CONCEPT PLAN APPLICATION DESIGN REPORT
FOR
RIVERWOOD NORTH RESIDENTIAL RENEWAL PROJECT

CIVIL, DRAINAGE, WATER AND SEWERAGE INFRASTRUCTURE

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Issue	Reason	Date	Prepared By	Reviewed By	Status
A	Concept Application Design Report	29.10.10	L Panagopoulos	W Smith	Superseded
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C	Concept Application Design Report	04.02.11	A McLennan	M Cahalane	Current

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ATTACHMENTS:

FIGURES:

REFERENCES:

[1] Survey by Denny Linker and Associates dated October 2008.

[2] Architectural Drawings by Turner and Associates, CD Series;

[3] Preliminary Environmental Assessment, Riverwood North Renewal Project by Urbis 1st October 2010.

ABBREVIATIONS

Ha	Hectare
Q	Discharge rate in m^3/sec
m^3/sec	Cubic metres per second
L/s	Litres per second
ARI	Average Recurrence Interval
RL	Reduced Level
M	Height in metres to Australian Height Datum
IL	Invert Level
DN	Nominal Diameter
RBC	Rectangular Box Culvert
FFL	Finished Floor Level
FGL	Finished Ground Level
Ch	Chainage
RCP	Reinforced Concrete Pipeline
PE	Polyethylene (pipeline)
RC	Reinforced Concrete
OD	Outside Diameter
OSD	On Site Stormwater Detention
DRAINS	Two Dimensional Numerical Drainage Modelling Programme
BCA	Building Code of Australia
OHS	Occupational Health and Safety
DA	Development Application
IWMP	Integrated Water Management Plan
IMP	Infrastructure Management Plan
PMF	Probable Maximum Flood
EP&A Act	Environmental Planning and Assessment Act
SEPP	State Environmental Planning Policy
WSUD	Water Sensitive Urban Design
WSP	Warren Smith and Partners Pty Limited
DOP	NSW Department of Planning
DGR	Director General's Requirements
CC	Canterbury Council
SWC	Sydney Water Corporation
RTA	Roads &Traffic Authority
DECC	NSW Department Environment, Climate Change and Water

1. INTRODUCTION

This Concept Application Design Report has been prepared for Housing NSW and Payce Communities Pty Ltd as the Client in collaboration, and M Projects Pty Ltd, Project Manager.

The report aims to identify and address the following infrastructure issues and proposed solutions with respect to:-

- Municipal overland flow and flooding;
- Existing Council drainage;
- Water Sensitive Urban Design (WSUD);
- Building On-Site Detention;
- Building rainwater reuse.
- Water supply;
- Gravity sewer reticulation;
- Building Natural Gas Service;
- Domestic Fire Hydrant Service;
- Domestic Cold Water Service and Fire Hose Reels
- Domestic Hot Water Service.

The proposed development site is located at the north end of the suburb of Riverwood and is bounded by the Salt Pan Creek to the north and east, Washington Avenue to the south and existing residential properties to the west.

Figure 1.1 Proposed Redevelopment Site

With reference to the aerial photograph (refer Figure 1.1), the site and the surrounding area consists of a developed catchment with a mixture of residential properties, roads and landscaping. The redevelopment site grades from south to north with levels varying from 18.0m to 10.3m AHD.

2. DESCRIPTION OF EXISTING HYDRAULIC SYSTEM

2.1 Existing Sydney Water Watermains

Sydney Water currently have watermains available for domestic cold water services and fire hydrant services water supply located in surrounding streets summarized as follows:-

- A 150mm diameter DICL watermain in Kentucky Road;
- A 150mm diameter DICL watermain in Vermont Crescent.

Both watermains are interconnected and form part of an overall ring main system.

2.2 Existing Sydney Water Gravity Sewer Reticulation

The existing gravity reticulation sewers that traverse the site include the following asset:-

- An existing 1219mm wide x 1371mm high concrete oviform sewer which runs between Washington Street and northward towards Belmore Road;
- A 225mm vitrified clay reticulation sewer which connects into the oviform beneath the existing Community Centre building at the eastern end of the site.

It is proposed that the under the current scheme of proposed consolidation of allotments that the existing 225mm diameter reticulation sewer is required to be extended to provide a Sydney Water owned sewer service to each of the proposed allotments. It is anticipated that the size of this sewer system will vary from a minimum 150mm up to 225mm and only the residential lots are required to be serviced.

