Stormwater Management Report and Concept Engineering Plans for Proposed Aged Care Facility Lot 1 D.P.377679 & Lot 784 D.P.533494 Marmong Street, Marmong Point

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Prepared on behalf of Empowered Living Support Services.

October 2012

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Document Control Sheet

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A	Preliminary Issue	18/8/2010	LG	CW
B	Issue to client	30/8/2010	CW	
C	Final Issue	4/5/2012	LM	LG
D	Updated for layout change	30/10/2012	JWu	LG

Executive Summary

ADW Johnson has been engaged by Empowered Living Support Services to complete a Stormwater Management Report to accompany a development application of Lot 1 D.P.377679 & Lot 784 D.P.533494. The proposed development is for a 94 unit aged care facility and accompanying community buildings and infrastructure.

The site is bounded to the north by Marmong Creek and Lake Macquarie and east, south and west by existing residential development. The subject site is approximately 33 ha in size. Due to environmental constraints the development application is proposing to only develop approximately 7ha of previously disturbed land.

The subject site was previously owned and used by Hunter Water as a wastewater treatment facility. It therefore is the subject of a number of Site Contamination reports, and contains existing features used as part of the treatment facility, such as sludge disposal areas, settlement ponds etc.

The object of this report is to take a holistic approach to the treatment of stormwater runoff from the proposed development.

Due to the proximity to the receiving waters of Lake Macquarie it has been determined that stormwater detention is not required. The proposed lowest habitable lot level for the development is RL 4.75m AHD. The community building level has been set at RL 3.15m AHD, both above the expected Year 2100 100 year Lake Macquarie flood level of 2.32m AHD, as documented in the Draft Lake Macquarie Waterway Flood Study September 2011.

The methodology employed was to treat all stormwater within the limits of the development prior to discharging to receiving waters. Catchments were determined based upon existing topography and proposed development layout. The majority of the developed area discharges north toward an existing pond. For design purposes this pond has not been included in the water quality treatment train however with its size and proximity it would provide a significant improvement to water quality discharging to receiving waters.

The stormwater quality modelling utilised a treatment train approach which included rainwater tanks, gross pollutant traps, grass lined swales and a bio-swale. The results of the modelling indicate the reduction in pollutant loads entering receiving waters meet the target objectives.

A Water Balance Assessment was undertaken to determine the optimal sizing of rainwater tanks for both an individual unit and the storage for the community building. It was determined that each unit should be provided with 1,000L for reuse in toilets, laundry and irrigation, and a storage of 15,000L should be provided for the community building, mainly for irrigation of community open space and gardens and some use in toilet flushing and laundry.

Temporary stormwater controls are to be implemented during construction. These controls will be in accordance with Landcom's Blue Book including clean and dirty water diversions, installation of sediment fencing downstream of stockpiles and disturbed areas, treatment of dirty water by sediment basins and fencing off of the 'no-go' areas.

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1.0 Introduction

ADW Johnson has been engaged by Empowered Living Support Services to complete a Stormwater Management Report to accompany development application of Lot 1 D.P.377679 & Lot 784 D.P.533494. The proposed development is for 94 unit aged care facility and accompanying community buildings and infrastructure. The site location is shown below.

(Source: www.googlemaps.com.au)

Figure 1: Site Location

The Stormwater Management Report will cover water quality considerations, and water balance assessment.

1.1 Background

The subject site was previously owned and used by Hunter Water as a wastewater treatment facility. It therefore is the subject of a number of Site Contamination reports, and contains existing features used as part of the treatment facility, such as sludge disposal areas, settlement ponds etc.

The objective of this report is to document the stormwater management requirements and to provide a comprehensive water cycle strategy and soil and water management plan for the proposed development having regard to best practice, water sensitive urban design regimes contained within Lake Macquarie City Council (Council) guidelines. Concept engineering and

services plans are to demonstrate that the works can be constructed to satisfy accepted engineering standards and practices.

