Costin Roe Consulting

Value in Engineering and Management

Water Cycle Management Plan

Proposed Subdivision
'Illawarra Regional Business Park'
Albion Park, NSW

Prepared For

Delmo Albion Park Pty Ltd

Prepared By:

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1. EXECUTIVE SUMMARY

The proposed water cycle management strategy has been developed in order to meet the requirements of the Director-General and the objectives of the Shellharbour City Councils Draft Stormwater Policy for the proposed sub-division at Albion Park. It involves a highly equitable sharing of the responsibility to treat and manage stormwater in the proposed development between the lot owners and the council. The system is based on the principles of Water Sensitive Urban Design (WSUD) and Ecologically Sustainable Development (ESD).

Stormwater management for individual lots will include the following:

- Treatment through the use of a Gross Pollutant Trap to remove gross pollutants and finer particles and to aid in the retention of nutrients.

- On Site Detention to limit the discharge from site.

- On Site Retention for the reuse of non-potable water.

The proposed strategy involves balancing the responsibility of the management of water use and quality between building owners, users and government. The objective of this is to focus attention of water management and use towards a ecologically based approach. Moreover, there are economic advantages to building owners through long term and sustained savings in water supply costs.

The proposed methodology for the site ensure that water quality and water flow from rainfall is controlled and negative impacts on the Fraser Creek and associated wetlands is mitigated. There is potential in providing improved water quality in flows to the Fraser Creek compared to the existing rural use runoff.

The specific requirements of the Director General have been addressed and included in the proposed management strategy. This includes:

- Demonstration that stormwater runoff will not have a significant impact on environments downstream of the development in terms of pollutant loads and environmental flows.

- The provision of appropriate information on the drainage and stormwater management measures to be incorporated on site, including (but not limited to) on site stormwater detention and water sensitive urban design measures.

- The provision of appropriate information on measures to be taken to promote demand management for potable water through the site.

2. BACKGROUND

The Illawarra Regional Business Park will be a new and modern location for a mixture of business uses. Overall, the park will consist of a combination of warehouse and industrial buildings of various sizes, truck parking and circulation areas, new roadways and supporting facilities. The development will also involve significant improvement in the existing Frazers Creek and wetland areas.

The project involves the subdivision of an existing rural area of Albion Park located adjacent to the Illawarra Regional Airport. The proposed subdivision occupies an area of approximately 81.2 hectares. The eastern side of the site is bounded by the Illawarra Regional Airport. To the south the site is bounded by Tongarra Rd with the Illawarra Highway adjacent to the northern boundary. Frazer Creek passes through the site starting from the southern boundary at Tongarra Rd and running north-west toward an existing wetland. From the wetland Frazer creek passes through the north-west of the siten then turning east toward Croome Lane. The existing wetland is included in the State Environmental Protection Policy No.14-Coastal Wetlands (SEPP no.14).

The location of the development presents some unique challenges to the successful management of rainwater runoff and water quality. The situation also offers a valuable opportunity to improve rainwater runoff quality compared to the existing rural runoff. It can be demonstrated that this can be achieved through the implementation of a holistic management strategy that is tailored to the site conditions and works within the framework of well proven water sensitive and sustainable use practices.

The purpose of this report is to demonstrate the Director General and Shellharbour City council that the development shall meet the objectives of councils *Draft Stormwater Policy, Subdivision drainage design-Development design specification D5* and the requirements specified by the Director General dated November 2006.

3. OBJECTIVES FOR DEVELOPMENT

In the context of rainfall and water use management, the proposed development is to include an innovative, low cost, water quality management strategy that is based on ESD and WSUD principles. The strategy will comply with council's draft stormwater policy, subdivision drainage design-development design specification D5 and the requirements of the Director General.

The key principles of WSUD include (*Urban Stormwater: Best Practice Environmental Management Guidelines* (Victorian Stormwater Committee, 1999) :

1. Protect and maintain natural systems
2. Protect water quality by improving the quality of stormwater runoff draining from urban developments.
3. Integrate stormwater treatment into the environment by using stormwater treatment systems within the landscape that incorporate multiple uses providing a variety of benefits such as water quality treatment, wildlife habitat, public open space, recreational and visual amenity for the community.
4. Reduce runoff peak flows from developments by on-site temporary storage measures (with potential for reuse) and minimise impervious areas.
5. Add long-term value while minimising development costs. This includes ecological and economical impacts.
6. Reduce potable water demand by using stormwater as a resource through capture and reuse for non-potable purposes.

