STORM_CONSULTING

Airds-Bradbury Renewal Project

Water Cycle Management Report

Report Prepared for:
Landcom / Urbis

March 2011
Project No. 1049

Prepared by:
STORM CONSULTING PTY LTD

SUSTAINABLE WATER
STORMWATER & RUNOFF
STREAMS & WATERWAYS
ENVIRONMENTAL

Head Office
Suite 3, 6 West Street
(PO Box 193)
Pymble NSW 2073
Australia
T +61 (02) 9499 4333
F +61 (02) 9499 4311
www.stormconsulting.com.au

Document Verification

Project title	Airds-Bradbury Renewal Project	ACN 080 852 231 ABN 73 080 852 231
Document title	Water Cycle Management Report	Project number 1049
Description	Water management for re-development of Airds Bradbury	
Client Contact	Dajon Veldman, Urbis, Paul Hourigan/Wayne Colman/Craig Smith - Landcom	

	Name	Signature	Iss	Date
Prepared by	Mal Brown, Dov Ben-Avraham, David Stone/Gerard Edwards		B	17/3/11
Checked by	Mal Brown	Malcolm Brown		
Issued by	Mal Brown	Malcolm Brown		
Filename	X:\1049 Airds Bradbury WCM Plan\Reports\1049_Airds_Bradbury_WCM_v2D.docx			

Document History

	Issue A		Issue B		Issue C	
Issue to:	Date	No. Copies	Date	No. Copies	Date	No. Copies
Amy Bendall	17/1/11	PDF				
Wayne Colman	17/1/11	PDF				
Dajon Veldman			17/3/11	PDF		
Paul Hourigan			17/3/11	PDF		
Craig Smith			17/3/11	PDF		
Wayne Colman			17/3/11	PDF		

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1. Background and Context

STORM_CONSULTING (STORM) was commissioned to prepare a Water Cycle Management (WCM) plan, including flooding analysis, for the redevelopment of the Airds Bradbury public housing area in south-western Sydney.

This background report has been prepared in support of a Part 3A (Concept Plan) application for the site. STORM's report focuses on Water Cycle Management (WCM) with a primary focus on stormwater and drainage with the integration of Water Sensitive Urban Design (WSUD) principles and approaches.

1.2. Understanding of Project Scope

Airds and Bradbury combined comprise approximately 1450 public housing residences constructed in the 1970s. Housing NSW has been working with stakeholders and the community on a Community Renewal Strategy and now a Masterplan is required to rationalise land use and to provide better social outcomes for the community.

The study area comprises the Smiths Creek Bypass Corridor land (the abandoned corridor which separates Airds and Bradbury and is no longer required for transport related purposes), the existing Airds and Bradbury public housing estates and Airds Town Centre.

1.3. Proposed Development

As a result of the preliminary opportunities and constraints studies and an Enquiry By Design (EBD) workshop, a preferred masterplan option has been developed (refer **Appendix A**).

Key features of the masterplan include:

- Redevelopment of existing townhouse precincts;
- Development of greenfield Department of Housing/Landcom land, predominantly within:
  - Smith's Creek Bypass Corridor
  - Baden Powell Reserve
  - Adjacent to Georges River Road
- Rationalised open space areas;
- Maintain existing pond in front of community centre; and
- New sporting fields in the Smiths Creek Bypass Corridor.

2.0 SITE INVESTIGATIONS AND BACKGROUND REVIEW

2.1. Site Inspection Observations

A site inspection was undertaken by two of STORM's engineers on the 14th January 2010. The aim of the site inspection was to identify physical features of the site that would assist or limit water cycle management.

The photographs below show the main features that were identified.

	Site Investigation Photographs
Smiths Creek	  Upper (Downstream of Creigan Rd) Mid (Upstream of College Rd)  Lower (Upstream of Georges River Rd culvert)
Water Quality Improvement Measures	  Gross Pollutant Trap Screen

	 Dam/Wetland
Drainage Infrastructure	  Inlet structures in Dorchester Park Outlet structures   Creigan Rd overland flowpath Inlet pits
Typical Street Configurations	 

Current development	

Potential opportunities include:

- Optimising or relocating the existing dam/wetland for water quality improvement and/or stormwater harvesting.
- Existing GPTs could be reconfigured/optimised. (Council have indicated that maintenance access is problematic in some cases). Also potential for more GPTs at strategic locations.
- Water quality measures (e.g.; raingardens/bioretention) could be incorporated into existing street configurations.
- Stormwater harvesting could provide water for playing field and open space irrigation
- Community education could be provided to increase the sense of ownership of water quality measures.

