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FLOODING AND STORMWATER IMPACT ASSESSMENT FOR PROPOSED REZONING

**40 RAYFORD STREET,
19 DAYDAWN AVENUE AND 18 WINTERLAKE ROAD
WARNERS BAY**

Project: 16/155
JUNE 2018



PREPARED FOR:

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Document Register

Issue	Details of Change	Prepared	Reviewed	Date
A	Initial Issue for Discussion	BC		
B	Inclusion of Daydawn Avenue and 18 Winterlake Road	DE		3/08/2017
C	Inclusion of assessment of existing stormwater network	DE		25/06/2018

EXECUTIVE SUMMARY

This flooding and stormwater impact assessment has been prepared to support a proposed rezoning at 40 Rayford Street, 19 Daydawn Avenue and 18 Winterlake Road, Warners Bay. Site flooding and stormwater management, water quality control and stormwater detention are considered in the assessment together with examination of the localised downstream flooding and solutions for upgrading the existing system to accommodate the rezoning of the land.

The only identified watercourse across the subject land is located on 18 Winterlake Road in the northern portion of the site. The catchment to this water course is small and the flows have been considered as part of this assessment. There is no known source of external flooding onto the subject land apart from runoff generated from the site catchment.

The existing downstream drainage system is known to be at or exceeding capacity in minor to moderate storm events. The results of this assessment show that modification of the existing system and construction of detention basin(s) on the subject lands will reduce the load on the downstream system and consequently remove any localised flooding of the existing system for design storms up to the 10% AEP event.

Augmentation of the existing system and construction of onsite detention structures on the subject land will rectify a known flooding issue within the Fairfax Road precinct. The proposed onsite detention structures, to be constructed as part of the development of the subject land, will ensure that discharge from the developed site will be regulated to predeveloped flows for all rainfall events up to and including the 1% AEP event. Nutrient control for the proposed development site will be achieved using a proprietary SPEL, or similar, water management structure to ensure nutrient loads of any discharge waters are treated to required standards.

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1.0 INTRODUCTION

This flooding and stormwater impact assessment has been prepared on behalf of Warners Bay Holdings Pty Ltd to support a planning proposal at 40 Rayford Street, 19 Daydawn Avenue and 18 Winterlake Road, Warners Bay.

The aim of this assessment is to determine the impacts of rezoning part of the land for residential development and to provide solutions to the flooding impacts and known inefficiencies in the downstream drainage system. For the purpose of this report, the investigation was limited to topographic assessment of LIDAR contours, aerial imagery, detail surveys and CCTV investigation of the existing stormwater system.

1.1 EXISTING SITE DESCRIPTION

The subject land is described by Lot 6 DP 814499 at 40 Rayford Street, Lot 100 DP 1173625 at 19 Daydawn Avenue and Lot 350 DP 776503 at 18 Winterlake Road, Warners Bay. The subject land is bounded by Munibung Hill in the west and existing residential development in the east. Existing use of the subject land is limited to rural activities.

The subject land is accessed by Winterlake Road in the north and Rayford Street and Daydawn Avenue in the south. Rayford Street and Daydawn Avenue have been constructed with a T-shaped turning head, with one 'leg' of the intersection facing to the north. It is likely that the future development of the subject land will connect between Rayford Street and Winterlake Road. Winterlake Road has been constructed as an 11m wide carriageway with kerb and gutter and a concrete footpath located immediately beside the kerb on each side.

1.1 SITE TOPOGRAPHY

Topographic features of the subject land are described by four distinct areas: The western most area is the east-facing escarpment of Munibung Hill. This upper western area is regarded as being very steep, at times up to 1V:1H or 45° inclination with densely vegetated surfaces in an elevation range from RL70-115m AHD.

The upper middle area is moderately sloping up to 15% and in an elevation range from RL 60-76m AHD. This portion of the site is mostly cleared and currently used for livestock grazing.

The lower middle area of the site is steep with grades ranging up to 30% (17° inclination). This portion of the site has a varying degree of vegetation, from fully cleared to densely vegetated, particularly within the southern half of the site. This area of the site ranges in elevation from RL 35-RL70m AHD.

