marchesepartners

STORMWATER MANAGEMENT REPORT

FOR

WATERBROOK DEVELOPMENT
2-18 CENTENNIAL ROAD, BOWRAL NSW 2576

Rev C

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1.0 INTRODUCTION AND OVERVIEW

This report discusses the site stormwater drainage system for the proposed Waterbrook Seniors Housing Independent Living Unit development located at 2-18 Centennial Road, Bowral.

The following engineering drawings have been prepared by Marchese Partners Engineering in support of the architectural drawings prepared by Marchese Partners Architects: -

CIVIL ENGINEERING DRAWINGS

C-001	TITLE SHEET AND LOCALITY PLAN
C-002	LEGEND, ABBREVIATIONS AND DRAWING LIST
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C-004	SURVEY PLAN
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This report is to be read in conjunction with the above drawings.

This report addresses the following key areas:-

1. Flooding effects;
2. Overland flow characteristics;
3. Creek drainage connections and riparian zone;
4. On-Site Detention storage;
5. Rainwater reuse storage; and
6. Stormwater quality improvement.

Reference is made to the following relevant Council documents.

- Wingecarribee Shire Council – Bowral Town Plan Development Control Plan – Version 8 dated September 2015
- Wingecarribee Shire Council – Development Design Specification D5 Stormwater Drainage Design
- Wingecarribee Shire Council – Bowral Floodplain Risk Management Study & Plan – Selected extract information provided on Council web site

2.0 THE EXISTING SITE

It is understood that the current land at 2-18 Centennial Road Bowral was previously purchased by Nuns from Our Lady of the Sacred Heart, Kensington in 1904 who established a convent school that was later converted into a Retreat Centre. The property is located within the Wingecarribee Shire Council local government area. The topographical plan below (Figure 1) indicates an existing natural waterway (Mittagong Creek, shown in blue) passing through the southeastern part of the site in the lower portion of the former convent school grounds. The site boundary is shown in green, roads are shown in red and driveways are shown in orange.

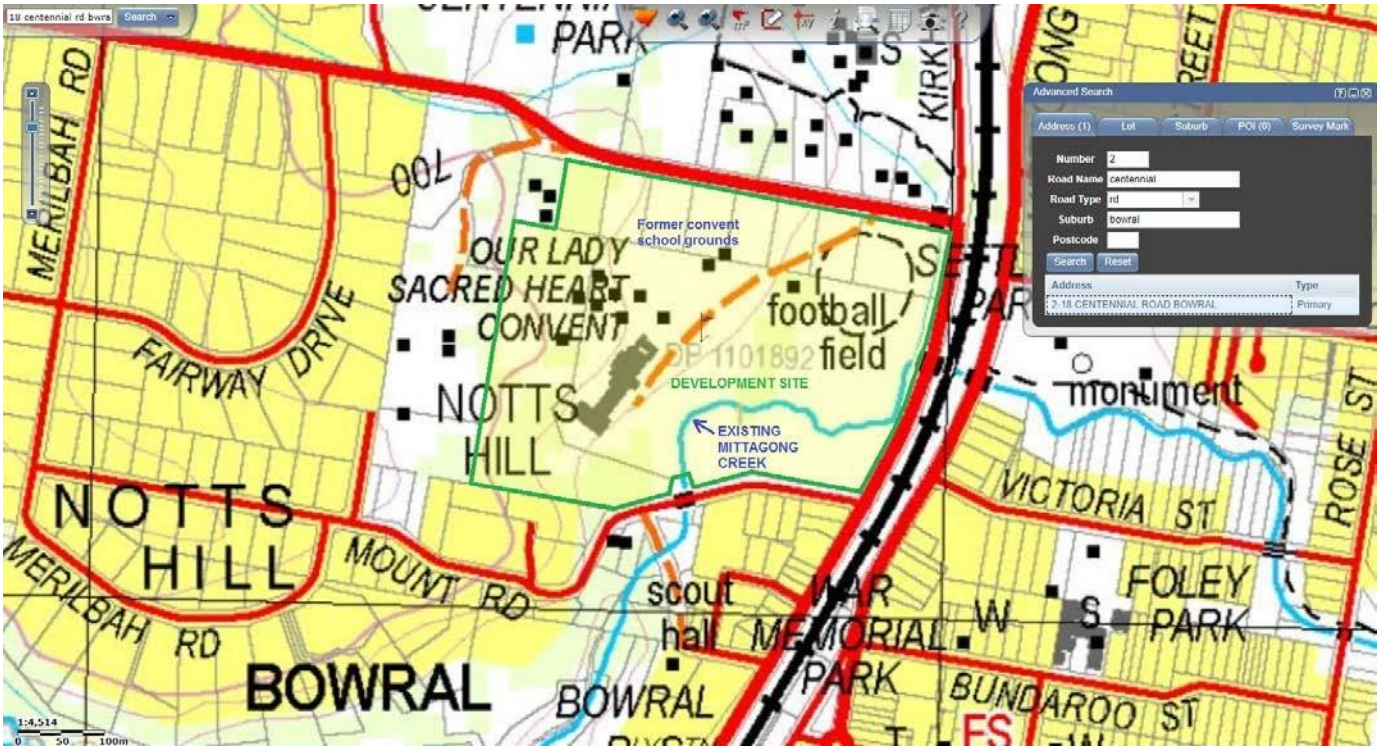

FIGURE 1 – Site location (green outline) with former Convent indicated

Approximate contour lines at 10 metre elevation intervals are shown in light crimson, with the upper ground surface near the western boundary estimated at about RL700.00. From the western boundary the natural ground surface generally falls to the east, gradually changing direction to drain stormwater runoff in a southerly direction at a roughly perpendicular angle into Mittagong Creek. The creek drains from the eastern side of the railway line (shown in black), directing water to the west and then to the south as it passes through the site.

