BROWN

Stormwater Concept Plan

Proposed for Industrial Development

813-913 Wallgrove Road, Horsely Park

August 2013

Reference Number X12254-01

Prepared for Gazcorp Pty Ltd

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1. INTRODUCTION

Brown Consulting has been engaged by Gazcorp Pty Ltd to develop a stormwater concept plan for a proposed industrial development at 813 – 913 Wallgrove Road, Horsely Park. This concept plan covers stormwater quality and quantity management issues to support the Development Application (DA) for the subdivision of 15 lots and proposed internal access road. The site is situated within the Local Government Area of Fairfield City Council. The locality sketch of the study area is shown in **Figure 1.1** below.

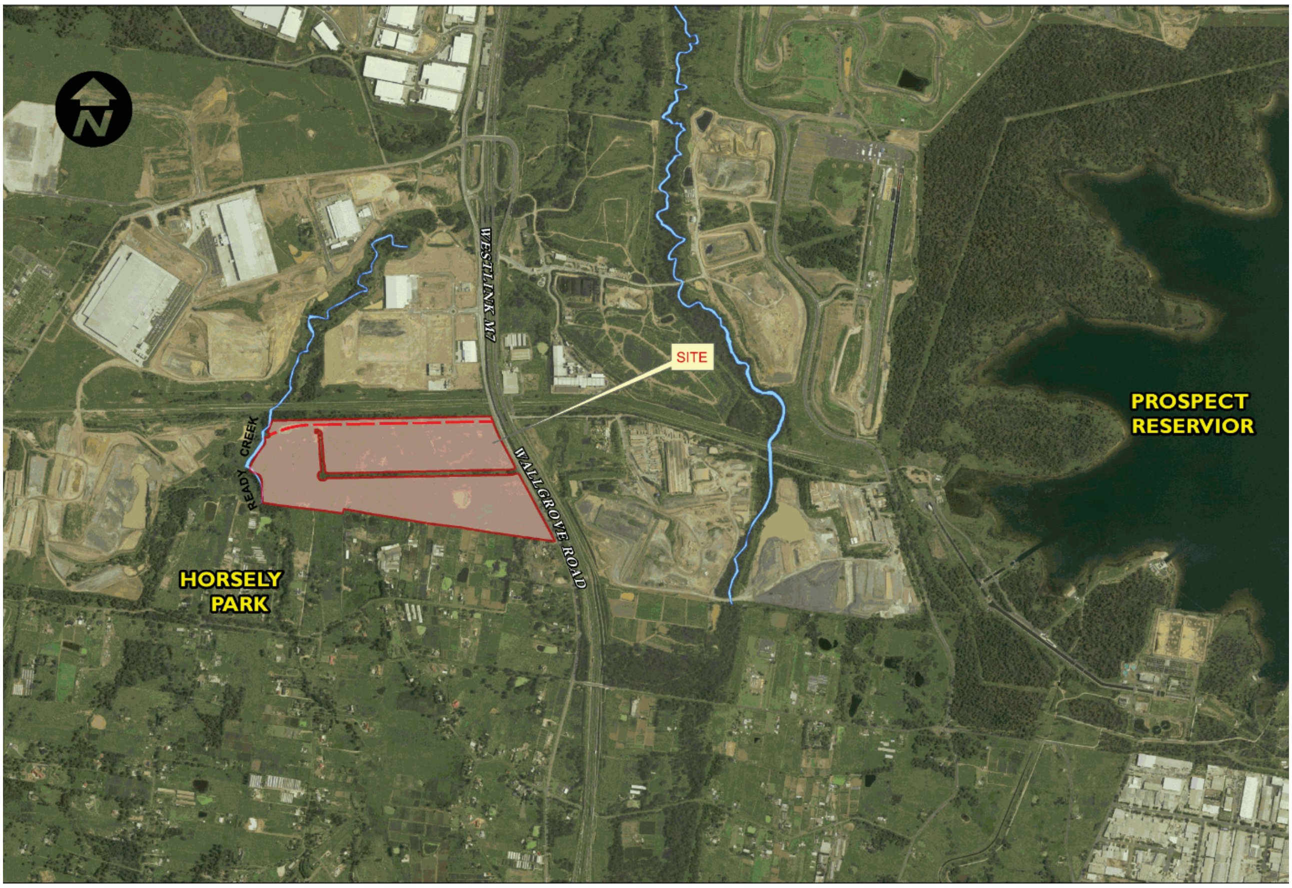

Figure 1.1: Locality Sketch

1.1 Description of the Study Area

The site is bordered by Wallgrove Road and Western Sydney Toll Road M7 at the east, Ready Creek at the west, and Sydney Catchment Authority pipeline at the northern boundary. Currently the site is used as grazing pasture land for cattle and horses.

The proposed development consists of 15 industrial lots with an internal access road to provide access to the proposed lots from Wallgrove Road. There is a future RMS Road reserve shared in part by the site, which will eventually run along the northern boundary of the site to be commissioned at a future stage. The general layout plan of the site is shown in **Figure 1.2** below.

