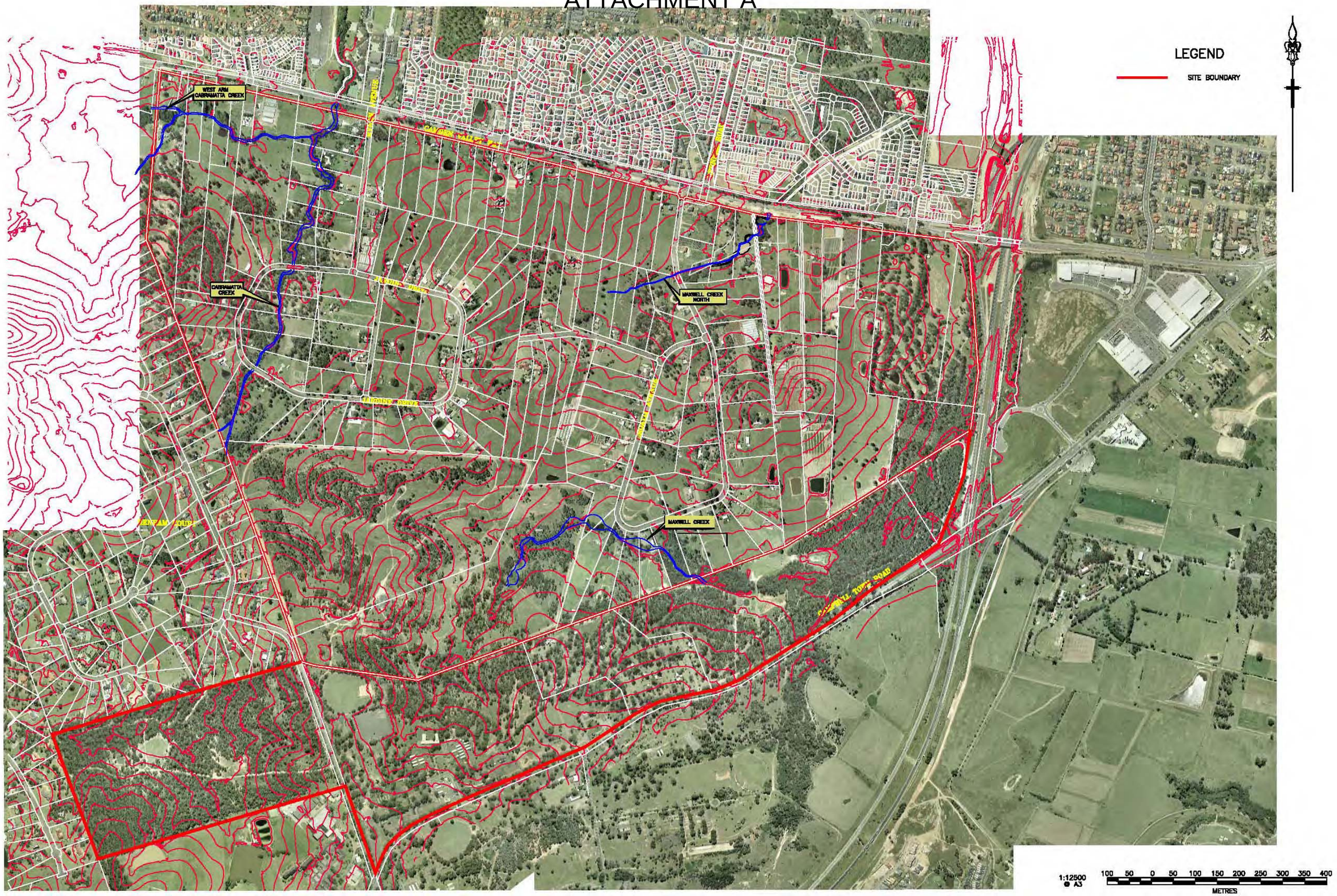
ATTACHMENT A

FIGURES

ATTACHMENT A



J. WYNDHAM PRINCE PTY LTD
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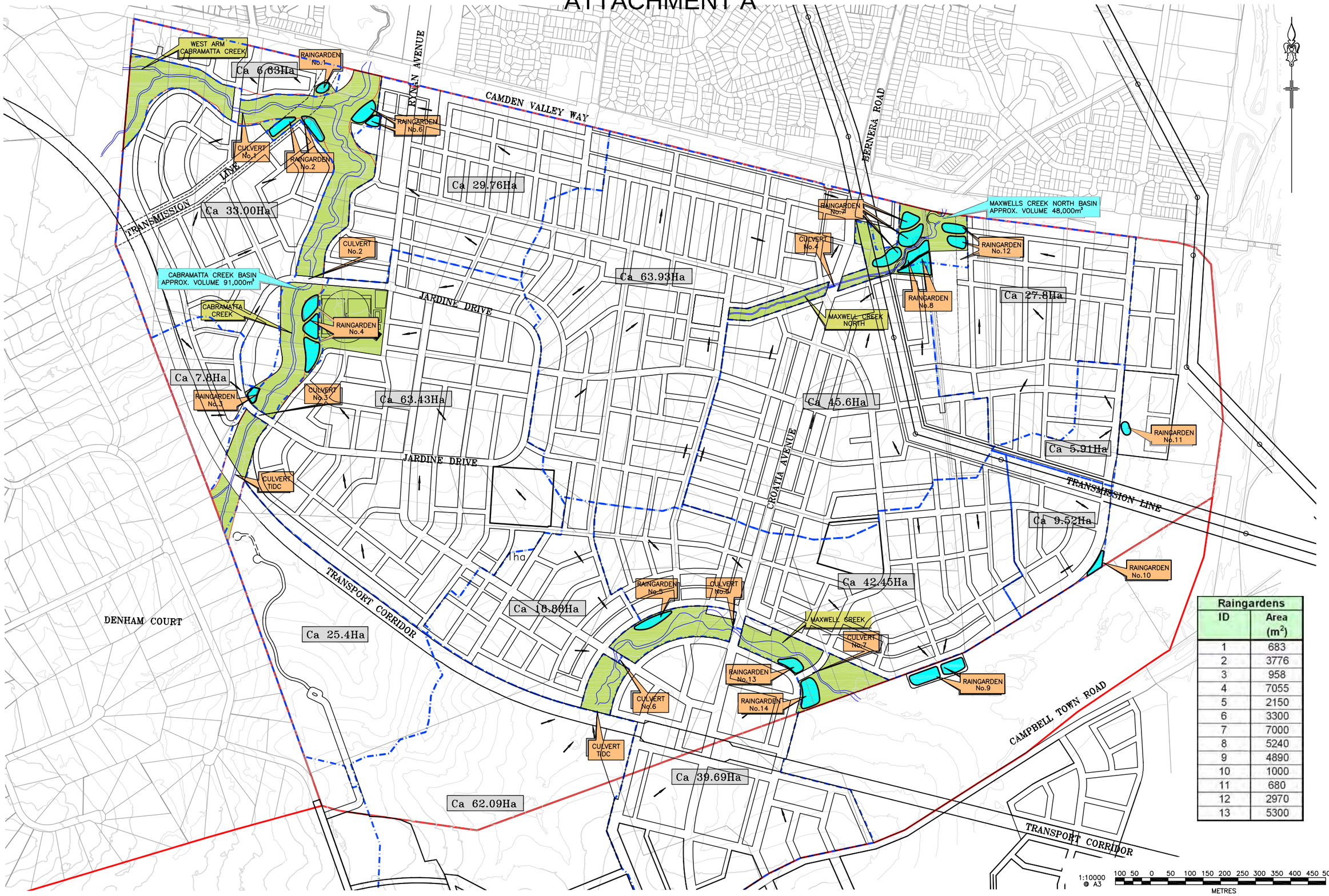
GROWTH CENTRES COMMISSION

Liverpool city council

Edmondson Park **FIGURE 1**

Site Plan **Oct 07 A**

ATTACHMENT A



Raingardens	
ID	Area (m^2)
1	683
2	3776
3	958
4	7055
5	2150
6	3300
7	7000
8	5240
9	4890
10	1000
11	680
12	2970
13	5300

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GROWTH CENTRES COMMISSION

Liverpool city council

Edmondson Park **FIGURE 2**

Stormwater Masterplan Oct 07 B

Attachment B

Stormwater Management Strategy Elements and Water Quality Parameters

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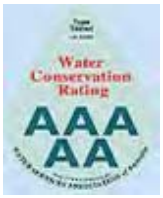
B.2. Water Quality Elements