The upper half of the property along the western and northern boundaries is intended for the construction of a Seniors Housing Independent Living Unit development by Waterbrook (a developer of resort-style retirement facilities). The designated area of proposed works is estimated to occupy approximately ten hectares or 100,000 square metres. The aerial phograph below (Figure 2) indicates the approximate location of the development site with a yellow outline.

FIGURE 2 – Aerial photograph of existing site location (yellow outline)

The Survey Plan prepared by Whelans Land Information Consultants (Job Ref A199 – dated 03/05/2002) together with Sixmaps web site contour information indicates that :-

- The existing topography associated with the site generally indicates the surface falls towards the existing creek.
- Existing surface levels in the vicinity of the proposed development range from approximately RL700.00 near the western boundary down to about RL667.00 near the base of the creek, a vertical height difference of some 33 metres over a distance of about 240 metres.
- The natural site slope is relatively steep, being approximately 14%
- Existing contours to the east and south of the existing main building are very close, indicating a steep slope of up to 60%. On the southeastern side of the creek the low-lying land exhibits gentle slopes of about 1%.

Below (Figure 3) is the site survey plan indicating existing contour lines and marked with approximate flow direction arrows.

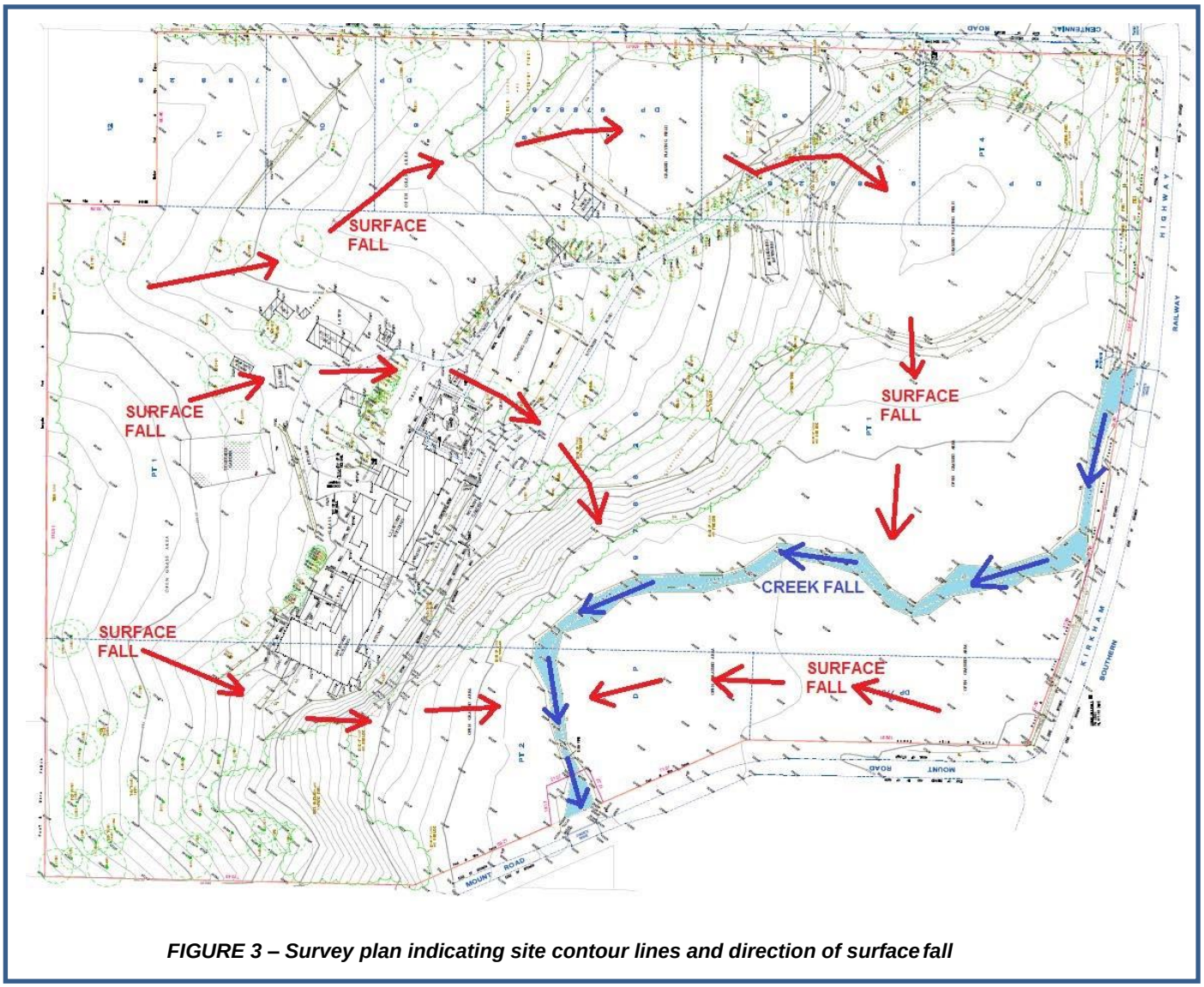

FIGURE 3 – Survey plan indicating site contour lines and direction of surface fall

