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EGC CUSTODIAN SERVICES

Allengrove Crescent, North Ryde - Stormwater Management and Flood Assessment

Part 3A Concept Plan Application

301015-02272 – 01-CI-REP-0003

7th October 2010

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SYNOPSIS

This report has been produced for EGC Custodian Services Pty Ltd in support of the proposed development located at Allengrove Crescent, North Ryde. This report covers and addresses stormwater management and flooding issues raised as part of a Part 3A concept plan submission to the New South Wales Department of Planning for a Concept Plan.

Disclaimer

PROJECT 301015-02272 - ALLENGROVE CRESCENT, NORTH RYDE - STORMWATER MANAGEMENT AND FLOOD ASSESSMENT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for internal review	JNH	FMC		27-07-10	N/A	
1	Final Issue	JNH	FMC	FMC	08-09-10		
2	Final Incorporating Candalepas Comments	JNH	FMC	FMC	27-09-10		
3	Amendments to Lot numbers	JNH	FMC	FMC	07-10-10		

CONTENTS

1. EXECUTIVE SUMMARY

EGC Custodian Services Pty Ltd proposes to re-develop an existing site, located on the corner of Allengrove Crescent and Lane Cove Road, which currently consists of 16 single residential lots with a free standing dwelling on each of the lots. The site covers an area of approximately 1.23 ha.

The proposed development would consist of the construction of three multi-storey buildings and an underground basement car park with integrated communal open spaces. The development would provide a total of 256 apartments, spread across the three buildings and approximately 366 basement car parking spaces. A plan of the site is shown in **Appendix 1**.

The site is bounded by Epping Road to the north east, Lane Cove Road to the north west, Allengrove Crescent to the south west and private residential properties to the south east.

The site is located within City of Ryde's Local Government Area (LGA) and is surrounded by low density housing towards the south, east and west and industrial/commercial space to the north.

The proposed development has been identified by the Director General of New South Wales Department of Planning (DoP) as a significant project. The Director General's Requirements (DGR) were issued by the DoP on the 22nd of June 2010. The issues to be addressed in this report for Concept Approval are as follows:

*"**8. Drainage, Stormwater Management and Flooding Potential***

- (8.1) *The EA shall include a Stormwater/Drainage/Flood Study addressing drainage/groundwater/flooding issues associated with the development and the site, including consideration of any required infrastructure upgrades and stormwater/flooding management strategies/mitigation measures for development of the site and adjacent lands.*
- (8.2) *The EA shall address the requirements for additional drainage infrastructure and incorporation of Water Sensitive Urban Design measures.*"

The DGR's will be addressed by adopting standard best practice for managing stormwater quantity, quality and flooding. Council's Development Control Plans (DCP) will be consulted during the assessment as a guideline.

This report will explore, in concept, how stormwater and flooding issues are to be addressed on-site to mitigate impacts to the local and downstream environments.

The site is not believed to be affected by flooding, as there are no defined overland flow paths across or through the site. The site is also located some distance and elevation away from any major water ways. Additional details are discussed further in **Section 6**. Adequate drainage and appropriately designed overland flow paths would be constructed across the development to ensure stormwater flows are conveyed safely from the site into Council's existing stormwater infrastructure network.

Stormwater runoff generated across the site would be controlled and reduced with the implementation of on-site detention (OSD). OSD tanks with a designed discharge control outlet would be used to control peak flows, such that flows generated across the proposed development do not exceed peak flows generated under pre-developed conditions. The discharge controls would be designed to cater for all storm events up to the 100 year average recurrence interval (ARI) storm event. This would ensure no impact to receiving water bodies or impacts to any of Council's existing stormwater infrastructure. The hydrologic modelling undertaken as part of this assessment is discussed in **Section 7**.

Water quality is to be managed on site with the implementation of Water Sensitive Urban Design (WSUD) best practices principles. Adopting these principles, a stormwater treatment train has been developed which incorporates the use of rainwater tanks, litter baskets, OSD tanks and bio-retention basins. Details of each of the stormwater treatment facilities are discussed in **Section 4.1**. Modelling of the treatment effectiveness of the proposed treatment train and the adopted WSUD principles are discussed in **Section 8**. The water quality modelling discussed in **Section 8** demonstrates that the proposed treatment train is effective at achieving the Department of Environment, Climate Change and Water (DECCW – formerly DECC) pollutant reduction targets for urban stormwater management.

The flooding and stormwater management assessments undertaken as part of this concept plan submission to the DoP clearly demonstrate that the proposed development and stormwater management strategies sufficiently mitigate any stormwater/drainage and flooding impacts to downstream properties and receiving environments.

2. INTRODUCTION

WorleyParsons was engaged by EGC Custodian Services Pty Ltd to address stormwater and flooding as part of a concept plan application to the Minister for Planning, for the proposed development at Allengrove Crescent, North Ryde.

The application seeks approval for a concept plan which includes demolition of existing single dwellings located within the site, and the construction of three multi-story buildings and underground basement car park with integrated communal open space. The proposed development is to provide a total of approximately 269 apartments across the three buildings and approximately 396 basement car parking spaces.

The Director General of NSW Planning has provided the issues to be addressed in the application in the Director General's Requirements (refer to **Appendix 2**).

This report addresses the proposed stormwater management and flooding constraints and demonstrates how the development would address issues raised by the Director General. This report also discusses, in brief, the implications the proposed development would have on groundwater and existing infrastructure.

3. EXISTING SITE CONDITIONS

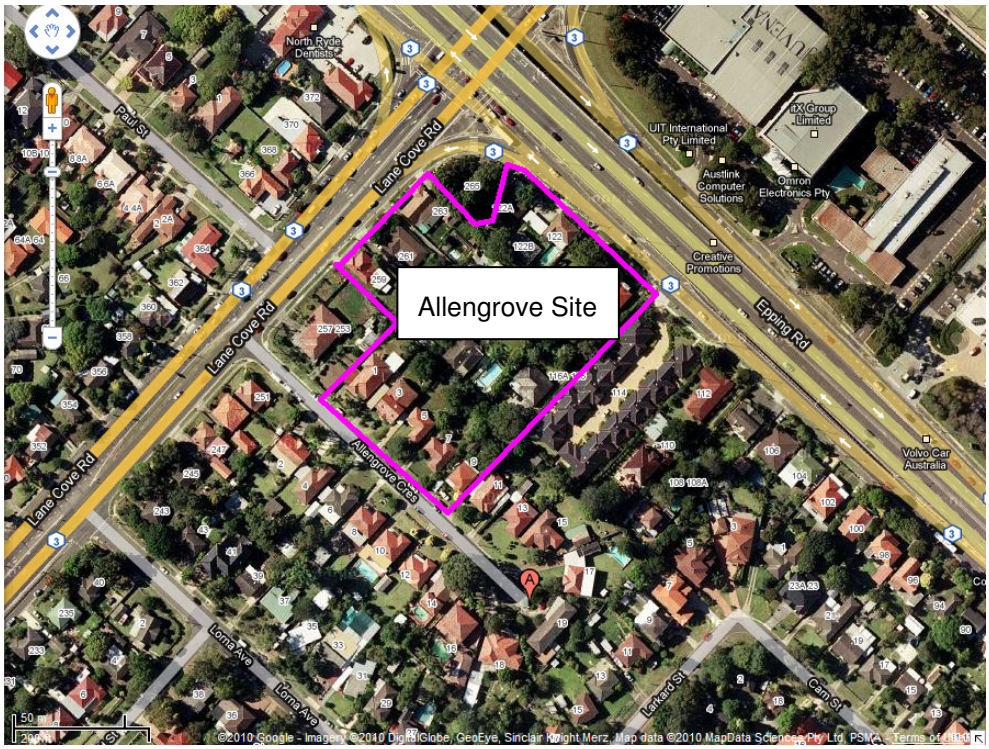
The proposed developed is located on Epping Road, Lane Cove Road and Allengrove Crescent in North Ryde. The site currently consists of 16 separate single lots, each with a free standing residential dwelling, which includes 116a – 122b Epping Road, 259 – 263 Lane Cove Road and 1 – 9 Allengrove Crescent. The site covers an area of approximately 1.23 ha.