A number of issues of concern were found during the site investigation and include:

- Smiths Creek – currently subject to erosion which has potential to be exacerbated by increased peak flows or flow volumes from the proposed development. The corridor also has significant weed infestations that limit biodiversity.
- Lack of maintenance of existing water quality treatment measures, Council's capacity to maintain future treatment measures proposed (e.g. wetlands, bioretention, additional GPTs).
- Council's capacity to operate and maintain a stormwater harvesting scheme.
- New development occurring in areas earmarked for re-development in the Masterplan. It is noted that BASIX requirements would be mandatory on these current developments, but it is unknown whether water quality treatment measures have been included on these developments.
- Overland flow paths (particularly towards the southern end of Dorchester Park) need to be provided through areas of potential development.

2.2. Summary of Background Information

2.2.1. Background Information

The following reports and documentation were reviewed by STORM:

- Campbelltown Council (2009). Campbelltown (Sustainable City) Development Control Plan 2009 Volume 2 Engineering Design for Development.
- GeoEnviro Consultancy (April 2009). Preliminary Geotechnical Investigation and Dam Embankment Investigation – Airds and Bradbury Redevelopment Project.
- Landcom (2009). Draft Water Sensitive Urban Design Book 1 - Policy

- Landcom (2009). Draft Water Sensitive Urban Design Book 2 – Planning and Management
- LFA (April 2004). Proposed Masterplan from Airds Neighbourhood Renewal Masterplan Study
- Patterson, Britton and Partners (August 2001). Airds Town Centre Masterplan – Infrastructure Investigations

2.2.2. Soils / Geology / Geotechnical

A geotechnical investigation was previously undertaken by GeoEnviro Consultancy (April 2009). The aim of the investigation was to obtain information on subsurface ground conditions and based on the information obtained, to provide preliminary comments and recommendations on geotechnical and salinity issues considered relevant to the proposed redevelopment of the site. A summary of the findings of the investigation is presented below:

- Sixty seven test pits were excavated around the masterplan area.
- The site is generally underlain by thin topsoil/fill and fill overlying residual clays overlying bedrock. The upper bedrock unit comprises of Ashfield Shale and the lower bedrock unit comprises of Hawkesbury Sandstone.
- The laboratory test results indicate the natural clay to be plastic and generally moderately reactive and non to slightly saline with localised moderately saline soil at lower depths. The topsoil was generally assessed to be non to slightly saline. It was noted that the relatively highly saline soils encountered at near surface in two test pits (TP 29 and TP 56) which were likely to be derived from landscaping activities (e.g. fertilizers) and noted that these soils are likely to be present in localised areas. Moderately to highly saline soil may affect yields of some plants. Future landscaping of the proposed development should incorporate planting of salt-tolerant plants. Saline soils can also affect buildings, e.g. attack of concrete foundations, however it is thought the limited extent of highly saline soils and the fact that soils will be subject to earthworks will limit the potential for this occurrence.
- Soil salinity is not considered significant within the site. However, future redevelopment of the site should include the following salinity management strategies including:
  - Avoid exposure and disturbance of dispersive soil found at lower depths. In general excavation should be kept less than 1.0m if possible. Deeper excavations in excess of 1.0m should be covered and retained by retaining walls.
  - Appropriate batter slopes for excavations should be adopted to prevent erosion and scouring. Under good drainage conditions, the following batter slopes may be adopted;

Material Recommended	**Minimum Batter Slopes**
In situ Fill (Poorly compacted)	3 Horizontal : 1 Vertical
Compacted Fill	2 Horizontal : 1 Vertical
Very stiff residual clay	2 Horizontal : 1 Vertical
Weathered Shale/Sandstone	0.5 Horizontal : 1 Vertical

  - All cut and fill batters should be stabilised by planting with appropriate plant species as soon as practicable after construction. Sprayed-on mulch may be applied to protect bare ground surfaces.
- Acid sulphate soil was not encountered in the investigation and is not considered to impact on the proposed redevelopment of the site.

- The site was assessed to have low to moderate erodibility.
- The investigation identified no major geotechnical constraints on the site. The dam (located south-west of the Community and Indoor Sports Centre) embankment of interest was considered inadequate and total reconstruction of the embankment was recommended.

