Cooranbong Town Common
Freemans Drive, Cooranbong

Stormwater Management Plan

Rezoning Proposal: Proposed Recreation and Community Facilities (in association with North Cooranbong Residential Development Precinct)

Issued: August 2007

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Johnson Property Group Pty Ltd

Issue	Description of Amendment	Prepared by (date)	Verified by (date)	Approved by (date)
1	Issued For Review	SWA (26.6.07)	BGP (28.6.07)	BGP (28.6.07)
2	Final	SWA (30.7.07)	BGP (30.7.07)	BGP (31.7.07)
3	Revised	KM (21/8/07)	BGP (21/8/07)	BGP (21/8/07)

Issue No. 3

Note:

This document is preliminary unless it is approved by principal of Patterson Britton & Partners.

Document Reference: Rp6946swa070723_Cooranbong TC SWMP I2.doc

Time and date printed: 21/08/2007 5:05 PM

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Table of Contents

LIST OF TABLES

EXECUTIVE SUMMARY

As part of the proposed North Cooranbong residential development precinct, Lake Macquarie City Council (Council) and Johnson Property Group (JPG) have negotiated additional land, informally referred to as the Cooranbong Town Common land, that is targeted for the provision of certain off-site recreation and community facilities associated with the residential rezoning of the North Cooranbong proposal.

It is anticipated that the community facilities will consist of a neighbourhood park, sports ground, multi-purpose courts, an amenities/club house building and associated roads, car parking and infrastructure to service the development.

To allow the recreation and community facilities to be established at the Cooranbong Town Common site, Council must first re-zone the land.

In consultation with Council staff, JPG engaged Patterson Britton and Partners (*PatBrit*) to prepare a Stormwater Management Plan suitable for a rezoning application for the proposed recreation and community facility. This report outlines the principles and design strategies to be adopted in order to service the proposed development with suitable stormwater infrastructure.

This report will be submitted to Council to demonstrate that the site is suitable for a recreational and community facility and that the proposed development is able to meet current best practice stormwater management.

In order to adhere to Council's DCP requirements the following key stormwater objectives were adopted:-

1. Incorporate (*where practical*) the principles of water sensitive urban design;
2. Ensure a Site Discharge Index of less than 0.1 is achieved;
3. Ensure the proposed development is able to maintain pre-developed stormwater pollutant export loads; and
4. Mitigate the runoff of chemicals/fertilisers (*associated with the sporting complex*) to provide no impact on Dora Creek through the appropriate design and management of the development and associated stormwater controls.

Hydrologic assessment of the site determine that the key infrastructure that will need to be incorporated into the development to deliver these objectives include:

1. Rainwater tank to collect runoff from the clubhouse;
2. Vegetated swales to convey stormwater and provide pre-treatment upstream of bio-retention swales and wetlands (*approximate length 340m*);
3. Vegetated bio-retention swales to filter stormwater prior to entering wetlands (*approximate length 210m*);

4. Compensation wetland area of 770m^2 (*0.5m* deep) to replace wetland area lost to sports field; and
5. Additional wetland area of 390m^2 (*0.5m deep*) to polish stormwater and provide additional storage to compensate for an increase in stormwater runoff resulting from the impervious area of the development.

This report also discusses operation and management considerations required by the proposed stormwater management controls (*as outlined in **Section 7**).*

The impact of Regional Flooding considerations on the proposed management plan were also considered, with the Dora Creek Floodplain Management Study (*1998*) determining that the 100 year flood level would inundate the site by approximately 1-3 metres. As such it is recommended that all construction be made of flood-proof materials and that adequate consideration given to the formulation of an evacuation plan.

It is recommended that a suitable evacuation route is available (Martinsville Road) to the Cooranbong Community Primary School on Government Road. It was also noted that as the facility will be used for active purposes, the public would require little warning time to evacuate the site.

1 INTRODUCTION

Lake Macquarie City Council is currently processing a rezoning proposal known as the North Cooranbong Residential Development precinct (LMLEP 2004 – Amendment 27) for approximately 35ha of land within and around the old Avondale Airport site at Cooranbong.

Development of the site is envisaged to yield in the order of 2,000 lots including low density residential (the majority of the development), medium density residential, commercial, some open space and a major school.

As part of the proposed North Cooranbong residential development precinct, Lake Macquarie City Council (Council) and Johnson Property Group (JPG) have negotiated additional land, informally referred to as the Cooranbong Town Common land, that is targeted for the provision of certain off-site recreation and community facilities associated with the residential rezoning of the North Cooranbong proposal.

