Ref Number: 8082 STW Report 160613 14 June 2016

Sutherland Shire Council

4-20 Eton Street, Sutherland,

NSW, Australia.

C/O Charles Koh, Geoform Architects

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Commercial Development – 84 Kiora Road, Miranda

On-Site Detention And Rainwater Tank Design

ISE Building Services has been engaged to size and document an on-site detention (OSD) and rainwater tank system for the proposed development located at 84 Kiora Road, Miranda.

The following is a summary of the detailed stormwater drainage design undertaken for the site. This report is largely based on the previous stormwater drainage design undertaken by EWFW Pty Ltd.

In preparing the detailed design documentation for the development some small changes have been made, predominately on how the size of the OSD and rainwater tank system have been determined, to ensure constructability of the proposed infrastructure, compliance with Council's requirements and industry best practice.

Further to the above we note that this report has taken into consideration Sutherland Shire Council's guidelines and requirements. If you have any questions or require any clarifications please call me on 0451 078 703.

Yours faithfully,

Mark Albury

Director

1 BACKGROUND INFORMATION

1.1 Site

The subject development area is located in the suburb of Miranda within Sutherland Shire Council Local Government Area (LGA). The site is bounded by Urunga Parade to the north, Kiora Road to the west, Urunga Lane to the East and adjoins an existing commercial development along the other (South) boundary. **Figure 1** below shows the location and boundary of the subdivision site, along with an approximate location of the existing pit within Kiora Road.

Figure 1: *Locality Plan (NSW SIX Maps 2016)*

The subdivision site drains in a south west direction towards Kiora Road, with a total site area of 476m2. The total site area including existing awnings hanging over the street footpath is approximately 574m2. There is an existing kerb inlet pit at the front of the site in Kiora Road prior to the street parking.

1.2 Proposed Development

The proposed development is for the construction of a 7 storey dental hospital comprising surgery facilities, inpatient accommodation, shop/café on the ground floor and three (3) levels of basement car parking. Vehicle access to the site will be via Urunga Lane, pedestrian access will be via the main entry fronting Kiora Road and lobby entry on Urunga Parade.

1.3 Council and Authority Requirements

The site is located within the Sutherland Shire Council local government area and as such the following specific requirements and guidelines have been adopted;

Sutherland Shire Council Development Control Plan Chapter 8 Ecological Sustainable Development (2006);

Sutherland Shire Council Stormwater Management Specification (2009);

Australian Government Australian Rainfall and Runoff (1987); and

Catchment Management Authority (CMA) Draft NSW MUSIC Modelling Guidelines (2010).

1.4 Department of Planning Conditions of Consent

Development consent for the proposed development was issued by the Minister for Planning (MoP), application No. MP11_0009 dated 23rd of August 2012. In summary the consent conditions pertaining to stormwater drainage for site are;

C11 Drainage Design – Detailed Requirements

A detailed drainage design shall be prepared in accordance with Sutherland Development Control Plan 2006 (Chapter 8 – Ecologically 'Sustainable Development'; Section 6 – 'Stormwater Management'), Council's Drainage Design Manual and Council's "On-site Stormwater Detention Policy and Technical Specification" as required.

The design shall include:

- *a) A detailed drainage design supported by drainage calculations.*
- *b) A layout of the drainage system showing existing and proposed pipe sizes, type, class, grades, lengths, invert levels, finished surface levels and location of all pipes with levels reduced to Australian Height Datum.*
- *c) A longitudinal section of the pipeline/s within the road reserve including existing natural surface levels, design surface levels, design invert levels of the proposed pipeline and the location, size and reduced level of all services to AHD where those services cross that proposed drainage line.*
- *d) Water from pathways and access driveways shall be prevented from entering the road reserve as surface flow. This can be achieved by constructing a box drain at the boundary equipped with a 300mm wide grate and frame to collect the flow or directing the flow to a sag pit within the property.*
- *e) The rate of discharge of stormwater from the site to a drainage system under Council's control shall be controlled so that it does not exceed the pre-development rate of discharge. Specific certification from the designer to this effect shall be incorporated in the submitted drainage plans/ details.*

A design certificate issued by an appropriately accredited person to the effect that these design requirements have been met shall accompany the Construction Certificate. Stormwater shall be connected to the existing piped system within the road reserve.

2 DETAILED STORMWATER DRAINAGE DESIGN

2.1 General

The detailed stormwater management strategy for the site has been based on a number of requirements and guidelines provided by Council and the development consent conditions issued by the Minister for Planning (MoP). These guidelines have been utilised in conjunction with industry best practice to develop the proposed detailed stormwater management strategy.

The proposed design as detailed on plans ISE-082-H01 to ISE-082-H-13 Revision T1. (Attachment A) remains consistent with the DA approved plans.

