eco@jumrum
The ultimate Kuranda address

ENGENY
WATER MANAGEMENT

Eco@Jumrum

Stage 1 – Rural Residential Subdivision

Detailed Stormwater Management Plan

July 2015

M7103_001

www.engeny.com.au
P: 07 3221 7174 | F: 07 3236 2399
[illegible] Brisbane QLD 4000 | PO Box 10183 Brisbane QLD 4000

DISCLAIMER

This report has been prepared on behalf of and for the exclusive use of Eco@Jumrum and is subject to and issued in accordance with Eco@Jumrum instruction to Engeny Water Management (Engeny). The content of this report was based on previous information and studies supplied by Eco@Jumrum.

Engeny accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party. Copying this report without the permission of Eco@Jumrum or Engeny is not permitted.

M7103_001 ECO@JUMRUM STAGE 1 – RURAL RESIDENTIAL SUBDIVISION DSMP					
M:\Projects\M7000_Miscellaneous Clients\M7103_001 Eco @ Jumrum DSMP\07 Deliverables\Documents\Report\Revisions\Jumrum DSMP_Rev 1.docx					
REV	**DESCRIPTION**	**AUTHOR**	**REVIEWER**	**APPROVED BY**	**DATE**
Rev 0	Client Issue	Emily Gordon	David Sexton	Mark Page	31 July 2015
Rev 1	Client Issue	Emily Gordon	David Sexton	Mark Page	7 August 2015
Signatures		EGordon		MPage RPEQ 15454	

CONTENTS

Appendices

List of Tables

List of Figures

1. INTRODUCTION

Engeny Water Management (Engeny) has been commissioned by Eco@Jumrum to prepare a detailed stormwater management plan (DSMP) to comply with the development permit conditions for Stage 1 of the development known as *Eco@Jumrum* (Development Application Reference No. 1180). This DSMP has been prepared in support of the development application for the proposed rural residential development off Fallon Road, Kuranda. The key objective of this DSMP is:

- Provide information on how water quality from Stage 1 of the Eco@Jumrum development will be managed during the construction, establishment and operational phases of the project.

Subsequently the DSMP has been prepared in accordance with the following:

- Queensland Urban Drainage Manual (QUDM) (Department of Energy and Water Supply (DEWS), 2013)
- State Planning Policy (SPP) (DSDIP, 2014)
- MUSIC Modelling Guideline for Southeast Queensland – V.1 (Water by Design, 2010)
- Far North Queensland Regional Organisation of Councils (FNQROC) Development Manual for Stormwater Quality Management – V. 06 (FNQROC, 2014)

1.1 Project Background

A Site Based Stormwater Management Plan (SBSMP) was completed, for the entire development (Stage 1, 2 & 3), by David Sexton in September 2012. This plan addressed stormwater treatment for the multi-staged development through the use of bioretention pods with kerb inlets. The stormwater network for this development was designed to collect runoff from the roadway and discharge directly into Jumrum Creek. This report established that 13 bioretention pods were required to treat the entire development. Of these 13, 5 bioretention pods were located within Stage 1 of the development. Due to topographical conditions this number has increased to 7 bioretention pods in the Detailed Stormwater Management Plan.

This DSMP further develops the work completed in the SBSMP, specifically for Stage 1 of the development. This stormwater management plan proposes to incorporate a number of bioretention street pods to treat runoff from the road area within the proposed development.

2. EXISTING SITE CHARACTERISTICS

2.1 Location and Zoning

The subject site is approximately 5.4 Ha in area and is located along Fallon Road, Kuranda. Stage 1 of the proposed development consists of 11 Lots ranging in size between 3005 m^2 and 6715 m^2. Each lot is accessible from Fallon Road via a proposed local road, *Road A.*

The development will be located within a regenerated forest and as such each lot has a maximum building envelope of 2000 m^2, the remaining area of each lot will remain undeveloped. Eight of the eleven lots are bordered by either Jumrum Creek or Ulysess Creek.

For stormwater quality purposes, the proposed treated catchment consists solely of the sealed roadway footprint within the development. The road extents contribute a catchment area of 0.235 Ha to be treated by a number of bioretention street pods positioned adjacent to the roadway.

2.2 Topography and Services

A description of the current site topography and existing services are as follows and are presented in Figure 3.1.

- The site generally slopes towards Jumrum Creek in an easterly direction.
- Lots 1 – 6 grade downhill towards Road A, with Lots 3 and 4 also falling in towards Ulysses Creek which runs between the two lots towards Jumrum Creek.
- Ulysess Creek will pass under Road A via a single barrel 1650 mm reinforced concrete pipe (RCP) culvert and will continue to flow between Lots 8 and 9 before joining with Jumrum Creek in the far east of the site.
- Lots 6 consists of a high point in the centre of the block, the half of the block adjacent to Road A grades east towards the road and the remainder of the lot grades towards Jumrum Creek in the south-west.
- A stormwater network will be included in the roadway, consisting of five stormwater pits (1/2SW, 2/2SW, 3/2SW, 1/3SW and 4/2SW). Stormwater flows from the final pit will discharge to Ulysess Creek, through a secondary outlet in the culvert headwall, downstream of Road A.

3. PROPOSED DEVELOPMENT

3.1 Lot Layout

This application proposes to develop Stage 1 of a 3 stage development on Fallon Road, Kuranda. Stage 1 involves the development of 11 rural residential lots ranging in size between 3005 m^2 and 6715 m^2. These lots are arranged along each side of the proposed roadway Road A, as can be seen in Figure 3.1 below.

Two creeks run within the proposed development, Jumrum Creek along the rear of Lots 7-11 and Ulysess Creek between Lots 3 and 4 and Lots 8 and 9. Stormwater detention is not required at the site; however stormwater treatment is required for the roadway to meet water quality targets for the site as outlined in Section 4.

