Stormwater Management Plan for Proposed Warehouse and Distribution Facilities, Cowpasture Road, Hoxton Park

February, 2010

ADW Johnson

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Executive summary

A stormwater management plan was prepared for the proposed warehouse and distribution facility off Cowpasture Road, Hoxton Park. The site drains to Hinchinbrook Creek, which is part of the Georges River catchment.

Stormwater Management Plans typically involve analysis of the impacts of development on:

- Peak runoff flow rates
- Surface runoff quality.

Subsequently, a Stormwater Management Plan may recommend treatment methods to ensure the above impacts are appropriately managed such that receiving waters are not denigrated.

In the case of the subject Hoxton Park site, Liverpool City Council has previously advised ADW Johnson that stormwater detention is not required due to specific circumstances.

For the purposes of analysis, the site was divided into 8 separate subcatchments, however catchment A (Existing) and B were not analysed because the proposed land use is not changing for these subcatchments. The resultant stormwater management plan is presented at Figure 5.

The existing and proposed developed site conditions were reviewed, and the following treatment devices are included in this stormwater management plan:

- Three separate dry vegetated water quality basins.
- In subcatchments where a dry vegetated water quality basin is proposed, a simple gross pollutant/sediment trap is also recommended.
- In other subcatchments, a more complex gross pollutant / sediment and hydrocarbon trap is recommended.
- In the case of catchment C, a landscaped buffer area is also recommended.

MUSIC water quality modelling was completed for existing and developed conditions. The modelling indicated that the treatment train proposed will be sufficient to achieve the water quality treatment criteria specified by Liverpool City Council and Australian Runoff Quality, on a whole-of-site basis.

Note that the model results in this report are based on the treatment trains as documented. However, alternative arrangements for the water quality devices may be considered as part of Construction Certificate in consideration of further detail that may be developed at that stage.

As the stormwater conveyance elements are generally designed and sized as part of the detail design at Construction Certificate stage, this stormwater management plan does not consider these elements.

1. Introduction

1.1 Background

Parsons Brinckerhoff (PB) was engaged by ADW Johnson to prepare a stormwater management plan for proposed warehouse and distribution facilities off Cowpasture Road, Hoxton Park, NSW. The location of the site is shown on Figure 1.

The development involves the construction of two distribution warehouses for Big W and Dick Smith Electronics, along with the supporting road, car park and utility services.

The Project Application for the development is being submitted to NSW Planning for approval under Part 3A of the Environmental Planning and Assessment Act 1979. This stormwater management plan will be included in the Environmental Assessment for the development, which comprises a core element of the Project Application.

PB has been informed by ADW Johnson that liaison had been previously undertaken with Liverpool City Council as part of the development planning process. Through this liaison it was revealed that Council does not consider on-site detention to be required for the development. Accordingly, this stormwater management plan has only focused on surface water quality management for the development.

1.2 Scope of work

The following tasks were completed in the development of this stormwater management plan:

- Review information pertaining to the site including the development site plan, conceptual engineering and landscape plans, and detail survey (all supplied by ADW Johnson).
- Estimate the undeveloped (baseline) runoff water quality from the proposed development using MUSIC, a recognised water quality model.
- Assess opportunities for water quality management that integrates with the site plan and engineering concept plan.
- Model the proposed water quality controls using MUSIC, relating the performance to Liverpool City Council’s stormwater management guidelines and Australian Runoff Quality (ARQ, Engineers Australia, 2005).
- Document the stormwater management plan including water quality modelling and results, for inclusion in the Project Application submission to NSW Planning.

Client: ADW Johnson
Project: Proposed Warehouse and Distribution Facilities
Project: Stormwater Management Plan
Location: Cowpasture Road, Hoxton Park NSW

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Legend:

Proposed Development Site

Locality Plan

Figure No. 1

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1.3 Site description

The site is located on part of the former Hoxton Park Aerodrome which is situated at the corner of Cowpasture Road and the M7 Motorway, in the central region of the Liverpool Local Government Area (LGA). Vehicular access to the site is from Cowpasture Road.

The Hoxton Park Aerodrome was most recently used as an uncontrolled airfield for light aircraft and helicopters for private flight training and flying. As the aerodrome was never used for commercial flights, the aerodrome does not have a passenger terminal. Several airport hangers and sheds which were occupied by the flying school and other similar companies had been erected to the west of the runway, with the majority being removed. The remaining buildings are low scale in nature and are generally constructed out of corrugated metal sheeting. This use ceased in December 2008 and the site is currently unoccupied.

The site is generally cleared, comprising mostly grassed areas. The former hangers and buildings are in the process of being demolished.

1.4 Development proposal

The proposed development on the site includes two warehouse buildings, which will be occupied by Big W and Dick Smith Electronics, as shown on the development layout (Figure 2).

The building to the south will be occupied by Big W and is the larger of the two warehouses comprising approximately 89,000 m^2 (GFA). It is proposed that this building will be constructed in one stage and will eventually accommodate approximately 420 employees. The Big W warehouse, as currently proposed, is approximately 200 m wide, 400 m long and 13.7 m high, however these dimensions may vary slightly as the detailed design of the warehouse develops.

The Dick Smith warehouse building, which is located on the northern part of the site, will be constructed in two stages. Initially the building will be approximately 200 m wide, 250 m long and 13.7 m high (Stage 1). As storage requirements increase, the warehouse will be expanded to include a possible 37 m Highbay facility and will accommodate approximately 50,300 m^2 GFA (Stage 2). At the end of Stage 2, the Dick Smith warehouse is expected to accommodate approximately 325 employees.