On Lot Treatments

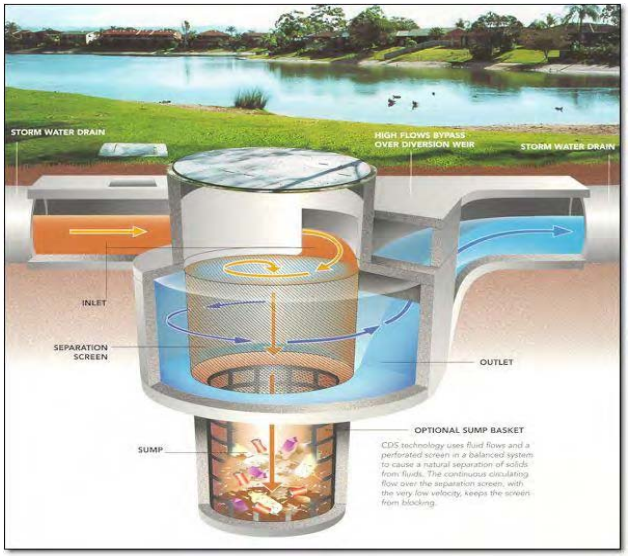


- Adoption of appropriate waterwise landscaping practices (resident education, native gardens, mulch, micro-irrigation).
- Implementation of water efficient fittings and appliances in all dwellings (dual flush toilet, AAA shower heads, water efficient taps and plumbing).
- Minimisation of impervious areas.
- The provision of a future reticulated recycled water main to the site, along with implementation of the above water efficient devices, will satisfy the requirements of BASIX.

Street Level Treatments

Gross Pollutant Traps (GPTs)

GPT devices are typically provided at the outlet to stormwater pipes. These systems operate as a primary treatment to remove litter, vegetative matter, free oils and grease and coarse sediments prior to discharge to a downstream (Secondary and Tertiary) treatment devices. They can take the form of trash screens or litter control pits, filter pit inserts and wet sump gross pollutant traps. Council approved GPT units are to be provided at the end of stormwater pipes from urbanised catchments prior to discharging to the receiving waters.



B.3. Water Quality Elements Standard Parameters

The general features and configuration of the various water quality elements are provide below.

	Pond
Storage	
Surface Area (m^2)	3000
Extended Detention Depth	0.3
Evaporative Loss as % of PET	100
Outlet	
Equivalent Pipe Diameter (mm)	50
Overflow Weir Width (m)	5
Notional Detention Time (hrs)	78.4

	Sand Filter
Storage	
Extended Detention Depth	0.3
Infiltration	
Filter Area (m^2)	700
Filter Depth (m)	0.6
Filter Particle Effective Diameter (mm)	1.00
Saturated Hydraulic Conductivity (mm/h)	3600
Outlet	
Overflow Weir Width (m)	5

	Raingarden
Storage	
Extended Detention Depth	0.3
Infiltration	
Filter Area (m^2)	750
Filter Depth (m)	0.6
Filter Particle Effective Diameter (mm)	0.45
Saturated Hydraulic Conductivity (mm/h)	100
Outlet	
Overflow Weir Width (m)	5

ADOPTED SOIL / GROUNDWATER PARAMETERS

	Units	Parks	Roofed*	Road*	Remaining Urban
Impervious Area Parameters					
Rainfall threshold	mm/day	1.4	0.5	1.0	1.4
Pervious Area Parameters					
Soil storage capacity	mm	210			170
Initial storage	% of capacity	30			30
Field capacity	mm	80			70
Infiltration capacity coefficient - a		175			210
Infiltration capacity coefficient - b		3.1			4.7
Groundwater Properties					
Initial depth	mm	10			10
Daily recharge rate	%	35			50
Daily baseflow rate	%	20			4
Daily deep seepage rate	%	0			0

* Roofed and Road catchments have been assumed to be 100% impervious

ADOPTED ANNUAL POLLUTANT EVENT MEAN CONCENTRATIONS

Pollutant	Roofed*		Road*		Remaining Urban		Parks	
	Base Flow (mg/l)	Storm Flow (mg/l)	Base Flow (mg/l)	Storm Flow (mg/l)	Base Flow (mg/l)	Storm Flow (mg/l)	Base Flow (mg/l)	Storm Flow (mg/l)
TSS	0.0	20.0	0.0	270	16.0	265.0	6.0	40.0
TP	0	0.13	0	0.50	0.140	0.18	0.030	0.08
TN	0.00	2.00	0.00	2.20	1.30	1.68	3.30	0.90

* Roofed and Road catchments have been assumed to be 100% impervious

B.4. Water Quality Device Performance Criteria

The expected sediment and nutrient removal performance of the proposed devices was determined using the default equations and parameters provided in the MUSIC model (Ref. 21). The water quality reduction mechanisms in MUSIC are based on an exponential decay equation referred to as the k – C* curve (refer to Wong et al. – Ref. 23).

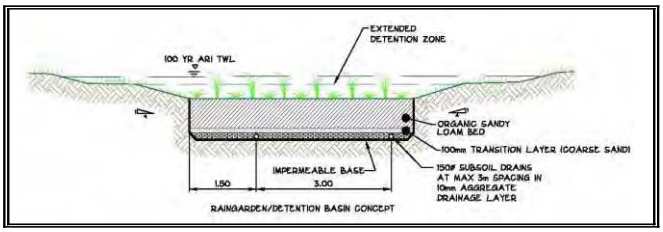
MUSIC – PERFORMANCE PARAMETERS

Pollutant	Sand Filter		Pond		Bio- Retention	
	k (m/yr)	C* (mg/L)	k (m/yr)	C* (mg/L)	k (m/yr)	C* (mg/L)
TSS	8000	20.000	400	12.000	8000	20.000
TP	6000	0.130	300	0.090	6000	0.130
TN	500	1.400	40	1.000	500	1.400

Ornamental Pond

The Ornamental Pond consists of an open water body with an extended detention zone typically from 100-300 mm deep designed to detain and treat first flush flows from the upstream catchment. Ornamental ponds are generally provided as an aesthetic amenity for the community and are typically located within focal open space areas. The overall depth of ornamental ponds are typically 1.5 – 2.5 m deep.

Bio-Retention Raingarden



Bio-retention raingardens consist of a filtration bed with either gravel or sandy loam media and an extended detention zone typically from 100-300 mm deep designed to detain and treat first flush flows from the upstream catchment. They are typically located within bushland corridors or other open space areas. The depth of the bio-retention raingarden media beds are typically 400 - 600 mm deep.

The Bio-retention Raingardens will also function to assist in detaining first flush flows to replicate the natural wetting and drying regime discharging from the development. The locations of the raingardens are shown on Figure 3. (Refer to Section 6.6 for further discussion).

Attachment C

Stream Classifications in Locality 1 & Stream Ephemerality Assessment

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C.1. Stream Classification West of Macdonald Road

The study area includes the catchment for Maxwells Creek upstream of Macdonald Road. The area is shown in Figure 11

The catchment for the upstream reaches of Maxwell's Creek above Macdonald Road, could be defined as a series of drainage depressions. The attached Figure 11 shows in detail the drainage depression locations and orientation, also photo locations and approximate locations of stormwater drainage systems.

C.1.1. Objectives

It is the objective of this investigation to assess whether riparian corridors exist upstream from Macdonald Road. The assessment is based upon field observations, topography and the calculated hydrology of the catchment.

C.1.2. Drainage Depression "B4 & B5"

This feature is represented as a blue line on the 1:25,000 topographic map (Refer to Figure 11). It stretches from Macdonald Road in the east to approximately 660 m to the west where the depression is no longer evident. Any flow carried by the drainage depression runs in an easterly direction towards Macdonald Road.

At the junction of Macdonald Road the depression has a combined catchment of 54 ha.

The topography of the depression can be seen in the following photos. The lower reaches of the drainage depression are formed by a shallow drainage depression with no banks evident and covered by mown turf and pasture grasses. Scattered trees inhabit the lower areas within the depression. The described topography and vegetation pattern changes from turf to a more forested area comprised of native trees, shrubs and grasses.

The area is heavily infested with herb and grass weed species and African Olive *Olea Europaea Subs Cuspidata* is dominating the shrub and tree layer. The drainage depression is less defined through this vegetation regime and sheet flow is more evident.

The location of the photos presented below are shown on Plate 3

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 12

Drainage Depression "E" from Macdonald Road to the junction with Drainage Depression "B" has a 600 – 900mm diameter stormwater pipe and associated pits that generally follow the base of the depression.

