Flooding and Stormwater Management Study

for

Rezoning Proposal Submission

at

Lot 14, DP 258848, Fullerton Cove

Job No: NL161067
Date: 28/02/2017
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Executive Summary

Northrop Consulting Engineers have undertaken a Flooding and Stormwater Management investigation to support the rezoning of Lot 14, DP 258848, located at 42 Fullerton Cove Road, Fullerton Cove.

The purpose of this investigation was to determine both whether flooding had any impact on the site, and whether it was feasible to implement Council's policies relating to stormwater management.

A preliminary assessment of the flood behaviour within the local catchment was undertaken and it was found that developing a two-hectare parcel of land and providing compensatory flood storage produced only marginal increases in flood level both on-site and downstream. Specifically, a 30mm increase on-site in the 1%AEP event and 40mm increases in the 5% and 20%AEP events. Downstream a 20mm increase was calculated in the 1%AEP and 10mm increases for the 5% and 20%AEP events.

Flood levels within Fullerton Cove were also considered and it is expected this will be used to specify finished floor and surface levels on-site. The 2100 1%AEP with a 10% increase in flow results in a flood level of 2.5m AHD adjacent to the site. It is expected a minimum 3.0m AHD floor level will be required.

Stormwater management policies of Port Stephens Council were analysed and tested for their feasibility to be implemented onsite. In particular, a DRAINS model was prepared to assess detention and a MUSIC model was built for water quality. It was found that providing detention and water quality measures to satisfy Council's policies was feasible on the subject site.

Watercourses were identified to the north and west of the subject site which will be subject to riparian corridor considerations. These do not encroach on the subject site, however correspondence with DPI Water during the Development Application process to identify any riparian requirements for standing water onsite is recommended.

The options presented herein have been chosen to demonstrate the feasibility of the subject site to accommodate the type of development expected in the proposed zoning. There are a number of alternatives which could be considered during Development Application stage.

1 Introduction

Northrop Consulting Engineers have been engaged to undertake a flooding and stormwater management investigation to support the rezoning of Lot 14, DP 258848, located in Fullerton Cove.

The objective of this investigation was to determine the feasibility of implementing New South Wales Government and Port Stephens Council's flooding and water management policies and guidelines, within the context of the proposed new zoning. This is not intended to be a summary of detailed design options, rather a conceptual study regarding the suitability of the land for development.

Consideration has been given to the following documents throughout the course of this investigation.

- Port Stephens Council Development Control Plan (2014);
- Williamtown / Salt Ash Flood Study Review (BMT WBM, 2012);
- NSW Government Floodplain Development Manual (NSW Government, 2005);
- NSW Government Floodplain Risk Management Guideline - Practical Consideration of Climate Change (NSW Government, 2007);
- Water Management Act 2000 (NSW Government, 2016); and,
- Department of Primary Industries - NSW Oyster Industry Sustainable Aquaculture Policy.

2 Locality Description

2.1 Subject Site

The site consists of Lot 14, DP 258848 and shall hereafter be known as "the subject site". The subject site is approximately 6.7 hectares in area and located in the suburb of Fullerton Cove in the Port Stephens LGA. Currently, the land is zoned Rural Landscape (RU2) and is used for a residential purpose.

The subject site is bounded a rural residential property to the north east, Fullerton Cove Road to the west and Nelson Bay Road to the south.

LIDAR elevation data shows that the topography of the site is low lying and generally flat for the western portion, with elevations in the order of 1-2m AHD. A ridgeline runs along the north western boundary with the existing dwelling on a pad at approximately 3m AHD and maximum elevation of approximately 6.7m AHD in the eastern corner.

The subject site drains to the south west through a 300mm diameter RCP under Fullerton Cove Road. Runoff then passes through the RMS road reserve and into Lot 1 DP 270695 “The Cove Village”. A drainage easement through the village directs water through three 900mm diameter pipes under the Cove Drive towards Fullerton Cove.

Vegetation varies around the subject site from pastoral grasses to densely wooded vegetation. Several species of Endangered Ecological Communities (EEC) have been identified onsite including Swamp Oak Forest and Swamp Mahogany. Soils in the area have been observed to vary between loamy sands at higher elevations, to clays in the lower areas to the south east.

The locality of the subject site is included in Figure A1.

2.2 Proposed Development

At this stage the final development proposal is unknown, however it is likely to comprise of a bulky goods or retail style development. Land take is expected to be in the order of 1.5 to 2 hectares.

A sketch showing the development layout used for the basis of this assessment is shown in Figure A2.

2.3 Local Catchment

Seven local sub-catchments have been considered as part of the analysis. These are shown in Figure A3 and summarised below in Table 1.

Table 1 - Local catchments characteristics

Catch	Area (ha)	Flood Storage Volume (ML)	Description
1	11.0	28.4	Catchment 1 encompasses the subject site and land adjacent to Nelson Bay Road to the east. Both clayey and sandy soil types are expected within the catchment with dense vegetation. Levels are lower in the west and up to approximately 6.5m AHD along the ridgeline with Catchment 3.
2	35.9	85.6	Catchment 2 is located to the south of Nelson Bay Road and is characterised by dense bushland. It is bounded by Seaside Boulevard to the west, a ridge to the east and the Seaside subdivision to the south.