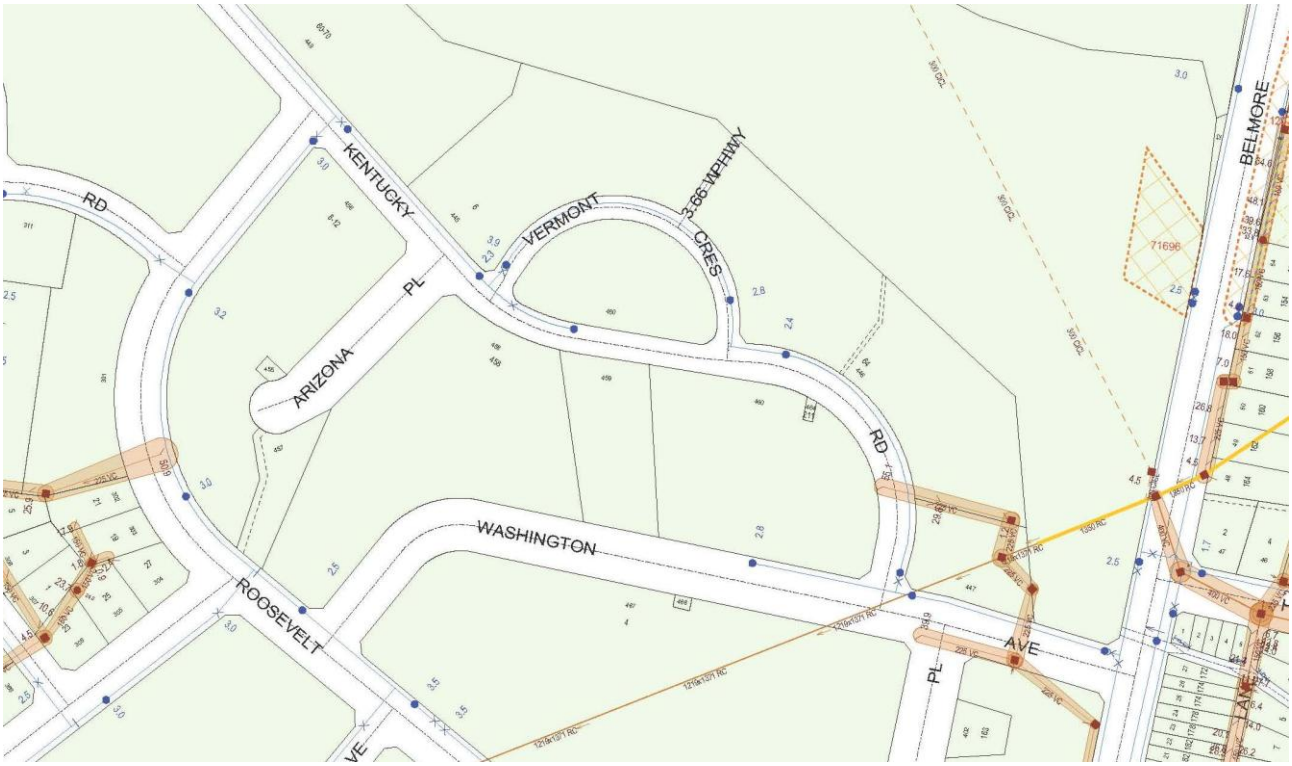

Figure 2.1 Sydney Water Hydra Data Base

2.3 Natural Gas

A new Jemena natural gas main will be extended from the corner of Kentucky Road and Washington Avenue along Kentucky Road and Vermont Crescent to provide a natural gas supply to each building.

3. AUTHORITY AND REGULATORY REQUIREMENTS

3.1 Canterbury Council

Preliminary discussions and a meeting on 25th January, 2011 have taken place with Senior Staff at Canterbury Council and Council has advised that compliance is required with respect to its current DCP for stormwater management and flooding. Council has indicated that it requires the incorporation of appropriate pollution control traps and the stormwater drainage system designed in accordance with its DCP.

3.2 Department Environment, Climate Change and Water

3.2.1 Stormwater Quality Criteria for Environmental Risk Management

Stormwater Quality Criteria are published by DECC and reference is made to the current guideline headed "Managing Urban Stormwater Harvesting and Reuse".

