Flood Study and Stormwater Management

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Transitional Part 3A Concept Plan Application

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SIMTA

Moorebank Intermodal Terminal Facility

Flood Study and Stormwater Management

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Executive summary

The purpose of this report is to provide the outcomes of a flooding and stormwater assessment for the Sydney Intermodal Terminal Alliance (SIMTA) proposal. This report has been prepared to inform the Concept Plan for the SIMTA proposal, which will be assessed under the provisions for transitional Part 3A projects of the *Environmental Planning and Assessment Act 1979*.

The assessment was undertaken adopting general principals of broader civil engineering design. The assessment was broken into two distinct areas of the development, the initial study covering:

- Current civil design
- Anzac Creek floodplain modelling
- Civil design options

Current civil design

This first stage of the flooding and stormwater assessment has involved an initial quantifying of site runoff, on-site detention requirements and identifying locations of potential flooding impacts on neighbouring land holders, based on the current civil design.

The initial on-site detention (OSD) volume estimate (discussed in Section 4.1 of this report) has been subject to revision as discussed in the 'Anzac Creek Floodplain Modelling' and 'Civil Design Options' Sections (4.2 and 4.3) of this report.

Anzac Creek floodplain modelling

Following the initial OSD assessment, two dimensional waterways modelling of potential impacts extending along Anzac Creek was carried out. This broader catchment assessment identified the need to increase the initial OSD requirements in the north-eastern portion of the site. It is anticipated that this would be achieved by reconfiguring the concept channel and pond, and raising the north-eastern area ground levels.

Flood flow regime figures for Anzac Creek (which include the additional OSD) are included in Appendix E. These figures indicate that on Anzac Creek, the SIMTA proposal would result in little if any impact on 100 year ARI flooding.

Civil design options

This assessment was carried out to indicate 100 year ARI flood levels along the proposed trunk drainage or OSD channels within the site, and provide civil design options for the purpose of mitigating potential adverse flooding and stormwater impacts on the neighbouring land holders.

Additional flood modelling

Following on from the above, more detailed flood modelling was undertaken to specifically investigate the impact of the development on the two waterways, Anzac Creek and Georges River. These are discussed in more detail in Sections 5 and 6 of this report

1 Introduction

The Sydney Intermodal Terminal Alliance (SIMTA) is a consortium of Qube Logistics and QR National. The SIMTA Moorebank Intermodal Terminal Facility (SIMTA proposal) is proposed to be located on the land parcel currently occupied by the Defence National Storage and Distribution Centre (DNSDC) on Moorebank Avenue, Moorebank, south west of Sydney. SIMTA proposes to develop the DNSDC occupied site into an intermodal terminal facility and warehouse/distribution facility, which will offer container storage and warehousing solutions with direct rail access to Port Botany. Construction of the rail connection from the SIMTA site to the Southern Sydney Freight Line (**SSFL**) will be undertaken as part of the first stage of works for the SIMTA proposal.

The SIMTA site is located in the Liverpool Local Government Area. It is 27 kilometres west of the Sydney CBD, 17 kilometres south of the Parramatta CBD, 5 kilometres east of the M5/M7 Interchange, 2 kilometres from the main north-south rail line and future Southern Sydney Freight Line, and 0.6 kilometres from the M5 motorway.

The **SIMTA site**, approximately 83 hectares in area, is currently operating as a Defence storage and distribution centre. The SIMTA site is legally identified as Lot 1 in DP1048263 and zoned as General Industrial under Liverpool City Council LEP 2008. The parcels of land to the south and south west that would be utilised for the proposed rail link are referred to as the **rail corridor**. The proposed rail corridor covers approximately 75 hectares and adjoins the Main Southern Railway to the north. The rail line is approximately 3.5 kilometres in length, 20 metres in width (variable width) and includes two connections to the SSFL, one south and one north.

The proposed rail corridor is owned by third parties, including the Commonwealth of Australia, RailCorp, private owners and Crown Land held by the Department of Primary Industries, and would link the SIMTA site with the Southern Sydney Freight Line. Existing uses include vacant land, existing rail corridors (East Hills Railway and Main Southern Railway), extractive industries, and a waste disposal facility. The rail corridor is intersected by Moorebank Ave, Georges River and Anzac Creek. Native vegetation cover includes woodland, forest and wetland communities in varying condition. The proposed rail corridor is zoned partly 'SP2 Infrastructure (Defence and Railway)' and partly 'RE1 - Public Recreation'. The surrounding Commonwealth lands are zoned 'SP2 Infrastructure (Defence)'.

Table 1 shows the lot and deposited plan number of the land parcels that will be impacted by the SIMTA proposal.

Table 1 Land parcels of the SIMTA proposal

Lot	Deposited Plan	Property Address/Description
1	1048263	Moorebank Avenue, Moorebank (SIMTA Site)
3001	1125930	Moorebank Avenue, Moorebank (land immediately south and south-west of SIMTA Site, including School of Military Engineering)
1	825352	Railway land and to the north of East Hills Railway Line
2	825348	
1	1061150	
2	1061150	

Lot	Deposited Plan	Property Address/Description
1	712701	
5	833516	Privately owned land north of East Hills Railway Line, east of Cumberland & South Passenger Line and Southern Sydney Freight line and west of Georges River
7	833516	
51	515696	
52	517310	
104	1143827	
103	1143827	
91	1155962	
4	1130937	Land west of the Georges River, north of the above privately owned land
5	833516	Railway land along shared railway line – Cumberland & South Passenger Line and Southern Sydney Freight Line
101	1143827	
102	1143827	
Conveyance Book 76	Number 361	Main Southern Rail Corridor
NA	NA	Georges River (Crown Land)

The SIMTA proposal will be undertaken as a staged development. An annual operating capacity of 1,000,000 TEU throughput is anticipated in the ultimate stage, when fully developed.

This report comprises a concept stormwater management plan and flood study assessment completed as part of the civil engineering concept designs developed for the proposed intermodal terminal facility. The report is intended to accompany the submission documents for Concept Plan approval of the SIMTA proposal under the transitional Part 3A project provisions of the *Environmental Planning and Assessment Act* 1979 (EP&A Act).

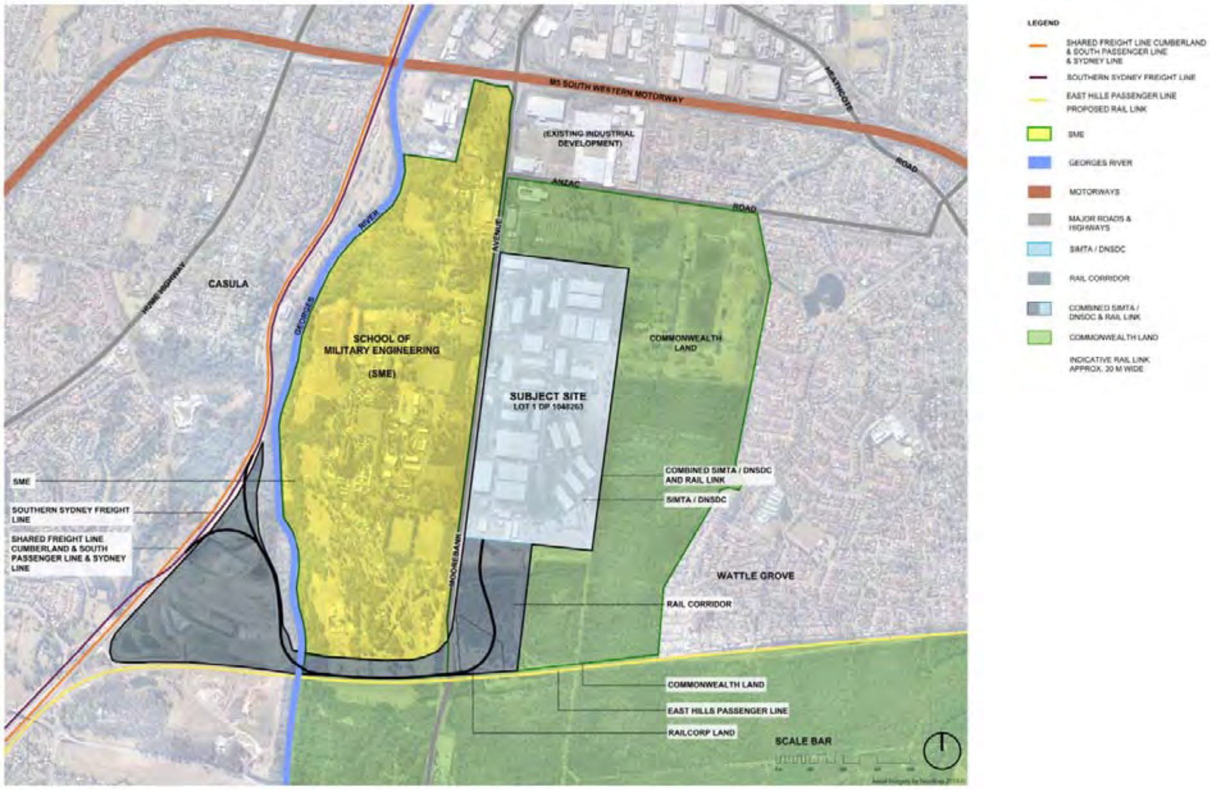

Figure 1: Moorebank intermodal terminal site location plan

2 Database

The following information has formed the database for this flood assessment and stormwater management plan:

- Australian Rainfall and Runoff by the Institute of Engineers Australia (2001).
- NSW Floodplain Management Manual by DIPNR (2005).
- Bureau of Meteorology Rainfall Intensities for the Liverpool City Council Area.
- The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method by Commonwealth Bureau of Meteorology (June 2003).
- Services and Flood Investigation Report for Defence National Storage and Distribution Centre, Moorebank by Cardno Willing (December 2002).
- Anzac Creek Floodplain Risk Management Study and Plan by BMT WBM Pty Ltd (30 May 2008) for Liverpool City Council.
- Georges River Floodplain Risk Management Study & Plan by Bewsher Consulting (May 2004) for Liverpool City Council.
- Practical Consideration of Climate Change Floodplain Risk Management Guideline by DECC (25 October 2007).
- Aerial laser survey provided by AAM Hatch Pty Ltd (May 2008, LiDAR Data Base).
- Ground survey for the site prepared by Hard and Forester (dated 3 August 2010).
- Liverpool City Council documents:
  - Liverpool Development Control Plan 2008.
  - Liverpool Development Control Plan 2008, Flood planning area map – sheet FLD-013, cadastre 31 July 2009.

3 Existing catchments and drainage patterns

The aerial photo in Figure 2, shows that the site currently contains a number of warehouse style facilities connected by internal roads, interspersed with grass and trees. The site fronts onto Moorebank Avenue on its western boundary and Greenhills Road reservation on its eastern boundary. Moorebank Avenue is a formalised two lane road with grassed swales. Greenhills Road is an unformed road reservation that is predominantly used as a utility services corridor.

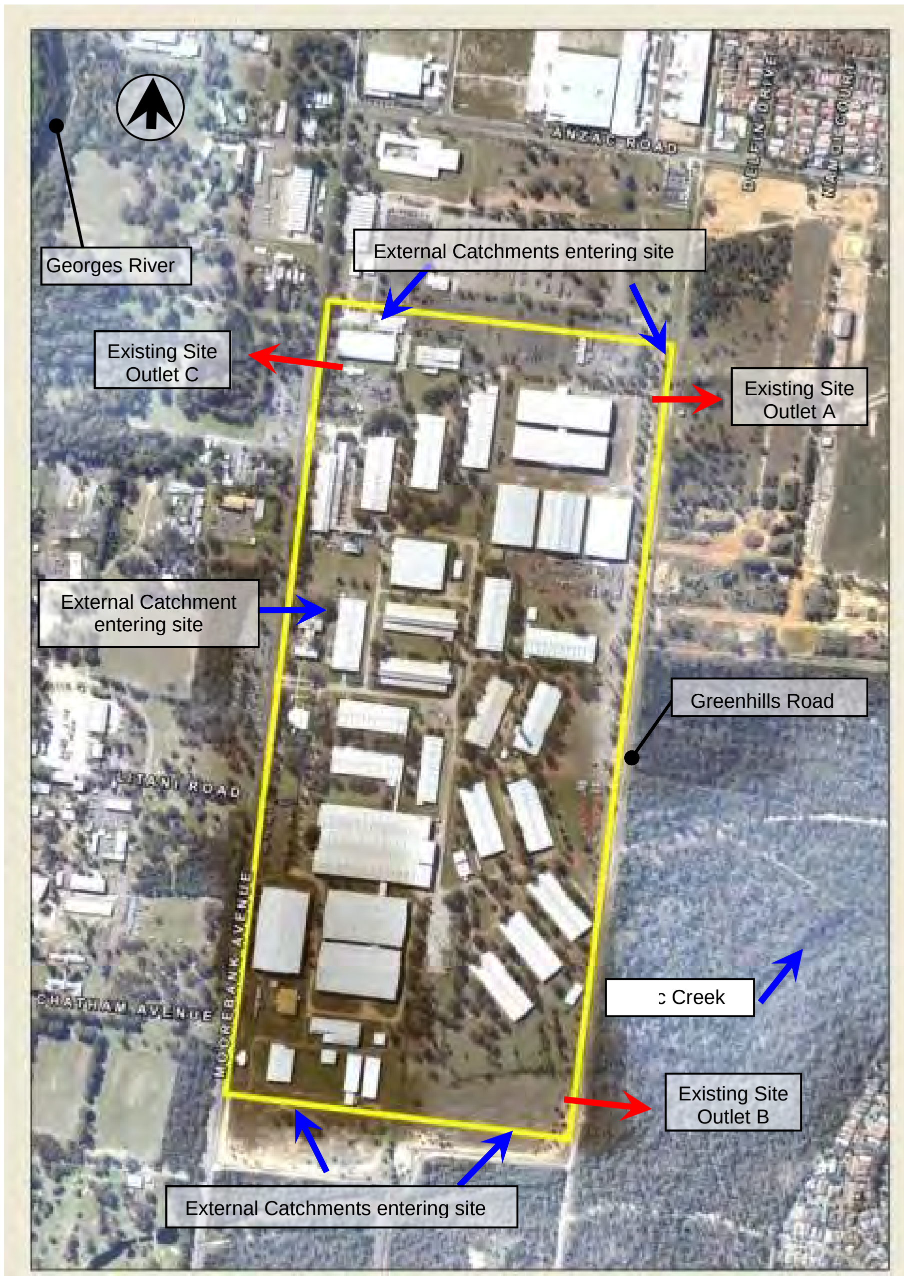

Figure 2: Existing site conditions (indicating external site flow locations)

The site is relatively flat, particularly along the Moorebank Avenue frontage. The levels along Moorebank Avenue range from RL 14 metres to 16 metres. Along the Greenhills Road frontage, the land rises from about RL 14 metres at each end to a localised peak of RL 22 metres about midway along the length.

The site has bushland located to its eastern and southern boundaries with Anzac Creek running from south to north within relatively close proximity to the site. Anzac Creek is predominantly in its natural state within the bush area, however, as it flows north towards Anzac Road, the creek passes through an area of highly disturbed ground owned by Department of Defence. North of Anzac Road the creek runs through the residential area of Wattle Grove.

There are three existing formal stormwater discharge outlets from the site. Two points discharge eastward into Anzac Creek and cross under the Greenhills Road formation via pipes and headwalls. Stormwater from the site is carried through the site via formal open grass lined channels to pipes and headwalls under Greenhills Road. From Greenhills Road to Anzac Creek, the channels are less formalised.

Photos show channelled approaches and piped crossing under Greenhills Avenue from the northern outlet point

Photo shows concrete trapezoidal channel leading into heavily vegetated open channel which then drains to existing outlet on south-eastern corner

There is one discharge westward into the Georges River. Water from the site is collected in a formal concrete lined trapezoidal channel running within the site parallel to Moorebank Avenue. Water is led to a formalised pipe crossing of Moorebank Avenue into a concrete rectangular channel which leads to Georges River.

Photos show the concrete trapezoid within the site and the approach to the pipes crossing under Moorebank Avenue.


Concrete Channel downstream of pipes crossing Moorebank Ave leading to Georges River

There is also a small local external catchment area which discharges into the site midway along the western site boundary from the eastern side of Moorebank Avenue.

Figure 3 indicates the external catchments which enter the site, and the existing catchments within the site that discharge to the three existing culvert outlets. The majority of the external catchments have been identified from aerial laser survey contours and consist of small open areas which fall towards the site boundary.

One catchment is a sealed carpark within the School of Military Engineering on the western side of Moorebank Avenue. Stormwater runoff from the sealed carpark is captured and piped under Moorebank Avenue into the concrete trapezoidal open channel which runs inside the SIMTA site.

Figure 3: Existing stormwater discharge points and approximate catchments

4 Flooding and stormwater assessment process

The flooding and stormwater assessment process has been carried out in three stages.

The three stages investigated are:

Current civil design - This first stage of the flooding and stormwater assessment (using DRAINS, HEC-RAS and MUSIC software) involved an initial quantifying of site runoff, on-site detention requirements and identifying locations of potential flooding impacts on neighbouring landholders, based on the current civil design. Current concept design drawings that relate to aspects of flooding and stormwater accompany this report.

Anzac Creek floodplain modelling - Following the initial OSD assessment, two dimensional (TUFLOW) waterway modelling of potential impacts extending along Anzac Creek was carried out. This broader catchment assessment identifies the need to increase the initial OSD requirements (determined by the DRAINS site modelling) in the north-eastern portion of the site.