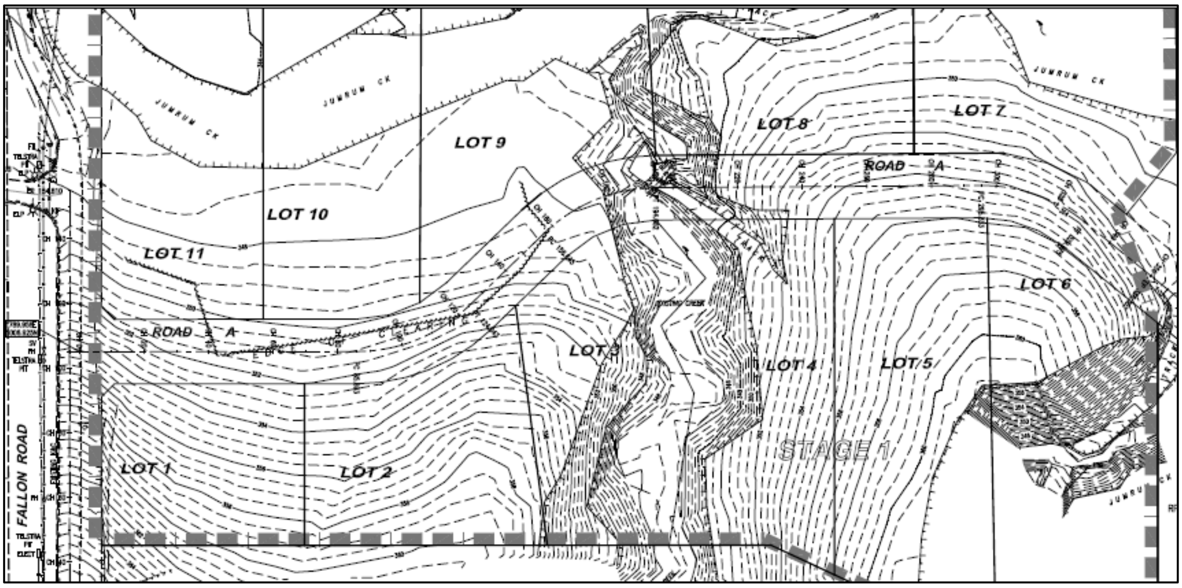


Figure 3.1 Proposed Lot Layout

3.2 Treatment Train

3.2.1 Bioretention Systems

The proposed water treatment train consists of seven bioretention street pods, positioned adjacent to each of the five stormwater gully pits in the roadway. Street pods have been chosen as the most suitable water quality treatment device for this application due to reduced availability of flat space adjacent to gully pits 1/3SW and 4/2SW. Street pods were also considered suitable despite the steep natural topography of the site.

Each of the seven street pods are consistent with a standard design for the site, this design has been based on the Brisbane City Council (BCC) standard design for bioretention street pods and adapted for conditions specific to this site.

3.2.2 Treated Catchment Area

No roof catchments have been included as it has been assumed the majority of runoff from roof areas will be stored in rainwater tanks. Additional lot area beyond the specified 2000 m^2 development area is assumed to remain densely vegetated forest. The regenerated forest surrounding each property will act as a vegetated buffer zone between the development area on each lot and the natural environment beyond the lot boundaries. Due to the presence of these buffer zones runoff from the lots is not believed to be a major contributor of pollutants to the natural environment downstream. The primary contributor of pollutants from the development is the road way and therefore only the impervious road footprint has been included in the catchment area for each water treatment system.

3.2.3 Sediment Forebay

As the catchment area for each bioretention system is < 2 Ha, a sediment forebay has not been included in the pod design. This is in accordance with the recommendations of Water by Design's - Bioretention Technical Design Guidelines (Water by Design 2014 - Table 14).

3.2.4 Drainage System

Due to the nature of rainfall in the tropics, which produces short intense storms with large runoff volumes, the volume of available storage was more critical for water treatment than the surface area of the filter media. Therefore the standard design for bioretention street pods outlined by BCC was adapted to suit the tropical climate experienced in Kuranda.

In order to accommodate these site specific requirements the filter media area of 3 m^2 was adopted for each system, in accordance with BCC standards. An additional 3.7 m^2 of basin floor area was included in these bioretention systems to achieve a surface area of 8 m^2 at half the extended detention depth.

A minimum filter media depth of 500 mm was assumed for each of the bioretention pods. The proposed drainage system will include the following layers (see detail in Appendix B):

- Filter Media – Loamy Sand (nom size 0.45-0.5 mm), 500 mm thick
- Transition Layer – Coarse Sand (nom. size 1 mm), 100 mm thick
- Drainage Layer – Fine Aggregate (nom. size 5 mm), 200 mm thick
- Under-drain – 90 mm slotted uPVC pipe within drainage layer (0.5% min grade)
- Collection pipe to connect with Gully Pit – 90 mm uPVC pipe (0.5% min grade).

3.2.5 Vegetation

Grasses and ground covers have been specified for the bioretention street pods. It has been specified to continue planting along the batter slopes in order to stabilise the excavation batters which are limited to a grade of 1V:2H due to space constraints.

The proposed schedule of plants for each bioretention street pod is included in Table 3.1 below.

Table 3.1 Vegetation Planting Schedule

Planted Area	Species	Planting Density
Floor Planting	Juncus Usitatus	6 / m^2
	Lomandra Hystrix	
	Dianella Longifolia	
Batter / Edge Planting	Lomandra Longifolia	6 / m^2

3.2.6 Overflows

All the bioretention systems are design to treat runoff from the 3 month ARI storm event. Once the capacity of the system is reached stormwater will no longer inflow to the system through the opening in the kerb and instead flows will pass directly to the adjacent gully pit downstream of the inlet.

4. STORMWATER QUALITY MANAGEMENT

The treatment train effectiveness was assessed using the Cooperative Research Centre for Catchment Hydrology's (CRCCH) Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Version 6.1. Model parameters including rainfall runoff and pollutant export parameters were adopted based on the recommendations of the Water by Design: MUSIC Modelling Guidelines for Southeast Queensland. While this site does not reside in Southeast Queensland this guideline has been adopted based on the recommendations of the FNQROC Development Manual for Stormwater Quality Management.

The MUSIC model layout is shown in Figure 4.1 below.