2.0 Existing Site

The existing site is approximately 33 hectares and the portion proposed for development is zoned 10 investigation zone. The subject site has been subject to extensive amounts of disturbance from previous land uses and the site has contaminated areas from previous use as a wastewater treatment facility.

The wastewater treatment facility has been removed and now a wastewater pumping station remains on the northern boundary.

The site has been subject to a number of Site Contamination Assessments and these indicate that potential heavy metal contamination may be present and all development proposed should cater for remediation or containment of these contaminants.

The site is bounded to the north by Marmong Creek and Lake Macquarie and east, south and west by existing residential development. The subject site is approximately 33 ha in size. Due to environmental constraints the development application is proposing to develop 7 ha of mostly previously disturbed land.

Site slopes are generally moderate in the range of 5-20%, with only a few locations of the site falling outside this range. The existing site has been previously used for wastewater treatment facility and is exhibits a large area of disturbed land where site filling has occurred with little vegetation growth surrounded by moderately dense vegetation.

3.0 Requirements

From Part 2.5 – Stormwater Management, Infrastructure and On-Site Services of Council's Development Control Plan No. 1 (DCP No. 1), the proposed development is described as that which: "incorporate 10 or more dwellings or lots". This triggers the requirement for a comprehensive water cycle strategy to be prepared as an acceptable solution to mitigate potential stormwater impacts from the proposed development.

The stormwater management system is to minimise environmental impact of urban runoff. Typically this is addressed by modelling simulation of water quality controls to target objectives. From Part 2.5 of DCP No. 1, the reference document "Managing Urban Stormwater: Treatment Techniques (NSW EPA, 1997)" is to be used for pollution minimisation objectives.

Councils requirements relating to stormwater for this investigation are described in the following documents:

- Lake Macquarie City Councils "Water Cycle Management Guidelines"
- Lake Macquarie City Councils "Stormwater Treatment Framework & Stormwater Quality Improvement Device Guidelines" (SQID)

Stormwater quality treatment is required for the management of water quality. Section 3.0 of Lake Macquarie's Water Cycle Management Guidelines (WCMG) requires that larger development consider sustainable water management. The issues to be addressed are as follows;

- Street layout, design and construction
- Major drainage system design and construction
- Stormwater source controls
- Erosion, sediment and pollution control
- Aquifer storage and recovery

The principals of stormwater treatment contained within the SQID have been adopted as part of the Stormwater Management.

Due to the proximity of the development to receiving waters of Lake Macquarie it is not required for the development to provide stormwater detention, the provision for assessment of aquifer storage and recovery has also not been addressed due to the developments location.

Water Balance

A Water Balance Assessment has been undertaken to determine the optimal sizing of rainwater tanks for both an individual unit and the storage for the community building. The owner and operator of the aged care facility has advised that rainwater is proposed to be collected and reused for toilet

flushing, laundry and irrigation purposes. It is proposed to determine the sizing of the rainwater tanks based on simulating 15 year watercycle and running a sensitivity analysis to optimise the storage of both an individual tank and the community building tank. The modelling will assess the reduction in potable demand for varies size tanks and determine an appropriate size.

Water Quality

As part of this assessment the requirements of Department of Environment, Climate Change and Water (DECC) have been adopted and have been listed in Table 1.

Table 1 *Stormwater Treatment Target Objectives*

Pollutant / Issue	Retention Criteria (Retention Of Average Annual Load)
Gross Pollutants (GP)	Retention of litter greater than 5mm and no visible oils for flows up to 50% of the 1:1 year ARI storm event.
Total Suspended Solids (TSS)	85%
Total Phosphorus (TP)	65%
Total Nitrogen (TN)	45%

4.0 Constraints and Opportunities

Several constraints have been placed on the Stormwater Management Strategy due to the nature of the site and the purpose of the development, including:

- *Site potential contamination* – As capping of the site is the preferred solution for site contamination remediation, the infiltration of stormwater is discouraged in this instance.
- *Soil Type* – The soils present on site have a high clay content which is not conducive to infiltration, therefore limiting the available treatment techniques.
- *Slope Stability* – Due to the steep nature of the site, and the soil conditions, infiltration techniques may have an impact on the stability of the slopes.
- *Socio Economic* considerations pose significant constraints. The selection and implementation of stormwater treatment cannot adversely affect the presentation of the estate. Thus the selected treatment techniques have to integrate into the estate in an aesthetically pleasing manner, and which will be widely accepted by the community.