The stormwater pipe discharges into a culvert that runs under Macdonald Road. The pipe depth is generally 1-1.5m below the landform. At the time of inspection, there was no visible flow in the pipes.

C.1.3. Drainage Depression "E"

Drainage Depression "E" joins Drainage Depression "B4" approximately 300m to the west of Macdonald Road. The depression is formed by England Road to the west then travels to the north to join Drainage Depression "B4". Total length of the road formation and drainage depression is 470m.

At the junction of Drainage Depression "B4" the catchment is approximately 7.4 ha.

The topography of the depression can be seen in the following photos. The lower reaches of Drainage Depression "E" where it joins Drainage Depression "B4" are similar to Drainage Depression "B3" forming a shallow drainage depression with no banks evident and covered with mown turf and pasture grasses. The northern side of the drainage depression is more timbered, while on the south pasture grass and scattered trees are more dominant. This topography and vegetation pattern continues until the depression intersects an existing formed road (England Road). The rest of Drainage Depression "E" is formed by the road formation which heads in a south westerly direction.

Photo 8

Photo 9

Drainage Depression "E" from the junction with Drainage Depression "B4" up to England Road has a stormwater line and associated stormwater pits running generally in the low part of the depression. The pipe size ranges from 600 mm – 750 mm dia in size. The pipe is laid generally 1-1.2 m below the surface. At the time of inspection there was no visible flow within the pipe.

C.1.4. Drainage Depression "F"

Drainage Depression "F" joins Drainage Depression "B4" approximately 60m to the west of Macdonald Road. Drainage Depression "F" runs in a northerly direction towards Campbelltown Road. From the junction with Drainage Depression "B4" to the point in the north where the drainage depression is ill defined the length is approximately 400m. At the junction of Drainage Depression "B4" the catchment is approximately 8.3ha.

The topography of the depression can be seen in the following photos. The lower reaches of the drainage depression are barely identified with a shallow depression, no banks evident covered with turf, pasture grasses and scattered trees. The drainage depression enters a more heavily timbered area 140m to the north of Drainage Depression "B4". The timbered area contains native trees, however little ground cover

or shrub species were evident. This area again is heavily infested with African Olive, Olea Europaea Subs Cuspidata. The drainage depression becomes a series of sheet flow areas and is difficult to distinguish as a drainage depression within the timbered area.

Photo 10

Photo 11

Within Drainage Depression "F" no stormwater pits were found, however, pipe directions from a pit on Drainage Depression "B4" indicate that a link could be present on the general line of Drainage Depression "F".

C.1.5. Drainage Depression "D"

Drainage Depression "D" joins Drainage Depression "B" approximately 140m to the west of Macdonald Road. Drainage Depression "D" runs in a southerly direction towards England Road. From the junction with Drainage Depression "A" to the point in the south where the drainage depression is ill defined is approximately 200m. At the junction of Drainage Depression "B4" the catchment is approximately 3.6ha.

The topography of the depression can be described as follows. The lower reaches of the drainage depression are ill defined with no banks evident covered with turf and pasture grasses. The drainage depression enters an area of scattered trees 70m to the south of Drainage Depression "B4". The scattered trees then give way to more open grasslands further to the south.

No stormwater pits were evident for Drainage Depression "D", however as with Drainage Depression "C" pipe directions from a pit on Drainage Depression "B4" indicate that a pipeline may be present.

C.1.6. Recommended Stream Classification

Drainage Depression "B4", "B5", "D", "E", "F", to the west of Macdonald Road would not be classified as a river because:

- There is no continuous channel with clearly defined bed and banks;
- There are no formed banks or any areas of erosion or deposition that would indicate surface flow
- There are no fluvial bedforms or aquatic habitats, such as pools or riffles;
- Flowing water would be generated rarely and only immediately after a storm event, indicating ephemeral flow (not intermittent). This ephemeral nature of the streams is supported by a hydrological assessment undertaken on the largest

catchment area under consideration (54ha) (Refer to Section 8.2.2). Under current NSW Office of Water guidelines only streams having intermittent or permanent flow regimes require the allocation of Riparian corridors.

- There is insufficient ground water or soil water flow to maintain a saturated drainage depression for any period of time.
- Runoff is so minor that it is incapable of eroding and or maintaining a channel.
- The pipes observed have been in the ground for 60+ years and thus the geomorphology of the area has been modified for that time. It could be argued that the installed pipe system is no different to systems designed and built in urban areas and as such the Strahler System of stream order does not apply

In summary we conclude that none of the drainage depressions investigated west of Macdonald Road meet the NSW Office of Waters classifications for watercourses requiring riparian corridors as presented in the Departments current guidelines (2008).

C.2. Stream Classification East Of Macdonald Road

It is the objective of this investigation to assess the existing depressions and creeks within the study area and propose Core Riparian Zone widths based upon the above criteria, field observations, and site topography.

The investigation covers the three main drainage depression to the east of Macdonald Road. The three drainage depressions form the upper reaches of Maxwells Creek south.

The attached Figure 11 shows in detail, the drainage depression locations and orientations, and indicates the photo locations associated with the field study undertaken.

C.2.1. Drainage Depression "A"

This feature is represented as a blue line on the 1:25000 topographic map, and under the Strahler classifications is a 1st order stream. The depression starts on the eastern side of Macdonald Road and runs in an easterly direction for 740m before joining Maxwell Creek south.

A pipe under Macdonald Road transfers flows from the public school upstream to the start of the drainage depression. At the limit of the development boundary in the east, the depression has a combined catchment of 31.2ha. Scattered trees and forested areas are common vegetation patterns along the lower areas within the depression.

A 45m wide riparian corridor has been set aside for the depression east of Macdonald Road until the junction with Maxwell Creek south. The riparian corridor includes an allowance of 10m of core riparian zone either side of the 5m for the creek invert and banks. A further 10m vegetated buffer outside the core has been accounted for in the planning. The width allowance of 45m is in accordance with the watercourse order as described in Section 3.

C.2.2. Drainage Depression "B1, B2 and B3"

This feature is represented as a blue line on the 1:25000 topographic map and under the Strahler classification is a 1st order stream. The depression starts on the eastern side of Macdonald Road. A box culvert under Macdonald Road transports flows from upstream into a section of "V" formed concrete channel, immediately to the west of the road.

The drainage depression runs in an easterly direction for 600m before heading north for another 540m and joining drainage depression “A”. The drainage depression forms the headwaters of Maxwell Creek south. At the junction with drainage depression “A”, drainage depression “B1” has a combined catchment of 114.4ha.

The topography of the drainage depression “B1” could be described as a broad, flat valley and having an incised creek with formed banks within the base of the valley. The topography and typical vegetation pattern of the depression can be seen in the following photos

The location of the photos presented below are shown on Plate 3.

Photo 13

Photo 14

Photo 15

Photo 16

Thick Casuarina stands are evident in the upper reaches of the depression before giving away to more scattered tree areas then further areas of more dense tree vegetation. This pattern repeats until the northern boundary of the development site is reached.

A 45m wide riparian corridor has been suggested for this drainage depression downstream of Macdonald Road. The riparian corridor consists of an allowance of 5m for creek invert and bank, 10m of core riparian zone either side of the creek and a further 10m either side of the core for a vegetated buffer. The width allowed for in accordance with the watercourse order as described in Section 3.

Approximately 400m to the east of Macdonald Road, a regional detention basin has been planned. An allowance has been made in the planning that the core riparian

zone can go through the southern edge of the detention basin. The location of the core riparian zone will be subject to future design and negotiation.

C.2.3. Drainage Depression "C"

This feature is represented as a blue line on the 1:25000 topographic maps. The depression starts on the western edge of the south western freeway and runs in a northern direction for 300m before joining drainage depression "B2".

A piped culvert under the south western freeway transports flows from the south east of the freeway to drainage depression "C".

At the junction with depression "B2", drainage depression "C" has a catchment of 12ha.

The topography of the drainage depression could be described as a broad flat valley with no defined creek banks or bed. The topography and typical vegetation pattern of the depression can be seen in the following photos.

Scattered trees and grasslands are the dominant vegetation type in a disturbed native vegetation community.

Photo 17

There has been no allowance for drainage depression "C" to have any designated riparian zones. The proposal does not allow for a corridor based on the assessment that the drainage depression does not fit the criteria that would necessitate the provision of a riparian corridor.