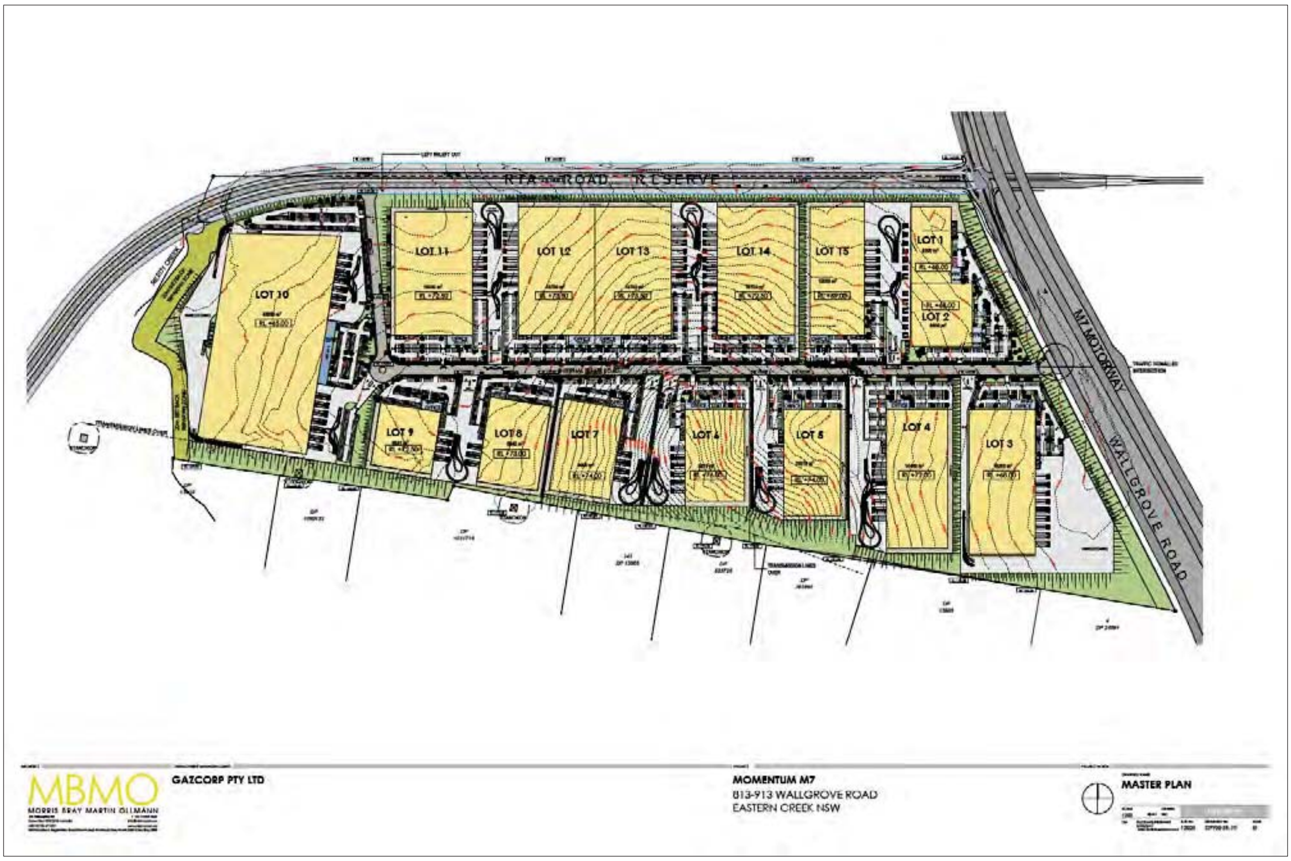

Figure 1.2: The Proposed Layout Plan of the Site

1.2 Objectives

The objectives of the Stormwater Concept Plan for the subdivision take into consideration the requirements of the *Fairfield Development Concept Plan (November, 2010)*; *Urban Area Onsite Detention Handbook (February, 1997) for water quantity and Sydney Metropolitan Catchment Management Authority, Interim Reference Guidelines for South East Queensland Concept Design Guidelines for WSUD* for water quality management. The objectives of this study is:

- To provide stormwater concept design of trunk drainage for the overall site
- To provide a concept sizing of detention storage requirement to reduce all the developed peak flows off the proposed development to the pre-development flows from the site.
- To demonstrate the proposed stormwater treatment strategy incorporated into the stormwater concept plan meet the pollution reduction targets outlined in the *Sydney Metropolitan Catchment Management Authority, Interim Reference Guidelines for South East Queensland Concept Design Guidelines for WSUD*.
- To provide an interim stormwater concept design for the interim Stage 1 of works for the site.

2. HYDROLOGY

2.1 Catchment Areas

The total site area is 52.38 ha which currently drains to three principle outlets:

Outlet 1 - The South Eastern principle subcatchment is **14.12ha** in size and drains to existing box culvert located under Wallgrove Road eventually drains to Eastern Creek.

Outlet 2 – The North Eastern subcatchment which is **13.0ha** in size, drains to north eastern corner of the site via an existing swale drain which then drains under the SCA pipeline.

Outlet 3 – The western subcatchments is the largest principle catchment area which is **26.0ha** in size and drains directly to Reedy Creek.

There are two external upstream catchment areas draining through the site:

External SE - The South Eastern external catchment is **74.71ha** in area, which drains through the south-eastern corner of the site which combines with the internal catchment areas of the site draining to Outlet 1.

External SW - The South Western external catchment is **5.6ha** in area, which drains through the site along to southern boundary and eventually discharges to Reedy Creek at the south-western corner of the site.

Stormwater runoff for the existing and proposed catchment conditions was modelled using the *XP-RAFTS* (version SP1, 2009) hydrological package. The Sub-catchments for the model were delineated using CatchmentSIM GIS based program based on a combination of 5m DEM of Smoothed ALS data supplied by the NSW Department of Lands and land survey of the site. The existing internal and external catchment areas shown in **Appendix A**.

2.2 Model Parameters

Intensity Frequency Duration (IFD) data were obtained from *Fairfield City Council, Stormwater Drainage Policy (Sept 2002).* Hydrological modelling for the study area was undertaken for 5y and 100 year ARI events of storm durations from 10 minutes to 72 hours.

The Initial and Continuous Loss (IL/CL) model was adopted for modelling in *XP-RAFTS* and the parameters recommended in *Australian Rainfall and Runoff –Volume 2* (Institution of Engineers, Australia, 1987) we adopted for this study and are shown in **Table 2.1** below.

Table 2.1: Design Loss Rates

Item	*Pervious Area Loss*	*Impervious Area Loss*
Initial Loss (mm)	10	1
Continuing Loss (mm/hr)	2.5	0

A fraction impervious of 5% and 90% was adopted for undeveloped and developed (industrial) areas respectively. The model input and output data for XP-RAFTS is provided in **Appendix B**.