A suite of treatment techniques have been assessed for suitability within the proposed development. Those that can easily be integrated into the proposed development footprint have been adopted.

5.0 Stormwater Management Strategy

5.1 Water Balance

The owner and future operator of the development have advised that collected rainwater will be used for toilet flushing, laundry and irrigation.

The water balance modelling included determining appropriate water demands for toilet flushing, laundry and irrigation. These demands were simulated with historical rainfall records for Rain Station 061223 (Maryville) for the 15 year period from 1978 to 1992.

It is proposed to install a rainwater tank to each unit for toilet flushing, laundry and irrigation as well as a larger rainwater tank to the community building, which will be used for toilet flushing within community building, and irrigation of community open space and gardens.

5.1.1 Methodology

The water balance assessment included simulation of 15 years of rainfall, the following has been used in determining water usage.

Single Unit Analysis

- No. residents per dwelling = 2
- Roof area = 125m^2
- Usages = Toilet and Laundry

Community Building

- Number of staff = 15
- Roof Area = 795m^2
- Usages = Toilet, Laundry and irrigation (common areas)
- Irrigation area = 7,000m^2

Irrigation has been assumed to be higher (1.5mm/m^2) during summer months (October – March) than in winter (April – September) of 0.25mm/m^2, adjustment has also been made to not irrigate if the daily rainfall for that day is greater the 5mm.

The above information was assessed using excel based water balance model provided to ADW Johnson by Lake Macquarie Council. This model was adjusted to include the alternate irrigation rates, number of residents, contributing roof area, and appropriate usages.

5.1.2 Results

Single Unit Analysis

A variety of rainwater tanks were assessed ranging from 500L to 2,500L, these tanks were modelled using 15 years of rainfall data and the comparison of tank size vs percentage (%) contribution of roof water to total water consumption was assessed. Figure 1 shows the comparison between tank size and contribution.