The site is bounded by Epping Road to the north east, Lane Cove Road to the North West, Allengrove Crescent to the south west and private residential properties to the south east. A vacant, densely forested lot (currently owned by City of Ryde Council) is located at the north corner of the site, while two privately owned residential lots are located to the west of the site. The site is located south of Macquarie Park and within 400m of the recently construction Macquarie Park Railway Station.

The site is located within a low density suburban region within the City of Ryde Local Government Area (LGA).

The location of the site is illustrated in **Figure 1**.

Figure 1 – Site Location



3.1 Topography

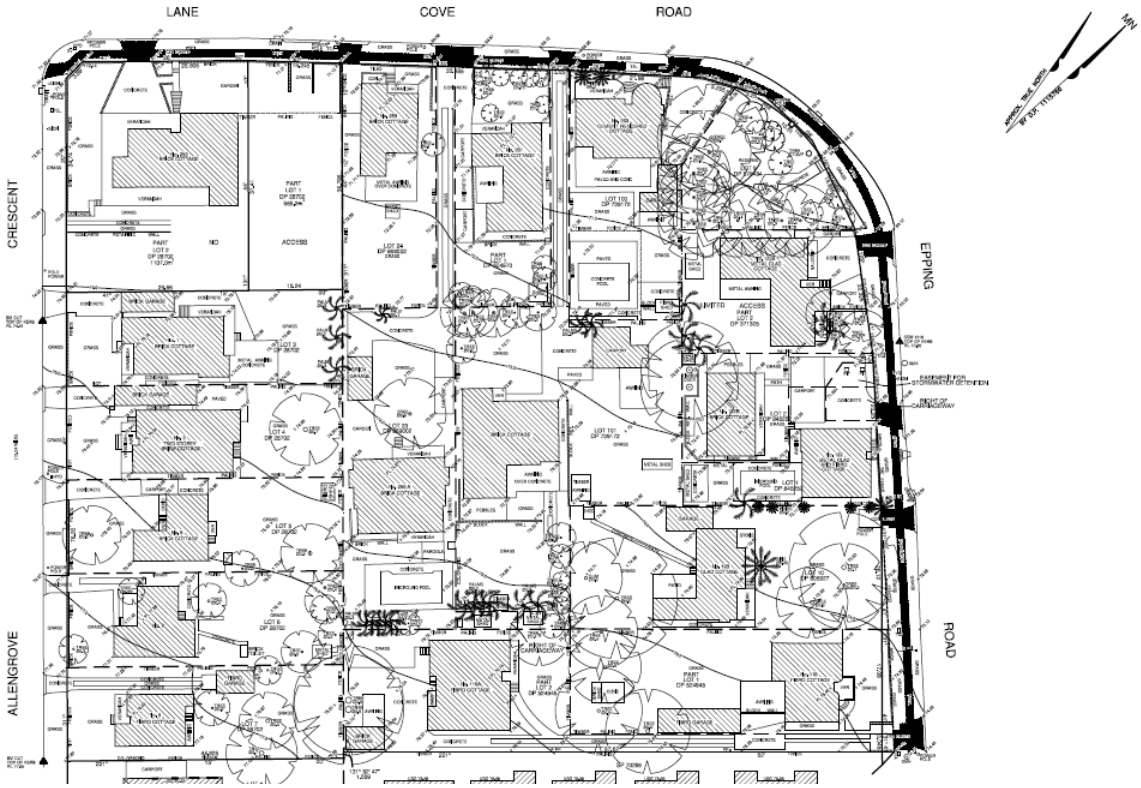
The site is located partially on the crest of a local high point, which slopes to the north of the site towards the intersection of Epping Road and Lane Cove Road. The site slopes uniformly to the north with a grade of approximately 5% from a high point of RL 77.8 m AHD to a local low point of RL 69.0 m AHD.

The majority of the site drains diffusely to the north towards the intersection of Epping and Lane Cove Road. The site catchment contributes to the Macquarie Park catchment, where stormwater is conveyed via Council's stormwater pit and pipe network within Lane Cove and Epping Road, and ultimately discharged into Lane Cove River to the north.

There are no defined overland flow paths that traverse across the site or immediately surrounding it.

A plan of the existing topography is illustrated in **Figure 2**.

Figure 2 – Plan of existing topography of site



3.2 Land Use and Site History

The site is currently zoned as 2(a) Residential under the Ryde Planning Scheme Ordinance. As mentioned earlier the site consists of 16 residential lots, each with a free standing single dwelling and complies with Council's current zoning description.

Based on visual site inspections and review of ortho-photographic maps and survey, the site is estimated to approximately 50% impervious.

It is understood that the site had once been used for agricultural purposes prior the 1930s and may have been used for vehicle servicing and repairs sometime between the 1980s and 2000s.

3.3 Geotechnical Conditions

A geotechnical assessment for the site was conducted by Jeffery and Katauskas (J&K) in April 2008 with field work undertaken on the 13th of February 2008. The assessment consisted of drilling seven boreholes using hand auger methods 1.25 m – 1.5 m deep with an additional seven Dynamic Cone Penetration tests, 1.25 m – 2.72 deep.

The assessment found the site to be:

- "*topsoil (or fill) comprising silty clay of high plasticity was encountered in all boreholes to depths between 0.2 m and 0.4 m.*";
- "*Residual silty clay was encountered below the topsoil/fill in all boreholes and extend to the borehole termination depths between 1.25 m and 1.5 m. Residual silty clay was generally of high plasticity and very stiff and hard strength.*";
- "*the residual silty clay extends to a maximum depth of about 2 m. Blowcounts of greater than 10 per 100 mm penetration are interpreted to indicate extremely weathered shale or clay with numerous shale and ironstone bands.*"; and
- "*Groundwater seepage was encountered at a depth of 1.35 m and 0.4 m whilst drilling BH1 and BH2 respectively. All boreholes were 'dry' on completion of drilling… Long term groundwater monitoring was not carried out.*"

For more information please refer to the J&K geotechnical report.

4. PROPOSED DEVELOPMENT

The proposed development would consist of the demolition of all existing dwellings located within the site to make way for the construction of 3 multi storey buildings, linked together via an underground basement car park.