Civil design options - This subsequent assessment was carried out to indicate 100 year ARI flood levels along the proposed trunk drainage/OSD channels within the site, and provide civil design options for the purpose of mitigating potential adverse flooding and stormwater impacts on the neighbouring landholders

4.1 Current civil design

The initial civil design (provided in the accompanying Drawings) has attempted to maximise the developable site area through an site layout and nominated site platform levels. In conjunction with the initial design site, stormwater runoff was assessed using:

- DRAINS software for quantifying site runoff and estimating on-site detention (OSD) requirements for the mitigation of potential adverse flow impacts on Anzac Creek and the Georges River.
- MUSIC software for developing appropriate water quality controls.

These stormwater management assessments and findings are discussed as follows.

4.1.1 Water quantity

4.1.1.1 Existing conditions

Assessment methodology

DRAINS software has been used to develop a rainfall runoff model to assess the performance of the proposed site drainage channels with respect to mitigating potential flow impacts on neighbouring downstream areas.

DRAINS models have been developed to represent existing site conditions and post development site conditions to enable a comparison of discharges under the two development conditions.

For existing conditions the model catchments and impervious areas have been based on aerial photography, aerial laser survey for areas external to the site boundary, and ground survey for the site and for specific areas such as details downstream of the site discharge points. A site inspection to verify certain surveyed features was undertaken during the course of this study. However, due to the very flat terrain surrounding the site, as shown in the ALS data, it is recommended that further detailed survey be obtained during the tender design/detailed design stages of the SIMTA proposal to better define external catchment boundaries and levels along Greenhills Road and Moorebank Avenue

A sub-catchment plan that represents the layout adopted for the existing conditions DRAINS model is included in Appendix A.

The model parameters include:

- Paved area and Supplementary area depression storage is one millimetre, and pervious area depression storage is five millimetres.
- Soil type is 3.0.
- Antecedent moisture condition is 3.0 (rather wet).
- Stage/discharge for the three site outlets (two eastward under Greenhills Road, and one westward under Moorebank Avenue) defined by HEC-RAS modelling of the culvert outlets and associated downstream channels. Model inputs and outputs are included in Appendix B.

The DRAINS model has been run for storm durations of five minute to 24 hours for the two year, five year, 10 year, 20 year, 50 year and 100 year ARIs, and 15 minute to six hours for probable maximum precipitation (PMP) events. A summary of the model input data is included in Appendix A.

Results

A summary of peak flows discharging from the three site sub-areas is presented in Table 1. A summary of model outputs are included in Appendix A. Sub-catchment flows leaving the site are included in Appendix A for a range of storm durations.

4.1.1.2 Post development conditions

Stormwater management objectives

The overall stormwater design of the proposed intermodal development seeks to:

- Adopt recognised standards reflecting current practices adopted for similar facilities around the world.
- Comply with recognised Australian Standards and Liverpool City Council's Development Control Plan 2008.
- Assist with achieving a balance between cut and fill earthworks to negate import or export of earth to/from the site.
- Provide site levels which are above localised flood levels but do not impact upon capacity of existing floodplains.
- Provide adequate grades for surface drainage which do not impact on the operational requirements of the facility.
- Provide drainage facilities which minimise requirements for in-ground pipework and provide facilities for stormwater detention and Water Sensitive Urban Design (WSUD).

Assessment methodology

The existing conditions DRAINS model was adjusted to represent the post development site conditions as outlined in the concept plan included in the accompanying drawings. In particular the adjustments have included:

- Changes to sub-catchment boundaries. A sub-catchment plan that represents the layout adopted for the proposed conditions DRAINS model is included in the accompanying drawings.
- Adopting a 100 per cent impervious percentage within the site (to be reviewed at future design stages).
- Reduced flow travel times representative of the SIMTA proposal.
- Detention storages to mitigate potential flow increases. Detention storage details are included in the accompanying design drawings.

DRAINS model input data is included in Appendix A.

Figure 4 shows the post development catchment areas. Note that the existing catchments which are external to the site and identified as currently flowing into the site have been included within the post development catchments.

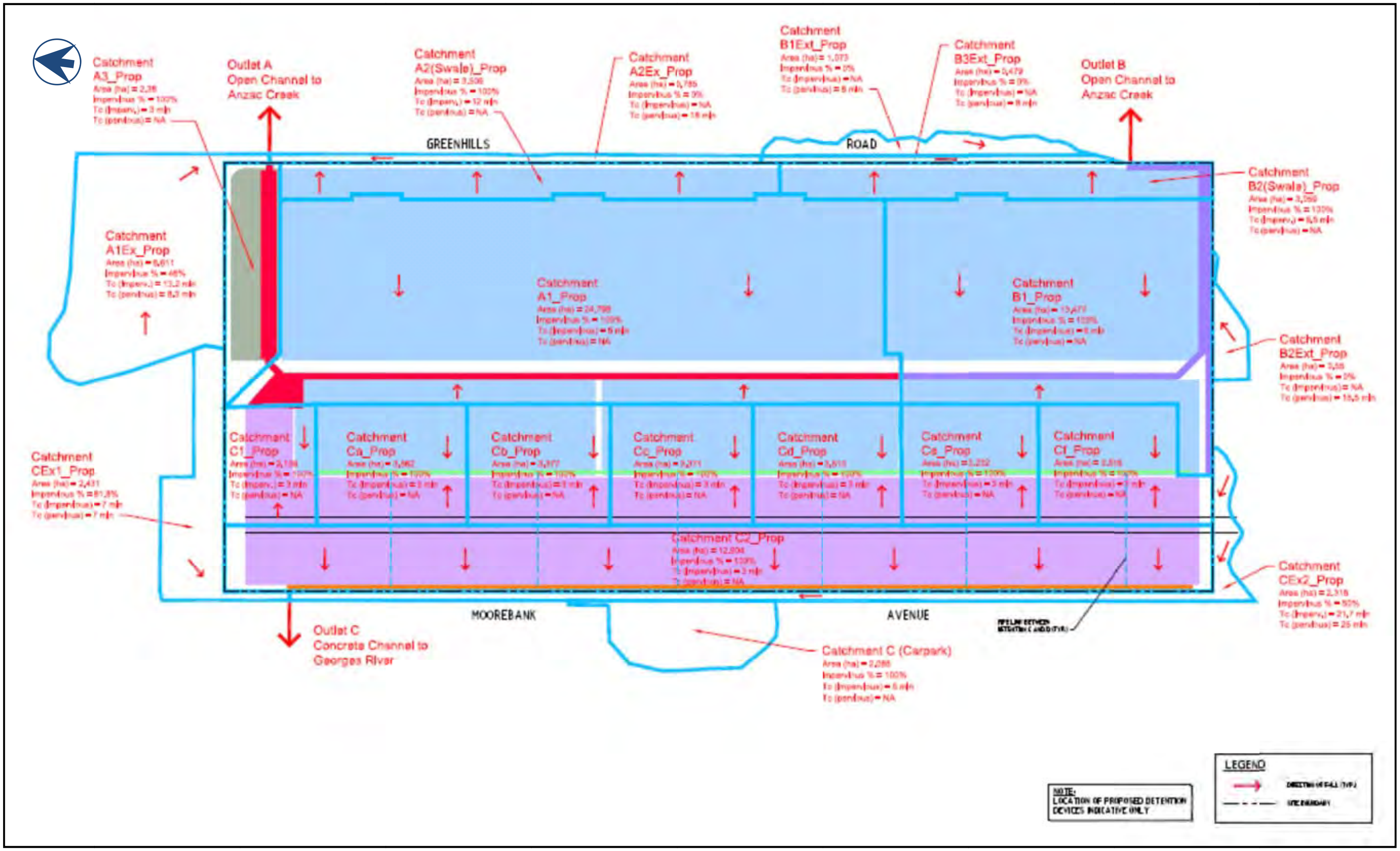

Figure 4: Post development catchment boundaries (including local external catchments)

Results

Table 1 provides a summary of peak flows just downstream of the site for a range of recurrence intervals. Flow results for a fuller range of storm durations range of durations is provided in Appendix A. Table 2 provides a summary of key detention storage parameters and their performance. Storage details are provided in the accompanying design drawings. Table 3 summaries peak flows on catchments neighbouring the site, and that will require management through the site as discussed in the following comments section of this report. DRAINS model output data is included in Appendix A.

Table 2: Comparison of peak flow estimates (m^3/s)

Discharge Location	Site Condition	Catchment Area (ha)	DRAINS Model Label	Flow at Downstream of Greenhills Rd / Moorebank Ave			
				2yr	20yr	100yr	PMF
Outlet A NE Corner of Site (Greenhills Road)	Existing	27.45	OF17	2.42	6.24	8.33	50
	Developed	38.08	OF64	1.72	2.93	3.54	56
Outlet B SE Corner of Site (Greenhills Road)	Existing	27.13	OF9	0.40	1.11	2.63	31
	Developed	18.64	OF51	0.39	0.86	2.01	27
Outlet C NW Corner of Site (Moorebank Avenue)	Existing	42.33	OF30	5.74	10.20	12.70	62
	Developed	40.22	OF102	3.43	8.35	7.82	104

Table 3: Summary of detention storage parameters and performance

Basin [Invert mAHD]	Parameters				Performance				
	Catch Area (ha)	Outlet Diameter		Outlet Weir	ARI	Peak Inflow (m^3/s)	Peak outflow (m^3/s)	Water Level (mAHD)	Volume (m^3)
		Low Level (mm)	High Level (mm)	Level (mAHD)					
A (in NE Cnr) [14.00]	30.68	250 & 475	490	14.40 & 15.75	2yr	8.53	0.71	14.96	12300
					100yr	4.95	1.95	15.91	27000
B (in SE Cnr) [14.00]	17.02	250	670	15.85	2yr	4.66	0.18	15.12	10000
					100yr	2.73	1.85	15.91	17060
D (in NW Cnr) [14.00]	38.15	730	760	15.45	2yr	10.9#	2.89	15.27	6930
					100yr	20.2#	7.82	15.90	10230

# Indicates inflow into lower portion of storage (Basin D) only (not inflows to model Basins C1 to C6)

Table 4: External catchment and flows potentially impacting on the site

Catchment Location	Catchment Area (ha)	DRAINS Model Label	Flow (m^3/s)		
			20yr	100yr	PMF
Northern Boundary and NE Corner of Site	6.61	OF60	2.34	2.81	13
Northern Boundary and NW Corner of Site	2.43	OF131	1.03	1.23	6
Southern Boundary and SE Corner of Site	0.55	OF47	0.13	0.17	0.9
Southern Boundary and SW Corner of Site	2.32	OF104	0.51	0.66	3.5
Mid-Eastern Site Boundary	2.09	OF487	0.99	1.23	5.2

Comments

Site detention storage

This initial assessment of peak flows leaving the site (summarised in Table 1) and the comparison graphs in Appendix A indicate that the proposed detention storages should adequately mitigate potential site runoff flow increases for a range of storm durations. However, in addition to the DRAINS modelling, a regional catchment wide analysis has been carried out to assess potential impacts on flow regimes on the broader Anzac Creek waterway as discuss in the Anzac Creek flood assessment section of this report (Section 6).

Management of external catchments

In general, maximising the developable site area would potentially impact on local neighbouring property, this includes:

- Impeding and diverting flows that currently enter the site along its northern and southern boundaries, and on its western boundary from a local carpark area (identified in Figures 3 and 4).
- Increasing flows along Moorebank Avenue.
- Increasing flooding across Greenhills.Road.

While these local adverse impacts may be open to negotiation with the various stakeholders, civil design options to avoid impacting on neighbouring property are discussed in Section 7 of this report.

Potential climate change sensitivity assessment

The DRAINS model which represents the post development site was re-run with a 20 per cent increase in 100 year ARI rainfall intensities to represent potential climate change sensitivity with respect to site discharges. The modelling results indicate that in a 100 year ARI event:

- Site water levels may increase by around 0.2 metres.

- Maximum site discharges from the two eastern outlets would not exceed existing condition maximum 100 year ARI discharges. For the single western outlet, the model indicates an increase in site discharge (compared to the existing condition) of 14.7-cubic-metres per second compared with 12.7-cubic-metres per second, however, additional survey information along Moorebank Avenue (to allow more accurately spill levels and length), may alter this result.

DRAINS model inputs and outputs are included in Appendix A.

4.1.2 Water quality

4.1.2.1 Stormwater quality objectives and treatment targets

The stormwater runoff quality objectives and treatment targets for the SIMTA proposal have been determined according to the Liverpool Development Control Plan 2008 (general controls and controls applicable to Moorebank Defence Lands). These include the following.

Objectives

- To prevent adverse impact on receiving environments which may be caused by the flow from the SIMTA site.
- Prevent bed and bank erosion and instability of waterways.
- Provide sufficient flows to support aquatic environments and ecological processes.
- To make certain that Water Sensitive Urban Design principles are appropriately applied to the SIMTA site.

Performance targets

- Ninety per cent reduction in the post development average annual gross pollutant load.
- Eighty per cent reduction in the post development average annual load of Total Suspended Solids load.
- Forty-five per cent reduction in the post development average annual load of Total Phosphorus load.
- Forty-five per cent reduction in the post development average annual load of Total Nitrogen load.
- Maximise water conservation through the use of water efficient devices and re-use of rainwater for non-potable water demands.

4.1.2.2 Proposed stormwater quality measures

A number of stormwater quality measures are proposed to be implemented as part of the SIMTA proposal to meet the set treatment targets. These include the following.

Rainwater tanks

Rainwater tanks are required to meet the water conservation controls set by Liverpool City Council's Liverpool Development Control Plan (2008) for development in Moorebank Defence Lands and also to satisfy sustainability building requirements.

Rainwater tanks will be used to collect roof water from the site's warehouses to be used for non-potable water demands for toilet flushing and for outdoor use. All rainwater tanks are assumed to have a first-flush device to capture gross pollutants and sediments which may have accumulated on the roof. Rainwater tanks also provide stormwater treatment through settling and harvesting in addition to their main purpose of providing alternative source of water for non-potable water uses.

Initial sizing for the proposed rainwater tanks is based on providing the estimated non-potable water demands for a period of 20 days. The non-potable water demands for the proposed warehouses were about 60 per cent of the total water use of these buildings. The population for each warehouse was around one person per 20-squared-metres using an average of 20 litres per person per day (VIC EPA Code of Practice for Small Wastewater Treatment Plants (1997). The proposed rainwater tank sizes for the various catchments of the site are presented in Table 4.

Pre-treatment

Buffer strips

Buffer strips are source control measures used to pre-treat stormwater runoff before it reaches the main treatment measures such as rain gardens and bio-swales. Buffer strips are vegetated areas adjacent to drainage lines that intercept diffused stormwater runoff from impervious areas before it reaches the treatment measures, thus removing coarse to medium sized suspended solids and associated nutrients. Buffered areas for the various catchments of the site are presented in Table 4.

Gross pollutant traps

A gross pollutant trap is a treatment device designed to capture coarse sediment, trash and vegetation matter carried in the stormwater. No removal of suspended solids and nutrients has been assumed to be associated with GPTs.

Bio-retention systems

Rain gardens

Rain gardens are bio-retention systems that comprise a combination of vegetation and filter substrate, which provide treatment of stormwater through filtration, extended detention and some biological uptake. They are very effective in stormwater pollutant removal, especially when associated with a submerged zone, which provides a permanent pool of water at the bottom of the system that helps to maintain a healthy plant community. Rain gardens are proposed to treat runoff from the majority of the site in an integrated structure that provides for OSD storage in addition to water quality treatment.

Bio-swales

Bio-swales are bio-retention systems that perform similarly to rain gardens but are generally associated with a longitudinal gradient. Thus they provide runoff conveyance in addition to the water quality treatment through filtration, extended detention and biological uptake. The proposed bio-swales for the Moorebank site have fairly flat gradient. Thus they provide extended detention during their normal operation, with excess runoff discharging to overflow pits. No OSD storage will be provided as part of the proposed bio-swales.

Lining

In general, bio-retention systems are lined either to protect adjacent structures or if the site has known salinity hazards. There are no known risk associated with salinity on the Moorebank site as indicated by the salinity hazard risk map of NSW produced by the Department of Environment and Climate Change. However, as the site's soils are predominantly clays and sandy clays associated with shrinkage and differential settlement, lining of the bio-retention systems may be required when they located next to footings of structures such as retaining walls and buildings.

The proposed rain garden and bio-swale areas for the various catchments of the site are presented in Table 4. Typical details are presented in the drawings associated with this report.

Table 5: Proposed stormwater quality treatment measures for the site

Catchment	Rainwater Tank (kL)	Buffer Area (m^2)	Rain Garden/ filter area (m^2)	Bio-swale/ filter area (m^2)
A1 (27.178 ha)	2083	1963	6960/4640	
A2 (3.506 ha)	0	525		1656/1035
B1 (13.477 ha)	1132	808	3200/4800	
B2 (3.059 ha)	0	459		1152/720
C (35.714 ha)	857	1714	5000/5000	

Rain garden and bio-swale areas are "average", the area is measured at half of the extended detention depth.
Refer to Drawing CP022 for WSUD catchment plan.