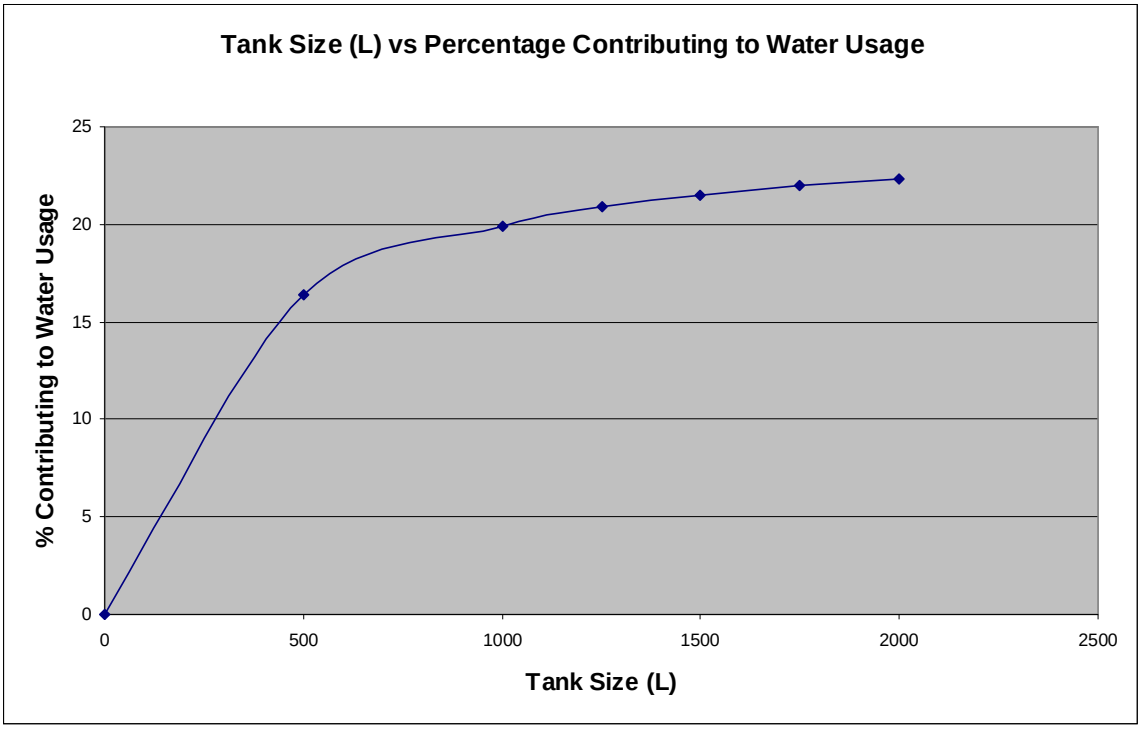


Figure 2: Tank Size vs Percentage Contributing to Water Usage for Single Unit.

The results of the analysis indicate that any increase in tank size above 1,000L has little increase in contribution to water usage. A tank of 1,000L indicates a percentage contribution of 20%.

Community Building Assessment

A variety of rainwater tanks were assessed ranging from 5,000L to 30,000L, these tanks were modelled using 15 years of rainfall data and the comparison of tank size vs percentage (%) contribution of roof water to total water consumption was assessed. Figure 2 shows the comparison between tank size and contribution for the community building roof area.

The results of the analysis indicate that any increase in tank size above 15,000L has little increase in contribution to water usage. A total tank volume of 15,000L indicates a percentage contribution of approximately 35%, which is considered an appropriate size for the development to incorporate.