2.2.3. Existing Services

Mott McDonald Hughes Trueman prepared an Infrastructure Report for the Airds Bradbury Renewal Project (March 2011). In that report, the key items and issues affecting water cycle management are as follows:

- Temporary stormwater management arrangements will need to be made during the staged development
- All Waterbodies and stormwater management facilities may need to be sealed to protect against the effects of soil salinity.

Patterson Britton (April 2001) previously investigated potential infrastructure constraints and opportunities (including stormwater drainage, water supply, sewer, gas and telecommunications) for the Airds Town Centre Masterplan. Note: the Town Centre Masterplan was a limited concept and did not cover the current area of investigation for the Airds Bradbury Masterplan. In relation to this water cycle management study, the following points were noted in relation to stormwater and flooding:

- The existing major flow path runs along Creigan Road into a manmade channel which becomes Smith's Creek. A catchment area of 96.6 Ha drains to this point at the end of Creigan Road.
- The majority of the study area forms part of the major catchment for the upstream region of Smiths Creek which drains to Georges River.
- A portion of the study area drains to a major flow path along Georges River Road which discharges directly to Smiths Creek.
- Approximately 8.2 Ha drains to the existing pond which ultimately drains to Creigan Road along a minor drainage path between houses.
- a 10m wide services easement running north-south along the Smith Creek drainage corridor, between Creigan Road and Riverside Drive will influence planning and development.
- Existing Council stormwater infrastructure in the area is based upon a minor and major flow philosophy with a piped network catering for low flows, and overland flow paths for higher event flows.
- Sydney Water has no stormwater infrastructure within the study area.
- It is also noted from Patterson Britton's report that a "green drainage corridor has been provided for Smiths Creek, and runs in a north/south direction. However, in the study area above Briar Road, this corridor does not coincide with the low point and major drainage path along Creigan Road. This has significant implications for future development, with potential for flood inundation, safety problems, and constraints for water quality management".

2.2.4. Stakeholder requirements

Campbelltown City Council

STORM and Landcom attended a meeting with Campbelltown City Council on 5 March 2010 and have further liaised to discuss Council's requirements with respect to water cycle management and flooding. Council has indicated the following:

- Long-standing drainage issues noted at Kullaroo Avenue, Bradbury – there is a need to intercept the flow to the existing private homes.
- Riparian corridor – some scour protection and weed management/re-plantings may be required;
- Centralised detention is preferred from a maintenance perspective. Any natural features must not require renewal within 5 years (ideally 10 years). Council will require an Operation and Maintenance Manual to be provided during handover covering specific water quality treatment measures including, but not limited to access issues;
- Maximisation of water quality opportunities - given the Masterplan covers an existing development area, there is flexibility in establishing firm water quality targets;
- Existing dam wall and stability issues – need to refer to current geotechnical investigations;
- Council are seeking improved performance of existing GPTs along the eastern boundary of the site. The existing GPTs are subject to several issues such as vandalism, sandy soils and poor access for maintenance.
- Stormwater flows need to be established along the Smiths Creek corridor (including Kullaroo Avenue). In other areas of the Masterplan, the design will need to justify that flows leaving the site, particularly towards Georges River Road, will not be greater than existing flows and therefore any existing capacity problems will not be any worse than currently is the case.
- Stormwater harvesting and reuse for playing fields need to be considered. Council are open to potential relocation of sporting fields to enable stormwater harvesting to occur. In addition, the relocation of the existing dam is negotiable, but also subject to geotechnical considerations.

2.3. Planning and Policy context

It is noted that the Masterplan will be submitted as a Part 3a Concept Plan application to NSW Planning.

2.3.1. Landcom WSUD Policy (draft)

Under Landcom's draft Water Sensitive Urban Design Policy, baseline and performance targets relating to a WSUD strategy, water conservation, pollution control and flow management have been identified for new developments as shown over.