Reference is made to Wingecarribee Shire Council – Bowral Town Plan Development Control Plan – Version 8 dated September 2015 – Part C Residential Zoned Land – Section 22 OLSH Precinct, which applies specifically to the subject site formerly occupied by the Our Lady of the Sacred Heart (OLSH) Convent School. The property contains items of heritage and ecological concern, which necessarily impose constraints on development activities. In particular, Endangered Ecological Communities (EEC) comprising existing stands of significant trees are to be retained without adverse impacts during construction works.

The aerial map below (Figure 4) indicates Council conceptual concerns as expressed in the Development Control Plan (DCP). It is noted that proposed pipe routes and stormwater structures are not to be located in positions that will impact the existing EEC tree groups in the central and southwestern parts of the property.

FIGURE 4 – Council's Development Concepts Plan for the site

The aerial photograph below (Figure 5) indicates the intersection of Centennial Road and Kirkham Road and the northeastern corner of the site, looking approximately west.

FIGURE 5 – Aerial photograph of northeastern corner of the site

The aerial photograph below (Figure 6) indicates the northeastern corner of the site looking approximately south.

FIGURE 6 – Aerial photograph of northwestern corner of the site

The aerial photograph below (Figure 7) indicates the southeastern corner of the site looking approximately northwest.

FIGURE 7 – Aerial photograph of southeastern corner of the site

The aerial photograph below (Figure 8) indicates the intersection of Centennial Road and Kirkham Road at the lower right and the predominantly landscaped site, looking approximately west.

FIGURE 8 – Aerial photograph of the site looking approximately west

3.0 FLOODING EFFECTS

Reference should be made to the FLOODMIT September 2018 Flood Assessment Report for the flood related conditions expected on the site

4.0 LOCAL OVERLAND FLOW

The main overland flow paths traversing the existing site generally tend to direct runoff from west to east and from north to south towards Mittagong Creek, as previously derived from the survey plan contour lines. Proposed main flow paths within the redeveloped site are generally intended to pass along new roadway locations sloping down towards the creek, with minor sheet flows across private yard spaces being directed towards the roadways and the new underground drainage system.

Where upstream neighbouring runoff naturally flows towards a new development, it is usually desirable to divert the external flows at the upper boundary and keep them separate from the internal site drainage which is collected by a detention storage system sized for the contributing catchment. However, in the case of this development proposal, significant trees are currently located along the upper western site boundary, indicating that forming diversion channels may be impractical without the relocation of buildings further away from the trees, which will have a significant impact on the current architectural footprint. The plan below (Figure 17) shows the current Masterplan

Figure 17 Masterplan

Until such time as appropriate tree assessment can be undertaken by an arborist, it is conservatively assumed that the upstream neighbouring catchment will be drained without diversion towards the development site, and on-site detention storages will be sized accordingly for conceptual development application purposes.

In the indicative concept plan below (Figure 18) the maximum design catchment for drainage of proposed impervious development areas is taken to be approximately 15 hectares or 150,000 square metres.