To allow the recreation and community facilities to be established at the Cooranbong Town Common site, Council must first re-zone the land.

In consultation with Council staff, JPG engaged Patterson Britton and Partners (*PatBrit*) to prepare a Stormwater Management Plan suitable for a rezoning application for the proposed recreation and community facility. This report outlines the principles and design strategies to be adopted in order to service the proposed development with suitable stormwater infrastructure.

This report will be submitted to Council to demonstrate that the site is suitable for a recreational and community facility and that the proposed development is able to meet current best practice stormwater management.

2 SITE DESCRIPTION

The site of the proposed Cooranbong Town Common Recreation and Community Facility is approximately 14 hectares in area and is generally bounded to the south by Martinsville Road, to the east by Freemans Drive, to the north by Dora Creek and to the west by land zoned 1(*2*) Rural (*living*).

The site comprises: -

- Lot 2, DP 517245;
- Lot 34, DP 736908; and
- Part Babers Road (*unformed*).

The current land use of the site is a combination of existing community area (*including picnic areas, playground, informal netball court and performance facility located on the eastern portion of the site*) and vacant grazing land (*western portion of site*). The site is generally open with scattered vegetation which becomes denser along an internal watercourse. Surrounding land uses include the existing township of Cooranbong, SES and fire brigade, church and cemetery, Avondale Retirement Village, Cooranbong Recreation and Equestrian Reserve and rural land.

Topographically, the site has a slight grade towards Dora Creek at the site's northern boundary. Much of the site sits between RL 5m to 6m AHD, with a rise to approximately RL 9m AHD at Martinsville Road near the southern boundary.

A site plan with contours extracted from the 1988 1:4000 series Cooranbong orthophotomap (*U3635*-6) is shown as **Figure 1**.

3 PROPOSED DEVELOPMENT

Council and JPG have agreed to develop the Cooranbong Town Common site in order to establish an additional local recreation and community facility. Facilities proposed to be incorporated into the development include: -

- Neighbourhood park (*play equipment, music bowl, picnic facilities*);
- Sports ground (*as combined AFL and two senior sports fields*);
- 1 x Cricket wicket;
- 2 x multi-purpose courts;
- Amenities / Club house; and
- Associated roads, car parking and infrastructure to service the development.

The proposed plan of the recreation and community facility is shown as **Figure 2**.

4 STORMWATER ASSESSMENT

4.1 INTRODUCTION

A Stormwater Management Plan (*SWMP*) has been developed in support of the proposed rezoning proposal. The SWMP implements a water sensitive design which would be integrated with the facility to provide the required stormwater management benefits.

This section describes the stormwater management philosophies adopted for the proposed development and outlines a conceptual stormwater design. Stormwater controls have been quantitatively assessed to establish the likely stormwater constraints on the proposed development.

4.2 GENERAL NOTE ON LMCC DCP 1

LMCC (*2006*) adopted the '*Lake Macquarie Development Control Plan No.1 – Principles of Development (revision 1*)' in order to provide detailed guidance for development within the Lake Macquarie LGA.

Section 2.5.3 of DCP 1 outlines Council's requirements with regard to stormwater management. The intent of Section 2.5.3 is to protect receiving waters from increased water-borne pollutants and increased stormwater flows. The stormwater management strategy proposed for the site is able to meet these requirements by adopting the stormwater performance objectives as outlined in **Section 4.3** of this report.

Section 2.5.4 of DCP 1 outlines Council's requirements for on-site stormwater harvesting. The intent of Section 2.5.4 is to maximise stormwater reuse and to prevent increases in stormwater discharge from impacting on downstream areas. Typically Section 2.5.4 recommends the adoption of rainwater tanks to provide stormwater reuse and controls such as porous pavement and retention trenches to protect downstream areas from increased stormwater discharge. A performance measure of the adopted on-site controls is the Site Discharge Index (*SDI*) which represents the proportion of impermeable surface that discharges directly to the downstream drainage system. Council has adopted a SDI objective of 0.1 (*meaning 10% of a lot's impervious area can be discharged directly to the drainage system*). The proposed development is estimated to have an impervious area of approximately 5%. Given this, the development would appear to satisfy Section 2.5.4 of DCP 1.