As defined by the National Strategy for Ecologically Sustainable Development (1992), ecologically sustainable development is "Development that uses, conserves and enhances the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life now and in the future can be increased."

It is proposed that the Illawarra Regional Business Park shall incorporate methods to achieve a balanced approach towards these key principles. These can be simple achieved at this stage of a new development. It can be expected that this development can set new standards to WSUD for the Illawarra Region.

4. OPPORTUNITIES & CONSTRAINTS

The proposed development provides an important opportunity to the improvement of water quality in Frazer Creek and the associated wet lands. Results from the National Land and Water Resources Audit show that rural runoff has detrimental impacts on water quality and maintenance of wetlands. Typically high nutrient loads from rural runoff lead to degradation of water quality due to higher than normal oxygen uptake and increased algae growth. The removal of high nutrient loads combined with an improvement in the management of the creek and wetland will improve the overall quality of waterways in the vicinity of the development.

The environmental and water management constraints to this development include Frazer Creek, the SEPP No.14 wetland, the location of the development in a flood affected zone and the flat terrain of the site.

Frazer Creek and the SEPP No.14 wetland lead to a requirement for a management and treatment system to ensure that the impacts to these existing water bodies is mitigated. The flat terrain of the site presents challenges to providing an effective drainage system. The low grades of roads, swales and piped drainages increases the required infrastructure size and potentially restricts water flow. Moreover, careful consideration of rainwater runoff management during peak rainfall events is important to reduce flooding risk and to maintain good access to the site and buildings at all times.

The objective of the treatment and management strategy for this site is to shift the responsibility for water quality and use to lot owners. This will be shared with the community by having Council responsible for the management of road runoff only. The final outcome of the strategy is to provide a highly effective water and re-use management practice that builds on the opportunity to improve the water quality in the existing degraded water ways.

5. DIRECTOR GENERAL REQUIRMENTS

Hydrology, Water Management & Geotechnical	
3. Demonstrate the stormwater runoff will not have a significant impact on environments downstream of the development in terms of pollutant loads and environmental flows (especially treatment infrastructure, water bodies and bushland areas).	To limit discharge from the site each lot will be required to provide on site detention
Utilities Infrastructure and Stormwater Management	
2. Provide appropriate information on the drainage and stormwater management measures to be incorporated on site, including (but not limited to) on site stormwater detention and water sensitive urban design measures.	
3. Provide appropriate information on measure to be taken to promote demand management for potable water through the site.	To limit the demand for potable water each lot is to provide a source of water for non-potable water use. This is to be accomplished through the use of on site stormwater collection and retention. Roof stormwater runoff is to be collected and stored in a rainwater tank where it can then be reused for such purposes as toilet flushing, laundry facilities, irrigation etc.

6. TREATMENT

Stormwater treatment is to be based using a holistic approach. The objectives of stormwater treatment as defined in the Shellharbour draft Stormwater policy and Director Generals requirements are outcomes based rather than loads based. To determine the best methods of treatment then for the site, the design shall be based on using case studies and knowledge of existing successful uses of treatment methods to justify the designs efficiency in meeting these requirements.

The system will be modelled using an estate trunk drainage line that is to service the roads and individual lots. The system will convey water from the road and lot areas to four outlet points located along the banks of Frazer's Creek.

6.1. Lot Treatment

To meet the principles of WSUD and ESD on site detention (OSD) and on site retention (OSR) shall be required by individual lots. The OSD shall limit the discharge from the site to that which is equal to or less than the pre-developed flow and the OSR shall provide a source of non-potable water that can be used on site for such uses as toilet flushing and irrigation therefore limiting the demand on the town water supply. Each lot will provide its own water quality treatment which will consist of oil and grease separation, gross pollutant and nutrient retention.

Stormwater treatment on individual lots will include the following:

- Grated inlet pits to remove large gross pollutants and prevent blockages of the system.

- A gross pollutant trap (GPT) that shall remove fine and coarse sediments, hydrocarbons, gross pollutants and oil and grease. Several types of proprietary GPT's area available with two such items being the Ecosol RSF 4000 range, and the Humes Humegard range, these are able to accommodate for varying lot sizes and flow rates. A table of the typical pollutant removal efficiency for the Ecosol range is included in ***Appendix A*** of` this document.

- A combined OSD and OSR tank. By combining the two tanks into one unit the total cost incurred by the lot owner is reduced. The tank would be buried with the OSD component limiting the discharge from site to those of pre-developed flows and the OSR component providing a source of non-potable water

The minimum standards for nutrient removal for individual lots shall be 40%. This is required to provide at source point removal and allows for the swale system to reduce additional nutrient loads. Nutrient removal may be achieved by physical devices as detailed in ***Appendix A*** or alternately by landscaped buffers. The final selection will depend on the individual lot development layout and design. The requirement for 40% removal must be achieved.

