



Our Ref: 110298-02-Rpt1_B.docx

28 August 2017

NBRS + Partners
Level 3, 4 Glen Street
MILSONS POINT NSW 2061

Attn: Andrew Tripet

**Subject: Katoomba Christian Convention
Proposed Auditorium and Associated Dwellings - Stormwater Assessment**

Dear Andrew,

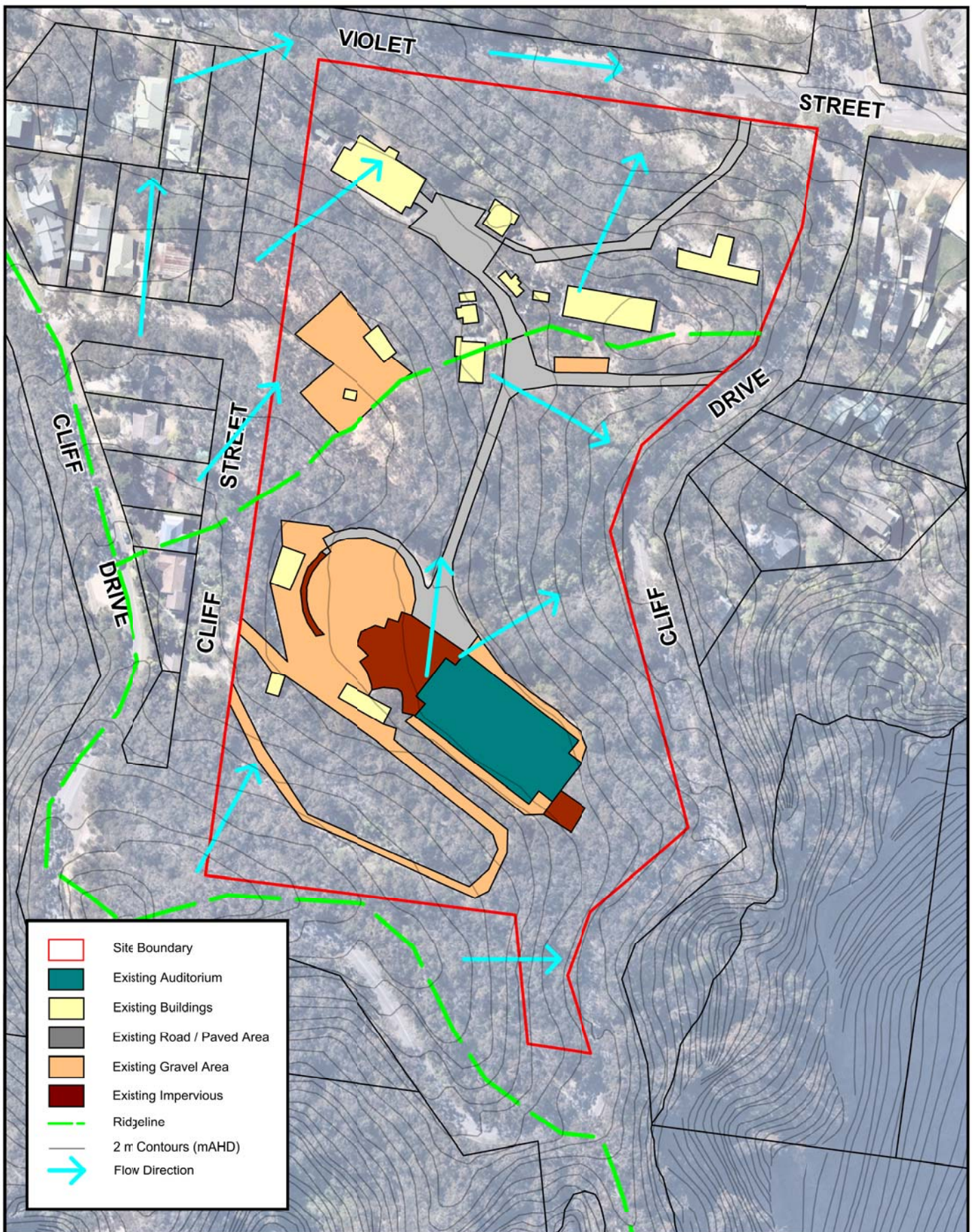
J. Wyndham Prince has undertaken a stormwater assessment to support a Development Application (DA) for the proposed development at Lot 5, DP 222736, Katoomba. The assessment includes hydrologic and water quality modelling to determine a stormwater management strategy which will ensure that developed conditions stormwater runoff and pollutant loads do not exceed existing levels due to the proposed development.

The assessments undertaken are detailed below.

1 THE SITE

The site is located at Lot 5, DP 222736, at the intersection of Cliff Drive and Violet Street, Katoomba which is within the Blue Mountains City Council (BMCC) Local Government Area. The site forms part of the Katoomba Christian Convention Centre (KCC) which currently consists of an existing auditorium, plaza area, access roads, parking and existing accommodation.

The existing site is heavily vegetated around a number of existing buildings. There is a ridgeline that runs along the western boundary of the site as well as a ridgeline that bisects the site. The site is relatively steep with grades between 10 - 30% towards the north-east. Plate 1.1 provides an overview of the existing site features.



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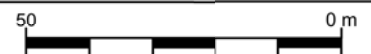
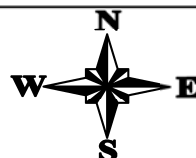
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Plate 1.1

Existing Site



Scale 1: 2,000 @ A4

25/08/17

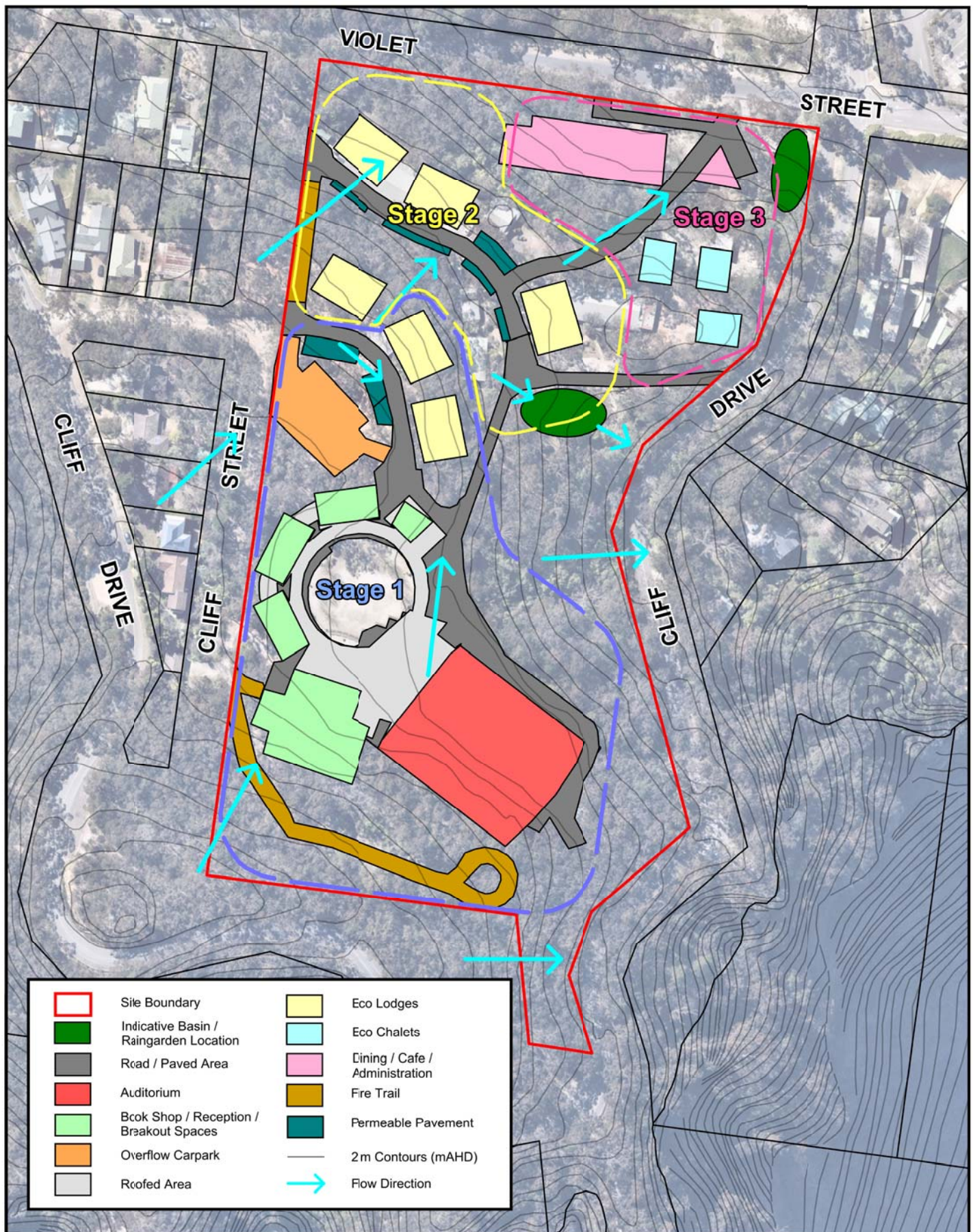
Issue : A

2 PROPOSED DEVELOPMENT

The proposed development consists of the demolition of 16 buildings, an upgrade to the existing auditorium, the construction of nine (9) new eco lodges/chalets and the construction of a dining/admin building and associated café. The overall development has been separated into three (3) stages which are to be covered in this strategy. Details of each of these development stages are as follows:

- Stage 1: Construction of two (2) eco lodges, three (3) breakout space areas, a reception building, a book shop, an overflow car parking area, an upgrade to the existing auditorium and upgrades to carparking facilities.
- Stage 2: Construction of four (4) eco lodges, a breakout space area, a new fire trail and upgrades to carparking facilities.
- Stage 3: Construction of three (3) chalets, a dining/admin/reception building, a café building and upgrades to carparking facilities.

In addition, vehicular and pedestrian access roads have been proposed as part of the development which will consist of sealed/gravel road upgrades. The proposed development layout has been prepared by NBRS + Partners Pty Ltd and is provided in Plate 2.1.



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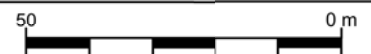
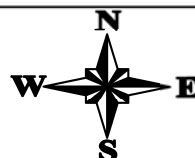
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Plate 2.1

Proposed Development



Scale 1: 2,000 @ A4

28/08/17

Issue : A

3 PREVIOUS REPORTS AND RELEVANT GUIDELINES

3.1 State Environmental Planning Policy (Sydney Drinking Water Catchment) (2011)

Review of the NSW Government's, State Environmental Planning Policy (SEPP) *Sydney Drinking Water Catchment Maps* (2011) indicates that the site is located within the Sydney Drinking Water Catchment. Therefore, the site is subject to the development conditions and constraints imposed by this SEPP, including conditional approval to be provided by WaterNSW.

Refer to Plate 3.1 for the site location within Sydney's Drinking Water Catchment.

