

STORMWATER MANAGEMENT

A.1 INTRODUCTION

Stormwater management measures will be required as part of the development of the employment lands to protect the water quality of downstream creeks. The site is divided into two main catchments these are:

- ❖ the Northern Employment Lands, approximately 82 hectares, that drain to the Greystanes Creek; and
- ❖ the Southern Employment Lands, approximately 134 hectares that drain to Prospect Creek.

Development of site will increase the flow volumes and pollutant loads discharged to these creeks. Greystanes Creek is a tributary of the Toongabbie Creek and is located in the upper Parramatta River catchment. A stormwater management plan was prepared for this catchment by the four catchment councils and the Upper Parramatta River Catchment Trust.

The Southern Employment Lands are located in the Prospect Creek catchment. Fairfield, Holroyd, Bankstown and Liverpool Councils have prepared a stormwater management plan for this catchment. The stormwater management plans provide pollutant retention criteria for new developments and rank treatment objectives for various types of developments.

Currently it is anticipated that the majority of the employment lands will be developed for a range of uses which would typically include warehouses, transport facilities, distribution centres, manufacturing and supporting offices. The minimum lot size is one hectare.

A.2 STORMWATER MANAGEMENT OBJECTIVES

Stormwater management objectives for water quality for new urban areas are set out in Council's stormwater management plans. These objectives include measures to manage pollutants generated during the construction and operational phase of the development. Stormwater management measures for the Greystanes Estate also address the issue of water quantity.

A.2.1 Construction Objectives

Sediment and Erosion control plans are required for new developments to prevent pollution of the creeks during the construction phase of the development. The plans are required to be prepared in accordance

with the manual ‘Managing Urban Stormwater: Soils and Construction’ (NSW Department of Housing, 1998). Measures that will be implemented include:

- ❖ staging development activities to minimise land disturbance;
- ❖ limiting earthworks and disturbance of stable rehabilitated landforms;
- ❖ diversion of clean run-off from upstream areas around disturbed areas;
- ❖ stabilise and vegetate areas immediately following the completion of works;
- ❖ provide sediment basins, fences, catch drains, check dams and other structures to collect and treat run-off from disturbed areas;
- ❖ sediment basins sized for the 1 in 3 month design storm based on the majority of fill materials being coarse-grained;
- ❖ monitoring discharges from sediment basins and flocculation as required to limit TSS concentrations in water discharged from the basins to 50 mg/L;
- ❖ vegetated buffer strips around all water bodies and drainage channels;
- ❖ temporarily stabilisation of stockpiles and disturbed areas, not associated with the on-going quarry operations, exposed for more than 15 days; and
- ❖ restricting vehicle access to designated entry and exit points.

A.2.2 Operational

The treatment objectives for Prospect Creek and the upper Parramatta River catchments are listed in *Table A.1* and *Table A.2* respectively.

Table A.1 Pollutant Retention Criteria for Prospect Creek Catchment

Pollutant	Treatment Objective
Suspended Solids	80% retention of the average annual load
Total Phosphorus	45% retention of the average annual load
Total Nitrogen	45% retention of the average annual load
Litter	Retention of litter greater than 50mm for flows up to 25% of the 1 year ARI peak flow
Coarse Sediment	Retention of sediment coarser than 0.125mm for flows up to the 1 in 1 year ARI peak flow
Oil and Grease	No visible discharge

Source: Prospect Creek Stormwater Management Plan

APPENDIX A

Table A.2 Pollutant Retention Criteria For Greystanes Creek Catchment

Pollutant	Description	Retention Criteria
Litter	All anthropogenic material	70% of objects 5 mm diameter or greater
Coarse Sediment	Coarse sand	80% of the load for particles 0.5mm or less
Nutrients	Total phosphorus and Total Nitrogen	45% retention of the load
Fine Particulates	Fine sand	50% of the load for particles 0.1mm dia. or less
Cooking Oil & Grease	Free Floating Oils that do not emulsify in aqueous solutions	90% of the load with no visible discharges
Hydrocarbons	Anthropogenic hydrocarbons that can be emulsified	90% of the load

Source: Upper Parramatta River Catchment Stormwater Management Plan

The range of urban land uses produce different types and quantities of pollutants and consequently the stormwater treatment strategies used to mitigate these impacts vary depending on the type of development proposed. To assist in selecting the appropriate treatment strategies the Upper Parramatta River Stormwater Management Plan (SMP) ranks the treatment objectives for a range of urban land use based on their importance for that particular land use. Rankings provided in the listed in *Table A.3* below.