Individual lots will need to target 100% removal of litter with a 80% minimum removal achieved. Hydrocarbon removal requirement shall be 60%.

The OSR component of the combined tank shall be calculated for the supply of non-potable water using the methods outlined in the enHEALTH document *GUIDANCE ON USE OF RAINWATER TANKS*.

The method involves determining the mean annual and monthly rainfalls for the development area, the expected water demand and the approximate catchment or roof area of the development, to determine the required tank size. This method is typically used for residential purposes and has been modified for the intended commercial zoning of the subdivision.

These modifications include a smaller water demand per person and a lower percent of security as mains water will be available for topping up purposes.

Information for the mean annual and monthly rainfall for the region has been obtained from the *Bureau of Meterology* and is located in ***Appendix D***. The expected water demand has been based on an expected average daily use of 100 litres per person. Due to the differing lot sizes a catchment area range was used, this is between 800m² and 3000m².

The tank volume allows for a maximum period of 10 days of dry weather before it will require topping up from the mains water supply.

A table of the results of this analysis can be found in ***Appendix C***. The table is to be used by the lot developer to determine the minimum size of rainwater tank that is to be used on the site.

The OSR tank is to be constructed in accordance with AS3500.1.2003.

The OSD volume is to be calculated so that the post development stormwater discharge flow is equal to or less than the pre developed stormwater discharge flow of the site. This discharge flow is the permissible site discharge (PSD) for the developed site. The site storage requirement (SSR) is the volume of water to be detained to achieve the PSD.

The pre-development peak 100-year stormwater flows were determined by using the modelling computer software program DRAINS to simulate a a typical site area with the following natural conditions:

- Typical catchment of 5000m²
- An average slop of 4%
- Manning's n of 0.08
- 5% of the area impervious

The model was run for a 100 year ARI storm event with durations including the 10, 20, 30, 60, 120, 180, and 360 minute storms. The peak flow values from each of these storms represent the target for post-development peak flows.

A separate DRAINS model was constructed for an individual lot with the following conditions:

- Total area of developed land 5000m²
- Average site slope of 2%
- Manning's n of 0.015 for impervious and 0.025 for pervious areas

Three separate development scenarios were then modelled:

1. 10% of the area impervious
2. 50% of the area impervious
3. 90% of the area impervious

The results of the analysis have been summarised into a two tables located in ***Appendix E*** of this document. The tables are to be used by the lot developers to determine the PSD and SSR requirement of the lot.

6.2 Road Treatment

The treatment of stormwater run-off is to include at source treatment through the use of a vegetated swale located centrally in the road and through the use of in-line filtration consisting of GPTs located at specific locations along the drainage network.

The vegetated swale will provide the following treatments to runoff, removal of sediments and attached pollutants by filtration through the vegetation, reduction of runoff volumes and delaying runoff peaks by reducing flow velocities.

Typical pollutant removal efficiencies for swales are provided in ***Appendix B*** of this document.

The GPT shall provide treatment in capturing litter, coarse sediments, fines and oil. The Ecosol RSF 4000 series of GPTs would be the recommended device, typical pollutant efficiencies for this GPT are located in ***Appendix A*** of this document.

6.3 Outlet Treatment

Outlet treatment is to include the use of energy dissipators located at the end of pipe outlets, and the use of rock armouring of the creek banks, this will significantly reduce the flow velocities leaving the pipe ensuring erosion of the creek banks does not occur.

The dissipater is to be designed by applying the methods outlined in *SOILS AND CONSTRUCTION, Volume 1, 4th Edition, March 2004, Managing Urban Stormwater, by LANDCOM.*

Outlet discharge flow rates have been calculated using the computer program DRAINS and using the parameters outlined in the *Shellharbour draft Stormwater Policy*.

7.

A riprap outlet on a steep slope. Source: *SOILS AND CONSTRUCTION, Volume 1, 4th Edition, March 2004, Managing Urban Stormwater, by LANDCOM.*

7. MAINTENANCE

By requiring each individual lot to provide their own water quality treatment, council's maintenance burden will be significantly reduced down to maintaining only the road water quality management system.

Through the use of the GPT's for the treatment of road runoff typical maintenance routines involve cleaning every 6 to 12 months depending on initial monitoring results of captured pollutants. This typical value indicates that council will not be burdened by an intensive maintenance schedule.