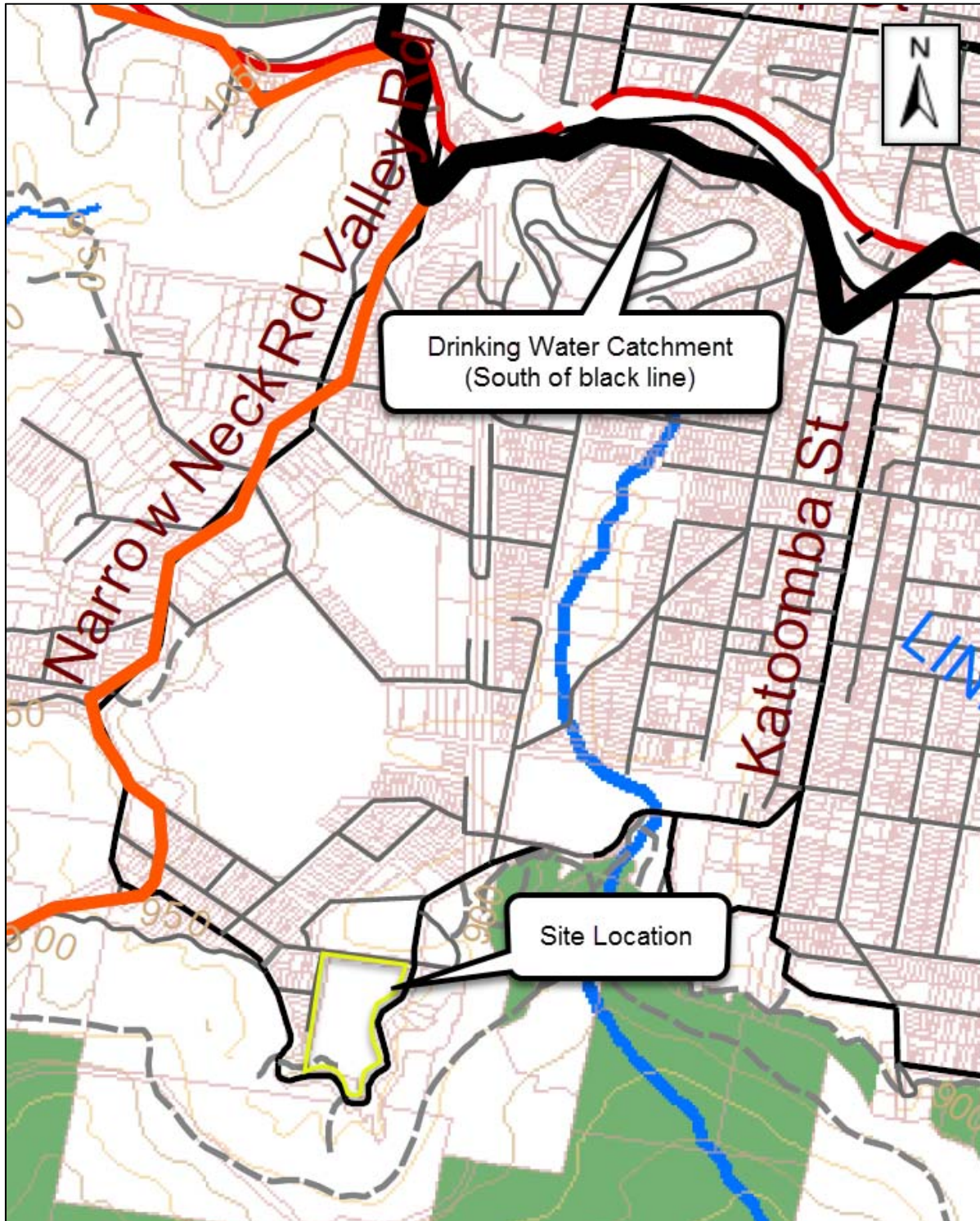


Plate 3.1 – SEPP Sydney Drinking Water Catchment Map (2011)
(ref: SEPP-Map-02.pdf (Sheet 2 of 19))

3.2 Neutral or Beneficial Effect on Water Quality - Assessment Guideline (Sydney Catchment Authority, 2015)

The *Neutral or Beneficial Effect on Water Quality - Assessment Guideline* supports the implementation of the *SEPP Sydney Drinking Water Catchment* (2011) and provides the necessary means to achieve a “Neutral or Beneficial Effect” for proposed developments located within the Sydney Drinking Water Catchment.

As outlined in this guideline, a “Neutral or Beneficial Effect” (NorBE) on water quality is satisfied if a proposed development:

- a) has **no** identifiable potential impact on water quality, or
- b) will **contain** any water quality impact on the development site and prevent it from reaching any watercourse, waterbody or drainage depression on the site, or
- c) will **transfer** any water quality impact outside the site where it is treated and disposed of, to standards approved by the consent authority.

Therefore, to ensure development approval is granted for the proposed development, a NorBE of water quality will be required.

3.3 Using *MUSIC* in Sydney's Drinking Water Catchment (Sydney Catchment Authority, 2012)

The Sydney Catchment Authority (now known as WaterNSW) has developed the “*Using MUSIC in Sydney's Drinking Water Catchment*” guidelines to help consultants prepare *MUSIC* stormwater quality models to achieve a neutral or beneficial effect on water quality for proposed developments.

3.3.1 NorBE Analysis

As outlined in the ‘*Using MUSIC in Sydney's Drinking Water Catchment*’ report, two (2) measures of pollutant criteria are listed as being relevant for a NorBE analysis. These are:

- **Pollutant Loads:** For total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN) in the post-development case must be 10% less than the pre-development case. For gross pollutants (GP), post-development pollutant loads only need to be equal or less than pre-development pollutant loads.
- **Pollutant Concentrations:** Pollutant concentrations for TP and TN in the post-development case should be equal to or less than the pollutant concentrations for the pre-development case within the 50th to 98th percentile range when runoff occurs.

4 HYDROLOGIC ASSESSMENT

The hydrologic analyses for this study were undertaken using the rainfall - runoff flood routing model *XP-RAFTS* (Runoff and Flow Training Simulation with XP Graphical Interface) for pre and post development flows.

Sub-catchment areas were established through assessment of available survey and contour information for the site. It is noted that a portion of the overall catchment to the south bypasses both water quantity devices proposed, however, the stormwater strategy has been delivered to ensure that pre-post objectives are met. Refer to Appendix A for further details.

4.1 Discharge Estimates and Detention Basin Performance

The peak flows were derived for the existing and developed catchments for the 20% and 1% AEP events. A range of storm durations from 10 minutes to 24 hours were analysed to determine the critical storm duration for each sub-catchment.

The peak flows from the catchments for the existing and developed conditions, along with the detention basin performance, are presented in Table 4.1 and 4.2. Refer to the figures in Appendix B for details of the catchment layout and Plates 4.1 and 4.2 for XP-Rafts layouts.

Table 4.1 -Summary of Peak Flows

Comparison Node	20% AEP		1% AEP	
	Ex	Dev	Ex	Dev
Stg1Out	0.87	0.81	1.82	1.74
Stg2Out	0.51	0.49	1.12	1.00
SthOut	0.13	0.13	0.22	0.22
Total1	1.40	1.37	2.98	2.89

Table 4.2 -Summary of Basin Performance

Detention Basin Performance					
Event	Inflow (m ³ /s)	Outflow (m ³ /s)	Storage Used (m ³)	Basin Depth (m)	m3/ha
20% AEP	0.81	0.57	255	0.45	57
1% AEP	1.62	1.31	497	0.88	112

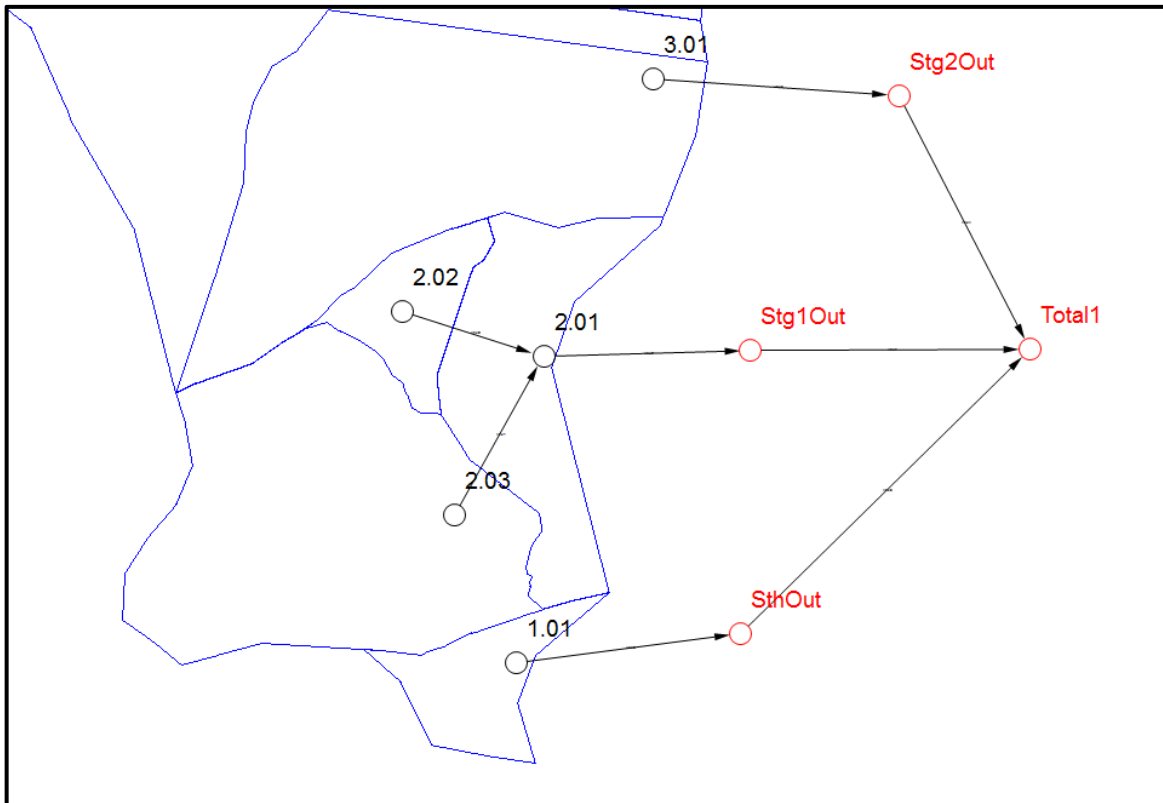


Plate 4.1 – Existing XP-Rafts Layout

(110298-02_RA01(b)_KCC_MPDA.xp)

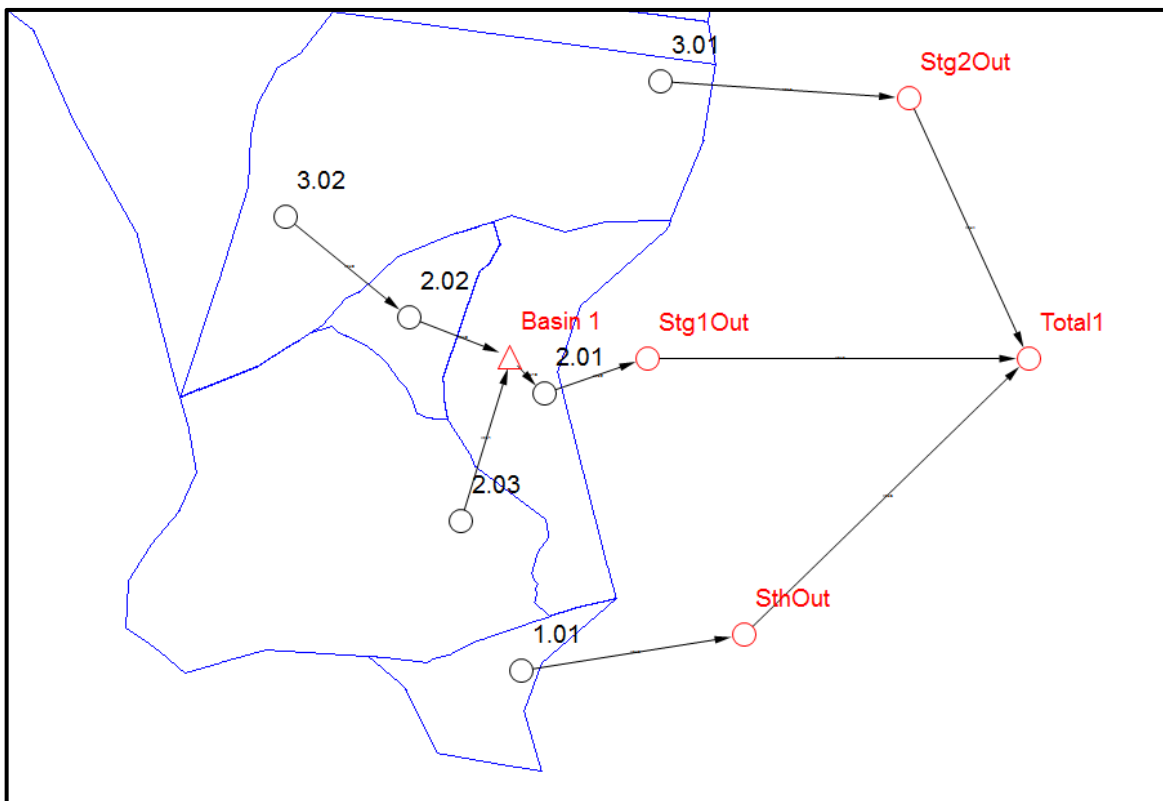


Plate 4.1 – Developed XP-Rafts Layout

(110298-02_RA04_KCC_MPDA(Dev).xp)