The applicant seeks approval for a concept plan for the proposed development which includes construction of 269 apartments spread across the 3 buildings and 394 basement car parking spaces. The development would provide communal open space, children playgrounds and communal vegetable gardens.

Three communal pedestrian access points would be provided on Lane Cove, Epping Road and Allengrove Crescent, while vehicular access would be provided via an ingress point located along Allengrove Crescent. A second access road has been provided along the south east boundary of the site for maintenance and emergency vehicles from Allengrove Crescent.

4.1 Stormwater Management Facilities

The concept stormwater treatment strategy for the proposed development would incorporate the use of rainwater tanks, litter baskets, OSD tanks, and a bio-retention basin. A stormwater treatment train has been specified for each of the sub-catchments across the proposed development (North and South Sub-Catchments).

An illustration of the Stormwater Management Concept Plan can be found in **Appendix 1**.

A stormwater pit and pipe network would be designed for the site such that flows up to the 20 year ARI storm event are conveyed underground in the pits and pipes. Overland flows above the 20 and up to the 100 year ARI would be conveyed safely via overland flow paths. The stormwater network in the site would discharge into Council's existing stormwater infrastructure located along Epping and Lane Cove Road.

Details for each of the treatment facilities are discussed below and should be read with the stormwater management strategy discussed in **Section 7.3**.

4.1.1 Rainwater Tanks

Rainwater tanks are proposed as part of the concept stormwater treatment train. A total volume of approximately 150kL would be incorporated into the stormwater treatment train and would assist in reducing runoff volume, maximising non-potable supply/reuse and minimising peak flows for frequent storm events.

The following assumptions for the rainwater tank reuse and demands are as follows:

- Equivalent tenement for one, two and three bedroom apartments of 1.25, 1.74 and 2.5, respectively (based on Australian Bureau of Statistics, ABS – 1301.0 Year book Australia 2007);
- Use of water saving devices, including dual flush toilets and water saving taps etc;
- Daily water consumption for toilets of 27 L/pp/day;
- Daily water consumption for car washing of 0.2 L/pp/day; and
- Daily water consumption for irrigation of 8.3 L/pp/day.

Possible locations for the rainwater tanks include across the roof of each of the buildings, or within the proposed underground basement car park. Overflows from the rainwater tanks would be directed into proposed site drainage network.

4.1.2 Litter baskets

Litter baskets are proposed and are to be included in the stormwater pits located across the emergency/maintenance access towards to the south east border of the site. This is based on the assumption that concrete lintels to pits and formal kerb and gutter would be included along the emergency/maintenance access road.

The purpose of litter baskets is to target and remove gross pollutants and coarse sediment from stormwater runoff from the site and to prevent gross pollutants and coarse sediment from discharging into Council's stormwater network.

The remaining drainage pits across the site would have grated lids, which would assist in screening large gross pollutants.

4.1.3 On Site Detention

Two on site detention (OSD) tanks are proposed as part of the stormwater treatment train. The OSD tanks would be sized and designed to control peak flow rates discharged from the proposed development to match those generated under pre-developed conditions.

The size of the OSD tanks would be approximately 100 kL each for OSD Tank 1 and OSD Tank 2 for the South and North Sub-catchments respectively. A discharge control outlet pit would be designed to control peak flows and would include an orifice plate and overflow weir outlet. It is envisaged that the proposed OSD tanks would be incorporated into the basement car park, within the basement car park foot print.

Access to the OSD tanks, for maintenance purposes, would be provided from the surface via access chambers from the top of the OSD tanks. Maintenance for the OSD tanks would be required every 6 months (twice a year).

The OSD tanks will have to be set at an invert level that provides sufficient cover and drainage. The minimum invert level of OSD Tank 1 and 2 would be RL 69.5 m AHD and 71.5 m AHD respectively. The OSD tanks could employ a proprietary product such as the Humes StormTrap or equivalent product.

A sump pit and trash screen would be included in the design of the OSD tank and discharge outlet to prevent blockage of the tank system.

It is also noted that it is believed that the existing lots do not currently have any form of on-site detention facilities.

4.1.4 Bio-Retention Basins

Two bio-retention basins are proposed as part of the stormwater treatment train. Bio-retention Basins 1 and 2 has been proposed for the South and North Sub-Catchments, respectively. The main purpose of the bio-retention basins is stormwater treatment.

Stormwater would be treated through sub-surface filtration via a filter medium of sandy loam and planted macrophytes. The filter medium would be 1 metre deep and cover a surface area of approximately 100 m^2 in Bio-Retention Basin 1 and 140 m^2 Bio-Retention Basin 2.

The bio-retention basins will have an extended detention depth of 300 mm and would be set at minimum invert levels of RL 68.3 m AHD and 69.8 m AHD for Bio-Retention Basin 1 and Bio-Retention Basin 2, respectively. This is required such that adequate drainage into Council's existing stormwater infrastructure is achievable. The bio-retention basins will cover surface areas of approximately 170 m^2 and 220 m^2 for Bio-Retention Basin 1 and Bio-Retention Basin 2, respectively, depending on final landscape levels.

5. LEGAL REQUIREMENTS AND OBJECTIVES

The proposed development has been identified by the Director General of New South Wales Department of Planning (DoP) as a significant project. The Director General's Requirements (DGR) were issued by the DoP on the 22nd of June 2010. The issues to be addressed in this report for Concept Approval are as follows:

*"**8. Drainage, Stormwater Management and Flooding Potential***

- (8.1) *The EA shall include a Stormwater/Drainage/Flood Study addressing drainage/groundwater/flooding issues associated with the development and the site, including consideration of any required infrastructure upgrades and stormwater/flooding management strategies/mitigation measures for development of the site and adjacent lands.*
- (8.2) *The EA shall address the requirements for additional drainage infrastructure and incorporation of Water Sensitive Urban Design measures.*"

Council is currently publishing a draft flood study of the Macquarie Park catchment, which is understood to be finalised shortly. This flood study would be consulted to confirm the site is not affected by flooding. If the site is affected by flooding, appropriate measures would need to be undertaken to ensure minimum habitable floor levels, minimal levels for driveway access for underground car parking and a suitable evacuation plan. However, due to the site's location, as discussed in **Section 3.1**, it is not believed that the site is flood affected

To address issues regarding stormwater quantity, standard practices would be adopted that require peak flows generated across the development to match or improve on existing, or preferably pre-development conditions, as discussed in **Section 4.1.3**.

For a development of this nature, where stormwater generated across the site will eventually discharge into a major water way (The Lane Cove River), it is imperative that the proposed development maintains peak runoff rates to ensure no impacts on existing infrastructure or flood levels within the downstream water ways.

Water Sensitive Urban Design (WSUD) best practices would be adopted to address pollutant discharge from the proposed development and, to an extent, water quantity. DECCW's pollutant reduction targets for urban stormwater would be adopted. Details of DECCW's pollutant reduction targets are discussed in **Section 8.2.1**.

This report has also consulted Councils DCP as a guideline to address all issues raised by the Director General.

This report also addresses issues concerning groundwater and impacts to existing infrastructure.

6. FLOODING

The site sits on the crest of a local high point where no defined overland flow paths have been identified.