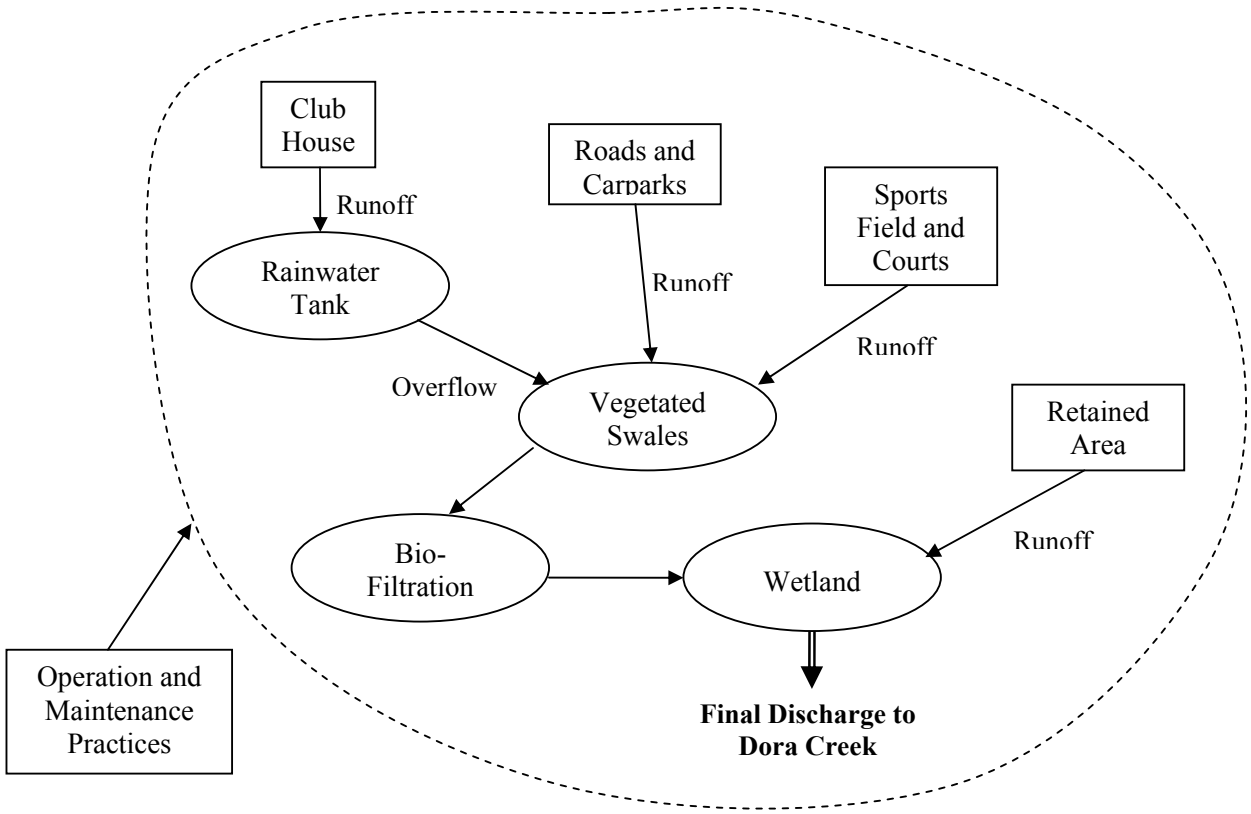
4.3 STORMWATER PERFORMANCE OBJECTIVES

In order to adhere to Council's DCP requirements (*refer **Section 4.2***), the following key stormwater objectives were adopted for the proposed SWMP:-

5. Incorporate (*where practical*) the principles of water sensitive urban design;
6. Ensure a Site Discharge Index of less than 0.1 is achieved;
7. Ensure the proposed development is able to maintain pre-developed stormwater pollutant export loads; and
8. Mitigate the runoff of chemicals/fertilisers (*associated with the sporting complex*) to provide no impact on Dora Creek through the appropriate design and management of the development and associated stormwater controls.

4.4 STORMWATER MANAGEMENT PLAN

The proposed SWMP would incorporate a water sensitive design, which would adopt a stormwater 'treatment train' philosophy. A schematic representation of the indicative stormwater management arrangement is shown below.