8. CONCLUSION & RECOMMENDATIONS

The proposed water cycle management strategy will meet council's objectives for stormwater quality and the requirements of the Director General. By requiring the individual lot owners to treat their own runoff, a high quality of stormwater treatment and reuse is achieved in a cost effective manner.

Council will be responsible for treatment of road runoff only.

Since the proposed strategy involves a user pays philosophy, this will help council to achieve both economical and ecological sustainability.

9. REFERENCES

National Land and Water Resources Audit, http://www.nlwra.gov.au

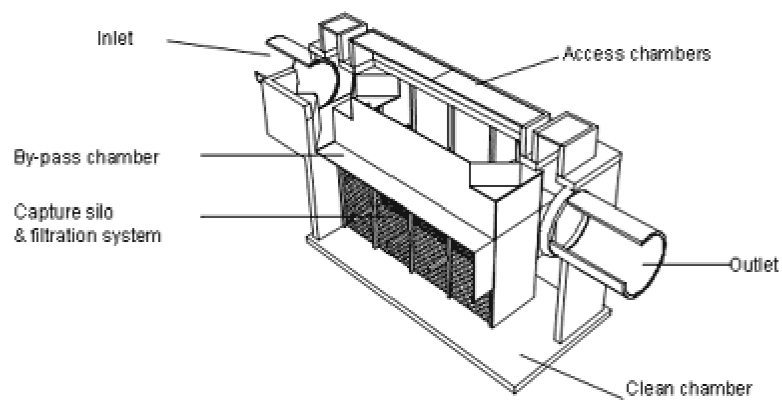
LANDCOM, *SOILS AND CONSTRUCTION, Volume 1, 4th Edition, March 2004, Managing Urban Stormwater*.

Upper Parramatta River Catchment Trust, *Water Sensitive Urban Design*, *Technical Guidelines for Western Sydney May 2004*.

Ecosol Wastewater Filtration Systems, *Technical Specification, The in-Line/End-of-Line RSF 4000 Solid Pollutant Filter/oil & Grease Arrestor*.

The Bureau of Meterology
http://www.bom.gov.au/climate/averages/tables/cw_068188.shtml

APPENDIX A



Typical pollutant removal efficiency for Ecosol RSF 4000 GPT (source: Ecosol Wastewater Filtration Systems, *Technical Specification, The in-Line/End-of-Line RSF 4000 Solid Pollutant Filter/oil & Grease Arrestor*).

Litter	Vegetation	Coarse Sediment	Fine Sediment	Free Oil and Grease	Nutrients (N & P)	Attached Pollutants	Dissolved Pollutants
80-100%	80-100%	80-100%	60-80%	60-60%	10-40%	10-40%	10-40%

APPENDIX B

Typical pollutant removal efficiency for vegetated swales (source: Upper Parramatta River Catchment Trust, *Water Sensitive Urban Design*, *Technical Guidelines for Western Sydney May 2004*).

Gross Pollutants*	Coarse Sediment	Medium Sediment	Fine Sediment	Free Oil and Grease	Nutrients (N & P)	Metals
-	50-80%	30-50%	10-50%	10-50%	10-50%	10-50%

* Assumes gross pollutant pre-treatment provided

APPENDIX C

Minimun Rainwater Tank Size (litres)

No. of Persons on site	Roof Area sq.m 800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000
5	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
6	"	"	"	"	"	"	"	"	"	"	"	"
7	"	"	"	"	"	"	"	"	"	"	"	"
8	"	"	"	"	"	"	"	"	"	"	"	"
9	"	"	"	"	"	"	"	"	"	"	"	"
10	"	"	"	"	"	"	"	"	"	"	"	"
11	12,500	12,500	12,500	12,500	"	"	"	"	"	"	"	"
12	"	"	"	"	"	"	"	"	"	"	"	"
13	16,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000
14	"	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000
15	20,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
16	25,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000
17	34,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000
18	44,000	21,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
19	54,000	25,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000
20	64,000	29,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
21	74,000	39,000	23,000	21,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000
22	84,000	49,000	27,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000
23		59,000	31,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000	23,000
24		69,000	35,000	25,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000
25		79,000	45,000	29,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
26		89,000	55,000	33,000	26,000	26,000	26,000	26,000	26,000	26,000	26,000	26,000
27			65,000	37,000	27,000	27,000	27,000	27,000	27,000	27,000	27,000	27,000
28			75,000	41,000	31,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000
29			85,000	51,000	35,000	29,000	29,000	29,000	29,000	29,000	29,000	29,000
30				61,000	39,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
31				71,000	43,000	33,000	31,000	31,000	31,000	31,000	31,000	31,000
32				81,000	47,000	37,000	32,000	32,000	32,000	32,000	32,000	32,000
33				91,000	57,000	41,000	33,000	33,000	33,000	33,000	33,000	33,000
34					67,000	45,000	34,000	34,000	34,000	34,000	34,000	34,000
35					77,000	49,000	38,000	35,000	35,000	35,000	35,000	35,000
36					87,000	53,000	42,000	36,000	36,000	36,000	36,000	36,000
37					97,000	63,000	46,000	37,000	37,000	37,000	37,000	37,000
38					107,000	73,000	50,000	40,000	38,000	38,000	38,000	38,000
39					117,000	83,000	54,000	44,000	39,000	39,000	39,000	39,000
40					127,000	93,000	58,000	48,000	40,000	40,000	40,000	40,000

