Tuesday, 10 September 2024

Attention: Nick Mullins
Senior Development Manager
ESR Australia and New Zealand
Level 12, 135 King Street
Sydney NSW 2000

CPESC review of the Westlink Industrial Development Stage 2 Erosion and Sediment Control Plans

1.0 Introduction

ESR are developing the Westlink Industrial Development at Kemps Creek with the works undertaken in a staged approval. The development is a State Significant Development (SSD) and subject to conditions of approval under Department of Planning and Environment (DPE) Approval SSD-913102.

In accordance with the SSD Approval, ESR must prepare Detailed Erosion and Sediment Control Plans (ESCP) and drawings prior to the commencement of earthworks for the development. The ESCP must be prepared by a Certified Professional Erosion and Sediment Control (CPESC) specialist. ESR engaged Bradley Cole from Ochre Environmental Management (CPESC Number 7645, refer to **Attachment A**) to assist with the development of the ESCPs.

The role of the CPESC has been to:

- Meet with ESR and their contractors to understand the proposed stating of the earthworks and road construction.
- Calculate the required sediment basins sizes for key stages of the development.
- Develop site specific specification for the design of the basins.
- Undertake review of the ESCP.

AT&L are the lead civil designers for the SSD and have prepared the design drawings for the development and along with Bradley Cole, (CPESC) have developed the Erosion and Sediment Control Plan as part of the design drawings package.

This letter has been prepared by Bradley Cole to support the preparation of the Erosion and Sediment Control Package for the Stage 2 development of the Westlink Industrial Development at Kemps Creek and certify that the plans have incorporated the relevant design and guidelines best practice requirements for the development. The section below addressed the responses and matters raised under the initial review submission by the NSW Department of Climate Change, Energy, and the Environment and Water – Biodiversity Conservation and Science Group.

2.0 Erosion and Sediment Control Requirements

This review has been prepared with reference to the matters raised by the NSW Department of Climate Change, Energy, and the Environment and Water – Biodiversity Conservation and Science Group for the Erosioan and Sediment control plans prepared for the Stage 2 submission. (refer to **Table 1**).

Table 1 – Response to Matters Raised

B21	Requirement	How addressed
1	The Water and Stormwater Management Plan does not address the construction-phase targets at all. The ESC plans in the civil drawing set (sheet C5201) are only applicable once final earthworks levels are reached and includes no sizing of any controls.	The ESCPs have been prepared in collaboration with Bradley Cole from Ochre Environmental Management (CPESC Number 7645) The current plans are to be updated with progression of project earthworks planning and construction delivery for management of site activities in accordance with best practice documents including Managing Urban Stormwater: Soils and Construction – Volume 1:Blue Book (Landcom, 2004) and with the WSUD design principles set out in the Technical Guidance for Achieving Wianamatta South Creek Stormwater Management Targets (Technical Guidance) (NSW Government, 2022).
2	Two of the plans cited in the 'CPESC Endorsement' letter have not been submitted.	Drawing numbers 20-748-C5200 to 20-748-C5202, 20-748-C5201 and 20-748-C5210, Revision C dated 12-09-23 were reviewed as part of the CPESC ESCP endorsement as stated in the endorsement letter.
3	Provide a revised ESC Plan which addresses the requirements of the Mamre Road Precinct DCP Section 4.4.2 and technical guidance for achieving Wianamatta–South Creek stormwater management targets (DPE, 2022), which demonstrates achievement of the targets listed in Table 5 of the DCP. The revised ESC Plan is to specifically address the following:	
(a)	Provide plans for each major phase of works, including clearing and grubbing, bulk earthworks (existing and final levels), civil works, and stabilisation/practical completion	The ESC plans for each of the major phases of work are to be completed in collaboration with the successful earthwork's contractor for effective staging and construction methodology. These are generally undertaken at the detailed design stage.
(b)	Identify the type of sediment basin and provide sizing and details for all functional components (e.g., forebay, level spreader, spillway, dosing system, flocculant type).	The basin design spreadsheet which identifies the specific elements of the basin including type etc and all relevant values used in the sizing are provided in **Attachment B**. The proposed dosing system is to be procured by the contractor required for implementation and management of the basin operation and would be consistent with the 2018 revision of Appendix B – Sediment Basin Design and Operation (IECA 2018) to the Best Practice Erosion and Sediment Control Document (EICA 2008, referred to as the White Book). To specify the dosing unit and flocculant would be considered limiting and may imply / impose proprietary bias in the procurement process.
(c)	Provide sediment basin calculations demonstrating compliance with the DCP Table 5 targets.	The basin design spreadsheet and all relevant values used in the sizing are provided in **Attachment B**. Basins have been sized for active treatment of 80% of average annual runoff in accordance with Table 2 of the Wianamatta South Creek Stormwater Management Targets and Table 5 requirements from the DCP.

B21	Requirement	How addressed
		The design of the Type A and B Basins along with addition site retention areas and filter controls will facilitate the management of oil, litter or waste contaminants through effective housekeeping, basin weir operation and decant systems. Prior to completion of works for the development, and prior to removal of sediment controls, all site surfaces must be effectively stabilised including all drainage systems. An effectively stabilised surface is defined as one that does not, or is not likely to result in visible evidence of soil loss caused by sheet, rill or gully erosion or lead to sedimentation water contamination. The determination of the stabilisation will be undertaken by the Project CPESC and submitted formally with evidence prior to the removal of controls for the development.
(d)	Provide catchments plans identifying the sub catchments for all major drainage and sediment controls for each phase of works.	Clean water channels have been identified on the site perimeter to divert clean water around the development site where practical. The catchment for the development is currently impacted through adjoining development and construction activity and is dynamic in nature. The Stage1 activities will reduce the potential catchment areas for the site and implement localised stormwater infrastructure for previous overland flows. The current catchment plans are presented in **Attachment B.**
(e)	Provide calculation tables and sizing/dimensions for all major controls during all phases of works.	The basin design spreadsheet and all relevant values used in the sizing are provided in **Attachment B**.
(f)	Provide a construction sequence identifying the order and timing for both the implementation and decommissioning of all controls, relative to specific site activities/hold points.	The approach to construction staging has been outlined in Section 4 of this letter. The implementation of controls relative to the site activities will be detailed on the specific ESC plans for each of the major phases of work as prepared in collaboration with the successful earthwork's contractor. All specific controls as identified on the ESC documentation for each individual catchment area will be verified by the Project CPESC prior to commencement of construction stages.
(g)	Provide details on the timing, methods and performance requirements for stabilisation of each area of site disturbance.	The ESCP design has included basin treatment controls for the development which are to be in place for the duration of the earthworks staging. The basin design has assumed worst case scenario of full disturbance in the Project design areas. The staged stabilisation of the development would be considered best practice and would be