Catch	Area (ha)	Flood Storage Volume (ML)	Description
3	31.4	43.3	Catchment 3 is to the east of the subject site and has been analysed to assess whether there is any interaction with the site. It is bounded by a ridge to the north, Nelson Bay Road to the east, Fullerton Cove Road and the subject site. The vegetation includes heavy vegetation apart from a small development in the north western corner.
4	30.8	67.8	Catchment 4 discharges into Catchment 3 under Fullerton Cove Road. It is characterised by dense wooded vegetation and lower levels, however rises sharply at its extremities up to approximately 20m AHD. A portion of the Seaside subdivision is included in this catchment.
5	25.4	40.1	Catchment 5 is located to west of Seaside Boulevard and is also bounded by Nelson Bay Road and the Bayway Village. Elevations are generally lower than Catchment 2 and the outlet connects the catchment with Catchment 6.
6	3.3	21.3	Catchment 6 is a triangular parcel of land bounded by the Cove Village, Nelson Bay Road and Fullerton Cove Road. Elevations are low, in the order of 1.2m AHD and coverage is heavily vegetated.
7	5.7	17.3	Catchment 7 located within the Cove Village site and outlets through a channel towards Fullerton Cove.

2.4 Fullerton Cove Catchment

The local Fullerton Cove catchment includes areas around Raymond Terrace, Williamtown and Salt Ash, however also has interactions with spill from the Hunter River to the north west as well as downstream outlet impacts. It is categorised by low elevations and open agricultural land.

3 Flooding

3.1 Objectives

A flood assessment was undertaken in order to ascertain the effect of flooding on the subject site, as well as any affect the proposed development may have on flood levels upstream or downstream. Peak flows were determined at various points within the catchment for a range of design storm events to inform the flood study, as well as the stormwater management options presented for the proposed development later within the report. The following cases have been considered;

- Flooding from Fullerton Cove and potential impacts of climate change.
- Runoff from upstream local catchments traversing the subject site.

This study has been undertaken to a level commensurate with a rezoning application. We expect further analysis may be required at the Development Application stage once a layout has been determined.

3.2 Authority Policies and Guidelines

3.2.1 Port Stephens Council

Council's requirements for floodplain management are outlined in DCP 2014 Section B5. Requirements vary depending on the hydraulic categorisation of the land and the flood hazard. Generally speaking, the minimum floor levels are set at the 1%AEP plus 500mm freeboard and fill is not supported unless accompanied by an engineer's report.

3.2.2 NSW Floodplain Development Manual

The Floodplain Development Manual specifies any development should not have a significant adverse impact on adjoining properties. It also provides guidance on the setting of floor levels, as well as assessment and management of flood risks.

3.3 Methodology

Firstly, a literature review was undertaken to determine the effect of downstream water bodies, sea level rise and climate change on the subject site. Catchments were then determined using LIDAR survey information provided by the NSW Land and Property Information (LPI).

Rainfall patterns for the design storm events ranging from the 20%AEP up to the 1%AEP was estimated using Australian Rainfall and Runoff 1987 (Engineers Australia, 1987), and the PMP rainfall hyetograph was estimated using the Generalised Short Duration Method (Bureau of Meteorology, 2003).

The flood assessment was then undertaken using design rainfall patters and the one-dimensional software, DRAINS. DRAINS was chosen to simplify the spill behaviour and assess the changes to available flood storage volume and range of potential mitigation solutions.

Meetings were also held with Council representatives to determine the requirements for finished floor levels, impacts on adjacent properties and potential points of discharge.

3.4 Fullerton Cove Flooding

The Fullerton Cove flood levels have been determined from the Williamtown / Salt Ash Flood Study and Review (BMT WBM, April 2005 and February 2012) and are listed below in Table 2.

For all but the baseline case, this results in a **High Hazard Flood Storage** categorisation for the subject site.

Table 2 - Fullerton Cove flood levels

Design Storm	Flood Level (m AHD)
Baseline	1.85
1%AEP 2100 (sea level rise)	2.40
1% AEP 2100 (sea level rise + 10% flow)	2.50
1% AEP 2100 (sea level rise + 30% flow)	2.70
PMF	4.00

Port Stephens Council DCP states that no fill is permitted in a high hazard flood storage area unless accompanied by an engineering report assessing the impact of fill. In the case of the Fullerton Cove catchment, it is considered the storage volume of the site compared to the total storage volume is negligible and as such will not have a significant impact on flood levels.

3.5 Local Catchment Flooding

3.5.1 Existing Case

The results for the existing scenario are shown below in Tables 3 and 4.