The lower slopes are the area subject to the planning proposal. Slopes in this area range from 5-10%, and in elevation from RL26-35m AHD. This area contains a number of low flat gullies that drains runoff from the upper three areas toward the eastern boundary outlet points. Lower slopes are intersected by a series of fences for the containment of horses kept on the property.

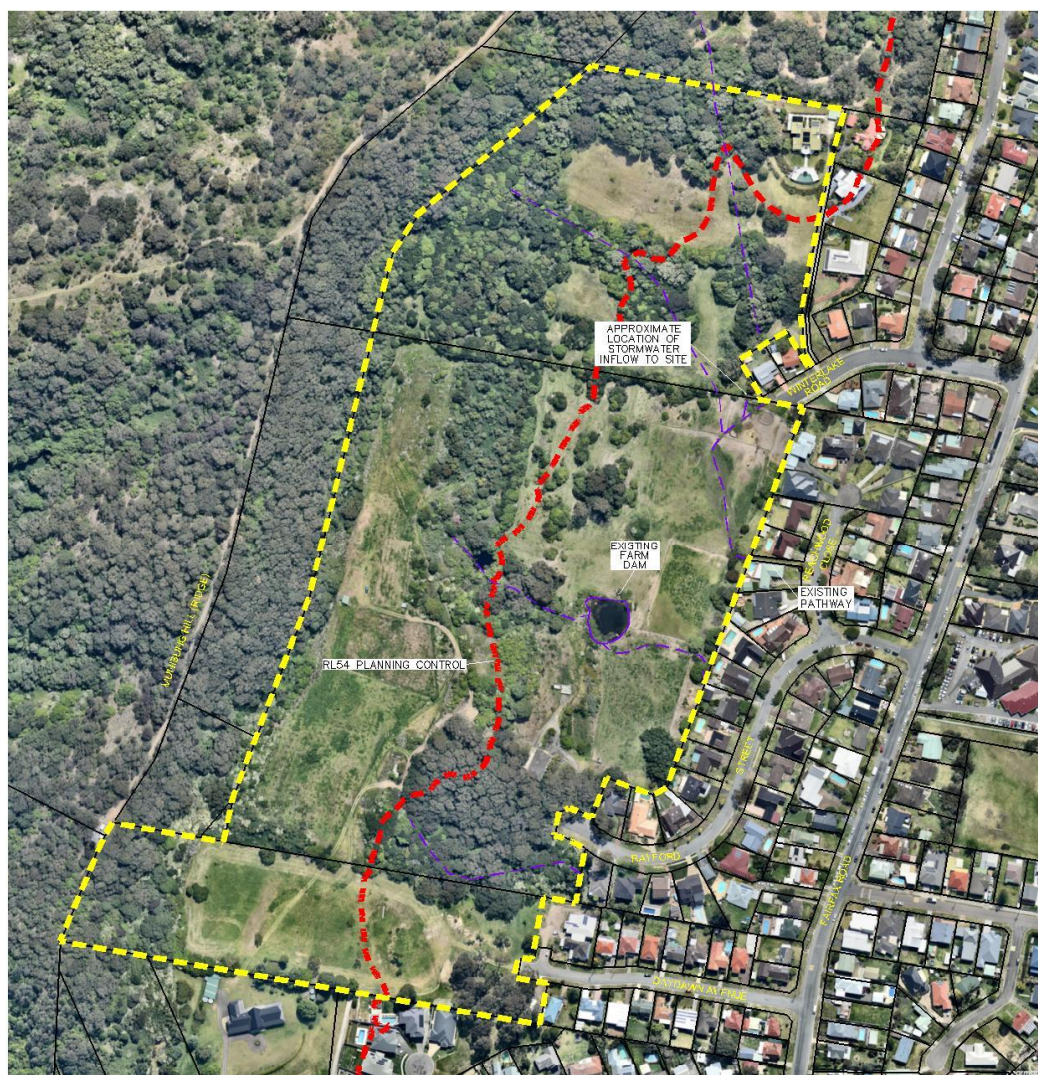


Figure 1: Existing Site Features

1.2 PLANNING GUIDELINES

1.2.1 EAST MUNIBUNG HILL PRECINCT PLAN

Development controls exhibited in the East Munibung Hill Precinct Plan¹ indicates limited development potential above RL54m AHD. Slope stability constraints identified in the Geotechnical assessment² suggest development potential above the lower slopes is limited, and any such development may require remedial works, such as surface and sub-surface drainage paths and soil stabilisation measures prior to development. The lower slopes are investigated as part of the rezoning application.