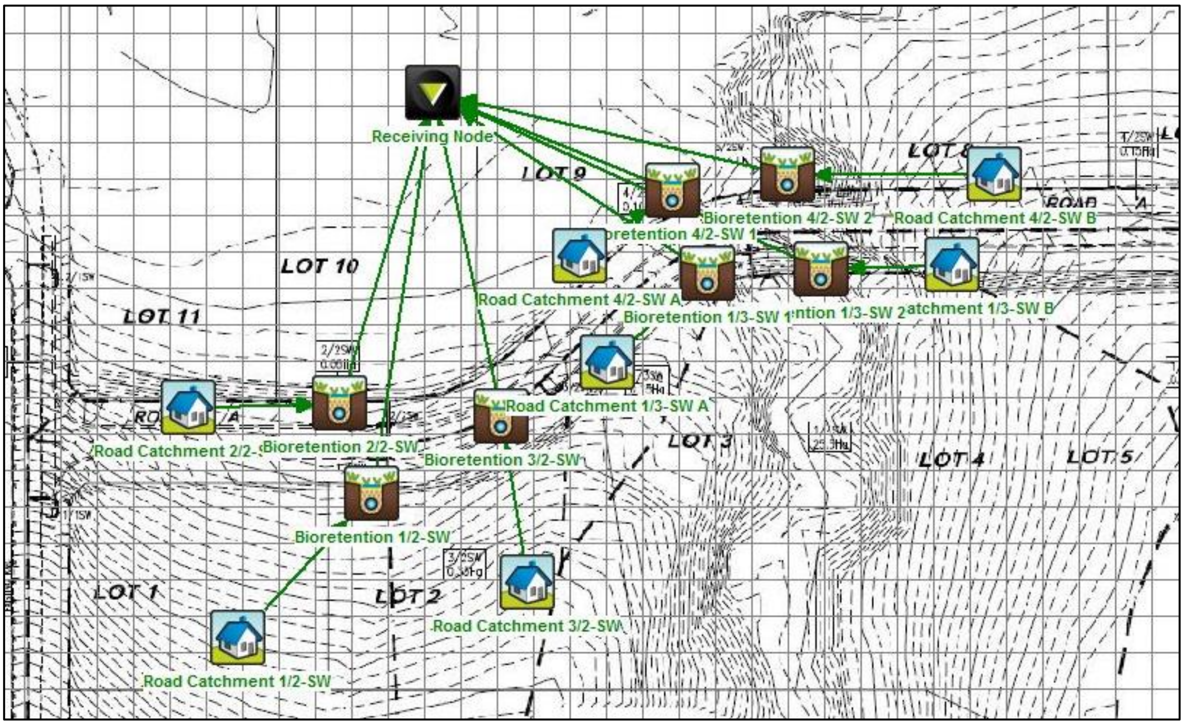


Figure 4.1 MUSIC Model Layout

4.1 Water Quality Design Objectives

A stormwater quality treatment strategy has been developed in accordance with the State Planning Policy (SPP) 2014. Based on the provisions of the SPP the load based pollutant reduction targets have been used to demonstrate compliance with water quality requirements. Load based targets identified in the SPP for Wet Tropical Regions were adopted for discharge targets as outlined in

Table 4.1.

Table 4.1 Adopted Water Quality Objectives

Pollutant	Minimum Load Reduction Target
Total Suspended Solids (TSS)	80 %
Total Phosphorus (TP)	60 %
Total Nitrogen (TN)	40 %
Gross Pollutants (GP)	90 %

4.1.1 Climate Data

Climate data, including rainfall and evapotranspiration data for the area was sourced from the Bureau of Meteorology (BOM). Rainfall data was obtained from the nearby BOM station Cairns Aero (031011) for a 10 year period between 31 May 1997 and 31 May 2007. The rainfall data was modelled at six (6) minute intervals as specified in the MUSIC Modelling Guidelines for South East Queensland (Water by Design, 2010).

This period was selected as an appropriate data set for the area which had minimal periods of missing data. This weather station was selected due to the reliability of records and the site's proximity to Cairns. The average annual rainfall over the period used in the MUSIC Modelling was 1810 mm. Long-term rainfall records at the Cairns Aero weather station from the period 1942 to 2015 were obtained from the Bureau of Meteorology web site. An analysis of this data is summarised below:

Table 4.2 Long-term Rainfall Data – Cairns Aero Weather Station (031011)

Data	Rainfall Depth
Lowest Annual Rainfall	721 mm
10th Percentile Annual Rainfall	1290 mm
Average Annual Rainfall	2008 mm
Median Annual Rainfall	1976 mm
90th Percentile Annual Rainfall	2780 mm
Highest Annual Rainfall	3149 mm

Based on a comparison of the long-term rainfall statistics with the average annual rainfall from the sample period, this data can be expected to yield satisfactory results. This is due to the fact the average rainfall of the dataset (1810 mm) is close to the long term average (2008 mm).

Average monthly potential areal evapotranspiration values were obtained for the site from the Bureau of Meteorology web site. These values are presented in Table 4.3.

Table 4.3 Evapotranspiration Data

Month	Evapotranspiration (mm)
January	190
February	155
March	195
April	140
May	120
June	110
July	105
August	125
September	150
October	195
November	195
December	190

4.1.2 Catchment Properties

The catchment area for water quality modelling has been taken as the extents of the impervious footprint of the roadway through the development. This area has been considered alone as it is believed the impervious roadway will be the primary contributor to pollutants within the development, when compared with other areas such as grassed areas and driveways.

Due to the steep topography of the site Bioretention Street pods coupled with a subsurface stormwater network were chosen as the most suitable stormwater treatment system for this development.

The roadway has been divided into seven individual catchments, each reporting to a single Bioretention Street pod. There will be a single bioretention street pod upstream of each stormwater gully pit, with the exception of pits 4/2SW and 1/3SW. These two pits will have two adjacent bioretention street pods, one on either side as these pits lie in a sag point in the roadway and receive catchment from both directions.

A split catchment approach was adopted for the water quality assessment. Rainfall-runoff parameters were adopted for an urban residential land use, Table 3.7 of the MUSIC Modelling Guidelines for Southeast Queensland (Water by Design, 2010). Urban residential values were adopted as they are associated with the split catchment approach. Pollutant export parameters were adopted from the recommended values for Roads in Table 3.8 of the MUSIC Modelling Guidelines for Southeast Queensland (Water by Design, 2010).

Table 4.4 provides a summary of the MUSIC model parameters adopted for each of the catchment areas considered as part of this water quality assessment. The fraction impervious was assumed as 100% as only the impervious extent of the road footprint was included in determining the catchment area for each water quality treatment device.

Table 4.4 Catchment Input Parameters

Catchment	Area (ha)	Impervious Fraction
Bioretention 1/2SW	0.031	100 %
Bioretention 2/2SW	0.036	
Bioretention 3/2SW	0.013	
Bioretention 4/2SW - 1	0.034	
Bioretention 4/2SW - 2	0.050	
Bioretention 1/3SW - 1	0.021	
Bioretention 1/3SW - 2	0.050	

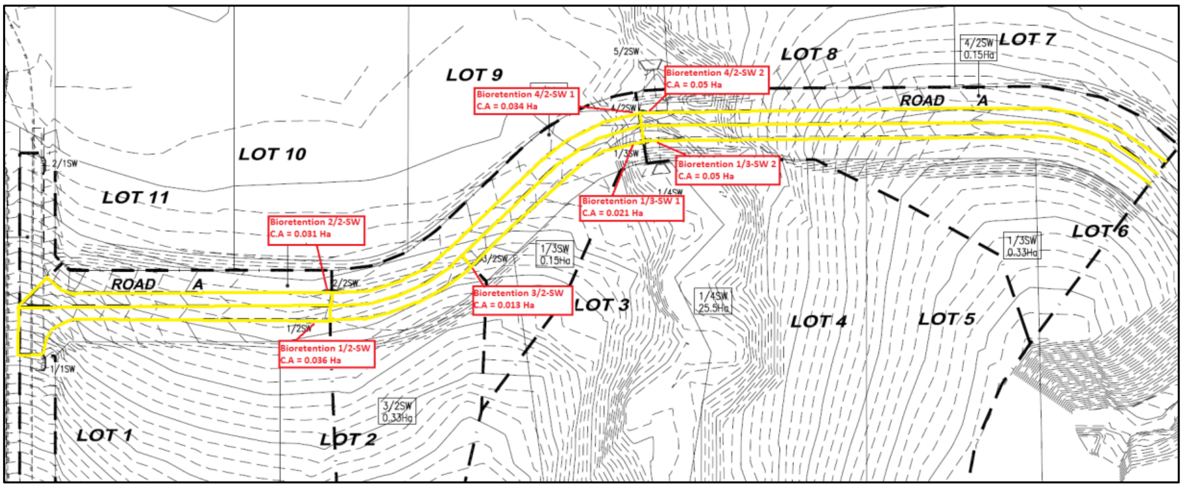


Figure 4.2 Water Quality Catchment Areas

4.1.3 Treatment Sizing and Location

Seven bioretention street pods are proposed for application within the development. All systems will be located along the kerb adjacent to a stormwater gully pit. Stormwater flows will enter the bioretention systems through an opening in the kerb which will collect low flows from the kerb channel. Once the capacity of the bioretention system is reached the kerb opening will act as an overflow weir and will allow water to flow back into the kerb channel and into the adjacent gulley pit downstream.

