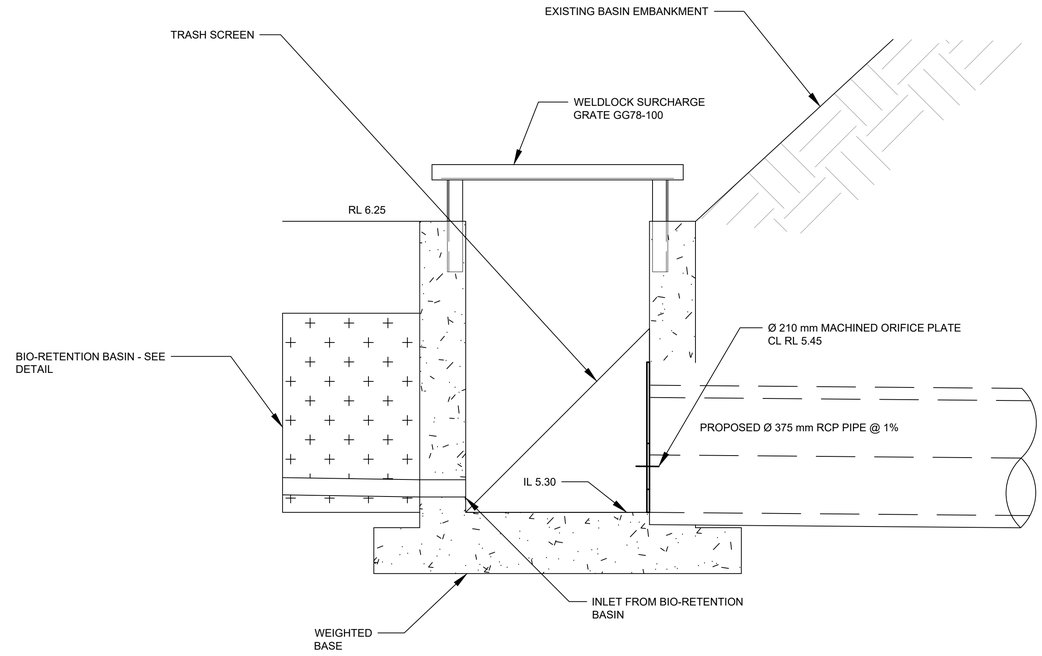
Scales: Plan 1:250
Horiz.
Vert.
X-Sect.
Datum: A.H.D.