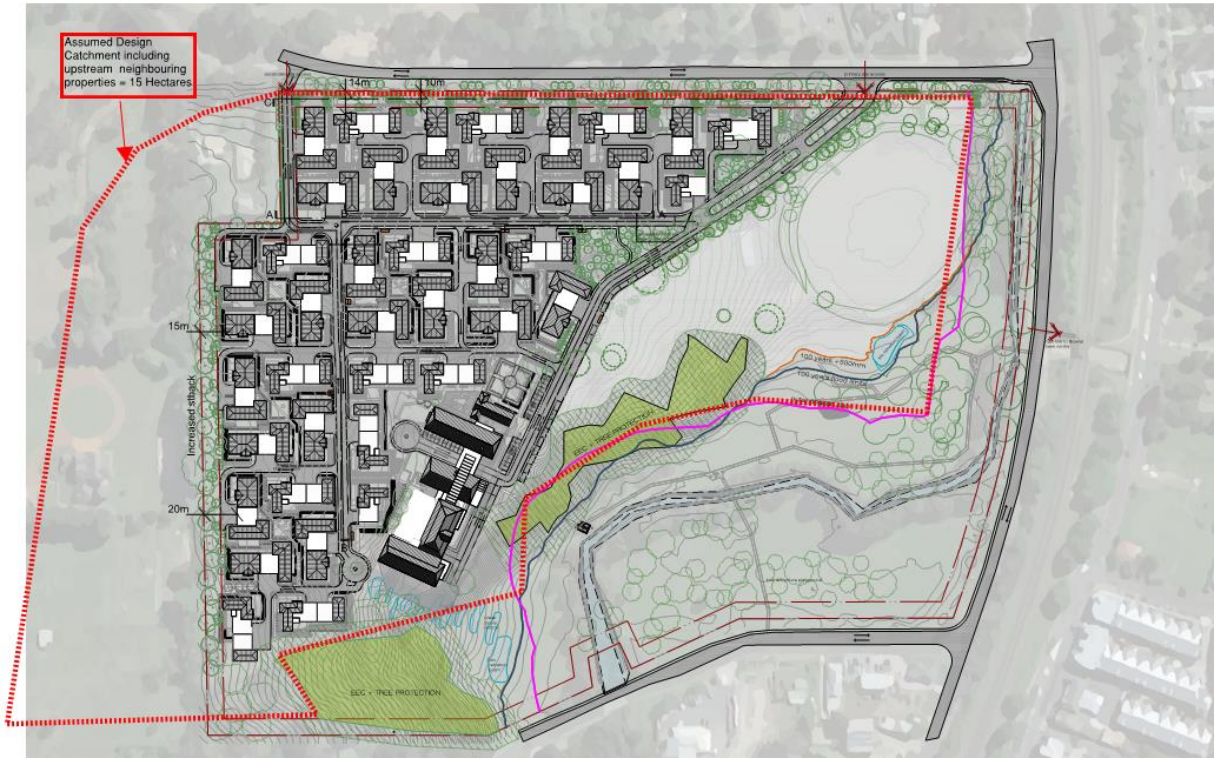

Figure 18 Catchment

5.0 CREEK DRAINAGE CONNECTIONS & RIPARIAN ZONE

Typical building developments in an urban environment normally direct stormwater runoff into an adjacent Council street drainage system within a public road reserve, but the large subject site provides the opportunity to take advantage of a natural watercourse that promotes natural soil infiltration as a desirable water sensitive urban design measure. The proposed stormwater pipe network associated with the new development works is intended to collect and convey runoff from the roof catchments, impervious driveways and paths around the new buildings towards bioretention and detention storages prior to discharge at appropriate locations into Mittagong Creek. This is anticipated to involve direct connection into the existing creek embankment with a new headwall and energy dissipator arrangement to accommodate flow into the watercourse. A sample outlet configuration is shown in the following images (Figures 19 & 20).

BCP PRECAST

DISSIPATOR HEADWALLS

Units are Made To Order

RCP Pipe size 225 to 375

RCP Pipe Size	Hole Dia mm	Mass kg	Order Code
225	320	1330	HWD-00225
300	400	1860	HWD-00300
375	485	2000	HWD-00375

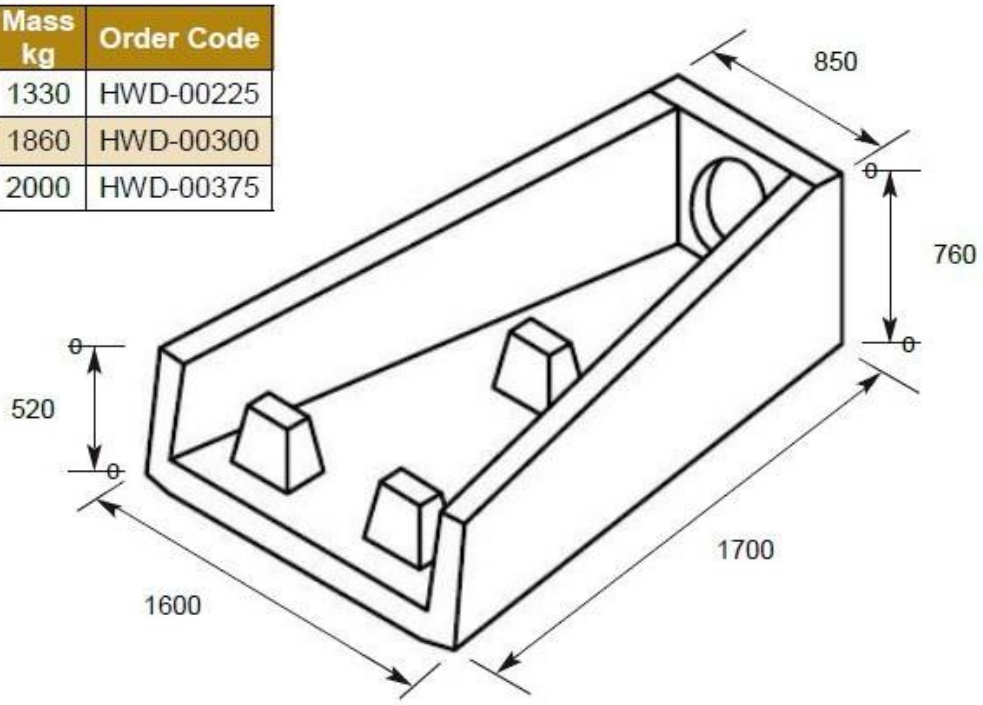

FIGURE 19 - Sample Headwall & Energy Dissipator Arrangement

FIGURE 20 – Sample Headwall Photograph

Proposed works in the vicinity of local creeks are typically controlled with the approval of the New South Wales Office of Water. The relevant requirements are related to the determination of the watercourse type that corresponds to the channel and adjacent vegetation (called the riparian corridor, as shown below in Figure 21).