2.3 Results of Modelling

2.3.1 Existing Conditions

The peak flows for exiting catchment conditions were analysed using *XP-RAFTS* and the modelled peak flows and critical storm duration are shown in **Table 2.2** below for 5 year and 100 year ARI design storm events. Refer to Drawing 01 in **Appendix A** for sub-catchment references and outlet locations.

Table 2.2: Existing Peak Flows

Node	***Peak Flow (m^3/s)***	
	5 Year	***100 Year***
OUT 1	2.40 [2 hours]	4.60 [2 hours]
OUT 2	2.30 2 hours]	4.00 [2 hours]
OUT 3	3.40 [2 hours]	6.80 [2 hours]

Note: [ ] denotes critical storm duration in hours.

The peak flow rates presented in Table 2.2 above at each discharge point of the site determine the Permissible Site Discharge (PSD) for the development. Refer to **Appendix B** for detailed results. The upstream catchments are not included in this study. Refer to Report and flood mapping BMT WBM.

2.3.2 Developed Conditions – With No Detention

The peak flows for developed catchment conditions without detention are shown in **Table 2.3** below for 5 year and 100 year ARI design storm events. Refer to Drawing 02 in **Appendix A** for sub-catchment references and outlet locations.

Table 2.3: Developed Peak Flows (No Detention)

Node	***Peak Flow (m^3/s)***	
	5 Year	***100 Year***
OUT 1	5.58 [25min]	8.52 [15min]
OUT 2	4.67 [25min]	7.13 [15min]
OUT 3	8.55 [25min]	13.04 [15min]

The results in Table 2.3 above indicate that, without detention, the development increases the peak flows at the discharge points of the site above the PSD rates, due to the increase in the impervious area of the catchment. On-site Detention is required for the development.

2.4 On-Site Detention

2.4.1 Performance Targets

Performance Targets as required for storm water quantity as outlined in *Fairfield City Council, Urban Area On Site Detention handbook (February, 1997)* are summarised below in **Table 2.4**.

Table 2.4: Performance Targets for storm water Quantity

Reduction of Peak flows to pre-development levels	5y and 100y ARI

2.4.2 Detention Requirements

The overall stormwater quantity management strategy for the site is for each lot of the subdivision to provide an individual OSD system incorporated into their respective internal drainage systems. Each lot will have Site Storage Requirement (SSR) and Permissible Site Discharge (PSD) based on a lot area basis as summarised in **Table 2.5**.

Table 2.5: Summary of On-Site Detention Requirements

Attribute	*5Y ARI*	*100Y ARI*
PSD*, (m^3/s/ha)	0.105	0.23
SSR*, (m^3/ha)	220	315

Note: * PSD and SSR are to be provided at a rate of the total Lot Area.

The PSD and SSR for each lot has been determined to compensate for the road catchments and other bypass catchments such as external batters and landscaping areas which naturally bypasses detention. An allowance of up to 20% bypass has been factored into determining the PSD and SSR.

The actual arrangement of the detention tanks is subject to detailed design of each lot, however. For purposes of determining site SSR, a below ground detention tank with two stage outlet control structure was modelled for the OSD with no High Early Discharge (HED) included.

2.4.3 Results of Modelling with Detention

The peak flows, critical storm durations and storage requirement for developed catchment conditions with on-site detention is summarised in **Table 2.6**. Refer to **Appendix B** for detailed model output.

Table 2.6: Summary of On-Site Detention Modelling Results

Outlet	***Total Storage Required (m^3)***		***Storage Requirement Rate, SSR (m^3/ha)***		***Permissible site Discharge, PSD (m^3/s/ha)***		***Peak Discharge At Outlet (m^3/s)****	
	5Y	***100Y***	***5Y***	***100Y***	***5Y***	***100Y***	***5Y***	***100Y***
OUT 1	2,740	3,845	220	315	0.105	0.230	2.1	4.3
OUT 2	2,295	3,225	220	315	0.105	0.230	1.9	3.8
OUT 3	4,220	5,920	220	315	0.105	0.230	3.4	6.7
TOTAL	9,255	12,990	220	315	0.105	0.230	-	-

Note:* Peak Discharge is total discharge at each outlet and includes 20% area bypass OSD.

2.4.4 Comparison with Pre and Post Development Flows

A comparison of pre and post developed with detention flows is presented in **Table 2.7** below. **OUT 1**, **OUT 2** and **OUT 3** represent the existing discharge points from the site.

Table 2.7: Comparison of Pre and Post Development Peak Flow Rates (with OSD)

ARI	***OUT 1***		***OUT 2***		***OUT 3***	
	Pre-dev (m^3/s)	***Post-dev (m^3/s)***	***Pre-dev (m^3/s)***	***Post-dev (m^3/s)***	***Pre-dev (m^3/s)***	***Post-dev (m^3/s)***
5	2.4 [2 hrs]	2.1 [1.5 hrs]	2.0 [2 hrs]	1.9 [1.5 hrs]	3.4 [2 hrs]	3.4 [1.5hrs]
100	4.6 [2 hrs]	4.3 [1.5hrs]	4.0 [2 hrs]	3.8 [1.5 hrs]	6.8 [2 hrs]	6.7 [1.5 hrs

Table 2.7 above shows that applying the proposed SSR and PSD rates to all lots attenuates the runoff from the post developed catchments to the existing flows at the discharge points from the site for 5 year and 100 year ARI. The OSD proposed for the lots provides adequate attenuation of flows to compensate for the roads and other bypass areas.

3. MANAGEMENT OF MAJOR AND MINOR FLOWS

Runoff from lots is generally directed to the internal access road drainage system. Inter-allotment drainage is to be provided for lots draining away from the road. Stormwater is to be generally conveyed through a below ground stormwater drainage network contained within the internal access road reserves. Peak discharges from the site is not to exceed the existing pre-development flow rate from the site. Detention requirements are described in more detail in **Section 2**.

3.1 Minor Flow Management

Stormwater runoff from Lots will be directed to a trunk drainage system for minor storm events in a conventional pit and pipe system. Each lot is required to have its own on site detention and water quality treatment to manage water quantity and quality at the outlet.