OBJECTIVE		BASELINE AND PERFORMANCE TARGET	STRETCH TARGET
1	WSUD Strategy	(a) 100% of projects to have project-specific WSUD strategies.	
2	Water Conservation	Combination of water efficiency and reuse options – % reduction on base case.	
		(a) Single dwelling, no reticulated supply available: Baseline 40 % Performance 50+ %	Stretch 65 %
		(b) Single dwelling, reticulated supply available: Baseline 50 % Performance 65 %	Stretch 75+ %
		(c) Apartment, no reticulated supply available: Baseline 40 % Performance 50 %	Stretch 60+ %
3	Pollution Control	(a) 45% reduction in the mean annual load of Total Nitrogen (TN). (b) 65% reduction in the mean annual load of Total Phosphorus (TP). (c) 85% reduction in the mean annual load of Total Suspended Solids (TSS).	(a) 65% reduction in the mean annual load of Total Nitrogen (TN). (b) 85% reduction in the mean annual load of Total Phosphorus (TP). (c) 90% reduction in the mean annual load of Total Suspended Solids (TSS).
4	Flow Management	Maintain 1.5 year ARI peak discharge to pre-development magnitude Stream Erosion Index = 2.0	Maintain 1.5 year ARI peak discharge to pre-development magnitude Stream Erosion Index = 1.0

With respect to this project, any new development (i.e. Greenfield development along the Smiths Creek corridor) will be subject to (at a minimum) the baseline and performance target identified above.

Redevelopment of the twelve townhouse precincts will be undertaken as part of the Concept Plan. The redeveloped area will be subject to BASIX for water conservation, which is 40% potable demand savings for a single dwelling.

Preliminary discussions with Council have suggested that the performance targets to be achieved are subjective and subject to further negotiation following analysis of the WCM plan.

2.3.2. Campbelltown City Council Requirements

Stormwater Quantity

- As outlined in Councils DCP: *Campbelltown (Sustainable City) Development Control Plan 2009 – Volume 2 Engineering Design for Development*
- Council indicated HEC-RAS modelling would be required for Smiths Creek, and DRAINS modelling required for Smiths Creek Corridor upstream of the natural creek zone
- DRAINS modelling is not required for other areas – however, confirmation that there will be no increase in flows is required and therefore the existing system will not be made any worse
- Impacts of development on the creek will need to be considered (i.e. increased frequency of flows leading to increased erosivity).

Stormwater Quality

- Refer to Section 3.4.1.1.

3.0 WATER CYCLE MANAGEMENT

3.1. Principles

The key principles associated with Water Cycle Management in an urban development context, are as follows:

- Water Cycle elements function in an integrated manner to provide a wide range of benefits
- At source controls to be employed where practical, i.e. at the lot and street level. This confers benefits downstream
- Provide an outcome which protects or enhances existing environmental and social values
- Look to provide source substitution of water where practical
- Maintain or enhance amenity, including flooding, aesthetics, recreation, etc.

In an urban retrofit situation where Water Cycle elements are chosen, there are considerable constraints to manage which can prevent the ultimate achievement of some of these principles. The options that have been selected take the best advantage of the opportunities and constraints available on the site.

The Landcom WSUD Guidelines provide guidance of how these principles can be implemented.

3.2. Water Cycle options

Three water cycle options have been thoroughly investigated using a combination of modelling and other analysis and they are described and shown below. Common to each Option are the following elements:

- Rain tanks on each lot plumbed in for non-potable use
- GPTs proposed in strategic locations
- Bioretention devices in each sub catchment
- Stormwater harvesting considered for the proposed new playing fields
- Smiths Creek restoration/rehabilitation including erosion controls, weed removal and revegetation

The preferred option is Option1, as discussed in Section 3.3.

3.2.1. Option 1: detention in Smiths Creek corridor

Water Cycle Option 1 (Figure 3-1) has the following features:

- Retention of the wetland/pond in current location, with landscaping and hydraulic enhancements
- Detention of flood flows in the Smiths Creek riparian corridor upstream of Georges River Road

The major benefits of Option 1 are that the pond and riparian corridor are retained which will enhance social and biodiversity outcomes associated with these features.

A constraint of Option 1 is that the highest flood waters will be detained above the height of Georges River Road and can spill across the road. Note that existing flood waters also flow across Georges River Road.