B21	Requirement	How addressed
		recommended under the regular inspections to be undertaken by the Project CPESC and ER. Prior to completion of works for the development, and prior to removal of sediment controls, all site surfaces must be effectively stabilised including all drainage systems. An effectively stabilised surface is defined as one that does not, or is not likely to result in visible evidence of soil loss caused by sheet, rill or gully erosion or lead to sedimentation water contamination. The determination of the stabilisation will be undertaken by the Project CPESC and submitted formally with evidence prior to the removal of controls for the development.
(h)	Provide specific advice in relation to dispersive soil management – particularly in relation to excavated drainage controls.	Dispersive soils will be managed with Type A and Type B HES Basins designed for treatment of 80% of average annual runoff and minimisation of disturbance areas. Additional measures including the lining of drains and application of soil binder and additional soil treatment with gypsum (as required) may be implemented during the construction of the Project which is to be overseen by the Project engaged CPESC and coordinated with the ultimate final design methodologies for the development in collaboration with the earthworks contractor.
(i)	Provide details on how discharges from each basin will be managed so as not to reduce the hydrologic effectiveness of other basins.	The basin layout for the development is to be established as separate end point management controls to individual catchment areas and do not interrelate to avoid impacting the operation of other basins. Following treatment in a basin the overflow / discharge is to be continued to the external drainage areas without impacting active working locations.

3.0 Design criteria

Condition B21(b) requires the ESCP to be prepared with reference to the water sensitive urban design (WSUD) design principles set out in the Technical Guidance for achieving Wianamatta South Creek Stormwater Management Targets (Technical Guidance) (NSW Government, 2022).

Under Table 2 of the Technical Guidance, all exposed areas greater than 2,500 m^2 are to be provided with sediment controls that are designed, implemented and maintained to a standard that would achieve treatment of at least 80% of the average annual runoff volume of the contributing catchment (i.e. 80% hydrological effectiveness) to 50 mg/L TSS or less, and pH in the range (6.5–8.5). No release of coarse sediment is permitted for any construction or building site.

To achieve this design criteria, Type A and Type B basins have been sized and designed with reference to the 2018 revision of Appendix B – Sediment Basin Design and Operation (IECA 2018) to the Best Practice Erosion and Sediment Control Document (EICA 2008, referred to as the White Book).

4.0 Construction Staging

ESR have proposed a staged approach to the development of the SSD:

- Stage 1 – Establishment of the erosion and sediment control and basins – Pending
- Stage 2 – Stage 2 Bulk Earthworks utilising the sediment basis– Pending
- Stage 3 – Service installation internally to the development area – Pending
- Stage 4 – Rehabilitation and landscaping – Pending
- Stage 5 – Building development by external contractors – Pending

3.0 Basin Sizing

The design factors for the Revised Universal Soil Loss Equation (RUSLE) and the basin sizing using the Qld_ESC_Design_Spreadsheet_V5.2 developed by **Strategic Environmental & Engineering Consulting (SEEC)** have been provided in **Attachment B**.

Additional design specification drawn from IECA 2018 are also provided in **Attachment B**.

4.0 Certification

I, Bradley Cole, certify that the Erosion and Sediment Control Plans prepared for the development have incorporated the recommendations with regard to best management practice and Type A and Type B sediment basins sizing and specifications and reflect the staging and other recommendations provided throughout the design review process.

Your Sincerely

Bradley Cole,
Director, CPESC #7645

Ochre Environmental Management Pty Ltd
Ph. 0407 782 830
E brad@ochreenvironmental.com.au

Attachment A – Bradley Cole CPESC certification

ENVIROCERT
International, Inc.

EnviroCert International, Inc.
3054 Fite Circle, Suite 108, Sacramento, CA 95827
(279) 888-6911 | www.envirocert.org

Bradley Stephen Cole

CPESC

Certified Professional in Erosion and
Sediment Control

7645	14-Nov-2024
CERTIFICATION NO.	EXPIRES

Attachment B – RUSLE soil loss factors, basins sizing calculations and design specification for the Westlink Industrial Estate Stage 2.

Soil Loss Characteristics

Constraint / characteristic	Value / Rating	Source
Disturbed Catchment Area	See stages	
Rainfall erosivity **(R-factor)**	2210	R = 164.74(1.1177)5 S0.6444 Where S = 2-year, 6-hour storm
IFD: 2-year, 6-hour storm (s)	10	http://www.bom.gov.au/cgi-bin/hydro/has/CDIRSWebBasic Location Badgerys Creek BoM Station
Rainfall zone		Blue Book Figure 4.9 [p4-16]
Runoff coefficient (Cv)	0.64	Blue Book Table F2 [pF4]
Rainfall coefficient (C10)	0.76	Blue Book Table F3
85th %ile, 5-day rainfall event	35	Blue Book Table 6.3 [6-24] Location Penrith
Soil erodibility **(K-factor)**	0.038	Blue Book Appendix C, Table 19 [pc-104] Based on Luddenham (lu) Landscape Group
Soil erodibility **(K-factor)**	0.05	Alternate factor to represent imported material
Soil texture group	Type D	Maximum values of Luddenham (lu) Landscape Group
Soil Hydrologic Group	Type C	Luddenham (lu) Landscape Group
Slope Gradient	5%	Based on 4.4% for east west gradient of natural ground.
Slope length	80	Slope length between terraces
LS-factor	1.19	Blue Book Table A1 [pA-9]
Erosion Control Practice Factor **(P-factor)**	**1.3**	Blue Book Table A2 [pA-11]
Cover Factor **(C-factor)**		Default factor for construction site for areas with not stabilization
Calculated Soil Loss (Uha/yr)	See staged calculation sheet	Blue Book Appendix A [pA-1]
Soil Loss Class (m3//ha/yr)	See staged calculation sheet	RUSLE Equation
Soil Loss Class		Blue Book Table 4.2 [p4-13]
Erosion hazard	Very low	Blue Book Table 4.2 [p4-13]

Rainfall Erosivity factor (R-factor)

Monthly % and annual rainfall erosivity (R – factor) values													
	Jan	Feb	Mar	Apr	Mar	Jun	July	Aug	Sep	Oct	Nov	Dec	Year
Mean rainfall (mm)	78	112	112	48	39	57	34	37	36	59	69	55	717
%	11%	16%	16%	7%	5%	8%	5%	5%	5%	8%	10%	8%	100
R-Value	241	344	347	148	119	174	105	113	110	182	213	168	2210