Table 3 - Existing scenario water level (m AHD)

Catch	PMF	1%AEP	5%AEP	20%AEP
1	2.46	1.98	1.82	1.62
2	2.63	2.21	2.07	1.95
3	2.11	1.62	1.51	1.34
4	2.80	2.27	2.06	1.85
5	2.30	1.93	1.81	1.67
6	2.66	1.86	1.67	1.53
7	1.78	1.24	1.17	1.11

Table 4 - Existing scenario flow (L/s)

Design Storm	PMF	1%AEP	5%AEP	20%AEP
Inflow to subject site	12,100	81	77	51
Outflow from subject site	8,400	76	73	38
Through the Cove Village	5,500	127	106	53

It is noted the flow magnitude is quite low given the upstream catchment size. This is likely due to the small size of stormwater infrastructure and relatively large storage volumes.

3.5.2 Development Impact

The impact of the proposed development has been assessed and the results are included overleaf in Tables 5 and 6.

In the 1%AEP, the level is increased on-site by a maximum of 30mm and downstream by a maximum of 20mm. No increase was calculated in Catchment 5 which contains the Bayway Village development.

It is likely these small increases are due to the increased volume of runoff from the proposed development footprint. No measures to mitigate this have been included in this model such as rainwater tanks or infiltration devices.

Table 5 - Post developed water levels (m AHD)

Catch	PMF	1%AEP	5%AEP	20%AEP
1	2.46	2.01 (+30mm)	1.86 (+40mm)	1.66 (+40mm)
2	2.63	2.21	2.07	1.95
3	2.11	1.62	1.51	1.34
4	2.80	2.27	2.06	1.85
5	2.30	1.93	1.81	1.67
6	2.66	1.88 (+20mm)	1.68 (+10mm)	1.54 (+10mm)
7	1.78	1.24	1.17	1.11

Table 6 - Post developed flow (L/s)

Design Storm	PMF	1%AEP	5%AEP	20%AEP
Inflow to subject site	12,100	81	76 (-1L/s)	51
Outflow from subject site	8,400	102 (+26L/s)	75 (+2L/s)	45 (+7L/s)
Through the Cove Village	5,500	129 (+2L/s)	107 (+1L/s)	54 (+1L/s)

4 Legal Point of Discharge

4.1 Objective

A number of informal drainage paths exist within the Port Stephens Council area with no easements and the objective of this portion of the investigation was to determine the legal point of discharge.

4.2 Methodology

Stormwater infrastructure was identified in the area and a number of meetings held with Port Stephens Council officers. A copy of the downstream deposited plan was also obtained from Monteath and Powys for our review.

4.3 Outcome

The subject site currently drains to the Fullerton Cove Road reserve to the west and this will remain the legal point of discharge for the site. Downstream of this road reserve, water discharges into Crown Land and through a 10-metre-wide easement benefiting Council on DP 270695 prior to entering Fullerton Cove.

5 Stormwater Quality

5.1 Objectives

A review of Council's water quality policies has been undertaken in order to assess whether it is feasible to implement them on the subject site. In particular, Council's Development Control Plan (DCP) 2014, Section B4 – Drainage and Water Quality has been assessed.

5.2 Targets

The proposed development area for this assessment has been taken as two hectares, and since it is outside the drinking water catchment, the following controls apply as per Figure BE from the DCP.

Table 7 - Adopted treatment train efficiencies used in assessment.

Pollutant	Target (%)
Gross pollutants	90
Total Suspended Solids	90
Total Phosphorus	60
Total Nitrogen	45

5.3 Model Development

MUSIC-Link rainfall data for Williamtown draining to a sensitive catchment with a sandy soil was entered as the hydrological template in order to most accurately reflect the climate and soil conditions expected at the subject site.

A possible treatment train has been proposed and assessed using the MUSIC software package. The model was developed in accordance with the NSW Guidelines to MUSIC Modelling, BMT WBM, 2012 using the surface type source node method.

A hypothetical development has been entered with a one-hectare roof at 100% impervious and a one-hectare carpark at 90% impervious.

5.4 Treatment Train

The treatment train incorporates water sensitive urban design measures in line with current industry practice. Roof water is captured by a rainwater tank for re-use internally and for landscape irrigation. Both the overflow from the tank and the carpark areas are conveyed into a bio-retention basin before being released back to the catchment.

Rainwater Tank

A rainwater tank has been included in the test treatment train and will perform as a primary treatment device, presenting several benefits. These include reduced potable demand as well as at-source control of roof water pollutants. Sediment and nutrients are removed from the stormwater stream via a "first flush" device and discharged to landscaped areas thus increasing the efficiency of the treatment devices downstream.

Bio-retention System

A vegetated bio-retention system has the potential to provide a good water quality outcome, as well as enhanced aesthetics. The system may form part of localised "rain gardens" around the carpark to treat local catchments prior to entering the pipe network, or through an end of line basin. An end of line basin has been included in the test treatment train for simplicity.

5.5 Results

The results from the MUSIC modelling are included in Table 8 below, and the MUSIC link report has been included in Appendix B.