Typically, the following Stormwater Quality Criteria are quoted in the Guideline:-

Level	Criteria[1]	Applications
Level 1	E.coli < cfu/100mL Turbidity ≤ 2 NTU[2] pH 6.5-8.5 1 mg/L Cl_2 residual after 30 minutes or equivalent level of pathogen reduction	Reticulated non-potable residential uses (eg, garden watering, toilet flushing, car washing)
Level 2	E.coli <10 cfu/100mL Turbidity ≤ 2 NTU[2] pH 6.5-8.5 1 mg/L Cl2 residual after 30 minutes or equivalent level of pathogen reduction	Spray or drip irrigation of open spaces, parks and sports grounds (no access controls) Ornamental waterbodies (no access controls) Fire fighting
Level 3	E.coli <1000 cfu/100mL pH 6.5-8.5	Spray or drip irrigation (controlled access) or subsurface irrigation of open spaces, parks and sports grounds Ornamental waterbodies (access controls)

1 Values are median for E.coli, 24 hour median for turbidity and 90th percentile for pH
2 Maximum is 5 NTU

Source: derived from NSW RWCC (1993), Dec (2004), ANZECC and ARMCANZ (2000)

3.2.2 Additional Stormwater Quality Criteria for Specific Applications (Irrigation)

Irrigation with stormwater has different water quality requirements to irrigation with treated sewerage effluent. The levels of pollutants in stormwater are normally much lower than in effluent. Further, effluent reuse schemes typically have higher application rates (higher hydraulic loadings) because they aim primarily to dispose of effluent, whereas stormwater schemes may have multiple objectives.

Urban stormwater is characterized by high loads of suspended solids, sand and grit. This can cause excessive wear and clogging of pumps and control equipment and may block irrigation sprays. The specific treatment level required would depend on the design of the irrigation systems. For irrigating playing fields and golf courses, suspended solids levels below 50mg/L are unlikely to result in operational problems. Limiting particle sizes to smaller than approximately 0.5 – 1.0mm may avoid operational problems in conventional spray irrigation schemes.

High nutrient levels can cause operational problems for irrigation schemes through biofilms clogging irrigation equipment. ANZECC and ARMCANZ (2000) provides trigger values for agricultural irrigation that could be used for stormwater irrigation. These are presented in the table below:-

Element	Long term (up to 100 years)	Short term (up to 20 years)
Total phosphorus (mg/L)	0.05	0.8-12[1]
Total nitrogen (mg/L)	5.00	25.0-125[1]

[1] Requires the site specific assessment (refer to ANZECC and ARMCANZ (2000)

3.2.3 Stormwater Treatment – Contaminants

Stormwater for harvesting and reuse shall require pre-treatment to remove gross pollutants, including litter, organic matter and coarse sediment before it enters a storage or downstream treatment measure.

The guideline illustrates indicative concentrations for pollutant retention and outflow from a range of stormwater treatment measures.

Stormwater Treatment Measure	Suspended solids	Total phosphorus	Total nitrogen	Turbidity	E.coli
Retention					
GPT	0-70%	0-30%	0-15%	0-70%	Negligible
Swale	55-75%	25-35%	5-10%	44-77%	Negligible
Sand filter	60-90%	40-70%	30-50%	55-90%	-25-95% (up to 1.5 log)
Bioretention system	70-90%	50-80%	30-50%	55-90%	-58-90% (up to 1 log)
Pond	50-75%	25045%	10-20%	35-88%	40-98% (0.5-2 log)
Wetland	50-90%	35-65%	15-30%	10-70%	-5-99% (up to 2 log)
Outflow*					
GPT	42-140	0.18-0.25	1.7-2.0	18-60	9,000
Swale	35-63	0.16-0.18	1.8-1.9	14-34	9,000
Sand filter	14-56	0.08-0.15	1.0-1.4	6-93	500-11,000
Bioretention system	14-42	0.05-0.13	1.0-1.4	6-93	900-15,000
Pond	35-70	0.14-0.19	1.6-1.8	7-81	200-5,000
Wetland	11-67	0.09-0.16	1.4-1.7	19-53	100-9,000

* concentrations in mg/L except for turbidity (NTU) and E.coli (cfu/100mL)

Source of retention data: DEC (2206), Fletcher et al. (2004), Victorian Stormwater Committee (1999).

4. DESCRIPTION OF PROPOSED HYDRAULIC SERVICES AND SITE INFRASTRUCTURE

4.1 Proposed Sydney Water Watermains

Reference is made to Section 2.1 explaining the existing Sydney Water watermains currently servicing the development. The proposed watermains will incorporate the following:

- DN150 Link watermain to connect the dead end at the eastern intersection of Kentucky Road and Vermont Crescent to the hydrant bend at the western intersection of Kentucky Road and Vermont Crescent.
- DN150 watermains to connect to the existing watermain in Kentucky Road and run along the eastern side of both future streets and terminate with a hydrant bend before Washington Avenue.