TABLE A.3 Ranking Of Treatment Objectives

Development Style	Litter	Coarse Sediment	Nutrients	Fine Particulate	Cooking Oil and Grease	Hydrocarbons Motor spirit, Oil and Grease
Commercial	a	d	f	b	e	c
Industrial	c	d	f	a	e	b
Fast Food Outlets and Restaurants	b	c	f	d	a	e
Carparks, Service Stations and Wash Bays	c	d	e	b	f	a

The stormwater management strategy for a new development is required to address all the listed pollutants, however in the case of an industrial development only the pollution retention criteria for objectives ranked (a) to (e) need to be met.

A.3 STORMWATER MANAGEMENT STRATEGY

A.3.1 Stormwater Management Principles

Stormwater management principles listed below for the employment lands have been developed to meet water quantity objectives, the water quality treatment objectives set out in the SMP's and to address the broader issues of water sensitive urban design. Key stormwater management principles to be used in the design of stormwater management systems in the employment lands are:

- ❖ stormwater management systems will be incorporated in the initial stages of design;
- ❖ on-site stormwater management measures will be used, where feasible to meet catchment wide water quality objectives;
- ❖ the proposed stormwater management measures will incorporate, where feasible, natural treatment mechanisms and features;
- ❖ integration of the public open space with the trunk stormwater drainage corridors;
- ❖ on-site stormwater reuse will be encouraged to minimise pollutant exports and reduce the hydrologic impacts associated with the development;
- ❖ stormwater systems designed so that there are no linkages between surface and groundwaters to minimise the risk of contamination of surface waters by potentially saline groundwaters;
- ❖ the results of the monitoring program required by Section 7.7 of this Plan should be used to inform surface water management practices as required;
- ❖ development should be designed so that downstream flows off-site are not adversely affected.
- ❖ For the Northern Employment Lands, avoid any increases in flood peak flows, velocities and water levels at all downstream points in the full range of flood magnitudes, taking into account the planned developments on the adjoining sites and modifications to the DUAP basin.
- ❖ For the Southern Employment Lands, avoid any increases in flood peak flows and velocities at all downstream points in the full range of flood magnitudes, taking into account the planned developments on the adjoining sites.

These principles are designed to meet the following key objectives:

- ❖ limit stream velocities to prevent erosion and scour of local waterways;
- ❖ reduce pollutant loadings to maintain downstream water quality;
- ❖ prevent the contamination of surface water or groundwater by stormwater run-off;
- ❖ reduced demand for imported mains water by water conservation measures and re-use of stormwater;
- ❖ protection of downstream aquatic ecosystems and riparian vegetation; and
- ❖ enhance the scenic and recreational value of creek corridors and water quality control ponds.

A.3.2 Stormwater Plan

A stormwater plan will be prepared to accompany the development applications for the employment lands. The stormwater plan for the sub-division of the land will address issues associated with the conveyance and discharge controls. Source controls will be designed at the development application stage for the individual lots. In summary the controls are:

- ❖ *Source Controls*- controls applied to the individual lots to address specific pollutants associated with the specific development;
- ❖ *Conveyance Controls* - controls applied in the local and trunk drainage systems these include grass swales, and streams incorporating ponds, riffle zones and macrophytes; and
- ❖ *Discharge Controls* - controls prior to discharge from the estate prior to run-off flowing into the creeks. These include gross pollutant traps, wetlands and water quality control ponds.

i. Source Controls

A range of source controls can be used to minimise the pollutant loads discharged from the individual development lots. The type of controls adopted will depend on the nature of the development. Stormwater management plans will be prepared and submitted with the development applications for the individual lots.

- ❖ *Pollution Prevention* - Minimise the amount of impervious areas on the site, bund and roof all chemical and fuel storage areas, roof vehicle servicing and refuelling facilities, separate run-off from 'clean' and 'dirty areas' of the site.
- ❖ *Stormwater Harvesting* – Maximise the amount of stormwater run-off used on-site. Investigate the feasibility of re-using stormwater run-off for dust suppression systems, vehicle washing and wheel washes, and irrigation of landscaped areas of the site.