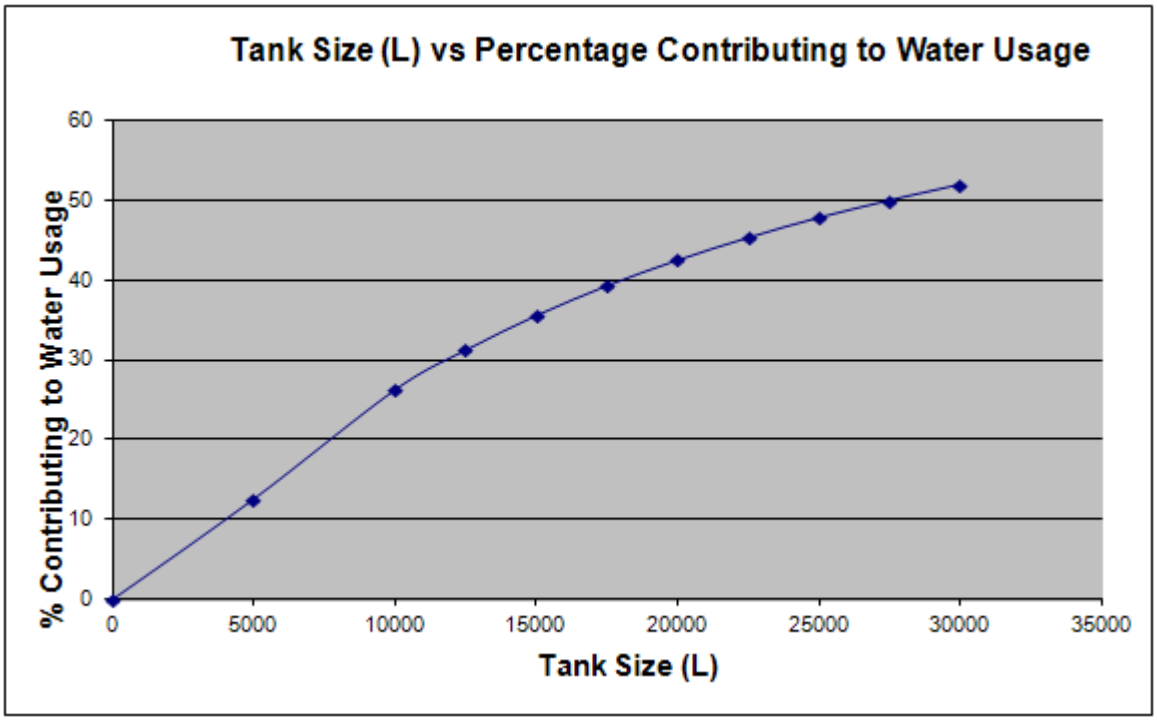


Figure 3: Tank Size vs Percentage Contributing to Water Usage for Community Building.

5.2 Water Quality Modelling

A treatment train strategy of permanent stormwater quality controls is proposed for the development for compliance with the water quality objectives.

MUSIC (Model for Urban Stormwater Improvement Conceptualisation) is the industry standard model for prediction of stormwater quality outcomes from proposed development. The modelling approach is based on continuous simulation, operating at time steps to match the scale of the catchment. The adopted time step for this investigation was 6 minutes.

5.2.1 Modelling Parameters

The parameters used for the MUSIC model are described below.

Rainfall data

Pluviograph data for use in the MUSIC model was obtained from the Bureau of Meteorology for Station 061223 (Maryville) for the period of 1964 to 1997. A five (5) year period from 1980 to 1984 was selected for modelling purposes. This data gives a good representation of expected rainfall in the Lake Macquarie area. The period has an annual average rainfall of 1085mm in comparison to 1112mm long term average, which is closely equivalent to Lake Macquarie average of 1132mm. It also has an average of 95 rain day of > 1mm in comparison to long term average of 97.9 rain days, (data sourced from Bureau of Meteorology).

Evapotranspiration

The average monthly area potential evapotranspiration (PET) rates for the site were sourced from BOM. The PET values for the model are summarised in Table 2.

Table 2 *Monthly Average Potential Evapotranspiration*

Month	Average PET (mm/month)	Month	Average PET (mm/month)
January	180	July	65
February	155	August	95
March	150	September	125
April	115	October	150
May	75	November	175
June	70	December	200

Pollutant Concentrations

MUSIC simulation uses event mean concentration data for urban land uses. The pollutant concentration values for the roads, roofs and residential (landscape) source nodes adopted in the model for storm flow have been sourced from "Urban Stormwater Quality – A Statistical Overview" Duncan (1999). Concentration parameters for storm flows for the relevant land uses are shown below in Table 3.

Table 3 *Concentration Parameters for Storm Flows*

Pollutant	Roofs				Roads				Landscape			
	Storm Flow (log mg/L)		Base Flow (log mg/L)		Storm Flow (log mg/L)		Base Flow (log mg/L)		Storm Flow (log mg/L)		Base Flow (log mg/L)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Total Suspended Solids	1.563	0.384	N/A	N/A	2.295	0.552	1.138	0.5	2.201	0.487	1.138	0.5
Total Phosphorus	-(0.868)	0.306	N/A	N/A	-(0.585)	0.437	-(0.823)	0.586	-(0.444)	0.358	-(0.823)	0.586
Total Nitrogen	0.352	0.277	N/A	N/A	0.352	0.277	0.328	0.352	0.434	0.281	0.328	0.352

Stormwater Treatment

As described in Section 4.0 there are several alternatives for stormwater treatment for the development of this site. The strategy for water quality is shown below.

- Install rainwater tanks on each residential allotment.
- Provide Gross Pollutant Traps at all street drainage outlet points.
- Construct grass lined/bio-retention swales within the development.

For the purposes of undertaking stormwater quality assessment of the site post development, the following has been adopted;

- Roof areas were set at 100% impervious,
- Road areas at 25% pervious / 75% impervious,
- Landscape areas external to lots have been adopted as 90% pervious / 10% impervious.
- Landscape areas within each lot have been adopted as 20% pervious / 80% impervious as it is expected to be minimal lawn and garden areas.
- Each unit is to be provided with 1,000L rainwater tanks to allow for re-harvesting of roof water runoff.
- The community building is to have a 15,000L of rainwater tank, for irrigation of community space.