4.2 Proposed Sydney Water Gravity Sewer Reticulation

Reference is made to Section 2.2 explaining the existing Sydney Water gravity sewer reticulation mains currently servicing the development. The proposed sewer mains will incorporate the following:

- DN225 sewer main to connect to the dead end section on the south east section of Kentucky Road and run along the southern side of Kentucky Road and terminating past the intersection of the eastern Future Street and Kentucky Road.
- DN225 sewer main to connect to the existing DN225 sewer main in the south eastern section of the development and run along the east and then north boundaries of the development and terminating within the carpark in the north west corner of the development.

4.3 On-Site Detention

On-Site Detention (OSD) is provided by a series of in-ground tanks located within or adjacent to the envelope of each building. A number of tanks may also be suspended beneath ground floor deck level. A new detention basin is proposed for the north end of the site in the parkland/picnic area. This basin, 1m maximum depth, has been designed to replace the existing basin which provides storage over a large area of the site during major storm events.

OSD has been designed in accordance with City of Canterbury's 'Specification 9, A Guide for Stormwater Drainage Design' and specifically the following extracts:-

- Permissible Site Discharge (PSD) shall be limited to 150 litres/sec per hectare;
- A minimum of 75% of the entire site must drain through the storage area;
- The design shall incorporate provision for on-site storage resulting from a storm with an ARI of:-
    - 10 years where overland flow paths are not through private property. A weir shall be designed to direct the 100 year discharge to the street drainage system;
    - 100 years where overland paths are through private property and/or known flooding problems occur.

The OSD system has been designed with no overflows occurring during the 10 Year ARI storm. This is due to the fact that tank overflows shall travel overland and not enter private properties before entering Salt Pan Creek.

Table 4.1 OSD Tank Design Summary

TANK	VOLUME (m^3)	IL (m)	TWL (m)
OSD 1	95.0	15.00	17.36
OSD 2	40.0	13.50	15.90
OSD 3	40.0	12.50	14.77
OSD 4	25.0	12.50	13.39
OSD 5	60.0	11.55	12.25
OSD 6	13.0	10.50	11.40
OSD 7	36.8	12.20	12.93
OSD 8	47.5	12.75	15.18
OSD 9	40.0	12.75	15.15

4.4 Stormwater Quality Treatment

The overall philosophy for drainage is as follows:-

- Provision of a network of bio-retention swales, with a nominal width of 3.0 metres, and permeable paving to remove nutrients and course sediments;
- Provision of a Humes 'Humeceptor' hydrodynamic separator to remove hydrocarbons and fine sediments.

The surface runoff will be collected within the swale up to the 1 in 10 Year event and will filter through the drainage medium and be collected within low flow pipes. The extent of the swales provided is illustrated in *Drawing PA-C-16*.

A MUSIC Model has been set up and computed and with the site catchment has been split into five (5) sub catchments contributing runoff and pollutant load to the detention pond. The inputs to the model include the proposed bio-retention swales and the pollution control device.

The Humeceptor Gross Pollutant Trap (GPT) is to be included in the stormwater system to provide for the treatment of heavy metals, grease and oil.

Table 4.2 represents a summary of the results at the outlet of the system for removal of target pollutants including suspended solids (SS), total Phosphorous (P), total Nitrogen (N) and Gross Pollutants. The level of removal per annum is tabulated and compared as a percentage of removal efficiency against published targets put by DECC.

Table 4.2 – MUSIC Removal Rates

Humeceptor GPT (Prior to Basin)	Source	Residual	%	Targets
Flow (ML/yr)	28.9	27.6	4.6	-
Total Suspended Solids (kg/yr)	6150	283	95.4	85.0
Total Phosphorus (kg/yr)	10.5	2.81	73.3	65.0
Total Nitrogen (kg/yr)	73.9	35.1	52.5	45.0
Gross Pollutants (kg/yr)	520	0.00	100	95.0

The above results suggest that the stormwater treatment system requires a level of vegetation to achieve the percent removal rate for Nitrogen. The best results are achieved by a combination of use of the vegetated bio-retention swale and Humeceptor GPT.