1 Determined locality coordinates from SIX Maps https://maps.six.nsw.gov.au/

-33.857364
150.797268

2 2-year ARI, 6-hour storm event

10

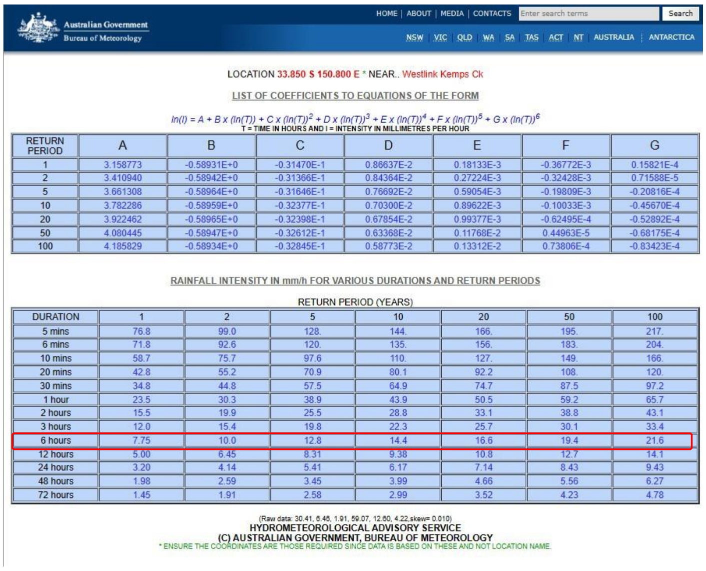
http://www.born.gov.au/ cgi-bin/hydro/has/CDIRSWebBasic

3 Calcualte R-factor

2210

4 Mean Rainfall
http://www.bom.gov.au/nsw/observations/map.shtml

67108
BADGERYS CREEK AWS



Australian Government
Bureau of Meteorology

HOME | ABOUT | MEDIA | CONTACTS | Search

NSW | VIC | QLD | WA | SA | TAS | ACT | NT | AUSTRALIA | ANTARCTICA

LOCATION 33.850 S 150.800 E * NEAR.. Westlink Kemps Ck

LIST OF COEFFICIENTS TO EQUATIONS OF THE FORM

$$ln(I) = A + B \times (ln(T)) + C \times (ln(T))^2 + D \times (ln(T))^3 + E \times (ln(T))^4 + F \times (ln(T))^5 + G \times (ln(T))^6$$

T = TIME IN HOURS AND I = INTENSITY IN MILLIMETRES PER HOUR

RETURN PERIOD	A	B	C	D	E	F	G
1	3.158773	-0.58931E+0	-0.31470E-1	0.86637E-2	0.18133E-3	-0.36772E-3	0.15821E-4
2	3.410940	-0.58942E+0	-0.31366E-1	0.84364E-2	0.27224E-3	-0.32428E-3	0.71588E-5
5	3.661308	-0.58964E+0	-0.31646E-1	0.76692E-2	0.59054E-3	-0.19809E-3	-0.20816E-4
10	3.782286	-0.58959E+0	-0.32377E-1	0.70300E-2	0.89622E-3	-0.10033E-3	-0.45670E-4
20	3.922462	-0.58965E+0	-0.32398E-1	0.67854E-2	0.99377E-3	-0.62495E-4	-0.52892E-4
50	4.080445	-0.58947E+0	-0.32612E-1	0.63368E-2	0.11768E-2	0.44963E-5	-0.68175E-4
100	4.185829	-0.58934E+0	-0.32845E-1	0.58773E-2	0.13312E-2	0.73806E-4	-0.83423E-4

RAINFALL INTENSITY IN mm/h FOR VARIOUS DURATIONS AND RETURN PERIODS

RETURN PERIOD (YEARS)

DURATION	1	2	5	10	20	50	100
5 mins	76.8	99.0	128.	144.	166.	195.	217.
6 mins	71.8	92.6	120.	135.	156.	183.	204.
10 mins	58.7	75.7	97.6	110.	127.	149.	166.
20 mins	42.8	55.2	70.9	80.1	92.2	108.	120.
30 mins	34.8	44.8	57.5	64.9	74.7	87.5	97.2
1 hour	23.5	30.3	38.9	43.9	50.5	59.2	65.7
2 hours	15.5	19.9	25.5	28.8	33.1	38.8	43.1
3 hours	12.0	15.4	19.8	22.3	25.7	30.1	33.4
6 hours	7.75	10.0	12.8	14.4	16.6	19.4	21.6
12 hours	5.00	6.45	8.31	9.38	10.8	12.7	14.1
24 hours	3.20	4.14	5.41	6.17	7.14	8.43	9.43
48 hours	1.98	2.59	3.45	3.99	4.66	5.56	6.27
72 hours	1.45	1.91	2.58	2.99	3.52	4.23	4.78

(Raw data: 30.41, 6.46, 1.91, 59.07, 12.60, 4.22,skew= 0.010)
HYDROMETEOROLOGICAL ADVISORY SERVICE
(C) AUSTRALIAN GOVERNMENT, BUREAU OF METEOROLOGY
* ENSURE THE COORDINATES ARE THOSE REQUIRED SINCE DATA IS BASED ON THESE AND NOT LOCATION NAME.

Climate statistics for Australian locations

Monthly climate statistics

All years of record

Summary statistics BADGERYS CREEK AWS

Site name: BADGERYS CREEK AWS
Site number: 067108

Rainfall Erosivity factor (R-factor) cont.

Background

R - Rainfall Erosivity factor is measure of the ability of rainfall to cause erosion

Risa product of two components: total energy (E) and maximum 30-minute intensity for each storm (130). So, the total of El for a year is equal to the R

- Correlation between the R-factor and the 2-year ARI, 6-hour storm event.