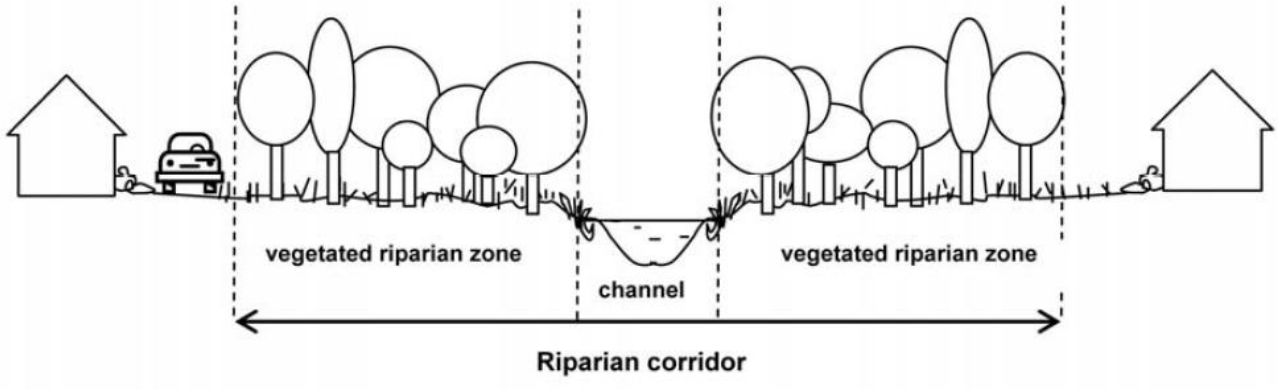

FIGURE 21 – Sectional view of a riparian corridor

It is understood that the main creek is classified as a 4th order watercourse with a 40 metre Vegetated Riparian Zone (VRZ) allowance from the top of the embankment on each side of the creek. The northeast tributary is considered to be a 3rd order watercourse with a 30 metre Vegetated Riparian Zone.

The matrix below (Figure 22) indicates that stormwater outlet structures such as headwall installations are permitted (shown by a black dot) as a controlled activity, where approval has been obtained from the Office of Water.

Riparian corridor matrix

The riparian corridor matrix enables applicants to identify certain works and activities that can occur on waterfront land and in riparian corridors. Applicants should note that the matrix relates to controlled activity approvals under the WM Act only. They are still required to comply with other relevant government legislation, such as threatened species, flood planning levels and fisheries guidelines.

Table 2. Riparian corridor matrix

Stream order	Vegetated Riparian Zone (VRZ)	RC off-setting for non RC uses	Cycleways and paths	Detention basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1st	10m	●	●	●	●	●	●	●		
2nd	20m	●	●	●	●	●		●		
3rd	30m	●	●	●		●			●	●
4th +	40m	●	●	●		●			●	●

FIGURE 22 – Riparian corridor matrix

6.0 ON-SITE DETENTION STORAGE

Reference is made to the requirements of Wingecarribee Shire Council – Development Design Specification D5 Stormwater Drainage Design – Section D5.22 Stormwater Detention. The extract below (Figure 24) indicates Council's detention storage requirements.

STORMWATER DETENTION

D5.22 STORMWATER DETENTION

1. Installation of Stormwater Detention may be required for any development site within the Shire. Confirmed as requirement during discussion with Council engineer on 8 DEC 2017	***Application***
2. For all situations, the maximum discharge for the 1:100 year storm shall not exceed the pre-development discharge, unless it is demonstrated by means of a hydraulic assessment that it is not required. The allowable discharge for the 1:10 year storm from a development site is to be limited to 0.04l/s per m^2 of the allotment area where the discharge is to kerb and gutter. A further limitation of 32l/s per discharge point with a minimum spacing of 15 metres between discharge points shall also be applied. If the stormwater runoff generated from the total developed site is greater than the above criteria an On Site Stormwater Detention System shall be designed so the above requirements can be met. The contributing catchment and the capacity of the downstream drainage system shall be assessed in the design of the discharge points and detention system.	***Criteria***
3. A risk assessment shall be undertaken of the Stormwater Detention storage to ascertain if fencing or other protection including signage is required. This assessment shall be submitted with the design. As a general principle, if the Stormwater Detention required is greater than 300mm water depth, it will require fencing and the impacts on the total catchment shall be considered.	***Access to Detention Storages***
4. The installation of underground detention facilities in residential developments or pumped discharge facilities for any developments will not be approved. A large catchment with steep slopes and low-lying flooded areas is not considered practical for shallow landscaped basins to store large volumes, so underground storage is proposed 5. Stormwater detention for each single torrens title allotment created by subdivision is required whether in the form of a rainwater tank and/or infiltration unit, or another system as approved in writing by Council. 6. Stormwater detention for public infrastructure may be in the form of oversized stormwater pipes, surcharging wetland systems or detention basins, or another system as approved in writing by Council.	***Underground or Pumped Prohibited***

It is noted that Council has a preference for shallow ponding in detention basins (maximum 300mm depth), but for a very large development catchment exceeding 100,000 square metres, together with steep natural surface slopes and low-lying flood-affected creek areas, it is considered more suitable to this development and provides a much more reduced risk to the village residents to contain detention storages in underground tanks with greater available depth to contain large volumes in a safer way.