Drainage depression "C" would not be classified as a river because:

- There is no continuous channel with clearly defined bed and bank;
- There are no fluvial bedforms or aquatic habitats, such as pools or riffles.
- Flowing water would be generated rarely and only immediately after a storm event, indicating ephemeral flow. Ephemeral flow regimes are excluded from the definitions of a river.
- There is insufficient ground water or soil water flow to maintain a saturated drainage depression for any period of time.
- Runoff is so minor that it is incapable of eroding and maintaining a channel.

C.2.4. Recommended Classification

East of Macdonald Road drainage depressions "A", "B3" and "B2" have been classified as First Order channels that require a riparian zone width of 45m, comprising of a creek bed and bank width of 5m, a core riparian zone width of 10m either side of the creek bank and a further 10m vegetated buffer either side of the core zone.

Drainage depression "C" does not meet the NSW Offices of Water classification for a watercourse requiring a riparian corridor.

C.3. Stream Ephemerality Assessment

Watercourses can be classified based on their flow characteristics as follows:

Ephemeral – Stream flows only during and immediately after rain

Intermittent – Stream flows cease for weeks or months each year

Perennial – Stream that has continuous flow all year round during years of normal rainfall.

In order to assess the stream category that best relates to watercourse B3 (refer to Plate 3 in Section 8) which is located to the west of Macdonald Road, an assessment of long term catchment hydrology was undertaken using XP-RAFTS.

C.3.1. Procedure

The following procedure was undertaken for this assessment:

- Continuous hourly rainfall data for the BOM gauge site at Liverpool (Station 67035) was derived for the period between 13/01/1966 and 28/09/1974 and converted into HYDSYS format. This hourly rainfall series for about 8.7 years was used as rainfall input storm in the XP-RAFTS model.
- A rainfall-runoff model for the catchment was developed in XP-RAFTS using the following catchment characteristics:
  - Catchment Area = 54 ha
  - Percentage Imperviousness = 0%
  - Catchment Slope = 2%
  - Manning's n = 0.04
- The ARBM Loss Model of the XP-RAFTS model was adjusted using the parameters recommended by Campbelltown City Council. These are summarised in Table C1 below.

Table C1. ARBM Loss Model parameters adopted in the XP-RAFTS Model.

ARBM parameters			
Parameter	Description	Value	Unit
CAPIMP	Capacity of Impervious Area Storage	1.5	mm
ISC	Interception Storage Capacity	1.5	mm
DSC	Depression Storage Capacity	5	mm
USC	Capacity – Upper Soil Zone Storage	25	mm
LSC	Capacity – Lower Soil Zone Storage	100	mm
UH	Maximum Potential Evapo-transpiration from Upper Soil Zone	10	mm/day
LH	Maximum Potential Evapo-transpiration from Lower Soil Zone	10	mm/day
ER	Proportion of Evapo-transpiration from USC	0.7	
IDS	Initial Impervious Area Storage	0.5	mm
IS	Initial Interception Storage	0.5	mm
DS	Initial Depression Storage (pervious)	0	mm
US	Initial Upper Soil Zone Storage	20	mm
LS	Initial Lower Soil Zone Storage	80	mm
GS	Initial Groundwater Storage	0	mm
GN	Groundwater Recession Factor	1	mm
SO	Sorptivity of Dry Soil	3.0	mm/min
Ko	Saturated Hydraulic Conductivity	0.33	mm/min
LDF	Lower Soil Drainage Factor	0.05	
KG	Constant Rate Groundwater Recession Factor	0.94	
ECOR	Rate of Potential Evaporation from "A" Class Pan	0.70	
IAR	Proportion of Rainfall intercepted by Vegetation	0.70	

Statistical analysis of the XP-RAFTS modelling output data was undertaken using Excel to determine the number of occurrences when runoff occurred in the catchment after a rainfall event and the typical response time between cessation of rainfall until cessation of surface runoff.

C.3.2. Results

A plot of the Excess Rainfall and Total Local Flow from the catchment obtained from the continuous Rainfall-Runoff modelling in XP-RAFTS is shown in Plate C1 below.

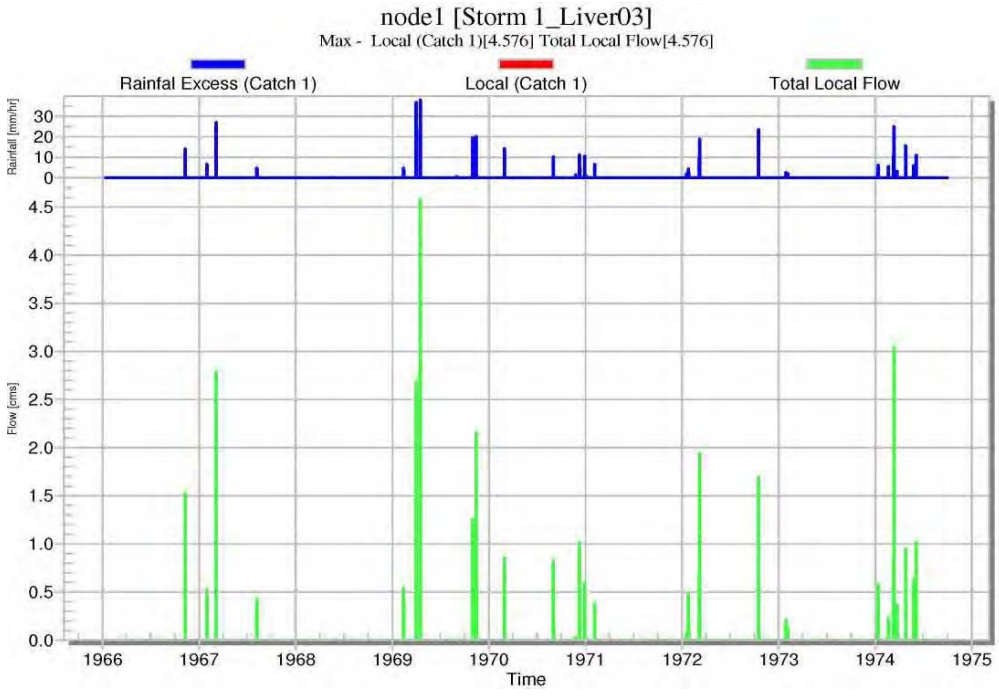

Plate C1. Plot of the Excess Rain (mm/hr) and Total Local Flow (cms) for the 54 ha catchment.

A summary of the statistics obtained from the Excel Analysis is given in Table C2 below.

Table C2: Results Summary of the Excel Statistical Analysis.

Parameter	Results
Years of Hourly Rain Data	8.7 years
Number of Rain Occurrences	5476 hrs (228 days equiv.)
Number of Runoff Occurrences	823 hrs (34.3 days equiv.)
Number of Occurrences of Runoff following a Rain Event	11 times
Median Lag between End of Rainfall and End of Runoff	16 hrs
Minimum Lag between End of Rainfall and End of Runoff	6 hrs
Maximum Lag Time between End of Rainfall and End of Runoff	17 hrs

The modelling results indicate that for the entire duration of about nine years, runoff has continued beyond cessation of rainfall on only 11 occasions. Runoff from the 54 ha catchment upstream of Macdonald Road, on the rare occasion that it occurs, usually ceases about 16 hours from the end of the preceding rainfall event.

The hydrological modelling undertaken supports the classification of this drainage depression *as ephemeral only and **not** Intermittent*.

The results of this assessment would also suggest that any other watercourses in this location with a smaller catchment than 54 Ha would also be classified as ephemeral.