1.2.2 LAKE MACQUARIE CITY COUNCIL DCP

Lake Macquarie City Council (LMCC) identifies sustainable water cycle management as an essential planning criterion for development; to minimise the negative impacts of increased urban activity on the City's waterways and lake. All development within the Lake Macquarie's local government area must provide for sustainable water cycle management, in accordance with LMCC's Development Control Plan³

¹ Lake Macquarie Development Control Plan 2014 – Revision 12, Part 12 – Precinct Area Plans – East Munibung Hill, December 2016

² Regional Geotechnical Solutions – Slope Stability Assessment RGS01 426.1-AB, 6 December 2016

³ Lake Macquarie Development Control Plan 2014 – Revision 12, Part 8 – Subdivision Development, December 2016

2.0 FLOODING ASSESSMENT

2.1 *SITE HYDROLOGICAL CONTEXT*

In the context of the overall catchment, the subject land is positioned on the south east facing slopes of Munibung Hill. The Munibung Hill escarpment contains dense native vegetation with a thick canopy and ground cover. The remainder of the subject land has been mostly cleared, with a thick grass cover, except on the lower slopes where the grasses are kept generally shorter on account of grazing horses.

The use of infiltration techniques for cleaning stormwater and promoting sub-surface flows is not suited to the lower slopes due to the presence of clay soils. Vegetation throughout the site will be retained where possible.

2.2 *STORMWATER OUTLETS*

There are four apparent outlets for stormwater runoff from the subject land. These are labelled as Outlets A-D on Figure 3 and as shown in Photographs 1-3.

Outlet A is a formal overland flow path between Lots 8 and 9 DP 244868 at 5 and 7 Peachwood Close. This formal flowpath contains a 675mm diameter concrete stormwater pipe connecting with the stormwater pit and pipe system in Peachwood Close. A grassed channel aligned along the boundary of the subject land, intercepts surface flows from a greater area and channels this toward Outlet A.



Photograph 1: Outlet A, looking from the subject land toward Peachwood Close

Outlet B is a small diameter pipe draining through an easement over Lot 8 DP249244, 12 Rayford Street. This pipe is not recorded on Council's stormwater records and is therefore assumed to connect to the existing stormwater pit at the front of number 10 Rayford Street. At the time of field investigation, this drain was described as frequently overtopping and causing inundation of the rear surrounds of this affected property. It is noted that the flooding of this drain coincided with overflows of the farm dam located approximately 50m upslope of the property.



Photograph 2: Outlet B, looking to the south.

Outlet C is the turning head at the end of Rayford Close. The remaining portion of the site drains toward a steep gully in the south, which tends toward the southeast corner. The details of this outlet (Outlet D) were not recorded as part of this study.