Bioretention street pod parameters have been adopted based on the Water by Design MUSIC Modelling Guidelines for Southeast Queensland. Parameters used for the proposed bioretention systems are summarised in Figure 4.3.

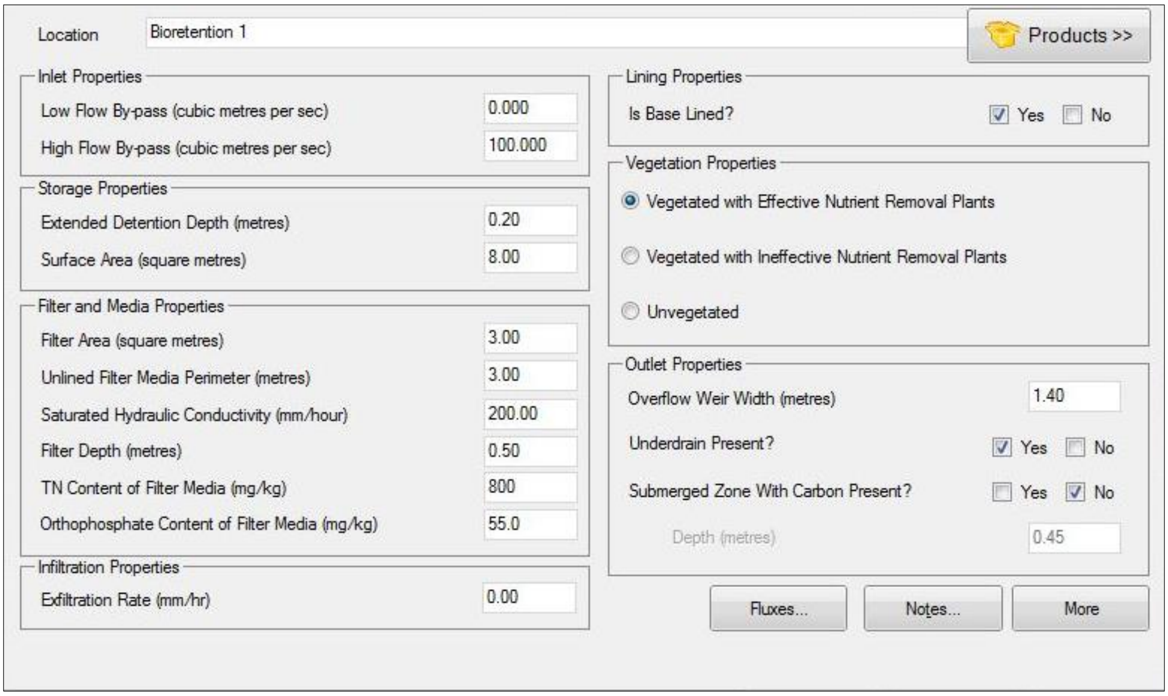


Figure 4.3 Stage 1 Bioretention Street Pod Properties

4.2 Water Quality Model Results

Results of the MUSIC model are presented in Table 4.5 and Figure 4.4

Table 4.5 MUSIC Model Results

Pollutant	Load Based Reduction Target (%)	Modelled Reduction (Total)
Total Suspended Solids (TSS)	80 %	84 %
Total Phosphorus (TP)	60 %	67 %
Total Nitrogen (TN)	40 %	41 %
Gross Pollutants (GP)	90 %	100 %

	Sources	Residual Load	% Reduction
Flow (ML/yr)	3.96	3.91	1.2
Total Suspended Solids (kg/yr)	1590	260	83.7
Total Phosphorus (kg/yr)	2.56	0.856	66.5
Total Nitrogen (kg/yr)	8.33	4.9	41.1
Gross Pollutants (kg/yr)	79.3	0	100

Figure 4.4 MUSIC Model Results

Results of the MUSIC modelling indicate that the load based reduction targets set out in the SPP have been achieved with the proposed treatment train.

5. TREATMENT TRAIN OPERATION AND MAINTENANCE

In the context of development sites and associated construction and building works, delivering bioretention pods and establishing vegetation can be very challenging. Therefore, bioretention pods require a careful construction and establishment approach to ensure the pods are formed in accordance with the design intent. The following sections outline a recommended staged construction and establishment methodology for bioretention pods as outlined within Healthy Waterways Technical Design Guidelines.

5.1 Construction and Establishment

The following is a proposed staged construction and establishment method:

5.1.1 Functional Installation

Construction of the functional elements of the bioretention pod will occur at the end of civil works construction along with the installation of temporary protective measures.

For example, using a temporary arrangement of a suitable geofabric covered with shallow topsoil (e.g. 25 mm) and instant turf, in lieu of the final pod planting.

Stormwater kerb openings are to be temporarily blocked during construction.

5.1.2 Sediment and Erosion Control

The temporary protective measures preserve the functional infrastructure of the bioretention pods whilst providing a temporary erosion and sediment facility throughout the building phase.

5.1.3 Operational Establishment

At completion of the building phase, removal of the temporary protective measures along with accumulated sediment and the system planted in accordance with the design planting schedule.

Vegetation establishment will be aided based on the following controls:

Weed control

Adopting high planting densities and if necessary, applying a suitable biodegradable erosion control matting to the pod batters will help to combat weed invasion and reduce labour intensive maintenance requirements. A heavy application of seedless hydro-mulch can also provide short term erosion and weed control. No matting or hydro-mulch is to be applied to the surface of the bioretention pod following the construction phase, as this will hinder filtration of stormwater through the filter media.

Watering

Regular watering of bioretention pod vegetation is essential for successful establishment and healthy growth. The frequency of watering to achieve the successful plant establishment is dependent upon rainfall, maturity of planting stock and the water holding capacity of the soil. The following watering program is generally adequate but should be adjusted to suit the site conditions:

- Week 1-2 3 visits/week
- Week 3-6 2 visits/week
- Week 7-12 1 visit/week

After this initial 3 month period, watering may still be required, particularly during the first winter. Watering requirements to sustain healthy vegetation should be determined during ongoing maintenance site visits.

5.2 Bioretention Maintenance

Vegetation plays a key role in maintaining the porosity of the filter media of a bioretention pod and a strong healthy growth of vegetation is critical to its performance. Therefore the most intensive period of maintenance is during the plant establishment period (first two years) when weed removal and replanting may be required.