The stormwater management controls proposed for the Cooranbong Town Common site have been selected to address the stormwater management objectives outlined in **Section 4.3**. The proposed stormwater management controls include:-

a) Source Controls: -
   - Limiting directly connected impervious areas to less than 10% of the site area; and
   - Connect clubhouse to rainwater tank for re-use.

b) Conveyance Controls: -
   - Vegetated swales to convey and pretreat stormwater prior to further treatment (*capture coarse sediment and provide minor nutrient removal*).

c) End of Line Controls: -
   - Bio-retention swales to filter stormwater and remove nutrients prior to entering the retained wetlands (*due to potential acid sulphate soils, the need, if any, for an impermeable liner should be assessed at the detailed design stage*);
   - Retention of existing freshwater wetlands and construction of additional wetland area. The wetland system will continue to operate as existing and will further polish stormwater prior to infiltration, evapotranspiration and overflow to Dora Creek.

d) Management Controls: -
   - Limiting directly connected impervious areas to less than 10% of the site area;
   - Management of ongoing operation and maintenance in an environmentally sensitive approach (*this is further discussed in **Section 7***).

4.5 HYDROLOGIC ASSESSMENT

This section outlines the hydrologic assessment undertaken for both existing and post-development catchment conditions for the site, including:-

- a description of the rainfall / runoff modelling undertaken for the site;
- a presentation of peak pre and post development flows; and
- an analysis of onsite detention / retention requirements.

4.5.1 Hydrologic Objectives

The following hydrologic objectives have been determined based on the requirements of LMCC DCP 1 and Australian Rainfall and Runoff (*IEAust, 1987*): -

- Reduce post development peak discharges to existing levels for all storm events up to the 2 year ARI rainfall event. It is considered that detention of higher recurrence interval events would provide no benefit to downstream properties, as the site is inundated by Dora Creek during events in excess of the 50 year storm ; and

- Provide overland flow paths to allow for stormwater conveyance during major flood events without damaging property or endangering the public.

4.5.2 RAFTS Hydrologic Model

RAFTS is a non-linear rainfall/runoff program developed by XP Software. RAFTS can be used to estimate peak flows and volumes for catchments, using design rainfall data derived from Australian Rainfall & Runoff (*IEAust*).

To undertake the hydrologic modelling, a RAFTS rainfall/runoff model was established for the proposed development site and upstream contributing catchments. The model was used to estimate design flows under existing catchment conditions for the 1, 5, 10, 20, 50 and 100 year ARI events. All hydrologic analysis was undertaken in accordance with AR&R.

RAFTS parameters adopted for the modelling of existing and developed conditions are contained in **Appendix A**.

4.5.3 Existing Hydrologic Conditions

A RAFTS model for the existing conditions was established in order to set the design benchmark for the SWMP. RAFTS modelling was used to estimate the existing peak flow rates for the 1, 5, 10, 20, 50 and 100 year ARI events. **Table 4-1** presents the estimated peak flows for all storm events considered in this study.

4.5.4 Developed Conditions

The existing-state RAFTS model was modified to reflect the increase in impervious area and altered roughness resulting from the sports field. The model results are presented in **Table 4-1**. Modelling indicates that the proposed facility would slightly increase peak flows over a range of flood events. This is due to an increase in impervious area (*representing 5% of the site*) and a reduction in catchment roughness resulting from proposed areas of sporting field that were previously grazing lands.

Table 4-1 – *RAFTS Results: Peak Discharge*

	Peak Flows (m^3/s)					
	1 yr	***5 yr***	***10 yr***	***20 yr***	***50 yr***	***100 yr***
Existing	0.29	0.79	0.98	1.22	1.45	1.70
Developed (no controls)	0.32	0.85	1.04	1.29	1.53	1.80

4.5.5 Sizing of Stormwater Controls

A small portion of the existing wetland system is proposed to be removed in order to create a suitable area for the sports field (*approximately 770m^3*). In order to maintain the water quality and

storage volume contribution of this wetland, it is proposed to provide a compensation wetland of the same area.

Water quality requirements were found to be the governing condition for the sizing of the wetland and bio-retention swales, with a total wetland area of 1,160 m^2 and a total bio-retention swale length of 210m required for water quality considerations. Peak flow calculations indicated that only 120m required to attenuate the two-year peak flow increase, resulting from the increased impervious areas.

4.6 STORMWATER QUALITY ASSESSMENT

This section details the proposed stormwater quality controls for the site and uses a water quality model to estimate the pollutant removal efficiency of the proposed controls, ensuring the SWMP would meet the water quality performance objectives outlined in **Section 4.3**.

4.6.1 Discussion

Stormwater quality control is an imperative aspect of the SWMP. The preservation of acceptable stormwater quality is essential in order to maintain the environmental, recreational and aesthetic qualities of Dora Creek and Lake Macquarie. In this regard it is proposed to maintain post development pollutant export to pre-development levels.

The philosophies adopted in the SWMP are discussed in **Section 4.4**. This section provides a quantitative analysis of the proposed stormwater management measures using a MUSIC water quality model.