Roof water, including stormwater runoff from any awnings, will be collected and drained to a tank located under the ground floor of the main entry. Please refer to plans by ISE Building Services Consultants for details of the roof drainage layout.

The proposed building envelope covers the full site and with additional awnings overhanging the street footpath, which equates to a total roof area of 574m2. Due to the

proposed layout of the building and existing site constraints, there is very limited spatial area and depth to provide an OSD tank. Therefore, the stormwater drainage strategy for the site is to provide an oversized rainwater tank to address Council's OSD and water re-use requirements.

The key elements of the proposed stormwater drainage strategy are;

- Drain as much of the roof area as possible to the rainwater tank for site re-use.
- Stormwater runoff from roof areas that cannot be re-used (i.e. that will bypass the rainwater tank) will drain to a separate tank chamber.
- Areas draining to the separate tank chamber will not be detained or restricted, i.e. the separate tank chamber will drain waters directly to the existing pipe system in Kiora Road.
- Overflow from the rainwater tank will drain to the separate tank chamber.

To ensure post development flows are limited to pre-development flows, calculations for storm events up to the 1% AEP have been undertaken to determine the following;

a. The permissible site discharge (PSD) for the site based on a maximum 75% impervious fraction as per Council's specification.

b. The post development flows for the portion of the roof that bypasses the rainwater tank and drains directly to the existing pipe system in Kiora Road.

c. The post development volume of runoff for the portion of roof that drains to the rainwater tank, based on the peak hydrograph design storm.

d. A water balance model to determine the re-use demand percentage met for the site and consequently the resulting percentage of time the tank is empty.

2.2 Peak Runoff Flows and Volumes

In order to determine the peak runoff flow and volume as per items a, b and c above hydrological/hydraulic modelling has been undertaken using a stormwater computer program called DRAINS by Watercom Pty Ltd, which was developed for the design and analysis of urban stormwater drainage.

DRAINS is a simulation program which converts rainfall patterns in stormwater runoff and routes flows through networks of pipes and channels. It develops hydrographs and calculates hydraulic grade lines throughout drainage systems, enabling the users to peak flow rates and volume over a range of storm events.

DRAINS draws on parts of the PIPES and ILSAX programs developed by Watercom Pty Ltd and Geoffrey O'Loughlin (formerly of the University of Technology, Sydney). In particular DRAINS uses the ILSAX hydrological model but substantially improves on ILSAX's hydraulic methods.

The site area was divided into two (2) sub-catchments to represent the roof area draining to the rainwater tank and the roof area bypassing the rainwater tank draining directly to the road. The total usable roof area that can drain to the rainwater tank is 294m2, with the remaining roof area being 280m2 bypassing the rainwater tank. The roof area bypassing the rainwater tank includes trafficable terraces and roof area containing plant that for health reasons cannot drain to a rainwater tank for reuse.

The model has been structured to simulate both the pre-development and post-development flows within the same model. A schematic of the DRAINS model is shown below in Figure 2.

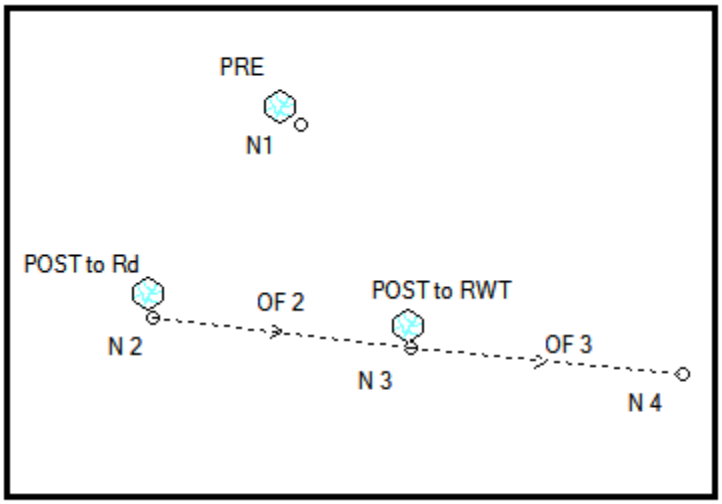


Figure 2: *DRAINS Schematic*

Both the pre-development and post-development cases have been analysed over a range of

storm durations from 5 minutes to 4.5 hours.

Table 2.1 on the following page summarises the pre-development and post-development discharge rates and volume of runoff for the 1, 2, 5, 10, 20, 50 and 100yr ARI events.