- ❖ *Oil/Water and Oil/Grit Separators* - Oil/water and oil/grit separators and first flush basins are to be used to treat run-off from 'dirty' areas of the site. These systems will be designed to meet the pollution retention criteria for hydrocarbons and coarse sediment in Tables A.2 and A.3. Oil/grit separators are to be provided for all site car parks with more than 12 spaces. Treatment devices are to be sized to treat the run-off from the 90th percentile rainfall event, (BCC 2001).
- ❖ *Buffer Strips* - Approximately 15% of the lots will be landscaping. Where the site layouts allow the landscaping will be used to treated run-off from the primary treatment devices. Vegetated buffer strips will be used to reduce the amount of fine sediment and nutrients discharged from the site to the wetlands and water quality control ponds. Research by the CRC for Catchment Hydrology on vegetated buffer strips found that a six metre wide strip can reduce sediment loads by up to 90% and nutrient loads by up to 70%, (CRC 1997).

ii. *Conveyance Controls*

- ❖ *Grass Swales* – In the detailed design of the sub-division open grass swales can be used in preference to conventional kerb and gutter and pipe drainage. Swales reduce flow velocities limiting erosion of the stream banks. The lower velocities and filtration through vegetation reduces fine sediments, nutrients, hydrocarbons and heavy metals discharged to the treatment ponds. Typical pollutant removal rates are; total suspended solids – 75 -100%, hydrocarbons 75-100%, nutrients - 50-75%, and heavy metals – 60%, (EPA 1997a).
- ❖ *Watercourse Profiles* – Three main watercourses will be provided through the site to collect stormwater run-off. Two for the southern employment lands draining to the southern water quality control ponds and the second drains to the northern water quality control ponds. Where feasible, the watercourses will include a meandering low flow invert, ponds and riffle zones, and aquatic and riparian vegetation.

iii. *Discharge Controls*

- ❖ *Gross Pollutant Traps* – Gross pollutant traps incorporating a screen and coarse sediment sump will be provided upstream of the ponds and wetlands. These will be designed to achieve the pollutant reduction targets set out in Tables A.2 and A.3 for coarse sediment and litter.
- ❖ *Constructed Wetlands and Water Quality Control Ponds* - Wetlands and ponds will be provided for tertiary treatment of stormwater before it is discharged from the estate to Prospect Creek or Greystanes Creek. The wetlands and ponds have been sized to meet the treatment objectives for sediments and nutrient outlined in the stormwater management plans. The ponds and wetlands would be located off-line with a bypass channel used to divert flows during large storms around the ponds. The ponds, where feasible, should consist of a series of shallow densely planted zones and deep water areas.

APPENDIX A

The relationship between the three levels of stormwater treatment in the treatment train approach is shown in *Figure A.1*.