R factor can be read from the
lsoerodent maps in Appendix B
Or

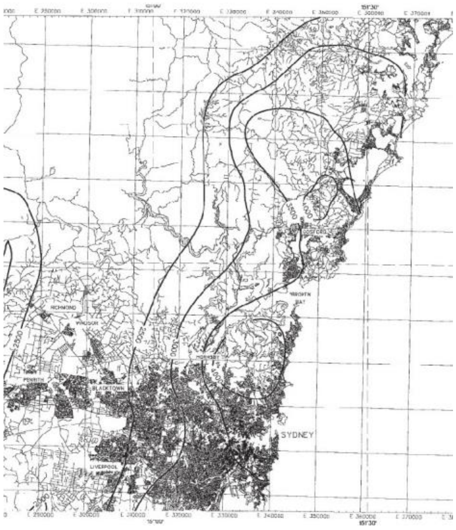
$R = 164.74(1.1177)^{5} S^{0.444}$ .... Equation (2)

where Sis the **2-year ARI, 6-hour ARI** rainfall event (mm)

2-year ARI, 6-hour storm event

Data is available here: http://www.bom.gov.au/cgi-bin/hydro/has/CDIRSWebBasic

New data is also available here but does not correspond to the **2-year ARI, 6-hour**



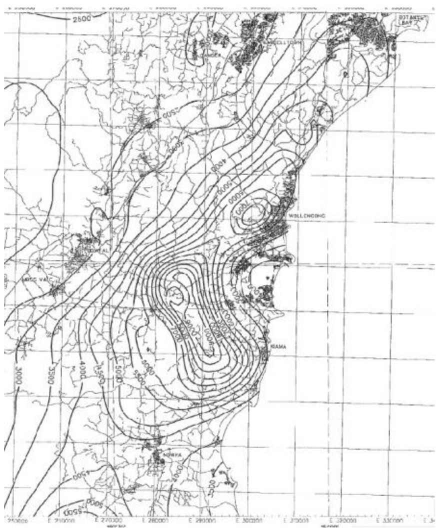
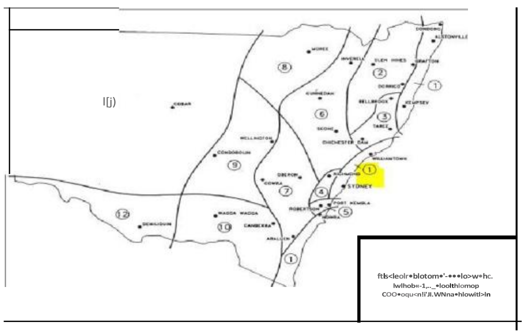


Table 6. 2 Percentage of average annual El that normally occurs in the first and second half of each morith for each Rainfall Zone (figure 4. 9) (Rosewell and Turner, 1992)

Zone	Jan		Feb		Ma,		Ap,		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
1	6	6	7	8	8	8	6	5	5	4	3	2	2	2	2	2	2	2	2	3	3	4	4	4
2	10	9	9	8	7	5	2	2	1	1	2	1	1	1	1	1	3	3	3	4	5	6	7	8
3	6	8	9	9	10	7	7	4	2	2	2	2	2	1	0	1	2	2	2	3	3	4	6	6
4	6	6	8	8	8	5	5	3	3	2	2	2	2	3	3	2	2	3	3	3	5	5	5	6
5	, ,	3	7	13	13	10	11	6	3	2	3	2	2	2	1	1	1	3	3	3	3	2	2	2
6		10	10	9	6	5	2	2	2	1	1	1	1	1	1	1	2	2	4	3	5	5	8	7
7	9	9	7	8	4	5	3	3	2	3	2	1	2	1	2	2	2	3	4	4	4	6	7	7
8	7	8	7	8	5	6	4	3	2	2	2	1	2	1	2	2	2	2	4	4	6	6	7	7
9	8	9	8	7	6	5	3	3	2	2	1	2	1	1	1	2	3	3	5	5	5	6	6	6
1 0	7	, ,	, ,	7	7	6	4	4	3	2	1	1	2	1	1	2	2	3	4	5	6	6	5	6
	10			9	10	5	3	1	1	1	1	1	1	1	2	2	1	2	2	5	6	6	6	6
12	10	9	8	7	5	4	4	2	2	1	1	2	1	1	1	2	3	4	3	4	4	6	7	9



Design Rainfall depth (mm)

Table 6.3a **(p144)** has the 75th, 80th, 85th, 90th and 95th-percentile 2 and 5-day rainfall depths for 59 sites in New South Wales

Table 6.3a 75th, 80th, 85th, 90th and 95thpercenfile 2 and 5-day rainfall depths For 59 sites in New South Wales

