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Evaluation of Water Management Measures Bayside Brunswick

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Evaluation of Water Management Measures - Bayside Brunswick

Prepared For:	NSW Department of Planning and Infrastructure
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Title :	Evaluation of Water Management Measures - Bayside Brunswick
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Synopsis :	This report outlines analyses undertaken to evaluate the water management measures proposed for the Bayside Brunswick development.

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1 BACKGROUND

The Bayside Brunswick development has been proposed for an area of land between the Pacific Highway and Simpsons Creek at Brunswick Heads. BMT WBM was commissioned by the Department of Planning and Infrastructure NSW (NSW DoPI) to undertake a review of the existing water management measures proposed by the developer's consultant (Land Partners Limited) and provide alternatives which would aim to protect existing Wallum Froglet habitat within and downstream of the development.

In this regard, the following tasks were undertaken:

- Document Review – From existing information as available on the NSW DoPI Major Projects portal and updated material provided through EcoAustralia and NSW DoPI.
- Preparation of Conceptual Design – Modelling of the site using the MUSIC urban stormwater modelling package and markups of existing layouts and drawings.
- Preparation of an Erosion and Sediment Control Plan – Markups of existing plans and drawings to show potential locations of erosion and sediment control

The focus of this work has been to evaluate whether the proposed development could proceed if alterations to the water management regime were implemented. This short report shows that it is possible to implement measures that have been in routine use across Australia within this development to return the hydrologic regime of the development back to that necessary to support the existing Wallum Froglet communities through the development area.

2 CONCEPT DESIGN OF TREATMENT SYSTEM

The site at Bayside Brunswick is low lying with only minimal grades. Underlying the site, the soils are sandy Aeolian deposits ranging in depth from 2-6m. Such highly free draining soils give opportunities for infiltrating water from the site during storm events where possible. This is important in terms of managing existing wetting and drying cycles of areas which are currently colonised by Wallum Froglet communities.

To develop the concept design of the treatment system, a "clean" lot layout (i.e. one without any treatments identified) was examined to look for opportunities to site treatment measures, but also to ensure that the existing drainage line in the centre of the site can be preserved as a number of Wallum Froglet sightings have been made in this area, especially in the northern section of it. As such, the aim of the concept design was to limit direct discharge into this drainage line, especially from hard (impervious) surfaces to ensure that the frequency and magnitude of flows is relatively consistent with that of the current undeveloped site.

In terms of urbanisation, the two major impacts upon hydrology are increases flow volumes and in the frequency of flow events. This is best illustrated in the figure below showing daily runoff from the proposed development prior to and post development (without treatment).

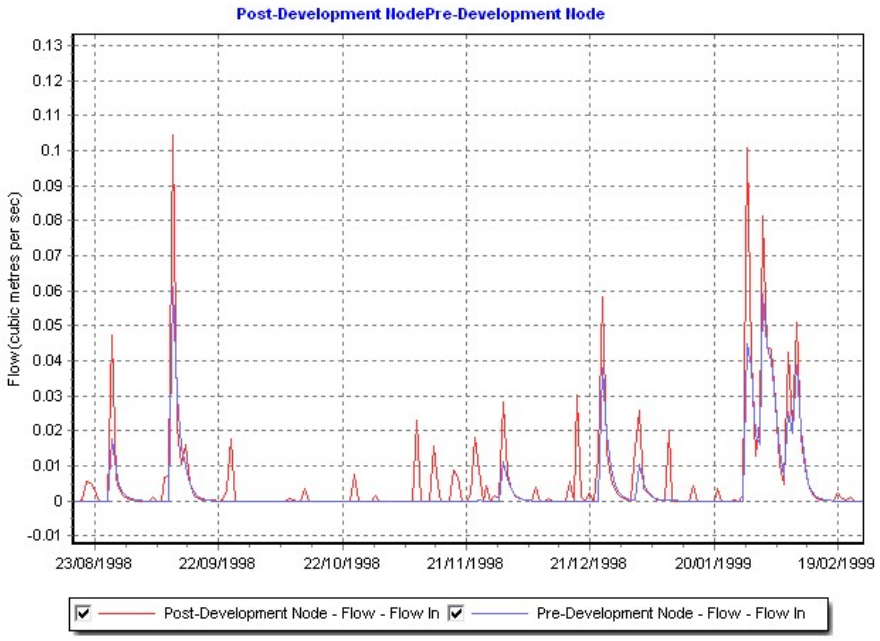

Figure 2-1 Bayside Brunswick Modelled Flows – Pre and Post Development (without treatment)

As can be seen in the above graph, the red line, which indicates flows after urbanisation has occurred, shows increases in peak height and in the frequency of flow, such that there are many more runoff events compared to the blue line, which indicates flows of the undeveloped site.