4.6.2 MUSIC Water Quality Model

MUSIC is a continual-run conceptual water quality assessment model developed by the Cooperative Research Centre for Catchment Hydrology (*CRCCH*). MUSIC can be used to estimate the long-term annual average stormwater volume generated by a catchment as well as the expected pollutant loads. MUSIC is able to conceptually simulate the performance of a group of stormwater treatment measures (*treatment train*) to assess whether a proposed water quality strategy is able to meet specified water quality objectives.

To undertake the water quality assessment, a MUSIC model was established for the Cooranbong Town Common site in its current condition. The results from the pre-development modelling were then used as the benchmark to assess the performance of the proposed stormwater quality controls.

4.6.3 Meteorological Data

In order to establish a MUSIC model, rainfall and evaporation records in the vicinity of Cooranbong were sought.

Rainfall

In order to develop a model that could comprehensively assess the performance of the proposed SWMP, the use of 6 minute pluviograph data was considered necessary. The nearest Bureau of Meteorology (*BoM*) weather station with pluviograph data was Bolton Point (*station 061139*). A review of the historical data found that the annual average rainfall depth at Bolton Point Bay is approximately 1,200mm. A selected 12 month period generating a rainfall depth of 1,200mm was adopted for the purposes of comparative modelling of existing and proposed conditions.

Evaporation

Monthly areal potential evapotranspiration (*PET*) rates for the site were estimated from PET data provided by the BoM. The monthly average PET adopted for the MUSIC model are shown in **Table 4-2**.

Table 4-2 *–Monthly Areal Potential Evapotranspiration*

Month	Areal Potential Evapotranspiration (mm)
January	180
February	135
March	128
April	85
May	58
June	43
July	43
August	58
September	88
October	127
November	152
December	163

4.6.4 Existing Conditions

A MUSIC model for the existing conditions was established in order to set the design benchmark for the SWMP. A pervious area of 14.7ha was adopted for existing conditions.

Pollutant Concentrations

The pollutant concentrations adopted for existing-conditions modelling are shown in **Table 4-3**. The event mean concentrations (*EMC*) were derived from '*Urban Stormwater Quality: A Statistical Overview*' (*Duncan, February 1999*) and '*Australian Runoff Quality*' (*Engineers Australia, 2006*).

Table 4-3 – *Existing Conditions Pollutant Concentrations (stormflow / baseflow - mg/L)*

Pollutant	Event Mean Concentration mg/l	Baseflow Concentration mg/l
Existing		
Suspended Solids	110	18
Total Phosphorous	0.22	0.06
Total Nitrogen	2.00	0.95

Existing Conditions Results

Estimated average annual pollutant exports from the current site are shown in **Table 4-4**.

Table 4-4 – *Existing Conditions Modelling Results*

Pollutant	Load
Suspended Solids (kg/yr)	5,510
Total Phosphorous (kg/yr)	11.3
Total Nitrogen (kg/yr)	100

4.6.5 Developed Conditions (*no treatment*)

Catchment Parameters

Table 4-5 presents the adopted subcatchment parameters, including catchment type and impervious percentage.

Table 4-5 – *MUSIC Catchment Parameters: Developed State*

Catchment Type	*Area (ha)*	*Impervious Percentage (%)*
Roof/Court	0.40	100
Oval / Grassed	2.02	0
Retained	12.24	0
Total	14.66	-

Pollutant Concentrations

The pollutant concentrations adopted for developed-conditions modelling are shown in **Table 4-6**. The event mean concentrations (*EMC*) for each of these land uses were derived from '*Urban Stormwater Quality: A Statistical Overview*' (*Duncan, February 1999*) and '*Australian Runoff Quality*' (*Engineers Australia, 2006*).

Table 4-6 – *Developed Conditions Pollutant Concentrations*

Pollutant	Event Mean Concentration mg/l	Baseflow Concentration mg/l
Road/Roof/Courts		
Suspended Solids	145	N/A
Total Phosphorous	0.21	N/A
Total Nitrogen	1.55	N/A
Oval / Grassed		
Suspended Solids	160	13
Total Phosphorous	0.36	0.15
Total Nitrogen	2.2	2.09
Undisturbed Site Area		
Suspended Solids	110	20
Total Phosphorous	0.22	0.05
Total Nitrogen	2.00	0.95

Developed Conditions (no treatment) Results

Estimated average annual pollutant exports from the developed but untreated site are shown in **Table 4-7**.