4.5 Hydraulic Services

Hydraulic Systems will comprise:

- Drainage
- Sewer Drainage
- Rainwater Downpipes and Roof Outlets
- Sanitary Plumbing
- Domestic Cold Water Service including Fire Hose Reels
- Rainwater Reuse
- Domestic Hot Water
- Natural Gas Service
- Fire Hydrant Service

4.5.1 Authorities and Code Requirements

The design of the Hydraulic Services will conform with the following Authorities and Code requirements:-

- Canterbury Council
- Housing NSW
- Environmental Planning and Assessment Act 1979
- Environmental Planning and Assessment Regulations
- Sydney Water
- Work Cover Authority
- NSW Department of Health
- Department of Infrastructure, Planning and Natural Resources
- Environmental Protection Authority
- Sydney Harbour Foreshore Authority
- NSW Maritime
- Jemena Limited
- Australian Competition and Consumer Commission
- NSW Department of Energy
- Energy Australia, Integral Energy
- Building Code of Australia
- Insurance Council of Australia
- New South Wales Fire Brigades
- Telstra, Austel, Optus
- Roads and Traffic Authority
- All relevant Australian Standards and reference International Standards referenced by the BCA unless noted otherwise by the Fire Services Specification or the Fire Engineering Solution Report.

4.5.2 Stormwater Drainage System

General

Stormwater drainage from roof gutters and downpipes will reticulate to the Council drainage system via rainwater reuse and on-site detention tanks. Drainage will also be provided to the Basement carpark in the form of grated drains at ramp bases and stormwater pits at low points of the basement slab.

Subsoil drainage systems will be installed around the perimeter of the Basement levels to each Building and will drain to subsoil drainage pump out pits complete with dual submersible pumps to pump subsoil water to the gravity drainage system.

Materials

The Stormwater drainage system will consist of HDPE (High Density Polyethylene) pipework and fittings as required throughout the development.

Subsoil drainage pipework will consist of 100mm diameter slotted UPVC pipework and fittings installed with a 150mm surround of 25mm diameter blue metal aggregate and overwrapped with Bidum sheeting.

4.5.3 Sewer Drainage

General

Sewer drainage will be provided to collect sanitary plumbing soil stacks for each building.

Sewer drainage will gravitate separately from each building and connect to the Sydney Water sewers.

Materials

Sewer drainage in ground will be constructed of HDPE pipes and fittings.

4.5.4 Rainwater Downpipes and Roof Outlets

General

Gravity roof rainwater downpipes will be provided to receive discharge from surface roof outlets, gutters to all roof areas and balconies

A fail safe gravity overflow system will be provided to all roofs and roof gutters to prevent roof overflow water entering buildings.

Materials

Downpipes will be constructed of HDPE (High Density Polyethylene) pipes and fittings with electro fusion joints.

Roof outlets will be cast iron type in general roof areas and bronze or stainless steel in special areas where architectural presentation is desirable. All outlets will have membrane flanges.

4.5.5 Sanitary Plumbing

General

A system of sanitary plumbing, relief vents and back vents is proposed to convey soil and waste water from sanitary fixtures to the sewer drainage system.

Sanitary plumbing pipework that is installed in noise sensitive areas will be acoustically treated with sound insulation to achieve a satisfactory noise level, to be determined.

Offset risers for inspection outlets (IO's) are to be installed for rodding purposes.

Soil pipes will be installed at a gradient of 1:60 and waste pipes will be installed at a gradient of 1:40 in accordance with the Australian Standard.

Sanitary Plumbing, soil waste and vent pipes will be located in close proximity to wet area facilities ensuring that horizontal pipework length is kept to a minimum. Soil stacks will be provided with 100mm diameter inspection access fittings close to drainage connection and at each floor connection.

Materials

Sanitary Plumbing, relief vents and back vents will be constructed of HDPE pipes and fittings.

4.5.6 Domestic Cold Water Service including Fire Hose Reels

General

It is proposed to extend domestic cold water services from the Sydney Water watermains to each Building.

A domestic cold water meter will be provided for each building and boundary protection backflow prevention valve will be provided on the outlet side of the water meters. Other areas that will require zone or individual protection, but not limited to, will include landscaped irrigation or where hoses are installed adjacent to sanitary fixtures, Plantrooms and Garbage rooms. All valves will be located in accessible locations for maintenance purposes.

Dual domestic cold water variable speed pumps will be provided for each building to provide adequate water pressure and flows.

Domestic cold water will be reticulated throughout the buildings using Type B copper tube and fittings. All risers and individual zones will have isolation valves.

All branch lines will be fitted with pressure limiting valves to ensure that equal pressures are maintained.