The underground tanks, associated GPTs and all stormwater water quality control works will be subject to regular maintenance by the operator of the development in accordance with the established Operations and Maintenance Manuals.

Using DRAINS software as distributed by Watercom, modelling of the existing and proposed flows from a design catchment of 150793 hectares(Combined Stage 1 and 2) was undertaken, with 9% existing impervious proportion increasing to 45% proposed impervious proportion for a range of statistical frequencies and storm durations. The large southern part of the site remains fully pervious for design purposes. The DRAINS results determined that a minimum design storage volume of 2,321m^3 was sufficient to demonstrate that post-development flows would not exceed pre-development flows. For conceptual calculation purposes this allowance can be proportioned to suit different locations, provided the total combined flow from the individual tanks do exceed the predevelopment flows. In the final design layout the actual distribution and tank geometry will be modelled to reflect the design layout for the individual detention storage locations.

The table below (Figure 25) provides a summary of flows and water levels derived from the DRAINS software model for six On-Site Detention (OSD) locations(combined Stages 1 and 2). For each Average Recurrence Interval (ARI), the green column proposed flow values must be no higher than the corresponding yellow column existing flow values.

STORMWATER DETENTION CALCULATION SUMMARY

Project: 2017-1356 2-18 Centenial Rd Bowral

	5 YEAR ARI								20 YEAR ARI								100 YEAR ARI							
Storm Duration	Existing Flow m3/s	OSD1 Outflow m3/s	OSD2 Outflow m3/s	OSD3 Outflow m3/s	OSD4 Outflow m3/s	OSD5 Outflow m3/s	OSD6 Outflow m3/s	Total Outflow m3/s	Existing Flow m3/s	OSD1 Outflow m3/s	OSD2 Outflow m3/s	OSD3 Outflow m3/s	OSD4 Outflow m3/s	OSD5 Outflow m3/s	OSD6 Outflow m3/s	Total Outflow m3/s	Existing Flow m3/s	OSD1 Outflow m3/s	OSD2 Outflow m3/s	OSD3 Outflow m3/s	OSD4 Outflow m3/s	OSD5 Outflow m3/s	OSD6 Outflow m3/s	Total Outflow m3/s
5min	3.660	0.605	0.264	0.443	0.958	0.166	0.432	2.868	5.940	0.808	0.402	0.580	1.240	0.316	0.548	3.894	8.390	1.060	0.454	0.757	1.490	0.427	0.700	4.888
10min	3.250	0.641	0.267	0.483	0.939	0.253	0.436	3.019	4.830	0.868	0.388	0.642	1.240	0.399	0.576	4.113	6.700	1.160	0.512	0.848	1.450	0.474	0.762	5.206
15min	3.820	0.711	0.379	0.530	1.070	0.298	0.494	3.482	5.650	0.962	0.422	0.703	1.400	0.454	0.647	4.588	7.610	1.240	0.552	0.890	1.520	0.493	0.812	5.507
20min	3.740	0.735	0.370	0.553	1.060	0.323	0.493	3.534	5.440	0.991	0.445	0.733	1.390	0.464	0.652	4.675	7.370	1.270	0.581	0.882	1.520	0.503	0.826	5.582
25min	4.000	0.767	0.379	0.576	1.140	0.337	0.529	3.728	5.760	1.030	0.456	0.765	1.390	0.467	0.694	4.802	7.250	1.270	0.546	0.893	1.520	0.497	0.837	5.563
30min	3.620	0.718	0.375	0.542	1.070	0.306	0.497	3.508	5.230	0.972	0.419	0.722	1.360	0.458	0.656	4.587	6.660	1.210	0.517	0.885	1.470	0.474	0.802	5.358
45min	3.010	0.637	0.262	0.485	0.915	0.257	0.431	2.987	4.430	0.879	0.385	0.657	1.250	0.420	0.583	4.174	5.920	1.130	0.478	0.835	1.410	0.470	0.735	5.058
1.0hr	3.090	0.638	0.290	0.488	0.963	0.256	0.453	3.088	4.530	0.869	0.389	0.654	1.240	0.417	0.590	4.159	6.210	1.140	0.510	0.850	1.400	0.483	0.761	5.144
1.5hr	3.240	0.651	0.301	0.497	0.992	0.263	0.465	3.169	4.780	0.872	0.395	0.660	1.300	0.415	0.599	4.241	6.450	1.130	0.510	0.847	1.400	0.480	0.758	5.125
2.0hr	3.370	0.668	0.272	0.505	0.943	0.266	0.448	3.102	4.820	0.919	0.385	0.682	1.300	0.438	0.604	4.328	6.320	1.170	0.521	0.863	1.420	0.483	0.758	5.215

MINIMUM TOTAL DESIGN STORAGE VOLUME =	2321	m3
CATCHMENT AREA DRAINED TO DETENTION =	150793	m2
EXISTING IMPERVIOUS PROPORTION =	9	%
PROPOSED IMPERVIOUS PROPORTION =	45	%

FIGURE 25 – Detention Flow & Depth Calculation Summary

In accordance with the conceptual DRAINS model detention storage analysis, a total minimum 2,321m3 detention storage allowance is proposed to be constructed below ground level.