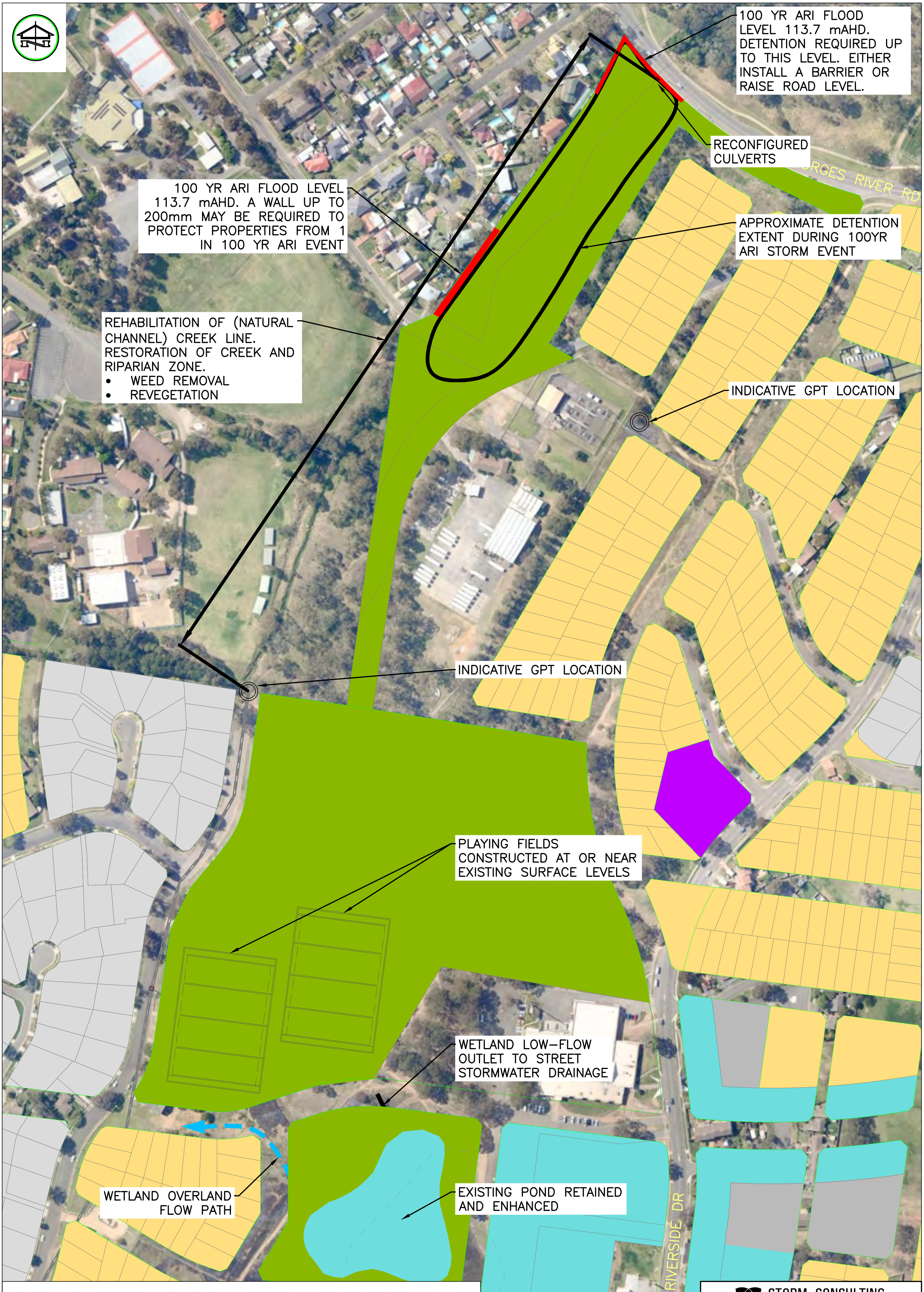


FIGURE 3–1: PREFERRED WATER CYCLE OPTION

3.2.2. Option 2: detention in western playing field

Water Cycle Option 2 has the following features:

- Retention of the wetland/pond in current location, with landscaping and hydraulic enhancements
- Detention of flood flows in the proposed western playing field within the Smiths Creek riparian corridor

The major benefit of Option 2 is that the pond is retained which will maintain biodiversity and social outcomes associated with the pond.

There are significant hydraulic constraints on using the western playing field for detention purposes. It needs to be excavated into the landscape by up to 3m. With side slopes of 1V:4-6H, there is only enough room for one playing field, unless retaining walls are used (Figure 3-2). This is a poor social and amenity outcome, and some riparian vegetation will also be lost as a result of the extensive excavation required.

- Western (LHS) playing field is also a retention basin.
- Basin has 1:6 side slopes on the North, South and Western sides, 1:4 side slopes on the Eastern side where elevation is greater.
- Basin base area of 100 x 70 = 7000m^2 and top area of 106 x 120 = 12,720 m^2.