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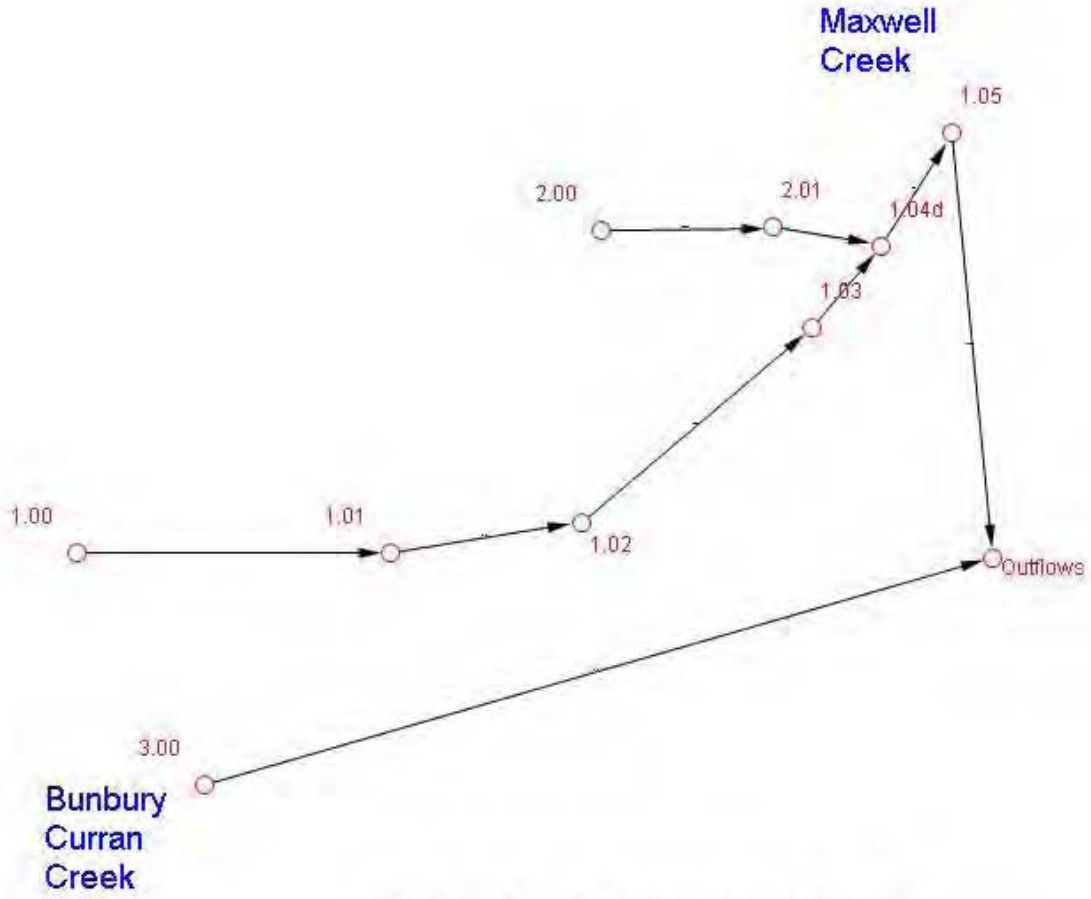
Attachment D

Hydrological Modelling Results
Pre-Development Conditions

XP-RAFTS Model: 9031RA_01.xp



9031W\XP-RAFTS\9031RA_01.XP

PRE-DEVELOPMENT CONDITIONS
INGLEBURN DEFENCE LANDS
16/06/2010

Run started at: 8th July 2010 9:16:14

##
INGLEBURN DEFENCE LANDS - Pre-Development Catchment
##

ROUTING INCREMENT (MINS) = 2.00
STORM DURATION (MINS) = 270.
RETURN PERIOD (YRS) = 5.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 200.80
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 200.80

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	33.200	0.000	3.000	0.000	10.00	0.000	.050	0.00	.1023	0.000	1.000
1.01	21.400	0.000	3.000	0.000	5.000	0.000	.050	0.00	.0991	0.000	1.001
1.02	46.000	0.000	2.500	0.000	5.000	0.000	.050	0.00	.1615	0.000	1.002
1.03	13.400	0.000	2.200	0.000	5.000	0.000	.050	0.00	.0907	0.000	1.003
2.00	21.600	0.000	3.200	0.000	10.00	0.000	.050	0.00	.0792	0.000	2.000
2.01	10.000	0.000	3.000	0.000	5.000	0.000	.050	0.00	.0667	0.000	2.001
1.04d	.00001	0.000	4.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.004
1.05	29.000	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1420	0.000	1.005
3.00	26.200	0.000	8.000	0.000	5.000	0.000	.050	0.00	.0675	0.000	3.000
Outflows	.00001	0.000	5.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.006

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	17.200	15.00	0.000	2.500	0.000	53.150	0.000	3.118	92.00	3.000
1.01	17.200	15.00	0.000	2.500	0.000	53.150	0.000	4.949	96.00	6.500
1.02	17.200	15.00	0.000	2.500	0.000	53.150	0.000	7.906	102.0	3.000
1.03	17.200	15.00	0.000	2.500	0.000	53.150	0.000	8.922	106.0	0.000
2.00	17.200	15.00	0.000	2.500	0.000	53.150	0.000	2.281	92.00	3.000
2.01	17.200	15.00	0.000	2.500	0.000	53.150	0.000	3.273	94.00	0.000
1.04d	17.200	15.00	0.000	2.500	0.000	53.150	0.000	11.623	102.0	5.300
1.05	17.200	15.00	0.000	2.500	0.000	53.150	0.000	13.499	108.0	0.000
3.00	17.200	15.00	0.000	2.500	0.000	53.150	0.000	3.084	90.00	0.000
Outflows	17.200	15.00	0.000	2.500	0.000	53.150	0.000	15.187	104.0	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 120.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 200.80
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 200.80

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	33.200	0.000	3.000	0.000	10.00	0.000	.050	0.00	.1023	0.000	1.000
1.01	21.400	0.000	3.000	0.000	5.000	0.000	.050	0.00	.0991	0.000	1.001
1.02	46.000	0.000	2.500	0.000	5.000	0.000	.050	0.00	.1615	0.000	1.002
1.03	13.400	0.000	2.200	0.000	5.000	0.000	.050	0.00	.0907	0.000	1.003
2.00	21.600	0.000	3.200	0.000	10.00	0.000	.050	0.00	.0792	0.000	2.000
2.01	10.000	0.000	3.000	0.000	5.000	0.000	.050	0.00	.0667	0.000	2.001
1.04d	.00001	0.000	4.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.004
1.05	29.000	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1420	0.000	1.005
3.00	26.200	0.000	8.000	0.000	5.000	0.000	.050	0.00	.0675	0.000	3.000
Outflows	.00001	0.000	5.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.006

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	45.000	15.00	0.000	2.500	0.000	70.833	0.000	6.075	50.00	3.000
1.01	45.000	15.00	0.000	2.500	0.000	70.833	0.000	9.629	54.00	6.500
1.02	45.000	15.00	0.000	2.500	0.000	70.833	0.000	16.015	64.00	3.000
1.03	45.000	15.00	0.000	2.500	0.000	70.833	0.000	18.087	65.00	0.000
2.00	45.000	15.00	0.000	2.500	0.000	70.833	0.000	4.442	46.00	3.000
2.01	45.000	15.00	0.000	2.500	0.000	70.833	0.000	6.421	49.00	0.000
1.04d	45.000	15.00	0.000	2.500	0.000	70.833	0.000	23.304	62.00	5.300
1.05	45.000	15.00	0.000	2.500	0.000	70.833	0.000	27.363	67.00	0.000
3.00	45.000	15.00	0.000	2.500	0.000	70.833	0.000	6.596	44.00	0.000
Outflows	45.000	15.00	0.000	2.500	0.000	70.833	0.000	30.943	65.00	0.000