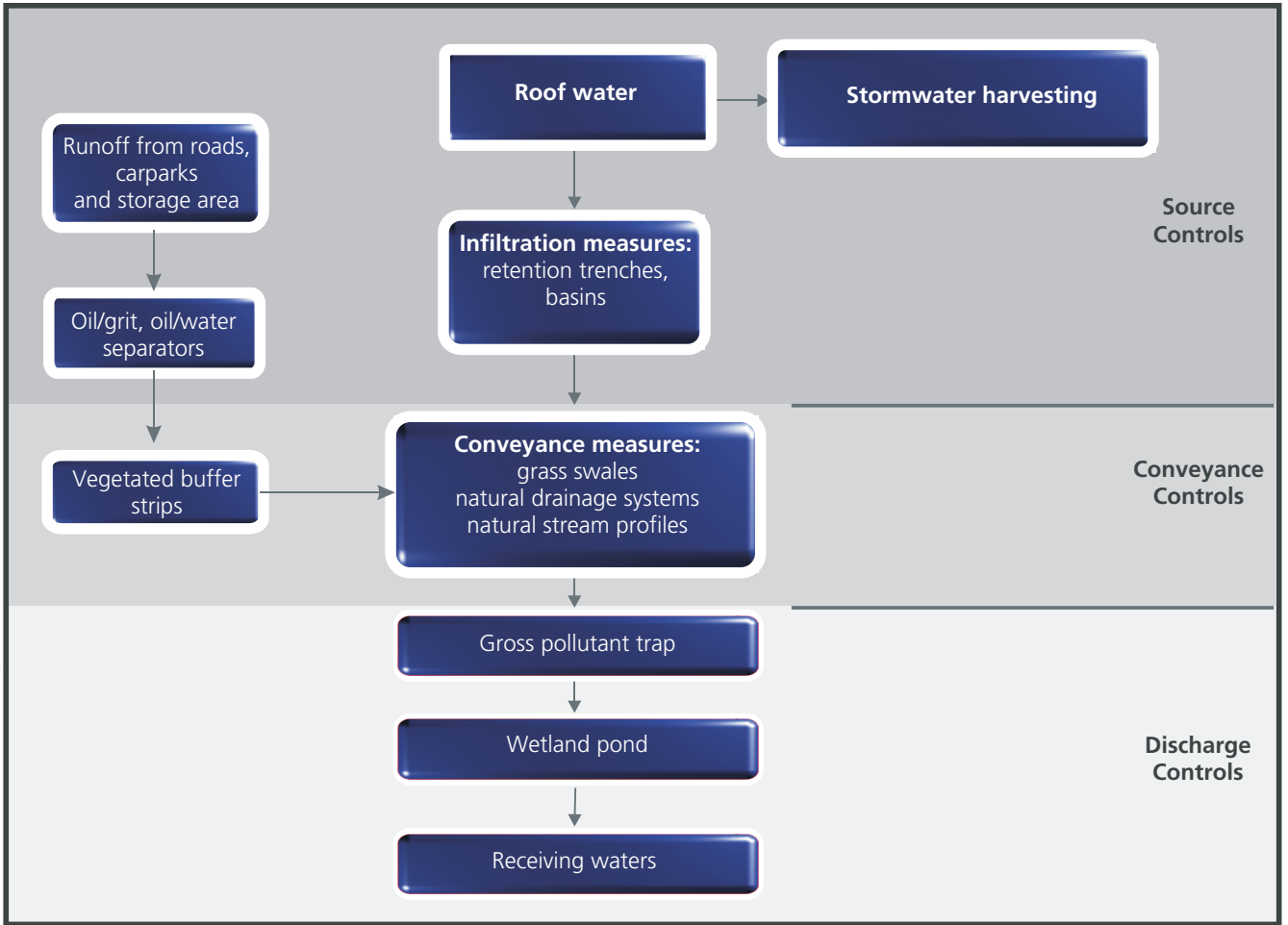


Figure A1 Stormwater Management System



A.4 STORMWATER POLLUTION LOAD ASSESSMENT

To provide preliminary sizes for the water quality ponds, a level one pollution load assessment was completed, as defined in the EPA guidelines, (EPA 1997c). This level of stormwater quality model is suitable for preliminary sizing, but given the size and scales of the development would need to be supported by a more detailed, level two water quality model, at the detailed design phase.

For the purposes of the modelling existing pollutant loads were estimated assuming that the entire area of the quarry was a rural catchment. Due to the lack of site specific water quality data Event Mean Concentrations (EMC’s) based on the Sydney Water’s water quality monitoring data for a range of land uses in the catchment. No EMC data is available for quarries so average rural EMC values have been used. This is a conservative approach and under-estimates the existing pollutant loads.

Pollutant loads after development with no controls were estimated using average EMC values for industrial catchments. The surface area of wetland/water quality control ponds necessary to achieve the pollutant reduction targets was then calculated. Pond sizes have been calculated based on achieving two levels of treatment the first is the treatment objectives outlined in the SMP’s and the second is to reduce post-development pollutant loads to the rural pollutant loads. Wetland surface areas were estimated using the surface loading rates included in the EPA’s guidelines ‘*Managing Urban Stormwater Treatment Techniques*’. These are described as Option 1 and Option 2 respectively in the tables below. Details of the pollution load assessment are included in Appendix A of this paper and summary of the results are provided in Tables A.4 – A.6.