Plan No. 07166E20_CA04
File Ref. 07166E20_CA.dwg
REV. E
SHEET 5 OF 9 SHEETS



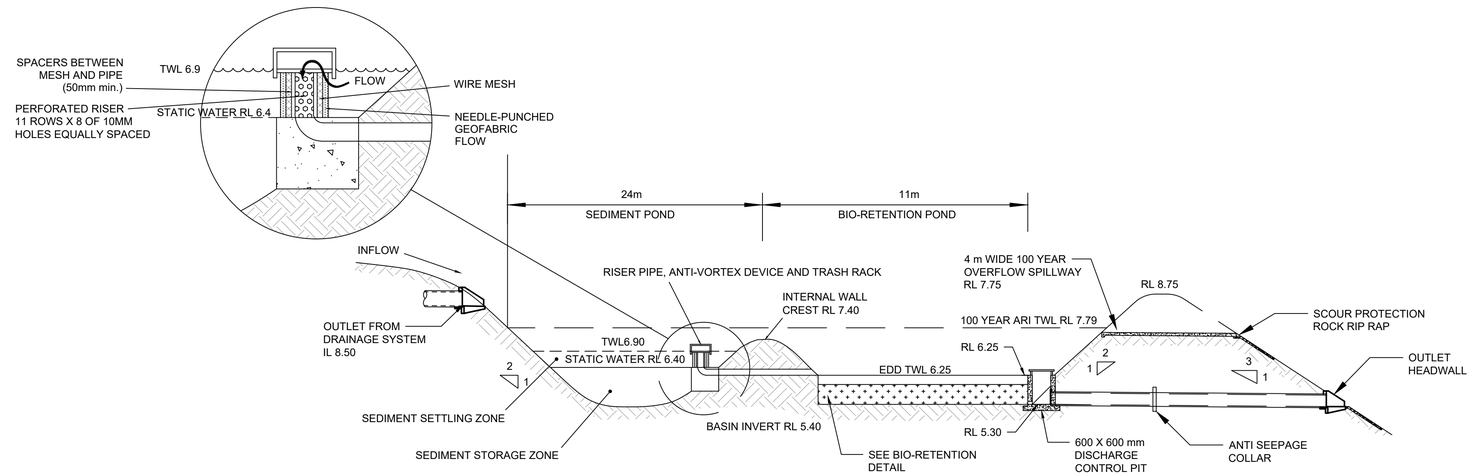
BASIN 3 SITE PLAN

1:250 SCALE



DISCHARGE CONTROL PIT 3 DETAIL

1:100 SCALE



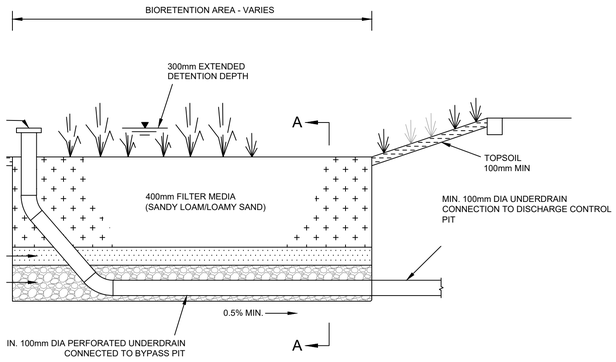
BASIN 3 SECTION DETAIL

NOT TO SCALE

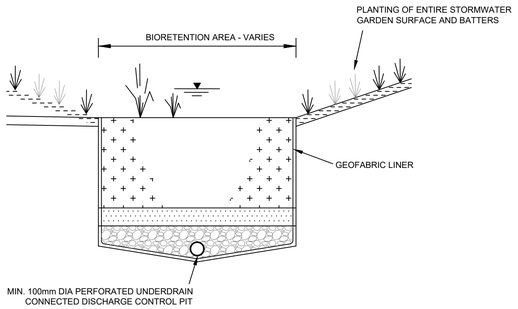
2 0 2 4 6 8 10 METRES 1:100

5 0 5 10 15 20 25 METRES 1:250

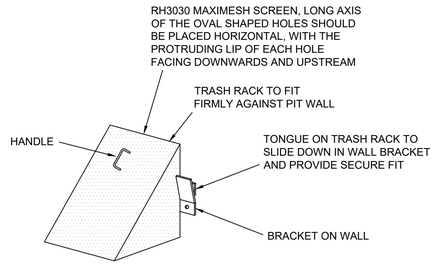
E	18	BARKER RYAN STEWART TOTAL PROJECT SOLUTIONS PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION	SYDNEY P: 02 9659 0005 CENTRAL COAST P: 02 4325 5255 HUNTER P: 02 4966 8388 ABN: 26 134 067 842 barkerryanstewart.com.au mail@barkerryanstewart.com.au	Client: ELF FARM SUPPLIES PTY LTD	108 - 112 MULGRAVE RD, MULGRAVE LOT 13 & 14 in DP 1138749 PROPOSED DRAINAGE WORKS BASIN 3 WORKS PLAN & DETAILS	Designed: JT Drawn: GJR / MB Checked: GJR Scales: Plan 1:250 Horiz. Vert. X-Sect. Datum: A.H.D.	Plan No. 07166E20_CA05 File Ref. 07166E20_CA.dwg REV. E SHEET 6 OF 9 SHEETS