Table 4-7 – *Developed Conditions (no treatment) Pollutant Loads*

Pollutant	Load
Suspended Solids (kg/yr)	6,280
Total Phosphorous (kg/yr)	12.72
Total Nitrogen (kg/yr)	105

4.6.6 Developed Conditions (*With Treatment*)

The stormwater management concepts discussed in **Section 4.4** have been integrated into the developed catchment MUSIC model. A conceptual layout of the minimum required treatment measures are shown in **Figure 3** and are summarised as follows: -

- Clubhouse to drain to rainwater tank;
- Vegetated swales to convey stormwater and provide pre-treatment upstream of bio-retention swales and wetlands (*approximate length 340m*);
- Vegetated bio-retention swales to filter stormwater prior to entering wetlands (*approximate length 210m*);
- Compensation wetland area of 770m^2 (*0.5m* deep) to replace wetland area lost to sports field;
- Additional wetland area of 390m^2 (*0.5m deep*) to polish stormwater (*this would provide more than the 60m^3 minimum storage volume required for an increase in peak runoff volume - refer Section 4.5.5*).

Estimated average annual pollutant exports from the developed site after treatment are shown in **Table 4-8**.

Table 4-8 – *Developed Conditions (with treatment) Pollutant Loads*

Pollutant	Load	Relative to Existing	Reduction from Developed Areas*
Suspended Solids (kg/yr)	4,730	-24.7%	91%
Total Phosphorous (kg/yr)	10.2	-19.8%	76%
Total Nitrogen (kg/yr)	95.7	-9.3%	45%

* Developed areas refers to all roofs, roads, carparks, courts and fields proposed as part of the development (*approximately 2.94ha or* 20% *of site*)

The assessment undertaken in MUSIC indicates that the water quality controls incorporated into the proposed SWMP are likely to achieve the water quality objectives outlined in **Section 4.3**, which requires stormwater pollutants to be reduced to current levels.

4.7 CONSTRUCTION PHASE

During construction, sediment and erosion control structures would be designed and installed in accordance with the NSW Department of Housing "*Managing Urban Stormwater – Soils and Construction*" (*Blue Book*). These controls will ensure that there are no significant adverse impacts on receiving water quality during the construction stage. An erosion and sediment control plan would accompany a Construction Certificate application for the development. Special attention should be given to the protection of bio-retention swales until the development is fully stabilised (*refer detail* ***Figure 3***).

4.8 STORMWATER HARVESTING

JPG would only propose to harvest rainwater where doing so would not impact on local ecological communities. It would be proposed to further explore this opportunity at later project stages (*i.e. Development Application stage*).

5 REGIONAL FLOODING

5.1 FLOOD LEVELS

A flood assessment has not been undertaken as part of this assessment. It is known however that the proposed facility would be located in an area prone to flooding. A flood marker from the 1977 flood suggests that the flood level was approximately 900mm deep at the existing toilet facility adjacent to Freemans Drive.

The Dora Creek Floodplain Management Study (*1998*) extends to the downstream side of Freemans Drive. The study estimates that the 1% AEP flood level is RL 5.12m AHD and the 5% AEP flood level is RL 4.64m AHD. An approximate estimate of flood levels upstream of Freemans Drive was made assuming a 250m long weir at RL 6m AHD (*estimated from orthophoto maps*). The 1% AEP discharge at Freemans Drive is reported in the Dora Creek Floodplain Management Study (*1998*) as approximately 400m^3/s. Assuming no culvert flow due to potential blockage by debris (*conservative*), the depth of flow over Freemans Drive would be in the order of 1m (*similar to the 1977 flood marker*). From orthophotos, Freemans Drive is at approximately RL 6m AHD, giving an approximate 100 year flood level of RL 7m AHD upstream of the crossing.

Given the proposed development sits between RL 4m AHD to RL 6m AHD, the depth of flow is estimated at 1-3m. Given this, it is recommended that all construction be made of flood proof materials, and that the site be evacuated prior to inundation.

5.2 FLOOD EVACUATION

The Dora Creek catchment has been identified by the NSW Flood Warning Consultive Committee (*May 1992*) as being a high flash flood risk catchment with a critical storm duration of 12 hours at the township of Dora Creek. The Dora Creek Floodplain Management Study (*1998*) suggests that the peak flowrate at the site occurs after approximately 15 hours. It is noted however, that flooding (*to a lesser degree*) may also result from shorter duration storms.