Figure 3-2: Configuration of detention within the western playing field

3.2.3. Option 3: Detention in relocated pond

Water Cycle Option 3 has the following features:

- Placing the two proposed playing fields where the pond currently is currently located
- Placing a new wetland/pond in the upper extent of the Smiths Creek riparian corridor , with landscaping and hydraulic enhancements
- Detention of flood flows either
  - Above the pond within the Smiths Creek riparian corridor (meaning that the pond has to be excavated into the riparian landscape, see Figure 3-3), or
  - Detention of flood flows in the riparian corridor upstream of Georges River Road (meaning that the pond can be installed with minimal excavation, or
  - A combination of both

The major benefit of Option 3 is that the pond can be enhanced for social and environmental outcomes in a new location. There is a secondary benefit that the detention option is flexible.

The major constraint of Option 3 is that stakeholders are unlikely to accept relocation of the pond to a new location.

- The western (LHS) playing field is replaced by a pond
- Ponding to occur to a depth of 0.5m.
- Basin has 1:6 side slopes on the North, South and Western basin sides, 1:4 side slopes on the Eastern side where elevation is greater.
- Basin base area of 40 x 75 = 3000m^2 and top area of 80 x 122 = 9600 m^2.

Figure 3-3: Pond in new location combined with detention

3.3. Preferred water cycle option

Option 1: Detention in the Smiths Creek Corridor is the preferred option. It provides the best balance of engineering, social and environmental outcomes. It means that the pond can be kept in its current general location, and the playing fields can be installed at existing ground surface levels with no need for extensive excavation. Flooding is effectively contained within the Smiths Creek corridor without any enhanced risk to life or property

Option 2: Detention in the western playing field requires the playing field to be excavated deep into the landscape and in order to be able to construct both playing fields, they would need to be separated by a retaining wall. In addition, the depth of excavation will mean that more EEC forested land would be lost. This is a very poor social and environmental outcome and this Option is not preferred for those reasons.

Option 3: Detention in relocated pond is proposed on the assumption that relocation of the pond is feasible. It is technically feasible and provides a good environmental outcome, but on cultural and social grounds, it is not considered feasible. Therefore this Option is not preferred.

3.4. Water quality approach

Opportunities for water quality management exist throughout the development and include a range of integrated components which together work to protect downstream ecosystems (water quality and quantity), reduce potable water demand, and enhance amenity and wellbeing for the community.

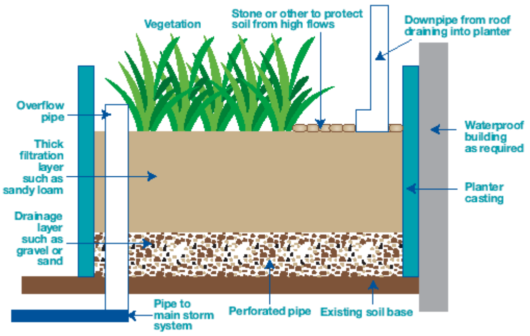
Five levels of water quality improvement and stormwater/rainwater harvesting have been considered for use throughout the Masterplan site:

1. At source controls such as rain tanks and lot-based measures;
2. Linear systems along road alignments, such as swales and bioretention filters;
3. Small "pocket" type systems such as raingardens (small scale bioretention) or small pond/wetland systems, generally at key points along road reserves or in open space such as riparian areas, or parks;
4. Gross pollutant traps
5. End-of-line (precinct scale) type system such as ponds/wetlands, bioretention basins and stormwater harvesting schemes located at the subdivision catchment level.

Examples of these systems are shown in **Table 3-1** and discussed further in the following sections.

Table 3-1: Treatment and Rainwater Harvesting Examples

<table>
<tr><th>System Type</th><th>Examples</th></tr>
<tr><td>Source controls, rainwater tanks (above ground or underground) and rain gardens or absorption trenches</td><td>



</td></tr>
<tr><td>Linear systems
(bioretention trenches along roads)</td><td>


</td></tr>
<tr><td>Pocket type systems
(bioretention areas where road reserve allows)</td><td>


</td></tr>
</table>

End of Line Systems (wetlands and filter systems, the lower photo is of a sand filter that surcharges)	  

3.4.1. Water quality modelling

3.4.1.1. Objectives

The Airds Bradbury renewal project involves the redevelopment of existing residential areas and new development of open space. For development of open space, there is a need to comply with water quality benchmarks.

The following water quality benchmarks are taken from Landcom's *Draft Water Sensitive Urban Design Guidelines*. It should be noted that these targets go beyond Council's requirements as summarised in **Table 3-2**.