3.2 Major Flow Management up to 100 year ARI

Flows in excess of the piped system capacity will be conveyed through the site to the nominated discharge pipes as overland flow along the internal access roads and temporary trunk drainage channels in place. The OSD system at each lot is designed in such a way to reduce post to pre developed peak flows for up to 100 year ARI and as such under normal operation of OSD systems, the major flows would be contained within the piped drainage system. Overland flow paths will be provided only as an emergency overflow provision for instances of blockage or OSD system failure.

The stormwater concept plan for the site is shown in **Appendix A**.

3.3 Temporary Conveyance Structures

During the development of the proposed site, the road drainage system under the future RMS road reserve located at the northern boundary of the site will not be planned as constructed until after the full development of the site. The proposed lots 1 to 2 and lots 11 to 15 will have their own individual OSD systems and be connected into the future road drainage system. As a temporary interim measure, two swales (Swale No 2 and Swale No 3) are proposed to convey 100 year ARI peak flows in place of the road drainage system. The swales will be contained within the area of the site reserved for the future road and will be decommissioned upon construction of the road drainage system. Refer to **Stormwater Concept Plan Drawing** provided in **Appendix A**. The proposed dimensions and hydraulic calculations of the temporary swales are summarised below in **Table 3.1**.

Table 3.1: Summary of Temporary Swales

Swale No	*Depth (m)*	*Base Width (m)*	*Batter (1:X)*	*Slope (%)*	*Q (m3/s)*	*Flow Depth (m)*	*Freeboard (mm)*	*Top Width (m)*
3	1.15	2.0	4.0	1.0	4.0	0.65	500	11
4	1.15	4.0	4.0	1.0	5.0	0.65	500	13

3.4 Conveyance of External Catchments

The two external catchment areas draining through the site are to be conveyed via vegetated swales and have been designed to for storms up to 100 year ARI based on flow information supplied by BMT WBM. The dimensions of the proposed vegetated swales located at South East (Swale No.1) and West (Swale No. 4) of site are summarised in **Table 3.2** below. Refer to **Stormwater Concept Plan Drawing** provided in **Appendix A** for locations of the respective swales.

Table 3.2: Dimensions of Swale for Upslope Diversion

Swale No.	*Depth (m)*	*Base Width (m)*	*Batter (1:X)*	*Slope (%)*	*Top Width (m)*
1	1.5	3.0	4	0.5	20
2	0.8	2.0	4	2.0	8.5

The hydraulic modelling of the proposed swales draining the external catchment areas has been undertaken by BMT WBM. Refer to report and flood maps by BMT WBM.

4. STORMWATER QUALITY TREATMENT

4.1 Performance Targets

The proposed treatment strategy for the site is such that the development site is capable of reducing export loads to the requirements of the *Sydney Metropolitan Catchment Management Authority, Interim Reference Guideline for the South East Queensland Concept Design Guidelines for WSUD*. These target reduction rates are as referred to in the *Director General's Environmental Assessment Requirements* for the site and are provided in **Table 4.1** below.

Table 4.1: Reduction Rate Targets for Water Quality Treatment.

Parameter	*Percentage Reduction (%)*
Reduction in mean annual load of Total Gross Pollutant (GP)	90%
Reduction in mean annual load of Total Suspended Solids (TSS)	85%
Reduction in mean annual load of Total Phosphorous (TP)	65%
Reduction in mean annual load of Total Nitrogen (TN)	45%

4.2 Stormwater Treatment Strategy

The stormwater treatment strategy for the overall site is to provide the majority of treatment as on-site treatment measures to within individual lots through adopting Waters Sensitive Urban Design (WSUD) principles. The access road is to provide primary treatment with Gross Pollutant Traps (GPTs). The removal rates to be employed by WSUD within the individual lots are to provide compensatory removal of pollutants for the access road such that the overall treatment of the site meets the removal rate targets presented in **Table 4.1**.

4.2.1 *Onsite Treatment for Individual Lots*

The stormwater treatment strategy for each individual lot is subject to the future development and building layout, however to compensate for the access road and bypass areas, the individual lots will need to achieve the following minimum reductions rate targets through WSUD:

- **Gross Pollutants** **92%**
- **Suspended Sediments** **89%**
- **Total Phosphorous** **69%**
- **Total Nitrogen** **48%**

4.2.2 *Gross Pollutant Traps (GPT's)*

The proposed gross pollutant traps for the access road area will be placed in line of the trunk drainage system prior to discharge into specific outlet to remove litter, debris and sediment. While the pollutant capture efficiency of various traps may vary, as a conservative measure for modelling purposes, it is assumed that the GPT will be capable of removing of the following as per typical treatment performance provided in *Sydney Catchment Authority, A guide to the Use of MUSIC in Sydney's Drinking Water Catchment ()*:

- Gross Pollutants 90%
- Suspended Sediments 65%
- Total Phosphorous 15%
- Total Nitrogen 14%

The selection of the proprietary device is subject to detailed design, however the selection of the GPT will need to ensure the device is capable of removing the above reduction rate targets.

4.3 Music Modelling

4.3.1 Modelling Parameters

The performance of the proposed water quality treatment strategy has been modelled using the *MUSIC V5* water quality model. The parameters adopted for *MUSIC* modelling are provided in **Appendix C**.

4.3.2 Music Modelling Network

A generic node was modelled to represent the WSUD removal rates to be applied to individual lots. Catchment areas were separated according to surface types with pollutant generation parameters assigned according to surface type. The music modelling adopted for this strategy lumped catchment areas representing total lot roof area, car park and loading area, taking into consideration bypassing catchment areas and road area such that the assessment of reduction rate covers the overall site. The music modelling network is shown in **Figure 4.1** below.