Recent research (Burns et al 2012) indicates that conventional approaches to improve drainage and reduce pollution have largely failed to protect ecosystem health in streams. Where ecosystem

protection is considered as a necessary objective, the management measures needs to focus not only on improving water quality, but on maintaining an appropriate hydrologic regime.

Over the last 25 years, Water Sensitive Urban Design (WSUD) has largely been formulated to assist in this process, by integrating water management measures that help to preserve all aspects of the water cycle. In the case of this development, the existing site is based on sandy soils. That suggests that infiltration of surface water is the primary process in the hydrologic regime and one that has to be maintained. The concept design has therefore been designed to treat the water quality impacts of urbanising the proposed site, but also to reduce surface water runoff and maximise infiltration wherever possible. It has also utilised rainwater harvesting as part of that regime, to assist in reducing overall increases in stormwater runoff volumes as a result of the development.

After assessing the site layout for suitable areas, a MUSIC (Model for Urban Stormwater Improvement Conceptualisation) model was used to simulate the hydrologic regime pre and post development, and to simulate the changes to hydrology and water quality as a result of implementing various treatment measures.

The model was prepared with MUSIC Version 5.1.16, the current version at the time of preparation of this report, and all modelling was conducted in accordance with the draft NSW MUSIC Modelling Guidelines 2010 (Hawkesbury Nepean CMA 2010). The primary objective for the model was to ensure that daily flows could be reduced to that of the predevelopment condition, with a secondary requirement to ensure that water quality objectives (as stipulated in Byron Shire Council's Development Control Plan 2010 – Chapter 1 Part N – Stormwater Management) be achieved. The final MUSIC model for the developed site is shown below.