Location	2-day rainfall depths (mm)					5-day rainfall depths (mm)				
	75th %ile	80th %ile	85th %ile	90th %ile	95th %ile	75th %ile	80th %ile	85th %ile	90th %ile	95th %ile
North Coast										
Coffs Harbour	18.3	23.6	31.8	44.4	70.8	33.6	42.7	55.8	74.9	117.6
Dorrigo	22.1	27.9	36.4	49.0	77.0	40.3	49.3	63.7	84.8	132.0
Grafton	14.0	17.8	22.9	31.2	48.9	23.3	29.0	37.2	50.1	75.4
Lismore	16.3	20.6	26.4	36.3	57.0	28.6	35.3	45.2	60.2	95.3
Port Macquarie	18.0	22.9	29.8	41.4	65.3	32.0	40.1	51.8	70.0	106.2
Taree	15.0	19.0	24.9	35.5	56.4	25.0	31.7	41.2	55.9	90.6
Tweed Heads	23.4	29.5	37.6	50.8	78.7	39.6	48.5	62.5	82.5	126.8
Central Coast/Hunter										
Cessnock	13.4	16.5	21.1	28.5	45.0	20.3	24.4	31.0	42.8	63.0
Gosford (Narara)	16.7	21.3	28.4	39.8	63.0	27.9	35.0	45.8	62.2	99.3
Nelson Bay	17.5	22.3	28.9	39.4	58.9	30.4	38.1	48.3	63.5	91.5
Newcastle	13.7	17.6	23.0	31.8	48.1	24.4	30.5	38.9	51.8	76.7
Scone	12.4	15.3	19.3	25.0	37.8	19.0	22.6	27.7	35.9	51.3
Wyong	16.8	20.8	26.9	37.2	58.8	26.8	33.8	43.2	58.7	90.1
Sydney/Blue Mountains										
Bankstown	11.4	14.5	19.6	27.0	42.0	19.4	24.4	31.5	42.6	66.6
Blacktown	12.0	15.0	20.3	28.0	43.6	19.0	24.6	32.2	43.2	70.8
Camden	13.6	16.8	21.6	29.2	44.8	20.2	25.1	32.0	43.4	66.3
Campbelltown	12.2	15.2	19.0	26.9	42.1	19.3	23.9	30.6	43.2	63.3
Hornsby	15.7	20.6	27.4	38.1	61.0	25.9	32.8	43.3	60.0	92.5
Katoomba	16.5	20.6	26.7	37.6	60.2	28.0	35.2	45.4	63.0	99.6
Lithgow	11.4	14.0	18.3	24.2	35.3	19.5	23.6	29.4	37.8	56.4
Liverpool	12.2	15.5	20.0	28.4	43.2	19.2	24.4	32.2	43.8	70.2
Mona Vale	19.0	23.6	29.2	38.7	62.0	29.0	35.2	44.0	61.2	92.0
Mosman	15.2	19.3	25.4	35.8	57.7	26.2	32.9	43.2	59.6	91.5
Parramatta North	11.7	15.2	20.6	28.2	45.5	20.3	25.8	33.1	45.8	74.1
Penrith	14.0	18.2	23.6	31.5	49.5	21.8	27.4	35.0	47.6	74.6
Richmond	10.2	13.5	18.0	24.9	39.2	17.5	22.4	29.5	39.7	61.4
Ryde	14.7	18.3	24.9	34.3	53.5	23.4	29.5	38.8	53.6	80.5
Springwood	15.5	20.1	25.9	35.0	55.6	25.2	31.4	40.4	55.0	84.1
Sutherland	15.0	18.8	24.9	34.8	55.0	23.4	29.7	38.9	54.6	85.1
Sydney	12.7	16.6	22.4	31.6	52.1	23.3	29.7	38.8	55.2	84.3
Wallacia	14.0	17.8	23.0	31.4	48.8	22.1	27.6	36.6	48.8	76.2
Wilberforce	11.4	14.9	19.8	27.7	46.4	19.8	24.6	33.2	46.7	69.4
Illawarra/South Coast										
Albion Park	16.5	21.1	27.9	39.1	67.4	25.2	31.8	41.9	59.8	101.2
Batemans Bay	13.7	17.8	24.1	34.2	54.9	22.1	28.0	37.4	52.4	84.4
Bega	12.6	16.1	21.3	30.5	51.1	19.5	24.6	32.5	46.2	77.2
Cooma	7.6	9.8	13.0	17.8	27.2	12.5	15.8	20.0	25.8	39.1
Helensburgh	23.1	28.7	38.1	53.0	81.3	35.6	45.0	57.4	78.2	124.6
Kiama	14.7	19.1	24.9	35.5	57.2	25.5	32.2	42.1	58.3	90.7
Kangaroo Valley	16.8	21.4	29.2	41.7	70.6	26.8	34.2	45.7	67.0	115.6
Mittagong	14.7	18.3	23.4	31.8	49.1	22.9	28.0	36.2	49.0	75.2
Robertson	15.8	20.3	27.9	38.2	67.3	28.4	36.0	46.1	67.3	113.0
Wollongong	13.8	18.0	24.8	36.6	61.3	25.4	33.0	43.5	60.8	95.6
Northern Tablelands and Northwestern Slopes										
Armidale	12.4	15.2	19.3	25.0	35.3	19.8	24.1	29.2	37.4	52.9
Gunnedah	14.2	17.3	21.3	27.7	39.2	20.0	24.1	30.2	38.4	53.0
Tamworth	15.2	18.3	22.2	27.7	39.6	21.6	25.2	30.8	39.2	54.2
Tenterfield	18.8	22.3	26.7	33.8	46.0	26.7	31.4	38.1	47.4	63.3
Central Tablelands and Central Western Slopes										
Bathurst	10.7	13.2	16.5	21.4	30.4	16.8	20.6	24.9	31.4	43.7
Cowra	12.0	14.7	18.0	22.9	32.8	18.1	21.6	26.1	32.5	44.9
Dubbo	12.7	16.0	20.2	26.1	36.0	18.8	22.8	28.4	35.6	50.7
Southern Tablelands and Southwestern Slopes										
Albury	11.8	14.4	17.4	22.4	31.6	20.0	23.7	28.4	35.2	45.2
Goulburn	7.8	10.0	13.2	18.0	27.4	14.2	17.8	22.2	28.6	40.8
Jindabyne	11.9	14.2	17.3	22.6	33.4	17.3	20.6	24.9	32.0	46.8
Queanbeyan	12.7	15.2	18.8	24.2	34.3	18.0	21.3	25.8	33.0	45.1
Wagga	9.2	11.4	14.4	19.3	27.6	15.6	18.8	23.4	29.4	40.2
Northwestern, Southwestern and Far Western Plains										
Bourke	11.7	14.6	18.3	24.8	35.6	15.3	19.0	23.9	30.9	44.5
Broken Hill	7.1	9.1	12.0	16.8	25.9	9.7	12.2	16.2	21.6	33.0
Griffith	9.5	11.7	14.0	18.5	26.2	13.8	16.4	20.6	25.4	34.6
Moree	12.6	15.8	19.3	25.1	36.8	18.0	21.9	26.8	36.3	51.4
Nyngan	12.2	15.2	19.1	25.6	37.3	16.5	20.4	25.8	33.8	47.8

Soil Erosivity factor (K-factor)

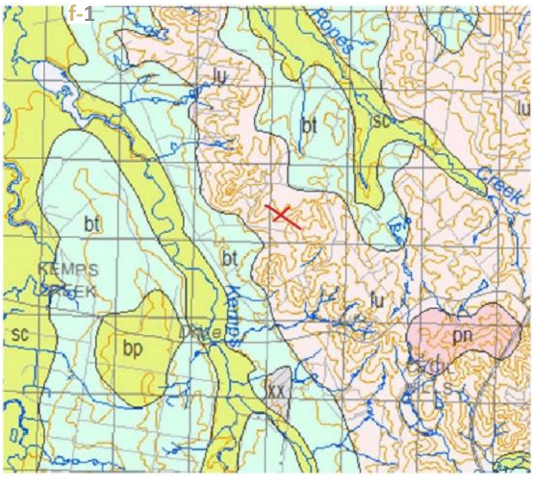


Table 19 Penrith Soil Landscapes

Soil landscape	Common constraints	Slope range	Soil hydrologic group	Acid sulfate risk	USCS class	K- factor	Sediment type	Sediment basin wall construction (earth)
					SC CL	0.042 0.024	*Type D* *Type F*	B A
Luddenham (lu)	moderately expansive, low wet strength, localised impermeable and highly plastic subsoils	5-20	Group C		CL CL CL	0.038 na na	*Type D* *Type F* *Type D*	B A A
Picton (pn)	high mass movement hazard; low permeability; low fertility; localised high expansion	>20	Group C		CL CL	na 0.034	*Type D* *Type D*	D B
Richmond (ri)	high soil erosion hazard (particularly at terrace edges) and localised flooding hazards; localised salinity	0-1	Group C		CL	0.059	*Type F*	A
South Creek (sc)	high flooding hazard; localised permanently high watertables; low fertility; localised salinity	0-5	Group C/D		CL	0.05	*Type F*	A
Upper Castlereagh (up)	very high soil erosion hazard; dispersible, impermeable soil layers	0-5	Group C/D		SC CL	na 0.032	*Type D* *Type F*	D D
Volcanic (vo)	moderately expansive soils with low wet strength, high soil erosion and mass movement hazards on steep slopes	5-60	Group C/D		CL	0.029	*Type F*	B
Warragamba (wb)	very high mass movement and soil erosion hazards; steep slopes, highly permeable soils with low fertility	>35	Group C		SM SC	0.036 0.032	*Type C* *Type D*	J B
Woodlands (wl)	soils with low fertility and low water holding capacity	0-10	Group B/D		CL CL	0.029 na	*Type F* *Type F*	C B