As mentioned earlier, the site drains towards the north and contributes to the Macquarie Park catchment which discharges into the Lane Cove River. Flooding from the Lane Cove River is unlikely as the river is located approximately 2-3 kilometres to the north east and 50 m below the lowest point of the site.

Two tributaries of Lane Cove River however, the first located to the north (Industrial Creek – located approximately 1 km away and 40 m below the lowest point of the site) and the second to the east (Porters Creek– located approximately 0.8 km away and 40 m below the lowest point of the site), have been known to flood and affect nearby residential homes. This is illustrated in Council's flood map of the Macquarie Park catchment flood simulation of the 1985 flood event, which Council describes as being similar to a one in 20 year flood. The flood map demonstrates that the simulated flood event does not affect the site.

Council is currently finalising a flood study report of the Macquarie Park catchment with Bewsher Consulting and the Department of Climate Change and Water (DECCW – formerly DECC), however discussions with Council's flooding engineers have identified that the site is not located within any flood prone areas.

Since the site is not affected by flooding the Director General's concerns for flooding on site have been addressed (Issue 8.1).

7. HYDROLOGY

A RAFTS rainfall/runoff model was formulated for the hydrological analysis of the Allengrove Crescent development. The model was used to estimate catchment runoff under existing and developed catchment conditions for the comparison of the 5, 20 and 100 year ARI storm events. A preliminary estimate of on-site detention requirements was undertaken.

7.1 RAFTS

RAFTS is a program consisting of five discrete modules that simulate the rainfall/runoff routing process, namely:

- A library module;
- A hydrograph generation module;
- A loss module;
- A reservoir routing module; and
- A river/channel routing module.

Intensity Frequency Duration (*IFD*) data for the site was obtained from *Bureau of Meteorology* and is shown in **Table 7-1** below.

Table 7-1 – Adopted IFD values

Storm Event	Duration	Rainfall Intensity
2 year ARI	1 hour storm	37.30 mm/hr
2 year ARI	12 hour storm	8.09 mm/hr
2 year ARI	72 hour storm	2.57 mm/hr
50 year ARI	1 hour storm	72.4 mm/hr
50 year ARI	12 hour storm	17.6 mm/hr
50 year ARI	72 hour storm	5.75 mm/hr

- Location skew (G) 0.00
- Geographical factor (F2) 4.3
- Geographical factor (F50) 15.85

Other input parameters adopted in the formation of the RAFTS model were as follows:

- Manning's 'n' was taken to be 0.02 for impervious areas and 0.035 for pervious areas;

- Initial and continuing losses for pervious areas were modelled as 5 mm and 1 mm/hr respectively; and
- Initial and continuing losses for impervious areas were modelled as 1 mm and 0 mm/hr respectively.

Three scenarios, as outlined below, were analysed to ascertain the hydrological impact of the proposed development to the nearby environment.

- Pre-developed conditions;
- Proposed developed conditions; and
- Proposed developed conditions with detention.

This analysis ensures the proposed development meets the stormwater quantity requirements discussed in **Section 5**.

7.1.1 Pre-developed Conditions

One catchment was identified for the site under pre-developed conditions. As discussed previously the catchment falls to the north of the site. The extents of the catchments were determined from supplied survey data. The areas included in each of the existing sub-catchments are shown in **Figure** 3 and detailed in **Table 7-2**.

Figure 3 – Catchment Plan of Pre-developed Site

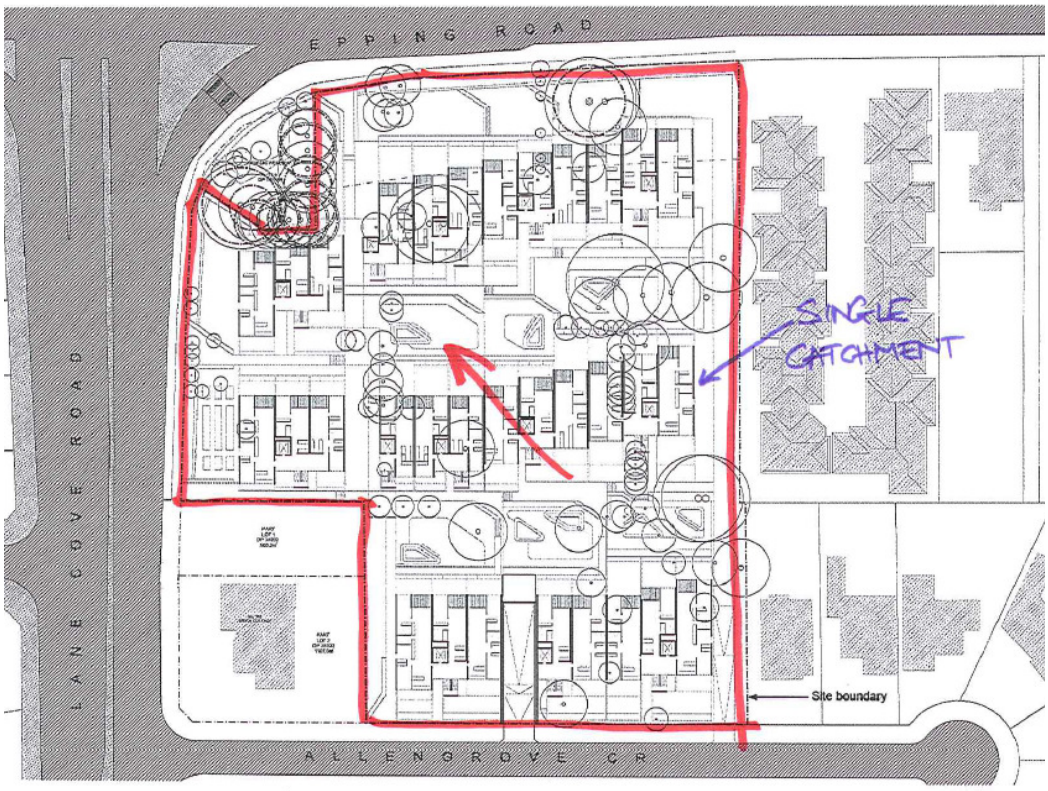


Table 7-2 – Pre-developed Catchment Details

Catchment	Area (ha)	Impervious (%)
Pre-developed Catchment	1.230	0%

The estimated peak 5, 20 and 100 year ARI outflows from the site are summarised in **Table 7-3**. It is noted that the pre-developed site conditions have been modelled with a manning's 'n' coefficient of 0.035. The results below are reported to two decimal places for comparative purposes.

Table 7-3 Estimated Peak Outflows under Pre-developed Conditions

Pre-developed Catchment	**Storm event**		
Storm Duration	**5 year ARI**	**20 year ARI**	**100 year ARI**
60 min	0.33 m^3/s	0.45 m^3/s	0.57 m^3/s
90 min	**0.34 m^3/s**	**0.47 m^3/s**	**0.59 m^3/s**
120 min	0.34 m^3/s	0.46 m^3/s	0.58 m^3/s

7.1.2 Proposed Conditions (without Detention)

Three sub-catchments were identified within the site under proposed conditions. The extents of the proposed catchments were determined from the proposed development layout, sections and elevations. The proposed catchments are defined in **Figure 4** and the data in **Table 7-4** was used to create a RAFTs model for the site.