Approximately 790 car parking spaces will be provided on site for staff. Consent will also be sought for construction of the internal roads and installation of associated infrastructure and services.

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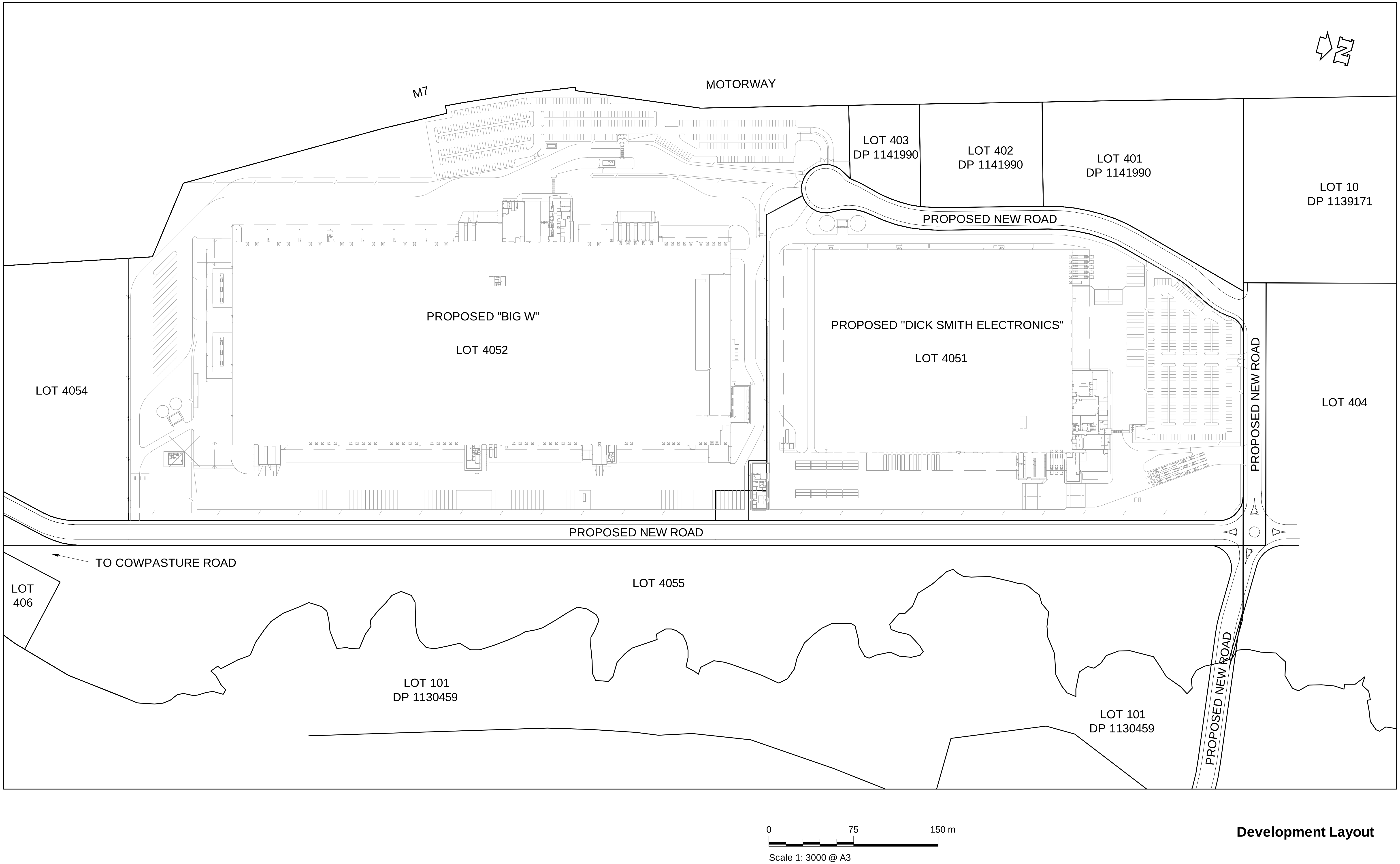

Development Layout

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Figure No. 2

1.5 Existing catchment and drainage

The site is located within the Georges River catchment. Runoff from the local site drains eastward to Hinchinbrook Creek through local drainage pits, culverts and channels, and as sheet flow across the grassed areas. The existing site surface slopes are generally around 1% to 2%, which is typical for airport sites. The estimated existing local drainage catchment plan is shown on Figure 3.

Hinchinbrook Creek is a tributary of Cabramatta Creek, which eventually drains through to the Tasman Sea near Kurnell (some 48 km downstream) via Chipping Norton Lake, and Georges River. Part of the site is located within the floodplain of Hinchinbrook Creek and is affected by regional flooding. Flooding considerations for the site are being documented by others.

Beyond Hinchinbrook Creek is Cowpasture Road and the suburb of Hinchinbrook which predominantly comprises low density residential development. North of the site is the future development, which will accommodate commercial/retail uses immediately adjacent to the site which will eventually provide a buffer for the future 200 (approximately) dwellings which are being considered further north on the same site.

The M7 adjoins the western boundary of the site. The M7 is a 4 lane motorway providing an uninterrupted journey between the M2, M4 and M5 motorways. Beyond the M7 is a Mirvac/Landcom joint venture called Parkbridge. Cowpasture Road bounds the southern part of the site.

Drainage of the developed site will be predominantly in an eastward direction into outfalls along Hinchinbrook Creek. The locations of these outfalls were determined from site survey and previous inspections, and in conjunction with ADW Johnson who are currently preparing the conceptual civil engineering designs for the development.