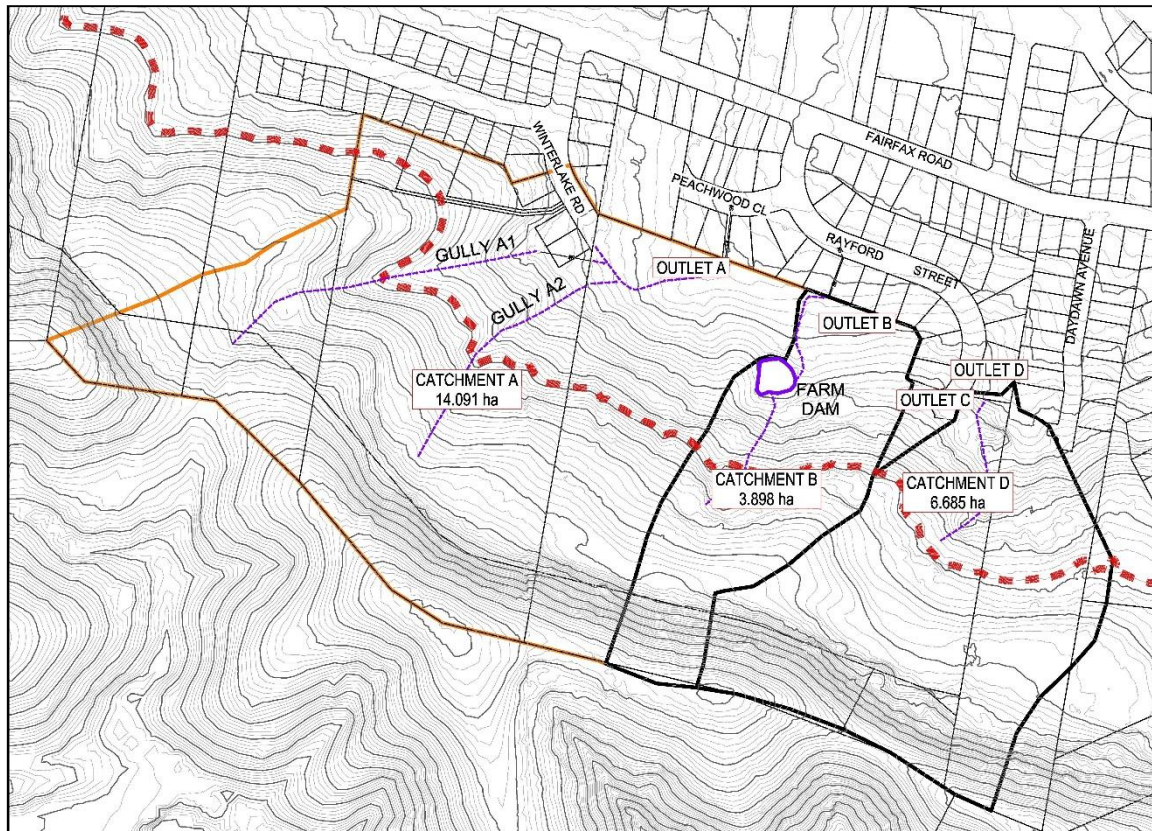


Figure 2: Existing Site Catchments

2.3 STORMWATER CATCHMENTS

Features of the topography, including farm dams and gullies, concentrate stormwater runoff shown by the catchment boundaries on **Figure 2**. Catchment A, which extends well beyond the northern limits of the subject land, has been further delineated into the individual sub-catchments draining through Gullies marked A1 and A2. A headwall outlet visible at the end of Winterlake Road is assumed to be directing flows from Gully A1 around or underneath number 20 Winterlake Road. Outflows from this headwall currently discharge across the northern boundary of the subject land and dissipate across the natural landform toward Outlet A. There are no apparent stormwater pits at the end of Winterlake Road collecting surface flows from the end of the pavement. Outlet D extends beyond the limits of the southern boundary.

2.4 FLOODING

The subject land lies within the regional catchment draining ultimately through North Creek at Warners Bay. The land is not identified on the LEP⁴ as flood-prone. All storm flows leading to Outlets A-D are caused by runoff from the catchments identified on Figure 3.

HYDROLOGICAL/HYDRAULIC MODEL

A computer model was established with the 12d Model software using event-based simulation of storm events to determine the runoff quantities in accordance with Australian Rainfall and Runoff 2016.

The pre-developed site was modelled with an impervious fraction of zero. Development within the lower slopes, identified as part of the proposed rezoning has an adopted impervious fraction of 60%.