Typical maintenance of bioretention pod elements as outlined within Healthy Waterways Technical Design Guidelines will involve:

- Routine inspection of the bioretention pod profile to identify any areas of obvious increased sediment deposition, scouring from storm flows, rill erosion of the batters from lateral inflows, damage to the profile from vehicles and clogging of the bioretention pod (evident by a ‘boggy’ filter media surface).
- Routine inspection of the inflows/overflow opening and under-drains to identify and clean any areas of scour, litter build up and blockages.
- Removal of sediment where it is smothering the bioretention pod vegetation.
- Where a sediment forebay is adopted, removal of accumulated sediment.
- Repairing any damage to the profile resulting from scour, rill erosion or vehicle damage by replacement of appropriate fill and revegetation.
- Tilling of the bioretention surface, or removal of the surface layer, if there is evidence of clogging.

- Regular watering/irrigation of vegetation until plants are established and actively growing.
- Removal and management of invasive weeds (herbicides should not be used).
- Removal of plants that have died and replacement with plants of equivalent size and species as detailed in the plant schedule.
- Pruning to remove dead or diseased vegetation material and to stimulate growth.
- Vegetation pest monitoring and control.

Maintenance should only occur after a reasonable rain free period when the soil in the bioretention system is dry. Inspections are also recommended following large storm events to check for scour and other damage. Inspections should occur every 6 months based on the size and complexity of the system.

To ensure the successful establishment and operation of bioretention pods the following checklists have been developed by Healthy Waterways and are available within the Technical Design Guidelines for South East Queensland:

- Design assessment checklist (detailed design).
- Construction inspection checklist (during and post construction).
- Operation and maintenance inspection form.
- Asset transfer checklist (following 'on maintenance' period).

6. CONCLUSION

The DSMP for the Stage 1 development of Eco @ Jumrum has been developed to achieve the required stormwater management objectives for the site as outline in the State Planning Policy (2014). The key objectives of this DSMP include:

- Water quality modelling to develop a stormwater quality treatment train which demonstrates compliance with FNQROC and SPP water quality objectives.
- Provide information on how water quality from Stage 1 of the Eco@Jumrum development will be managed during the construction, establishment and operational phases of the project.

The key design outcomes of the stormwater quality management area as follows:

- Three month flows will enter the bioretention street pods from the adjacent kerb channel through an inlet point in the kerb.
- Seven bioretention street pods will be incorporated into the Stage 1 development to treat runoff from the impervious road area alone.
- 3 m^2 of filter media area and 8 m^2 of surface area are required in each of the seven street pods to achieve the water quality objectives outlined in the SPP.
- The bioretention street pods will be located immediately upstream of each gulley pit in the roadway, all runoff exceeding the capacity of the systems will bypass the pods and flow into the adjacent gulley pits.

The proposed water quality treatment system outlined within this DSMP achieves the required water treatment objectives for this development, as outlined in the SPP (2014).

7. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b. Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

c. Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

   (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

   (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

d. Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

e. This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this report.

f. If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

g. This report does not provide legal advice.

8. REFERENCES

1. Australian Government Bureau of Meteorology (www.bom.gov.au);

2. Brisbane City Council 2014, Standard Drawings – 9000 series Streetscape and landscape, April 2014.

3. Far North Queensland Regional Organisation of Councils (2014), Development Manual for Stormwater Quality Management, FNQROC V. 06, 2014

4. Healthy Waterways 2006, WSUD Technical Guidelines for Southeast Queensland

5. Queensland Department of Natural Resources and Water, "Queensland Urban Drainage Design Manual", 2013

6. Queensland Government 2014, State Planning Policy July 2014

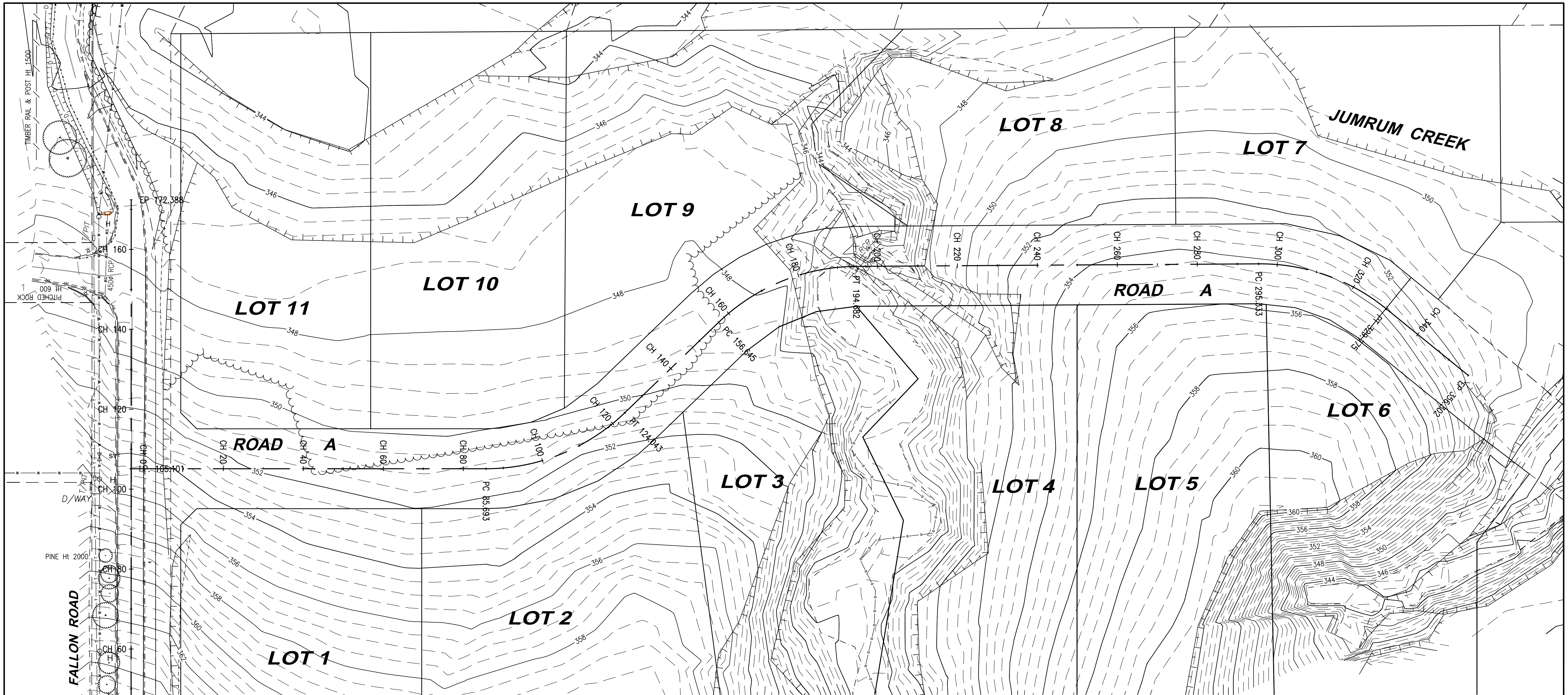
7. Sexton, David 2012, Eco @ Jumrum Estate – Concept Operational Phase Stormwater Quality Management Plan, Revision 1, September 2012