APPENDIX D

Monthly Climate Statistics for 'WOLLONGONG UNIVERSITY' [068188]
Created on [20 Mar 2007 15:31:24 GMT]

068188 WOLLONGONG UNIVERSITY
Commenced: 1970
Last Record: 2007
Latitude: 34.40 Degrees South
Longitude: 150.88 Degrees East
Elevation: 25 m
State: NSW

Statistic Element	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Number of Years	Start Year	End Year
Mean rainfall (mm)	131.1	150.6	164.1	127.1	111.9	107.1	64	83.4	67.1	102.3	114.5	91.8	1254.4	38	1970	2007
Highest rainfall (mm)	423.9	488.3	484.1	655.8	415.5	637.6	249.7	763.8	214.6	400.4	367.6	367.8	1984.5	38	1970	2007
Date of Highest rainfall	1972	1992	1978	1988	2003	1991	1999	1998	1982	1987	1984	1991	1974	N/A	1970	2007
Lowest rainfall (mm)	22.8	20.1	11.5	1.8	1.9	7.4	0.4	0.6	2.8	4.4	16	14.3	752.9	38	1970	2007
Date of Lowest rainfall	1975	2000	1981	1997	1982	1986	1977	1995	1989	1988	1982	1986	1994	N/A	1970	2007
Decile 1 monthly rainfall (mm)	40.7	48.2	25.4	17.8	24.2	21.4	8	6.1	9.4	11.9	33.3	24.6	863.8	38	1970	2007
Decile 5 (median) monthly rainfall (mm)	110	107.8	146	69.9	80.2	79.6	51.2	29.2	51.7	62.2	92.8	74.6	1301.4	38	1970	2007
Decile 9 monthly rainfall (mm)	259.9	335.6	348.8	317.2	239.5	232.5	162.4	260.2	151.9	252.8	227.8	201	1869	38	1970	2007
Highest daily rainfall (mm)	137.7	240.5	247.7	212.2	158.4	224.8	198.8	316	101.6	106.4	145.8	149.1	316	38	1970	2007
Mean number of days of rain >= 1 mm	10.7	10.2	10.7	7.9	8	6.8	6	5.4	6.7	8.6	10.4	9.1	8.4	38	1970	2007
Mean number of days of rain >= 10 mm	3.8	4	3.9	2.8	3	2.7	1.6	1.5	1.6	2.6	3.3	2.4	2.8	38	1970	2007
Mean number of days of rain >= 25 mm	1.6	1.6	1.4	1.7	1.4	1.2	0.5	0.6	0.7	1.1	1.1	0.8	1.1	38	1970	2007

APPENDIX E

Permissible Site Discharge for On-site Detention Systems (l/s/ha)

	Percentage of Development area draining to OSD system						
Percent Impervious	100	95	90	85	80	75	70
10	277	273	268	262	255	254	253
20	264	259	254	249	243	242	241
30	251	245	240	236	232	230	228
40	238	323	225	223	220	218	216
50	225	218	211	210	208	206	203
60	222	215	208	204	201	195	190
70	219	212	205	199	194	185	177
80	215	208	201	194	187	175	163
90	212	205	198	189	180	165	150

Site Storage Requirement for On-site Detention Systems (m^3/ha)

	Percentage of Development area draining to OSD system						
Percent Impervious	100	95	90	85	80	75	70
10	20	26	32	36	39	41	43
20	37	43	50	54	58	62	66
30	53	61	68	73	77	83	89
40	70	78	86	91	96	104	111
50	86	95	104	110	115	125	134
60	103	112	121	127	133	142	152
70	119	129	138	144	150	160	169
80	136	145	155	161	168	177	187
90	152	162	172	179	185	195	204