A suitable evacuation route is available west along Martinsville Road to the Cooranbong Community Primary School on Government Road (*> RL 14m AHD*). Council, in conjunction with the SES and facility managers, should promote community awareness with regards to flooding. Given the facility will be used for active purposes, the public would require little warning time to evacuate the site (*i.e. as not residential, the packing of belongings etc. is not as critical*). In conjunction with a suitable flood evacuation plan/route, the positioning of a community facility within the floodplain of Dora Creek is considered suitable.

It should also be noted that due to the relatively limited size of the Dora Creek catchment, there is a good chance that intense rainfall during a major flood would most likely mean that the sporting facilities would not be utilised during a storm event of this magnitude.

6 RIPARIAN CORRIDORS

The Department of Water and Energy (*16 July 2006*) has advised that the following riparian corridors are to be adopted along Dora and Burnt Bridge Creeks (*distances are to be measured from the top of bank*): -

- Dora Creek: 20m riparian zone plus an additional 10m vegetated buffer.
- Burnt Bridge Creek: 10m riparian strip.

The above corridor widths would not compromise the establishment of the proposed community facility.

7 OPERATION AND MAINTENANCE ISSUES

7.1 BACKGROUND

We understand that Council has commented on the possible impact of the development on Dora Creek. While **Section 4** shows that the recommended stormwater controls are able to maintain suspended solids and critical nutrients to current levels, the operation and maintenance activities required to sustain the sporting facility have the potential to impact on downstream water quality.

The following section outlines the main operational and management aspects that have the potential to affect downstream areas and recommends techniques that can be adopted to minimise these effects. Recommendations are based on the NSW EPA publication '*Stormwater Management for Parks and Gardens*'.

7.2 OPERATION AND MANAGEMENT ISSUES

The main operational and management aspects that have the potential to affect downstream areas include: -

1. mowing and edging of grass;
2. application of pesticides / herbicides;
3. application of fertilisers; and
4. rubbish collection.

7.2.1 Mowing and Edging of Grass

Mowing and edging of grass areas can lead to excessive clippings entering downstream water bodies. This increases the organic load entering the watercourse which, through decomposition, can lead to a reduction in dissolved oxygen and changes in the chemical makeup of the water body.

Mowing introduces a risk of petrol spillage into water bodies and over-enthusiastic mowing can lead to the removal of native vegetation that may act as a natural stormwater filter, buffering downstream water bodies from upstream landuses.

It is suggested that the following techniques be adopted to minimise downstream impacts:-

- consider the use of slower growing grasses to minimise ongoing mowing requirements and/or capture and disposal of grass clippings;
- establish a buffer area between retained / constructed wetlands and mowed areas and encourage the establishment of native vegetation within this zone;
- establish 'no-mow' boundaries where native grasses which do not require mowing are maintained; and

- do not refuel mowers in close proximity of drainage lines or wetlands, refuel only in a covered/bunded area.

7.2.2 Application of Pesticides / Herbicides

Chemicals such as pesticides and herbicides are required for the control of weeds and pests. Improper use of these chemicals can lead to their entry into downstream water bodies where they can impact on vegetation and aquatic organisms.

It is suggested that the following techniques be adopted to minimise downstream impacts:-

- avoid the general application of chemicals – identify the weeds and pests that require treatment and adopt the most specific control to suit the purpose;
- limit the application of chemicals to that required for the purpose (*i.e. do not over apply chemicals*);
- do not apply chemicals in windy or wet conditions or when rain is forecast;
- minimise the transport of chemicals, ensure containers are sealed and secure;
- wash out containers at a suitable facility, away from stormwater drains;
- store and mix chemicals in a covered, bunded area; and
- ensure material data safety sheets are available and understood by staff.

7.2.3 Application of Fertilisers

Fertilisers are required to maintain the appearance and usefulness of sporting fields. Improper use of fertilisers can result in high nutrient levels in downstream water bodies resulting in excessive plant / algae growth.

It is suggested that the following techniques be adopted to minimise downstream impacts:-

- avoid the general application of fertilisers – identify the need for fertiliser application and adopt the most specific type to suit the purpose;
- use controlled release fertilisers where practical;
- use the correct rates and procedures for fertiliser application;
- store and mix fertilisers in a covered, bunded area; and
- maintain a buffer between areas of fertiliser application and stormwater drains / downstream water bodies.

7.2.4 Rubbish Collection

Litter from sporting events can enter and pollute downstream water bodies. This can be minimised through the adequate provision and maintenance of rubbish receptacles and appropriate signage.