Run completed at: 8th July 2010 9:16:16

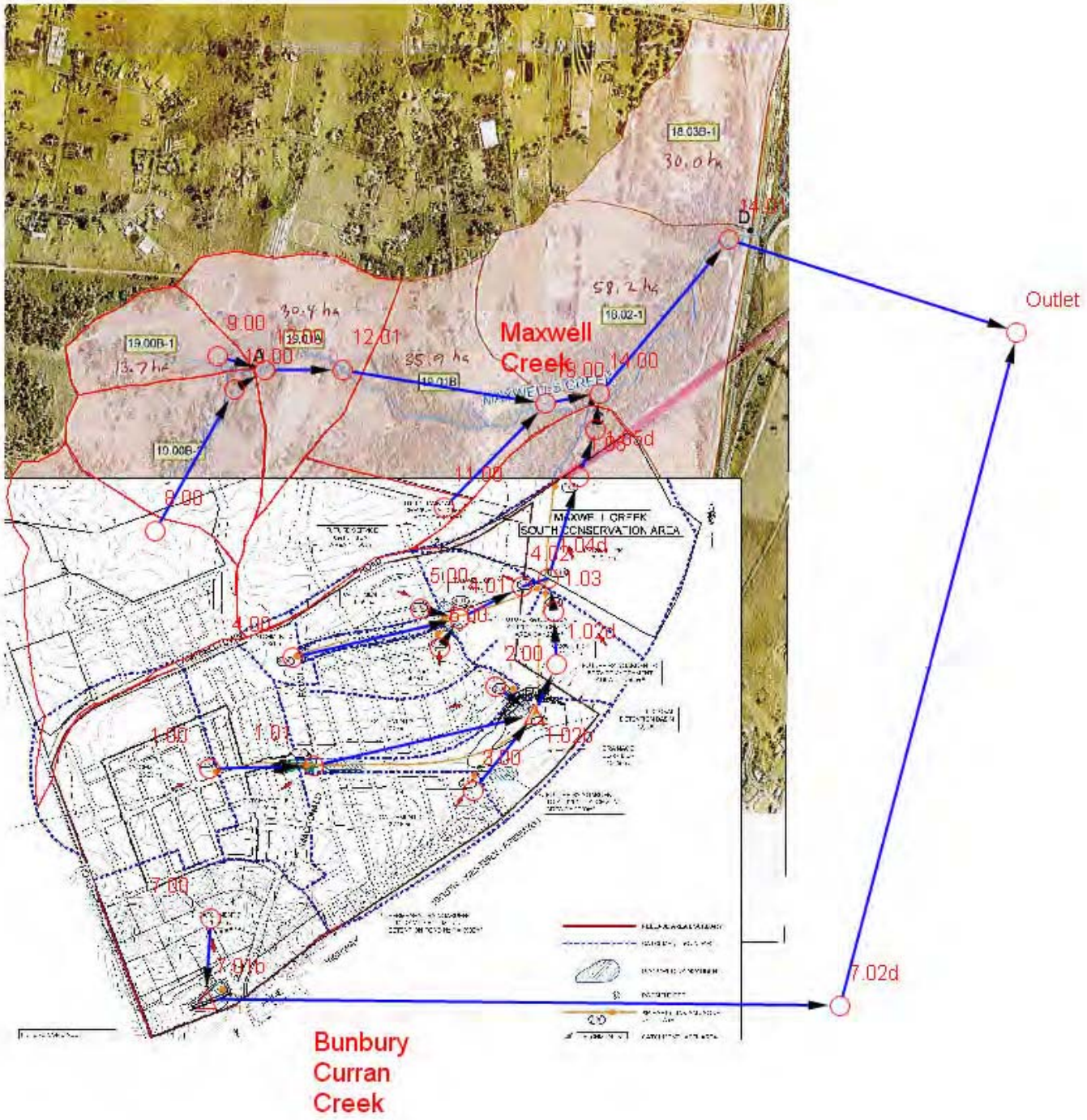
Attachment E

Hydrological Modelling Results
Post-Development Conditions

XP-RAFTS Model: 9031RA_06.xp

POST-DEVELOPMENT CONDITIONS
INGLEBURN DEFENCE LANDS
19/08/2010

9031W\XP-RAFTS\9031RA_06.XP



Run started at: 24th August 2010 9:02:05

##

INGLEBURN DEFENCE LANDS - Post-Development Catchment

##

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 120.
RETURN PERIOD (YRS) = 5.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 220.07
TOTAL OF SECOND SUB-AREAS (ha) = 228.59
TOTAL OF ALL SUB-AREAS (ha) = 448.66

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
1.00	14.530	18.500	3.000	5.000	1.000	100.0	.025	.015	.0577	.0030	1.000
1.01	3.900	15.700	3.000	3.000	1.000	100.0	.025	.015	.0291	.0036	1.001
2.00	2.210	12.510	3.000	3.000	1.000	100.0	.025	.015	.0217	.0032	2.000
3.00	4.430	17.720	3.000	5.000	1.000	100.0	.025	.015	.0311	.0030	3.000
1.02b	4.290	9.000	1.000	1.000	1.000	100.0	.025	.015	.0530	.0047	1.002
1.02d	.00001	0.000	2.200	0.000	5.000	0.000	.025	0.00	0.000	0.000	1.003
1.03	11.620	0.000	2.000	0.000	5.000	0.000	.025	0.00	.0530	0.000	1.004
4.00	0.7200	2.880	3.200	3.200	1.000	100.0	.025	.015	.0117	.0014	4.000
5.00	0.8500	7.650	3.500	3.500	1.000	100.0	.025	.015	.0122	.0023	5.000
6.00	0.8400	7.610	3.500	3.500	1.000	100.0	.025	.015	.0121	.0023	6.000
4.01	0.4300	1.720	1.000	1.000	1.000	100.0	.025	.015	.0160	.0020	4.001
4.02	8.550	0.000	2.500	0.000	5.000	0.000	.025	0.00	.0404	0.000	4.002
1.04d	.00001	0.000	4.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.005
1.05	29.000	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1420	0.000	1.006
1.05d	2.880	6.720	2.000	2.000	1.000	100.0	.025	.015	.0305	.0028	1.007
11.00	3.570	20.230	3.000	3.000	1.000	100.0	.025	.015	.0278	.0041	7.000
8.00	29.770	16.030	3.500	3.500	1.000	100.0	.025	.015	.0776	.0034	8.000
10.00	16.860	11.240	3.000	3.000	1.000	100.0	.025	.015	.0624	.0030	8.001
9.00	3.420	10.280	3.000	3.000	1.000	100.0	.025	.015	.0272	.0029	9.000
12.00	.00001	0.000	.1000	0.000	1.000	0.000	.025	0.00	.0002	0.000	8.002
12.01	12.160	18.240	2.500	2.500	1.000	100.0	.025	.015	.0576	.0043	8.003
13.00	21.540	14.360	2.500	2.500	1.000	100.0	.025	.015	.0776	.0038	7.001
14.00	.00001	0.000	.1000	0.000	1.000	0.000	.025	0.00	.0002	0.000	1.008
14.01	29.100	29.100	2.000	2.000	1.000	100.0	.025	.015	.1014	.0061	1.009
7.00	19.250	8.500	8.000	8.000	1.000	100.0	.025	.015	.0410	.0016	10.00
7.01b	0.1500	0.6000	1.000	1.000	1.000	100.0	.025	.015	.0093	.0011	10.00
7.02d	.00001	0.000	5.000	0.000	1.000	0.000	.025	0.00	0.000	0.000	10.00
Outlet	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0002	0.000	1.010

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	6.555	35.00	1.500
1.01	27.000	15.00	1.500	2.500	0.000	35.125	52.500	11.715	35.00	4.000
2.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	4.337	33.00	0.000
3.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	6.074	33.00	0.000
1.02b	27.000	15.00	1.500	2.500	0.000	35.125	52.500	21.406	39.00	.5000
1.02d	27.000	15.00	0.000	2.500	0.000	35.125	0.000	5.621	73.00	2.000
1.03	27.000	15.00	0.000	2.500	0.000	35.125	0.000	6.584	54.00	0.000
4.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	1.013	35.00	2.500
5.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	2.604	33.00	0.000
6.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	2.589	33.00	0.000
4.01	27.000	15.00	1.500	2.500	0.000	35.125	52.500	6.680	35.00	1.500
4.02	27.000	15.00	0.000	2.500	0.000	35.125	0.000	7.315	37.00	0.000
1.04d	27.000	15.00	0.000	2.500	0.000	35.125	0.000	12.134	37.00	5.300
1.05	27.000	15.00	0.000	2.500	0.000	35.125	0.000	13.128	42.00	3.000
1.05d	27.000	15.00	1.500	2.500	0.000	35.125	52.500	14.148	45.00	0.000
11.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	6.875	33.00	6.000
8.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	6.145	35.00	6.000
10.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	9.703	40.00	0.000
9.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	3.599	33.00	0.000
12.00	27.000	15.00	0.000	2.500	0.000	35.125	0.000	12.413	40.00	4.000
12.01	27.000	15.00	1.500	2.500	0.000	35.125	52.500	15.329	44.00	8.000
13.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	22.788	44.00	0.000
14.00	27.000	15.00	0.000	2.500	0.000	35.125	0.000	36.493	45.00	7.000
14.01	27.000	15.00	1.500	2.500	0.000	35.125	52.500	40.257	52.00	0.000
7.00	27.000	15.00	1.500	2.500	0.000	35.125	52.500	4.628	40.00	0.000
7.01b	27.000	15.00	1.500	2.500	0.000	35.125	52.500	4.783	40.00	0.000
7.02d	27.000	15.00	0.000	2.500	0.000	35.125	0.000	2.935	50.00	0.000
Outlet	27.000	15.00	0.000	2.500	0.000	35.125	0.000	43.185	52.00	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
1.02b	39.00	21.41	72.00	5.621	48878.3	10.000	21501.6	53.009
7.01b	40.00	4.783	50.00	2.935	11600.6	0.0000	2204.8	39.257

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
1.02b	3.0	1.000		0.000	20.000	0.5000

7.01b	1.0	1.000	0.000	20.000	0.2000	

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 120.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 220.07
TOTAL OF SECOND SUB-AREAS (ha) = 228.59
TOTAL OF ALL SUB-AREAS (ha) = 448.66