Table 3-2 Stormwater Treatment Targets Summary

Pollutant	Council Targets*	Landcom Targets*
Total Suspended Solids (TSS)	80%	85%
Total Phosphorus (TP)	45%	65%
Total Nitrogen (TN)	45%	45%

*Values are expressed as the percent reduction in mean annual loads generated by the development

Improvements to water quality to achieve these targets will be achieved with the installation and maintenance of a range of treatment measures as discussed further below.

In addition, Council also requires that the following general objectives be applied:

- A 'treatment train' approach be used;
- Consideration be given to local and site conditions;

- Designs must be functional and aesthetically pleasing; and
- Maintenance must be considered.

3.4.1.2. Treatment Train and Modelling Process

A number of treatment trains were considered and modelled to simulate the effectiveness of varying treatment measures in reducing the pollutant loads associated with new development.

The treatment train incorporated rainwater tanks (RWTs) and combinations of Gross Pollutant Traps (GPTs), bioretention systems and wetlands (Rainwater tanks are considered to be an effective treatment measure by reducing the quantity of runoff and, by association, removing pollutants).

While wetlands are generally better suited to the precinct scale, bioretention systems are easily scaled to be either source controls or end-of-line basins. In addition, bioretention systems have higher treatment rates per unit area, and so require less land take.

The modelling has been undertaken on a representative 2.8 Ha catchment. The results for bioretention systems are able to be roughly scaled to suit the ultimate catchment size. Wetlands are not so easily scaled and may require further modelling, particularly if they are to be applied at a small scale.

Several scenarios were modelled in order to assess the performance of various treatment configurations, namely;

- Treatment Train 1 – RWT + Bioretention System
- Treatment Train 2 – RWT + GPT + Bioretention System
- Treatment Train 3 – RWT + Wetland
- Treatment Train 4 – RWT + GPT + Wetland

Configuration of the MUSIC model is shown in **Figure 3-4** below.

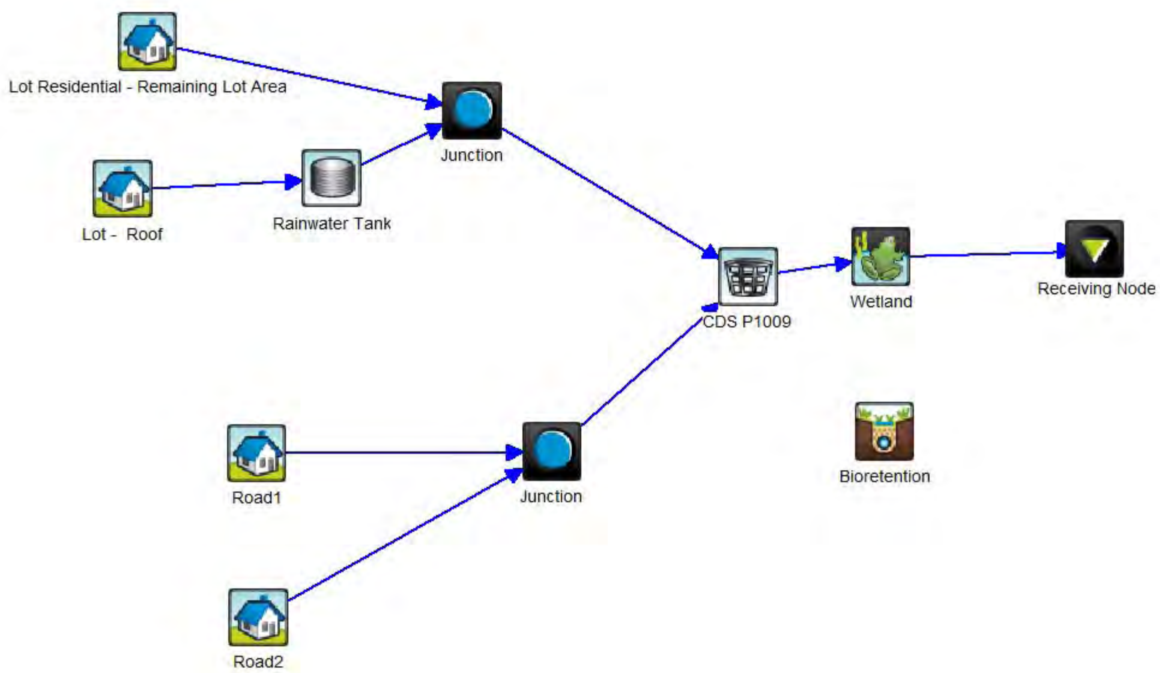


Figure 3-4: MUSIC Model Layout

3.4.1.3. Model Inputs

Model Inputs were selected in accordance with the *Draft NSW MUSIC Modelling Guidelines* (SMCMA, 2010). A total catchment area of 2.8 ha was modelled.