Vegetated Swales

Two vegetated swale drains will be included in the development. The first swale will be located east of the development. It will have a base width 0.5m and 1(V):5(H) side slopes. The concept engineering plans indicate the grade of this swale varies from approx 0.7% to 2.4% with total length of 60m, the grade has been conservatively estimated at 2.0% for modelling purposes.

The second swale will be located between Road 1 and the basin to the north of the site. This swale will be 0.5m wide, have side slopes of 1(V):4(H) and a length of approximately 50m.

Details of both swales can be found in the concept engineering plans.

Bio-swale

It is proposed that a bio-swale will be constructed downstream of the first vegetated swale to provide additional nutrient treatment for stormwater flows.

The bio-swale will be constructed with a perforated subsoil drain beneath the invert which will act as a bio retention area within the base of the swale. The seepage loss therefore has been adopted at 36mm/hour, to represent sandy loam.

The bio-swale will be 0.5m base, have side slopes of 1(V):5(H) and a length of 80m. In detailed design it may be required to include check dams at regular intervals; however this will be dependent upon the final grade or the swale.

A typical section of the bio-swale can be found in the concept engineering

plans.

Gross Pollutant Trap

A number of gross pollutant traps will be utilised in the development. The GPTs are expected to be proprietary devices. The GPTs used inside the development will be equivalent to the Ecosol RSF 4000. For modelling purposes the reduction in pollutant through the GPT have been sourced from Ecosol "*Integration of Ecosol RSF 4000 GPTs with the MUSIC Catchment Package*", which indicate pollutant reductions as shown in Table 4 below.

Table 4 *Ecosol RSF 4000 GPT Pollutant Reduction*

Pollutant	Reduction (%)
Gross Pollutants (GP)	95%
Total Suspended Solids (TSS)	91%
Total Phosphorus (TP)	30%
Total Nitrogen (TN)	13%

The reduction through the GPT of TSS has been adopted as 80% rather than the documented 91%.

An additional GPT type (pit basket) has been included to treat stormwater runoff from section of the entrance road that drains to Marmong Street. For modelling purposes an Ecosol RSF 100 has been included using the reductions sourced from Ecosol, shown in Table 5 below.

Table 5 *Ecosol RSF 100 GPT Pollutant Reduction*

Pollutant	Reduction (%)
Gross Pollutants (GP)	95%
Total Suspended Solids (TSS)	65%
Total Phosphorus (TP)	40%
Total Nitrogen (TN)	21%

5.2.2 Stormwater Quality Modelling Results

The MUSIC modelling results of water quality post development are shown in Table 6.

Table 6 *MUSIC Model Pollutant Reduction Prediction*

Pollutant	Post Development (No Treatment)	Post Development (with Treatment)	Reduction (%)
Suspended Solids (kg/year)	14,300	1130	92%
Total Phosphorus (kg/year)	20.1	6.14	70%
Total Nitrogen (kg/year)	158.2	83.1	48%

From Table 6, MUSIC modelling indicates compliance with DECC target reduction objectives (shown in Table 1).

5.4 Stormwater Management Conclusion

The Stormwater Management Strategy has been prepared to support accompany development application of Lot 1 D.P.377679 & Lot 784 D.P.533494. The proposed development is for 94 unit aged care facility and accompanying community buildings and infrastructure.

The strategy has been undertaken to meet Lake Macquarie City Council and DECC requirements as well as industry best practice management and environment constraints.

Water quality treatment has been modelled and is predicted to meet Council and DECC target pollutant removal objectives prior to discharge of stormwater from the site. This was achieved by a treatment train approach utilising rainwater tanks, gross pollutant traps and swales.

Details of the treatment train required to meet the target values are shown below.