Figure 4 – Catchment Plan of the Site under Proposed Conditions

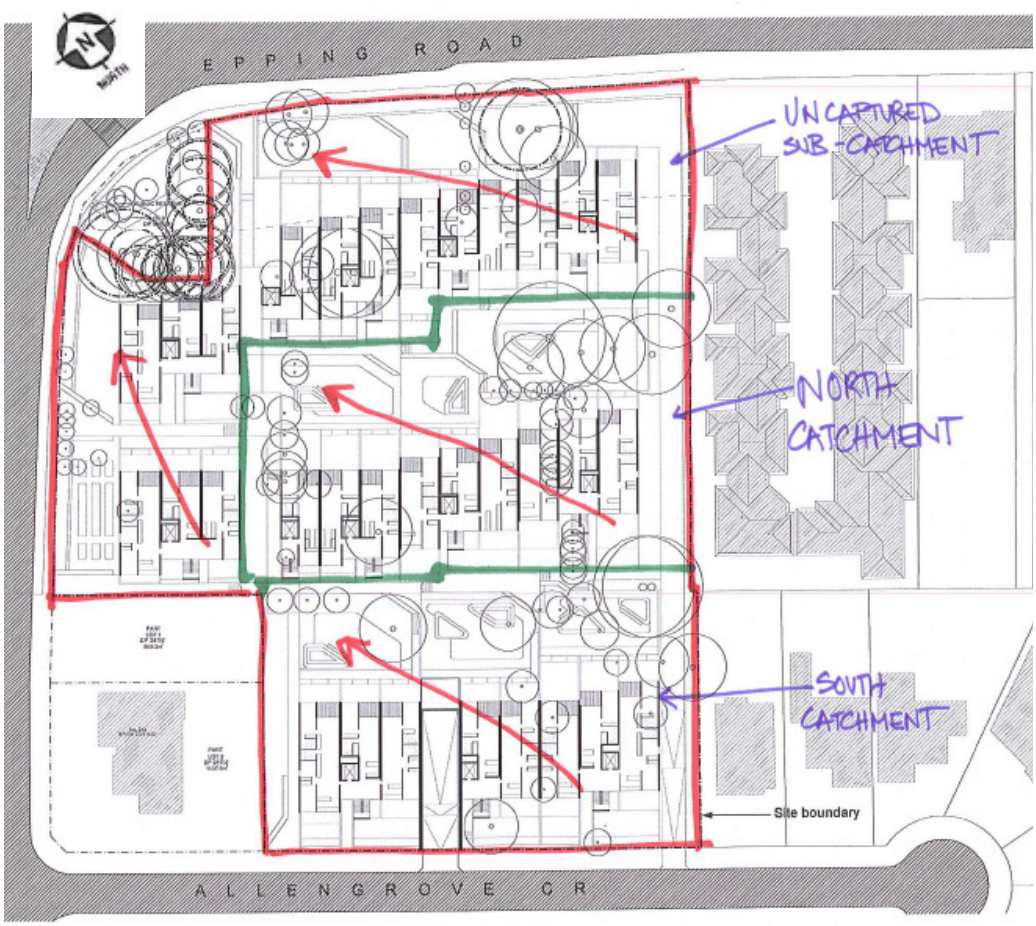


Table 7-4 -Proposed Catchment Details

Catchment	Area (ha)	Impervious (%)
South Sub-Catchment	0.365	66%
North Sub-catchment	0.350	67%
Uncaptured Sub-catchment*	0.515	66%
Total	**1.230**	**67%**

* Note- Uncaptured Sub-catchment has been identified as low-lying catchment that cannot be captured for detention based on the proposed stormwater management strategy

The estimated peak 5, 20 and 100-year ARI outflows from the site are summarised in **Table 7-5**. The results below are reported to two decimal places for comparative purposes.

Table 7-5 Estimated Peak Outflows under Proposed Conditions without Detention

Total Site	**Storm event**		
Storm Duration	**5 year ARI**	**20 year ARI**	**100 year ARI**
60 min	0.45 m^3/s	0.58 m^3/s	0.71 m^3/s
90 min	**0.48 m^3/s**	**0.63 m^3/s**	**0.77 m^3/s**
120 min	0.46 m^3/s	0.60 m^3/s	0.75 m^3/s

The results above of the proposed development have been modelled without the implementation of OSD tanks.

7.1.3 Proposed Conditions (with On-Site Detention)

A final scenario has been developed to model the proposed development with OSD tanks The three same sub-catchments that were identified in **Section 7.1.2** were adopted for this assessment. The two OSD tanks discussed in **Section 4.1.3** were included in this model. Effective detention volumes provided by the proposed rainwater tanks and bio-retention basins have not been included in this assessment.

The estimated peak 5, 20 and 100-year ARI outflows from the site are summarised in **Table 7-6**. The results below are reported to two decimal places for comparative purposes.

Table 7-6 Estimated Peak Outflows under Proposed Conditions with Detention

Total Site	**Storm event**		
Storm Duration	**5 year ARI**	**20 year ARI**	**100 year ARI**
60 min	0.30 m^3/s	0.38 m^3/s	0.46 m^3/s
90 min	**0.32 m^3/s**	**0.41 m^3/s**	**0.49 m^3/s**
120 min	0.29 m^3/s	0.38 m^3/s	0.46 m^3/s

7.2 Results

The results of the hydrologic assessment illustrate that the implementation of OSD tanks within the proposed development is capable of reducing peak flows to pre-development levels. Overall, the peak flows estimated in this preliminary assessment, under proposed conditions, show a considerable decrease from those generated under pre-developed conditions. Further, more detailed analysis is

required at the project plan and construction certificate stages to ensure the final design achieves the objectives.

It is noted that the RAFTS modelling has not taken into account the effective detention volumes of the proposed rainwater tanks. It is believed that an analysis into the detention capacities of the rainwater tanks in the hydrologic model would further assist in reducing peak flows. This would assist in achieving no impact on peak flows discharging from the site.

Further details of the proposed stormwater strategy are discussed in **Section 7.3**.

With improvements in peak flows from the proposed development, compared to those generated under pre-developed conditions, there would be no impact on existing surrounding stormwater infrastructure and little to no impact on properties downstream.

7.3 Stormwater Drainage Strategy

A Stormwater Management Concept Plan is illustrated in **Appendix 3**.

Under proposed conditions it is envisaged that the development would be split into 2 main catchments, a North and South catchments. A stormwater drainage network and stormwater treatment train is proposed for each catchment.

Stormwater runoff generated from the site will be collected and piped via an underground stormwater drainage network, as illustrated in the Stormwater Concept Plan. The drainage lines will be designed to convey storms up to the 20 year ARI storm events. It is envisaged at this stage that a majority of the stormwater network on site will comprise of PVC pipes in the range of 100 to 225 mm diameter. Detailed hydraulic modelling will be undertaken at future stages of this development to design the drainage work in more detail.