Table 8 - MUSIC water quality results

Pollutant	Target (%)	Sources	Residual	Reduction
Gross pollutants	90	495	0	100
Total Suspended Solids	90	3360	256	92.4
Total Phosphorus	60	6.85	1.56	77.3
Total Nitrogen	45	43.7	16.3	62.8

On this basis, it is considered implementing Council's policies is feasible on this site.

5.6 Construction Runoff Quality Control

Management of water quality during any construction activity on the subject site is to be undertaken in accordance with the recommendations outlined in Landcom's, Managing Urban Stormwater-Soils and Construction; "the Blue Book". This may include but not limited to; cut off swales on the high side of disturbed work, sediment fences, sediment basins, staked bales and stockpile erosion protection.

6 On-Site Detention

6.1 Objectives

Council's Development Control Plan (DCP) 2014, Section B4 – Drainage and Water Quality has been reviewed with respect to detention requirements.

6.2 Requirements

The proposed impervious percentage is less than 30 percent of the site and therefore would not normally require detention in accordance with Figure BD in Section B4 of the DCP. However, due to the flooding constraints it is considered appropriate to take measures to alter the catchment so that no significant adverse impacts are realised on downstream properties.

For the purposes of this exercise, detention has been assessed for the proposed developed area reducing post developed flows back to the natural case.

6.3 Model Development

Detention has been assessed using the DRAINS software. The ILSAX hydrological model has been adopted with soil type of 4 representing the sandy soils encountered on-site, a grassed depression storage of 5mm and a paved depression storage of 1mm.

The pre developed node was adopted as 100% pervious, with the developed roof 100% impervious and the carpark 90% impervious as per the water quality modelling.

A basin has been proposed with a low level outlet pipe and high level weir. At the weir spill depth approximately 650m³ of storage has been provided. This option would be compatible with the biofiltration basin as an increase in depth should it be adopted in the final design.

6.4 Results

The results from the detention analysis are shown below in Table 9. It is noted these numbers are for flows leaving the development footprint only.

Table 9 – DRAINS OSD results

Event	Pre development (L/s)	Post development (L/s)	Difference (L/s)
20% AEP	390	353	-37
10% AEP	455	368	-87
5% AEP	547	397	-150
2% AEP	669	421	-248
1% AEP	763	611	-152

It is therefore considered that detention can be provided on the subject site.

7 Watercourses and Riparian Corridor Management

7.1 Objectives

A review of available information regarding watercourses in the vicinity of the subject site was undertaken to determine any potential constraints regarding riparian corridors running through the subject site.

7.2 Methodology

A review of the latest 1:25,000 topographic maps was undertaken to identify any “blue line watercourses” on or adjacent to the subject site. A site visit was also undertaken on the 25 May 2016 to validate these lines and observe other features.

7.3 Location of Waterfront Land

No watercourses are noted on the topographical maps traversing the subject site. To the north, a first order stream passes under Fullerton Cove Road and to the south a first order stream originates from Bayway Village and passes under Nelson Bay Road and The Cove Drive before joining another first order stream from the east. This forms a second order stream in accordance with the Strahler system prior to discharging to Fullerton Cove. These were all verified onsite and photos are included overleaf.

It was also noted during the site visit that standing water was present in the western portion of the lot commensurate with its low lying nature. This may be classified as a wetland in accordance with the act and require a riparian offset. It is not likely this will have an impact on the develop-ability of the subject site given the ecological constraints already in place throughout this area.

7.4 Riparian Corridor Widths and Management

Core riparian zone widths are outlined in DPI Water; Guidelines for Riparian Corridors on Waterfront Land and requires a 10 metre buffer distances from the defined top of bank for first order streams and 20 metre from second order streams. For the wetland areas, previous experience suggests a 10 metre offset will be required.

The respective buffer distances are plotted with respect to the proposed development is included in Figure A4. As shown, the first order watercourse to the north of the development is clear of the development envelope. Furthermore, the guidelines make provision for re-alignment of first order watercourses and riparian corridors should it be required.

It is expected discussions with DPI Water at Development Application stage will confirm the classification of waterfront land on the subject site and in the vicinity. From the investigations undertaken to date, it does not appear this will form a significant constraint for development.

Photo 1 - Drainage running west from Fullerton Cove Road from discharge location of subject site

Photo 2 - First order stream running north from Fullerton Cove Road to the east of subject site


Photo 3 - Eastern branch first order stream through The Cove Village


Photo 4 - Western branch first order stream through The Cove Village

8 Discussion and Recommendations

8.1 Finished Floor Level and Site Surface Levels

Council has stipulated finished floor levels for the development are to be set at the 2100 1%AEP plus 500mm freeboard. The worst case has not been adopted in this case with the 2100 1%AEP plus 10% flow used for the purposes of this analysis. As outlined above, this level is 2.5m AHD resulting in a **proposed minimum finished floor level of 3.0m AHD.**

Site surface levels are expected to be determined to minimise the risk to property with depths limited to approximately 300mm in the 2100 1%AEP event. This would mean car-parking levels **are above 2.2m AHD.**

8.2 Management of Flood Risks

The site is currently exposed to High Hazard flood waters in the 1%AEP and PMF events.