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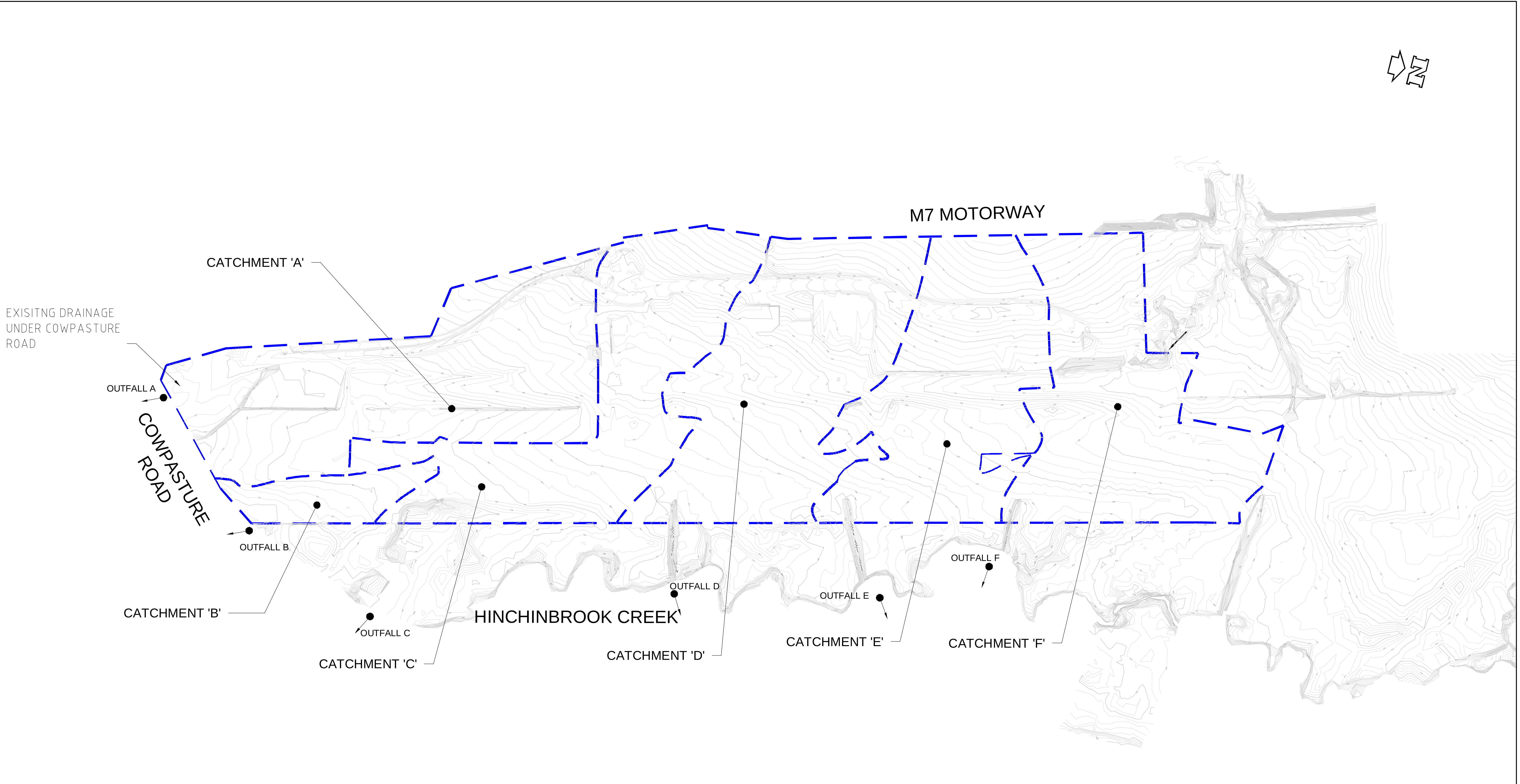

NOTE: PIPE NETWORK HAS BEEN ASSUMED BASED ON PIPE INVERT LEVELS DETERMINED BY SURVEY AND THE LOCATION OF OUTFALLS.

LEGEND:

MAJOR SUB-CATCHMENT BOUNDARY
CHANNEL/OVERLAND CONCENTRATED FLOW PATH/XP-SWMM LINK

50 0 50 100 150 200 250 m
Scale 1: 5000 @ A3

Existing Model subcatchment plan

Figure No. 3

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1.6 Previous report

Hoxton Park Airport – Stormwater and Water Quality Management Strategy (PB, 2006)

A stormwater management study was previously completed by PB for a proposed residential, industrial and retail development on the Hoxton Park Airport site. Stormwater flow and water quality modelling was completed as part of the study. The previous stormwater management plan and modelling results were not used in the development of this stormwater management plan. However, PB was able to draw from the general knowledge of the site, existing drainage, and surrounding area gained from the previous work.

1.7 Available information

The following information was used in the development of this stormwater management plan:

- Concept civil design plans prepared by ADW Johnson.
- Site detail survey supplied by ADW Johnson.

2. Methodology

The methodology for the development of the stormwater management plan is outlined below.

2.1 MUSIC model

An estimate of pollutant loads from the current land use was undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). MUSIC is a continuous simulation water quality model used to evaluate the short and long-term performance of stormwater improvement devices that are configured in series or in parallel to form a 'treatment train'.

The MUSIC model considers suspended solids, total nitrogen and total phosphorus, which are typical components of urban stormwater runoff. The key MUSIC model inputs are:

- rainfall and evaporation data
- catchment area and percentage impervious
- soil storage parameters
- pollutant event mean concentrations for source nodes.