5 WATER QUALITY ASSESSMENT

Stormwater has the potential to be laden with several pollutants such as Suspended Solids, Phosphorous, Nitrogen and Gross Pollutants. Development works generally include proposed changes to the surfaces types on the site (such as concrete and gravel areas), which impacts on the quantity of pollutants generated as compared to current conditions. This affects the water quality by reducing the amount of pollutants that would naturally be filtered out by soil and flora. To preserve the environment, Blue Mountains City Council and WaterNSW requires these pollutants to be reduced when delivering new developments in the Drinking Water Catchment.

MUSIC software was used to model the water quality and assess the suitability of proposed treatment train. The model was used to size the proposed water quality treatment system to ensure the water quality objectives of WaterNSW are achieved (i.e. a neutral or beneficial effect on water quality).

5.1 MUSIC Model

A Water Quality assessment has been undertaken using *MUSIC* modelling software, version 6.2. The model was then used to determine an appropriate treatment train which will satisfy the water quality targets.

Models were developed for this project which reflect both the existing and developed conditions. The catchment area was broken into the different “source nodes” to reflect the various land uses (i.e. roof, road, urban pervious, urban impervious, gravel and forest areas).

Refer to Appendix C for the *MUSIC* model parameters and Plate 5.1 and 5.2 for the current *MUSIC* model layouts.

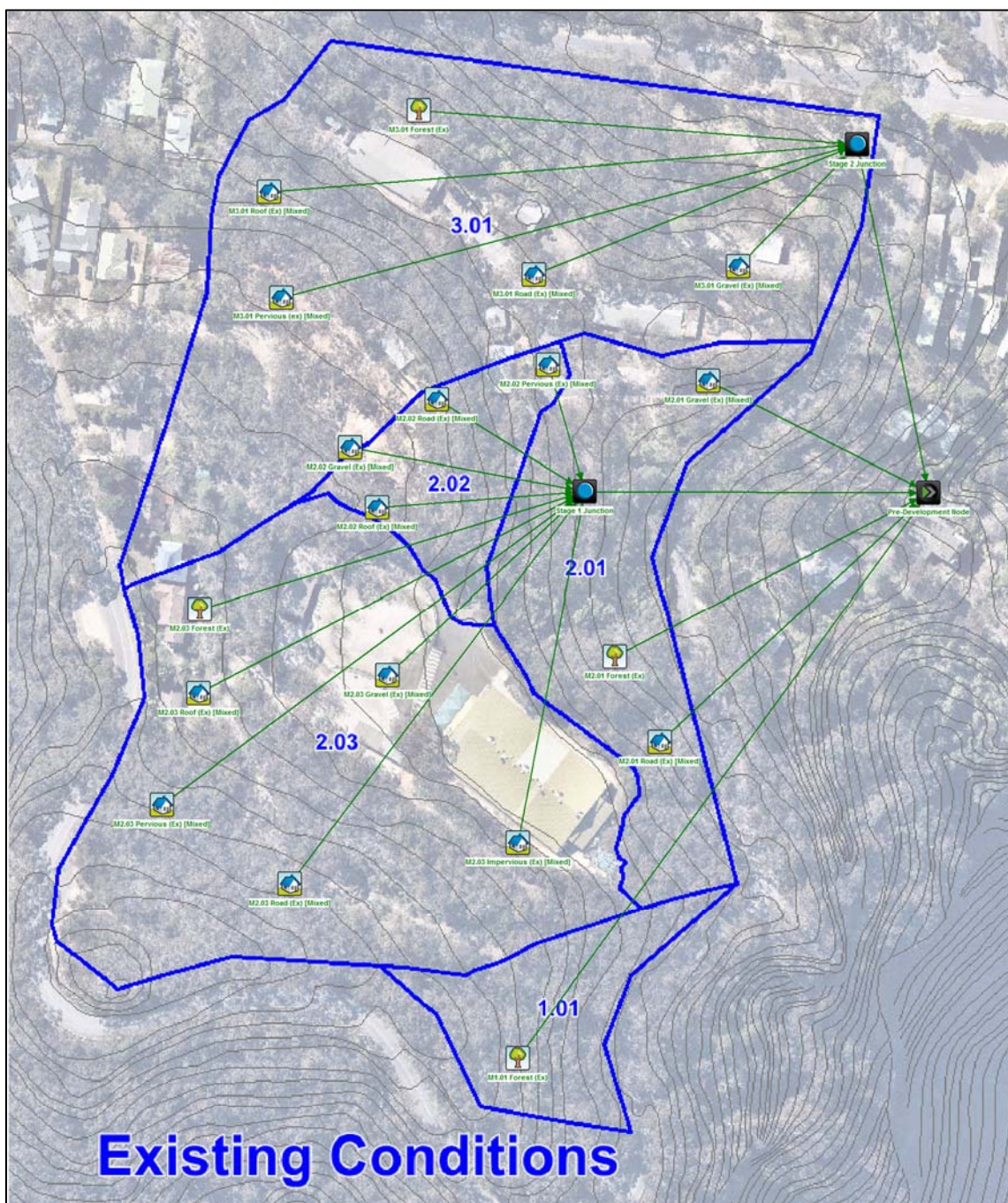


Plate 5.1 – Existing MUSIC Model Layout
(110298-02_MU6_final.sqz)

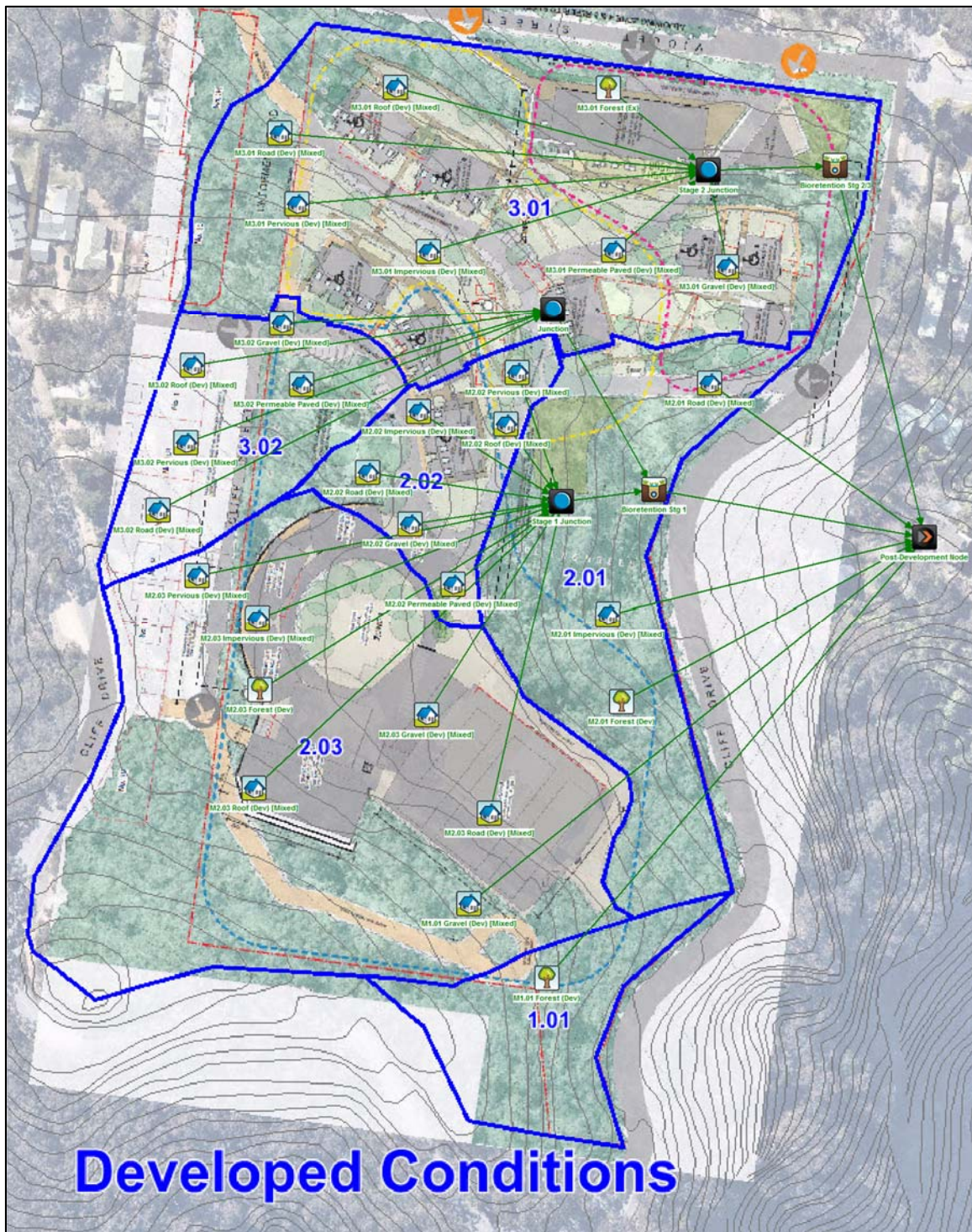


Plate 5.2 – Developed MUSIC Model Layout
(110298-02_MU6_final.sqz)

5.2 Water Quality Results

5.2.1 Pollutant Loads

The proposed raingardens have been sized at 150 m² (Raingarden 1) and 84 m² (Raingarden 2). A summary of pre-post mean annual pollutant load results and developed pollutant load reductions from the water quality assessment are shown in Table 5.1.

Table 5.1 -Pre-Post Mean Annual Pollutant Loads (kg/yr)

Pollutant	Mean Existing Source Nodes	Mean Developed Source Nodes	Target Reduction Required	Total Reduction Achieved
	(kg/yr)	(kg/yr)	(%)	(%)
TSS	9410	2670	10.0%	71.6%
TP	9.25	6.00	10.0%	35.1%
TN	64.2	57.6	10.0%	10.3%
Gross Pollutants	394	14	0.0%	96.4%

Results indicate that by adopting raingardens with filter areas of 150 m² and 84 m² (approximately 0.4% of their respective catchment areas), mean annual pollutant loads in the developed case are at least 10% less than existing conditions and, thus achieve the NorBE requirement.

5.2.2 Pollutant Concentrations

As outlined in Section 3.3, a NorBE assessment is to achieve pollutant concentrations for TP and TN in the post-development case that are equal to or less than the pollutant concentrations for the pre-development case within the 50th to 98th percentile range.