- The individual units are to have a 1,000L rainwater tank installed for capture and reuse of all stormwater generated as roof runoff.
- The community building is to have a 15,000L rainwater tank, for irrigation of community space, and toilet reuse.
- Industry standard proprietary product, end of line Gross Pollutant Trap (GPT) on each stormwater line in order to collect pollutants before they discharge to a vegetated swale or bio-swale, or are discharged from the site.
- Construction of vegetated swale drains within landscaped area on east of the developed area as well as between Road 1 and the existing basin.
- Construction of a bio-swale section downstream of the vegetated swale drain on the east of the developed area.

5.5 Soil & Water Management

A concept Soil & Water Management Plan has been prepared, a copy of which is found in Appendix A. This plan is to outline the temporary control measures for the protection of the downstream receiving waters during construction and has been broken up into the expected staging arrangement for the development.

Sediment fencing will be installed to boundaries and work areas. Stockpiles will be protected by sediment fencing. These measures need to be installed prior to commencement of earthworks. All controls are to be designed in accordance with '*Managing Urban Stormwater – Soils & Construction Volume 1*' (Landcom, 2004) – 'Blue Book'.

6.0 Concept Engineering and Services

The concept engineering design has indicated that all road grades for the development of the site can be maintained within council standards covered in "LMCC Engineering Requirements Part 1 Design Specification".

Earthworks - Cut/fills are manageable over the site. As part of the geotechnical/contamination requirements for the development remediation works are required on the potential contaminant and uncontrolled material. It is proposed that the uncontrolled filling will be removed and reinstated as controlled fill and the potential contaminants will be removed, remediated or relocated. Refer to Concept Engineering Plans in Appendix A.

Roads – The design of the internal roads, including the entrance road, indicates that the longitudinal grades have been maintained generally below 1:14, the internal footpath network generally aligns parallel to the internal road network, or other designated areas which will all be maintained to accessibility grades.

Access external from the site will be available through an onsite community bus to surrounding local shops etc.

Stormwater - Stormwater from the site will discharge to the existing pond located within the development land. During large storm events this pond overtops and discharges to Marmong Creek which connects to estuarine inlet connected to Lake Macquarie.

Wastewater – Existing Hunter Water infrastructure of a pump station exists on the site. Conceptual designs indicate one connection is required into the existing system.

An existing rising main is located within the development area, as part of the development this rising main is to be relocated through the development and a new collecting manhole is to be position northwest of the maintenance shed.