Table 4.2 The Soil Loss Classes (adapted from Morse and Rosewell, 1996)

Soil Loss Class	Calculated soil loss (tonnes/ha/yr)	Erosion hazard
1	0 to 150	very low
2	151 to 225	low
3	226 to 350	low-moderate
4	351 to 500	moderate
5	501 to 750	high
6	751 to 1,500	very high
7	>1,500	extremely high

Table A1 LS-factors on construction sites using the RUSLE

Slope ratio	Slope gradient (%)	Slope length (m) 5	10	20	30	40	50	60	70	80	90	100	150	200	250	300
100:1	1	0.09	0.11	0.13	0.15	0.16	0.17	0.18	0.19	0.19	0.20	0.20	0.23	0.24	0.26	0.27
50:1	2	0.14	0.18	0.24	0.28	0.31	0.34	0.36	0.39	0.41	0.43	0.44	0.52	0.58	0.64	0.69
33.3:1	3	0.17	0.24	0.34	0.41	0.47	0.52	0.57	0.61	0.65	0.69	0.72	0.87	1.00	1.11	1.22
25:1	4	0.21	0.30	0.44	0.54	0.63	0.71	0.78	0.85	0.91	0.97	1.03	1.26	1.47	1.65	1.82
20:1	5	0.24	0.36	0.54	0.68	0.80	0.91	1.01	1.10	1.19	1.27	1.35	1.70	2.00	2.28	2.53
16.6:1	6	0.28	0.42	0.64	0.81	0.97	1.11	1.24	1.36	1.47	1.58	1.68	2.14	2.54	2.91	3.25
12.5:1	8	0.34	0.53	0.83	1.08	1.31	1.51	1.70	1.88	2.05	2.21	2.37	3.07	3.70	4.28	4.82
10:1	10	0.42	0.68	1.09	1.44	1.75	2.04	2.31	2.56	2.81	3.04	3.27	4.06	4.94	5.75	6.52
8.3:1	12	0.52	0.85	1.39	1.85	2.27	2.66	3.02	3.37	3.70	4.02	4.33	5.77	7.07	8.28	9.42
7.1:1	14	0.62	1.02	1.69	2.26	2.79	3.28	3.74	4.18	4.61	5.02	5.42	7.27	8.95	10.52	12.01
6.3:1	16	0.71	1.19	1.98	2.67	3.31	3.90	4.46	5.00	5.52	6.02	6.51	8.78	10.86	12.81	14.65
5.5:1	18	0.80	1.35	2.27	3.07	3.82	4.51	5.17	5.81	6.42	7.02	7.59	10.30	12.78		
5:1	20	0.89	1.50	2.55	3.47	4.32	5.12	5.88	6.61	7.32	8.01	8.68	11.92	14.84		
4:1	25	1.09	1.88	3.23	4.43	5.54	6.59	7.60	8.57	9.51	10.43	11.32				
3.3:1	30	1.28	2.23	3.86	5.32	6.69	7.99	9.23	10.43	11.60	12.74	13.85				
2.5:1	40	1.61	2.83	4.98	6.92	8.74	10.48	12.15	13.77							
2:1	50	1.88	3.33	5.89	8.22	10.42	12.52	14.55								

Table A2 P-factors for construction sites (Goldman et al., 1986)

Surface condition	P-factor
Compacted and smooth	1.3
Track-walked along the contour[6]	1.2
Track-walked up and down the slope[7]	0.9
Punched straw[8]	0.9
Loose to 0.3 metres depth	0.8

Table F2. Runoff coefficients (Cv) for volumetric data in disturbed catchments (adapted from USDA, 1996)

Soil Hydrologic Group	Design Rainfall depth (mm) <20	21-25	26-30	31-40	41-50	51-60	61-80	Runoff potential
A	0.01	0.05	0.08	0.15	0.22	0.28	0.37	very low
B	0.10	0.19	0.25	0.34	0.42	0.48	0.57	low to moderate
C	0.25	0.35	0.42	0.51	0.58	0.63	0.70	moderate to high
D	0.39	0.50	0.56	0.64	0.69	0.74	0.79	high

Table F3 Runoff coefficients (C10) for peak flow data in disturbed catchments

Soil Hydrologic Group	Rainfall intensity (mm) in the design storm <20	21-40	41-60	61-80	81-100	>100	Runoff potential
A	0.20	0.37	0.55	0.64	0.68	0.75	very low
B	0.46	0.58	0.70	0.75	0.78	0.82	low to moderate
C	0.69	0.76	0.83	0.85	0.86	0.88	moderate to high
D	0.80	0.86	0.89	0.90	0.90	0.90	high

Westlink Stage 2 Basin Specifications		Lot 3&5	Lot 6
Item	**Unit**	**Type B**	**Type B**
Design volume requirement	m^3	2421.4	5765
Design surface area requirement	m^2	1241.6	2956.6
Length	m	69	99.3
Width	m	23	33.1
Surface area	m^2	693	803
Length to width ratio	ratio	3:1	3:1
Depth	m	2	2
Basin wall batter slope	ratio	2:1	2:1
X-section area	m^2	38	58.2
Basin volume	m^3	2622	5779.26
Forebay (10% of volume)	m^3	*262.2*	*577.926*
Forebay length	m	10	10
Forebay width	m	23	33.1
Forebay depth	m	1.5	1.5
Forebay spillway basin slope	ratio	3:1	3:1
X-section area	m^2	30	45.15
Forebay volume	m^3	300	451.5
Spillway crest below basin wall	m	0.45	0.45
Spillway width	m	21	30
Spillway freeboard	m	0.3	0.3
Basin lining	ea	A29 bidim	A29 bidim
Spillway lining	ea	rip rap	rip rap
Outlet, concrete culvert	dia	>450	>450