All input parameters to the MUSIC model were derived from either climate data supplied by the Bureau of Meteorology (BOM) or estimated from the MUSIC model manual (2005) and other published papers.

MUSIC model outputs include:

- average annual pollutant export rates
- treatment train effectiveness, expressed in terms of pollutant reduction.

There has been no baseline water quality monitoring undertaken for the site. As a result, predicted pollutant loads and runoff volumes from the MUSIC model were compared against typical values for similar land uses.

Pollutant loads were estimated for the proposed development and compared against existing pollutant loads. The relative effectiveness of proposed water quality management structures was also examined for the site using the MUSIC model.

2.2 Water quality treatment targets

The quantitative and qualitative stormwater objectives for new developments provided in Table 1 have been sourced from the *WSUD Technical Guidelines for Western Sydney* (May 2004). The quantitative objectives represent achievable targets using current best practice stormwater management techniques and have been used to assess the performance of the proposed treatment trains. These targets also correspond to the targets set in Liverpool City Council's 'Development Control Plan' 2008, and Australian Runoff Quality (Engineers Australia, 2006).

Table 1: Quantitative post-construction phase stormwater management objectives

Pollutant	Stormwater treatment objective
Coarse sediment	80% retention of average annual load for particles 0.5 mm or less.
Fine sediment	50% retention of average annual load for particles 0.1 mm or less.
Total phosphorus	45% retention of the average annual load.
Total nitrogen	45% retention of the average annual load.
Litter	70% retention of average annual litter load greater than 5 mm.
Oil and grease	90% retention of average annual pollutant load.

For the purposes of modelling in MUSIC, coarse and fine sediment are grouped as Total Suspended Solids (TSS). The treatment target adopted for TSS is 80%, which is the higher target treatment value for coarse and fine sediment presented in Table 1.

The MUSIC model does not consider litter, oil and grease, but these pollutants were considered in more qualitative sense when recommending treatment devices in the stormwater management plan.

3. Existing conditions

This section documents pollutant loads for existing conditions and establishes a baseline for assessing the effectiveness of the proposed water quality controls.

3.1 Modelling parameters

3.1.1 Catchment plan

The site consists of six drainage catchments being Catchments A, B, C, D, E and F. The existing catchment plan is provided in Figure 3. Catchment data for the MUSIC model is provided in Appendix A.

3.1.2 Rainfall and evapotranspiration

Six minute rainfall data for Liverpool (Whitlam Centre) was obtained from the BOM for input into the model. This data spans a period of approximately 14 years and was selected for input because the station is located only 6 kilometres from the site and comprises the most complete continuous rainfall data set. The mean annual rainfall recorded at this gauging station is 745 mm.

Monthly average areal potential evapotranspiration values for the area were obtained from the *Climatic Atlas of Australia – Evapotranspiration* (BOM, 1999). Evapotranspiration values are given in Table 2. The total annual evapotranspiration was 1225 mm.

Table 2 Monthly average areal potential evapotranspiration values

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evapo-transpiration (mm/month)	170	135	125	80	55	40	45	60	85	125	150	155

3.1.3 Time step

The model was run with a time step of 30 minutes that spanned the period 1981 to 1995. This time step was considered to provide a reasonable compromise between computational speed, file size and model reliability.

3.1.4 Land use

The land use for the existing conditions comprises areas of impervious surfaces (runway, roads and roof areas) and lawn.

3.1.5 Hydrology

MUSIC hydrology parameters adopted for each land use are summarised in Table 3 and are based on the default parameters provided in the MUSIC User Guide Version 3 (2005) for Sydney.

Table 3 MUSIC hydrology parameters for existing conditions

Parameter	Existing
Impervious Area	Varies^
Rainfall Threshold (mm)	1
Pervious Area Properties:	
Soil Storage Capacity (mm)	200
Initial Storage (%)	30
Field Capacity (mm)	170
Infiltration Capacity Coefficient, a	200
Infiltration Capacity Exponent, b	1
Groundwater Properties:	
Initial groundwater Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	5
Daily Deep Seepage Rate (%)	0

^ Impervious percentage varies between 0 and 34% for each catchment.

3.1.6 Event mean concentrations

The MUSIC model requires pollutant generation parameters for baseflow and stormflow conditions. Baseflow is derived from the groundwater store, which is recharged from the pervious soil store. Stormflow is generally generated from the impervious area, and under some conditions the pervious area as well.

The pollutant parameters for each land use are based on concentrations documented in *Urban Stormwater Quality: A Statistical Overview (*Duncan, 1999) for urban areas.

A summary of event mean concentrations adopted for baseflow and stormflow conditions are provided in Table 4. Note that concentrations adopted for the existing and developed land uses were identical. This is considered reasonable given the current level of development existing on the site.

Table 4 Baseflow and stormflow pollutant mean concentrations for each land use

Flow	Mean Concentration		
	Total Suspended Solids	Total Phosphorous	Total Nitrogen
	(mg/L)	(mg/L)	(mg/L)
Baseflow	10	0.1	1.0
Stormflow	100	0.25	1.8

3.2 Existing model results

The predicted average annual pollutant loads leaving each of the existing drainage catchments is provided in Table 5. Pollutant load estimates are provided for suspended solids, total phosphorus and total nitrogen.