8 CONCLUSION

A stormwater management strategy has been developed in order to meet Council's DCP 1 requirements and the following key objectives: -

- Incorporate (*where practical*) the principles of water sensitive urban design;
- Ensure a Site Discharge Index of less than 0.1 is achieved;
- Ensure the proposed development is able to maintain pre-developed stormwater pollutant export loads; and
- Mitigate the runoff of chemicals (*associated with the sporting complex*) to provide no impact on Dora Creek.

The key infrastructure that will need to be incorporated into the development to deliver these objectives include:

6. Rainwater tank to collect runoff from the clubhouse;
7. Vegetated swales to convey stormwater and provide pre-treatment upstream of bio-retention swales and wetlands (*approximate length 340m*);
8. Vegetated bio-retention swales to filter stormwater prior to entering wetlands (*approximate length 210m*);
9. Compensation wetland area of 770m^2 (*0.5m* deep) to replace wetland area lost to sports field; and
10. Additional wetland area of 390m^2 (*0.5m deep*) to polish stormwater and provide additional storage to compensate for an increase in stormwater runoff resulting from the impervious area of the development.

Combined with suitable operations and maintenance procedures (*as outlined in **Section 7)***, the above stormwater infrastructure would allow the development to meet the stormwater objectives adopted for the site.

9 REFERENCES

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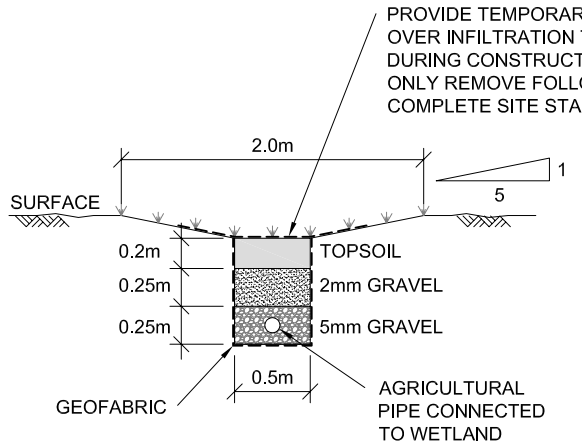
FIGURES

FIGURE 3



VEGETATED BIO-SWALE TYPICAL SECTION

SCALE 1:50 (A3)

WETLAND TO BE
REMOVED ≈ 770m²

CONSTRUCTED
WETLAND ≈ 1,160m²

MARTINSVILLE ROAD

babers road
(unformed)

FREEMANS DRIVE

BIO-SWALE

SWALE

ASSUMED CROSSFALL

CONSTRUCTED WETLAND

0 2000mm
1: 50

0 80 m
1: 2000

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CONCEPTUAL STORMWATER MANAGEMENT PLAN

FIGURE 1

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0 120 m
1: 3000

SITE PLAN

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FIGURE 2

DORA

WETLAND TO BE
REMOVED ≈ 770m²

CONSTRUCTED
WETLAND ≈ 1,160m²

Lot 2
DP 517245

PROPOSED
AFL,
CRICKET,
SOCCER,
MULTIFIELD

PROPOSED
CLUBHOUSE

CREEK

POSSIBLE
LOCATION
OF NETBALL
COURTS

Lot 34
DP 736908

EXISTING
PERFORMANCE
FACILITY

FREEMANS DRIVE

EXISTING
PLAYGROUND

EXISTING TOILET
BLOCK

babers road
(unformed)

MARTINSVILLE ROAD

GENERAL LAYOUT
SCALE 1:2000 (A3)

0 2000mm
1: 50

0 80 m
1: 2000

PROPOSED DEVELOPMENT

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APPENDIX A

RAFTS Model Parameters

The RAFTS parameters that were adopted for the Cooranbong Town Common site are shown in **Table A1.**

Table A1 – *RAFTS Modelling Parameters*

Parameter		Value
IFD Data	$^{1}I_{2}$	31 mm/hr
	$^{12}I_{2}$	7.2 mm/hr
	$^{72}I_{2}$	2.5 mm/hr
	$^{1}I_{50}$	58 mm/hr
	$^{12}I_{50}$	16 mm/hr
	$^{72}I_{50}$	5.5 mm/hr
	F2	4.32
	F50	15.95
	Location skew 'G'	0.04
Rainfall Losses	Pervious initial loss	15 mm
	Pervious continuing loss	3.5 mm/hr
	Impervious initial loss	1.5 mm
	Impervious continuing loss	0 mm/hr
Roughness	Existing	0.060
	Impervious	0.015
	Turfed Surface (*20% of Site*)	0.025
Impervious Percentage	Existing	0.00%
	Proposed	5.00%