Table A.4 Rural Catchment Stormwater Pollution Loadings

Catchment	Flow Volume (ML/yr)	TSS (t/annum)	TP (kg/yr)	TN (kg/yr)
Greystanes Creek Catchment	141.7	7.1	12.8	99.2
Prospect Creek Catchment	231.6	11.6	20.8	162.1

Table A.5 Post Development Pollutant Loadings

Catchment	Flow Volume (ML/yr)	TSS (t/annum)	TP (kg/yr)	TN (kg/yr)
Greystanes Creek Catchment	346.3	67.2	117.6	608.1
Prospect Creek Catchment	499.7	90.4	158.3	829.2

Table A.6 Wetland Pond Sizing

Catchment	Wetland/ Pond Surface Areas (ha)	
	Option 1	Option 2
Greystanes Creek	1.4	2.2
Prospect Creek	2.0	2.5

A.5 RECOMMENDATIONS

Staged sediment and erosion control plans should be prepared for the development of the infrastructure for the employment lands. Sediment and erosion plans should also be submitted with the individual development applications for the lots. The plans should be prepared in accordance with the guidelines published by the NSW Department of Housing ‘Managing Urban Stormwater Soils and Construction’.

The stormwater management strategy outlined in Section A.3.2 should be adopted for the site so that the water quality objectives set in the relevant SMP’s are met and exceeded. These measures include a ‘treatment train’ approach with site specific controls included on the individual lots and conveyance and discharge controls included during the design of the infrastructure for the employment lands.

Water quality control ponds (WQCP) are to be included in both the northern and southern employment lands. These are to have a minimum surface area of 1.4 and 2.0 hectares respectively. WQCP’s will be designed to achieve the treatment objectives set out in both the Prospect Creek and Upper Parramatta River SMP’s for suspended solids and nutrients for the Southern Employment lands and Northern Employment Lands respectively. Approximately 50% of the water quality control ponds are to be shallow wetland area planted with appropriate species of emergent macrophytes. The remaining areas are deeper open water zones. The ponds should have a minimum hydraulic retention time of twelve days.

The effectiveness of the proposed stormwater management measures is to be confirmed using more detailed water quality modelling. The model should use appropriate EMC values, a daily time step and a ten year simulation period that incorporates years with rainfall totals similar to the 10th, 50th and 90th percentile years, (EPA 1997c).

A.6 REFERENCES

- Bankstown, Fairfield, Holroyd and Liverpool City Councils, 1999
Prospect Creek Catchment Stormwater Management Plan
- BCC 2001 Blacktown City Council, 2001
Stormwater Quality Control Policy
- CRC 1997 Cooperative Research Centre for Catchment Hydrology, 1997
Controlling Sediment and Nutrient Movements within Catchments - Industry Report.
- Cooperative Research Centre for Catchment Hydrology, 1997
Urban Stormwater Pollution - Industry Report.
- Cooperative Research Centre for Catchment Hydrology, 1998
From Roads to Rivers. Gross Pollutant Removal from Urban Waterways.
- EPA 1997a Environment Protection Authority, November 1997
Managing Urban Stormwater. Treatment Techniques.
- EPA 1997b Environment Protection Authority, April 1997
Managing Urban Stormwater. Strategic Framework. Draft.
- EPA 1997c Environment Protection Authority, November 1997
Managing Urban Stormwater. Council Handbook. Draft.
- Environment Protection Authority, December 1998
Managing Urban Stormwater. Source Control. Draft.
- New South Wales Department of Housing, August 1998
Managing Urban Stormwater: Soils and Construction
- Lower Hunter and Central Coast Regional Environmental Management Strategy, 1999
Water Sensitive Urban Development. Implementation Issues for the Lower Hunter & Central Coast.
- Patterson Britton and Partners, January 2000
Greystanes Estate General Services Plan
- PPK Environment and Infrastructure, April 2001
Drainage Services Plan for the Employment Land
- Upper Parramatta River Catchment Trust, July 1999
Upper Parramatta River Catchment Trust Stormwater Management Plan