Table 5 Predicted average annual pollutant loads leaving each drainage catchment for existing conditions

Outfall	Average Annual Pollutant Load (kg/yr)		
	Total Suspended Solids	**Total Phosphorus**	**Total Nitrogen**
A	1,970	4.8	33.2
B	438	1.0	7.3
C	2,910	6.7	45.1
D	2,010	4.9	34.7
E	1,150	2.9	21.3
F	1,510	3.8	26.2
Total Site	9,988	24.1	167.8

Note that existing pollutant loads from the site will be higher than those expected from a site covered in natural bushland.

4. Developed conditions

This section quantifies developed pollutant loads with no mitigation measures.

4.1 Modelling parameters

Provided below is a description of the catchment plan and land uses adopted in the developed MUSIC model.

4.1.1 Catchment plan

A developed catchment plan is shown in Figure 4. The catchment plan comprises a number of subcatchments (A to F) that drain to Hinchinbrook Creek through a variety of culverts and channels located on the eastern side of the site. It should be noted that for modelling purposes catchment F was broken up into smaller subcatchments (F1 and F2) in order to more appropriately represent the runoff flowing into proposed basin.

The following *new* land uses were used within the developed MUSIC model:

- Urban (Commercial) – This comprises the area of the proposed commercial development and is assumed 100% impervious. This is a reasonable approach following review of the concept engineering and landscape plans.
- Urban (Industrial) – This comprises the industrial lots on the north western section of the development. This area does not comprise part of the Dick Smith or Big W development, but was included as the treatment train in the north end of the site may collect stormwater from these sites. Urban (Industrial) area is assumed 90% impervious.
- Urban (Roads) – This comprises urban road area, assumed 100% impervious.
- Urban (Roofs) – This comprises the roofed areas of the proposed warehouses and was modelled as being 100% impervious.

Parts of Catchment A and F will not be altered as part of the development and therefore, these parts were separated out and were assigned the same parameters as the existing model. Catchment B will be altered by the development through the addition of a road, however, the land use was not expected to change significantly since impervious areas associated with the old airport are expected to be similar to those post development. For this reason catchment B was modelled with the same parameters as the existing model.

Catchment data for the developed model can be seen in Appendix B.

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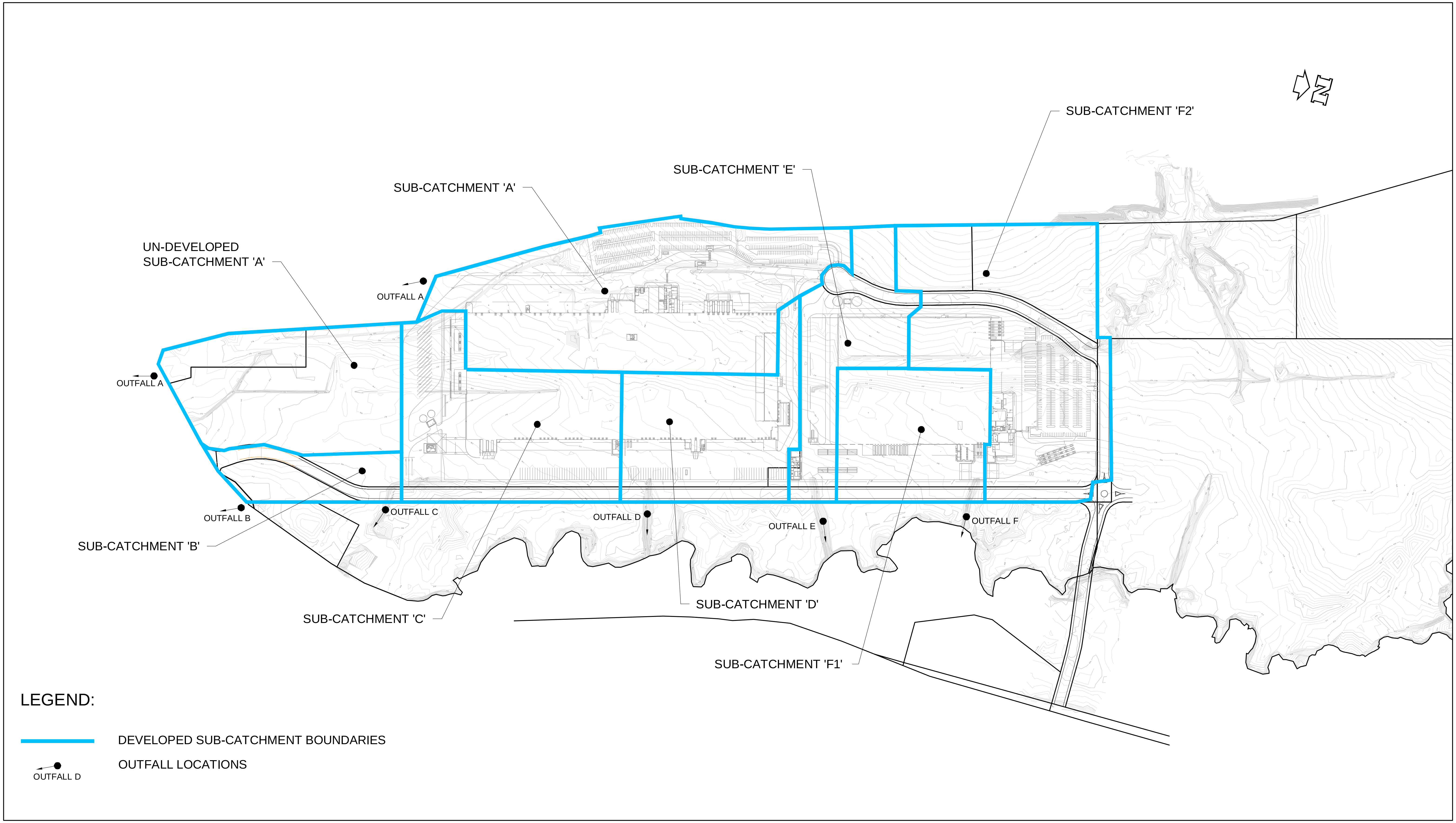

Developed Model Sub-Catchment Plan

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Figure No. 4

4.1.2 MUSIC Model parameters

MUSIC hydrology parameters adopted for each land use are summarised in Table 6 and are based on the default parameters provided in the MUSIC User Guide Version 3 (2005) for Sydney.