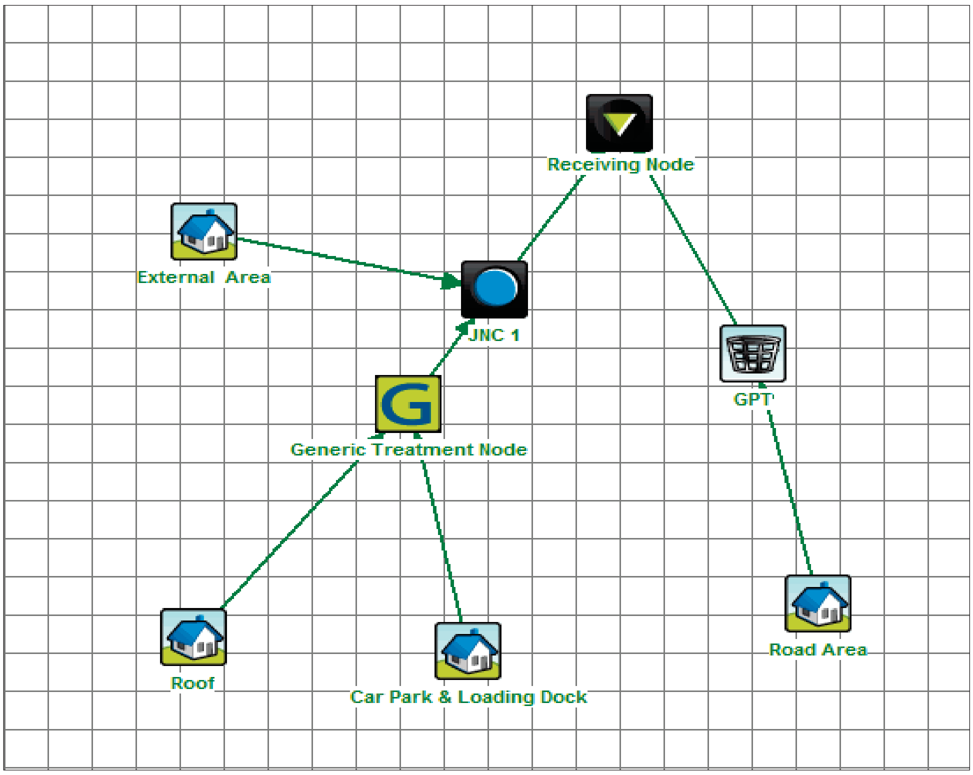

Figure 4.1: Music Model Network for Overall Site.

4.3.3 Music Modelling Results

Table 4.2 shows the removal rates for the overall water quality treatment for the site. Refer to **Appendix C** for MUSIC model output.

Table 4.2: Results of MUSIC Modelling for Stormwater Treatment Strategy No 1 for Site

Parameter	***Proposed Removal Targets for Road***	***Modelled Removal Rates for Lots***	***Modelled Removal Rates for Site***	***Required Removal rates****
TSS	65%	89%	86.6%	85%
TP	15%	69%	65.0%	65%
TN	14%	48%	45.0%	45%
Gross Pollutant	90%	92%	90.8%	90%

Note:

* Performance targets as required in *Interim Reference Guideline for the South East Queensland Concept Design Guidelines for WSUD*

Table 4.2 shows the proposed removal rates for the future lots are capable of removing the pollutant loads below the required target removal rates for TSS, TP, TN and Gross Pollutants in *Interim Reference Guideline for the South East Queensland Concept Design Guidelines for WSUD*.

5. STAGE 1 INTERIM WORKS

5.1 On-site Detention for Stage 1

Stage 1 of the development involves the construction of the central access road and the development of proposed Lot 10 only. OSD is to be provided for Lot 10 under the SSR and PSD requirements to be applied to all lots and temporary detention is to be provided for the access road until the future development of the overall site proceeds such that interim peak flows at each discharge point at Stage 1 does not exceed existing hydrological conditions. The tstorage requirement for temporary Basin Number 1 and Number 2 is 536 m^3 and 817 m^3 respectively, however once the remaining lots have been developed at a future stage, the OSD systems provided on all the lots will compensate for the impervious area of the access road as provided for under the ultimate strategy and the temporary basins can be decommissioned. The **Stormwater Concept Plan** for Stage 1 is provided in **Appendix A**.

The interim detention strategy for Stage 1 was modelled using *XP-RAFTS*. A comparison of pre and post developed flows with detention is presented in **Table 5.1** below where, **OUT 1**, **OUT 2** and **OUT 3** represent the existing discharge points from the site. It should be noted that, an addition outlet identified as **OUT 3a** will be drain undeveloped catchments for the stage 1 interim strategy. Under the ultimate strategy, this drainage line will only drain external catchments through the site (Swale number 2) and all internal catchments will drain to OUT 3. Refer to Drawing No. 05 in Appendix A for outlet locations.

Table 5.1: Comparison of Pre and Post Development Peak Flow Rates (with OSD)

ARI	*OUT 1*		*OUT 2*		*OUT 3*		*OUT 3a*	
	Pre-dev (m^3/s)	*Post-dev (m^3/s)*	*Pre-dev (m^3/s)*	*Post-dev (m^3/s)*	*Pre-dev (m^3/s)*	*Post-dev (m^3/s)*	*Pre-dev (m^3/s)*	*Post-dev (m^3/s)*
5	2.4 [2 hrs]	2.3 [2 hrs]	2.0 [2 hrs]	1.7 [2 hrs]	3.4 [2 hrs]	3.4 [2 hrs]	0.8 [2 hrs]	0.7 [2 hrs]
100	4.6 [2 hrs]	4.6 [2 hrs]	4.0 [2 hrs]	3.3 [2 hrs]	6.8 [2 hrs]	6.8 [2 hrs]	1.6 [2 hrs]	1.4 [2 hrs]

Table 5.1 shows that the interim detention strategy for the site is capable of attenuating peak flows discharging from the site to existing peak flows for 5 years to 100 year ARI.

5.2 Stormwater Quality Treatment

The drainage strategy for Stage 1 incorporates temporary catch drains to separate runoff from undeveloped catchments from the stage 1 development footprint. It is proposed to provide a temporary 600 mm diameter pipe culvert under the access road which will drain the undeveloped catchments under the access road and around stormwater treatment basins.

The treatment strategy for Stage 1 is to be with a combination of internal treatment devices for lot 10 and temporary bio retention basins for the access road. Once the future lots have been developed at a future stage, the on lot treatment system provided on all the lots will compensate for the access road catchment and the temporary basins can be decommissioned.