All stormwater events above the 20 year ARI and up to the 100 year ARI will be conveyed safely via overland flow paths and into Council's stormwater infrastructure. The stormwater network will discharge into Council's existing stormwater network along Epping and Lane Cove Road for the North and South Catchments, respectively.

The stormwater treatment train will begin with rain water collected from the roofs of the development into rainwater tanks. Collected rainwater will be reused for internal and external non-potable water reuse (ie toilet flushing and irrigation). Overflows from the rainwater tanks as well as runoff from the open space of the site will be directed into corresponding OSD tanks via the above described stormwater drainage network.

Gross pollutants will be controlled via grated inlet pits, litter baskets and a trash screen inside the ODS tanks.

Peak flows would be controlled within the detention tanks before overflows are discharged out into a bio-retention basin located at the down slope end of each of two the catchments. Peak flows will be

controlled via orifice plates and weir outlets within the tanks. Details of the proposed tanks are discussed in more detail in **Section 4.1.3**.

Stormwater would be treated by bio-retention basins through filtration in the basin. Details of the filtration system are discussed in more detail in **Section 4.1.4**. Sub-soil drainage will be incorporated to discharge treated stormwater into Council's stormwater network.

During storm events, stormwater will be allowed to pond to an extended detention depth of 0.3 m, before flows are collected via a stormwater high flow pit within the basin. The high flow pit will be connected to Councils stormwater network. An overflow weir would be incorporated into the basins with appropriate energy dissipation devices to ensure safe conveyance of stormwater overflow.

The modelling has demonstrated that the proposed Stormwater Management Concept Plan is capable of reducing peak flows and discusses how stormwater and drainage would best be managed on site. Provided that the stormwater treatment facilities have been designed appropriately, WorleyParsons believes the proposed stormwater management strategy complies with standard practice for management urban stormwater and clearly addresses the issues raised by the Director General (Issue 8.1).

8. WATER SENSITIVE URBAN DESIGN

The water sensitive urban design (WSUD) strategy for the Allengrove development has been formulated to negate any impacts on the Lane Cove River. The Lane Cove River passes through the Lane Cove National Park and ultimately discharging into Sydney Harbour. For this reason, a WSUD approach has been adopted to minimise water quality impacts.

The proposed development includes a range of best practice measures to meet the following WSUD objectives:

- Reduction in potable water consumption through the use of water saving devices (ie. dual flush toilets etc);
- Reduction in wastewater production;
- Utilisation of available rainwater;
- Minimisation of impacts on downstream receiving waters;
- Safe conveyance of stormwater; and
- Integration of water management measures with landscape design into the proposed development.

It is proposed to sustainably minimise reliance on mains water through the introduction of rainwater tanks for water reuse.

Further details of the adopted WSUD strategy integrating with the site's stormwater drainage infrastructure is discussed in detail in **Section 7.3**. WorleyParsons believes the adopted WSUD measures address the WSUD considerations in the DGR (Issue 8.2).

8.1 Water Resources

It is understood that potable water needs within the existing dwellings of the site are provided by local Sydney Water Corporation (SWC) water mains.

8.2 Water Quality

8.2.1 Water Quality Treatment Targets

The NSW Department of Environment, Climate Change and Water (*DECCW formally DECC*) recommend reduction targets in annual runoff pollutant loads for developments of:

- 85% for total suspended solids (TSS);
- 60% for total phosphorous (TP); and
- 45% for total nitrogen (TN).

This guiding principle is generally adopted for new developments where significant changes to the landuse and impervious fraction are proposed. Since the proposed development involves changing the land use from low to medium/high residential, a stormwater treatment train will be required to achieve this treatment target.

It is noted that the above treatment targets are echoed in Council's Stormwater Management Plan.

8.2.2 MUSIC Water Quality Model

MUSIC is a continual-run conceptual water quality assessment model developed by the Cooperative Research Centre for Catchment Hydrology (*CRCCH*). MUSIC can be used to estimate the long-term annual average stormwater volume generated by a catchment as well as the expected pollutant loads. MUSIC is able to conceptually simulate the performance of a group of stormwater treatment measures (*treatment train*) to assess whether a proposed water quality strategy is able to meet specified water quality objectives.

To undertake the water quality assessment component of the Stormwater Management Plan, a long-term MUSIC model was established for the proposed development. The model was used to estimate the annual pollutant load generated under existing state and developed conditions over a period of historical average rainfall.

MUSIC was chosen for this investigation because it has the following attributes:

- It can account for the temporal variation in storm rainfall throughout the year;
- Modelling steps can be as low as 6 minutes to allow accurate modelling of treatment devices;
- It can model a range of treatment devices;
- It can be used to estimate pollutant loads at any location within the catchment; and
- It is based on logical and accepted algorithms.

8.2.3 Input Data

RAINFALL

The nearest rainfall station to the site is located at Macquarie Park (Willandra Village – Station Number 66156), just over 2 kilometres north west of the site. Daily rainfall data only was available for the Macquarie Park station and monthly average rainfalls were obtained from the Bureau of Meteorology for all available years. The mean annual rainfall at Macquarie Park was found to be of the order of 1,150 mm (Data dating back from 1971).

In order to develop a model that could comprehensively assess the performance of water quality treatment, the use of pluviograph rainfall data (captured at six minute intervals) was considered necessary. The nearest station to the site with similar elevation for which pluvial data was available was from the Sydney Observatory Hill.

Six-minute pluviograph data was used for the 15 year period of rainfall data from 1/01/1937 to 31/05/1952 from the Sydney Observatory Hill. The average rainfall for this period is 1,150 mm/yr, the dataset contains the highest recorded rainfall over a 15 year period for the Sydney Observatory Hill station. As such, this is the best available dataset to represent a 15 year period at North Ryde.

EVAPORATION

Monthly areal potential evapotranspiration values were obtained for North Ryde from the Bureau of Meteorology data and are shown in **Table 8-1**.

Table 8-1 – Monthly Areal Potential Evapotranspiration

Month	Areal Potential Evapotranspiration (*mm*)
January	180
February	135
March	128
April	88
May	58
June	43
July	43
August	58
September	88
October	127
November	152
December	163
Total	**1,265**

SOIL PROPERTIES

Calibration of the runoff-rainfall parameters within the MUSIC model was completed to achieve an appropriate runoff co-efficient for the site. The MUSIC default and adopted rainfall run-off parameters along with the resulting run-off co-efficient are presented in **Table 8-2**. The Soil Storage Capacity and Field Capacity were changed to achieve a suitable volumetric runoff co-efficient of 0.30 for the site under natural undeveloped conditions. This is in the range of expected values based on available data for gauged catchments.

Table 8-2 – Adopted MUSIC Soil Parameters

	Default Parameters	Adopted Parameters
Impervious Area Properties		
Rainfall Threshold (mm/day)	1	1
Pervious Area Properties		
Soil Storage Capacity (mm)	120	90
Initial Storage (% of capacity)	30	30
Field Capacity (mm)	80	70
Infiltration Capacity Coefficient (a)	200	200
Infiltration Capacity Exponent (b)	1	1
Groundwater Properties		
Initial Depth (mm)	10	10
Daily Recharge Rate (%)	25	25
Daily Baseflow Rate (%)	5	5
Daily Deep Seepage Rate (%)	0	0
Runoff Co-efficient		
100% Pervious	0.25	0.35
65% Impervious	0.67	0.71

The adopted MUSIC soil parameters yielded a volumetric runoff coefficient (C_v) of 0.35 for the existing site. This Cv value is believed to be acceptable considering the grade of the site and the silty clay layer found across the site (refer to geotechnical report).