7.0 RAINWATER STORAGE

Reference is made Wingecarribee Shire Council – Bowral Town Plan Development Control Plan – Version 8 dated September 2015 – Section A3.6 Water Sensitive Urban Design – Section A3.6.3 Controls. The extract below (Figure 26) indicates Council's relevant controls.

A3.6.3 Controls

WSD controls are to be satisfied for all development applications and integrated into the Water Cycle Management Study (or equivalent plan) for the proposed development and included in all modelling conducted (e.g. MUSIC or small-scale stormwater quality modelling).

Objective 1: Conservation of potable water

Controls:

1. All development within the shire is to utilise potable water efficiently. For residential dwellings including houses and units, the requirements of BASIX ensures the development complies with NSW planning requirements to conserve water. For all other development within the shire, the following must be achieved:
   (a) Minimum 3A* star rated shower heads, tap fittings and toilet flush systems.
   (b) Installation of rainwater tank/s to be utilised on site for watering of landscaping and may be plumbed to toilets and/ or laundry facilities. Size of tank will vary in accordance with development type and capacity to utilise water onsite. Rainwater tanks should be sized to capture (at minimum) the first 10mm of rainfall runoff from all building roofs proposed onsite.

**3A star rating means a fixture or appliance is rated to that level of water efficiency in accordance with AS/NZS 6400:2005 Water efficient products rating and labelling.*

FIGURE 26 – Extract from Council DCP for rainwater storage requirements

Rainwater storage requirements for new residential dwellings are typically provided to satisfy State Environmental Policy Building Sustainability Index (BASIX) assessment requirements. Relatively clean runoff from the roof drainage system is normally collected for reuse purposes, and remains separate from the more contaminated runoff collected from surface drainage which may accumulate leaves, sediment and other debris. Non-potable uses such as the supply to garden hose taps, irrigation and toilet flushing may be nominated in the BASIX tool.

Leafguards provided on lengths of roof guttering are recommended, particularly in bushfire prone areas where dry leaves and other flammable debris may be collected at roof level. This can also reduce the pollutants which may find their way into a rainwater storage tank and cause discolouration of the non-potable water supply. A rainwater pump is to be provided to pressurise the rainwater service and maintain minimum flow performance requirements at the relevant fixtures and taps. A backup mains supply should be fitted with an appropriate backflow prevention device to ensure that contaminants in the rainwater tank will not pollute the public drinking water system and that taps will still function during a power failure.

Preliminary BASIX advice indicates a typical 2500L rainwater tank for each private individual dwelling unit and a common 10,000L rainwater tank for the central community building. The conceptual layout below (Figure 27) indicates a simplified view of the basic components within the proposed drainage system. Final locations and actual drainage sequence will be arranged to suit the site constraints as required.