The proposed pad has been located along the northern boundary in an area of higher ground to reduce the impact of flooding on any future development. The floor level has been set as described above to provide mitigation with respect the 1%AEP and also the potential impacts of climate change. Filling is also proposed as a mechanism to reduce the hazard category of the development area.

Given the site will be inundated in the PMF and a flood island created it is recommended flood refuge above the PMF is created either at natural levels on-site or within the proposed development.

It is expected education and awareness procedures will be implemented prior to occupation to assist in responding to a flood emergency.

8.3 Development Footprint

A two-hectare footprint has been assumed for this analysis, however should additional area be required it is expected it could be accommodated to the east of the proposed pad by cutting into areas of higher elevation, or alternatively, flood storage could be provided under the carpark area reducing the potential flood impact.

8.4 Flood Impact Assessment

A preliminary flood impact assessment has been undertaken which shows the development proposal does not significantly impact the flood behaviour in the vicinity of the subject site. It is expected this will be refined as the detailed layout is determined at Development Application stage.

8.5 Stormwater Management Strategies

The stormwater management strategy proposed herein indicates the feasibility of implementing the Council's policies on the subject site. Alternative measures may be considered for achieving the water quality and detention outcomes as discussed below.

Grass Lined/Vegetated Swales

Swales further filter stormwater and replicate natural concentration of water which reflects the objectives of a secondary treatment device. Sediment is deposited in the vegetation and some pollutants attach to soil particles and organic matter. The use of swales may be considered as a perimeter treatment measure or within the carpark layout.

Permeable Paving

Permeable paving can be used to filter sediment and attached particulates close to the source of pollutants. Detention and retention can also be considered in the granular base.

Permeable paving is not typically considered for high traffic areas, but may perform an important function over the parking areas.

Proprietary Devices

Proprietary devices such as gross pollutant traps, pit inserts or filtration technology may be considered to supplement the treatment train at various stages. This may have benefits in terms of reducing land occupied by water treatment devices.

Proprietary devices should not be considered as a replacement for water sensitive design measures, however. Generally speaking, they are expensive to install and maintain, and become ineffective after poor maintenance.

Underground Detention Tanks

At this stage detention has been proposed above ground, however it is considered to have the same impact below ground.

8.6 NSW Oyster Industry Aquaculture Strategy

The aquaculture strategy nominates guidelines for maintaining and improving water quality in the vicinity of oyster growing areas. In particular the following recommended actions are outlined;

- Fencing of riparian corridors on agricultural properties;
- Riparian corridor buffer areas for high nutrient generating activities;
- At source control of stormwater for new developments;

This proposal considers at source treatment measures that may be implemented as part of the final layout. Section 5 demonstrates compliance with Council's policies with respect to stormwater management and as such, it is considered the intent of the aquaculture strategy is also satisfied.

9 Conclusion

Through the completion of the flooding and stormwater management assessment, the following is concluded regarding the rezoning of Lot 14 DP 258848;

- It is expected the proposed filling for development of approximately two hectares will not have a significant impact on flood levels or behaviour in both the Fullerton Cove and local catchment dominated events;
- Development larger than this area may occur to the south east of the proposed pad at levels above 2m AHD from a flood management perspective. There may be ecological constraints in this area;
- Development larger than this area which encroach on areas lower than 2m AHD to the south west of the proposed pad would be expected to maintain flood storage in underground tanks to minimise impact on surrounding properties;
- The subject site has an existing legal point of discharge to Fullerton Cove Road to the south west. Further investigations undertaken on behalf of Council show a 10-metre-wide easement for drainage through the downstream development to Fullerton Cove;
- Council's policies regarding water quality and detention for the proposed development are feasible to be implemented in this case;
- Riparian corridors are not expected to be a constraint for the proposed development, however liaison with DPI Water during the Development Application phase should be undertaken to confirm this; and
- The treatment measures and flood impact are based on a hypothetical development footprint through which to assess the feasibility of implementing Council policies. This has been undertaken for a rezoning purpose and should not preclude alternative devices or design solutions which would be assessed as part of any Development Application submission.

10 References

Bureau of Meteorology (2003) The Estimation of Probable Maximum Precipitation in Australia: General Short Duration Method

New South Wales Government (2005) Floodplain Development Manual: the management of flood liable land

New South Wales Government Department of Environment and Climate Change (2007) Floodplain Risk Management Guideline – Practical Consideration of Climate Change

New South Wales Office of Water (2012) Guidelines for Riparian Corridors on Waterfront Land

The Institute of Engineers, Australia (1987) Australian Rainfall and Runoff - A Guide to Flood Estimation