Table 2.1: Peak runoff Flows and Volumes

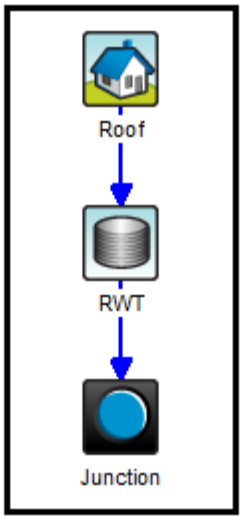
ARI Event	Peak Discharge Rates (flows)		Peak Volume of runoff
	Item a)	Item b)	Item c)
	PSD	Post-Development (to road)	Post-Development (to rainwater tank)
(years)	l/s	l/s	m3
1	14	7	5.6
2	19	10	7.4
5	25	12	9.8
10	28	14	11.1
20	33	16	12.9
50	35	18	15.3
100	40	20	17.1

Table 2.1 above shows that the post development flows from the portion of the roof bypassing the rainwater tank (item b) is significantly less than the pre-development flows (item a) for the site. The maximum volume of runoff from the portion of the roof draining to the rainwater tank (item c) is 17.1m3 or 17.1kL.

2.3 Water Balance calculations

In order to determine the re-use demand percentage met for the site and consequently the resulting percentage of time the tank is empty (item d) a stormwater computer program called MUSIC by ewater was used. Model for Urban Stormwater Improvement Conceptualisation (MUSIC) is a water sensitive urban design modelling software program that has been developed by the Cooperative Research Centre for Catchment Hydrology (CRC).

The program simulates the performance of proposed stormwater quality treatment infrastructure, including undertaking water balance calculations to determine appropriate rainwater tank sizes. The roof area draining to the rainwater tank has been modelled (294m2) along with a single rainwater tank in accordance with CMA modelling guidelines. A schematic of the MUSIC model is shown below in Figure 2.1.



Rainwater re-use for the site will be for toilet flushing purposes. Water re-use rates for the site have been approximated using the Building Code of Australia (BCA), AS/NZS3500 and relative authority studies and reports.

The usable floor space of the building outside areas such as fire stairs, lifts, voids and toilets is approximately 230m2 per floor. BCA Table D1.13 Commercial space recommends for this type of building that a floor space a 10m2 is equivalent to a person, i.e. there will be up to 23 people on each floor. With a proposed building comprising 7 levels this equates to up to approximately 160 people.

Typically an average person flushes a toilet 2-3 times per day whilst at work/during work hours. Of this toilet use it is assumed that approximately 25% will be full flush (4.5 litres) and the remaining 75% will be small flush (3 litres). Therefore for a building with up to 160 people this equates to 160 x 2.5 flushes per day = 400 flushes/day and 75% x 400 x 3litres + 25% x 400 x 4.5 litres = 1350 litres/ day of toilet flushing. This re-use rate has been entered into MUSIC to determine the percentage of re-use demand met.

Daily rainfall data from the Sydney Airport, No. 066037 from 2000 to 2010 (the most recent and closest to the site) was used in combination with Sydney's monthly averages for potential evapotranspiration (PET). Table 2.2 below summarises the water balance results from MUSIC.

Table 2.2: Water Balance Results

Roof area	Rainwater Tank Volume	Demand met
(m^2)	(m^3)	(%)
294	17.1	0.04
294	2	0.04
294	0.5	0.04
574	0.5	0.09
7700	10	1.0

The rainwater tank volume was initially varied to determine the optimum tank size to meet 70- 80% of water demand. It was found that increasing the tank size has no impact on reducing potable water demand, as the roof area is too small to supply the sites re-use demand. The annual re-use demand for the site is in the order of 495.6ML while the incoming runoff from the roof is just 0.22ML/year. The results above show that irrespective of the rainwater tank volume a maximum 0.04% re-use demand can be achieved with such a small roof area. The results above also show that even if the entire site/roof area was able to drain to the tank only 0.09% re-use demand is met. Even increasing the roof size more than 10 fold, the re-use demand is just 1.0%.

It is therefore concluded that for this type of development, with a high re-use demand and very limited roof area, it is not possible to meet re-use demands. It is further concluded that the rainwater tank will be empty over 95% of the time.

In combination with the results of Section 2.2 it is therefore considered acceptable to provide a rainwater tank with a volume of 17.1kL to address Council's OSD and water re-use requirements. The rainwater tank can capture and detain the 100 year peak flow volume from the portion of the roof that drains to the rainwater tank without any overflow

from the rainwater tank, hence peak flows from the site will be less than pre-development levels in accordance with Council's requirements.

3 CONCLUSION

This report has been compiled to provide a summary of the detailed stormwater drainage strategy and requirements for the proposed development at 84 Kiora Road, Miranda.

Based on our findings we note the following:

- The stormwater drainage system has been designed in accordance with Sutherland Council's requirements,
- The proposed tank with two separate compartments, including rainwater re-use will effectively limit post development flows to less than the pre-development levels, and
- The site will require water mains top up to meet re-use demands.