POLLUTANT CONCENTRATIONS

The event mean concentrations (*EMCs*) of pollutants that were used in the modelling were derived from the Engineers Australia publication Australian Runoff Quality – A guide to Water Sensitive Urban Design (2006). The adopted pollutant concentrations are shown **Table 8-3**.

Table 8-3 – Adopted Pollutant Concentrations

Land Use	Pollutant Concentration (mg/L)					
	Wet Weather Concentration (mg/L)			Dry Weather Concentration (mg/L)		
	Suspended Solids	Total Phosphorous	Total Nitrogen	Suspended Solids	Total Phosphorous	Total Nitrogen
Urban	180	0.35	2.8	16	0.14	1.3
Roofs	36	0.13	2.2	-	-	1.3
Roads	200	0.250	2.2	-	-	-

The road concentrations were used for car parks

8.2.4 Existing Conditions

The primary objective is to achieve DECCW's (formerly DECC) pollutant reduction targets as discussed in **Section 8.2.1**. Therefore, MUSIC modelling of the existing or pre-developed conditions is not necessary. A MUSIC assessment of the existing site will be undertaken however for comparative and discussion purposes.

MODEL INPUTS

The existing catchment is defined in **Figure 3** and the data in **Table 8-4** was used to create a MUSIC model for the site. The extents of the catchments were determined from supplied survey data.

Table 8-4 – Existing Catchment Data

Site Catchment	Land Use	Area (*ha*)	Impervious (%)
Roof area	Roofs	0.278	100
Open space	Urban	0.949	40
Total		**1.230**	**54**

MODEL RESULTS

The calibrated MUSIC model was used to simulate pollutant export generated during the 15 year rainfall period using the typical pollutant concentrations contained in **Table 8-3**.

For the purposes of comparing the proposed case with the existing case, the estimated annual exports of pollutants generated by the site are shown in **Table 8-5**.

Table 8-5 – Total Annual Pollutant Export Loads from Site – Existing State

Scenario	Pollutant Load (*kg/yr*)			
	Suspended Solids	Total Phosphorous	Total Nitrogen	Gross Pollutants
Existing Site	1,010	2.25	21.4	222

Results from the MUSIC modelling show average volumetric flows from the existing site to be 8.83 ML/year, yielding a volumetric runoff coefficient (C_v) of 0.63. The high C_v value is a result of the high percentage of impervious area within the site.

8.2.5 Proposed (*No Treatment*)

MODEL INPUTS

The existing state model was modified to reflect the proposed conditions. No treatment techniques were implemented in the proposed (*no treatment*) model. The model was modified to reflect the impervious proportions of the catchment as defined in **Table 8-6** and illustrated in **Figure 4**.

Table 8-6 – Proposed Catchment Data

Sub Catchment	Land use	Area (ha)	Impervious (%)
Car park/Roads	Roads	0.094	100
Open Space	Urban	0.329	50
Roof Area	Roof	0.807	100
Total		**1.230**	**67**

MODEL RESULTS

The estimated annual export of pollutants from the proposed (*no treatment*) site are compared with existing conditions in **Table 8-7**.

Table 8-7 – Annual Pollutant Export Loads – Proposed (No Treatment)

Scenario	Pollutant Load (*kg/yr*)			
	Suspended Solids	Total Phosphorous	Total Nitrogen	Gross Pollutants
Existing	1,010	2.25	21.4	222
Proposed (no treatment)	1,330	2.77	26.5	280

By comparing the pollutants discharged from the proposed site without treatment measures, it is clear that the proposed development is generating an elevated volume of pollutants. This increase is a

result of an increase in impervious area across the development (no treatment) and changes to the redistribution of roof, roads/car parking and open space areas and corresponding EMC associated with these land use areas.

Results from the MUSIC modelling show average volumetric runoff under proposed conditions (no treatment) to be 10.9 ML/year, yielding C_v of 0.77.

8.2.6 Proposed (*With Treatment*)

MODEL INPUTS

The MUSIC model of the proposed site (with treatment) takes into consideration of the use of the proposed litter baskets, rainwater tank and bio-retention basins on site. Details of the proposed stormwater treatment train facilities are discussed further in **Section 4.1**.

MODEL RESULTS

The estimated annual exports of pollutants from the proposed (with treatment) site are compared with the existing and proposed (no treatment) conditions in **Table 8-8**.

Table 8-8 – Annual Pollutant Export Loads – Proposed (With Treatment)

Scenario	Pollutant Load (*kg/yr*)			
	Suspended Solids	Total Phosphorous	Total Nitrogen	Gross Pollutants
Existing Site	1,010	2.25	21.4	222
Proposed (no treatment)	1,330	2.77	26.5	280
Proposed (with treatment)	145	0.87	13.4	6.10
Percentage Reduction	88%	65%	45%	98%

By comparing the volumes of pollutants discharged from the proposed site with treatment measures, it is clear that the proposed development with treatment effectively reduces the volume of pollutants discharged from the site.

Results from the MUSIC modelling show average volumetric runoff from the re-developed site (with treatment) of 10.3 ML/year, yielding a C_v of 0.73. The modelling demonstrates that the proposal has decreased average volumetric flow from the site.

The total volumes of pollutants discharged from the site under developed conditions (with treatment) are significantly lower than those generated under existing conditions. The MUSIC model suggests that the proposed development would improve water quality runoff and hence meets the water quality treatment targets discussed in **Section 8.2.1**.

With improvements in water quality from the proposed development, compared to those generated under existing conditions, there would be no impact on downstream properties or environments. Provided that the proposed stormwater treatment facilities are designed appropriately, WorleyParsons believes the proposed stormwater treatment train complies with standard practice for managing urban stormwater.

9. GROUNDWATER

9.1 Local Groundwater Conditions

As discussed earlier, A geotechnical assessment for the site was conducted by Jeffery and Katauskas (J&K) in April 2008 with field work undertaken on the 13th of February 2008. The assessment found the site to be:

- "*topsoil (or fill) comprising silty clay of high plasticity was encountered in all boreholes to depths between 0.2 m and 0.4 m.*";
- "*Residual silty clay was encountered below the topsoil/fill in all boreholes and extend to the borehole termination depths between 1.25 m and 1.5 m. Residual silty clay was generally of high plasticity and very stiff and hard strength.*";
- "*the residual silty clay extends to a maximum depth of about 2 m. Blowcounts of greater than 10 per 100 mm penetration are interpreted to indicate extremely weathered shale or clay with numerous shale and ironstone bands.*"; and
- "*Groundwater seepage was encountered at a depth of 1.35 m and 0.4 m whilst drilling BH1 and BH2 respectively. All boreholes were 'dry' on completion of drilling… Long term groundwater monitoring was not carried out.*"

Currently, the site is approximately 50% impervious, covered by roof and sealed car park areas, which limits the amount of infiltration into the groundwater system. Under proposed conditions however, the impervious areas will increase from 54% to 67%, which would marginally decrease the amount of infiltration into the local groundwater system. This marginal decrease is not a significant change to the existing situation.