4.1.2.3 Assessment methodology

Assessment of the performance of the proposed stormwater quality measures has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC V4.0). A MUSIC model for the SIMTA site has been developed assuming that the site has industrial land use with imperviousness shown in Table 5. The MUSIC model layout and key modelling parameters are included in Appendix C.

Table 6: MUSIC model land use for the site

Catchment	Land use	Land Use area (ha)	Land use imperviousness
A1 (27.178 ha)	Roof	17.359	100%
	Pavement to buffer	3.930	100%
	Pavement to GPT	5.892	100%
A2 (3.506 ha)	Roof	0	
	Pavement to buffer	3.506	100%
	Pavement to GPT	0	
B1 (13.477 ha)	Roof	9.434	100%
	Pavement to buffer	1.617	100%
	Pavement to GPT	2.426	100%

Catchment	Land use	Land Use area (ha)	Land use imperviousness
B2 (3.059 ha)	Roof	0	
	Pavement to buffer	3.059	100%
	Pavement to GPT	0	
C (35.714 ha)	Roof	7.143	100%
	Pavement to buffer	11.428	100%
	Pavement to GPT	17.143	100%

4.1.2.4 Results and comments

Based on the proposed stormwater quality measures the treatment performance for each catchment and the whole site is presented in Table 6.

In summary, the water quality assessment methodology and treatment performance of the proposed WSUD measures is understood to comply with the treatment targets according to the Liverpool Development Control Plan (2008).

Table 7: Treatment performance summary for the site

Catchment	Pollutant reduction			
	Gross pollutants (%)	**TSS (%)**	**TP (%)**	**TN (%)**
A	100	91.7	76.8	61
B	100	94.0	80.8	67.8
C	100	86.6	71.6	46.4
Total site	100	89.1	74.7	55.9
Treatment targets	*90*	*80*	*45*	*45*

4.2 Anzac Creek floodplain modelling

Following the initial DRAINS modelling of on-site detention (OSD) the Post Development site flow hydrographs were used as inputs into a TUFLOW model of Anzac Creek to identify potential impacts extending along Anzac Creek, and if necessary revised OSD requirements. This assessment process and findings are discussed as follows.

4.2.1 Background

Existing condition flow regimes along Anzac Creek have been previously determined by Liverpool City Council in the process of conducting their Anzac Creek Floodplain Risk Management Study and Plan (by BMT WBM Pty Ltd, 30 May 2008), and the Georges River Floodplain Risk Management Study & Plan (by Bewsher Consulting, May 2004). The council modelling indicates that only the 100 year ARI and larger events along Anzac Creek impact on the subject site, as such only the 100 year ARI and PMF events have been assessed, although this has also included examining potential Climate Change flow regimes.

The RAFTS catchment rainfall runoff model files developed for the abovementioned studies were obtained from council. The provided files were re-run by Hyder and the hydrographs for both the 100 year ARI nine-hour event and PMF nine hour event used in the studies were replicated.

Council also provided to Hyder the 100 year ARI nine hour event and PMF one hour event TUFLOW model files. The provided files were re-run by Hyder and the council's 100-year nine hour results were reproduced. PMF TUFLOW results were not provided by council, nonetheless the provided files were used in developing an adjusted 'existing conditions' Anzac Creek model, as described in Section 6.2.

Council provided a number of TUFLOW run files incorporating various degrees of blockage for structural elements across the system. For the purposes of this regional assessment, the 25 per cent scenario was adopted as a base and amended for this study as described following. The modelling process and results are described as follows.

4.2.2 Existing conditions

4.2.2.1 Hydrology

Council's RAFTS model catchments were adjusted to exclude the subject site, which has been more accurately defined in the site drainage assessment DRAINS software (as discussed in the earlier sections of this report). Hence hydrographs generated from the RAFTS and DRAINS models have been used as flow inputs for TUFLOW modelling to define flow regimes as discussed below. RAFTS model input data and output are included in Appendix D.

4.2.2.2 Flow regimes

The 100 year ARI nine hour duration hydrographs from the DRAINS and adjusted RAFTS models have been used to assess flow regimes along Anzac Creek, in accordance with the files provided by council, in TUFLOW. Similarly, an adjusted existing conditions PMF one hour event model has also been assessed in TUFLOW using DRAINS and adjusted RAFTS hydrograph inputs.

The adjusted existing condition TUFLOW model flow regime figures (for 100 year and PMF conditions) are included in Appendix E. The 100 year results were compared with that of Council's and flood level variations found to generally vary by less than 0.025 metres.

The adjusted existing conditions model has been adopted as a base for comparing potential impacts in Anzac Creek due to the SIMTA site development.

4.2.3 Post development conditions

4.2.3.1 Hydrology

Hydrographs generated from the SIMTA site development conditions DRAINS model of the site have been used as input into the TUFLOW modelling, in conjunction with existing conditions RAFTS model hydrographs which represent the Anzac Creek catchment areas external to the subject site.

4.2.3.2 Flow regimes

Using the 100 year ARI nine hour event hydrographs from the initial proposed conditions DRAINS modelling, TUFLOW modelling indicated potential water level increases of up to around 0.05 metres. As such on-site storage in the north-eastern portion of the site was increased from 28,500-cubic-metres to 35,000-cubic-metres in the DRAINS modelling, and the TUFLOW model re-run and the potential flood level increases were seen to be reduced.

The TUFLOW model was then also re-run for the PMF one hour event. The modelling results for these assessments are included in Appendix E.

With respect to potential flood impacts on the Anzac Creek floodplain the results indicate that:

- Flood level increases would be limited to less than five millimetres in the100 year ARI nine hour event. (Management of local catchment flows directly neighbouring the site are discussed in the 'Civil Design Options', Section 7, of this report.)
- For the PMF one hour event, the proposed site raising would result in flood level increases of up to 0.25 metres immediately south of the site. Since this area to the south is largely undeveloped there is little current implication for this neighbouring area. Further downstream, to the north of the southern site boundary, flood level increases are limited to no more than five millimetres.

It is anticipated that the OSD storage increase could be achieved by reconfiguring the concept channel as outlined in Figure 5, reconfiguring the pond (located in the northern area of the site), and raising the north-eastern area ground levels by around 0.2 metres (as indicated in the design option drawings).

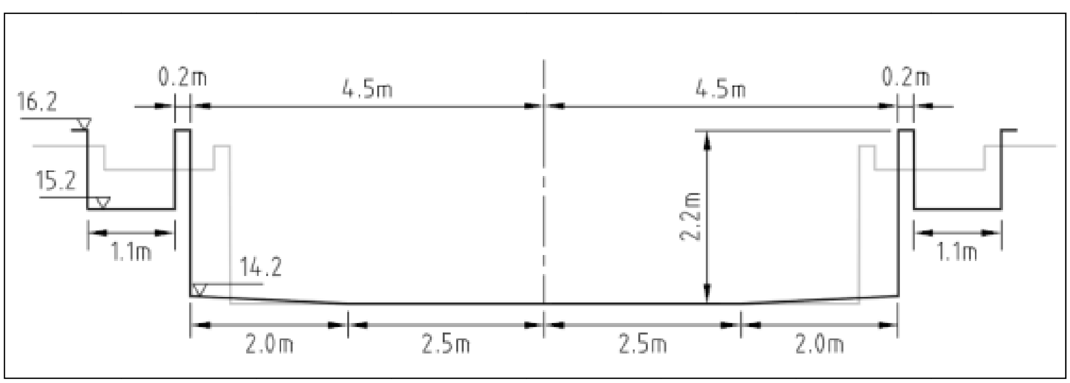

Figure 5: Typical channel section for increased NE site detention

4.3 Civil design options

This assessment was carried out to indicate civil design options for the purpose of mitigating potential adverse flooding and stormwater impacts on the local land holders that immediately neighbour the site. In particular, modelling of existing and post development site conditions (and the immediately surrounding areas):

- Quantifies within site flood levels along the SIMTA site development main trunk drainage channels.
- Flow regimes in the vicinity of the north-eastern corner of the site.

For this assessment the lumped catchments adopted in the initial DRAINS model were further subdivided into smaller local catchment areas. The DRAINS model discharges were then incorporated into a TUFLOW model of the site and its immediate surrounds. These ‘site only’ DRAINS and TUFLOW models firstly represented existing development conditions, and were then adjusted to represent the ‘alternative post development’ developable area conditions.

Sketches of the areas where the initial civil design are to be modified to limit flood impacts on the local neighbouring properties are included in the accompanying Drawings, and are intended as a guide for future design decisions and detailing.

While the accompanying Drawings indicate options to mitigate adverse flood impacts on the neighbouring properties in events up to 100 year ARI, the design options would not, however, offset potential flood increases in all larger events, as indicated in the probable maximum flood results figures included in Appendix G.

4.3.1 Existing and proposed conditions modelling

4.3.1.1 DRAINS

Details of the further catchment subdividing of the initial DRAINS model is provided in Appendix F and the 100 year ARI hydrographs then served as inputs for the site-based TUFLOW model.

4.3.1.2 TUFLOW

A TUFLOW model was developed to represent the site itself, first for existing conditions then for a representation of the proposed site development. Sufficient model detail has been provided to specifically represent flow regimes:

- In the north-eastern corner of the site where the neighbouring property and Greenhills Road flows enter the site via an open channel before discharging under Greenhills Road via culvert “Outlet A”.
- Within the site itself along the proposed main channel systems.

The TUFLOW model input data and result figures are included in Appendix G. The 100 year ARI results figures indicate that:

- In the north-eastern corner of the site (where the neighbouring property and Greenhills Road flows enter the site via an open channel before discharging under Greenhills Road via culvert “Outlet A”) the existing open channel is to be retained to avoid potential adverse flood impacts on Greenhills Road the neighbouring areas to the north and east.
- Adopting bridge crossings that span the main channels, there is less than a 0.1 metres water surface gradient along the proposed main channels in the site.
- To accommodate minor internal site drainage systems for up to 100 year capacity consideration further consideration of site levels will be necessary.

- Platform levels in the south-eastern portion of the site are likely to require raising by around 0.4 metres (due to the 100 year ARI flood levels of up to 16.3 metres AHD in the channel/OSD, and the outlet to the Greenhills Road system, 'Outlet B', being partially submerged under 100 year ARI conditions).

4.3.2 Management of external catchments

In general, maximising the developable site area (represented by the accompanying concept civil drawings, and discussed previously in Section 5 of this report) would potentially impact on neighbouring property flooding and require negotiation with neighbouring landholders (with respect to obtaining drainage easements).

The specific locations of potential impact are discussed below, and indicative 'civil design options' sketches of the areas where the current concept civil design may be modified to limit flood impacts on the local neighbouring properties are included in the accompanying Drawings.

4.3.2.1 Southern site boundary

Along the southern boundary of the site the concept civil design provides for a buffer about two metres wide at existing ground levels between the raised development platform and the site boundary. This southern buffer width requires widening as indicated in the accompanying Drawings. Such widening is to allow for the following.

- Under existing conditions the external south-western catchment discharges into the site. The proposed site filling requires a flow path to be provided that would convey flows westward to a Moorebank Avenue southbound carriageway drainage system.
- Under existing conditions the external south eastern catchment discharges into the site. The proposed site filling requires a flow path to be provided that would convey flows eastward to the existing Greenhills Road ('Outlet B') culvert.

4.3.2.2 Western site boundary

The existing drainage system serves the western portion of the site also several external catchment areas (the southern external catchment discussed above, a local carpark area to the west of Moorebank, and Moorebank Avenue itself). This existing channel is to be replaced under the current concept civil design by internal site drainage systems. In addition, it is likely that a new channel/culvert system (located within the site) will be necessary to convey runoff from the neighbouring areas along the western site boundary to the existing twin box culverts at "Outlet C" near the north-western corner of the site. Indicative sketches are included in the accompanying Drawings.

4.3.2.3 Northern site boundary

Along the northern boundary of the site, areas of neighbouring land discharge into the site and are to be conveyed within the site via channel or culvert systems to the existing north-western and north-eastern outlets ("Outlets C" and "Outlet A" respectively). Indicative sketches are included in the accompanying Drawings.

4.3.2.4 Eastern site boundary

In the north-east corner of the site, current civil design builds over an existing open channel (replacing it with a culvert) that conveys flows to the existing Greenhills Road culvert ("Outlet A"). To avoid adverse flood impacts on neighbouring property it will be necessary to retain the exiting open channel. Indicative sketches are included in the accompanying Drawings.

The accompanying Drawings also include sketches which indicate the management of neighbouring property flows that discharge to the south-eastern culvert (“Outlet B”), and a two metre wide stormwater corridor along the eastern boundary to allow the capture of Greenhills Road runoff.

The next two sections within this report contain the modelling assumptions made, and conclusions reached in undertaking a detailed assessment of the two main watercourses affected by the proposed SIMTA development, Anzac Creek and Georges River.

5 Anzac Creek

Anzac Creek is within the larger Georges River catchment and a sub-catchment of the Liverpool District catchment. The creek is 4 kilometres long, forming in the Royal Australian Engineers Golf Course, owned by the Department of Defence, and flowing northward past the suburb of Wattle Grove and underneath the M5 at the intersection with Heathcote Road. From there the creek continues northwards through Ernie Smith Recreation Reserve, flanked by the Moorebank Industrial Area to the west and the suburb of Moorebank to the east, under Newbridge Road, through McMillan Park, and into Lake Moore at Chipping Norton.

5.1 Railway Culvert Over Anzac Creek

While the Concept Plan report included an assessment of the impacts of site runoff on Anzac Creek there was no assessment of the potential flooding impact of the rail alignment and associated embankment. A concept rail design has now been developed along with a preliminary analysis of potential flooding impacts of the embankment for the 100 year ARI and PMF events.

Existing condition flow regimes along Anzac Creek have been previously determined by Liverpool City Council (Council) in the process of conducting their Anzac Creek Floodplain Risk Management Study and Plan (by BMT WBM Pty Ltd, 30 May 2008), and the Georges River Floodplain Risk Management Study and Plan (by Bewsher Consulting, May 2004). The Council modelling of the existing conditions indicates that the SIMTA site would not be impacted by ANZAC Creek flooding up to the 100 year ARI event but the SIMTA site would be impacted along its southern boundary by the extreme PMF. The Council's RAFTS catchment rainfall runoff model files developed for these studies were reviewed by Hyder. The provided files were re-run by Hyder and the hydrographs for both the 100 year ARI nine-hour event and PMF nine-hour used in the Council studies were replicated.

Council also provided Hyder with the 100 year ARI nine-hour event and PMF one-hour event TUFLOW model files. The provided files were re-run by Hyder and the Council's 100 year nine-hour results were reproduced. The PMF TUFLOW modelling results were not provided by Council, nonetheless the provided files were used in developing an adjusted 'existing conditions' Anzac Creek model (see Section 2.1.1).

Council provided a number of TUFLOW run files incorporating various degrees of blockage for the structural elements across the stormwater infrastructure system. For the purposes of this railway culvert assessment, the 25 percent blockage scenario was adopted and was amended to create a base model suitable for the purposes of this assessment.

5.1.1 Assessment Methodology

DRAINS modelling of flows

Council's RAFTS model catchments were adjusted to:

- Exclude the subject site, which has been more accurately defined in the site drainage DRAINS software.

- Provide additional sub-catchment areas upstream of Greenhills Road to facilitate assessment of the upstream flow regimes.

Catchment plans are provided in Appendix A. The adjusted RAFTS model was used to generate 100 year ARI hydrographs which served as inputs in the TUFLOW modelling of Anzac Creek for existing and post-development conditions.

TUFLOW Modelling of Flow Regimes

Council's ANZAC Creek TUFLOW model was adjusted to include ground information sourced from Aerial Laser Survey data collected in August 2010 by AAMHatch. In the vicinity of the subject site, levels were updated to include the detailed survey data of Hard and Forester Pty Ltd (July 2012). The Hard and Forester survey represents the latest available survey information for the part of the Anzac Creek floodplain to the south of SIMTA site area which the crossing of the rail link is currently proposed.

The model adopts a 5 m grid using TUFLOW Build: 2006-06-DB. The Council inflow boundary setup was modified to define local catchments to the south of the SIMTA site, taking into account the proposed railway embankment intersecting the floodplain. In addition, outflows from the SIMTA site area were incorporated into the TUFLOW model, and the lag times for RAFTS and DRAINS in relation to the Georges River inflow were adjusted to be consistent with the original setup of the Council model.

To assess the post-development conditions of the area, the railway alignment was included in the TUFLOW digital elevation model along with the proposed Anzac Creek culvert crossing (3, 4.0m x1.5m reinforced concrete box culverts (**RCBC**)) which has been modelled with 50 per cent blockage. A concept design figure of railway alignment and culvert sizing is included in the design drawings (**Attachment A**).

5.1.2 Results and Comments

RAFTS model output summaries are included in Appendix A.

Existing and post-development condition TUFLOW figures of flood extents and levels are included in Appendix B and indicate the Anzac Creek:

- Under existing conditions the 100 year ARI flood level to the south of the SIMTA site is 15 m Australian height datum (**AHD**). When modelled with the proposed rail link culverts and allowing for 50 per cent blockage of those culverts the flood levels to the south of the SIMTA site rise up to 20 mm, upstream of the proposed railway. The post-development condition model was also run with the proposed railway culvert fully unblocked, with the result that the 100 year flood level increase (as a result of the proposed railway crossing) reduced to less than 5 mm.
- Under existing conditions the PMF level to the south of the site is approximately 15.6 mAHD. Downstream of the proposed railway culvert crossing there is no anticipated increase to PMF flood levels, however upstream of the proposed rail link culvert crossing flood levels would increase by between 0.1 m and 0.2 m upstream and across Moorebank Avenue under a 50 per cent blockage scenario.