⁴ Lake Macquarie City Council Local Environmental Plan (LEP) 2014

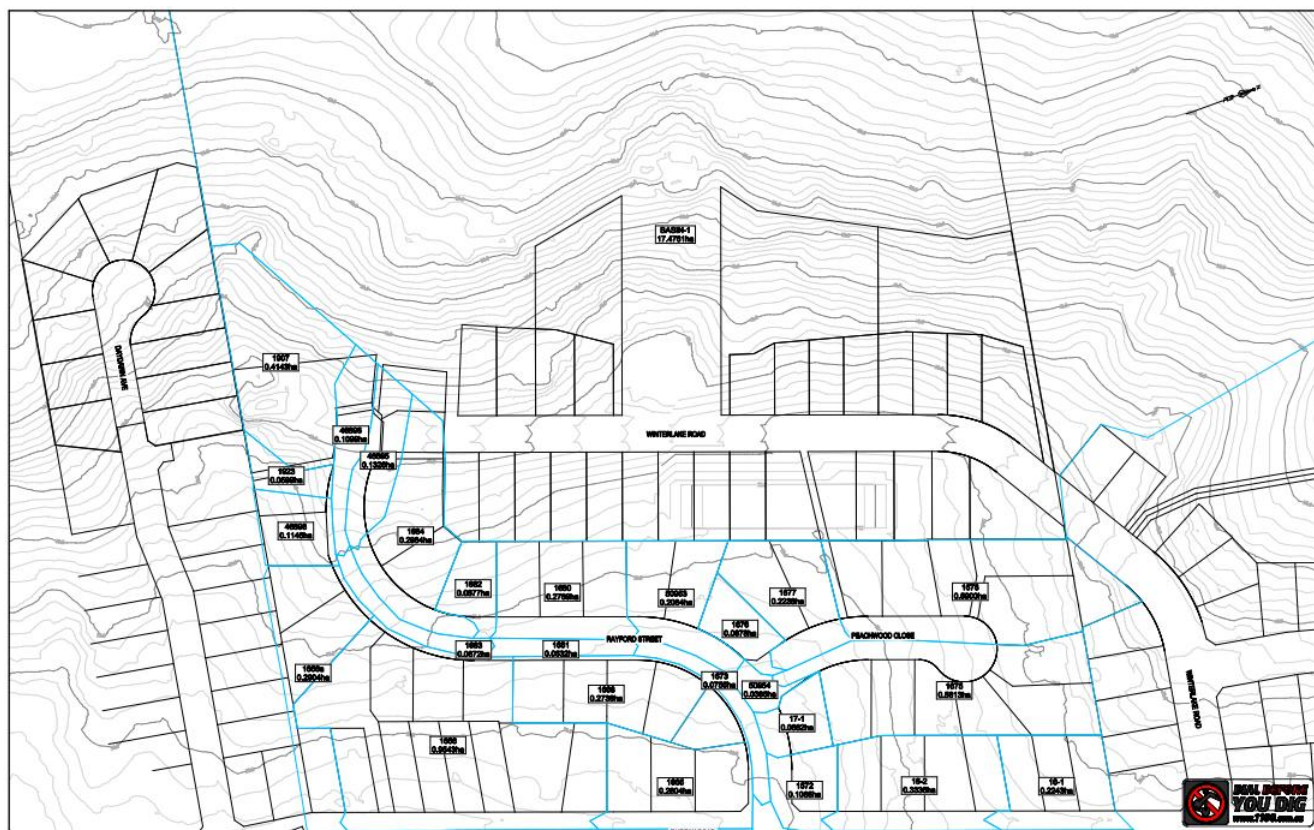


Figure 3: Proposed Developed Catchments

Horton infiltration (ILSAX) was utilised with final infiltration rates of 25mm/hr and relatively wet conditions prior to the start of the storm. Time of concentration for each of the model nodes was based on the Kinematic Wave equations adopted in AR&R. The surface roughness coefficients adopted was $n=0.4$ for rural surfaces. The results of such analysis generally gave minimum times of 5 minutes for directly connected impervious surfaces such as roads and roofs, and pervious area times dependent on flow path length, slope and roughness.

2.1 ESTIMATED PEAK FLOWS

The estimated peak flows from the pre-developed computer model are outlined in Table 2-1. For the purposes of the drainage analysis all flows are considered through Outlet A (Peachwood Close) and from Outlet D (Headwall Southern Most Outlet).