8. Water by Design 2012, Bioretention Technical Design Guidelines – Version 1.1, October 2014

9. Water by Design 2010, MUSIC Modelling Guidelines for Southeast Queensland – Version 1

APPENDIX A

Lot Layout



EXISTING SERVICES

1. EXISTING SERVICES ARE PLOTTED FROM THE BEST INFORMATION AVAILABLE. NO RESPONSIBILITY IS TAKEN BY THE SUPERINTENDENT FOR THE ACCURACY AND COMPLETENESS OF THE INFORMATION SHOWN.
2. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, THE CONTRACTOR IS TO ESTABLISH ON SITE THE EXACT LOCATION OD ALL UNDERGROUND SERVICES IN THE PROPOSED WORKS AREA. METHODS TO ACHIEVE THIS WILL INCLUDE BUT NOT BE LIMITED TO:–
   - CAREFUL EXAMINATION OF THE CONTRACT DRAWINGS
   - CONSULTATION WITH THE RELEVANT SERVICE AUTHORITIES
   - COMPREHENSIVELY SCANNING THE AFFECTED AREAS WITH A CABLE DETECTOR AND MARKING ON THE GROUND THE POSITION OF ALL SERVICES
   - HAND EXCAVATING TO EXPOSE ALL SERVICES WHICH MAY BE AFFECTED BY THE PROPOSED WORKS UNDER THE DIRECTION OF THE RELEVANT SERVICE AUTHORITY.
3. THE CONTRACTOR SHALL BRING TO THE SUPERINTENDENTS ATTENTION ANY DISCREPANCIES BETWEEN THE EXISTING SERVICES THUS IDENTIFIED AND THE DOCUMENTED SERVICES WHICH MIGHT AFFECT THE PROPOSED WORKS. APPROPRIATE MEASURES TO RESOLVE ANY CONFLICTS WILL BE DOCUMENTED BY THE SUPERINTENDENT.

LEGEND

- EXISTING TOP OF BANK
- EXISTING TOE OF BANK
- EXISTING CHANGE OF GRADE
- EXISTING EDGE OF BITUMEN
- EXISTING KERB & CHANNEL
- SW — EXISTING UNDERGROUND DRAINAGE
- EXISTING TREES
- W — EXISTING WATER MAINS
- E — EXISTING ELECTRICITY
- T — EXISTING TELSTRA CABLES
- PROPOSED STAGE BOUNDARIES
- 375 — EXISTING CONTOURS (AT 0.5m, INDEXED AT 2.0m)

NOTES:

SURVEY CONTROL

ORIGIN OF LEVELS:
PM 114534 RL 352.945 AHD.

ORIGIN OF COORDINATES: UNKNOWN, ARBITRARY

CONTOUR INTERVAL: 0.50m INDEXED AT 2.0m INTERVALS.

NOTE: CONTRACTOR TO CONFIRM SURVEY DATUM WITH SURVEYOR PRIOR TO COMMENCEMENT OF WORK.

THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE DETAILED STORMWATER MANAGEMENT PLAN PREPAREI BY ENGENY DATED JULY 2015 AND DEPT. OF ENVIRONMENT APPROVAL DECISION DATED AUGUST 5, 2014.

RP DESCRIPTION
LOT 72 ON RP 903071
PARISH OF CAIRNS
COUNTY OF NARES
LOCAL AUTHORITY
MAREEBA SHIRE COUNCIL

amendments

A	ORIGINAL ISSUE FOR OPERATIONAL WORKS	17.12.10
B	POSSIBLE ACCESS LOCATIONS SHOWN	28.02.11
C	DRAWING RENUMBERED AND ISSUED FOR OPERATIONAL WORKS	19.05.14
D	GENERAL REVISION, NOTES ADDED	27.07.15

JIM PAPAS CIVIL ENGINEERING DESIGNER PTY. LTD.
CIVIL ENGINEERING DESIGN AND DRAFTING
P. O. Box 2347 Mareeba Q 4880
Mob. 0408 770 394
Email: admin@jpced.com.au

eco@jumrum
The ultimate Kuranda address

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

eco@jumrum
PROPOSED RURAL RESIDENTIAL DEVELOPMENT AT FALLON ROAD, KURANDA.

DRAWING TITLE: EXISTING SITE PLAN

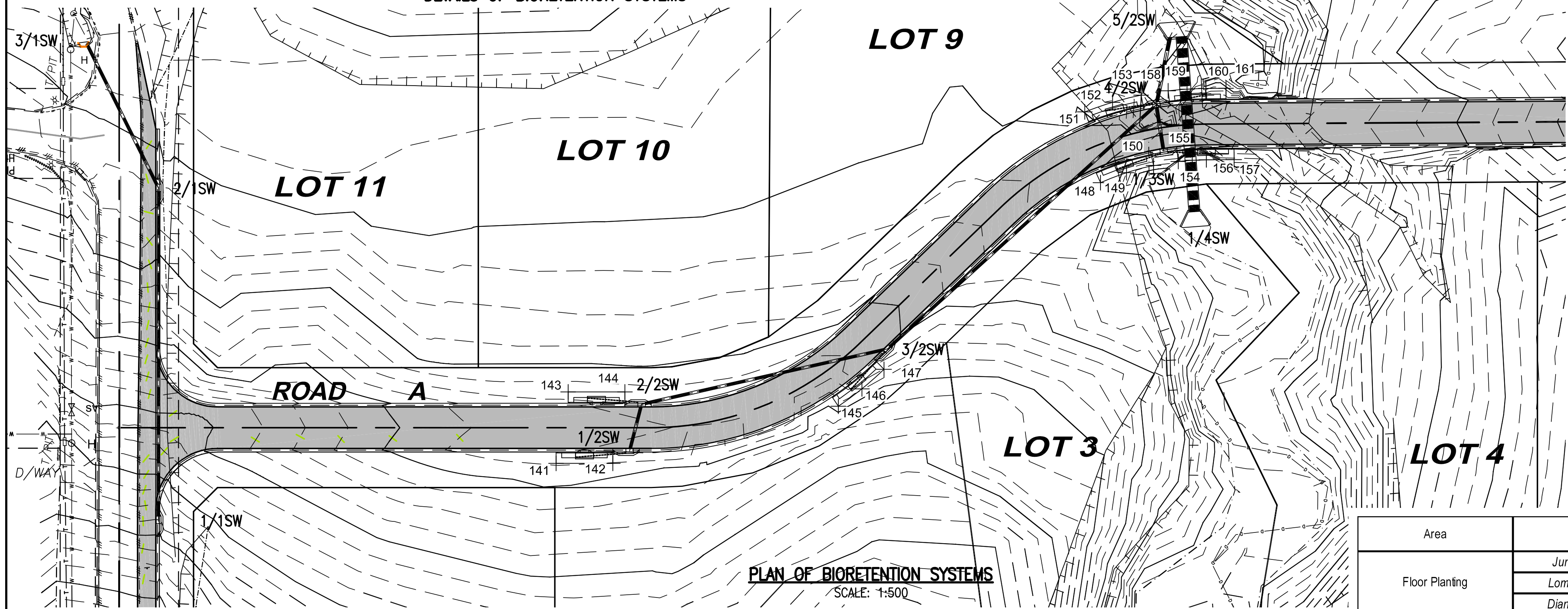
SCALE (AT A1 SIZE)	HOR 1:500 / VER	DRAWN	J.P.
		DESIGNED	J.P.
DATE	DEC. 2010	CHECKED	J.P.
APPROVED			
DWG NUMBER	1299 – C01	AMDT	D