BMT WBM (2005) Williamtown Salt Ash Flood Study

BMT WBM (2012) Williamtown Salt Ash Flood Study Review

Port Stephens Council (2014) Development Control Plan - B General Provisions

NSW DPI (2016) NSW Oyster Industry Sustainable Aquaculture Strategy

APPENDIX A – FIGURES

FIGURE A1

Locality

42 Fullerton Cove Road,
Fullerton Cove

Legend

Subject Site

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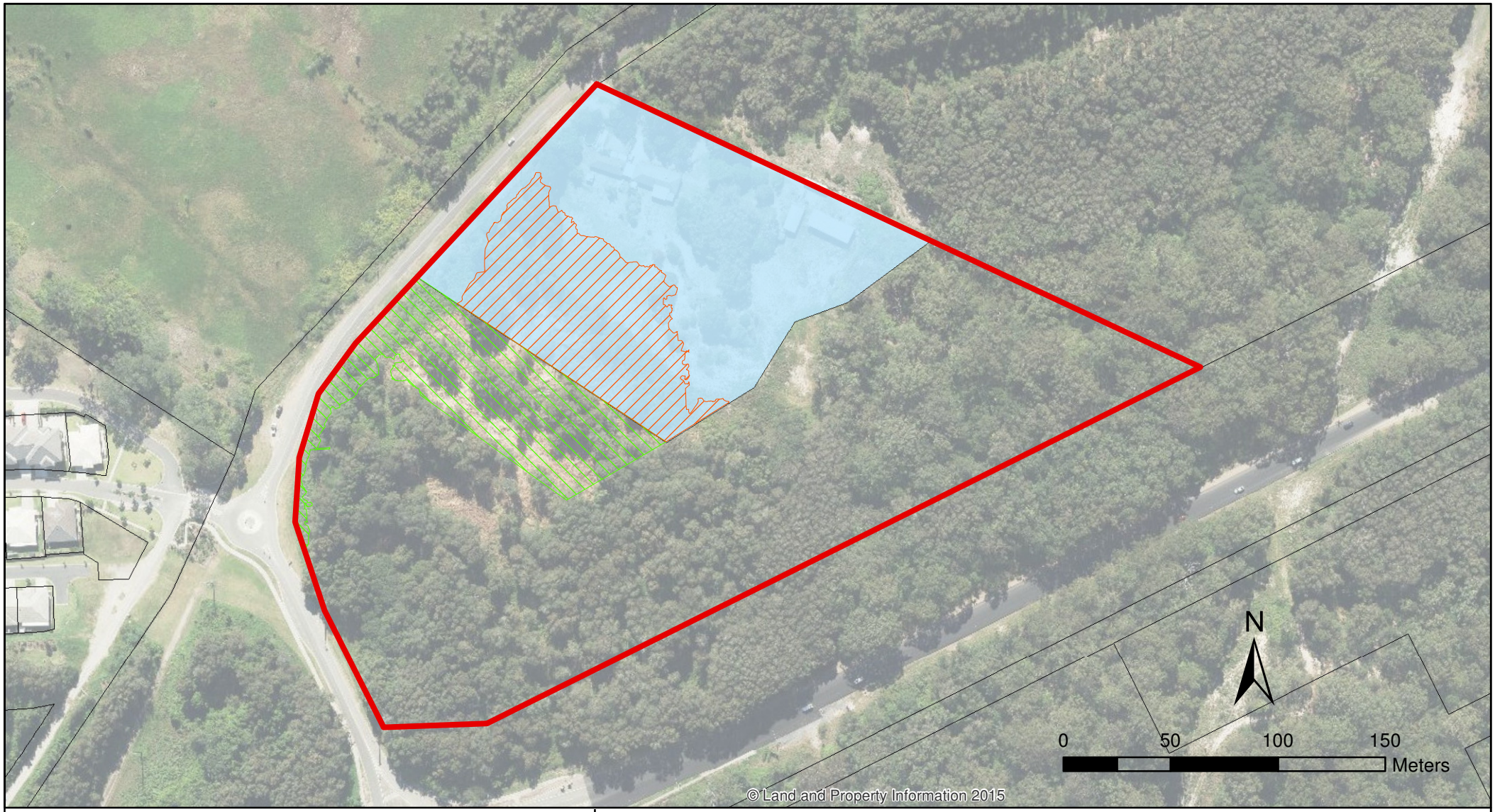

FIGURE A2

Preliminary Development Layout

42 Fullerton Cove Road,
Fullerton Cove

Legend

- Subject Site
- Indicative Fill Areas
- Indicative Cut Areas
- Development
- Cadastre