Table 2-1 Catchment Outflow Summary

	63.2%AEP 1 YR ARI (L/s)	18.13%AEP 5 YR ARI (L/s)	10%AEP 10 YR ARI (L/s)	1%AEP 100 YR ARI (L/s)
Outlet A	349	1377	1937	5037
Outlet D	257	809	1015	1993
TOTAL	606	2186	2952	7030

The existing pipe draining to Peachwood Close at Outlet A is undersized for the contributing upstream catchment. From the calculated discharge rates it is expected that the excess flow is conveyed along the grassed channel to Peachwood Close.

Lake Macquarie Council provided information from their GIS system regarding the downstream stormwater system which was included in the drainage model. Pipe sizes and types were confirmed by field survey and CCTV investigation.



OUTLET A



OUTLET D

2.2 KNOWN PROBLEMS WITHIN THE EXISTING NETWORK

LMCC is aware of localised flooding downstream of the subject lands during most rainfall events, particularly at the intersection of Fairfax Road and Rayford Street (Adjacent to Warners Bay Private Hospital).



Figure 4 - Existing Network with Identified Issues

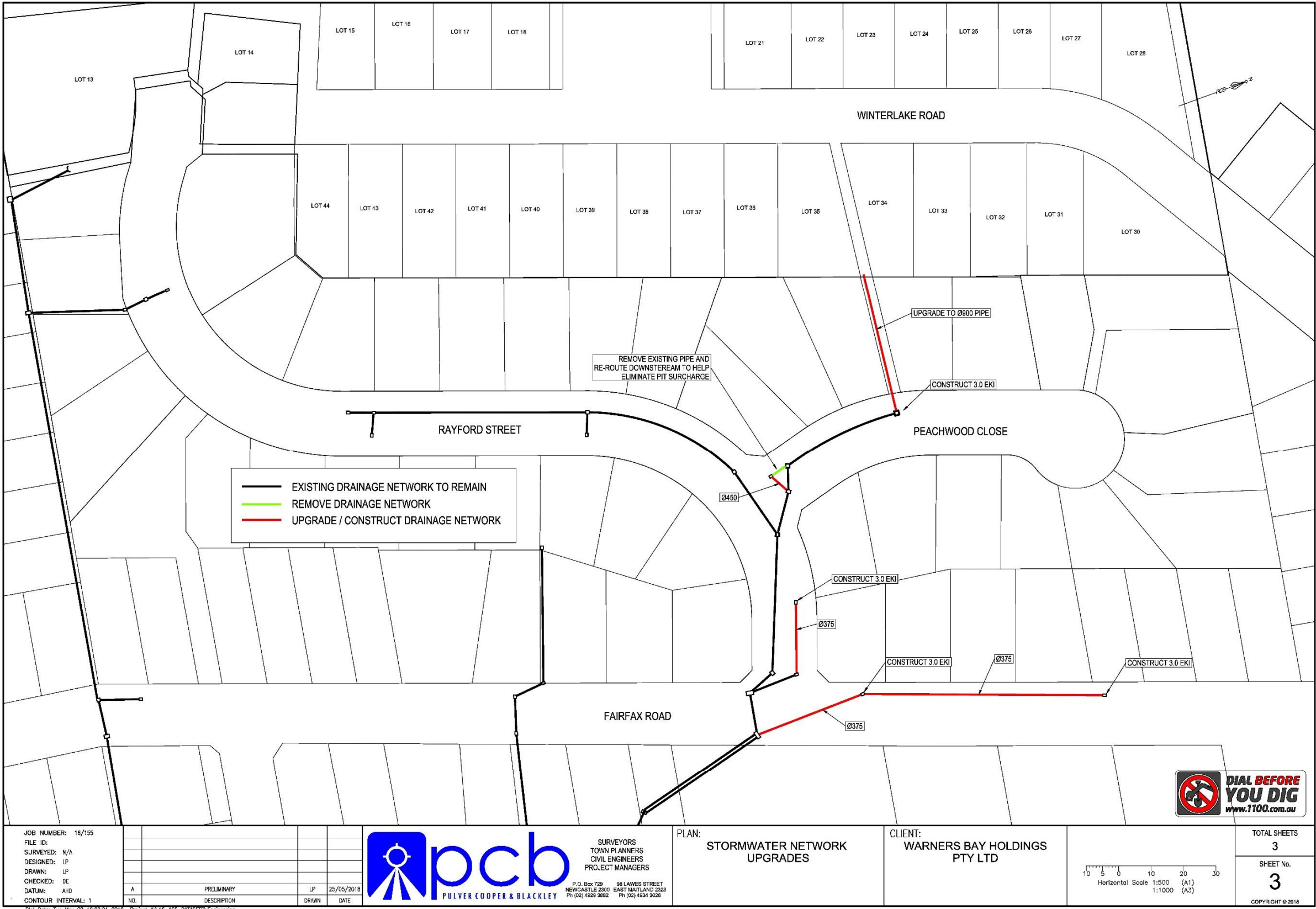
A detailed hydrological examination of the existing stormwater network was undertaken to identify the current operational capacity of the network. Figure 4 identifies problem areas that must be addressed to satisfy the 10% AEP design guidelines established by LMCC.