Pipework will be sized to achieve flows with a maximum velocity of 3.0m/s in accordance with the Australian Standard.

Valving of the main distribution water services pipes within the buildings will be provided to allow maintenance shut downs to occur on portions of the service not entire floors.

Five (5) star rated flow control devices will be provided within each tap set to limit the amount of water outflow from taps to reduce water wastage.

Fire hose reels will be installed within four (4) metres of all Fire Stairs and Fire Exits and will connect to the domestic cold water service.

Materials

The Domestic Cold Water and Fire Hose Reel Service will consist of Type B copper tube and fittings with silver soldered joints.

4.5.7 Rainwater Reuse

General

An inground rainwater reuse tank will be installed to each building to collect rainwater from downpipes from the roof areas.

Rainwater reuse will be utilised for WC flushing and irrigation with the tank topped up from the potable domestic cold water service supply to 10% of the overall storage capacity at times of no rainfall so as the tank will always have at least 90% of the tank capacity available for filling from the next rainfall event.

A variable speed pressure pump set would need to will be provided to pump rainwater from the reuse tank to a filtration plant and a one (1) day treated water storage tank will be provided. From the treated water storage tank, treated reuse water would need to will be pumped by a separate set of variable speed pressure pumps to supply all flushing points.

Separate sets of pressure unit pumps will be provided to pump untreated water for irrigation purposes.

Materials

Stormwater drainage connecting to the rainwater reuse tanks will consist of HDPE (High Density Polyurethane) pipework and fittings.

Rainwater reuse pipework will consist of Class 16 lilac polyethylene pipework and fittings.

4.5.8 Domestic Hot Water Service

General

Domestic hot water plant for each Building will consist of solar hot water heating and storage with natural gas heating to provide adequate domestic hot water at times of heavy cloud cover.

Domestic hot water will be reticulated throughout the project using Type B copper tube and fittings. All risers and individual zones will have isolation valves.

All branch lines will be fitted with pressure limiting valves to ensure that equal pressures are maintained.

Domestic hot water circulating pumps will be provided to circulate the hot water to all fixtures and fittings as required.

Pipework will be sized to achieve flows with a maximum velocity of 3.0m/s in accordance with the Australian Standard.

Valving of the main distribution water services pipes within the buildings will be provided to allow maintenance shut downs to occur on portions of the service not entire floors.

Thermostatic mixer valves will be provided to control the domestic hot water temperatures to all basins, baths and showers.

Five (5) star rated flow control devices will be provided within each tap set to limit the amount of water outflow from taps to reduce water wastage.

Materials

The Domestic Hot Water Service will consist of Type B copper tube and fittings with silver soldered joints and all domestic hot water pipework will be insulated.

4.5.9 Natural Gas Service

General

A new Jemena natural gas main will be extended from the corner of Kentucky Road and Washington Avenue along Kentucky Road and Vermont Crescent to provide a natural gas supply to each building.

Separate connections will be made to the new Jemena natural gas main and separate natural gas meters and regulator assemblies will be provided for each building.

Separate natural gas meters will be provided within each Apartment together with wiring to central master gas readout meters within each Building.

Materials

The natural gas service will consist of Type B copper tube and fittings with silver soldered joints.

4.5.10 Fire Hydrant Service

General

The proposed development will be provided with a fire hydrant service to satisfy the requirements of all current BCA requirements, Authority Codes, Standards and Regulations. It is proposed to extend fire hydrant services from the 150mm diameter Sydney Water watermains to each building.

A fire hydrant Fire Brigade booster valve assembly will be provided for each building and a fire hydrant service will extend to supply fire hydrants throughout each building. A diesel fire hydrant booster pump will be required to be installed to each Building to provide adequate water pressures and flows to each hydrant.

Fire Hydrants will be installed in the Fire Stairs and Fire Exit corridors on all floors of the buildings.

Materials

The Fire Hydrant Service will consist of medium grade galvanised mild steel pipes and fittings with rolled grooved joints for suspended pipework above ground and any fire hydrant service pipework below ground will consist of ductile iron cement lined pipes and fittings.

5. FLOOD STUDY

5.1 Introduction and Overview

This Flood Study section of the report consists of a hydrological analysis of the catchment discharging into and through the Riverwood North Development in an existing and proposed scenario.