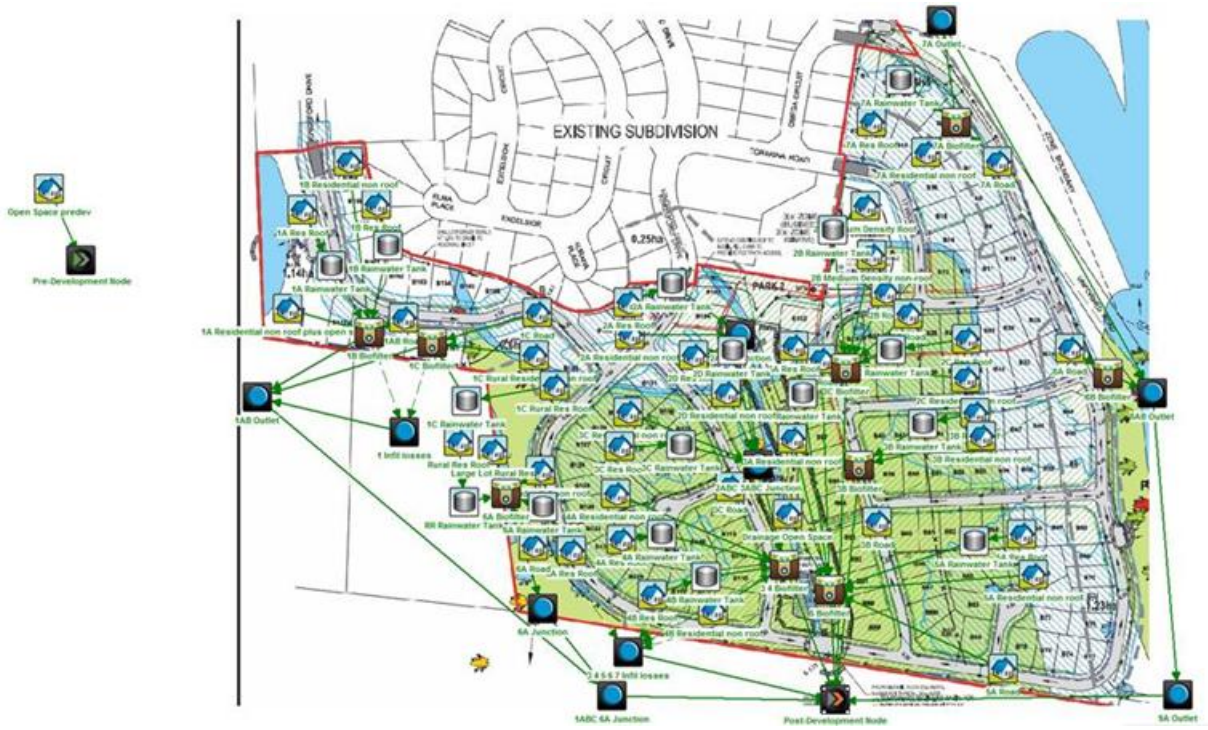

Figure 2-2 Final MUSIC Model

In establishing the water management measures, the approach was to provide for linear biofilters that can be incorporated into the road verge where it does not impinge upon driveway crossovers and the

like, and directing all runoff, including rainwater tank overflows, to be discharged into these measures to ensure that replenishment of the perched water table still occurs consistent with the existing site.

It was assumed that all residential properties would contain a 5kL rainwater tank with a 200L per day reuse demand on average. This was kept consistent with the previous work undertaken by Land Partners as the details on BASIX requirements for the site were not available, and as the rainwater tanks are likely sized to meet those requirements, it was decided to retain them as is.

A revised site plan with the most recent development layout was then marked up to show where the treatment measures are proposed. While the locations are shown upon the plan along with indicative areas, it should be noted that there is some flexibility in this, though the total biofilter area will need to be maintained and the amount of runoff entering the treatment measures maximised wherever possible.

It should be also noted that no flood modelling has been conducted as part of this analysis. The objective of the modelling has been around ensuring that the Wallum Froglet habitat in the existing main drain is preserved consistent with the existing site conditions.

The results of the modelling are indicated in the figure below, showing how the daily flow regime has largely been preserved, with only minimal changes in flow frequency and volumes.

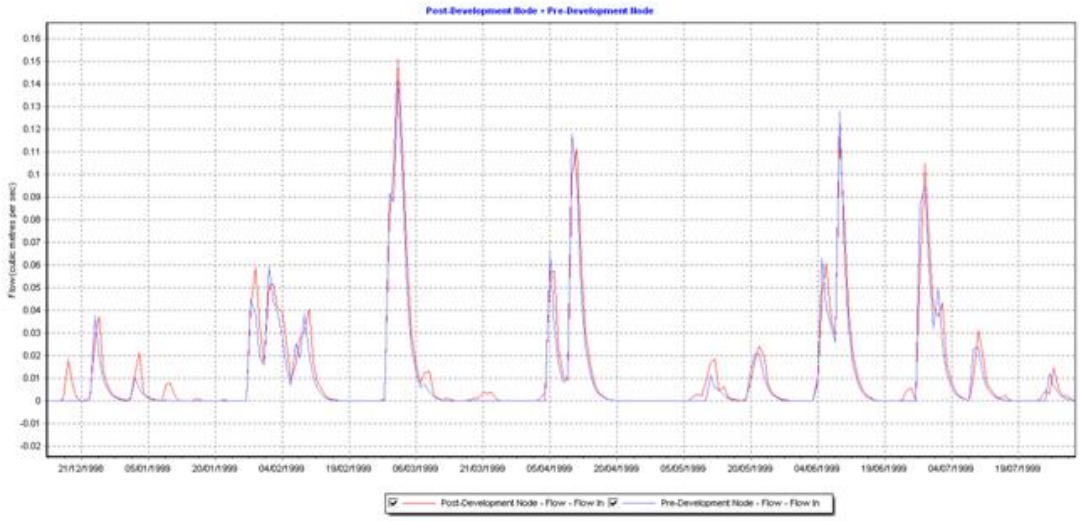

Figure 2-3 Pre and Post Development (treated) flows

When developing the MUSIC model, while infiltration was maximised, it was all accounted for within the model to ensure that the pollutants weren't "lost" from the system. This was done using the split flow functionality of the latest MUSIC software.