A rainfall increase sensitivity assessment was carried out with the results indicating that a 20% increase in rainfall intensities would increase 100 year ARI flood levels by up to approximately 0.06 m under a 50 per cent blockage scenario.

5.1.3 Conclusion

The TUFLOW model results indicate that the impact of the proposed railway and associated culvert would result in negligible flood impacts within the Anzac Creek catchment area.

6 Georges River

The SIMTA site is located entirely within the catchment area of the Georges River, which lies approximately 750 m to the west of the site. The rail corridor is located within the mid-Georges River catchment and is a Liverpool District sub-catchment. The Georges River enters the Liverpool LGA from the south on the western side of the Defence Lands at Holsworthy and flows to the north, meeting with Glenfield Creek at Casula. The river then continues to flow north past the Liverpool City Centre, under Newbridge Road, past Lighthorse Park and over the Liverpool Weir. Downstream of the Liverpool Weir, the Georges River becomes brackish and is subject to tidal influences.

Figure 6 shows the proposed rail link alignment. The proposed rail link has the potential to directly impact the Georges River and its immediate floodplain at two locations:

1. Georges River railway bridge.
2. Rail link crossing of the Georges River floodplain.

Potential for flooding impacts at these two locations are discussed in the following sections of this report.

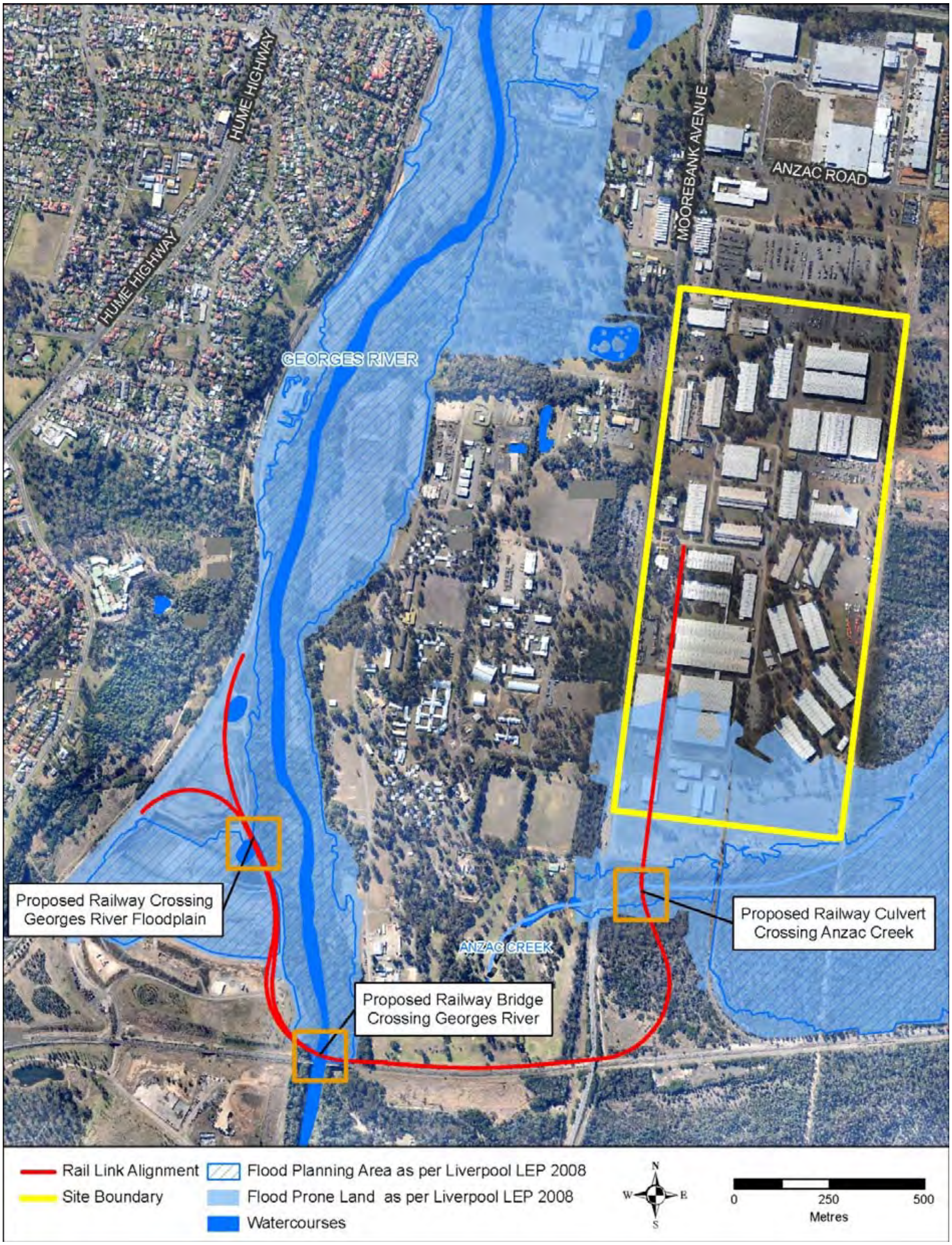

Figure 6 - Proposed rail link alignment (overlaying Liverpool City Council Regional Flood Planning Areas)

6.1 Georges River Railway Bridge

A flood assessment has been undertaken to analyse potential flooding impacts of the proposed railway bridge crossing of the Georges River for the 100 year ARI flood event. The assessment was based on assumed pier and abutment locations and bridge superstructure with the aim of minimising potential flooding increases. Design mitigation measures are discussed further in Section 4.1.5 of this report.

6.1.1 Assessment Methodology

The potential flood impact assessment of the proposed Georges River railway bridge was assessed through development of a HEC-RAS model of the Georges River. HEC-RAS was determined to be the most appropriate software to assess flooding impacts associated with the proposed Georges River railway bridge as the software better represents hydraulic impacts than MIKE 11 when structures are introduced within the river profile and therefore provides more reliable results when assessing headloss. The model was built using information provided in the 'Upper Georges River Flood Study' prepared by Department of Land and Water Conservation in conjunction with Liverpool City Council (December 2000). Information from the December 2000 study was provided by FloodMit Pty Ltd, and included:

- River section geometry, location and roughness.
- Flow hydrographs.
- Hydraulic boundary conditions.
- Flood levels (generated by MIKE-11 software).

The location of the MIKE 11 and corresponding HEC-RAS sections modelled as part of this assessment are shown in Figure 7.

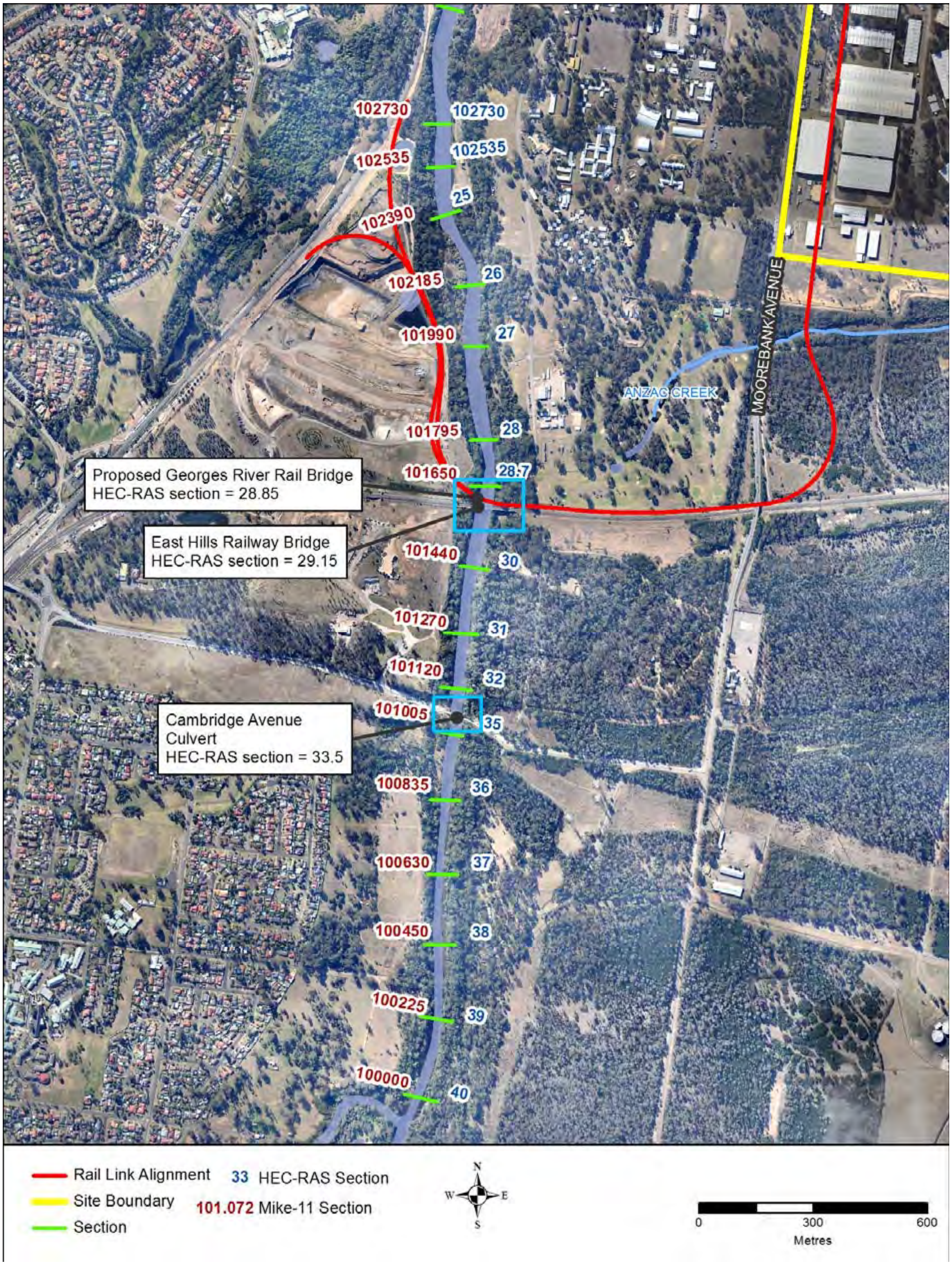

Figure 7- Location of HEC-RAS sections modelled

6.1.2 Existing Conditions

An initial HEC-RAS model was built to reproduce the MIKE-11 flood levels, generated by the December 2000 model. Modelling undertaken in December 2000 excluded the existing East Hills Railway line bridge as it had not been constructed at this time. The 100 year ARI peak flow adopted from the December 2000 study was 1877 m^3/s and the water levels generated by the initial HEC-RAS model were compared to the December 2000 reported MIKE-11 levels, as shown in Table 8.

Table 8 – Comparison of HEC-RAS and Mike 11 results; Year 2000 scenario

Mike-11 Section Label	HEC-RAS Section Label	Year 2000 Scenario [No Railway Bridges]	
		MIKE-11	HEC-RAS
100.000 (P1)	40	13.2	13.11
100.225 (P2)	39	13.0	12.83
100.450 (P3)	38	12.9	12.77
100.630 (P4)	37	12.7	12.59
100.835 (P5)	36	12.6	12.48
101.005 (P6)	35	12.5	12.35
101.057 (P6.4)	34	12.5	12.09
Cambridge Ave culvert	33.5	-	-
101.072 (P6.6)	33	12.1	11.87
101.120 (P7)	32	12.0	11.93
101.270 (P8)	31	12.0	11.86
101.440 (P9)	30	11.7	11.82
New Section	29.3	-	11.72
Existing. Rail Bridge	29.15	-	-
101.650 (P10)	28.7	11.6	11.70
Proposed Rail Bridge	28.85	-	-
New section	28.7	-	11.67
101.795 (P11)	28	11.5	11.50
101.990 (P12)	27	11.4	11.35
102.185 (P13)	26	11.3	11.35
102.390 (P14)	25	11.2	11.20

As can be seen, there is a high level of correlation between the two results and it was determined that the HEC-RAS model developed adequately reflected the flooding regime of the George's River.

Subsequently, the HEC-RAS model was adjusted to include the existing East Hills Railway bridge crossing. The existing railway bridge details have been based upon 'WAE' drawing information included in Appendix C. The results of this modelling are presented in Table 9.

Table 9 - HEC-RAS results; Year 2000 scenario and East Hills Railway Bridge comparison

HEC-RAS Section Label	Year 2000 Scenario [No Railway Bridges]	East Hills Railway Bridge flood level	Flood Level Change* (m)
40	13.11	13.13	0.02
39	12.83	12.85	0.02
38	12.77	12.79	0.02
37	12.59	12.62	0.03
36	12.48	12.50	0.02
35	12.35	12.37	0.02
34	12.09	12.12	0.03
33.5	-	-	-
33	11.87	11.90	0.03
32	11.93	11.95	0.02
31	11.86	11.88	0.02
30	11.82	11.85	0.03
29.3	11.72	11.75	0.03
29.15	-	-	-
28.7	11.70	11.70	0
28.85	-	-	-
28.7	11.67	11.67	0
28	11.50	11.50	0
27	11.35	11.35	0
26	11.35	11.35	0
25	11.20	11.20	0

As can be seen, installation of the East Hills Railway bridge, resulted in a modelled rise in the 100 year ARI flood level within the immediate vicinity of the bridge of approximately 30 mm. This result is ameliorated between 1 km and 600 m from the bridge structure.

6.1.3 Post-Development Conditions

The HEC-RAS model was further adjusted to include a concept of the proposed Georges River railway bridge, to be located on the downstream side of the existing bridge, as proposed for the Stage 1A works. The proposed bridge incorporated into the model assumed that the abutments, piers, bridge decking and noise barriers are favourably aligned hydraulically, as described in Section 4.1.5 of this report. Further modelling will be undertaken once detailed design of the bridge is complete to verify results presented in this report.

6.1.4 Results

Table 10 provides a summary of the HEC-RAS results for 100 year ARI water levels on the Georges River. These results indicate that upstream of the proposed Georges River railway bridge is likely to result in a minimum increase in the 100 year ARI flood levels of:

Up to 30 mm for a distance of approximately 600 m upstream of the proposed railway bridge.

Up to a 10 mm increase for a distance of approximately 1 km upstream.

HEC-RAS model details and results are included in Appendix C.

Table 10 - Georges River 100 year ARI flood levels (mAHD); pre and post Georges River railway bridge development

HEC-RAS Section Label	Existing Railway Bridge only	Inclusive of Proposed Railway Bridge	Flood Level Change* (m)
40	13.13	13.14	**0.01m**
39	12.85	12.85	**0.00m**
38	12.79	12.79	**0.00m**
37	12.62	12.62	**0.00m**
36	12.50	12.51	**0.01m**
35	12.37	12.39	**0.02m**
34	12.12	12.14	**0.02m**
33.5	-	-	**-**
33	11.90	11.92	**0.02m**
32	11.95	11.98	**0.03m**
31	11.88	11.91	**0.03m**
30	11.85	11.87	**0.02m**
29.3	11.75	11.78	**0.03m**
29.15	-	-	**-**
28.7	11.70	11.72	**0.02m**
28.85	-	-	**-**
28.7	11.67	11.67	**0.00m**
28	11.50	11.50	**0.00m**
27	11.35	11.35	**0.00m**
26	11.35	11.35	**0.00m**
25	11.20	11.20	**0.00m**

* Due to proposed railway bridge

6.1.5 Flood Mitigation Measures

The following design principles were incorporated into the HEC-RAS flood modelling and are to be adopted during future design stages of the proposed Georges River railway bridge so as to minimise flooding impacts.

- The bridge abutments are not to encroach on the existing Georges River waterway area.
- The piers of the Georges River bridge structure are to be streamlined in shape, and aligned and oriented to the existing rail bridge, to minimise afflux and to avoid the formation of large-scale turbulence or the erosion of the bed and banks of the waterway.
- The bridge deck structure, including noise/guard rails, is to be no lower and no higher than that of the existing railway bridge.