Site area	Sub-catchment or Name of Structure						Notes
	Lot 3&5	Lot 6	Lot 3	Lot 5			
Total catchment area (ha)	11.64	20.42	2.59	8.96			
Disturbed catchment area (ha)	11.64	20.42	2.59	8.96			
Soil analysis (enter sediment type if known, or laboratory particle size data)							
Sediment Type (C, F or D) if known:	D	D	D	D			If known. Type D is worst-case.
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							Pg 3.15 (IECA, 2008)
Soil Texture Group	D	D	D	D			Automatic calculation from above
Rainfall data							
Rainfall R-factor (if known)	2210	2210	2210	2210			Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	10	10	10	10			
RUSLE Factors							
Rainfall erosivity (*R*-factor)	2210	2210	2210	2210			Auto-filled from above
Soil erodibility (*K*-factor)	0.038	0.038	0.038	0.038			RUSLE LS factor calculated for a high rill/interrill ratio. See Appendix E of IECA (2008)
Slope length (m)	80	80	80	80			
Slope gradient (%)	5	5	3	3			
Length/gradient (*LS*-factor)	1.19	1.19	0.65	0.65			
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	
Calculations Erosion Hazard							
Soil loss (t/ha/yr)	130	130	7				
Soil Loss Class	1	1					Pg 3.4 (IECA, 2008)
Soil loss (m³/ha/yr)	100	100	5				Conversion to cubic metres - assumes
Is a Basin Required?	Yes	Yes	N			No	Refer to Table B1 Pg B.6 (IECA, 2018)

Slope Gradient
Enter slope as percent.

Sediment Basin Type

Soil/Catchment Details							
Duration of soil disturbance	> 12 months	> 12 months	> 12 months	> 12 months	> 12 months	< 12 months	<70% effective ground cover (C ≥ 0.05)
Is the soil coarse?	No	No	No	No	No	No	< 33% finer than 0.02mm & ≤ 10% disper
Are WQOs likely to be met by Type C	No	No	No	No	No	No	Particle settlement testing is
Is automated dosing reasonable or	Yes	Yes	Yes	Yes	Yes	Yes	inflow?
Required Basin Type	A	A	N/A	N/A	N/A	N/A	Refer to Table B2 Pg B.7 (IECA, 2018)

Version 5.2

3. Flow Calculations

Peak flow is given by the Rational Formula: $Q_y = 0.00278 \times C_{10} \times F_Y \times I_{y,tc} \times A$

where:
- Q_y is peak flow rate (m³/sec) of average recurrence interval (ARI) of "Y" year
- C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years.
- F_y is a frequency factor for "Y" years.
- A is the catchment area in hectares (ha)
- $I_{y,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) is determined by a range of formulae - see Pg A.9 to A.14 in IECA, 2008

A simple method to calculate time of concentration is: $tc\ (hrs) = 0.76 \times (A/100)^{0.38}$

Basic tc calculator: Area (ha): 2.59

Tc = 0.19 hrs or 11 mins

Structure Details									Notes
Name	Lot	Lot 6	Lot 3	Lot 5					
Catchment Area	11.64	20.42	2.59	8.96					hectares
First time of conc.	0.336	0.416	0.19	0.3					minutes
Second tc (if									minutes
Third tc (if									minutes
Total time of conc.	0.336	0.416	0.19	0.3					minutes
Rainfall									
1-year, tc	46.5	40.9	62.9	49.5					Enter the relevant rainfall intensities (in mm/hr) for each of the nominated rainfall events. The time of concentration (tc) determines the duration of the event to be used
2-year, tc	53.4	47	72.2	56.8					
5-year, tc	75.4	66.2	102	80.1					
10-year, tc	90.6	79.5	122	96.2					
20-year, tc	106	92.8	142	112					
50-year, tc	126	111	169	134					
100-year, tc	142	124	190	150					
C10 runoff	0.76	0.76	0.76	0.76					Pg A.7 (IECA, 2008)
Frequency Factors									
FF, 1-year	0.8	0.8	0.8	0.8					Can use 0.8 for a
FF, 2-year	0.85	0.85	0.85	0.85					Can use 0.85 for a
FF, 5-year	0.95	0.95	0.95	0.95					Can use 0.95 for a
FF, 10-year	1	1	1	1					Generally always 1
FF, 20-year	1.05	1.05	1.05	1.05					Can use 1.05 for a
FF, 50-year	1.15	1.15	1.15	1.15					Can use 1.15 for a
FF, 100-year	1.2	1.2	1.2	1.2					Can use 1.2 for a
Flow Calculations									**Notes**
1-year, tc (m³/s)	0.915	1.412	0.275	0.75					
2-year, tc (m³/s)	1.116	1.724	0.336	0.91					
5-year, tc (m³/s)	1.762	2.713	0.53	1.44					
10-year, tc (m³/s)	2.228	3.43	0.668	1.82					
20-year, tc (m³/s)	2.737	4.204	0.816	2.23					
50-year, tc (m³/s)	3.564	5.507	1.064	2.92					
100-year, tc (m³/s)	4.191	6.42	1.248	3.41					

Page 1

Version 5.2

2. Sediment Basin Type B

	Sub-catchment or Name of Structure						Notes
Basin Name	Lot 3&5	Lot 6	Lot 3	Lot 5			Must be same as site area on Worksheet 1
Catchment Area (ha)	11.64	20.42	2.59	8.96			Total catchment area - autofilled from Worksheet 1
Peak Flow Calculation	**Q = C x I x A / 360**						
Peak 1 year flow - Q1 (m^3/s)	0.915	1.412	0.275	0.750			Peak Q1 flow
0.5 x Q1 flow (m^3/s)	0.458	0.706	0.138	0.375			Half Q1 flow
Settling Zone Dimensions							
Length to width ratio X : 1	3	3	3	3			3:1 recommended
Batter slope (1 in X)	2	2	2	2			< 1V:5H
Option 1B	**Calculates minimum settling pond surface area (As) and depth (Ds)**						
(mm)	150	150	150	150			(IECA, 2018)
(s/m)	8000	8000	8000	8000			Refer Table B17, page B.26 (IECA, 2018)
Minimum surface area - As (m^2)	3660.0	5648.0	1100.0	3000.0			Eqn B19
Minimum settling depth - Ds (m)	0.68	0.68	0.68	0.68			Refer to Table B17, page B.26 (IECA, 2018)
Critical settling zone length - L_r (m)	81	81	81	81			Refer to Table B17, page B.26 (IECA, 2018)
Approx. width of basin - Ws (m)	34.9	43.4	19.1	31.6			software
Approx. length of basin (m)	104.8	130.2	57.4	94.9			software
Check Ls is less than critical	Need Large Basin. Use method below	Basin. Use method below	OK	Basin. Use method below			Supernatant veocity will not resuspend settled sediment if basin length is less than Ls. Use Large Basin design if length > Ls
Large Basin Design - 1B	**Large basins require a different sizing based on reducing supernatant velocity. If above method does not satisfy Ls requirem**						
Large basin - Ds (m)	1.5	1.5		1.5			The depth Ds or width Ws must be increased to limit the supernatant velocity for large basins. Refer Equation B22 (IECA)
Large basin width - Ws (m)	20.34	31.39		16.68			
Large basin length (m)	61.03	94.18		50.03			Assumes 3:1 length to width ratio
Sediment Storage Zone (SS)							
Soil loss (t/ha/yr)	129.6	129.6	71.1	71.1			Calculated on worksheet 1
Sediment density (t / m^3)	1.3	1.3	1.3	1.3			m3
Soil loss (m^3/ha/yr)	99.7	99.7	54.7	54.7			Based on sediment density above
Put an X here for 30% of water zone	X	X	X	X			Fill in one or the other - either an X or nominate the number of months. Refer to Page B.40 (IECA, 2018)
Storage (soil) zone design (months)							
Basin storage (soil) volume (m^3)	559.0	1330.0	224.0	375.0			Refer to Page B.40 (IECA, 2018)