In terms of overall treatment train effectiveness, the final model yielded the following results as shown in the table below.

Table 2-1 MUSIC Modelling Results

	Sources	Outlet	% Reduction	Water Quality Guideline
Flow (ML/yr)	160	141	11.8	n/a
Total Suspended Solids (kg/yr)	11400	1360	88	80%
Total Phosphorus (kg/yr)	31.6	15.7	50.2	45%
Total Nitrogen (kg/yr)	297	115	61.4	45%
Gross Pollutants (kg/yr)	2660	0	100	90%

A marked up site plan based on Figure 27 of Appendix B in the revised PPR document was used as the basis of this markup. The total area of biofiltration proposed is approximately 3,540 m^2.

Linear biofilters have been used in many locations across Australia. Some images below show typical applications in urban development contexts.

Figure 2-4 Streetscape linear biofilters

These treatment systems have been selected as they are relatively robust (i.e. maintenance requirements are minimal as they are generally self-maintaining), can be incorporated into the streetscape and enhance the overall amenity of the development.

It will be necessary to work through a structured establishment program for the treatment measures to ensure that their functional installation only occurs once the majority of residential home construction is completed (suggest that this be set at >90%). There is good guidance on this provided within the Water by Design Construction and Establishment Guidelines and technical guidance on the design and construction of these measures is also available at the same location at http://waterbydesign.com.au (and many others across Australia see www.wsud.org for further information). Maintenance Guidelines are also available at several locations in Australia, however recent focus on this by the Water by Design maintenance guidelines might be particularly useful for Councils. This document is available at http://waterbydesign.com.au/maintenanceguide/ .

In terms of costing, the MUSIC Life Cycle Costing (LCC) Module was used to derive *indicative* costs for acquisition (construction), maintenance and establishment costs. From recent experience associated with these costings, if the measures are constructed as part of the development works, it is likely that construction costs will be lower than indicated by the model. The maintenance costs provided are also likely to be an upper indication of likely costs where treatment measures have to be regularly maintained (i.e. 3 monthly inspections and maintenance). From assessments and audits of maintenance of biofilters in Australia, it has been found that maintenance requirements are significantly less than this, however this can be site and local government region specific. Acquisition and Establishment costs are likely to be borne by the developer during the construction phase (i.e. it is likely that these will be incurred prior to handover to Council. All costs were determined with a 2013 base date and the Life Cycle Costs were determined over a 50 year life span assuming a 2% discount rate.

Table 2-2 Indicative Costings

Cost Element	Proposed Treatments	Original Proposal
Total Acquisition Cost	$355,284	$389,631
Annual Maintenance Cost	$41,993	$22,988
Establishment Cost	$83,988	$45,977
LCC ($2013)	$1,201,731	$900,669

Figure 2-5 Proposed Treatment Layout (markup of Figure 27 Impact Upon Wallum Froglet – Appendix B of PPR)

3 EROSION AND SEDIMENT CONTROL PLAN

The proposed erosion and sediment control plan as shown in Figure 28 of Appendix B of the PPR was reviewed in conjunction with the proposed management measures noted in the previous section. Given the need to preserve the existing Wallum Froglet habitat within the current drainage channel, the proposed E&SC plan was not considered suitable as it would be highly likely that considerable amounts of sediment would silt up existing habitat areas during the construction phase such that they would no longer be suitable.

In general, the overall E&SC plan elements were satisfactory, the combination of managing drainage using sand bags to define flow paths, creation of dedicated entry points and the use of appropriately sized sediment basins is largely supported. It will be necessary to ensure suitable conditions are placed on the development to ensure that the measures are in place for a sufficient length of time during the construction phase to continue to protect downstream environments and to prevent siltation of any treatment measures that may be in place. As noted previously, good guidance for this is available.

In terms of modification to the E&SC plan, markups were made to identify locations of revised cut-off drains to prevent sediment laden water entering the existing drainage channel, and several proposed sediment basin locations are shown. Not all of these may be required depending on the sizes of sediment basins needed for the soils on the site, however they have been located to capture particular subcatchments and as such they may need to be located where indicated, but at a different size.