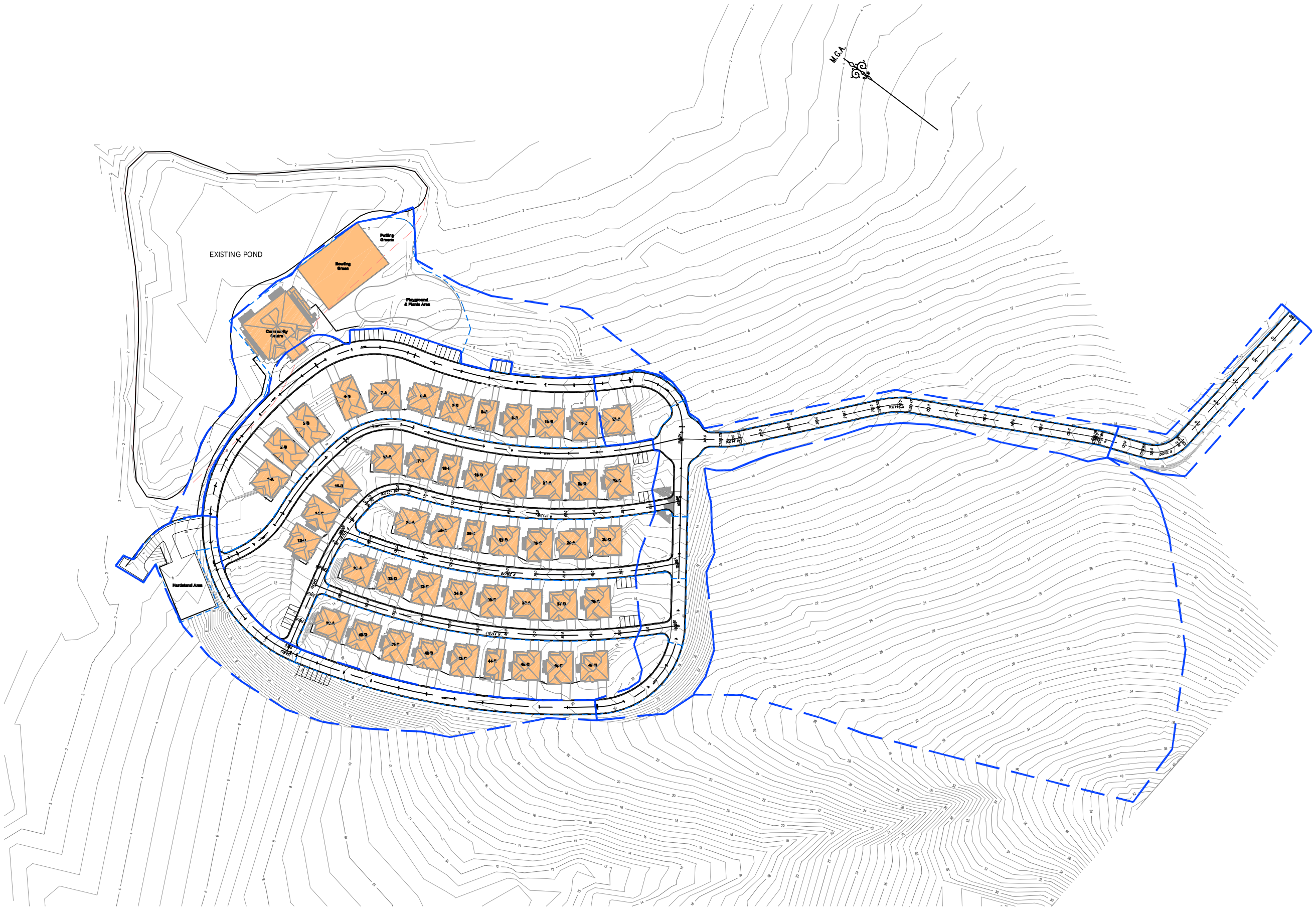
Potable Water - Hunter Water Corporation has provided indicative potable water requirements for proposed development. The advice confirmed that potable water services are available to the site for development with connection to the existing surrounding mains in both Marmong Street and Defender Close. A servicing strategy is to be prepared to determine the most appropriate connection point.

Electrical and Telecommunications – Contact has been made with Energy Australia and Telstra and their standard servicing requirements apply.

Additional Figures

Figure 4: Stormwater Catchment Plan

238111-Fig 01 Catchment - Rev D



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PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DRAWN	CHECK	DESIGN	VERIFY
A	18/08/2010	Issued with Development Application	A.M.	H.W.	L.G.	C.W.
B	10/10/2011	Modified Development Layout	L.W.	L.G.	L.G.	C.W.
C	4/05/2012	Issued with Stormwater Report Rev C	C.O.	L.G.	L.M.	C.W.
D	30/10/2012	Issued with Stormwater Report Rev D	J.W.	L.G.	J.W.	C.W.

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

SCALES
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1:1000 / 1:2000

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CLIENT
EMPOWERED LIVING SUPPORT SERVICES.

PROPERTY DESCRIPTION
PROPOSED SUBDIVISION OF
LOT1 D.P. 377679 & LOT 784 D.P. 533494,
135a MARMONG ST,
MARMONG POINT

SURVEYED: ADWJ
DATUM: A.H.D.

PROJECT: MARMONG AGED CARE FACILITY
PLAN TITLE: FIGURE 1 CATCHMENT PLAN

PROJECT No. 238111 – DISCIPLINE FIG – NUMBER 01 REV. D

100mm AT FULL SIZE

Plotted By: joshuaw Plot Date: 30/10/12 – 11:02 Cad File: N:\238111\Dwg\REPORTS\STORMWATER\238111–Fig 01 Catchment – Rev D.dwg

Appendix A

Concept Engineering Plans