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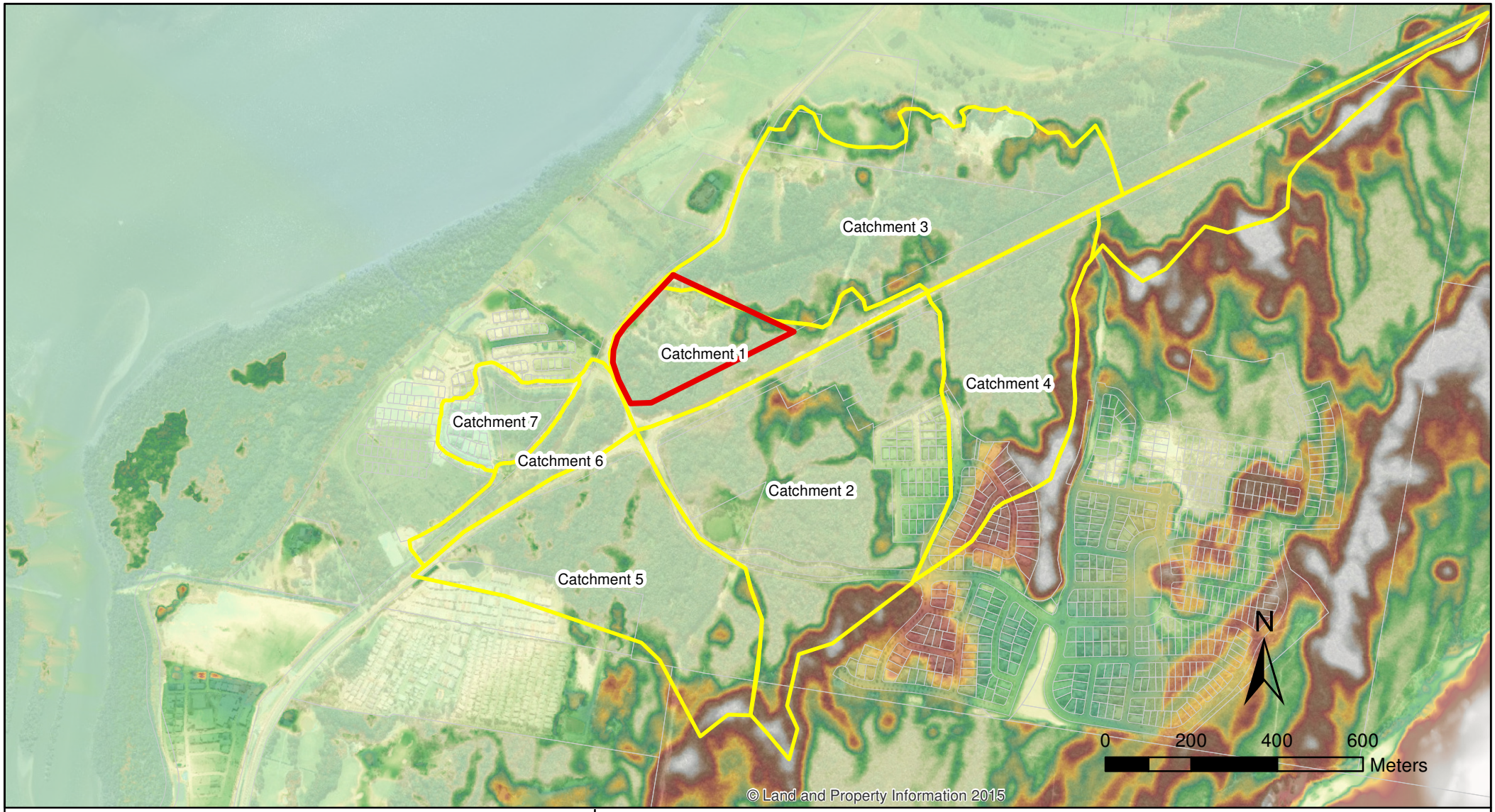

FIGURE A3

Local Catchments

42 Fullerton Cove Road,
Fullerton Cove

Legend

- Subject Site
- Local Catchments
- Cadastre

Elevation (m AHD)

25
12.5
0

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P.O Box 180, Charlestown NSW 2290
email newcastle@northrop.com.au ABN 81 094 433 100

Document Path: Y:\YEAR 2016 Jobs\NL161067\O - Drawings\GIS\ArcMap Figures - Nov 2016\FIGUREA3_CATCHMENTS.mxd