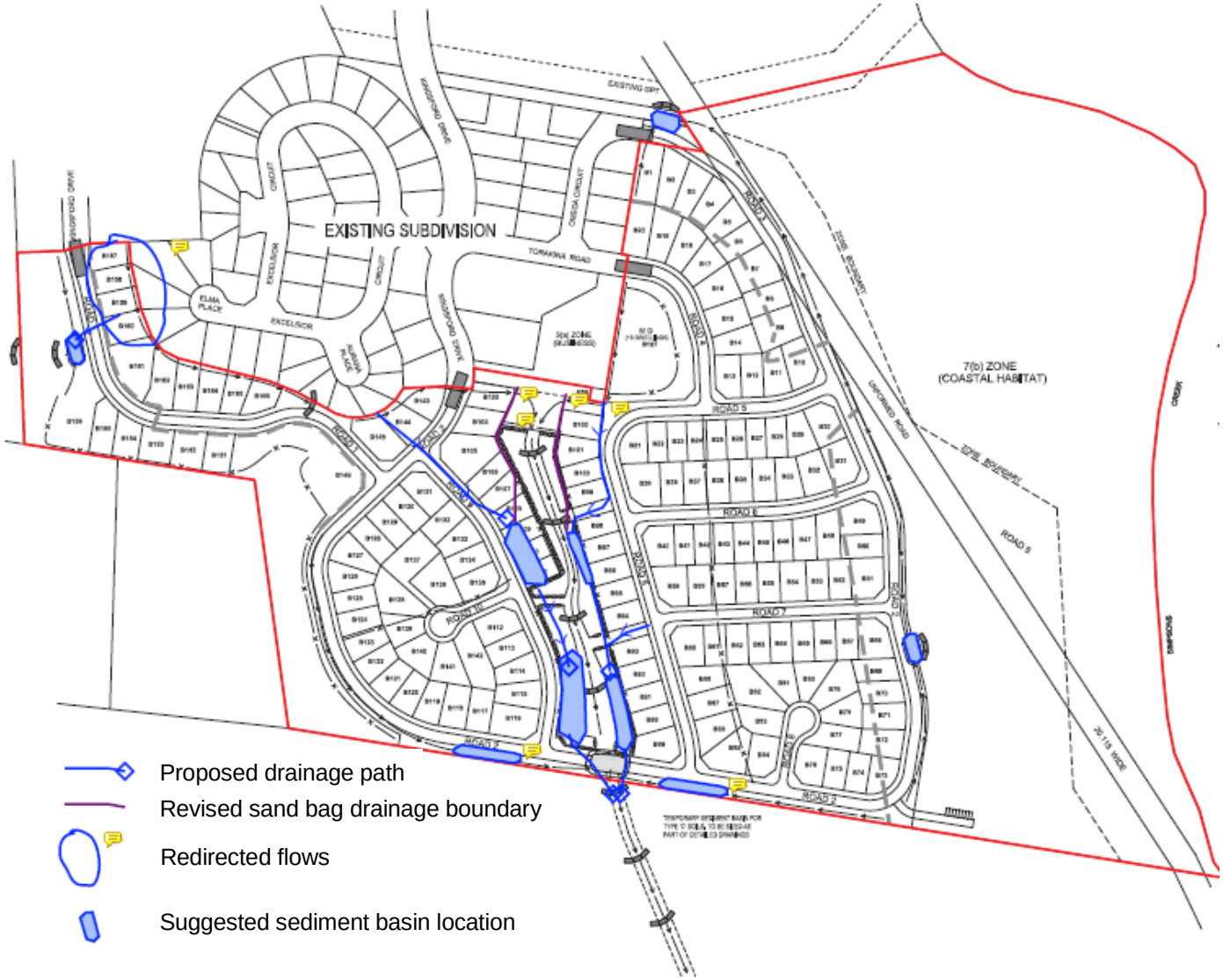

Figure 3-1 Sediment Basin Plan Markups

APPENDIX A: REFERENCES AND BIBLIOGRAPHY

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