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1	% Impervious #2	Perm #1	Perm #2	B #1	B #2	Link No.
1.00	14.530	18.500	3.000	5.000	1.000	100.0	.025	.015	.0577	.0030	1.000
1.01	3.900	15.700	3.000	3.000	1.000	100.0	.025	.015	.0291	.0036	1.001
2.00	2.210	12.510	3.000	3.000	1.000	100.0	.025	.015	.0217	.0032	2.000
3.00	4.430	17.720	3.000	5.000	1.000	100.0	.025	.015	.0311	.0030	3.000
1.02b	4.290	9.000	1.000	1.000	1.000	100.0	.025	.015	.0530	.0047	1.002
1.02d	.00001	0.000	2.200	0.000	5.000	0.000	.025	0.00	0.000	0.000	1.003
1.03	11.620	0.000	2.000	0.000	5.000	0.000	.025	0.00	.0530	0.000	1.004
4.00	0.7200	2.880	3.200	3.200	1.000	100.0	.025	.015	.0117	.0014	4.000
5.00	0.8500	7.650	3.500	3.500	1.000	100.0	.025	.015	.0122	.0023	5.000
6.00	0.8400	7.610	3.500	3.500	1.000	100.0	.025	.015	.0121	.0023	6.000
4.01	0.4300	1.720	1.000	1.000	1.000	100.0	.025	.015	.0160	.0020	4.001
4.02	8.550	0.000	2.500	0.000	5.000	0.000	.025	0.00	.0404	0.000	4.002
1.04d	.00001	0.000	4.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.005
1.05	29.000	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1420	0.000	1.006
1.05d	2.880	6.720	2.000	2.000	1.000	100.0	.025	.015	.0305	.0028	1.007
11.00	3.570	20.230	3.000	3.000	1.000	100.0	.025	.015	.0278	.0041	7.000
8.00	29.770	16.030	3.500	3.500	1.000	100.0	.025	.015	.0776	.0034	8.000
10.00	16.860	11.240	3.000	3.000	1.000	100.0	.025	.015	.0624	.0030	8.001
9.00	3.420	10.280	3.000	3.000	1.000	100.0	.025	.015	.0272	.0029	9.000
12.00	.00001	0.000	.1000	0.000	1.000	0.000	.025	0.00	.0002	0.000	8.002
12.01	12.160	18.240	2.500	2.500	1.000	100.0	.025	.015	.0576	.0043	8.003
13.00	21.540	14.360	2.500	2.500	1.000	100.0	.025	.015	.0776	.0038	7.001
14.00	.00001	0.000	.1000	0.000	1.000	0.000	.025	0.00	.0002	0.000	1.008
14.01	29.100	29.100	2.000	2.000	1.000	100.0	.025	.015	.1014	.0061	1.009
7.00	19.250	8.500	8.000	8.000	1.000	100.0	.025	.015	.0410	.0016	10.00
7.01b	0.1500	0.6000	1.000	1.000	1.000	100.0	.025	.015	.0093	.0011	10.00
7.02d	.00001	0.000	5.000	0.000	1.000	0.000	.025	0.00	0.000	0.000	10.00
Outlet	.00001	0.000	.1000	0.000	0.000	0.000	.025	0.00	.0002	0.000	1.010

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	11.464	35.00	1.500
1.01	45.000	15.00	1.500	2.500	0.000	70.833	88.500	19.661	35.00	4.000
2.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	6.853	33.00	0.000
3.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	9.870	35.00	0.000
1.02b	45.000	15.00	1.500	2.500	0.000	70.833	88.500	36.305	39.00	.5000
1.02d	45.000	15.00	0.000	2.500	0.000	70.833	0.000	9.511	73.00	2.000
1.03	45.000	15.00	0.000	2.500	0.000	70.833	0.000	11.227	49.00	0.000
4.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	1.688	35.00	2.500
5.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	4.162	33.00	0.000
6.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	4.141	33.00	0.000
4.01	45.000	15.00	1.500	2.500	0.000	70.833	88.500	10.843	35.00	1.500
4.02	45.000	15.00	0.000	2.500	0.000	70.833	0.000	12.883	37.00	0.000
1.04d	45.000	15.00	0.000	2.500	0.000	70.833	0.000	20.206	37.00	5.300
1.05	45.000	15.00	0.000	2.500	0.000	70.833	0.000	22.973	42.00	3.000
1.05d	45.000	15.00	1.500	2.500	0.000	70.833	88.500	24.847	45.00	0.000
11.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	11.170	33.00	6.000
8.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	11.858	40.00	6.000
10.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	18.629	40.00	0.000
9.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	5.889	35.00	0.000
12.00	45.000	15.00	0.000	2.500	0.000	70.833	0.000	23.400	40.00	4.000
12.01	45.000	15.00	1.500	2.500	0.000	70.833	88.500	29.070	44.00	8.000
13.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	41.518	44.00	0.000
14.00	45.000	15.00	0.000	2.500	0.000	70.833	0.000	65.543	45.00	7.000
14.01	45.000	15.00	1.500	2.500	0.000	70.833	88.500	73.635	52.00	0.000
7.00	45.000	15.00	1.500	2.500	0.000	70.833	88.500	9.518	40.00	0.000
7.01b	45.000	15.00	1.500	2.500	0.000	70.833	88.500	9.780	40.00	0.000
7.02d	45.000	15.00	0.000	2.500	0.000	70.833	0.000	6.439	46.00	0.000
Outlet	45.000	15.00	0.000	2.500	0.000	70.833	0.000	79.422	52.00	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
1.02b	39.00	36.30	72.00	9.511	85746.9	10.000	40873.0	53.666
7.01b	40.00	9.779	46.00	6.439	21757.0	0.0000	4446.2	39.626

SUMMARY OF BASIN OUTLET RESULTS

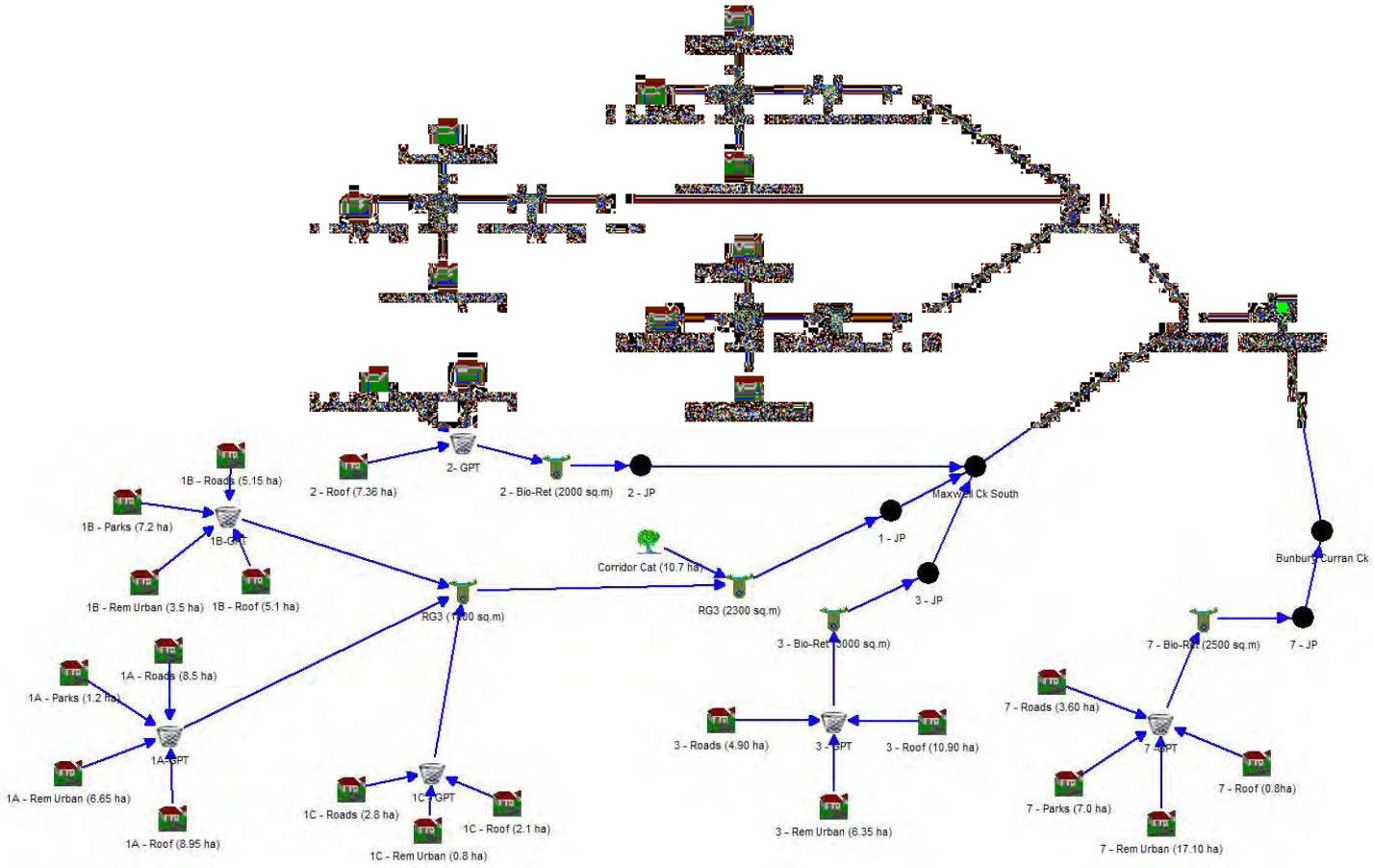
Link Label	No. of	S/D Factor	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
1.02b	3.0	1.000		0.000	20.000	0.5000
7.01b	1.0	1.000		0.000	20.000	0.2000