The cumulative frequency graphs provided in Plates 5.3 and 5.4 on the following page indicate that pollutant concentrations targets are achieved in accordance with NorBE guidelines. Note blue, represents “pre-developed” case and red represents “post-developed” case.

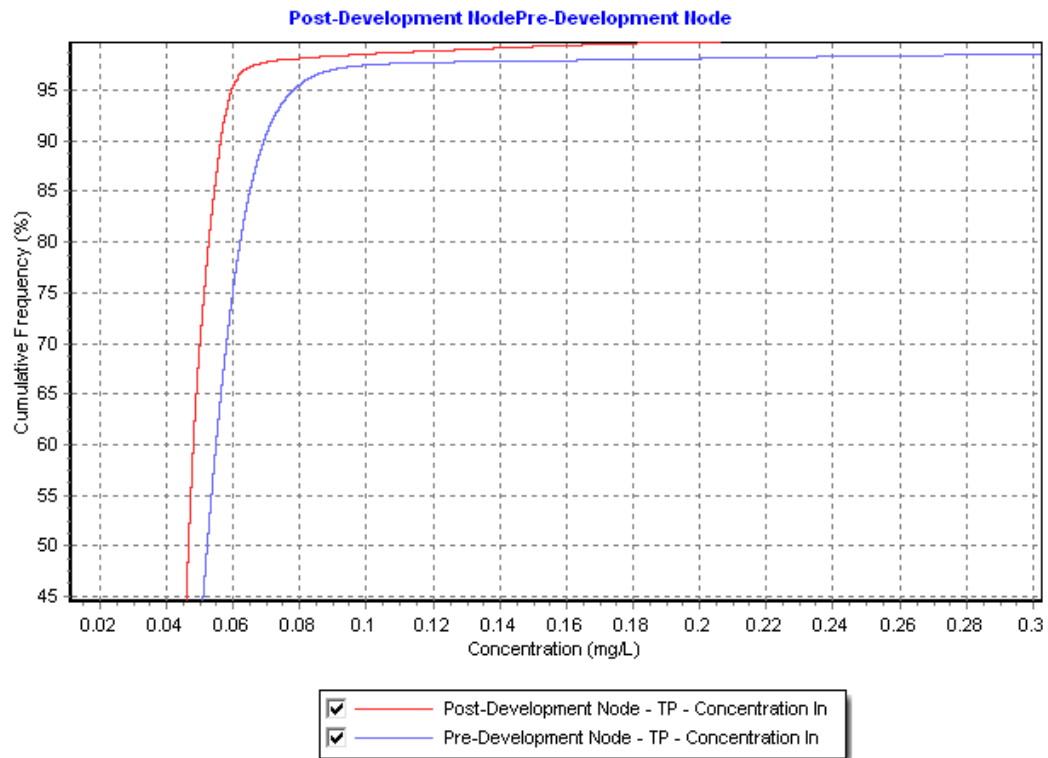


Plate 5.3 – Cumulative Frequency Graph – TP

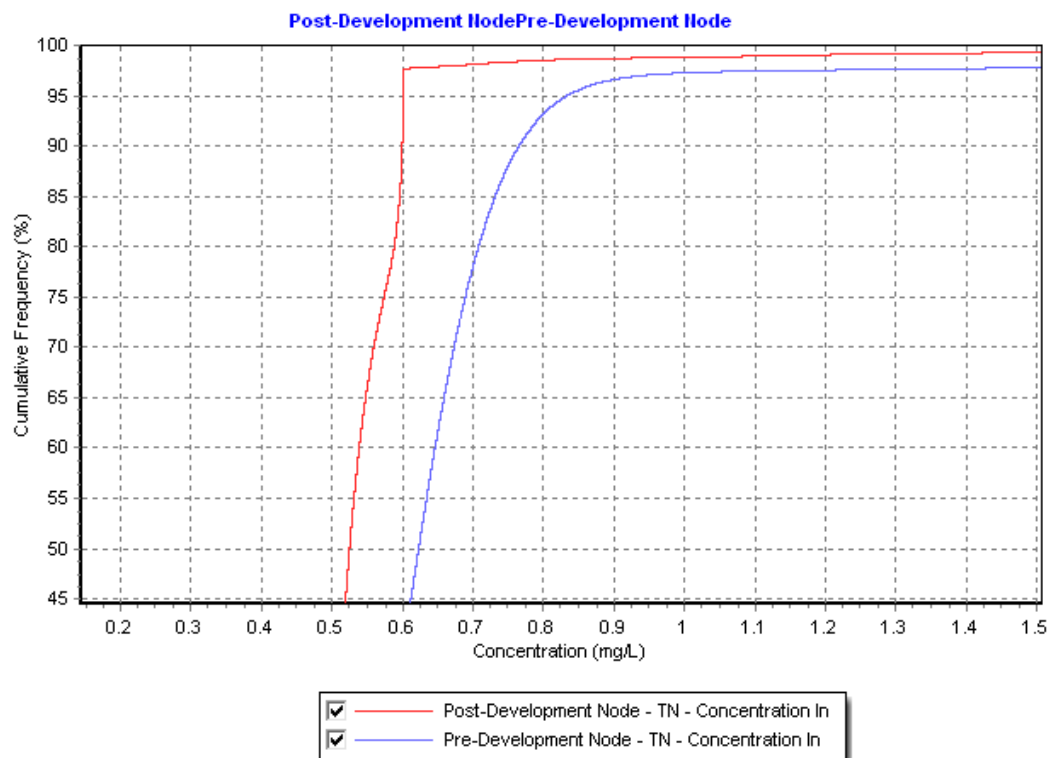


Plate 5.4 – Cumulative Frequency Graph – TN

6 CONCLUSION

J. Wyndham Prince has undertaken an assessment to determine the water management devices required to treat/manage the runoff at the Katoomba Christian Convention Centre. This assessment has ensured that the proposed development will provide pre-post flow management in accordance with statutory requirements and delivers a practical water quality outcome.

The proposed stormwater treatment system includes the following:

- 497 m³ above ground detention basin located east of Stage 1.
- Co-located 150 m² bio-retention raingarden system to service Stage 1.
- 84 m² bio-retention raingarden system to service Stages 2 & 3.

The basin provides the necessary attenuation to support both Stage 1 and Stage 2 & 3 of the development with the delivery of flow management as part of Stage 1.

The MUSIC modelling results have conceptually shown that the proposed management measures for the Katoomba Christian Convention Centre would achieve pre-post water quantity requirements as well as sufficient reduction in pollutant loads and concentrations to achieve NorBE.

The solution provided is considered to be a balance between environmental outcomes and sustainable development.

Should there be any queries regarding this matter please do not hesitate to contact the undersigned on 4720 3340 or dcrompton@jwprince.com.au

Yours faithfully

J. WYNDHAM PRINCE



DAVID CROMPTON

Manager – Stormwater and Environment Group

7 REFERENCES

Blue Mountains City Council, (2015), Development Control Plan

State Environmental Planning Policy (Sydney Drinking Water Catchment) (2011)

Sydney Catchment Authority, (2012), "Using MUSIC in Sydney's Drinking Water Catchment – A Sydney Catchment Authority Standard", prepared for the NSW Government

Sydney Catchment Authority, (2015), "Neutral or Beneficial Effect on Water Quality Assessment Guideline"

Appendix A – *XP-RAFTS* Model Parameters

Model Layout

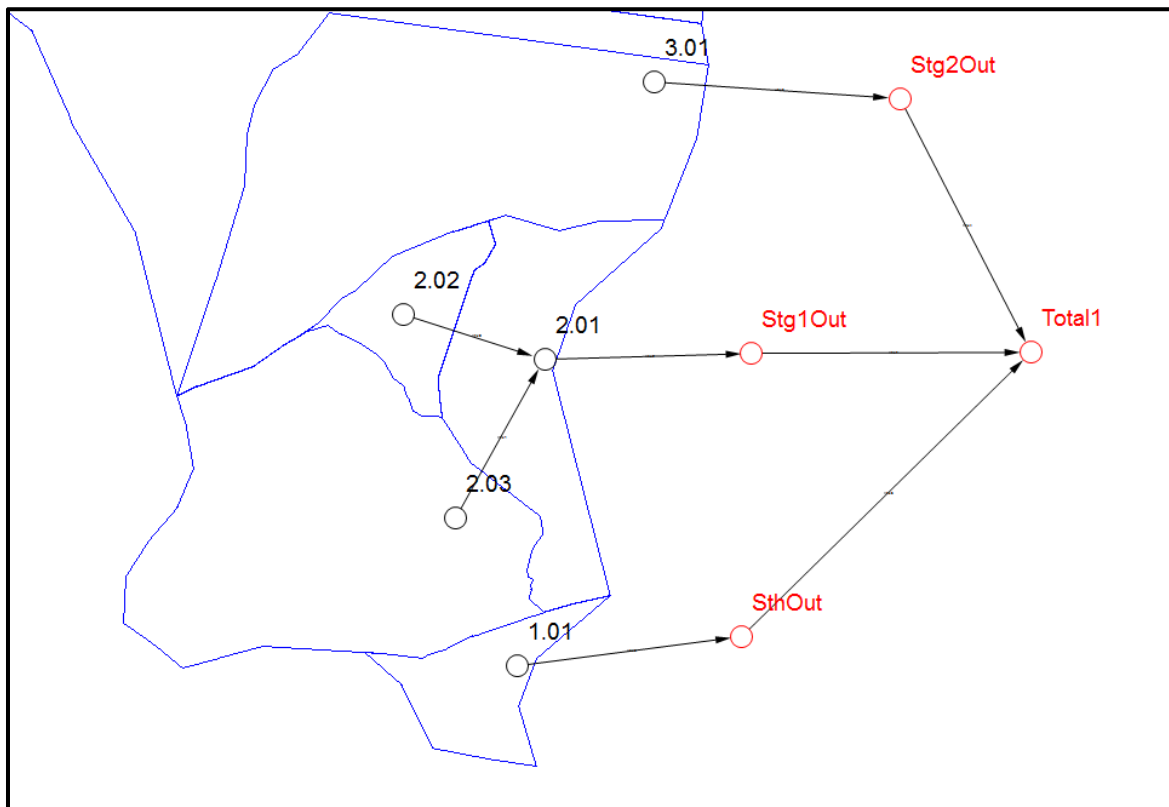


PLATE A.1 - EXISTING *XP-RAFTS* MODEL LAYOUT

(Model ref: 110298-02_RA01(b)_KCC_MPDA.xp)