APPENDIX B

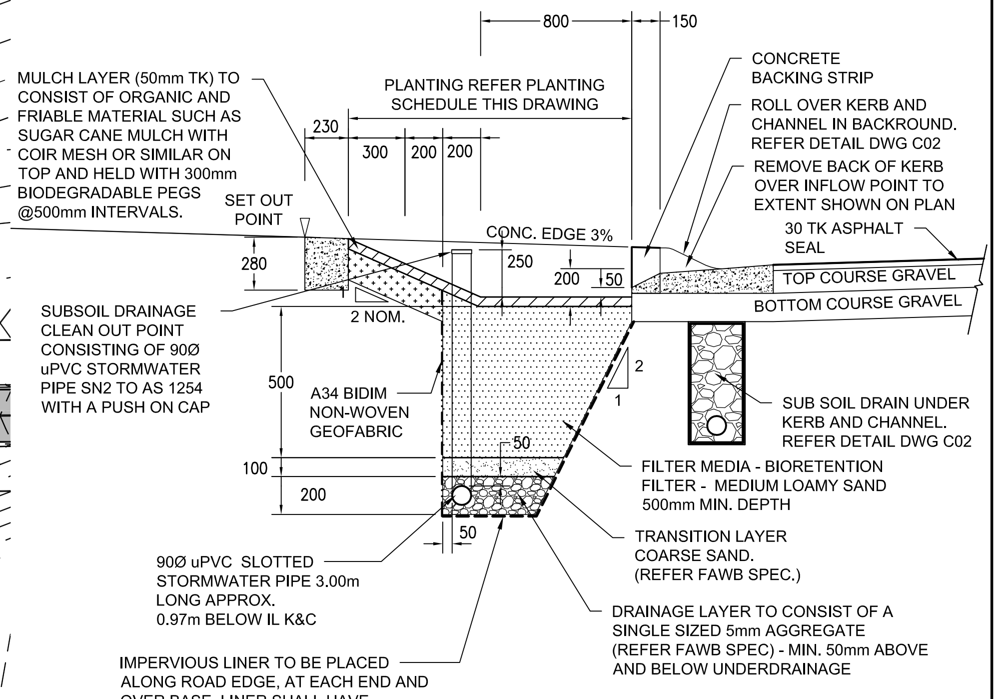
Bioretention System Design

DETAILS OF BIORETENTION SYSTEMS

	Bioretention System 1/2SW	Bioretention System 2/2SW	Bioretention System 3/2SW	Bioretention System 4/2SW -1	Bioretention System 4/2 SW-2	Bioretention System 1/3SW-1	Bioretention System 1/3SW-2
SL of filter media	350.78	350.98	350.17	347.93	349.95	347.85	347.96
Extended Detention Depth	200mm	200mm	200mm	200mm	200mm	200mm	200mm
90mm slotted IL (Approx)	349.73	349.93	349.12	346.88	348.90	346.80	346.91
90mm non - slotted IL to pit	349.62	349.57	349.00	346.70	346.70	346.60	346.60
Filter media depth	500mm	500mm	500mm	500mm	500mm	500mm	500mm
Top Level - Transition Layer	350.28	350.48	349.67	347.43	349.45	347.35	347.46
Top Level - Drainage Layer	350.18	350.38	349.57	347.33	349.35	347.25	347.36
Concrete level at inlet to filter media	350.88	351.08	350.27	348.03	350.05	347.95	348.06
Surface area - Filter media	3m^2	3m^2	3m^2	3m^2	3m^2	3m^2	3m^2
Bottom Level - Drainage Layer	349.98	350.18	349.37	347.13	349.15	347.05	347.16



PLAN OF BIORETENTION SYSTEMS
SCALE: 1:500



SECTION A
THROUGH BIORETENTION FILTER
NTS

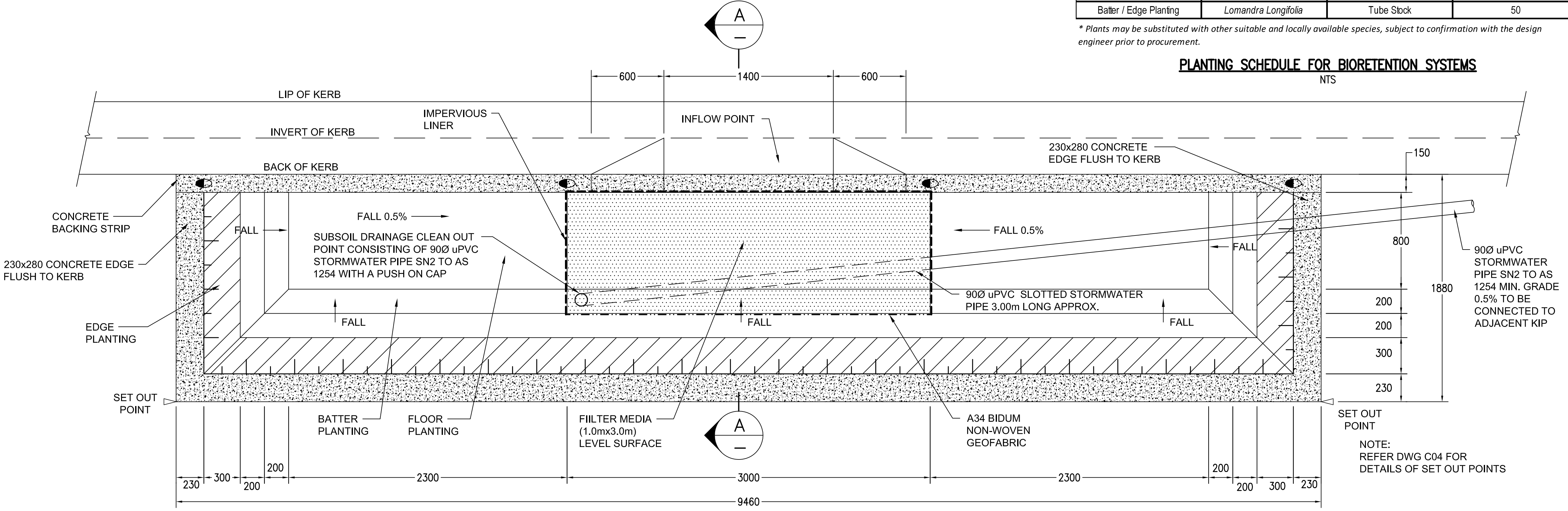
Area	Species*	Size	Number per Bioretention System
Floor Planting	*Juncus Usitatus*	Tube Stock	12
	Lomandra Hystrix	Tube Stock	12
	Dianella Longifolia	Tube Stock	12
Batter / Edge Planting	*Lomandra Longifolia*	Tube Stock	50