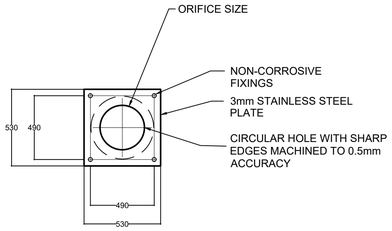
STORMWATER BIO-RETENTION
TYPICAL SECTION
NOT TO SCALE



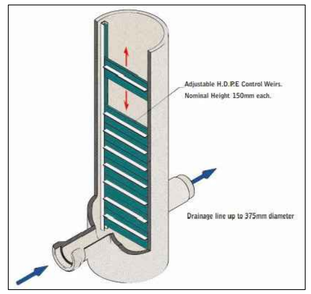
SECTION A-A
NOT TO SCALE



TRASH SCREEN
NOT TO SCALE



ORIFICE PLATE DETAIL
NOT TO SCALE



ROCLA WATER LEVEL
CONTROLLER DETAIL
NOT TO SCALE

E	BARKER RYAN STEWART TOTAL PROJECT SOLUTIONS PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION	SYDNEY P: 02 9659 0005 CENTRAL COAST P: 02 4325 5255 HUNTER P: 02 4966 8388 ABN: 26 134 067 842 barkerryanstewart.com.au mail@barkerryanstewart.com.au	Client: ELF FARM SUPPLIES PTY LTD	108 - 112 MULGRAVE RD, MULGRAVE LOT 13 & 14 in DP 1138749 PROPOSED DRAINAGE WORKS STORMWATER DETAILS	Designed: JT Drawn: GJR / MB Checked: GJR Scales: Plan NTS Horiz. Vert. X-Sect. Datum: A.H.D.	Plan No. 07166E20_CA06 File Ref. 07166E20_CA.dwg SHEET 7 OF 9 SHEETS	REV. E
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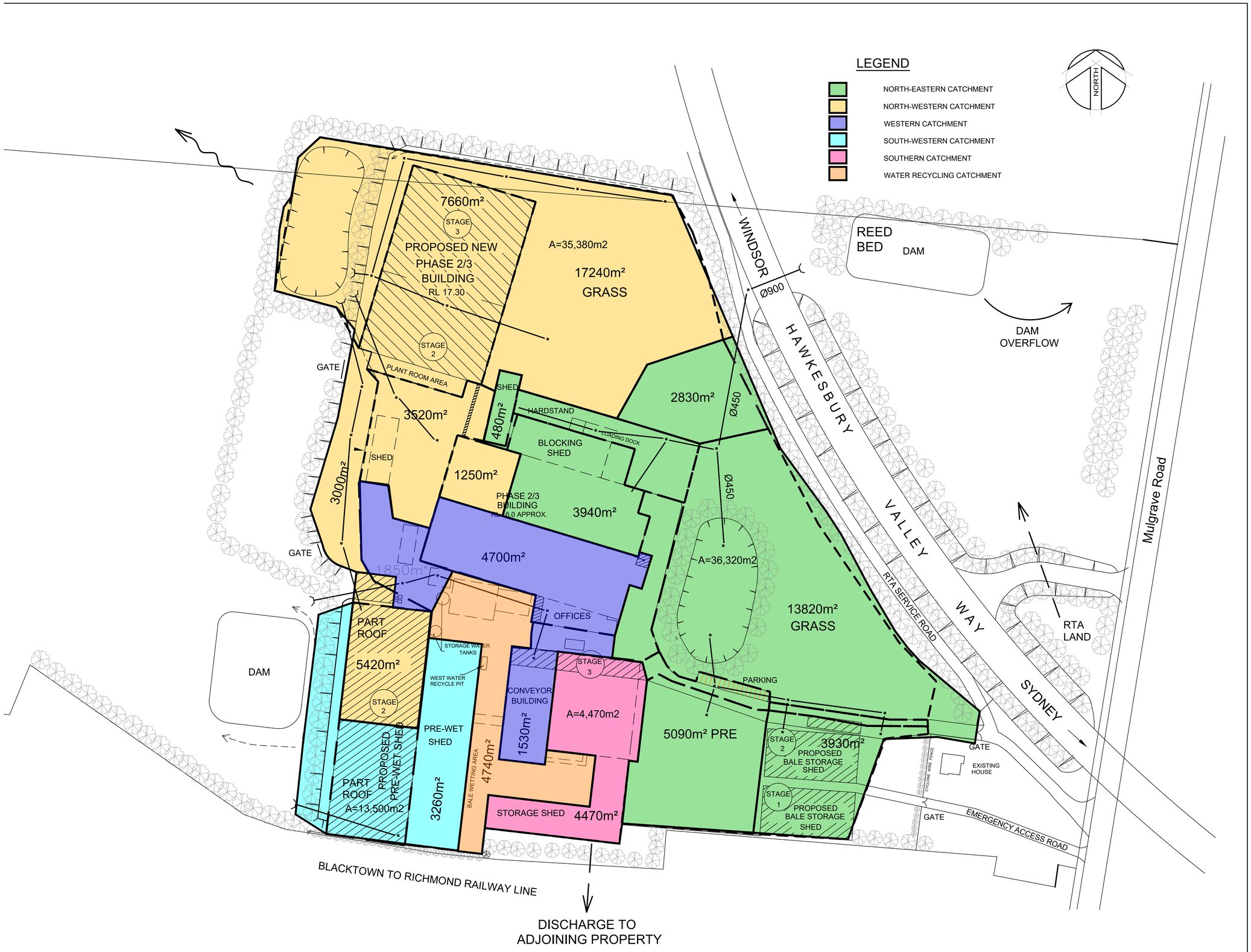

BARKER RYAN STEWART TOTAL PROJECT SOLUTIONS PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION	SYDNEY P: 02 9659 0005 CENTRAL COAST P: 02 4325 5255 HUNTER P: 02 4966 8388 ABN: 26 134 067 842 barkerryanstewart.com.au mail@barkerryanstewart.com.au	Client: ELF FARM SUPPLIES PTY LTD	108 - 112 MULGRAVE RD, MULGRAVE LOT 13 & 14 in DP 1138749 PROPOSED DRAINAGE WORKS CATCHMENT PLAN - EXISTING APPROVAL	Designed: JT Drawn: GJR / MB Checked: GJR Scales: Plan 1:1000 Horiz. Vert. X-Sect. Datum: A.H.D.	Plan No. 07166E20_CA07 File Ref. 07166E20_CA.dwg REV. E SHEET 8 OF 9 SHEETS