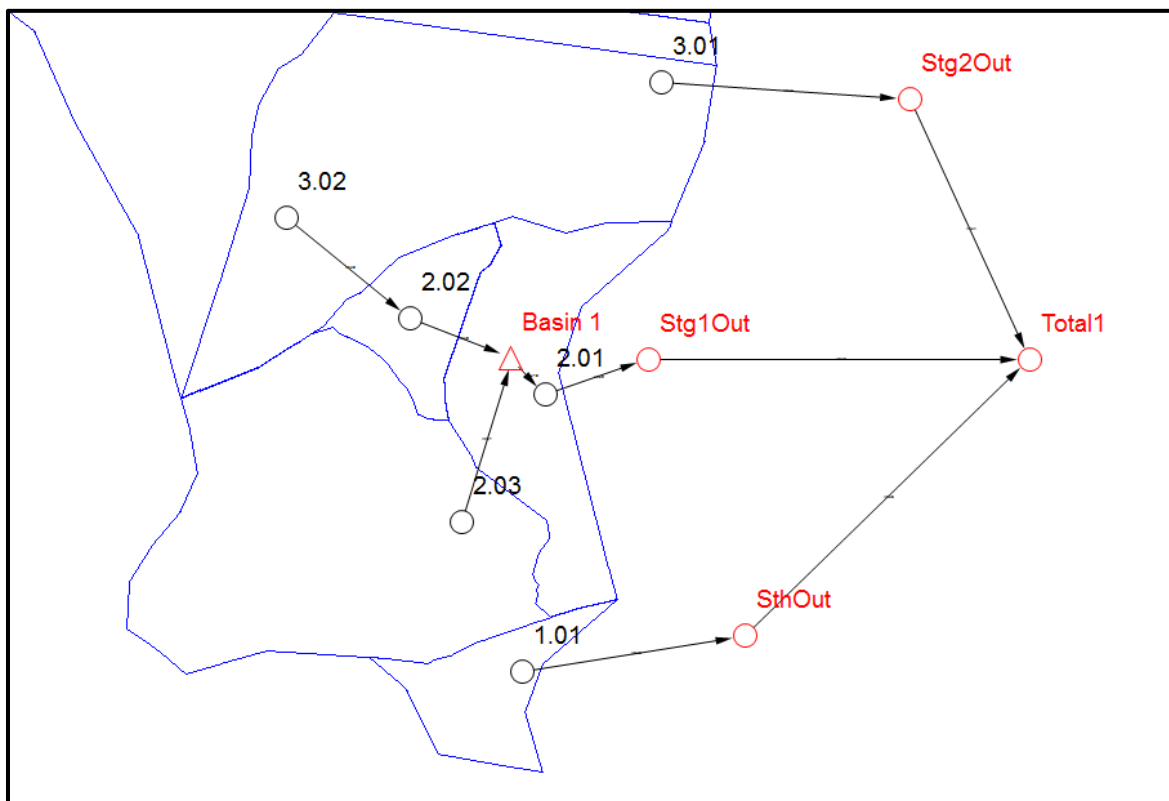


PLATE A.1 - DEVELOPED *XP-RAFTS* MODEL LAYOUT

(Model ref: 110298-02_RA04_KCC_MPDA(Dev).xp)

Percentage Impervious

Given the nature of the development, the percentage impervious adopted in the *XP-RAFTS* model was based on the proposed surface types in the development. The surface types proposed and the corresponding percentage impervious are as follows:

- Sealed Road / Concrete Area = 100% Impervious
- Gravel Area = 50% Impervious
- Turfed Area = 0% Impervious
- Roof Area = 100% Impervious
- Permeable Pavement = 30% Impervious

PERN and Loss Parameters

XP-RAFTS modelling was undertaken using a standard initial and continuing loss rate model, which adopted PERN values based on particular surface types. The values adopted for the catchments in the XP-RAFTS modelling are listed in Table A.1.

Table A.1 - *XP-RAFTS* PERN & Loss Values

Catchment Condition	PERN	Initial Loss / Continuing Loss
Existing Pervious	0.050	15 / 2.5
Urban Pervious	0.025	15 / 2.5
Urban Impervious	0.015	1 / 0

Rainfall Data

Design rainfall intensity-frequency-duration (I.F.D.) data for the site were generated using rainfall data obtained from the Bureau of Meteorology's "*Rainfall IFD Data System*", which adopts methods set out in "*Australian Rainfall and Runoff*" (A.R.R.) (1987). A summary of the rainfall intensities adopted in this study is provided in Table A.2.

Table A.2 - Adopted IFD Rainfall Intensities

AEP	Duration		
	1 hr	12 hr	72 hr
50%	30.00	8.72	2.87
2%	61.7	17.5	6.16

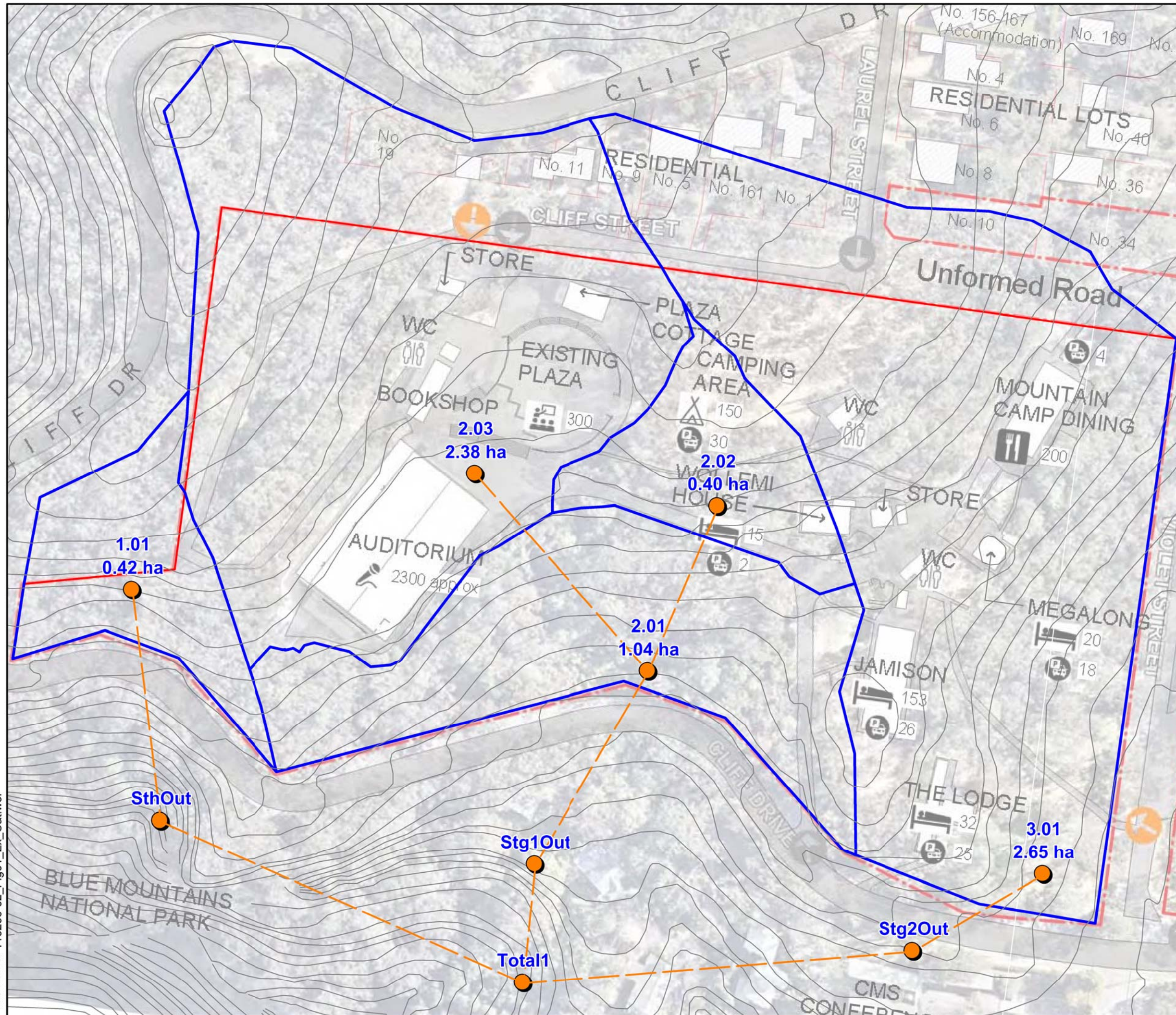
Lag Assumptions

Lag was calculated for the XP-Rafts model based on Table 4.3 below.

Table A.3 -Lag Assumptions

Stream Slope	Assumed Velocity
<10%	2.0 m/s
10%-15%	2.5 m/s
>15%	3.0 m/s

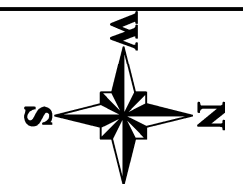
Appendix B – Figures



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LEGEND

- Catchment Boundary
- Rafts ID
- XP-Rafts Link
- XP-Rafts Node / Basin
- 2 m Contour (m AHD)
- Extent of Works

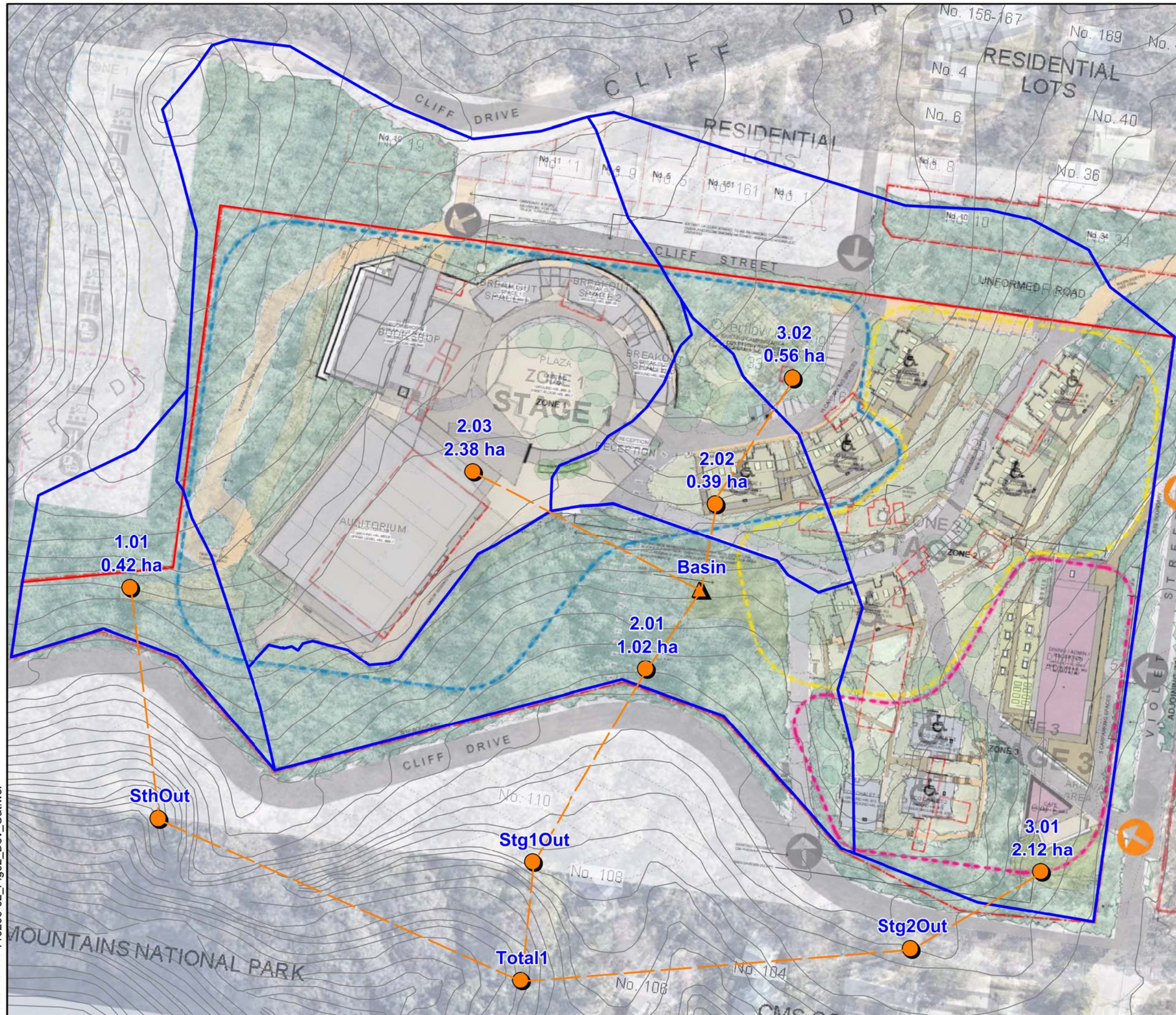


Scale 1: 1,200 @ A3



Figure 01
Katoomba Christian
Convention

Existing XP-Rafts
Layout

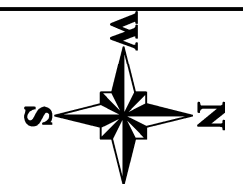


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LEGEND

- Catchment Boundary
- 1.03 Rafts ID
- XP-Rafts Link
- ▲ XP-Rafts Node / Basin
- 800 2 m Contour (m AHD)
- Extent of Works



Scale 1: 1,200 @ A3



Figure 02
Katoomba Christian
Convention

Developed XP-Rafts
Layout

Appendix C – *MUSIC* Model Parameters

Model Breakup

A *MUSIC* model was established to represent both existing conditions and the proposed development. The catchment was broken up into various land use types for input into the *MUSIC* model. Refer to Table B.1 and B.2 for the catchment areas.