The target removal rate for Lot 10 proposed to be achieved through a combination of bioretention in car park areas, Enviropods located within gully pits for Hardstand areas and finally whole site routing through in line GPTs with Stormfilter treatment system fitted to the OSD tanks. Refer to the **Stormwater Concept Plan** for Stage 1 provided in **Appendix A**. The internal drainage of Lot 10 is subject to detailed design however the sizing of the treatment systems used for MUSIC modelling to achieve the target removal rates for Stage 1 is provided in **Appendix C**.

5.2.1 Music Modelling Network

The music modelling adopted for the stage 1 interim strategy lumped catchment areas representing total lot roof area, car park and hardstand (loading) area, taking into consideration external catchment areas and road area such that the assessment of reduction rate covers Stage 1 site. The music modelling network for stage 1 is shown in **Figure 5.1** below.

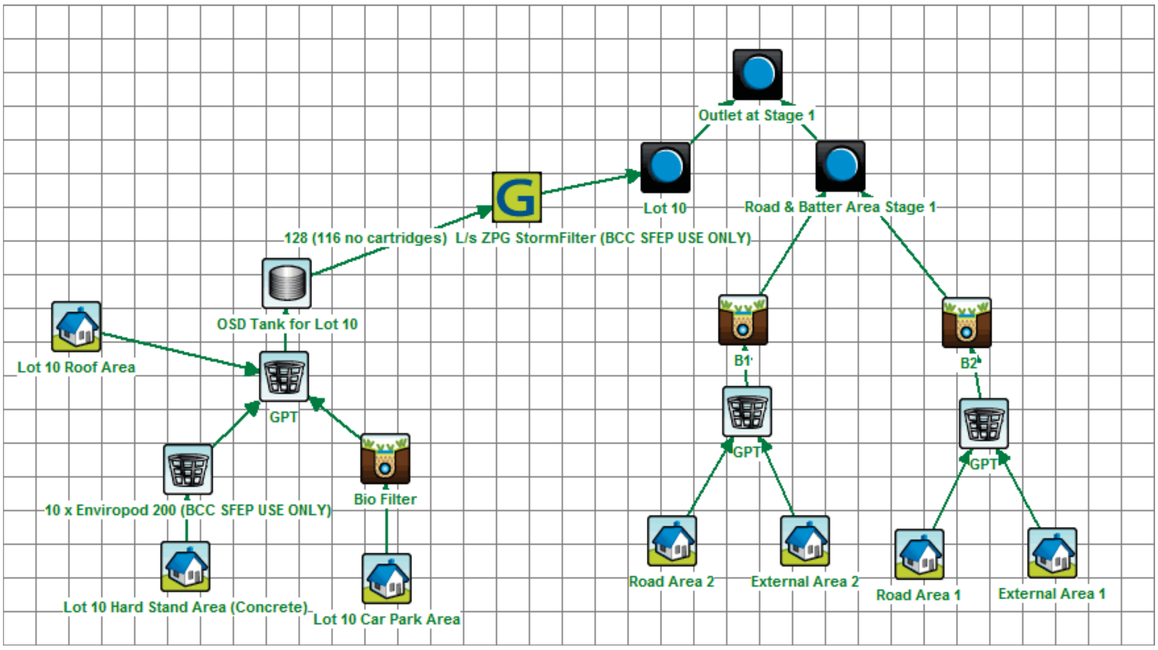

Figure 5.1: Music Model Network for Stage 1

5.2.2 Music modelling Results

Table 5.2 shows the removal rates for the overall water quality treatment for the site. Refer to **Appendix C** for *MUSIC* model output.

Table 5.2: Results of MUSIC Modelling for Stormwater Treatment Strategy for Stage 1

Parameter	***Proposed Removal Targets for Lot 10***	***Modelled Removal Rate using Treatment Strategy for Lot 10***	***Modelled Overall Removal Rate for Road Area***	***Modelled Removal Rates for Site***	***Required Removal rates****
TSS	89%	93%	88%	91.5%	85%
TP	69%	69%	58%	65.4%	65%
TN	48%	51%	45%	49.3%	45%
Gross Pollutant	92%	100%	100%	100.0%	90%

Note:
* Performance targets as required in *Interim Reference Guideline for the South East Queensland Concept Design Guidelines for WSUD*

Table 5.2 shows that, the stormwater treatment strategy for Stage 1 is capable of removing the pollutant loads below the required target removal rates for TSS, TP, TN and Gross Pollutants in *Interim Reference Guideline for the South East Queensland Concept Design Guidelines for WSUD*.

6. CONCLUSION

It is concluded that the proposed Stormwater Concept Plan for the site:

- Provides on-site detention (OSD) strategy capable of reducing developed peak flows to pre-developed flows from the site for 5 year to 100 year ARI design storm events for the ultimate developed site as well as the Interim Stage 1 to manage stormwater quantity discharging from the site.
- Provides stormwater treatment strategy which is capable of reducing pollutant loads of TSS, TP, TN and gross pollutants to the reduction targets outlined in the *Sydney Metropolitan Catchment Management Authority, Interim Reference Guidelines for South East Queensland Concept Design Guidelines for WSUD*.

7. REFERENCES

Fairfield City Council, Urban Area OnSite Detention handbook (February, 1997)

Fairfield Town Centre, Development Control Plan (November, 2010)

Fairfield City Council, Stormwater Drainage Policy (September, 2002)

Sydney Metropolitan Catchment Management Authority, Interim Reference Guideline for the South East Queensland Concept Design Guidelines for WSUD.