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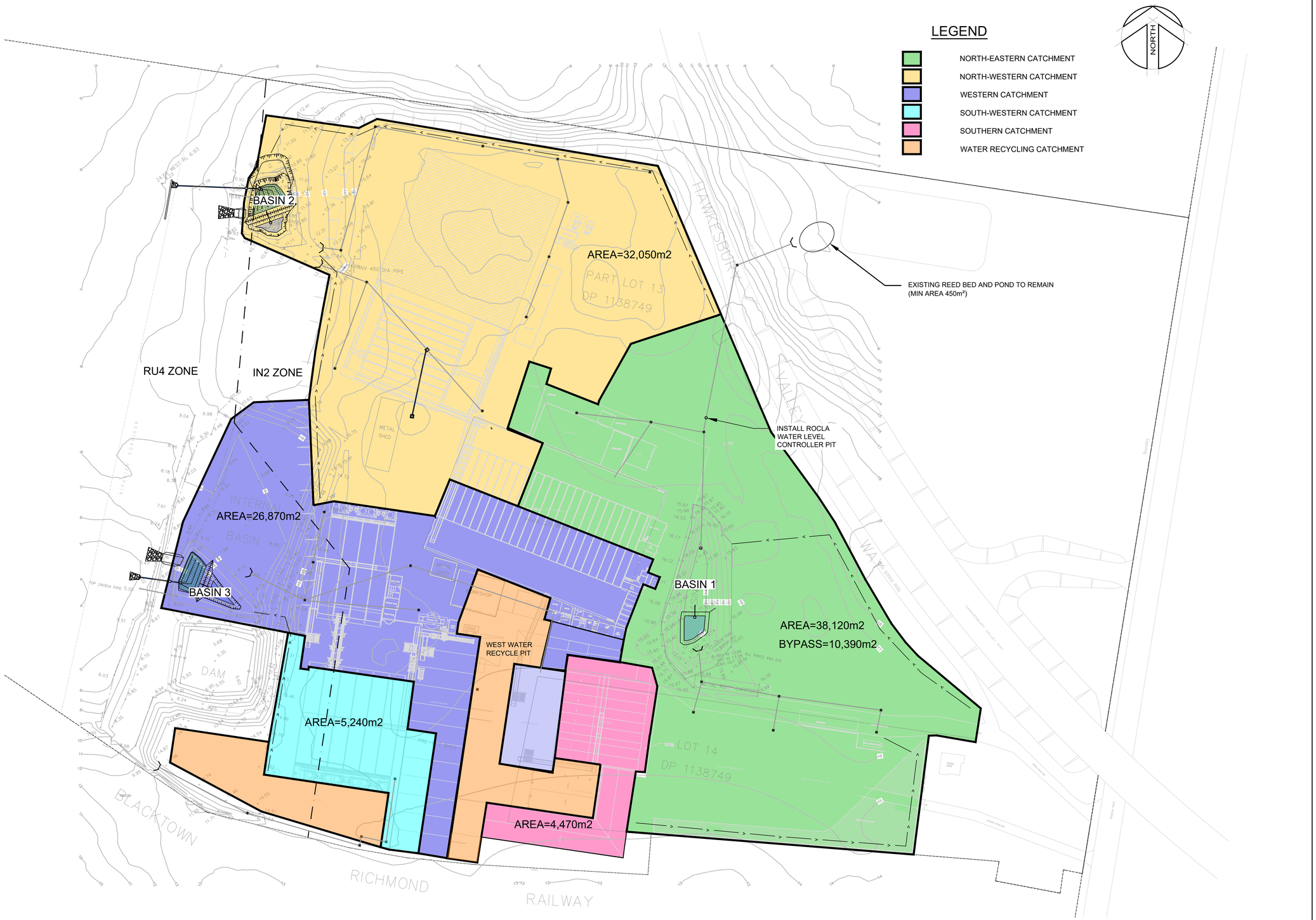

BARKER RYAN STEWART TOTAL PROJECT SOLUTIONS PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION	SYDNEY P: 02 9659 0005 CENTRAL COAST P: 02 4325 5255 HUNTER P: 02 4966 8388 ABN: 26 134 067 842 barkerryanstewart.com.au mail@barkerryanstewart.com.au	Client: ELF FARM SUPPLIES PTY LTD	108 - 112 MULGRAVE RD, MULGRAVE LOT 13 & 14 in DP 1138749 PROPOSED DRAINAGE WORKS CATCHMENT PLAN - PROPOSED WORKS (MOD 3)	Designed: JT Drawn: GJR / MB Checked: GJR Scales: Plan 1:1000 Horiz. Vert. X-Sect. Datum: A.H.D.	Plan No. 07166E20_CA08 File Ref. 07166E20_CA.dwg REV. E SHEET 9 OF 9 SHEETS