TABLE B.1 - EXISTING CATCHMENT BREAKUP

Catchment	Existing Conditions Catchment Division						
	Total Catchment Area (ha)	Road Area (ha)	Roof Area (ha)	Gravel Area (ha)	Impervious Area (ha)	Pervious (ha)	Forest Area (ha)
M1.01	0.42	0.000	0.000	0.000	0.000	0.000	0.416
M2.01	1.03	0.036	0.000	0.013	0.000	0.000	0.986
M2.02	0.40	0.060	0.011	0.037	0.000	0.290	0.000
M2.03	2.40	0.062	0.252	0.441	0.105	0.322	1.216
M3.01	2.64	0.123	0.195	0.247	0.000	1.701	0.378
Sum	6.89						

TABLE B.2 - DEVELOPED CATCHMENT BREAKUP

Catchment	Developed Conditions Catchment Division							
	Total Catchment Area (ha)	Road Area (ha)	Roof Area (ha)	Gravel Area (ha)	Impervious Area (ha)	Pervious Area (ha)	Porous Pavement (ha)	Forest Area (ha)
M1.01	0.42	0.000	0.000	0.011	0.000	0.000	0.000	0.405
M2.01	1.02	0.038	0.000	0.000	0.007	0.000	0.000	0.974
M2.02	0.39	0.103	0.078	0.000	0.058	0.149	0.006	0.000
M2.03	2.40	0.031	0.774	0.292	0.168	0.220	0.000	0.912
M3.01	2.12	0.194	0.408	0.069	0.199	1.057	0.031	0.157
M3.02	0.55	0.091	0.025	0.055	0.000	0.358	0.023	0.000
Sum	6.89							

Rainfall Data

The *MUSIC* model is able to utilise rainfall data based on 6 minute, hourly, 6 hourly and daily time steps. A 6-minute time step was used in the analysis which was chosen in accordance with the recommendations for selecting a time step within the *MUSIC* User's Manual.

The rainfall and potential evapo-transpiration data for the period analysed is shown on the graph which is provided in Plate B.1.

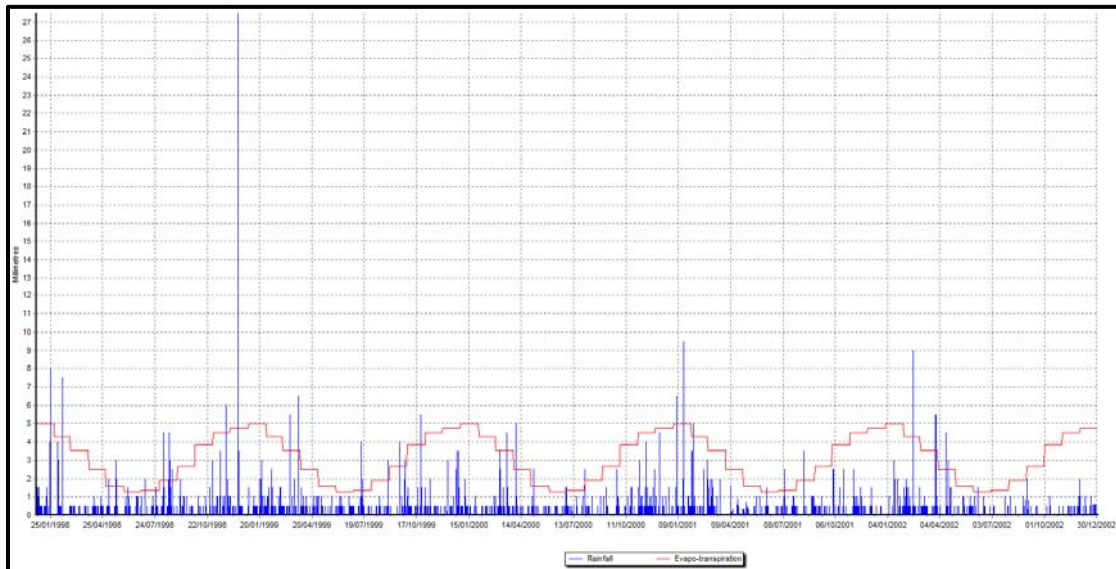


PLATE B.1 - RAINFALL & EVAPO-TRANSPARATION DATA ADOPTED

As outlined in the “*Using MUSIC in Sydney's Drinking Water Catchment*” guidelines (SCA, 2012), the default rainfall threshold values vary depending on the surface type or land use adopted in the MUSIC model. The adopted rainfall threshold values are presented in Table B.3.

TABLE B.3 - RAINFALL THRESHOLD VALUE

Surfaces	Rainfall Threshold (mm)
Roof	0.30
Sealed roads	1.5
Unsealed roads	1.5
For all land uses*	1.0

* Residential, rural residential, forest etc.

Rainfall Runoff Parameters

As part of previous MUSIC modelling prepared by JWP for the Clairvoux Oval carpark, rainfall runoff parameters were adopted based on the Stormwater Report completed by Sparks and Partners Pty Ltd. These rainfall parameters have been adopted for this site. The adopted parameters are presented in Table B.4.

TABLE B.4 - ADOPTED RAINFALL RUNOFF PARAMETERS

Property	Units	Clay loam, sandy
Pervious Area Parameters		
Soil Storage Capacity	mm	120
Initial Storage	% of Capacity	30
Field Capacity	mm	80
Infiltration Capacity Coefficient - a		200
Infiltration Capacity Coefficient - b		1.0
Groundwater Properties		
Initial Depth	mm	10
Daily Recharge Rate	%	25
Daily Baseflow Rate	%	5
Daily Deep Seepage Rate	%	0

Pollutant Concentration Parameters

The pollutant concentration parameters for Base Flow and Storm Flow were based on the “Using MUSIC in Sydney’s Drinking Water Catchment” guidelines (SCA, 2012). The adopted pollutant concentrations parameters are presented in Table B.5.

TABLE B.5 – ADOPTED POLLUTANT CONCENTRATION PARAMETERS

Surface / Landuse Type	TSS		TP		TN	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Base Flow						
Roof	-	-	-	-	-	-
Sealed Roads / Concrete	1.20	0.17	-0.85	0.19	0.11	0.12
Unsealed Roads / Gravel	1.20	0.17	-0.85	0.19	0.11	0.12
General Landuse	1.20	0.17	-0.85	0.19	0.11	0.12
Storm Flow						
Roof	1.30	0.32	-0.89	0.25	0.30	0.19
Sealed Roads / Concrete	2.43	0.32	-0.30	0.25	0.34	0.19
Unsealed Roads / Gravel	3.00	0.32	-0.30	0.25	0.34	0.19
General Landuse	2.15	0.32	-0.60	0.25	0.30	0.19

Bio-Retention Raingarden

Treatment within bio-retention raingardens is attained by detaining flows to promote sedimentation, direct filtration of particulate matter and nutrient stripping by bio-films which establish on the surface of the media bed and within the gravel layer. The organic sandy loam bed and plant system minimises evaporation losses and the raingarden will be constructed with an impermeable barrier to prevent seepage losses and to avoid groundwater salinity impacts. The adopted parameters for the bio-retention raingardens are presented in Table B.6.

TABLE B.6 – BIO-RETENTION RAINGARDENS – GENERAL FEATURES & CONFIGURATION

Parameter	Value
High Flow Bypass (m ³ /s)	100.000
Extended Detention Zone (m)	0.30
Surface Area (m ²)	0.4% of catchment
Filter Area (m ²)	0.4% of catchment
Filter Depth (m)	0.50
Unlined Filter Media Perimeter (m)	0.01
Saturated Hydraulic Conductivity (mm/h)	100
TN Content of Filter Media (mg/kg)	400
Orthophosphate Content of Filter Media (mg/kg)	40
Exfiltration Rate (mm/hr)	0.00
Overflow Weir Width (m)	1.40



KATOOMBA CHRISTIAN CONVENTION

MAIN SITE

STORMWATER MANAGEMENT PLANS

GENERAL NOTES:

1. ALL WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH BLUE MOUNTAINS CITY COUNCIL STANDARDS AND SPECIFICATIONS.
2. SURVEY MARKS:-
 - a) STATE SURVEY MARKS SHOWN THUS  SHALL BE SET IN TOP OF THE KERB AS IT IS BEING LAID, BY THE CONTRACTOR, IN THE INDICATED LOCATIONS. MARKS SHALL BE SUPPLIED BY THE PROJECT SURVEYOR.
 - b) SURVEY MARKS SHOWN THUS  SHALL BE RETAINED AT ALL TIMES. WHERE RETENTION IS NOT POSSIBLE THE SUPERINTENDENT MUST BE NOTIFIED AND CONSENT RECEIVED PRIOR TO THEIR REMOVAL.
3. THE CONTRACTOR SHALL LOCATE AND LEVEL ALL EXISTING SERVICES PRIOR TO COMMENCING CONSTRUCTION AND MAKE ARRANGEMENTS WITH THE RELEVANT AUTHORITY TO RELOCATE OR ADJUST IF NECESSARY.
4. THE CONTRACTOR SHALL NOT ENTER UPON NOR DO ANY WORK WITHIN ADJACENT LANDS WITHOUT THE WRITTEN PERMISSION OF THE OWNERS. TO BE PROVIDED PRIOR TO THE APPROVAL OF THE PLANS.
5. THE CONTRACTOR SHALL MAINTAIN SERVICES AND ALL WEATHER ACCESS AT ALL TIMES TO ADJOINING PROPERTIES.
6. COUNCIL'S TREE PRESERVATION ORDER MUST BE OBSERVED AND NO TREE SHALL BE FELLED, LOPPED OR REMOVED WITHOUT THE PRIOR APPROVAL OF COUNCIL'S ENGINEER.
7. THE CONTRACTOR SHALL CLEAR THE SITE BY REMOVING ALL RUBBISH & FENCES AS SPECIFIED, DEBRIS ETC.
8. SCOURS SHALL BE DEWATERED AND DESILTED. LEVELS SHALL BE OBTAINED ON SOUND MATERIAL PRIOR TO FILLING.
9. SITE FILL AREAS:- THE CONTRACTOR SHALL TAKE LEVELS OF EXISTING SURFACE AFTER STRIPPING TOPSOIL AND PRIOR TO COMMENCING FILL OPERATIONS.
10. ALL SITE FILLING TO BE COMPACTED TO 95% STANDARD COMPACTION AND SHALL BE CONTROLLED BY A REGISTERED SOIL LABORATORY IN ACCORDANCE WITH COUNCIL'S "WORKS SPECIFICATION".
11. ALL SITE REGRADING AREAS SHALL BE GRADED AT A MINIMUM 1% TO COUNCIL'S REQUIREMENTS
12. SURPLUS EXCAVATED MATERIAL SHALL BE PLACED WHERE DIRECTED BY THE SUPERINTENDENT.
13. ALL CONDUITS AND MAINS SHALL BE LAID PRIOR TO LAYING FINAL ASPHALTIC CONCRETE SEAL.
14. ALL NEW WORKS SHALL MAKE A SMOOTH JUNCTION WITH EXISTING CONDITIONS.
15. DIMENSIONS OF ANY DETAIL SHALL NOT BE SCALED - DIMENSIONS, IF IN DOUBT, SHALL BE VERIFIED BY THE SUPERINTENDENT.
16. TRAFFIC CONTROL DURING CONSTRUCTION IS TO BE IN ACCORDANCE WITH AS.1742-3 AND RTA MANUAL "TRAFFIC CONTROL AT WORKS SITE" 1998 EDITION