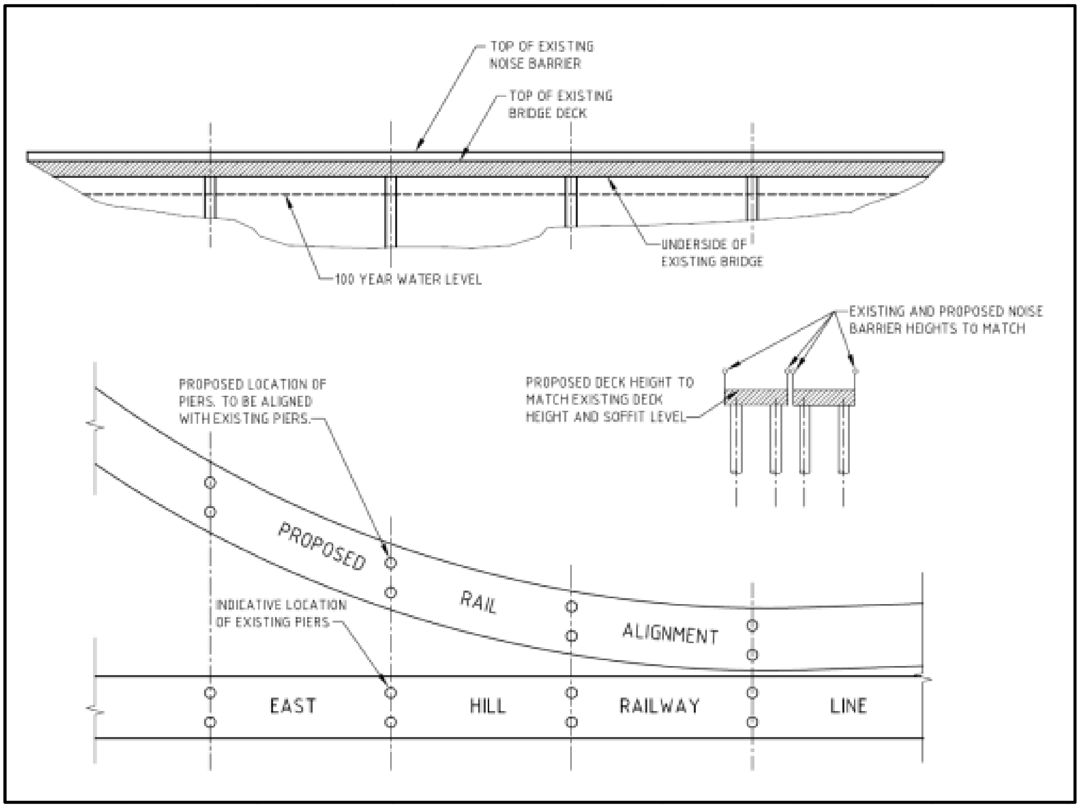

Figure 8 –Indicative bridge layout adopted for flood modelling

6.1.6 Cumulative Impacts

The SIMTA site is located adjacent to the Moorebank Intermodal Company Limited (MICL) Site, which is currently being investigated as a potential intermodal facility serving both interstate and intrastate freight.

Based on the information currently available it appears that the MICL development is proposing to provide a railway access point north of the SIMTA development. This connection also connects to the South Sydney Freight Line (SSFL) and crosses the Georges River. No details of the proposed bridge are available. It is likely that the proposed bridge would have an impact upon existing flood levels. These impacts must be quantified and presented to the appropriate authorities (e.g. Liverpool City Council and the Floodplain Risk Management Committee) for approval. At this stage we can only assume that similar design considerations and statutory processes have been taken into account in developing their scheme.

6.1.7 Conclusion

With the implementation of the above noted design principles, impacts of the SIMTA proposal upon flooding of Georges River would be minimised but not negated.

6.2 Proposed Railway Floodplain Crossing

Figure 9 indicates a section of the proposed rail link alignment to be located within the western floodplain of the Georges River.

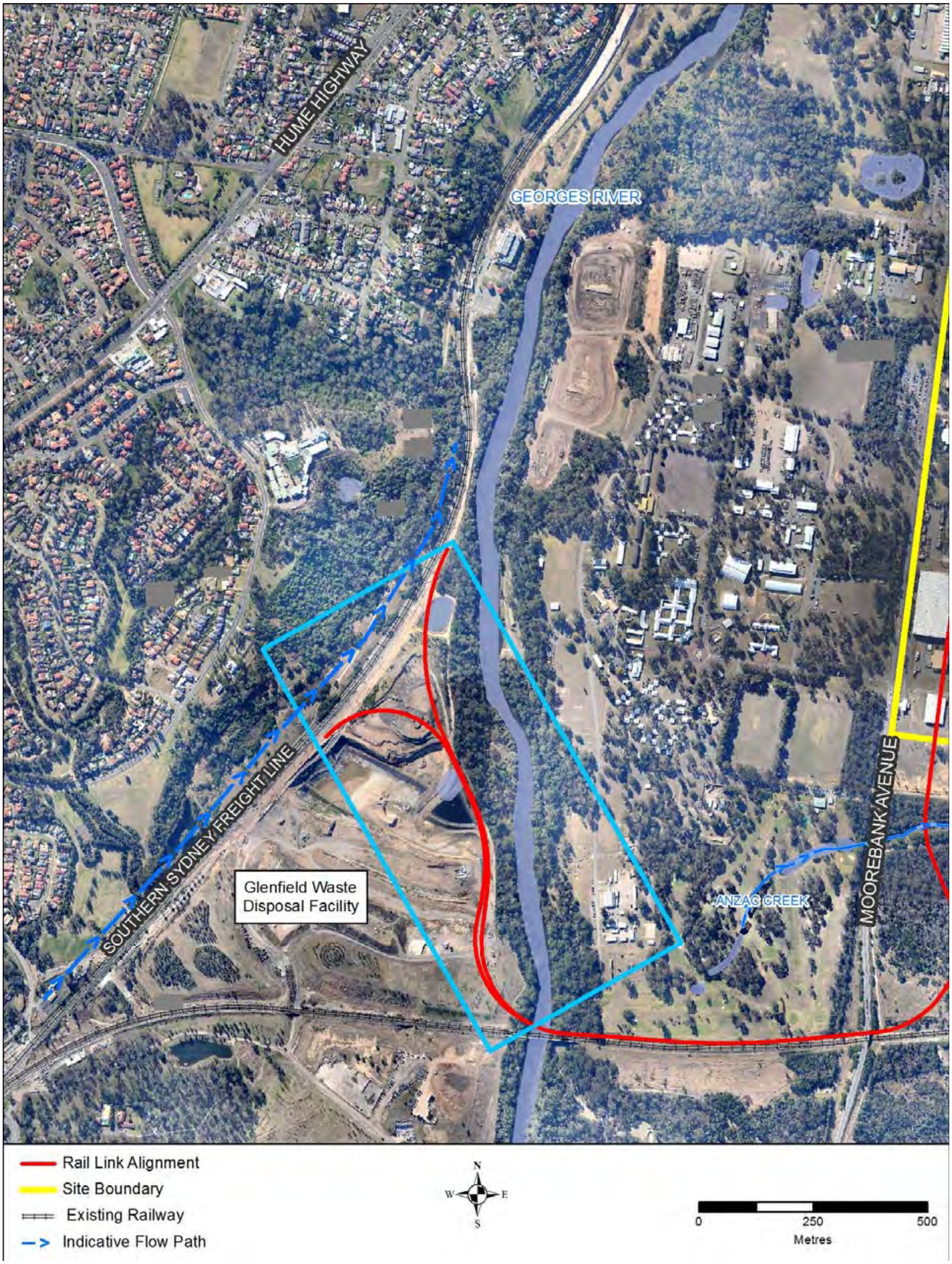

Figure 9 –Proposed rail link alignment on western floodplain of the Georges River

Figure 10 shows the George's River floodplain 'flood planning' and flood prone' areas as defined by Liverpool City Council. The flood planning and flood prone areas extend westward, across the overbank of the Georges River and through the existing Glenfield Waste Disposal Facility and quarry.

Ground surveys undertaken by Hard and Forester Pty Ltd in August 2010 and July 2012 have confirmed that the Georges River western top of bank levels are no lower than 11.8 mAHD. This is at least 0.3 m above the Georges River 100 year ARI flood levels in this vicinity, which range from 11.5 mAHD at Mike-11 Section 101.795 (HEC-RAS section 28) to 11.2 mAHD at Mike 11 Section 102.390 (HEC-RAS section 25)(see Figure 7 and Appendix C). As such the Georges River 100 year ARI mainstream flood flows would not extend overbank to the Glenfield Waste Disposal Facility, nor as far west as the proposed rail link alignment.

In terms of the Georges River PMF, the Mike-11 flood level is 13.9 mAHD at Section 101.795 to 13.3 mAHD at Mike 11 section 102.390. It is noted that the proposed top of rail level in this area would be at approximately 16.0 mAHD. Therefore to avoid adverse flood impacts along the Georges River floodplain (in extreme events larger than the 100 year ARI) as a result of the proposed rail link, sections of the rail embankment would require waterway structures to allow for extreme event flood flows to spread westward across the floodplain, as is currently the case. The necessity for, and sizing of, these structures will be investigated during detailed design.

Also, it appears that under existing conditions, there is little if any catchment runoff impacting on the western side of the proposed railway alignment due to the quarry excavation within the Glenfield Waste Disposal Facility. Larger catchment areas to the west of the quarry are cut-off and directed northward to Georges River as indicated in Figure 9.

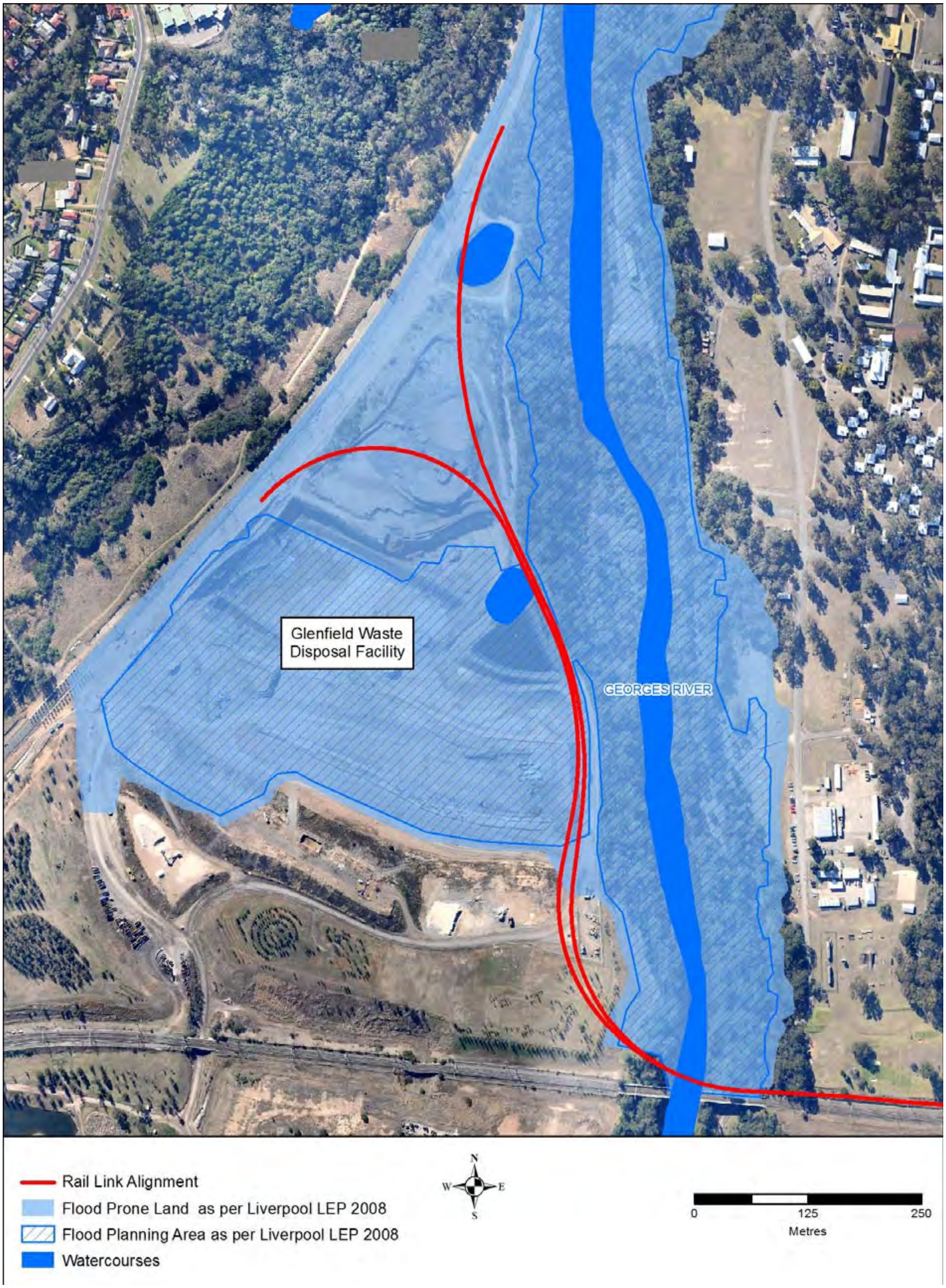

Figure 10 - Liverpool City Council Flood Planning Areas for existing catchment conditions

The status of approval for the filling of the Glenfield Waste Disposal Facility is not currently known. The waste disposal facility is proposing to fill up to a level of 21 mAHD, and if approved this would likely fill in some of the storage currently available in a PMF event.

6.2.1 Conclusion

The proposed link alignment along the western floodplain of the Georges River does not impact on the 100 year ARI Georges River flooding levels.

7 Evacuation and refuge

A flood emergency response plan for the site will be necessary.

The TUFLOW site model results for Anzac Creek (see Appendix E, SIMTA site development) indicates that filling will raise the site above the regional PMF flood levels.

The site is located within upper catchment areas and, as recognised in the NSW Floodplain Management Manual (April 2005, Section L6.2), there would be little if any available warning time for people to undertake action. As such, in developing an evacuation and refuge plan it should include a refuge within the proposed buildings until hazardous flows have subsided and safe evacuation is possible.

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Appendix A

Initial DRAINS model input and output – existing and proposed conditions

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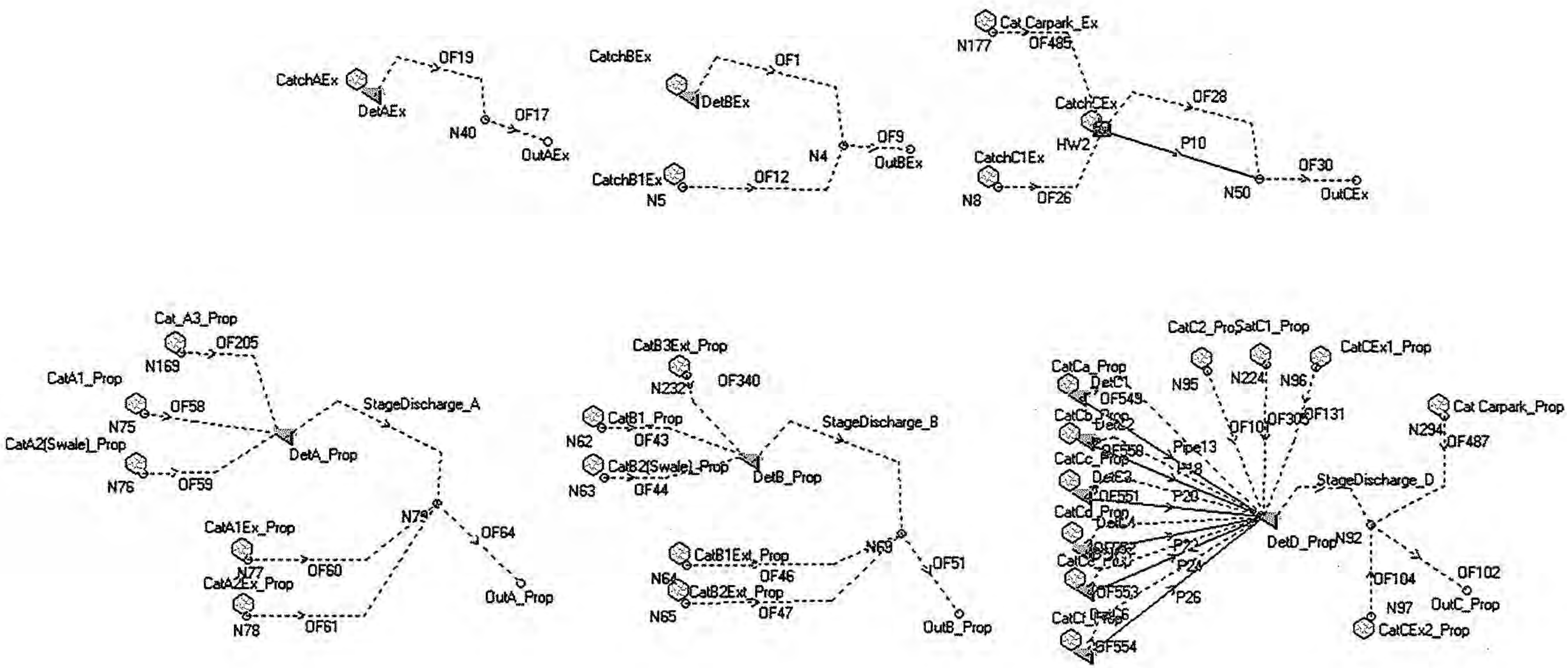

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OF12
Cat Carpark_Ex
N177
OF485
CatchCEx
OF28
HW2
P10
CatchC1Ex
N8
OF26
N50
OF30
OutCEx
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OF59
DetA_Prop
StageDischarge_A
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OF51
OutB_Prop
CatC2_Prop
CatC1_Prop
CatCEx1_Prop
N95
N224
N96
OF101
OF30
OF131
CatCa_Prop
DetC1
OF549
CatCb_Prop
DetC2
OF550
Pipe13
P18
CatCc_Prop
DetC3
OF551
P20
CatCd_Prop
DetC4
P22
P24
OF553
P26
OF554
Cat Carpark_Prop
N294
OF487
StageDischarge_D
DetD_Prop
N92
OF104
OF102
N97
OutC_Prop
CatCEx2_Prop

DATA

DRAINS Model Name and File Path:	F:\AA003210\D-Calculations\C-Civil\Stormwater\DRAINS\Moorebank.drn
DRAINS Version:	2010.09 - 5 August 2010
Modeller's Name:	Chris McClelland
Description:	Moorebank OSD