Figure 5.1 Flood Study Locality Plan

This report estimates the 10 and 100 Year ARI catchment peak discharges in relation to local area rainfall and runoff. Two (2) drainage models have been generated for the following scenarios:-

- Existing Catchment Model estimating the flows discharging into Salt Pan Creek from the existing development and upstream catchment in their current state;
- Proposed Model estimating the flows discharging into Salt Pan Creek from the proposed development and upstream catchment in the redeveloped state.

The catchment discharges were calculated using the 'DRAINS' model. 'DRAINS' is a program for designing urban stormwater drainage systems and analysing their flooding behaviour. As well as modelling piped drainage systems, 'DRAINS' describes detention basins, rural and urban catchments. There are choices of hydrological models and between the basic and the unsteady flow hydraulic models.

5.2 Study Area

5.2.1 Existing Catchment

The total catchment for the existing model covers an area of 4.4 Ha, which consists primarily of residential apartment lots, sealed pavements and parks. Pits throughout the catchment are typically lintel pits, 1.7m in length, with pipes typically 375mm to 600mm in diameter.

The catchment is broken down into a series of sub-catchments which extend from the development site to Washington Avenue encompassing the following areas:-

- Washington Avenue excluding the north-south section which connects into Roosevelt Avenue;
- Part of the residential and parkland area between Washington Avenue and Roosevelt Avenue. This area is not currently in the catchment due to a berm located close to Washington Avenue. However, Council have requested for it to be included in the stormwater design to cater for future development;
- Residential and parkland area between Washington Avenue and Kentucky Road;
- Kentucky Avenue from the junction of Washington Avenue to the junction of Arizona Place;
- Residential and parkland area between Kentucky Avenue and Salt Pan Creek from Washington Avenue to Roosevelt Avenue (excluding the proposed future library site).

The DRAINS model has analysed six (6) stormwater lines in the catchment, of which discharge into a 900mm Council Stormwater pipe located that runs south of Salt Pan Creek.

Line 1 emanates from Washington Ave and runs in a west-east direction before turning north down Kentucky Road. The pipeline changes direction at the sag point of Kentucky Rd and connects through a drainage easement to the Council pipeline to the north, adjacent to Salt Pan Creek. Line 4 runs in an east-west direction along Kentucky Road before joining Line 1 at the sag point of Kentucky Rd. Lines 2, 3 and 5 are all minor pipelines which connect into Lines 1 and 4.

Line 6 emanates from the sag point of Vermont Crescent and connects to the Council pipeline adjacent to Salt Pan Creek.

5.2.2 Proposed Catchment

The proposed catchment replicates the extents of the existing catchment encompassing an area of 4.4 Ha. Eight (8) on-site detention tanks are proposed to be located adjacent to the proposed buildings to receive and detain stormwater that falls within each building envelope.

Stormwater is proposed to be intercepted by adopting two (2) measures:-

- Utilising the existing stormwater Pit and pipe system with minor adjustments;
- Bio-retention swales to intercept and treat overland flow and safely convey them into the drainage system;

Bio-retention swales and permeable paving are being utilised for the treatment of gross pollutants and nutrients. The swale component provides pretreatment of stormwater to remove coarse to medium sediments while the Bio-retention system removes finer particulates and associated contaminants.

Bio-retention swales provide flow retardation for frequent storm events and are particularly efficient at removing nutrients. The system possesses a filter media and a liner to treat the stormwater. The swale is typically 3.0m in width and 0.3m in depth with side slopes of 1V:3H.

5.3 Approach to the Study

The approach to the study can be summarised as follows:-

- Hydrologic Assessment

The 'DRAINS' model has been used to estimate the peak flows generated in the 10 and 100 year ARI storm events for the existing and proposed scenarios.

- Hydraulic Analysis

The 'DRAINS 'model has been used to estimate the overland flows and their depths at all critical points.

5.4 Hydrologic Assessment

5.4.1 Data

WSP obtained detailed survey plans by Denny & Linker Consulting Surveyors illustrating contour and spot levels in the area. The survey plan has been used to define the existing catchment and sub-catchment boundaries. Council's stormwater plans and observations made from site visits were also used to verify the catchment and sub-catchment boundaries.

Architectural and landscaped plans received illustrating the structures and landscaping proposed have also been incorporated into the design.

5.4.2 DRAINS Model

The catchment peak flows at all the relevant points of interest were calculated using the' DRAINS' model.

The existing catchment was divided into seventeen (17) sub-catchments, extending to Washington Avenue as shown on WSP *Drawing C-04*.