Table 6 MUSIC hydrology parameters for each developed land use

Parameter	Urban Commercial	Urban Industrial	Urban Roads	Urban Roofs
Impervious Area				
Impervious Percentage	100%	90%	100%	100%
Rainfall Threshold (mm/day)	1	1	1	1
Pervious Area Properties:				
Soil Storage Capacity (mm)	200	200	200	200
Initial Storage (%)	30	30	30	30
Field Capacity (mm)	170	170	170	170
Infiltration Capacity Coefficient, a	200	200	200	200
Infiltration Capacity Exponent, b	1	1	1	1
Groundwater Properties:				
Initial groundwater Depth (mm)	10	10	10	10
Daily Recharge Rate (%)	25	25	25	25
Daily Baseflow Rate (%)	5	5	5	5
Daily Deep Seepage Rate (%)	0	0	0	0

4.1.3 Event mean concentrations

A summary of event mean concentrations adopted for baseflow and stormflow conditions for each developed land use are provided in Table 7. The concentrations were sourced from Australian Runoff Quality 2006.

Table 7 Baseflow and stormflow pollutant mean concentrations for each developed land use

Landuse	Mean Concentration		
	Total Suspended Solids	Total Phosphorous	Total Nitrogen
	(mg/L)	(mg/L)	(mg/L)
Urban (Commercial, Industrial, Road, Roofs) – Baseflow	10	0.1	1.0
Urban (Commercial, Industrial) – Stormflow	150	0.3	3.0
Urban (Roads) – Stormflow	250	0.25	3.0
Urban (Roofs) – Stormflow	35	0.1	3.0

4.2 Model calibration

4.2.1 Hydrology

Due to the absence of site specific runoff and pollutant data, accurate calibration of the MUSIC model could not be undertaken. Instead, the predicted volumetric runoff coefficients have been compared against typical values for similar land uses documented in *Managing Urban Stormwater: Strategic Framework* (DEC, 1997).

A comparison of model predicted and typical volumetric runoff coefficients is summarised in Table 8 for each land use. Predicted volumetric runoff coefficients were calculated using the predicted runoff volume and the average annual rainfall reported in the model for the analysed rainfall period.

Table 8 Comparison of typical and predicted volumetric runoff coefficients

Landuse	Description	Volumetric Runoff Coefficient	
		Typical	MUSIC Predicted
Existing	Low Urban	0.30	0.26
Developed	High Urban	0.80	0.78

Volumetric runoff coefficients predicted by the MUSIC model compare well with the typical volumetric runoff coefficients documented in *Managing Urban Stormwater: Strategic Framework* (DEC, 1997).

4.3 Developed model results

A comparison of existing and developed (with no mitigation) average annual pollutant loads is provided in Table 9 for the total site. The comparison has been provided to demonstrate the net increase in pollutants arising from the site rather than for each of the drainage catchments.

Table 9 Comparison of existing and developed average annual pollutant loads (total site)

Outfall	Parameter	Existing	Developed	Relative Difference (%)
Total Site	Suspended Solids (kg/yr)	9,988	39,200	+292%
	Total Phosphorus (kg/yr)	24.13	65.5	+171%
	Total Nitrogen (kg/yr)	167.83	797	+374%

As expected, Table 9 shows an increase in the concentration of TSS, TP and TN for the developed site, emphasising the importance of incorporating water quality treatment devices within the stormwater and water quality management strategy for the proposed development.

5. Mitigated conditions

This section outlines the proposed treatment train for the management of stormwater runoff from the site and examines its relative performance.

5.1 Treatment devices

5.1.1 Type

The treatment devices were chosen to integrate with the development plan and concept civil engineering design (by ADW Johnson), and include:

- Vegetated (dry) basins [essentially oversized swales] in subcatchments A, C and F.
- A landscaped buffer area on subcatchment C prior to the GPT and the vegetated water quality basin.
- Gross pollutant traps for the removal of coarse sediment, gross pollutants, nutrients, heavy metals and hydrocarbons. Two types of gross pollutant traps were specified. The first type is based on a typical gross pollutant trap, removing sediment and gross pollutants only, and is used prior to the vegetated basins. The second type has a higher hydraulic residence time, which results in higher sediment removal rates, as well as heavy metal and hydrocarbon removal properties, and is proposed where the basins and other vegetated elements could not be accommodated in the development layout.

A general description of the modelling parameters adopted for each treatment device is provided below. The locations of the devices are shown on Figure 5.