PIT / NODE DETAILS			Version 9											
Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
N4	Node					14		0		755.938	215.845		33	
N5	Node							0		500	150		34	
N8	Node							0		1000	150		37	
OutBEx	Node					13		0		861.978	209.629		1051047	
N40	Node					14		0		166.986	258.088		4370447	
OutAEx	Node							0		280.589	226.888		4370448	
OutCEx	Node							0		1568.098	160.549		5647966	
N57	Node							0		519.483	217.78		12060722	
N62	Node							0		372.322	-233.435		13086144	
N63	Node							0		375.778	-312.823		13086145	
N64	Node							0		505.378	-451.163		13086146	
N65	Node							0		503.65	-511.643		13086147	
N69	Node							0		845.794	-401.051		13086153	
OutB_Prop	Node							0		937.378	-528.923		13086154	
N75	Node							0		-353.438	-210.971		14111581	
N76	Node							0		-356.894	-306.011		14111582	
N77	Node							0		-189.278	-442.523		14111583	
N78	Node							0		-192.734	-532.379		14111584	
N79	Node							0		111.394	-354.395		14111585	
OutA_Prop	Node							0		242.722	-480.539		14111586	
N92	Node					16		0		1591.586	-387.112		15137076	
OutC_Prop	Node							0		1743.309	-491.164		15137077	
N95	Node							0		1331.362	-142.543		15137086	
N96	Node							0		1503.471	-136.322		15137090	
N97	Node							0		1591.586	-533.112		15137091	
N169	Node							0		-296.422	-113.077		46653709	
N177	Node							0		990.6	397.15		51463360	
N224	Node							0		1425.586	-133.112		66906726	
N232	Node							0		507.444	-149.02		73934574	
HW2	Headwall				0.5	14.2		0		1164.783	240.386		83086008	
N50	Node					16		0		1414.308	162.277		5647965	
N294	Node							0		1705.992	-214.147		84070742	

DETENTION BASIN DETAILS															
Name	Elev	Volume	Init Vol. (cu.m)	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	Id
DetBEx	13.24	0	0	None						514.018	288.421	No			48
	13.3	0.015													
	13.4	0.19													
	13.5	4.388													
	13.6	23.299													
	13.7	70.52													
	13.8	162.39													
	13.9	326.236													
	14	598.866													
	14.1	1061.17													
	14.2	1822.46													
	14.3	2998.53													
	14.4	4603.56													
	14.5	6635.68													
	14.6	9172.45													
	14.7	12192.7													
	14.8	15734.5													
	14.82	16517.8													
DetAEx	13	0	0	None						10.018	295.909	No			4370434
	13.1	0.457													
	13.2	7.16													
	13.3	26.645													
	13.4	71.296													
	13.5	153.944													
	13.6	292.6													
	13.7	516.484													
	13.8	880.951													
	13.9	1439.4													
	14	2241.32													
	14.1	3343.31													
	14.2	4761.79													
DetB_Prop	14	0	0	None						609.058	-288.731	No			13086138
	16	17843													
DetA_Prop	14	0	0	None						-130.806	-249.09	No			14111587
	14.1	977.948													
	14.2	2048.82													
	14.3	3209.08													
	14.4	4467.21													
	14.5	5793.01													

	14.6	7148.15																			
	14.7	8527.31																			
	14.8	9930.54																			
	14.9	11357.9																			
	15	12809.4																			
	15.1	14285																			
	15.2	15784.9																			
	15.3	17309.1																			
	15.4	18857.5																			
	15.5	20430.3																			
	15.6	22027.5																			
	15.7	23649.2																			
	15.8	25295.3																			
	15.9	26893.9																			
	16	28517.1																			
DetC1	15	0	0	Culvert	0.5					1129.186	-186.779	No			15137024						
	15.5	200																			
	16	600																			
DetD_Prop	14	0	0	None						1431.586	-382.043	No			15137030						
	16	12437																			
DetC2	15	0	0	Culvert	0.5					1141.282	-257.627	No			15137025						
	15.5	200																			
	16	600																			
DetC3	15	0	0	Culvert	0.5					1136.098	-344.027	No			15137026						
	15.5	200																			
	16	600																			
DetC4	15	0	0	Culvert	0.5					1136.098	-432.155	No			15137027						
	15.5	200																			
	16	600																			
DetC5	15	0	0	Culvert	0.5					1141.282	-496.091	No			15137028						
	15.5	200																			
	16	600																			
DetC6	15	0	0	Culvert	0.5					1137.826	-596.315	No			15137029						
	15.5	200																			
	16	600																			
SUB-CATCHMENT DETAILS																					
Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Lag Time	Gutter	Gutter	Gutter
	Node	Area	Area	Area	Area	Time	Time	Time	Length	Length	Length	Slope(%)	Slope	Slope	Rough	Rough	Rough	or Factor	Length	Slope	FlowFactor
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%	%					(m)	%	
CatchB1Ex	N5	1.073	0	100	0	3	8	0										0			
CatchC1Ex	N8	2.431	81.8	18.2	0	7	7	0										0			
CatchBEx	DetBEx	26.052	33.4	66.6	0	14.5	24	0										0			
CatchAEx	DetAEx	27.453	50	50	0	13.75	15	0										0			
CatB1_Prop	N62	13.477	100	0	0	6	3	0										0			
CatB2(Swale)_Prop	N63	3.059	100	0	0	9.5	8.5	0										0			
CatB1Ext_Prop	N64	1.073	0	100	0	5	8	0										0			
CatB2Ext_Prop	N65	0.55	0	100	0	8.5	15.5	0										0			
CatA1_Prop	N75	24.798	100	0	0	6	3	0										0			
CatA2(Swale)_Prop	N76	3.506	100	0	0	12	11	0										0			
CatA1Ex_Prop	N77	6.611	46	54	0	13.2	8.3	0										0			
CatA2Ex_Prop	N78	0.785	0	100	0	0	18	0										0			
CatCa_Prop	DetC1	3.562	100	0	0	3	0	0										0			
CatCb_Prop	DetC2	3.377	100	0	0	3	0	0										0			
CatCc_Prop	DetC3	3.371	100	0	0	3	0	0										0			
CatCd_Prop	DetC4	3.513	100	0	0	3	0	0										0			
CatCe_Prop	DetC5	3.232	100	0	0	3	0	0										0			
CatCf_Prop	DetC6	3.616	100	0	0	3	0	0										0			
CatC2_Prop	N95	12.904	100	0	0	3	0	0										0			
CatCEx1_Prop	N96	2.431	81.8	18.2	0	7	7	0										0			
CatCEx2_Prop	N97	2.318	50	50	0	21.7	25	0										0			
Cat_A3_Prop	N169	2.38	100	0	0	3	0	0										0			
Cat Carpark_Ex	N177	2.085	100	0	0	5	0	0										0			
CatC1_Prop	N224	2.139	100	0	0	3	0	0										0			
CatB3Ext_Prop	N232	0.479	0	100	0	0	8	0										0			
CatchCEx	HW2	39.9	60.7	39.3	0	25	30	0										0			
Cat Carpark_Prop	N294	2.085	100	0	0	5	0	0										0			
PIPE DETAILS																					
Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe is	No. Pipes	Chg From	At Chg	Chg	RI	Chg	RL	etc		
			(m)	(m)	(m)	(%)		(mm)	(mm)						(m)	(m)	(m)	(m)	(m)		
Pipe13	DetC1	DetD_Prop	160	15	14	0.63	Box Culverts	1.2W x 0.45H		0.3	Existing	2	DetC1	0							
P18	DetC2	DetD_Prop	160	15	14	0.63	Box Culverts	1.2W x 0.45H		0.3	Existing	2	DetC2	0							
P20	DetC3	DetD_Prop	160	15	14	0.63	Box Culverts	1.2W x 0.45H		0.3	Existing	2	DetC3	0							
P22	DetC4	DetD_Prop	160	15	14	0.63	Box Culverts	1.2W x 0.45H		0.3	Existing	2	DetC4	0							
P24	DetC5	DetD_Prop	160	15	14	0.63	Box Culverts	1.2W x 0.45H		0.3	Existing	2	DetC5	0							
P26	DetC6	DetD_Prop	160	15	14	0.63	Box Culverts	1.2W x 0.45H		0.3	Existing	2	DetC6	0							
P10	HW2	N50	21	11.45	11.4	0.24	Box Culverts	2W x 1.8H		0.3	Existing	2	HW2	0							
DETAILS of SERVICES CROSSING PIPES																					
Pipe	Chg	Bottom	Height of Service	Chg	Bottom	Height of Service	Chg	Bottom	Height of Service	etc											
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc											

DRAINS Model Name and File Path:	F:\AA003210\D-Calculations\C-Civil\Stormwater\DRAINS\Moorebank.drn
DRAINS Version:	2010.09 - 5 August 2010
Modeller's Name:	Chris McClelland
Description:	Moorebank OSD

DRAINS results prepared 02 September, 2010 from Version 2010.09

RESULTS
2 YEAR ARI

PIT / NODE DETAILS — Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
HW2	12.34	5.744			1.86	0	None
N50	11.97		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
CatchB1Ex	0.165	0	0.165	3	8	0	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
CatchC1Ex	0.617	0.542	0.076	7	7	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
CatchBEx	2.76	1.56	1.313	14.5	24	0	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
CatchAEx	4.115	3.019	1.136	13.75	15	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
CatB1_Prop	3.805	3.805	0	6	3	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
CatB2(Swale)_Prop	0.785	0.785	0	9.5	8.5	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
CatB1Ext_Prop	0.185	0	0.185	5	8	0	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
CatB2Ext_Prop	0.06	0	0.06	8.5	15.5	0	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
CatA1_Prop	7.002	7.002	0	6	3	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
CatA2(Swale)_Prop	0.819	0.819	0	12	11	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
CatA1Ex_Prop	1.165	0.682	0.512	13.2	8.3	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
CatA2Ex_Prop	0.076	0	0.076	0	18	0	AR&R 2 year, 1 hour storm, average 33.7 mm/h, Zone 1
CatCa_Prop	1.078	1.078	0	3	0	0	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
CatCb_Prop	1.022	1.022	0	3	0	0	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
CatCc_Prop	1.021	1.021	0	3	0	0	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
CatCd_Prop	1.064	1.064	0	3	0	0	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
CatCe_Prop	0.979	0.979	0	3	0	0	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
CatCf_Prop	1.095	1.095	0	3	0	0	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
CatC2_Prop	3.907	3.907	0	3	0	0	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
CatCEx1_Prop	0.617	0.542	0.076	7	7	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
CatCEx2_Prop	0.268	0.197	0.087	21.7	25	0	AR&R 2 year, 1.5 hours storm, average 26.3 mm/h, Zone 1
Cat_A3_Prop	0.721	0.721	0	3	0	0	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
Cat Carpark_Ex	0.618	0.618	0	5	0	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
CatC1_Prop	0.648	0.648	0	3	0	0	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
CatB3Ext_Prop	0.083	0	0.083	0	8	0	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
CatchCEx	4.757	3.863	0.998	25	30	0	AR&R 2 year, 1 hour storm, average 33.7 mm/h, Zone 1
Cat Carpark_Prop	0.618	0.618	0	5	0	0	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1

Outflow Volumes for Total Catchment (142 impervious + 56.3 pervious = 198 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff	Impervious Ru cu.m (Runoff	Pervious Runoff cu.m (Runoff %)
AR&R 2 year, 5 min	18008.62	11568.16 (64.	11472.57 (89.	95.59 (1.9%)
AR&R 2 year, 10 mi	27591.18	19238.41 (69	18332.42 (92.	906.00 (11.6%)
AR&R 2 year, 15 mi	34695.5	25419.27 (73	23418.14 (94.	2001.13 (20.3%)
AR&R 2 year, 20 mi	40445.04	30511.70 (75	27534.07 (95.	2977.62 (25.9%)
AR&R 2 year, 25 mi	45166.76	34650.07 (76	30928.55 (95.	3721.52 (29.0%)
AR&R 2 year, 30 mi	49366.74	38067.76 (77	33920.91 (96.	4146.84 (29.6%)
AR&R 2 year, 45 mi	59180.61	46349.80 (78	40946.35 (96.	5403.45 (32.1%)
AR&R 2 year, 1 hou	66813.62	52769.25 (79	46410.55 (97.	6358.70 (33.5%)
AR&R 2 year, 1.5 ho	78213.57	61817.24 (79	54571.59 (97.	7245.65 (32.6%)
AR&R 2 year, 2 hou	87234.42	69022.24 (79	61029.34 (97.	7992.91 (32.2%)
AR&R 2 year, 3 hou	100517.83	79483.61 (79	70537.84 (98.	8945.77 (31.3%)
AR&R 2 year, 4.5 ho	115982.09	90767.91 (78	81608.90 (98.	9159.01 (27.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe13	1.018	1.5	15.29	15.273	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
P18	0.964	1.4	15.284	15.273	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
P20	0.962	1.4	15.284	15.273	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
P22	1.004	1.5	15.288	15.273	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
P24	0.921	1.4	15.283	15.273	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
P26	1.034	1.5	15.292	15.273	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
P10	5.744	2.5	12.017	11.967	AR&R 2 year, 1.5 hours storm, average 26.3 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF9	0.4	0.4	0.256	0.06	0.04	15.94	0.75	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
OF12	0.165	0.165	0.256	0.044	0.03	12.89	0.59	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
OF26	0.617	0.617	0.256	0.071	0.06	18.28	0.84	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
OF40	0	0	0.256	0	0	0	0	
OF1	0.279	0.279	0.256	0.052	0.03	14.33	0.67	AR&R 2 year, 3 hours storm, average 16.9 mm/h, Zone 1
OF19	2.424	2.424	0.256	0.125	0.15	29.06	1.21	AR&R 2 year, 1.5 hours storm, average 26.3 mm/h, Zone 1
OF17	2.424	2.424	0.256	0.125	0.15	29.06	1.21	AR&R 2 year, 1.5 hours storm, average 26.3 mm/h, Zone 1
StageDischarge_B	0.155	0.155	0.256	0.041	0.02	12.17	0.57	AR&R 2 year, 4.5 hours storm, average 13 mm/h, Zone 1
OF43	3.805	3.805	0.256	0.15	0.2	34.08	1.36	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
OF44	0.785	0.785	0.256	0.079	0.07	19.72	0.9	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
OF46	0.185	0.185	0.256	0.044	0.03	12.89	0.59	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
OF47	0.06	0.06	0.256	0.029	0.01	9.73	0.42	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
OF51	0.3	0.3	0.256	0.053	0.04	14.69	0.68	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
OF58	7.002	7.002	0.256	0.193	0.31	42.53	1.58	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
OF59	0.819	0.819	0.256	0.08	0.07	20.08	0.9	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1

OF60	1.185	1.185	0.256	0.094	0.09	22.77	0.99	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
OF61	0.076	0.076	0.256	0.032	0.01	10.38	0.45	AR&R 2 year, 1 hour storm, average 33.7 mm/h, Zone 1
OF64	1.72	1.72	0.256	0.109	0.12	25.82	1.1	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
StageDischarge_A	0.656	0.656	0.256	0.073	0.06	18.64	0.85	AR&R 2 year, 4.5 hours storm, average 13 mm/h, Zone 1
StageDischarge_D	2.895	2.895	0.256	0.135	0.17	31.03	1.25	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
OF102	3.427	3.427	0.256	0.144	0.19	32.83	1.32	AR&R 2 year, 1.5 hours storm, average 26.3 mm/h, Zone 1
OF101	3.907	3.907	0.256	0.152	0.21	34.44	1.36	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
OF131	0.617	0.617	0.256	0.071	0.06	18.28	0.84	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
OF104	0.268	0.268	0.256	0.051	0.03	14.15	0.67	AR&R 2 year, 1.5 hours storm, average 26.3 mm/h, Zone 1
OF205	0.721	0.721	0.256	0.076	0.07	19.18	0.88	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
OF485	0.618	0.618	0.256	0.071	0.06	18.28	0.84	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1
OF305	0.648	0.648	0.256	0.073	0.06	18.64	0.84	AR&R 2 year, 5 minutes storm, average 109 mm/h, Zone 1
OF340	0.083	0.083	0.256	0.033	0.02	10.56	0.46	AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1
OF28	0	0	0.256	0	0	0	0	
OF30	5.744	5.744	0.256	0.178	0.27	39.65	1.5	AR&R 2 year, 1.5 hours storm, average 26.3 mm/h, Zone 1
OF487	0.618	0.618	0.256	0.071	0.06	18.28	0.84	AR&R 2 year, 25 minutes storm, average 54.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
DetBEx	14.41	4876.2	0.279	0	0.279
DetAEx	14.03	2581.4	2.424	0	2.424
DetB_Prop	14.87	7789.8	0.155	0	0.155
DetA_Prop	14.85	10678.8	0.656	0	0.656
DetC1	15.4	158.6	1.018	1.018	0
DetD_Prop	15.27	6864.5	2.895	0	2.895
DetC2	15.38	152.9	0.964	0.964	0
DetC3	15.38	152.7	0.962	0.962	0
DetC4	15.39	157.1	1.004	1.004	0
DetC5	15.37	148.3	0.921	0.921	0
DetC6	15.4	160.2	1.034	1.034	0