Sydney Metropolitan Catchment Management Authority, Draft NSW Music Modelling Guidelines (August 2010)

Sydney Catchment Authority, Draft a Guide to the Use of MUSIC in Sydney's Drinking Water Catchments

8. GLOSSARY OF TERMS

Afflux	The rise in water level upstream of a hydraulic structure such as a bridge or culvert, caused by losses incurred from the hydraulic structure.
Australian Height Datum	National survey datum corresponding approximately to mean sea level.
Annual Exceedance Probability	The chance of a flood of a given size or larger occurring in any one year, generally expressed as percentage probability. For example, a 100 year ARI flood is a 1% AEP flood. An important implication is that when a 1% AEP flood occurs, there is still a 1% probability that it could occur the following year.
Average Recurrence Interval	Is the long term average number of years between the occurrence of a flood as big as, or larger than the selected flood event.
Catchment	The catchment at a particular point is the area of land which drains to that point.
Design floor level	The minimum (lowest) floor level specified for a building.
Design flood	A hypothetical flood representing a specific likelihood of occurrence (for example the 100 year or 1% probability flood). The design flood may comprise two or more single source dominated floods.
Development	Existing or proposed works which may or may not impact upon flooding. Typical works are filling of land, and the construction of roads, floodways and buildings.
Discharge	The rate of flow of water measured in terms of volume over time. It is not the velocity of flow which is a measure of how fast the water is moving rather than how much is moving. Discharge and flow are interchangeable.
Digital Terrain Model	A three-dimensional model of the ground surface that can be represented as a series of grids with each cell representing an elevation (DEM) or a series of interconnected triangles with elevations (TIN).
Effective warning time	The available time that a community has from receiving a flood warning to when the flood reaches their location.
First Flush	The initial surface runoff of a rainstorm. During this phase, water pollution in areas with high proportions of impervious surfaces is typically more concentrated compared to the remainder of the storm.
Flood	Above average river or creek flows which overtop banks and inundate floodplains.
Flood awareness	An appreciation of the likely threats and consequences of flooding and an understanding of any flood warning and evacuation procedures. Communities with a high degree of flood awareness respond to flood warnings promptly and efficiently, greatly reducing the potential for damage and loss of life and limb. Communities with a low degree of flood awareness may not fully appreciate the importance of flood warnings and flood preparedness and consequently suffer greater personal and economic losses.
Flood behaviour	The pattern / characteristics / nature of a flood.

Flooding	The State Emergency Service uses the following definitions in flood warnings: *Minor flooding:* causes inconvenience such as closing of minor roads and the submergence of low level bridges *Moderate flooding:* low-lying areas inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered. *Major flooding:* extensive rural areas are flooded with properties, villages and towns isolated and/or appreciable urban areas are flooded.
Flood frequency analysis	An analysis of historical flood records to determine estimates of design flood flows.
Flood fringe	Land which may be affected by flooding but is not designated as a floodway or flood storage.
Flood hazard	The potential threat to property or persons due to flooding.
Flood level	The height or elevation of flood waters relative to a datum (typically the Australian Height Datum). Also referred to as “stage”.
Flood liable land	Land inundated up to the probable maximum flood – flood prone land.
Floodplain	Land adjacent to a river or creek which is inundated by floods up to the probable maximum flood that is designated as flood prone land.
Flood Planning Levels	Are the combinations of flood levels and freeboards selected for planning purposes to account for uncertainty in the estimate of the flood level.
Flood proofing	Measures taken to improve or modify the design, construction and alteration of buildings to minimise or eliminate flood damages and threats to life and limb.
Floodplain Management	The coordinated management of activities which occur on flood liable land.
Floodplain Management Manual	A document by the NSW Government (2001) that provides a guideline for the management of flood liable land. This document describes the process of a floodplain risk management study.
Flood source	The source of the flood waters.
Floodplain Management Standard	A set of conditions and policies which define the benchmark from which floodplain management options are compared and assessed.
Flood standard	The flood selected for planning and floodplain management activities. The flood may be an historical or design flood. It should be based on an understanding of the flood behaviour and the associated flood hazard. It should also take into account social, economic and ecological considerations.
Flood storages	Floodplain areas which are important for the temporary storage of flood waters during a flood.
Floodways	Those areas of the floodplain where a significant discharge of flow occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if they are partially blocked, would cause significant redistribution of flood flows, or a significant increase in flood levels.

Freeboard	A factor of safety usually expressed as a height above the flood standard. Freeboard tends to compensate for the factors such as wave action, localised hydraulic effects and uncertainties in the design flood levels.
Geographical Information System	A form of computer software developed for mapping applications and data storage. Useful for generating terrain models and processing data for input into flood estimation models.
High hazard	Danger to life and limb; evacuation difficult; potential for structural damage, high social disruption and economic losses. High hazard areas are those areas subject to a combination of flood depth and flow velocity that are deemed to cause the above issues to persons or property.
Historical flood	A flood which has actually occurred – Flood of Record.
Hydraulic	The term given to the study of water flow in rivers, estuaries with coastal systems.
Hydrograph	A graph showing how a river or creek's discharge changes with time.
Hydrology	The term given to the study of the rain-runoff process in catchments.
Low hazard	Flood depths and velocities are sufficiently low that people and their possessions can be evacuated.
Map Grid Australia	A national coordinate system used for the mapping of features on a representation of the earths surface. Based on the geographic coordinate system 'Geodetic Datum of Australia 1994'.
Peak flood level, flow or velocity	The maximum flood level, flow or velocity occurring during a flood event.
Probable Maximum Flood	An extreme flood deemed to be the maximum flood likely to occur at a particular location.
Probable Maximum Precipitation	The greatest depth of rainfall for a given duration meteorologically possible over a particular location. Used to estimate the probable maximum flood.
Probability	A statistical measure of the likely frequency or occurrence of flooding.
Riparian Zone	Areas that are located adjacent to watercourses. Their definition is vague and can be characterised by landform, vegetation, legislation or their function.
Runoff	The amount of rainfall from a catchment which actually ends up as flowing water in the river of creek.
Stage	Equivalent to water level above a specific datum- see flood level.
Triangular Irregular Network	A mass of interconnected triangles used to model three-dimensional surfaces such as the ground (see DTM) and the surface of a flood.
Velocity	The speed at which the flood waters are moving. Typically, modelled velocities in a river or creek are quoted as the depth and width averaged velocity, i.e. the average velocity across the whole river or creek section.