Meteorological Data

Continuous rainfall data was obtained from the Bureau of Meteorology (BOM) for Sydney Observatory Hill (BOM station #66062). As suggested by the MUSIC Guidelines, Meteorological data from 05/011962 to 31/12/1966 (average rainfall conditions) was used in the model in an attempt to gain typical climatic conditions of the sites.

The MUSIC User Guide (CRCCH, 2005) suggests that the time-step should not be greater than the time of concentration of the smallest sub catchment, but consideration should also be given to the smallest detention time of treatment nodes in the system. To accurately model the performance of the treatment nodes, a 6-minute time step was chosen.

Soil Properties

The MUSIC model uses an impervious store, pervious store and groundwater store to calculate surface runoff and base flow (interflow). Soil properties used in the model were typical values used for a 'Silty Clay'- the dominant soil material identified in the geotechnical report by GeoEnviro.

The parameters used include:

- Soil Storage Capacity = 54 mm
- Field Capacity = 30mm
- Infiltration Capacity Coefficient 'a' = 180
- Infiltration Capacity Exponent 'b' = 3.0

Event Mean Concentrations

The default MUSIC Event Mean Concentration (EMC) values have been adjusted to reflect more recent data available by Fletcher (2004) which are currently recommended for use by the Sydney Catchment Authority (Draft NSW MUSIC Guidelines, 2009). The parameter concentrations adopted are shown in **Table 3-3**.

Table 3-3: Event Mean Concentrations

Land use	TSS		TP		TN	
	Dry weather concentration (mg/L)	Wet weather concentration (mg/L)	Dry weather concentration (mg/L)	Wet weather concentration (mg/L)	Dry weather concentration (mg/L)	Wet weather concentration (mg/L)
Residential	15.8	141	0.141	0.251	1.29	2
Sealed Roads	n/a	269	n/a	0.501	n/a	2.19

Fletcher, T., Duncan, H., Poelsma, P. & Lloyd, S. (CRCCH, 2004)

Treatment Measures

The proposed treatment measures include:

- 3 kL rainwater tanks (*Technical Review and Development of Specification for Rainwater Tanks and Associated Infrastructure* STORM CONSULTING October 2009 states minimum 2kL per dwelling across all housing types) for standard lots to capture roof water from 80% of roof areas, with a proposed reuse for toilet, laundry and irrigation purposes;
- To simplify the model the source catchments and rainwater tanks proposed for each dwelling were aggregated into one centralised node;

- Treatment levels for a typical CDS type GPT were used (refer **Table 3-4**);

Table 3-4: GPT (CDS) Treatment Efficiency

	CDS P1009
Treatable Flow, L/s *(Manufacturer information)*	100
Total Suspended Solids removal	70%
Total Phosphorus removal	30%
Gross Pollutants removal	98%

- Two treatment alternatives; a bioretention system and wetland were tested for treatment of all road reserve runoff and excess lot based runoff (i.e. runoff not captured by rainwater tanks). Bioretention systems were assumed to have a filter media depth of 500mm, hydraulic conductivity of 200mm/hr and a seepage rate of 0.36 mm/hr into the underlying soil.

3.4.1.4. Results

The size required to meet Landcom's water quality targets for each treatment measure and treatment train scenario is summarised in **Table 3-5**, both for the modelled 2.8 Ha catchment and as a unit rate per hectare of development. The subsequent tables summarise the performance of each treatment train.

Table 3-5: Treatment Measure Sizing

Treatment Train		Surface Area (m^2)	Surface Area (m^2/Ha of new development)
1	Bioretention	165	59
2	Bioretention + GPT	130	46
3	Wetland	1402	500
4	Wetland + GPT	643	230

Table 3-6: Pollutant Load Reductions for Treatment Train 1

Parameter	A Post-Development Results (without treatment controls)	B Post-Development Results (with treatment controls)	% Reduction ((A-B)/A)*100	Target % Reduction
Flow (ML/yr)	14.6	11.3	22.4	
TSS (kg/yr)	3150	467	85.2	85
TP (kg/yr)	5.58	1.54	72.4	65
TN (kg/yr)	33.3	17	48.9	45
Gross Pollutants	347	0	100	