CONTINUITY CHECK for AR&R 2 year, 2 hours storm, average 22 mm/h, Zone 1

Node	Inflow	Outflow	Storage Chan	Difference
	(cu.m)	(cu.m)	(cu.m)	%
N4	2738.29	2738.29	0	0
N5	154.26	154.26	0	0
N8	918.79	918.79	0	0
DetBEx	6196.01	2587.93	3610.15	0
OutBEx	2734.38	2734.38	0	0
DetAEx	7860.27	7860.33	0	0
N40	7860.33	7860.33	0	0
OutAEx	7860.33	7860.33	0	0
OutCEx	14438.72	14438.72	0	0
N57	0	0	0	0
DetB_Prop	7179.35	1219.52	5960.83	0
N62	5795.11	5795.11	0	0
N63	1315.37	1315.37	0	0
N64	154.26	154.26	0	0
N65	78.4	78.4	0	0
N69	1450.19	1450.19	0	0
OutB_Prop	1448.18	1448.18	0	0
N75	10663.14	10663.14	0	0
N76	1507.58	1507.58	0	0
N77	1820.55	1820.55	0	0
N78	111.59	111.59	0	0
N79	7309.26	7309.25	0	0
OutA_Prop	7301.13	7301.13	0	0
DetA_Prop	13194.12	5385.22	7813	0
DetC1	1531.66	1530.95	0.72	0
DetD_Prop	16271.57	15231.24	1042.43	0
DetC2	1452.11	1451.4	0.71	0
DetC3	1449.53	1448.82	0.71	0
DetC4	1510.59	1509.88	0.71	0
DetC5	1389.76	1389.05	0.71	0
DetC6	1554.88	1554.16	0.72	0
N92	16785.89	16785.88	0	0
OutC_Prop	16781.74	16781.74	0	0
N95	5548.72	5548.72	0	0
N96	918.79	918.79	0	0
N97	662.22	662.22	0	0
N169	1023.4	1023.4	0	0
N177	896.55	896.55	0	0
N224	919.77	919.77	0	0
N232	68.87	68.87	0	0
HW2	14438.71	14438.72	0	0
N50	14438.72	14438.72	0	0
N294	896.55	896.55	0	0

Run Log for Moorebank.drn run at 17:01:26 on 2/9/2010

The maximum flow exceeded the safe value in the following overflow routes: OF487, OF485, OF305, OF205, OF131, OF104, OF102, OF101, StageDischarge_D, OF64, StageDischarge_A, OF60,

DRAINS results prepared 02 September, 2010 from Version 2010.09

PIT / NODE DETAILS — Version 8

Name	Max HGL	Max Pond	Max Surface	Max Pond	Min	Overflow	Constraint
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)	
			(cu.m/s)	(cu.m)	(m)		
HW2	12.06	3.217			2.14	0	None
N50	11.78		0				

SUB-CATCHMENT DETAILS

Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm
	Flow Q	Max Q	Max Q	Tc	Tc	Tc	

	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)	
CatchB1Ex	0.07	0	0.07	3	8	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatchC1Ex	0.208	0.179	0.029	7	7	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatchBEx	1.753	0.684	1.069	14.5	24	0	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
CatchAEx	2.117	1.235	0.882	13.75	15	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatB1_Prop	1.213	1.213	0	6	3	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatB2(Swale)_Prop	0.275	0.275	0	9.5	8.5	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatB1Ext_Prop	0.07	0	0.07	5	8	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatB2Ext_Prop	0.035	0	0.035	8.5	15.5	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatA1_Prop	2.232	2.232	0	6	3	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatA2(Swale)_Prop	0.316	0.316	0	12	11	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatA1Ex_Prop	0.507	0.274	0.233	13.2	8.3	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatA2Ex_Prop	0.048	0	0.048	0	18	0	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
CatCa_Prop	0.321	0.321	0	3	0	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatCb_Prop	0.304	0.304	0	3	0	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatCc_Prop	0.303	0.303	0	3	0	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatCd_Prop	0.316	0.316	0	3	0	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatCe_Prop	0.291	0.291	0	3	0	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatCf_Prop	0.325	0.325	0	3	0	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatC2_Prop	1.161	1.161	0	3	0	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatCEx1_Prop	0.208	0.179	0.029	7	7	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatCEx2_Prop	0.163	0.091	0.071	21.7	25	0	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
Cat_A3_Prop	0.214	0.214	0	3	0	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
Cat Carpark_Ex	0.188	0.188	0	5	0	0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatC1_Prop	0.193	0.193	0	3	0	0.0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatB3Ext_Prop	0.031	0	0.031	0	8	0.0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
CatchCEx	2.87	1.904	0.966	25	30	0.0	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
Cat Carpark_Prop	0.188	0.188	0	5	0	0.0	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1

Outflow Volumes for Total Catchment (142 impervious + 56.3 pervious = 198 total ha)

Storm	Total Rainfall	Total Runoff	Impervious Ru	Pervious Runoff
	cu.m	cu.m (Runoff	cu.m (Runoff	cu.m (Runoff %)
AR&R 2 year, 6 hou	128472.47	100604.63 (7	90548.96 (98.	10055.67 (27.5%)
AR&R 2 year, 9 hou	148457.06	117073.04 (7	104858.02 (98	12215.03 (29.0%)
AR&R 2 year, 12 ho	164635.09	130169.91 (7	116433.61 (98	13736.30 (29.4%)
AR&R 2 year, 18 ho	190924.36	146675.19 (7	135258.25 (99	11416.94 (21.0%)
AR&R 2 year, 24 ho	211741.67	160682.31 (7	150162.25 (99	10520.06 (17.5%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
Pipe13	0.321	1.5	15.09	14.999	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
P18	0.304	1.5	15.087	14.999	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
P20	0.303	1.5	15.086	14.999	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
P22	0.316	1.5	15.089	14.999	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
P24	0.291	1.4	15.084	14.999	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
P26	0.325	1.5	15.09	14.999	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
P10	3.217	2.1	11.831	11.781	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q	Max V	Chainage	Max	Due to Storm
	(cu.m/s)	(m/s)	(m)	HGL (m)	

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF9	0.32	0.32	7.665	0.054	0.04	14.9	0.71	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
OF12	0.07	0.07	7.665	0.031	0.01	10.2	0.44	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF26	0.208	0.208	7.665	0.046	0.03	13.3	0.61	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF40	0	0	7.665	0	0	0.0	0	
OF1	0.286	0.286	7.665	0.053	0.04	14.5	0.67	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
OF19	1.28	1.28	7.665	0.097	0.1	23.3	1.02	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
OF17	1.28	1.28	7.665	0.097	0.1	23.3	1.02	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
StageDischarge_B	0.18	0.18	7.665	0.044	0.03	12.7	0.59	AR&R 2 year, 12 hours storm, average 6.92 mm/h, Zone 1
OF43	1.213	1.213	7.665	0.095	0.09	23.0	1	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF44	0.275	0.275	7.665	0.052	0.03	14.3	0.67	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF46	0.07	0.07	7.665	0.031	0.01	10.2	0.44	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF47	0.035	0.035	7.665	0.024	0.01	7.9	0.37	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF51	0.246	0.246	7.665	0.049	0.03	13.8	0.65	AR&R 2 year, 12 hours storm, average 6.92 mm/h, Zone 1
OF58	2.232	2.232	7.665	0.121	0.14	28.2	1.19	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF59	0.316	0.316	7.665	0.054	0.04	14.9	0.7	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF60	0.507	0.507	7.665	0.066	0.05	17.2	0.79	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF61	0.048	0.048	7.665	0.026	0.01	8.8	0.41	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
OF64	1.16	1.16	7.665	0.093	0.09	22.6	0.99	AR&R 2 year, 12 hours storm, average 6.92 mm/h, Zone 1
StageDischarge_A	0.712	0.712	7.665	0.076	0.07	19.2	0.87	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
StageDischarge_D	2.42	2.42	7.665	0.125	0.15	29.1	1.2	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF102	2.718	2.718	7.665	0.132	0.16	30.3	1.24	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF101	1.161	1.161	7.665	0.093	0.09	22.6	0.99	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF131	0.208	0.208	7.665	0.046	0.03	13.3	0.61	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF104	0.163	0.163	7.665	0.042	0.02	12.4	0.58	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
OF205	0.214	0.214	7.665	0.046	0.03	13.3	0.63	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF485	0.188	0.188	7.665	0.044	0.03	12.9	0.59	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF305	0.193	0.193	7.665	0.044	0.03	12.9	0.61	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF340	0.031	0.031	7.665	0.023	0.01	7.63	0.36	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1
OF28	0	0	7.665	0	0	0	0	
OF30	3.217	3.217	7.665	0.141	0.18	32.11	1.3	AR&R 2 year, 9 hours storm, average 8.32 mm/h, Zone 1
OF487	0.188	0.188	7.665	0.044	0.03	12.89	0.59	AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
DetBEx	14.44	5477.2	0.286	0	0.286
DetAEx	13.95	1865.5	1.28	0	1.28
DetB_Prop	15.12	10003.7	0.18	0	0.18

DetA_Prop	14.96	12294.1	0.712	0	0.712
DetC1	15.18	73.4	0.321	0.321	0
DetD_Prop	15	5388.2	2.42	0	2.42
DetC2	15.18	70.6	0.304	0.304	0
DetC3	15.18	70.7	0.303	0.303	0
DetC4	15.18	72.7	0.316	0.316	0
DetC5	15.17	68.6	0.291	0.291	0
DetC6	15.19	74.1	0.325	0.325	0
CONTINUITY CHECK for AR&R 2 year, 6 hours storm, average 10.8 mm/h, Zone 1					
Node	Inflow	Outflow	Storage Chan	Difference	
	(cu.m)	(cu.m)	(cu.m)	%	
N4	5908.5	5908.5	0	0	
N5	192.6	192.6	0	0	
N8	1348.14	1348.14	0	0	
DetBEx	8645.3	5719.64	2927.67	0	
OutBEx	5904.76	5904.76	0	0	
DetAEx	11214.22	11214.25	0	0	
N40	11214.25	11214.25	0	0	
OutAEx	11214.25	11214.25	0	0	
OutCEx	20919.38	20919.38	0	0	
N57	0	0	0	0	
DetB_Prop	10635.92	3011.81	7625.3	0	
N62	8598.28	8598.28	0	0	
N63	1951.65	1951.65	0	0	
N64	192.6	192.6	0	0	
N65	98.42	98.42	0	0	
N69	3300.56	3300.55	0	0	
OutB_Prop	3298.29	3298.29	0	0	
N75	15821.16	15821.16	0	0	
N76	2236.83	2236.83	0	0	
N77	2580.85	2580.85	0	0	
N78	140.32	140.32	0	0	
N79	15036.61	15036.64	0	0	
OutA_Prop	15028.91	15028.91	0	0	
DetA_Prop	19576.53	12323.19	7257.09	0	
DetC1	2272.56	2271.95	0.61	0	
DetD_Prop	24129.7	23534.2	597.04	0	
DetC2	2154.49	2153.92	0.6	0	
DetC3	2150.67	2150.09	0.6	0	
DetC4	2241.27	2240.69	0.61	0	
DetC5	2062.03	2061.42	0.6	0	
DetC6	2307.02	2306.4	0.61	0	
N92	25808.08	25808.09	0	0	
OutC_Prop	25805.72	25805.72	0	0	
N95	8232.74	8232.74	0	0	
N96	1348.14	1348.14	0	0	
N97	946.02	946.02	0	0	
N169	1518.43	1518.43	0	0	
N177	1330.24	1330.24	0	0	
N224	1364.68	1364.68	0	0	
N232	85.98	85.98	0	0	
HW2	20919.38	20919.38	0	0	
N50	20919.38	20919.38	0	0	
N294	1330.24	1330.24	0	0	
Run Log for Moorebank.drn run at 17:01:52 on 2/9/2010					
The following detention basins have little effect (less than 2%) in reducing peak discharge: DetC6, DetC5, DetC4, DetC3, DetC2, DetC1 You might consider upsizing these, or removing them					

CHANNEL DETAILS														
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Width	L.B. Slope	R.B. Slope	Manning	Depth	Roofed	
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)		
OVERFLOW ROUTE DETAILS														
Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe Depth	SafeDepth	Safe	Bed	D/S Area		Id
			Time	Level	Length	Coeff. C	Section	Major Storms	Minor Storms	DxV	Slope	Contributing		
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%		
OF9	N4	OutBEx	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		1051048
OF12	N5	N4	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		1575195
OF26	N8	HW2	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		5647957
OF40	DetBEx	N57	0.1	14.82	10	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		12060721
OF1	DetBEx	N4	0.1	13.24			Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		70
OF19	DetAEx	N40	0.1	13			Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		4370450
OF17	N40	OutAEx	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		4370449
StageDischarge_B	DetB_Prop	N69	0.1	14			Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		13086155
OF43	N62	DetB_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		13086141
OF44	N63	DetB_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		13086142
OF46	N64	N69	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		13086156
OF47	N65	N69	4.75				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		13086157
OF51	N69	OutB_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		13086163
OF58	N75	DetA_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		14111588
OF59	N76	DetA_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		14111589
OF60	N77	N79	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		14111590
OF61	N78	N79	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		14111591
OF64	N79	OutA_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		14111594
StageDischarge_A	DetA_Prop	N79	0.1	14			Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		14111593
StageDischarge_D	DetD_Prop	N92	0.1	14			Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		15137075
OF102	N92	OutC_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		15137087
OF101	N95	DetD_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		15137085
OF131	N96	DetD_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		20006340
OF104	N97	N92	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		15137089
OF205	N169	DetA_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		46653710
OF485	N177	HW2	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		84070745
OF305	N224	DetD_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		66906727
OF340	N232	DetB_Prop	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		73934575
OF28	HW2	N50	0.1	14.2	20	1.6	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		5647963
OF30	N50	OutCEx	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		5647967
OF487	N294	N92	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		84070747

DRAINS Model Name and File Path:	F:\AA003210\D-Calculations\C-Civil\Stormwater\DRAINS\Moorebank.drn
DRAINS Version:	2010.09 - 5 August 2010
Modeller's Name:	Chris McClelland
Description:	Moorebank OSD

RESULTS 20 YEAR ARI

DRAINS results prepared 02 September, 2010 from Version 2010.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
HW2	12.76	10.166			1.44	0	None
N50	12.25		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
CatchB1Ex	0.381	0	0.381	3	8	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatchC1Ex	1.032	0.87	0.163	7	7	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatchBEx	5.832	2.538	3.35	14.5	24	0	AR&R 20 year, 2 hours storm, average 35.8 mm/h, Zone 1
CatchAEx	7.717	4.854	3.112	13.75	15	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatB1_Prop	6.108	6.108	0	8	3	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatB2(Swale)_Prop	1.26	1.26	0	9.5	8.5	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatB1Ext_Prop	0.381	0	0.381	5	8	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatB2Ext_Prop	0.132	0	0.132	8.5	15.5	0	AR&R 20 year, 2 hours storm, average 35.8 mm/h, Zone 1
CatA1_Prop	11.239	11.239	0	6	3	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatA2(Swale)_Prop	1.315	1.315	0	12	11	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatA1Ex_Prop	2.342	1.094	1.248	13.2	8.3	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatA2Ex_Prop	0.179	0	0.179	0	18	0	AR&R 20 year, 2 hours storm, average 35.8 mm/h, Zone 1
CatCa_Prop	1.732	1.732	0	3	0	0	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
CatCb_Prop	1.642	1.642	0	3	0	0	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
CatCc_Prop	1.639	1.639	0	3	0	0	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
CatCd_Prop	1.708	1.708	0	3	0	0	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
CatCe_Prop	1.571	1.571	0	3	0	0	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
CatCf_Prop	1.758	1.758	0	3	0	0	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
CatC2_Prop	6.273	6.273	0	3	0	0	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
CatCEx1_Prop	1.032	0.87	0.163	7	7	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatCEx2_Prop	0.511	0.32	0.211	21.7	25	0	AR&R 20 year, 1.5 hours storm, average 42.7 mm/h, Zone 1
Cat_A3_Prop	1.157	1.157	0	3	0	0	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
Cat Carpark_Ex	0.992	0.992	0	5	0	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatC1_Prop	1.04	1.04	0	3	0	0	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
CatB3Ext_Prop	0.17	0	0.17	0	8	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
CatchCEx	8.567	6.236	2.563	25	30	0	AR&R 20 year, 1 hour storm, average 54.4 mm/h, Zone 1
Cat Carpark_Prop	0.992	0.992	0	5	0	0	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1