As a result, it is assessed that the proposed redevelopment would have no adverse affect on groundwater.

9.2 Local Groundwater Interception

Groundwater could potentially be intercepted by the proposed basement car park. The extent of the impact is dependent on the design of the basement car park.

Should there be any intercepted groundwater in the proposed car park, captured groundwater would be drained or pumped back into the Council stormwater network.

It is worth noting that due to the localised proximity and minor size of the development, in respect to the size of the Macquarie Park catchment, any impacts on regional groundwater water as a direct result of the proposed development would be minimal.

10. SERVICES AND SURROUNDING INFRASTRUCTURE

In additional to Council's stormwater drainage network, other major service trunk lines have been identified along Epping and Lane Cove Road. These include services from Sydney Water Corporation (SWC), Energy Australia, AGL and Telstra.

10.1.1 Water and Sewer

A 100 mm SWC water main surrounds the site along Lane Cove, Epping Road and Allengrove Crescent. To sufficiently supply potable water to the proposed development would require a 250 mm pipe connection to SWC water mains. Larger 250 mm and 150 mm water mains are found nearby on the opposite sides of Lane Cove and Epping Road.

An existing sewer network currently services all of the existing lots within the site as well as conveying sewage from upstream catchments, particularly from the south and the east. The sewer network drains to a 225 mm pipe that crosses Lane Cove Road and continues west towards a 500 mm concrete sewer main alongside Shrimpton Creek. The existing sewer network is serviced by the North Head Sewage Treatment Plant. The existing sewer network will need to be augmented and relocated to cater for the proposed development.

10.1.2 Power

Energy Australia is currently servicing to the existing lots on the site. A major High Voltage (HV) power trunk line currently runs along underground along Lane Cove Road, while a minor distribution line is found running along Epping Road. It is also noted that overhead power lines were also identified visually in Epping, Lane Cove Road and Allengrove Crescent.

Additional loads placed by the higher density proposed by the development may require an upgrade or construction of a new substation. Discussions with Energy Australia have identified that power is likely to be available for the proposed development, however may come at a cost to the developer if augmentation is required before Energy Australia's scheduled upgrades.

An investigation at future stages of the development would be required to assess what upgrades, if any, are required.

10.1.3 Gas

AGL currently provides gas to the existing lots on the site. A 450 mm high pressure gas main has been identified along Epping Road, while a 32 mm gas main has been identified along Allengrove Crescent.

10.1.4 Telecommunications

Telstra currently services the existing lots on the site. Major telecommunication trunks lines have been identified along Epping and Lane Cove Road and Allengrove Crescent. Additional service suppliers and asset owners such as Optus, Powertel, Pipe Networks and CSIRO have also been identified and are found sharing Telstra's trunk lines.

11. CONSTRUCTION PHASE EROSION AND SEDIMENT CONTROL

In accordance with the best practice state government guideline "Managing Urban Stormwater – Soils and Construction" (*Landcom, 2004*), Erosion and Sediment Control Plans are required for sites of area less than 2,500 m^2 while Soil and Water Management Plans (SWMPs) are required for sites greater than 2,500m^2. The proposed development covers a total area of over 12,000 m^2, therefore a Soil and Water Management Plan would be required.

Detailed SWMPs would be completed to accompany further applications for construction and other works.

The soil and water management plans would provide a control strategy for each sub catchment to ensure appropriate runoff quality. These controls would consist of filter fences, run off diversion mounds, a sediment basin and stabilised site access.

12. CONCLUSION

This report has been produced for EGC Custodian Services Pty Ltd in support of the redevelopment of their site located on the corner of Lane Cove Road and Epping Road, North Ryde. EGC Custodian Services are seeking approval for a concept plan including demolition of existing single dwellings located within the site, and the construction of three multi-storey buildings and underground basement car parking with integrated communal open space. The proposed development is to provide a total of approximately 269 apartments across the three buildings and approximately 394 basement car parking spaces.

This report has addressed the drainage, stormwater and flooding concerns raised by the Department of Planning in Section 8 of the Director General's Requirements (DGR) (Refer to **Appendix 2**). The DGR's have been addressed by adopting standard practices for management of stormwater quantity, quality and flooding. The City of Ryde Council's Development Control Plans (DCP) were also consulted.

The site is also located some distance and elevation away from any major water ways. There are no defined overland flow paths across or through the site and is not affected by flooding. Adequate drainage and appropriately designed overland flow paths would be constructed across the development to ensure stormwater flows are conveyed safely from the site into Council's existing stormwater infrastructure network.

Stormwater runoff generated across the site would be controlled and reduced with the implementation of on-site detention (OSD). OSD tanks with a designed discharge control outlet would be used to control peak flows, such that flows generated across the proposed development do not exceed peak flows generated under pre-developed conditions. This is a significant improvement from existing conditions. The discharge controls would be designed to cater for all storm events up to the 100 year average recurrence interval (ARI) storm event. This would result in no impact to receiving water bodies or Council's existing stormwater infrastructure.

Water quality is to be managed on site with the implementation of Water Sensitive Urban Design (WSUD) best practice principles. Adopting these principles, a stormwater treatment train has been developed, which incorporates the use of rainwater tanks, litter baskets, OSD tanks and bio-retention basins. Modelling of the treatment effectiveness of the proposed treatment train demonstrates that the proposed treatment train is effective at achieving the Department of Environment, Climate Change and Water pollutant reduction targets for urban stormwater management.

The flooding and stormwater management assessments undertaken as part of this concept plan submission to the DoP clearly demonstrate that the proposed development and stormwater management strategies sufficiently mitigate any stormwater/drainage and flooding impacts to downstream properties and receiving environments.

13. REFERENCES

- Australian Bureau of Statistics, 2007, ABS – 1301.0 Year book Australia 2007;
- Bureau of Meteorology, 1937-1952, Daily Rainfall Data from the Sydney Observatory Hill Rainfall Station;
- City of Ryde Council, 2006, City of Ryde Development Control Plan 2006 – Stormwater Management;
- Jeffery and Katauskas Pty Ltd, April 2008, Report to EGC Custodian Services Pty Ltd on Geotechnical Investigation for Proposed Residential Development at the Allengrove Crescent site, Corner Lane Cove Road and Epping Road, North Ryde, NSW;
- Jeffery and Katauskas Pty Ltd, April 2008, Report to EG Funds Management on Stage 1 Environmental Site Assessment for Proposed Residential Development at Lane Cove Road and Epping Road, North Ryde;
- Landcom, March 2004, Managing Urban Stormwater: Soils and Construction; and
- Watson Buchan Pty Ltd, 2008, Plan Showing levels and details over No. 1-9 Allengrove Crescent, 253-263 Lane Cove Road, 116A-122A Epping Road, North Ryde.

APPENDIX 1 – PLAN OF PROPOSED DEVELOPMENT

APPENDIX 2 – DIRECTOR GENERALS REQUIREMENTS

APPENDIX 3 - STORMWATER MANAGEMENT CONCEPT PLAN