2.3 UPGRADES TO THE EXISTING NETWORK

The analysis of the existing network included an assessment of upgrades that will enable the existing system to operate without surcharge or flooding for all rainfall events up to the 10%AEP event. The following network upgrades were identified;

1. Additional Pits & Pipes on Fairfax Road – The additional pits will capture flows and convey them directly into the network, assisting in the elimination of localised ponding at the sag pit (1672) located on the corner of Rayford Street & Fairfax Road. The additional pits will reduce flow widths and any likely bypass flow that currently occurs in a storm event.
2. Additional Pit Rayford Street – The insertion of a 3.0 Extended Kerb Inlet upstream of sag pit (1672), will assist in conveying bypass/gutter flow from upstream into the pipe network consequently reducing localised ponding at the sag pit.
3. Re-configuration of pit & pipes on the corner of Rayford Street & Peachwood Close by removing the existing pipe between Pits 1677 & 1676 and relaying a pipe from Pit 1677 to Pit 1675. This modification of the existing system will improve flow through the network and minimise any surcharge occurring from a given storm event.
4. Upsize Pit, Pipe & Headwall - Upgrade the existing 600mm pipe connecting Headwall (1679) & Pit 1678 to a 900mm concrete pipe. This upgrade will ensure that current and future flows are captured more readily by the existing system.

2.4 PROPOSED UPGRADES PLAN



3.0 STORMWATER MANAGEMENT STRATEGY

3.1 DESIGN PRINCIPLES

Proposed development of the subject land is limited to the creation of lots that have a street frontage. Future subdivision development of the subject land will place the extension of Winterlake Road aligned with the end of the turning head in Rayford Street, affording approximately 40m deep lots on the eastern side with smaller length properties on the western side. The orientation and alignment of lots will be dictated by the road layout.

The natural landform upslope of the proposed development will generally remain undisturbed. This is to reduce the likelihood of further vegetation loss and soil retention. Street trees will be designed to both sides of the proposed road extension in accordance with council's landscape design principles.

There are no known trunk drainage lines through the subject land, or leading directly from the subject land as the land is located at the extremity of the catchment(s). Drainage across the site is only attributed to direct runoff from the site. Most of the runoff from the catchment is sourced from the considerably larger areas upslope of the proposed rezoning areas. Runoff from the undeveloped upslope areas will need to be channelised to either the existing the farm dam or another purpose built catchment basin through a series of cross-slope earth mounds. This system of surface cut-off drains has also been identified in the Geotechnical report as a control measure for some of the risks associated with slope stability. The existing farm dam embankment will need to be re-built under geotechnical design and supervision, to ensure embankment stability. The re-constructed farm dam or purpose built basin should be constructed as a dry detention basin to a depth that is sufficient to ensure outflows are piped safely to the outlet.