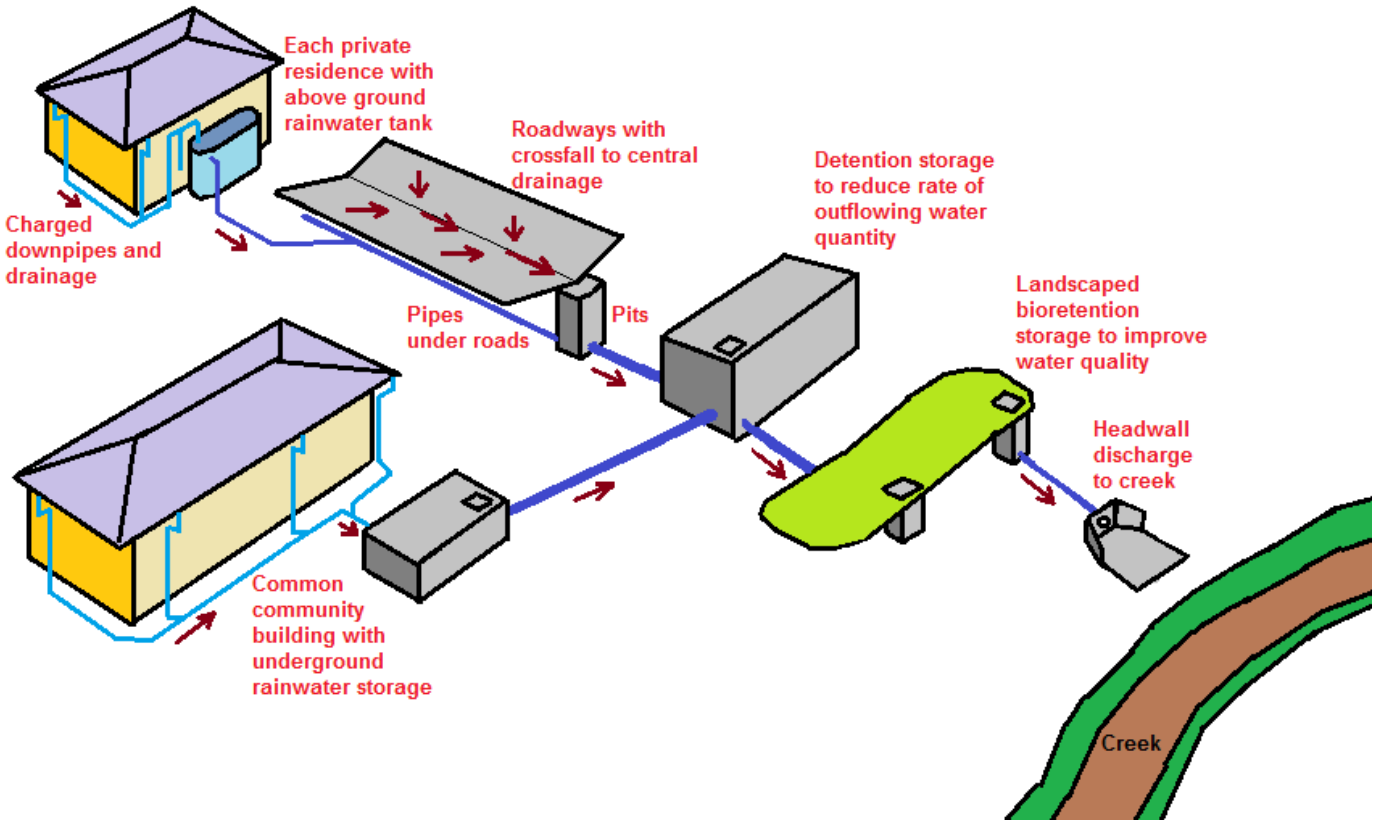

FIGURE 27 – Conceptual drainage diagram with rainwater tanks and basic drainage system components

Due to a constrained spatial layout, the On-Site Detention (OSD) tanks are located upslope of the bioretention basins. Also, from an access and maintenance perspective, the OSD tanks are located within roadways.

8.0 STORMWATER QUALITY IMPROVEMENT MEASURES

Reference is made Wingecarribee Shire Council – Bowral Town Plan Development Control Plan – Version 8 dated September 2015 – Section A3.6 Water Sensitive Urban Design – Section A3.6.3 Controls. The extract below (Figure 28) indicates Council's controls for stormwater quality improvement.

Objective 3: Protection of water quality entering natural ecosystems and waterways

Controls:

3. All development within the shire must comply with the requirements of *SEPP (Drinking Water Catchment) 2011* to ensure water quality exiting a site post development achieves a neutral or beneficial effect (NorBE) in comparison to pre-development water quality runoff.

4. Development which proposes to re-develop an existing, developed site (particularly those used previously for commercial and/ or industrial purposes), the proposed development must comply with one of the following, whichever provides the greatest treatment of water:
   (a) Water quality exiting a site post-development must achieve a neutral or beneficial effect (NorBE) in comparison to pre-development water quality runoff (in accordance with *SEPP (Sydney Drinking Water Catchment)* 2011.
   (b) Post-development water quality runoff must achieve the following targets as improvements to the pre-development water quality runoff exiting the site:
      (i) 85% reduction in the average annual total suspended solids loads.
      (ii) 65% reduction in the average annual total phosphorus load.
      (iii) 45% reduction in the average annual total nitrogen load.
      (iv) 90% reduction in the average annual gross pollutant (size >5mm) load.
      (v) To retain sediment coarser than 0.125mm for flows up to 25% of the 1 year ARI peak flow.
      (vi) To ensure no visible oils for flows up to 25% of the 1 year ARI peak flow, in areas with concentrated hydrocarbon deposition.

(Source: Draft Environmental Targets *DECCW Managing Urban Stormwater*, in Coffs Harbour City Council *Water Sensitive Urban Design Policy)*

FIGURE 28 – Extract from Council DCP for stormwater treatment requirements

Stormwater quality improvement devices are typically selected to satisfy the relevant pollutant target performance criteria as demonstrated by a software package known as MUSIC (Model for Urban Stormwater Improvement Conceptualisation).

Refer to separate report prepared by Civil Development Solutions and corresponding MUSIC model analysis for details of proposed measures and performance characteristics.

9.0 CONCLUSION

This Stormwater Management Report for the proposed Waterbrook development identifies and addresses the following items for the development application assessment by Wingecarribee Shire Council :-

- Mainstream flooding effects are considered to be applicable to the site of the proposed works and require confirmation of permissible building locations and floor levels in accordance with Authority requirements;
- Local overland flow paths currently direct stormwater surface runoff towards the existing creek and this drainage principle is to be maintained as sheet flow between proposed building structures and along new roadway locations;
- The creek drainage connection is to incorporate headwall and energy dissipator arrangements in suitable locations to the approval of the NSW Office of Water;
- On-site detention is to be provided in accordance with Council requirements;
- Rainwater storage is to be provided to comply with BASIX assessment requirements; and
- Stormwater quality improvement measures are to be incorporated as described in a separate report prepared by Civil Development Solutions.