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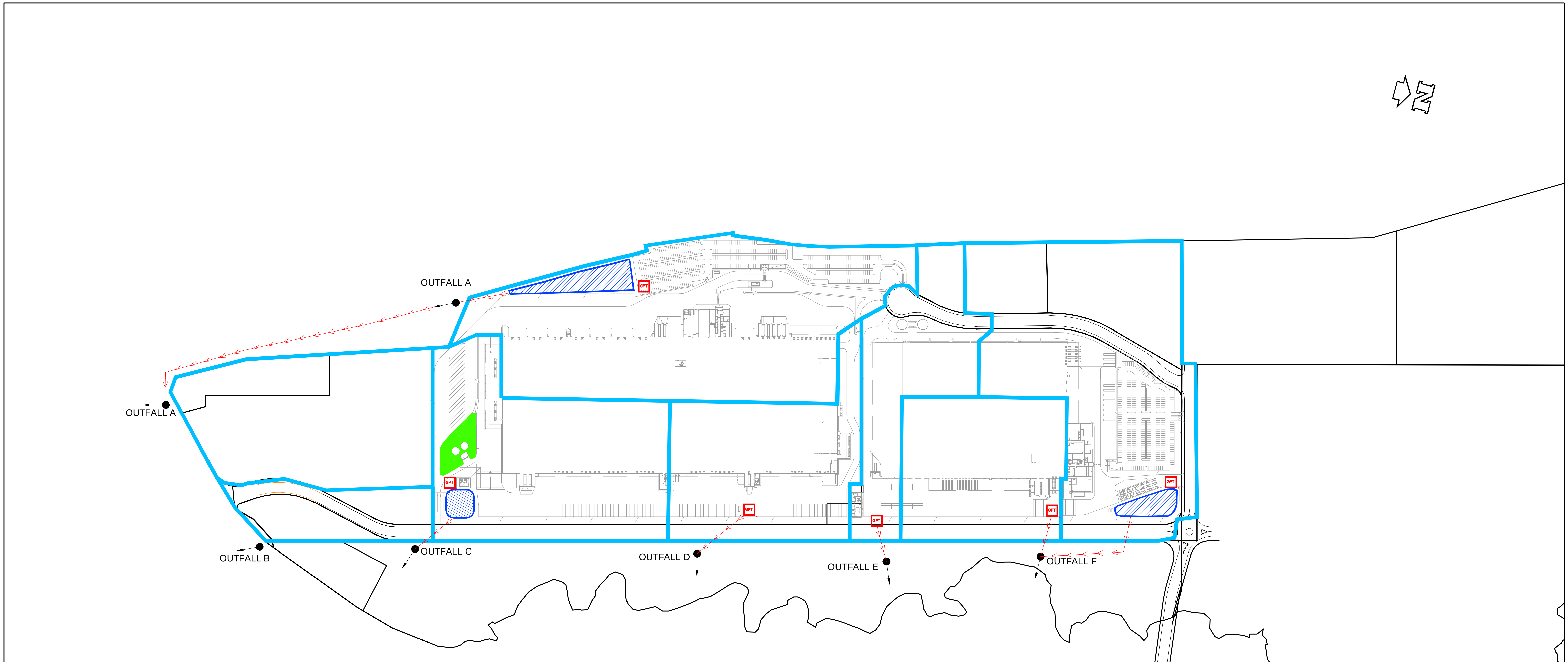

LEGEND:

- DEVELOPED SUB-CATCHMENT BOUNDARIES
- OUTFALL LOCATIONS
- GROSS POLLUTANT TRAP (TRADITIONAL - SEDIMENT AND GROSS POLLUTANT REMOVAL)
- GROSS POLLUTANT TRAP (ADVANCED - WITH HYDROCARBON REMOVAL) - CATCHMENTS D, E & F
- PROPOSED VEGETATED DRY TREATMENT BASIN
- LANDSCAPE BUFFER AREA

0 75 150 m
Scale 1: 3000 @ A3

Stormwater Management Plan

Figure No. 5

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5.1.2 Modelling parameters

Vegetated basins

The vegetated basins located on subcatchments A, C and F2 were modelled as sedimentation basins in MUSIC, with key parameters as provided in Table 10. As mentioned earlier subcatchment F was broken up into smaller subcatchments F1 and F2 to differentiate the areas of the subcatchment flowing into the basin and those areas that do not flow into the basin.

Table 10 Adopted sedimentation basin parameters

Parameter	Basin A	Basin C	Basin F2
Surface Area	3,600 m^2	1,600 m^2	1,100 m^2
Extended Detention Depth	0.5 m	1.0 m	0.5 m
Permanent Pool Volume	0 m^3	0 m^3	0 m^3
Exfiltration Rate	5 mm/hr	5 mm/hr	5 mm/hr

Note that the key parameter from Table 11 is the surface area, and may guide the future design of these three basins. The detention depth, weir width, and outlet configuration (generally) will be determined and confirmed at the detail design stage.

Landscaped buffer area

A landscaped buffer area was modelled on subcatchment C to reduce suspended solids and to allow infiltration into sub-surface layers. Subcatchment C was broken up in MUSIC to accurately simulate the runoff that actually flows into the landscaped buffer area. The parameters used to model this buffer zone are shown below in Table 11.

Table 11 Adopted buffer area parameters

Parameter	Value
Percentage of upstream area buffered (%)	*100*
Buffer Area (% of upstream impervious area)	15.0
Exfiltration Rate (mm/hr)	*5.0*

Gross pollutant traps

The pollutant removal efficiencies adopted for a proprietary gross pollutant traps (GPT) are presented in Table 12. GPTs that did not form part of a treatment train with basins were modelled as SPEL Stormceptors (Class 1), as they have longer hydraulic residence time and are designed to remove hydrocarbons. Smaller GPT units were modelled prior to the basins since these GPTs form part of a larger treatment train. The exact sizes of these GPTs are subject to the final detailed design of the site.