Concentrated flows approaching the site, such as from the headwall outlet near Winterlake Road and the farm dam outlet, will be directed along the Winterlake Road extension to a sag point located approximately adjacent to the pathway extension from Peachwood Close. The stormwater pipe will interconnect with the existing pipe in this pathway.

3.2 INTEGRATED STORMWATER DETENTION

A conceptual hydrological model was integrated with the existing downstream stormwater network for the proposed residential development at 40 Rayford Street, 19 Daydawn Avenue and 18 Winterlake Road, Warners Bay.

The analysis identified that the development requires an on-site stormwater detention facility or facilities with a storage capacity of 5000m³. The detention facility will also require a structured outlet that permits flows that do not adversely affect flow volumes downstream of the development.

The final arrangement and location of the detention facility and subdivision layout is subject to further approval following the rezoning of the land. Figures 6 & 7 depict potential detention basin locations.



Figure 5 - Detention Basin Arrangement Option 1



Figure 6 - Stormwater Detention Arrangement Option 2

Rainwater tanks provided for each lot will have the effect of reducing mains water usage as well as reducing the peak of runoff for storms of smaller intensity. The same tanks tend to fill quickly in storms of higher intensity and have very little benefit in total storage for the more extreme weather events. Rainwater tanks were not modelled as part of this investigation.

3.3 **PRE-DEVELOPED vs POST DEVELOPED SITE DISCHARGE**

Table 3-1 - Pre vs Post Developed Site Discharge

	63.2%AEP 1 YR ARI (L/s)	18.13%AEP 5 YR ARI (L/s)	10%AEP 10 YR ARI (L/s)	1%AEP 100 YR ARI (L/s)
Outlet A	349	1377	1937	5037
Outlet D	257	809	1015	1993
Pre-Developed	606	2186	2952	7030
Outlet A	0	906	1175	2130
Outlet D	60	122	129	187
Post Developed	60	1028	1304	2317

3.4 **STORM WATER QUALITY**

Discussions with LMCC have identified that stormwater quality for the subject land will best be provided by a proprietary water quality device similar to a SPEL system. This type of device is preferred to an infiltration type system due to the history of land slip on the site created by excess subterranean water. For the purposes of this report it is assumed that an appropriately sized SPEL system will be available for the treatment of nutrients from the proposed development.

3.5 **EROSION AND SEDIMENTATION CONTROLS**

Temporary measures adopted to control erosion during the construction phase would be maintained by the development contractor.

Construction of the proposed development would need to be sequenced in a manner that would divert 'clean' runoff from the undisturbed upslope surfaces around the development. The concept stormwater plan indicates that the existing farm dam is to be re-built to a suitable construction standard. It is recommended that this farm dam be rebuilt first, along with the network of pipes linking with the site outlet. A temporary outlet pipe discharging from the farm dam may be necessary for the period of time over which the proposed road extension is under construction. This is to reduce the risk of high-volume flows draining onto the road surface.

Higher sediment loads can be expected from the disturbed surface of the road subgrade, footways and batters of the road extension until adequate road seal has been placed and full turf has been established on the road verge. Until this point, sediment fencing is recommended down slope of the disturbed surface to trap sediment flows on-site.

A separate Soil and Water Management Plan will be prepared when a Development Application is made for subdivision.

4.0 DISCUSSION AND RECOMMENDATIONS

The subject land at 40 Rayford Street, 19 Daydawn Avenue and 18 Winterlake Road Warners Bay is not impacted by flooding. Runoff from the subject land has been known to cause pit surcharge and flooding in the streets below the site resulting in localised flooding at the intersection of Rayford Street and Fairfax Road adjacent to Warners Bay Private Hospital.

Development of the subject land, implementation of the proposed stormwater management strategies and augmentation of the existing system will remove downstream flooding and pit surcharge from all storm events up to and including the 10% AEP rainfall event. It is encouraged that the upgrades to the existing stormwater network be completed irrelevant of any further development in the area.

This assessment has demonstrated that the subject land is suitable to be rezoned for residential purposes from a flooding and stormwater perspective and will not cause any adverse flooding or drainage impacts to the downstream properties provided that the existing stormwater system is augmented as outlined.