The adopted catchment characteristic factor values used in the Existing 'DRAINS' Model are listed below:

➢ Impervious fraction for fully developed catchment	Varies
➢ Paved area depression storage	1mm
➢ Grassed area depression storage	5mm
➢ Soil group type	3
➢ Antecedent moisture content (AMC)	3
➢ Blockage factor for existing stormwater pits	0-30%
➢ Water Level Discharge	To Ex. Pits with given H.G.L levels

The overland flow times are calculated using abbreviated data.

The adopted catchment characteristic factor values used in the Proposed 'DRAINS' Model are listed below:

- Impervious fraction for fully developed parkland catchment — Varies
- Paved area depression storage — 1mm
- Grassed area depression storage — 5mm
- Soil group type — 2
- Antecedent moisture content (AMC) — 3
- Blockage factor for proposed stormwater pits — 0-30%
- Water Level Discharge — To Ex. Pit with given H.G.L. levels

The overland flow times are calculated using abbreviated data.

5.4.3 Catchment Discharges

5.4.3.1 Existing Development Model

The 'DRAINS' model has been used to estimate the pipe and overland flows for the 10 and 100 Year ARI storms for the existing scenario.

The peak flow rates from the 'DRAINS' model at various discharge pipelines are summarised below:-

Table 5.4.3.1

	Catchment Pipe and Overland Flows (m^3/sec)			
Location	10 Year ARI		100 Year ARI	
	Pipe	Overland	Pipe	Overland
Line 1	0.931	0.796	0.962	1.390
Total	**1.727**		**2.352**	

5.4.3.2 Proposed Development Model

The 'DRAINS' model has been used to estimate the pipe and overland flows for the 10 and 100 Year ARI storms for the proposed development scenario. OSD tank sizes have been calculated utilising the Mass Curve Technique. PSD rates discharging from each of these OSD tanks for the 10 Year ARI Storm have been incorporated in the 'DRAINS' model.

The system has been designed to ensure that the site, in the proposed state will have no increase in the volume of flows exiting the site during the 10 Year ARI storm. Flow volumes during the 100 Year ARI have also been checked.

The peak flow rates from the 'DRAINS' model at various discharge pipelines are summarised below:-

Table 5.4.3.2

	Catchment Pipe and Overland Flows (m^3/sec)			
Location	10 Year ARI		100 Year ARI	
	Pipe	Overland	Pipe	Overland
Detention Basin	1.250	0.124	1.270	0.366
Total	**1.374**		**1.636**	

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The total discharge during the 10 Year ARI storm for the proposed development is 1.374m^3/sec which is less than the pre-development flow of 1.727m^3/sec.

6. ATTACHMENTS

ATTACHMENT A RAINWATER REUSE CALCULATIONS

ATTACHMENT B ON-SITE DETENTION MASS CURVE TECHNIQUE SIZING SCHEDULES

ATTACHMENT C FLOOD STUDY – MODEL DATA AND RESULTS

CATCHMENT ANALYSIS USING 'DRAINS' PROGRAM – EXISTING CONDITION

- DRAINS Model Node Diagram
- DRAINS Model Data Sheet
- DRAINS Model 10 Year ARI Results
- DRAINS Model 100 Year ARI Results

CATCHMENT ANALYSIS USING 'DRAINS' PROGRAM – PROPOSED CONDITION

- DRAINS Model Node Diagram
- DRAINS Model Data Sheet
- DRAINS Model 10 Year ARI Results
- DRAINS Model 100 Year ARI Results

FIGURES:

C-01	TITLE, DRAWING LIST, LEGEND, ABBREVIATIONS AND NOTES
C-02	SPECIFICATION NOTES
C-03	EXISTING SITE SURVEY PLAN
C-04	STORMWATER DRAINAGE - EXISTING CATCHMENT PLAN
C-05	STORMWATER DRAINAGE - EXISTING LAYOUT PLAN
C-06	STORMWATER DRAINAGE - PROPOSED CATCHMENT PLAN
C-07	STORMWATER DRAINAGE - PROPOSED LAYOUT PLAN
C-08	BASEMENT FLOOR LEVELS PLAN
C-09	GROUND FLOOR LEVELS PLAN
C-10	SYDNEY WATER WATERMAIN SERVICING PLAN
C-11	SYDNEY WATER SEWER MAIN SERVICING PLAN

ATTACHMENT A

RAINWATER REUSE CALCULATIONS

ATTACHMENT B

ON-SITE DETENTION MASS CURVE TECHNIQUE SIZING SCHEDULES

ATTACHMENT C

FLOOD STUDY – MODEL DATA AND RESULTS

FIGURES