STORMWATER POLLUTION LOAD CALCULATIONS

APPENDIX A.1

Greystanes Estate _Employment Lands

Preliminary Pollution Load Estimates

Generic EMC data from Sydney Water Monitoring Data

Landuse	Pollutants			Cv
	TSS (mg/L)	TP (mg/L)	TN (mg/L)	
Natural	10	0.02	0.4	0.15
Rural	50	0.09	0.7	0.2
Residential	150	0.25	1.5	0.35
Commercial	200	0.35	1.8	0.5
Industrial	200	0.35	1.8	0.52

Prospect Mean Annual Rainfall 864 mm/yr

Catchment Areas

Catchment Areas		Zoning	
		Industrial	Open Space
Northern Employment Lands	82 hectares	74	8
Southern Employment Lands	134 hectares	97	37

Pollutant Loads

	Existing		Post Development	
Assume Rural				
Northern Employment Lands				
Flow Vol	141.7 ML/yr		Flow Vol	346.3 ML/yr
TSS Load	7.1 t/annum		TSS Load	67.2 t/annum
TP Load	12.8 kg/annum		TP Load	117.6 kg/annum
TN Load	99.2 kg/annum		TN Load	608.1 kg/annum
Southern Employment Lands				
Flow Vol	231.6 ML/yr		Flow Vol	499.7 ML/yr
TSS Load	11.6 t/annum		TSS Load	90.4 t/annum
TP Load	20.8 kg/annum		TP Load	158.3 kg/annum
TN Load	162.1 kg/annum		TN Load	829.2 kg/annum

APPENDIX A.1

Stormwater Treatment Pre Treatment

Filter Strips	Removal Rate (%)	Grass Swales	Removal Rate (%)
TSS	83	TSS	87.5
TP	29	TP	62.5
TN	5	TN	60

Loads after pre-treatment

Northern Employment Lands

TSS Load	11.4 t/annum
TP Load	83.5 kg/annum
TN Load	577.7 kg/annum

Southern Employment Lands

TSS Load	15.4 t/annum
TP Load	112.4 kg/annum
TN Load	787.7 kg/annum

Option 1 Pre-Treatment Grass Filter Strips

Wetlands/ Ponds		Input Loads	Target Loads	RR (%)	HLR (m3/m2/yr)	SA (ha)
Northern Employment Lands						
TSS Load	11.4 t/annum	TSS Load	7.1 t/annum	38.0	150	0.2
TP Load	83.5 kg/annum	TP Load	12.8 kg/annum	84.7	5	6.9
TN Load	577.7 kg/annum	TN Load	99.2 kg/annum	82.8	6	5.8
Southern Employment Lands						
TSS Load	15.4 t/annum	TSS Load	11.6 t/annum	24.6	150	0.3
TP Load	112.4 kg/annum	TP Load	20.8 kg/annum	81.5	5	10.0
TN Load	787.7 kg/annum	TN Load	162.1 kg/annum	79.4	6	8.3

Option 2 Pre-Treatment Grass Filter Strips and Swales

Wetlands/ Ponds		Input Loads	Target Loads	RR (%)	HLR (m3/m2/yr)	SA (ha)
Northern Employment Lands						
TSS Load	1.4 t/annum	TSS Load	7.1 t/annum	-396.2	150	0.2
TP Load	31.3 kg/annum	TP Load	12.8 kg/annum	59.3	15.5	2.2
TN Load	231.1 kg/annum	TN Load	99.2 kg/annum	57.1	16	2.2
Southern Employment Lands						
TSS Load	1.9 t/annum	TSS Load	11.6 t/annum	-503.0	150	0.3
TP Load	42.1 kg/annum	TP Load	20.8 kg/annum	50.6	25	2.0
TN Load	315.1 kg/annum	TN Load	162.1 kg/annum	48.6	20	2.5

APPENDIX A.1

Target Reduction

Upper Parramatta River Catchment (Northern Employment Lands)

Parameter	Reduction	HLR	SA (ha)
TSS	80	35	0.99
TP	45	30	1.15
TN	45	25	1.39

Prospect Creek Catchment (Southern Employment Lands)

TSS	80	35	1.43
TP	45	30	1.67
TN	45	25	2.00

Pond Details

Northern

Mean Depth	Volume (ML)	HRT (days)
1	13.85	14.6

Southern

Mean Depth	Volume (ML)	HRT (days)
1	19.99	14.6