Run completed at: 24th August 2010 9:02:06

Attachment F

Water Quality Modelling Layout – Post Development Catchment

MUSIC Model: 9031MU_06.sqz

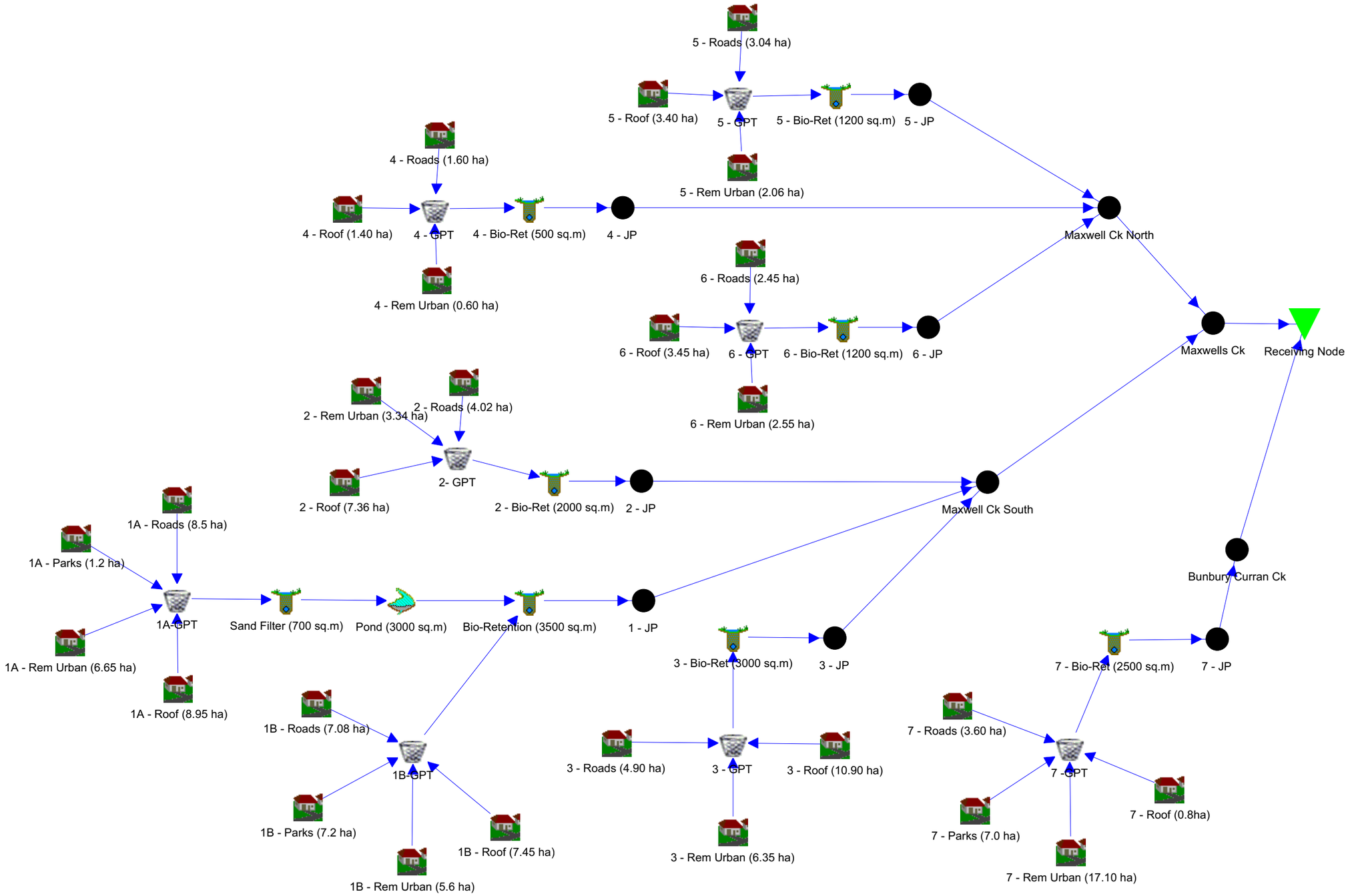

1B - Roads (5.15 ha)
1B - Parks (7.2 ha)
1B-GPT
1B - Rem Urban (3.5 ha)
1B - Roof (5.1 ha)
2 - Roof (7.36 ha)
2- GPT
2 - Bio-Ret (2000 sq.m)
2 - JP
Maxwell Ck South
1 - JP
Corridor Cat (10.7 ha)
RG3 (2300 sq.m)
3 - JP
3 - Bio-Ret (3000 sq.m)
3 - Roads (4.90 ha)
3 - GPT
3 - Roof (10.90 ha)
3 - Rem Urban (6.35 ha)
Bunbury Curran Ck
7 - Bio-Ret (2500 sq.m)
7 - JP
7 - Roads (3.60 ha)
7 - GPT
7 - Roof (0.8ha)
7 - Parks (7.0 ha)
7 - Rem Urban (17.10 ha)
1A - Parks (1.2 ha)
1A - Roads (8.5 ha)
1A-GPT
1A - Rem Urban (6.65 ha)
1A - Roof (8.95 ha)
1C - Roads (2.8 ha)
1C - GPT
1C - Roof (2.1 ha)
1C - Rem Urban (0.8 ha)

Attachment G

Stream Erosion Index Modelling Layout and Results

Pre-Development MUSIC Model: 9031MU_00.sqz

Post-Development MUSIC Model: 9031MU_03.sqz


5 - Roads (3.04 ha)
5 - Roof (3.40 ha)
5 - GPT
5 - Bio-Ret (1200 sq.m)
5 - JP
5 - Rem Urban (2.06 ha)
4 - Roads (1.60 ha)
4 - Roof (1.40 ha)
4 - GPT
4 - Bio-Ret (500 sq.m)
4 - JP
4 - Rem Urban (0.60 ha)
Maxwell Ck North
6 - Roads (2.45 ha)
6 - Roof (3.45 ha)
6 - GPT
6 - Bio-Ret (1200 sq.m)
6 - JP
6 - Rem Urban (2.55 ha)
Maxwells Ck
Receiving Node
2 - Rem Urban (3.34 ha)
2 - Roads (4.02 ha)
2- GPT
2 - Roof (7.36 ha)
2 - Bio-Ret (2000 sq.m)
2 - JP
Maxwell Ck South
1A - Roads (8.5 ha)
1A - Parks (1.2 ha)
1A-GPT
Sand Filter (700 sq.m)
Pond (3000 sq.m)
Bio-Retention (3500 sq.m)
1 - JP
Bunbury Curran Ck
1A - Rem Urban (6.65 ha)
1A - Roof (8.95 ha)
3 - Bio-Ret (3000 sq.m)
3 - JP
7 - Bio-Ret (2500 sq.m)
7 - JP
1B - Roads (7.08 ha)
1B-GPT
3 - Roads (4.90 ha)
3 - GPT
3 - Roof (10.90 ha)
7 - Roads (3.60 ha)
7 -GPT
1B - Parks (7.2 ha)
1B - Roof (7.45 ha)
3 - Rem Urban (6.35 ha)
7 - Roof (0.8ha)
7 - Parks (7.0 ha)
1B - Rem Urban (5.6 ha)
7 - Rem Urban (17.10 ha)