** Plants may be substituted with other suitable and locally available species, subject to confirmation with the design engineer prior to procurement.*

PLANTING SCHEDULE FOR BIORETENTION SYSTEMS
NTS

LEGEND

- MULCH AS NOTED
- TOPSOIL 150mm TK.
- BIOFILTER MEDIA LAYER
- TRANSITION LAYER
- DRAINAGE LAYER
- CONCRETE WORK



PLAN OF BIORETENTION FILTER
NTS

NOTES:

1. THIS DETAIL SHALL BE READ IN CONJUNCTION WITH THE CURRENT EDITION OF BIOFILTRATION FILTER MEDIA GUIDELINES PREPARED BY THE FACILITY for ADVANCING WATER BIOFILTRATION (FAWB SPECIFICATION).
2. BIORETENTION FILTER MEDIA, TRANSITION AND DRAINAGE MATERIALS SHALL HAVE A HYDRAULIC CONDUCTIVITY 200mm/HR
3. GUIDE POSTS SHOWN THUS: ◐ SUPPLY AND INSTALL BOLT DOWN FLEXIBLE GUIDE POSTS. (e.g. FLEXI360 GUIDE POSTS AVAILABLE FROM ADVANCED ROAD SIGNS OR EQUIVALENT)
4. CONCRETE CONSTRUCTION SHALL COMPLY WITH THE FOLLOWING STANDARDS AND CODES:
   a. GENERAL: AS3600 CONCRETE CODE
   b. CURING PERIODS AND METHODS - AS3600 AND AS3799 RESPECTIVELY
   c. SLIP RESISTANCE - AS/NZS 4586 SLIP RESISTANCE OF PEDESTRIAN SURFACES
   d. ALL SURFACE FINISHED TO BE CONFIRMED WITH THE SUPERINTENDENT.

amendments

A	ORIGINAL ISSUE FOR OPERATIONAL WORKS	17.12.10
B	POSSIBLE ACCESS LOCATIONS SHOWN	28.02.11
C	DRAWING RENUMBERED AND ISSUED FOR OPERATIONAL WORKS	19.05.14
D	TEMPORARY CONNECTION AT END OF ROAD A ADDED	19.06.14
E	NEW DRAWING SHOWING SHOWING STORMWATER QUALITY DEVICES	27.07.15

JIM PAPAS CIVIL ENGINEERING DESIGNER PTY. LTD.
CIVIL ENGINEERING DESIGN AND DRAFTING
P. O. Box 2347 Mareeba Q 4880
Mob. 0408 770 394
Email: admin@jpced.com.au

eco@jumrum The ultimate Kuranda address

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

eco@jumrum
PROPOSED RURAL RESIDENTIAL DEVELOPMENT AT FALLON ROAD, KURANDA.
DRAWING TITLE: STORMWATER QUALITY PLAN

SCALE (AT A1 SIZE)	HOR 1:500	DRAWN	J.P.
	VER	DESIGNED	J.P.
DATE	DEC. 2010	CHECKED	J.P.
APPROVED			
DWG NUMBER	1299 – C07	AMDT	E

Document Set ID: 3086183
Version: 1, Version Date: 20/08/2015

APPENDIX C

Comparison (Biopod vs GPT)

Level 11, 344 Queen Street Brisbane QLD 4000
PO Box 10183 Brisbane QLD 4000
www.engeny.com.au
P: 07 3221 7174
F: 07 3236 2399
E: admin@engeny.com.au

7 August 2015

Jim Papas Civil Engineering
PO Box 2347
Mareeba, Qld, 4880

Attention: Jim Papas

Dear Jim

RE: Response to Council's request for Additional Stormwater Quality Information

The following letter has been written in response to a comment raised by Mareeba Shire Council that relates to the bioretention pods proposed to manage stormwater quality at the eco@jumrum development.

Councils comment reads as follows;
'We have concerns with the ongoing maintenance and consequently the long term effectiveness of the Bioretention Filters. The review group questioned this solution over the installation of a single Gross Pollutant Trap (GPT) located at the outfall point of the system. Can you please request Engeny to provide advice on their preference for this type of structure over the GPT and provide advice for ongoing maintenance regime necessary to keep them effective and operating in the future.'

Benefits of Bioretention over Gross Pollutant Traps

Bioretention systems are classified as tertiary treatment systems due to the ability to remove fine suspended and dissolved pollutants such as nitrogen and phosphorous from stormwater. Bioretention will also effectively remove gross pollutants and sediments however care must be taken to ensure loads in systems with large contributing catchments are not excessive which may affect filter media performance.

Gross pollutant traps only remove gross pollutants such as litter and some sediments. They have little impact on reducing nutrients which are responsible for increased weed growth and algal blooms. In some cases due to the nature of some types of GPT's, nutrient levels can increase as the gross pollutants 'stew' in a hot damp environment for extended periods before nutrients are mobilised in the next storm event. The State Planning Policy requires that nitrogen, phosphorous, total suspended solids all be managed in new developments, gross pollutant traps only have the ability to manage sediments and gross pollutants while bioretention systems treat all pollutants allowing the load objectives to be met.

Life Cycle Cost Comparison

Recent work undertaken by Brisbane City Council as part of their current asset management project has shown that small streetscape bioretention systems have an average maintenance cost of approximately \$12.50/ m^2 of filter media/ visit. This equates to just over \$500/ year and allows for general maintenance such as hand removal of litter and sediment, pruning and replacement of dead plants. In additional to general maintenance costs, bioretention systems will require renewal of the filter media approximately every 20 to 25 years. This involves removing and replacing the filter media and plants within the base of the system. The costs associated with this work vary depending on a number of factors, however a high level estimate of \$4,000 for all seven systems has been applied as a rough estimate.

Maintenance requirements for a GPT vary significantly depending on the type of system employed. Some systems require a franna crane and a truck to remove the basket and dispose of waste whilst others may require a vacuum excavation truck. Both of these costs for maintaining GPT's are likely to significantly exceed the costs for maintenance and renewal of the seven bioretention systems.

Maintenance Regime

Details of recommended maintenance requirements are provided in Section 5.2 of Engeny's DSMP.

Conclusion

Bioretention is the preferred water quality treatment measure for the eco@jumrum development. The benefits to water quality and the ability to meet the State Planning Policy objectives coupled with the low maintenance costs make these systems both economical and effective in removing pollutants. Bioretention systems also provide the secondary benefit of enhancing visual amenity within the streetscape and can substitute traditional streetscape plantings.

Yours faithfully

David Sexton
Senior Engineer

Associate