Table 12 Adopted MUSIC GPT removal efficiencies

Pollutant	% Removal Efficiency Subcatchments D,E,F1	% Removal Efficiency^ Subcatchments A, C, F2
Total Suspended Solids (TSS)	90%	70%
Total Nitrogen (TN)	20%	20%
Total Phosphorus (TP)	35%	20%

^ Source: (CRC, 1999)

5.2 Treatment train

The treatment devices listed above have been arranged into a treatment train for the removal of pollutants from each catchment. A summary of devices used within each subcatchment are provided in Table 13. The bracketed numbers represent the number or length of each device contained within the catchment. The arrangement of treatment devices in each catchment is shown in Figure 5.

Table 13 Treatment train for each mitigated model subcatchment

Subcatchment	Treatment Train
A	*GPT (1), Basin*
B	*Does not change significantly with proposed development*
C	*Buffer Area, GPT (1), Basin*
D	*GPT (1)*
E	*GPT (1)*
F	*GPT (2), Basin*

5.3 Mitigated model results

A summary of developed and mitigated average annual pollutant loads and treatment train efficiencies within each subcatchment is provided in Table 14. It should be noted that catchment B will not be effected by the proposed development and therefore was not included in the results.

Table 14 Comparison of developed and mitigated average annual pollutant loads and treatment efficiency for each subcatchment

Sub-catchment	Pollutant	Developed	Mitigated	Treatment Efficiency (%)
A	TSS (kg/yr)	8780	1030	88
	TP (kg/yr)	16.6	6.68	60
	TN (kg/yr)	211	78.3	63
	Gross Pollutants (kg/yr)	1830	0.0	100
C	TSS (kg/yr)	7330	730	90
	TP (kg/yr)	12.2	4.69	62
	TN (kg/yr)	147	56.6	62
	Gross Pollutants (kg/yr)	1270	0.0	100
D	TSS (kg/yr)	4110	410	90
	TP (kg/yr)	6.75	4.36	35
	TN (kg/yr)	94.2	73.7	22
	Gross Pollutants (kg/yr)	822	41.1	95
E	TSS (kg/yr)	4450	444	90
	TP (kg/yr)	6.93	4.52	35
	TN (kg/yr)	75.1	59.6	21
	Gross Pollutants (kg/yr)	663	33.1	95
F1	TSS (kg/yr)	3480	347	90
(No Basin)	TP (kg/yr)	5.5	3.58	35
	TN (kg/yr)	83.3	65.8	21
	Gross Pollutants (kg/yr)	723	36.1	95
F2	TSS (kg/yr)	11100	1310	88
(Basin)	TP (kg/yr)	17.5	7.92	55
	TN (kg/yr)	186	105	44
	Gross Pollutants (kg/yr)	1650	0.0	100
Total	TSS (kg/yr)	39200	4280	89
	TP (kg/yr)	65.5	31.7	52
	TN (kg/yr)	797	440	45
	Gross Pollutants (kg/yr)	6960	110	98

The results in Table 14 indicate that the treatment targets may not be achieved at some of the individual subcatchments. This is expected as some subcatchments, whilst employing the latest technology in GPT's, still do not have the vegetation that is ultimately required for the removal of dissolved nutrients (eg. nitrogen). However, the basins and vegetated buffer provide a very high level of treatment so that the surface runoff quality is met for the total development site. Hinchinbrook Creek ultimately receives all stormwater flow from the site, and the local outfall locations are sufficiently close, such that consideration of the treatment train performance on a total site basis is a reasonable approach.

6. Conclusions and recommendations

A stormwater management plan was prepared for the proposed warehouse and distribution facility off Cowpasture Road, Hoxton Park. ADW Johnson had informed PB that their previous liaison with Liverpool City Council revealed stormwater detention (i.e. developed flow rates) did not require further consideration. Accordingly, the stormwater management plan has been formulated with respect to surface runoff water quality treatment only. The capacity of the drainage elements to convey the developed flow rates will be assessed at the detail design stage, in conjunction with the detail civil engineering design.

The existing and proposed developed site conditions were reviewed, and the following treatment devices proposed as part of the development stormwater management plan:

- gross pollutant traps, in consideration of other devices that are present within the treatment train of each subcatchment
- dry vegetated water quality basins
- a landscaped buffer area.

MUSIC water quality modelling was completed for existing and developed conditions, and revealed that the proposed treatment train will be sufficient to achieve the water quality treatment criteria specified by Liverpool City Council and Australian Runoff Quality, on a whole-of-site basis.

Note that the model results in this report are based on the treatment trains as documented. However, alternative arrangements for the water quality devices may be considered as part of Construction Certificate in consideration of further detail that may be developed at that stage.

The proposed treatment devices will require inspection and maintenance to maintain optimal performance, and will also be a consideration at the Construction Certificate stage.

7. References

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Appendix A

Existing MUSIC Model
Subcatchment Data

Outfall	Existing		
	Total Area	Pervious Area (ha)	Impervious Area (ha)
A	10.46	8.86	1.60
B	1.71	1.67	0.04
C	8.42	5.53	2.89
D	9.16	7.45	1.71
E	7.99	7.19	0.81
F	8.84	7.67	1.16
Totals:	46.58	38.38	8.20

Appendix B

Developed and Mitigated MUSIC Model Subcatchment Data

MUSIC Developed and Mitigated Data (ha)							
Catchment	**Commercial (no buffer)**	**Commercial (buffer)**	**Road**	**Roof**	**Industrial**	**Un-developed**	
A	5.736			4.143		5.221	
B						1.71	
C	1.578	2.419	0.701	2.156			
D	1.778		0.499	2.156			
E	1.772		0.582	0.752	0.494		
F1	1.113		0.652	2.134	3.184		
F2	3.032			1.528		3.240	