PLAN INDEX		
PLAN No.	PLAN NAME	REV
11029802/DA01	COVER SHEET, INDEX & GENRAL NOTES	A
11029802/DA02	EXISTING SITE LAYOUT PLAN	A
11029802/DA03	PROPOSED DEVELOPMENT LAYOUT PLAN	A
11029802/DA04	TYPICAL RAINGARDEN DETAILS	A
11029802/DA05	SOIL & WATER MANAGEMENT PLAN	A

LOCALITY SKETCH

Prepared By:

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FILE No. 11029802DA01

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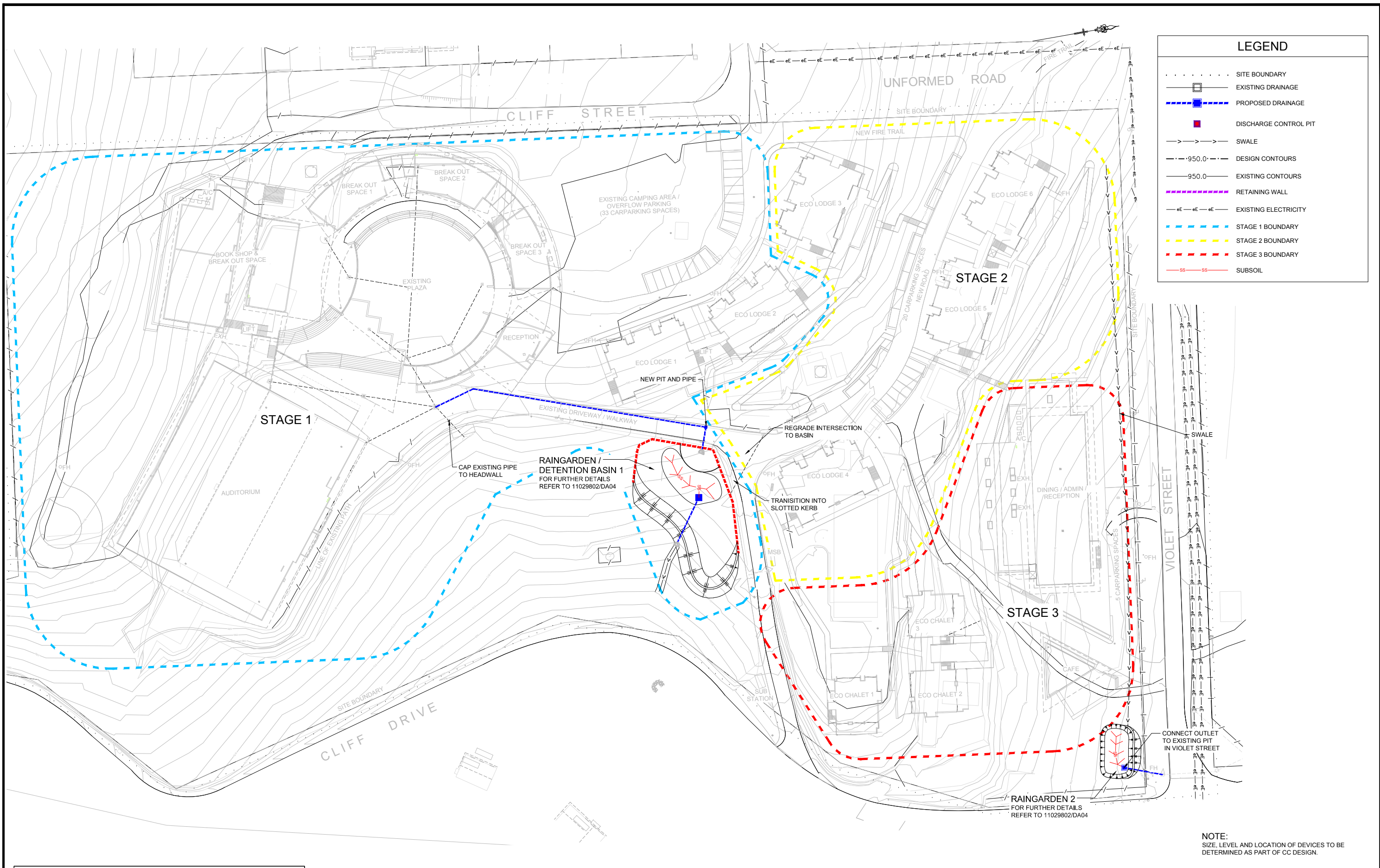
KATOOMBA CHRISTIAN CONVENTION
MAIN SITE

EXISTING SITE LAYOUT PLAN

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FILE No:	11029802DA02	
SHEET SIZE:	A1 ORIGINAL	

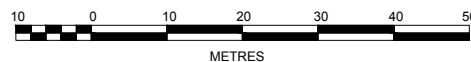
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MAIN SITE

PROPOSED DEVELOPMENT LAYOUT PLAN

PLAN No:
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FILE No: 11029802DA03
SHEET SIZE: A1 ORIGINAL