Outflow Volumes for Total Catchment (142 impervious + 56.3 pervious = 198 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff	Impervious Ru cu.m (Runoff	Pervious Runoff cu.m (Runoff %)
AR&R 20 year, 5 m	28912.92	21141.76 (73	19278.57 (93.	1863.19 (22.7%)
AR&R 20 year, 10	44278.07	35484.35 (80	30278.09 (95.	5206.26 (41.4%)
AR&R 20 year, 15	55512.8	45990.70 (82	38320.65 (96.	7670.05 (48.6%)
AR&R 20 year, 20	64897.1	54719.92 (84	45038.60 (96.	9681.32 (52.5%)
AR&R 20 year, 25	72530.12	61675.56 (85	50502.84 (97.	11172.72 (54.2%)
AR&R 20 year, 30	79204.67	67548.72 (85	55281.07 (97.	12267.66 (54.5%)
AR&R 20 year, 45	95313.5	81994.24 (86	66812.62 (97.	15181.62 (56.1%)
AR&R 20 year, 1 h	107853.43	93281.42 (86	75789.75 (98.	17491.67 (57.1%)
AR&R 20 year, 1.5	126985.53	110127.93 (8	89485.90 (98.	20642.03 (57.2%)
AR&R 20 year, 2 h	141954.16	123152.02 (8	100201.45 (98	22950.57 (56.9%)
AR&R 20 year, 3 h	165348.81	143616.59 (8	116949.47 (98	26667.13 (56.8%)
AR&R 20 year, 4.5	191816.53	165548.05 (8	135896.13 (99	29651.93 (54.4%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe13	1.549	1.4	15.728	15.649	AR&R 20 year, 15 minutes storm, average 112 mm/h, Zone 1
P18	1.469	1.4	15.716	15.649	AR&R 20 year, 15 minutes storm, average 112 mm/h, Zone 1
P20	1.487	1.4	15.716	15.649	AR&R 20 year, 15 minutes storm, average 112 mm/h, Zone 1
P22	1.533	1.4	15.724	15.649	AR&R 20 year, 15 minutes storm, average 112 mm/h, Zone 1
P24	1.449	1.3	15.707	15.649	AR&R 20 year, 15 minutes storm, average 112 mm/h, Zone 1
P26	1.567	1.5	15.731	15.649	AR&R 20 year, 15 minutes storm, average 112 mm/h, Zone 1
P10	10.166	3	12.303	12.253	AR&R 20 year, 1.5 hours storm, average 42.7 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF9	0.652	0.652	0.256	0.073	0.06	18.64	0.85	AR&R 20 year, 4.5 hours storm, average 21.5 mm/h, Zone 1
OF12	0.381	0.381	0.256	0.059	0.04	15.76	0.73	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF26	1.032	1.032	0.256	0.088	0.08	21.69	0.96	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF40	0	0	0.256	0	0	0	0	
OF1	0.632	0.632	0.256	0.072	0.06	18.46	0.84	AR&R 20 year, 4.5 hours storm, average 21.5 mm/h, Zone 1
OF19	6.244	6.244	0.256	0.185	0.28	40.91	1.53	AR&R 20 year, 2 hours storm, average 35.8 mm/h, Zone 1
OF17	6.244	6.244	0.256	0.185	0.28	40.91	1.53	AR&R 20 year, 2 hours storm, average 35.8 mm/h, Zone 1
StageDischarge_B	0.21	0.21	0.256	0.046	0.03	13.25	0.62	AR&R 20 year, 4.5 hours storm, average 21.5 mm/h, Zone 1
OF43	6.108	6.108	0.256	0.183	0.28	40.55	1.52	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF44	1.26	1.26	0.256	0.096	0.1	23.13	1.02	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF46	0.381	0.381	0.256	0.059	0.04	15.76	0.73	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF47	0.132	0.132	0.256	0.039	0.02	11.81	0.53	AR&R 20 year, 2 hours storm, average 35.8 mm/h, Zone 1
OF51	0.565	0.565	0.256	0.069	0.06	17.74	0.82	AR&R 20 year, 2 hours storm, average 35.8 mm/h, Zone 1
OF58	11.239	11.239	0.256	0.23	0.42	49.99	1.83	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF59	1.315	1.315	0.256	0.097	0.1	23.49	1.03	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1

OF60	2.342	2.342	0.256	0.123	0.15	28.7	1.2	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF61	0.179	0.179	0.256	0.044	0.03	12.71	0.59	AR&R 20 year, 2 hours storm, average 35.8 mm/h, Zone 1
OF64	2.935	2.935	0.256	0.135	0.17	31.03	1.27	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
StageDischarge_A	0.901	0.901	0.256	0.083	0.08	20.61	0.94	AR&R 20 year, 4.5 hours storm, average 21.5 mm/h, Zone 1
StageDischarge_D	7.154	7.154	0.256	0.194	0.31	42.89	1.59	AR&R 20 year, 1.5 hours storm, average 42.7 mm/h, Zone 1
OF102	8.354	8.354	0.256	0.207	0.34	45.4	1.65	AR&R 20 year, 1.5 hours storm, average 42.7 mm/h, Zone 1
OF101	6.273	6.273	0.256	0.185	0.28	40.91	1.54	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
OF131	1.032	1.032	0.256	0.088	0.08	21.69	0.96	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF104	0.511	0.511	0.256	0.066	0.05	17.2	0.8	AR&R 20 year, 1.5 hours storm, average 42.7 mm/h, Zone 1
OF205	1.157	1.157	0.256	0.092	0.09	22.41	1	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
OF485	0.992	0.992	0.256	0.087	0.08	21.33	0.96	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF305	1.04	1.04	0.256	0.088	0.09	21.69	0.97	AR&R 20 year, 5 minutes storm, average 175 mm/h, Zone 1
OF340	0.17	0.17	0.256	0.043	0.02	12.53	0.58	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1
OF28	0	0	0.256	0	0	0	0	
OF30	10.166	10.166	0.256	0.224	0.39	48.81	1.74	AR&R 20 year, 1.5 hours storm, average 42.7 mm/h, Zone 1
OF487	0.992	0.992	0.256	0.087	0.08	21.33	0.96	AR&R 20 year, 25 minutes storm, average 87.8 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
DetBEx	14.69	11800.6	0.632	0	0.632
DetAEx	14.14	3976	6.244	0	6.244
DetB_Prop	15.52	13588.4	0.21	0	0.21
DetA_Prop	15.42	19125.6	0.901	0	0.901
DetC1	15.75	397.6	1.549	1.549	0
DetD_Prop	15.65	8894.7	7.154	0	7.154
DetC2	15.73	385.7	1.489	1.489	0
DetC3	15.73	385.3	1.487	1.487	0
DetC4	15.74	394.4	1.533	1.533	0
DetC5	15.72	376.9	1.449	1.449	0
DetC6	15.75	401.2	1.567	1.567	0

CONTINUITY CHECK for AR&R 20 year, 2 hours storm, average 35.8 mm/h, Zone 1

Node	Inflow	Outflow	Storage Chan	Difference
	(cu.m)	(cu.m)	(cu.m)	%
N4	4022.52	4022.52	0	0
N5	440.09	440.09	0	0
N8	1585.5	1585.5	0	0
DetBEx	13202.29	3588.01	9617.16	0
OutBEx	4016.95	4016.95	0	0
DetAEx	15299.77	15299.78	0	0
N40	15299.78	15299.78	0	0
OutAEx	15299.78	15299.78	0	0
OutCEx	26519.06	26519.06	0	0
N57	0	0	0	0
DetB_Prop	11870.87	1631.8	10240.45	0
N62	9514.76	9514.76	0	0
N63	2159.65	2159.65	0	0
N64	440.09	440.09	0	0
N65	224.69	224.69	0	0
N69	2293.86	2293.86	0	0
OutB_Prop	2291.16	2291.16	0	0
N75	17507.38	17507.38	0	0
N76	2475.24	2475.24	0	0
N77	3610.76	3610.76	0	0
N78	320.31	320.31	0	0
N79	11412.44	11412.44	0	0
OutA_Prop	11400.89	11400.89	0	0
DetA_Prop	21662.89	7492.92	14175.77	0
DetC1	2514.77	2514.02	0.75	0
DetD_Prop	26795.02	25435.83	1357.83	0
DetC2	2384.16	2383.42	0.75	0
DetC3	2379.93	2379.16	0.75	0
DetC4	2480.18	2479.43	0.75	0
DetC5	2281.79	2281.05	0.74	0
DetC6	2552.89	2552.15	0.75	0
N92	28192.02	28192.02	0	0
OutC_Prop	28186.63	28186.63	0	0
N95	9110.22	9110.22	0	0
N96	1585.5	1585.5	0	0
N97	1289.56	1289.56	0	0
N169	1680.28	1680.28	0	0
N177	1472.01	1472.01	0	0
N224	1510.13	1510.13	0	0
N232	196.46	196.46	0	0
HW2	26519.04	26519.06	0	0
N50	26519.06	26519.06	0	0
N294	1472.01	1472.01	0	0

Run Log for Moorebank.drn run at 17:00:05 on 2/9/2010

The maximum flow exceeded the safe value in the following overflow routes: OF487, OF485, OF305, OF205, OF131, OF104, OF102, OF101, StageDischarge_D, OF64, StageDischarge_A, OF60,

DRAINS results prepared 02 September, 2010 from Version 2010.09

PIT / NODE DETAILS

Name	Max HGL	Max Pond	Max Surface	Version 8 Max Pond	Min	Overflow	Constraint
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)	
			(cu.m/s)	(cu.m)	(m)		
HW2	12.4	6.295			1.8	0	None
N50	12		0				

SUB-CATCHMENT DETAILS

Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm
	Flow Q	Max Q	Max Q	Tc	Tc	Tc	

	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)	
CatchB1Ex	0.139	0	0.139	3	8	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatchC1Ex	0.355	0.298	0.057	7	7	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatchBEx	3.523	1.305	2.218	14.5	24	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatchAEx	3.825	2.059	1.766	13.75	15	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatB1_Prop	2.022	2.022	0	6	3	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatB2(Swale)_Prop	0.459	0.459	0	9.5	8.5	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatB1Ext_Prop	0.139	0	0.139	5	8	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatB2Ext_Prop	0.071	0	0.071	8.5	15.5	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatA1_Prop	3.72	3.72	0	6	3	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatA2(Swale)_Prop	0.526	0.526	0	12	11	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatA1Ex_Prop	0.917	0.456	0.461	13.2	8.3	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatA2Ex_Prop	0.101	0	0.101	0	18	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatCa_Prop	0.534	0.534	0	3	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatCb_Prop	0.507	0.507	0	3	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatCc_Prop	0.506	0.506	0	3	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatCd_Prop	0.527	0.527	0	3	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatCe_Prop	0.485	0.485	0	3	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatCf_Prop	0.542	0.542	0	3	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatC2_Prop	1.936	1.936	0	3	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatCEx1_Prop	0.355	0.298	0.057	7	7	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatCEx2_Prop	0.322	0.174	0.148	21.7	25	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
Cat_A3_Prop	0.357	0.357	0	3	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
Cat Carpark_Ex	0.313	0.313	0	5	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatC1_Prop	0.321	0.321	0	3	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatB3Ext_Prop	0.062	0	0.062	0	8	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
CatchCEx	5.627	3.633	1.994	25	30	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
Cat Carpark_Prop	0.313	0.313	0	5	0	0	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1

Outflow Volumes for Total Catchment (142 impervious + 56.3 pervious = 198 total ha)

Storm	Total Rainfall	Total Runoff	Impervious Ru	Pervious Runoff
	cu.m	cu.m (Runoff	cu.m (Runoff %	cu.m (Runoff %)
AR&R 20 year, 6 h	214120.8	184181.44 (8	151861.70 (9	32319.73 (53.1%)
AR&R 20 year, 9 h	249807.59	211575.89 (8	177413.33 (9	34162.56 (48.1%)
AR&R 20 year, 12	278357.03	236380.27 (8	197848.50 (9	38531.77 (48.7%)
AR&R 20 year, 18	327961.66	273387.85 (8	233369.67 (9	40018.18 (42.9%)
AR&R 20 year, 24	368287.61	301332.22 (8	262250.53 (9	39081.69 (37.3%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
Pipe13	0.534	0.5	15.518	15.48	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
P18	0.506	0.5	15.514	15.48	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
P20	0.505	0.5	15.514	15.48	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
P22	0.526	0.5	15.517	15.48	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
P24	0.484	0.4	15.512	15.48	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
P26	0.542	0.5	15.519	15.48	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
P10	6.295	2.6	12.055	12.005	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q	Max V	Chainage	Max	Due to Storm
	(cu.m/s)	(m/s)	(m)	HGL (m)	

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF9	1.108	1.108	7.665	0.091	0.09	22.23	0.98	AR&R 20 year, 12 hours storm, average 11.7 mm/h, Zone 1
OF12	0.139	0.139	7.665	0.039	0.02	11.81	0.56	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF26	0.355	0.355	7.665	0.057	0.04	15.41	0.72	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF40	0	0	7.665	0	0	0	0	
OF1	1.075	1.075	7.665	0.089	0.09	21.87	0.98	AR&R 20 year, 12 hours storm, average 11.7 mm/h, Zone 1
OF19	3.46	3.46	7.665	0.145	0.19	33.01	1.32	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF17	3.46	3.46	7.665	0.145	0.19	33.01	1.32	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
StageDischarge_B	0.805	0.805	7.665	0.079	0.07	19.9	0.9	AR&R 20 year, 18 hours storm, average 9.19 mm/h, Zone 1
OF43	2.022	2.022	7.665	0.116	0.13	27.26	1.15	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF44	0.459	0.459	7.665	0.063	0.05	16.66	0.77	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF46	0.139	0.139	7.665	0.039	0.02	11.81	0.56	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF47	0.071	0.071	7.665	0.031	0.01	10.2	0.44	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF51	0.855	0.855	7.665	0.081	0.08	20.25	0.92	AR&R 20 year, 18 hours storm, average 9.19 mm/h, Zone 1
OF58	3.72	3.72	7.665	0.15	0.2	33.9	1.34	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF59	0.526	0.526	7.665	0.067	0.05	17.38	0.8	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF60	0.917	0.917	7.665	0.084	0.08	20.79	0.94	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF61	0.101	0.101	7.665	0.035	0.02	10.91	0.51	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF64	1.776	1.776	7.665	0.11	0.12	26	1.12	AR&R 20 year, 12 hours storm, average 11.7 mm/h, Zone 1
StageDischarge_A	0.973	0.973	7.665	0.086	0.08	21.15	0.95	AR&R 20 year, 12 hours storm, average 11.7 mm/h, Zone 1
StageDischarge_D	5.301	5.301	7.665	0.172	0.25	38.4	1.48	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF102	5.916	5.916	7.665	0.18	0.27	40.01	1.52	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF101	1.936	1.936	7.665	0.115	0.13	26.9	1.13	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF131	0.355	0.355	7.665	0.057	0.04	15.41	0.72	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF104	0.322	0.322	7.665	0.055	0.04	15.05	0.69	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF205	0.357	0.357	7.665	0.057	0.04	15.41	0.72	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF485	0.313	0.313	7.665	0.054	0.04	14.87	0.69	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF305	0.321	0.321	7.665	0.054	0.04	14.87	0.71	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF340	0.062	0.062	7.665	0.029	0.01	9.73	0.44	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF28	0	0	7.665	0	0	0	0	
OF30	6.295	6.295	7.665	0.185	0.28	40.91	1.54	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1
OF487	0.313	0.313	7.665	0.054	0.04	14.87	0.69	AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
DetBEx	14.72	12778.8	1.075	0	1.075
DetAEx	14.07	3022.5	3.46	0	3.46
DetB_Prop	15.87	16664	0.805	0	0.805

DetA_Prop	15.62	22285.6	0.973	0	0.973
DetC1	15.53	220.8	0.534	0.534	0
DetD_Prop	15.48	7982.5	5.301	0	5.301
DetC2	15.52	217.3	0.506	0.506	0
DetC3	15.52	217.2	0.505	0.505	0
DetC4	15.52	219.9	0.526	0.526	0
DetC5	15.52	214.7	0.484	0.484	0
DetC6	15.53	221.9	0.542	0.542	0

CONTINUITY CHECK for AR&R 20 year, 6 hours storm, average 18 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Chan (cu.m)	Difference %
N4	10685.39	10685.4	0	0
N5	615.82	615.82	0	0
N8	2381.69	2381.69	0	0
DetBEx	19264.64	10075.01	9192.28	0
OutBEx	10679.95	10679.95	0	0
DetAEx	22564.03	22564	0	0
N40	22564	22564	0	0
OutAEx	22564	22564	0	0
OutCEx	39522.07	39522.07	0	0
N57	0	0	0	0
DetB_Prop	17968.42	4176.21	13793.81	0
N62	14420.32	14420.32	0	0
N63	3273.11	3273.11	0	0
N64	615.82	615.82	0	0
N65	315.6	315.6	0	0
N69	5104.5	5104.48	0	0
OutB_Prop	5101.33	5101.33	0	0
N75	26533.87	26533.87	0	0
N76	3751.43	3751.43	0	0
N77	5302.78	5302.78	0	0
N78	450.42	450.42	0	0
N79	23469.25	23469.22	0	0
OutA_Prop	23457.26	23457.26	0	0
DetA_Prop	32831.63	17727.97	15109.91	0
DetC1	3811.34	3810.68	0.65	0
DetD_Prop	40591.9	39837.63	752.57	0
DetC2	3613.4	3612.74	0.65	0
DetC3	3606.96	3606.32	0.65	0
DetC4	3758.69	3758.25	0.65	0
DetC5	3458.23	3457.6	0.65	0
DetC6	3869.14	3868.47	0.66	0
N92	43970.65	43970.64	0	0
OutC_Prop	43967.65	43967.65	0	0
N95	13807.34	13807.34	0	0
N96	2381.69	2381.69	0	0
N97	1905.04	1905.04	0	0
N169	2546.6	2546.6	0	0
N177	2230.95	2230.95	0	0
N224	2288.74	2288.74	0	0
N232	274.91	274.91	0	0
HW2	39522.06	39522.07	0	0
N50	39522.07	39522.07	0	0
N294	2230.95	2230.95	0	0

Run Log for Moorebank.drn run at 17:00:37 on 2/9/2010

The following detention basins have little effect (less than 2%) in reducing peak discharge: DetC6, DetC5, DetC4, DetC3, DetC2, DetC1 You might consider upsizing these, or removing them