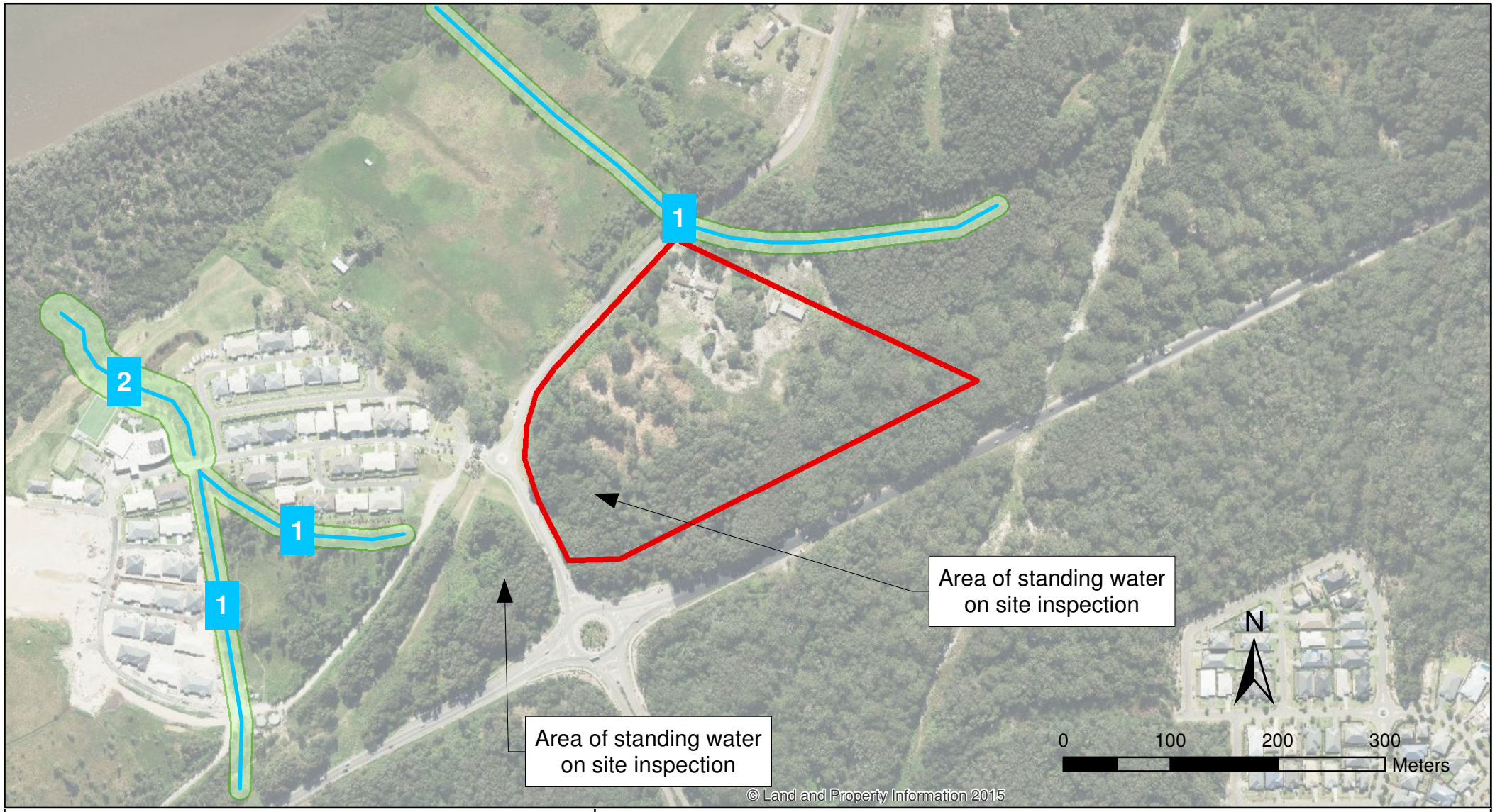

FIGURE A4

Riparian Corridors

42 Fullerton Cove Road,
Fullerton Cove

Legend

- Creeks
- Preliminary Riparian Corridors
- Subject Site

NORTHROP

Newcastle
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APPENDIX B – MUSIC LINK REPORT

PORT STEPHENS COUNCIL

music@link

MUSIC-*link* Report

Project Details		Company Details	
Project:	Fullerton Cove Rezoning	**Company:**	Northrop Engineers
Report Export Date:	15/11/2016	**Contact:**	Angus Brien
Catchment Name:	NL161067_Rezoning_2ha	**Address:**	
Catchment Area:	2ha	**Phone:**	49431777
Impervious Area*:	94.78%	**Email:**	abrien@northrop.com.au
Rainfall Station:	WILLIAMTOWN RAAF - Station 061078 - Zone B		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1998 - 31/12/2007 23:54:00		
Mean Annual Rainfall:	1125mm		
Evapotranspiration:	1394mm		
MUSIC Version:	6.2.1		
MUSIC-link data Version:	6.21		
Study Area:	Williamtown		
Scenario:	Sensitive Catchment - Sandy soils		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness

Node: Post-Development Node	Reduction
Flow	4.78%
TSS	92.5%
TP	77.3%
TN	62.7%
GP	100%

Treatment Nodes

Node Type	Number
Rain Water Tank Node	1
Bio Retention Node	1

Source Nodes

Node Type	Number
Urban Source Node	2

Comments

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	Bioretention	Hi-flow bypass rate (cum/sec)	None	None	100
Bio	Bioretention	PET Scaling Factor	2.1	2.1	2.1
Post	Post-Development Node	% Load Reduction	None	None	4.78
Post	Post-Development Node	GP % Load Reduction	90	None	100
Post	Post-Development Node	TN % Load Reduction	50	None	62.7
Post	Post-Development Node	TP % Load Reduction	65	None	77.3
Post	Post-Development Node	TSS % Load Reduction	85	None	92.5
Rain	Rainwater Tank	% Reuse Demand Met	None	None	100
Urban	Carpark	Area Impervious (ha)	None	None	0.895
Urban	Carpark	Area Pervious (ha)	None	None	0.104
Urban	Carpark	Total Area (ha)	None	None	1
Urban	Roof	Area Impervious (ha)	None	None	1
Urban	Roof	Area Pervious (ha)	None	None	0
Urban	Roof	Total Area (ha)	None	None	1

Only certain parameters are reported when they pass validation