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		DES	DRN	CKD	APR

LEGEND

SITE BOUNDARY

EXISTING DRAINAGE

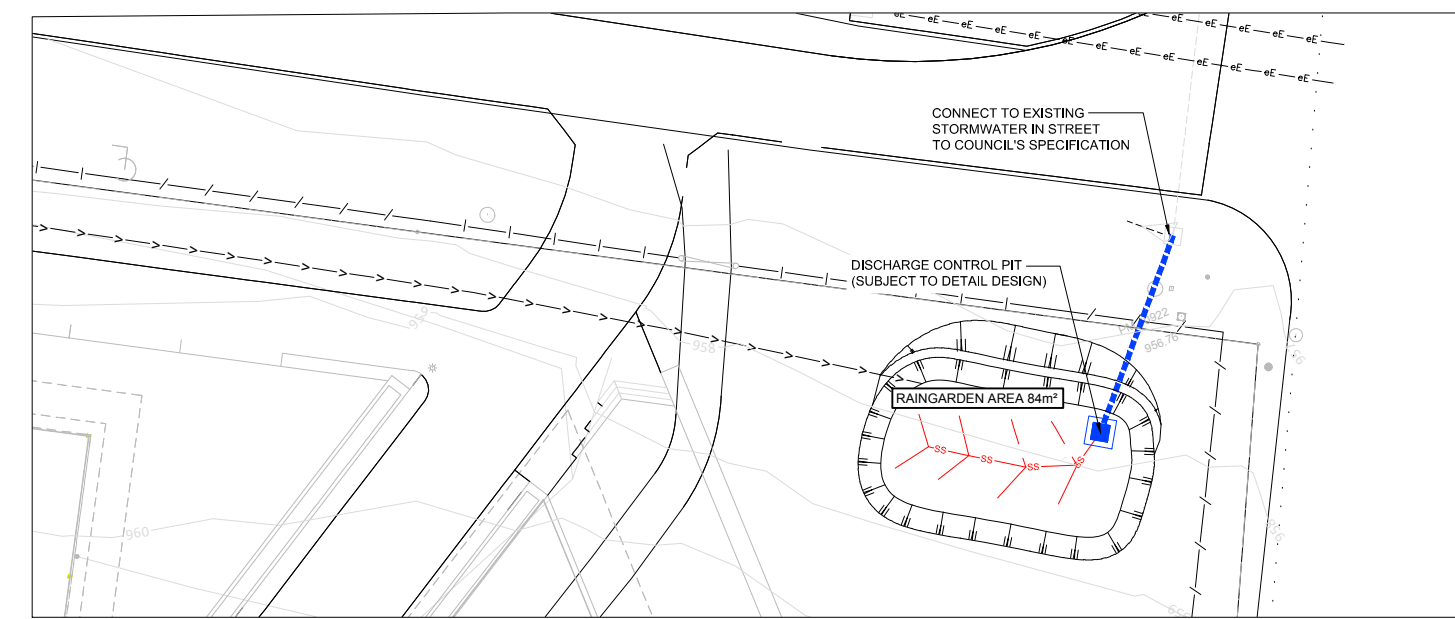
PROPOSED DRAINAGE

DISCHARGE CONTROL PIT

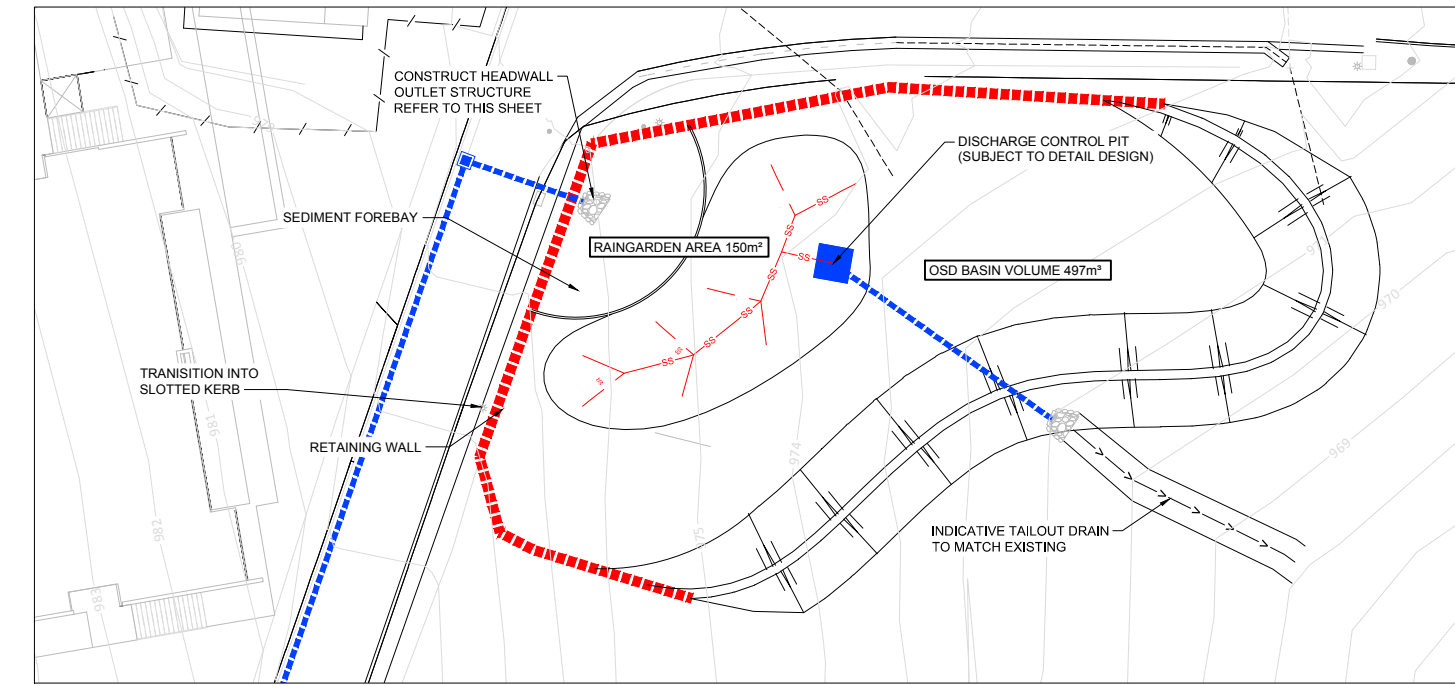
RETAINING WALL

SUBSOIL

EXISTING CONTOURS



RAINGARDEN 2
SCALE 1:200



RAINGARDEN/ DETENTION BASIN 1
SCALE 1:200

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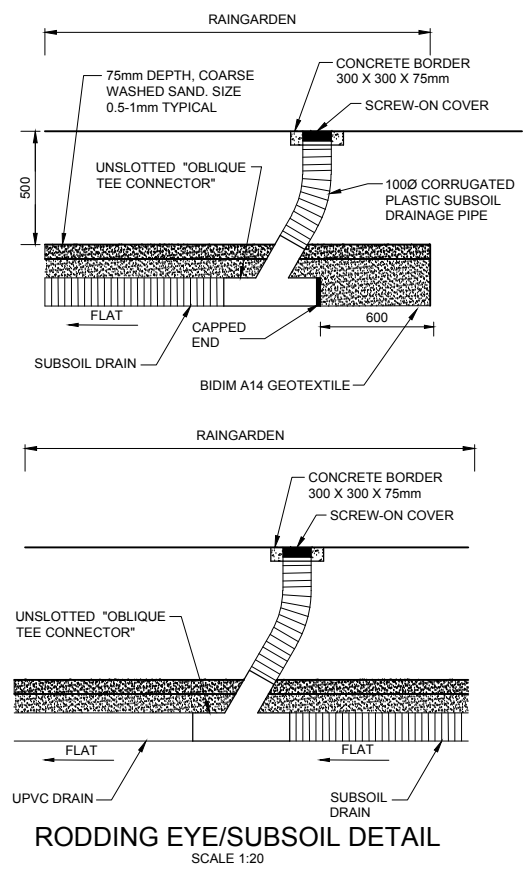
KATOOMBA CHRISTIAN CONVENTION
MAIN SITE

TYPICAL RAINGARDEN DETAILS

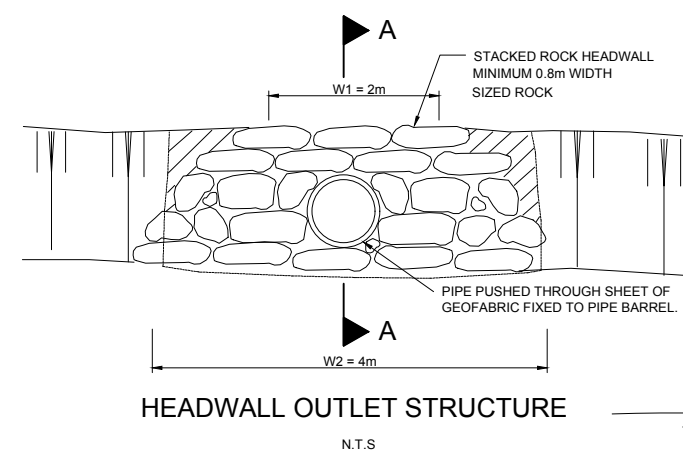
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FILE No: 11029802DA04

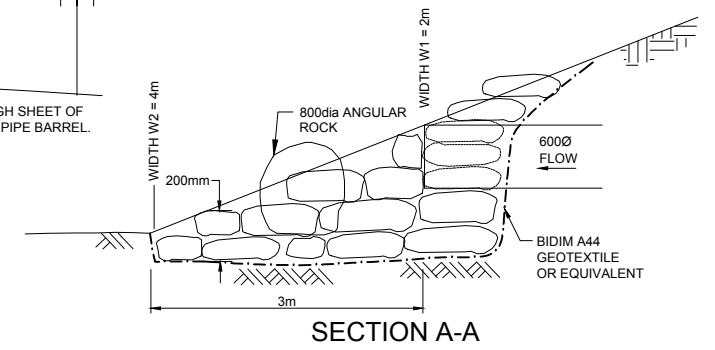
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RODDING EYE/SUBSOIL DETAIL
SCALE 1:20



HEADWALL OUTLET STRUCTURE
N.T.S.



RAINGARDEN MEDIA BED DETAIL
SCALE 1:20

MEDIA MATERIAL IN BIO FILTRATION

DEFINITIONS - AS1726-1993

SEDIMENT	SIZE(mm)	
BOULDERS	>200	
COBBLES	63-200	
GRAVELS	COURSE	20-63
	MEDIUM	6-20
	FINE	2.36-6
SANDS	COURSE	0.6-2.36
	MEDIUM	0.2-0.6
	FINE	0.075-0.2
SILTS	COURSE	0.02-0.075
	MEDIUM	0.006-0.02
	FINE	0.002-0.006
CLAYS	COLLOIDAL	<0.002

EC dS/m

TOLERANCE	RATING	dS/m
Sensitive	Very Low	<0.95
Moderately Sensitive	Low	0.95-1.9
Moderately Tolerant	Medium	1.9-4.5
Tolerant	High	4.5-7.7
Very Tolerant	Very High	7.7-12.2
Too Saline	Extreme	>12.2

Preferred Mix Percentage of Mix

Fine Gravel	<3%
Course Sand	7-10%
Medium Sand	40-60%
Fine Sand	10-30%
Very Fine Sand	5-30%
Clay and Silt	<3%
Organic Matter	<5%

IN REFERENCE TO ABOVE MIX TABLE, THE FOLLOWING PERFORMANCE PARAMETERS SHALL BE APPLIED.

- HYDRAULIC CONDUCTIVITY $\geq 100\text{mm/hr}$
- DETERMINED BY THE McINTYRE AND JAKOBSEN TEST METHOD (1993) AND CARRIED OUT BY AN INDEPENDENT NATA REGISTERED SOIL LABORATORY &/OR THE PREDICTED AND ACTUAL VALUES USING USGA OR ASTM F1815-06 STANDARD TESTING PROCEDURES
- ELECTRICAL CONDUCTIVITY $<1.2\text{dS/m}$
- PHOSPHORUS CONCENTRATION $<20\text{mg/kg}$ FOR P SENSITIVE PLANTS (FOR VERY P SENSITIVE PLANTS USED: $P<5\text{mg/kg}$)
- NITROGEN DRAWDOWN >0.5
- CIRCUMNEUTRAL pH
- SANDY LOAM TO LOAMY SAND TEXTURE
- GYPSUM APPLIED AT 2kg/cu.m
- BULK DENSITY TO BE BETWEEN 1.1g/cum & 1.8g/cum
- FREE OF STONES, STUMPS, ROOTS, OR OTHER WOODY MATERIAL OVER 25mm DIAMETER
- FREE OF BRUSH OR SEED FROM WEEDS

Benedict Sand & Gravel Bio-Retention Filter Media M165 generally complies with above specification and is considered 'fit for purpose' as a suitable filter media for use within a Bio-Filtration stormwater treatment practice.

PLACEMENT:
THE MEDIA SHALL BE PLACED IN 300mm LIFTS AND LOOSELY COMPACTED.

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LEGEND	
STABILISED SITE ACCESS	
SEDIMENT FENCE	
SWALE	
STRAW BALE BARRIER	
STOCKPILE	
PROTECTIVE FENCING	
MESH AND GRAVEL INLET FILTER	
GEOTEXTILE INLET FILTER	

GENERAL NOTES:

- ALL EROSION AND SEDIMENT CONTROL MEASURES, INCLUDING REVEGETATION AND STORAGE OF SOIL AND TOPSOIL, SHALL BE IMPLEMENTED TO THE REQUIREMENTS OF THE "ENVIRONMENT PROTECTION AUTHORITY" AND "DEPT OF WATER AND ENERGY".
- TOPSOIL FROM ALL AREAS TO BE DISTURBED SHALL BE STOCKPILED AND LATER RESPREAD TO AID REVEGETATION IN THOSE AREAS.
- ALL DRAINAGE WORKS SHALL BE CONSTRUCTED AND STABILIZED AS EARLY AS POSSIBLE DURING DEVELOPMENT.
- ALL TAIL-OUT DRAINS SHALL BE STABILISED TO DETAIL. STRAW BALES SHALL BE PLACED AS A SEDIMENT CONTROL DEVICE WHERE REQUIRED.
- VEHICULAR TRAFFIC SHALL BE CONTROLLED DURING DEVELOPMENT CONFINING ACCESS WHERE POSSIBLE TO DESIGNATED TRACKS. AREAS TO BE LEFT UNDISTURBED SHALL BE MARKED OFF.

SEDIMENTATION CONTROL DEVICES:

- ALL STRAW BALES SHALL BE BOUND WITH WIRE. STRAW BALES SHALL BE PLACED END TO END IN A SINGLE ROW AND EMBEDDED INTO THE SOIL TO A DEPTH OF 100mm. EACH BALE SHALL BE SECURELY ANCHORED WITH TWO STEEL STAKES DRIVEN 450mm INTO THE GROUND AND LOCATED ON THE BALE CENTRE LINE.
- SILT FENCES SHALL BE CONSTRUCTED BY STRETCHING A FILTER FABRIC (PROPEX OR SIMILAR) BETWEEN POSTS AT A MAXIMUM SEPERATION OF 3m CENTRES. FABRIC SHALL BE BURIED 150mm ALONG ITS LOWER EDGE.

STOCKPILE NOTES:

- SPOIL AND TOPSOIL STOCKPILES SHALL BE LOCATED AWAY FROM DRAINAGE LINES AND AREAS WHERE WATER MAY CONCENTRATE.
- IF STOCKPILES ARE TO BE IN PLACE FOR LONGER THAN 30 DAYS THEN THEY SHALL BE STABILIZED BY COVERING WITH A MULCH OR WITH TEMPORARY VEGETATION.
- FOLLOWING CONSTRUCTION, TOPSOIL SHALL BE RESPREAD TO A MINIMUM DEPTH OF 100mm ON THE BARE SOIL SURFACES AND REVEGETATE.

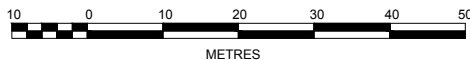
SPECIAL NOTES:

- LOCATION AND EXTENT OF SOIL AND WATER MANAGEMENT DEVICES IS DIAGRAMMATIC ONLY AND THE ACTUAL REQUIREMENTS SHALL BE CONFIRMED ON SITE.
- THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE GUIDELINES SET OUT IN "MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION" - 4TH EDITION AND THE ACCOMPANYING ROAD AND DRAINAGE PLANS.
- CONFORMITY WITH THIS PLAN SHALL IN NO WAY REDUCE THE RESPONSIBILITY OF THE CONTRACTOR TO PROTECT AGAINST WATER DAMAGE DURING THE COURSE OF THE CONTRACT.
- MANAGEMENT DEVICES SHALL BE MAINTAINED ON A REGULAR BASIS. WHERE CLEANING IS REQUIRED, THE SEDIMENT SHALL BE REMOVED TO A POINT NOMINATED BY THE ENGINEER.
- PRIOR TO THE COMMENCEMENT OF ANY EARTHWORKS, THE SITE MUST BE INSPECTED BY COUNCIL'S REPRESENTATIVE AND THE APPLICANT'S REPRESENTATIVE TO IDENTIFY AND APPROPRIATELY MARK:
 - THE TREES TO BE RETAINED.
 - ALL TREES TO BE LEFT UNDISTURBED AND TO BE CORDONED OFF.
- NO TREES SHALL BE REMOVED WITHOUT COUNCIL'S CLEARANCE.



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KATOOMBA CHRISTIAN CONVENTION
MAIN SITE

SOIL & WATER MANAGEMENT PLAN

PLAN No:
11029802/DA05 **A**
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