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Appendices

Appendix A Drawings

Appendix B *XP-RAFTS* Modelling Results

Appendix C Music Modelling Results

APPENDIX A

Drawings

STORMWATER CONCEPT PLAN

Revisions					
First Issue	VC	RB	PB		2/08/2013
Issue	Drawn	Design	Check	Appd.	Date

Revision Details

0 20 40 60 80 100 120 140 160 180 200
SCALE 1:2000 (A1) SCALE 1:4000 (A3)

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CONSULT AUSTRALIA Member Firm

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Client: GAZCORP PTY. LTD.

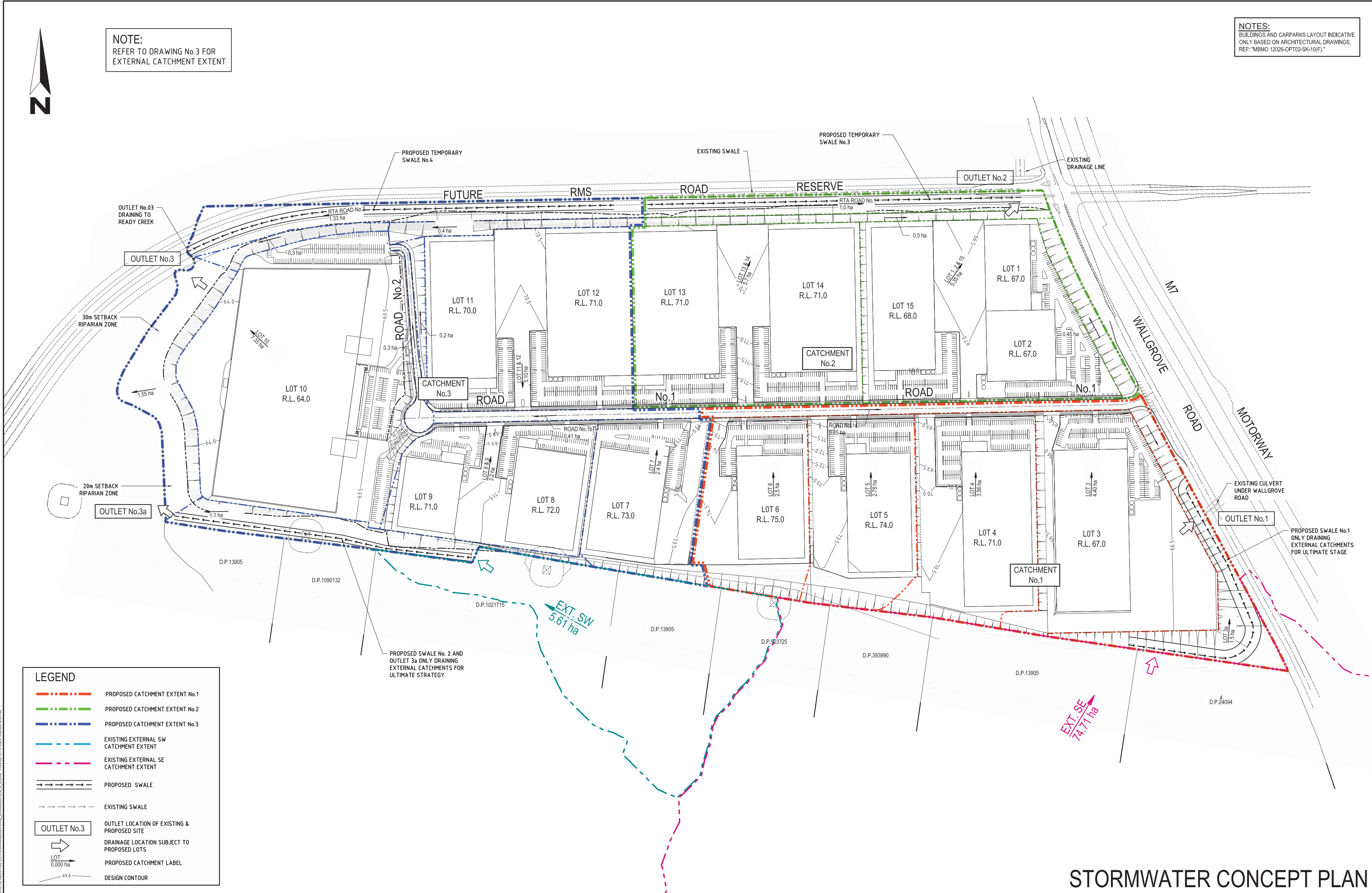
Project: GAZCORP INDUSTRIAL ESTATE
WALLGROVE ROAD, HORSLEY PARK

BROWN Smart Consulting

 www.brownconsulting.com.au

Drawing Title: EXISTING CATCHMENT PLAN

Project No.:	Stage:	Milestone:	Dwg No.:	Revision:
X12254.W		SCP	01	_



STORMWATER CONCEPT PLAN

Issue	Drawn	Design	Check	Appd.	Date	Revision Details
First	VC	RB	PB	–	2/08/2013	–

0 20 40 60 80 100 120 140 160 180 200

SCALE 1:2000 (A1) SCALE 1:4000 (A3)

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Project: GAZCORP INDUSTRIAL ESTATE WALLGROVE ROAD, HORSLEY PARK

BROWN Smart Consulting

Drawing Title: PROPOSED CATCHMENT PLAN

Project No.:	Stage:	Milestone:	Dwg No.:	Revision:
X12254.W		SCP	02	–

BROWN Smart Water

Legend

- EX. EXTERNAL SW CATCHMENT
- EX. EXTERNAL SE CATCHMENT
- READY CREEK
- EXISTING CONT. 1m INC.

Details

Issue	Amendment	Date

Project

WALLGROVE ROAD INDUSTRIAL ESTATE

Drawing Title

EXTERNAL CATCHMENT PLAN FOR EXISTING AND PROPOSED CONDITION

Scale	1:6,000 @ A3
Drawn	RB
Checked	PB
Job No.	X12254
Drawing No.	03

Issue

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