Summary of Type B Basin Dimensions

Basin Name	Lot 3&5	Lot 6	Lot 3	Lot 5			
Adopted basin type	Option 1B - Larg	Option 1B - Larg	Option 1B	Option 1B - Larg			
Settling zone surface area - As (m^2)	1241.6	2956.6	1100.0	834.2			
Depth of settling zone - Ds (m)	1.5	1.5	0.68	1.50			
Settling zone volume - Vs (m^3)	1862.4	4435.0	748.0	1251.3			
Basin storage (soil) volume (m^3)	559.0	1330.0	224.0	375.0			30% of V_{SS} or x months storage. See pg B.40
level (m^3)	2421.4	5765.0	972.0	1626.3			

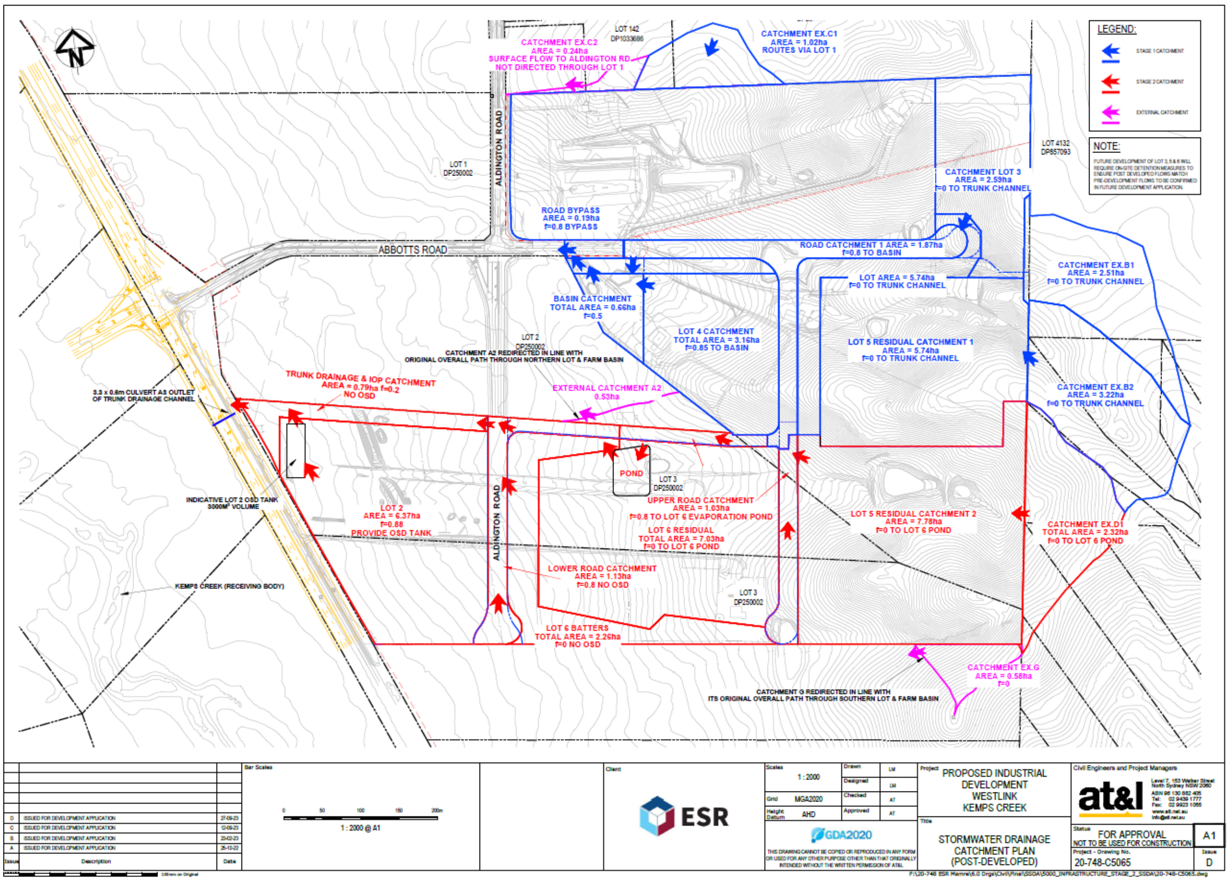
Version 5.2

Table B5 – Suggested 'trial value' of the optimum low-flow decant rate, Q_A

Likely optimum Q_A	Locations
4 L/s/ha	Mildura, Adelaide, Mt Gambier (D_S = 1.0 to 1.5 m)
5 L/s/ha	Wagga, Melbourne, Bendigo, Ballarat, Hobart (D_S = 1.0 m) Bourke, Dubbo, Bathurst, Goulburn (D_S = 1.5 m)
6 L/s/ha	Bourke, Bathurst, Canberra, Perth (D_S = 1.0 m) Toowoomba (based on D_S = 2.0 m)
7 L/s/ha	Dubbo, Tamworth, Goulburn (based on D_S = 1.0 m) Roma, Toowoomba (based on D_S = 1.5 m)
8 L/s/ha	Dalby, Roma, Armidale (based on D_S = 1.0 m)
9 L/s/ha	Darwin, Cairns, Townsville, Mackay, Rockhampton, Emerald, Caloundra, Brisbane, Toowoomba (D_S = 1.0 m), Lismore, Port Macquarie, Newcastle, Sydney, Nowra

Pre – Disturbance Cathment Areas

Current Catchment Area (including existing development)



Catchment diagram for basin calculations