SINCLAIR KNIGHT MERZ
SKM

Lend Lease

Riparian Corridors - Soil and Water Management Plan Report

FINAL REPORT

FEBRUARY 2014

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Contents

1. Introduction

An erosion and sediment control plan has been prepared for the construction of the Riparian Corridor and an area upstream of the proposed Riparian Corridor at Jordan Springs. The plan is included in **Appendix A**.

2. Strategy

Appendix A shows the proposed erosion and sediment control strategy and the location of the proposed Riparian Corridor temporary sediment basin. The proposed erosion and sediment control strategy is based on the following five principles:

- Controlling the occurrence of erosion.
- Controlling the movement of sediment.
- Diverting offsite "clean" water away from construction areas using temporary clean diversion drains.
- Diverting onsite "dirty" water towards a sediment basin using temporary dirty diversion drains..

- Capturing and treating sediments from the cleared areas that are transported using sediment basin.

The developed catchment upstream of Jordan Springs Lake will be captured by Jordan Springs Lake and will bypass the Riparian Corridor using a temporary clean diversion drain. The existing 'clean' catchments upstream of Village 5 will also be diverted around the construction site using temporary 'clean' diversion drains. In total, four temporary clean drains (CD) will be required.

Runoff from the construction areas will be diverted to sediment basin locations. The majority of runoff will diverted to the Riparian Corridor which will act as a sediment basin during construction. This basin (Basin No 1- 46,000m3) will be built at the beginning of construction using local sediment controls.

Another much smaller temporary sediment basin (Basin No 2 – 300m3) will be required to capture a small catchment located south of the Jordan Springs Lake that cannot be diverted to the Riparian Corridor sediment basin, due to constraints of the natural topography.

Six temporary dirty drains (DD) will be required to divert dirty construction runoff to the Riparian Corridor sediment basin. One of these will be the proposed East West channel, which will be built at the beginning of construction as per the permanent design using local sediment controls to protect downstream waterways. It will then act as a dirty drain, called DD2, during construction. An existing channel, called DD3, will also be used as one of the required dirty drains.

Any small construction area that cannot be diverted to a sediment basin will receive treatment through the implementation of local controls such as sediment fences, in line with the Blue Book.

3. Catchment sizes

Catchments were measured using 12d modelling software based on existing contours. The catchment sizes flowing to each of the diversion drains are given in Table 3-1.

- **Table 3-1 Catchment areas flowing to dirty drains (DD) and clean drains (CD)**

Area (m^2)	DD1	DD2	DD3	DD4	DD5	DD6	CD1	CD2	CD3	CD4
Disturbed catchment	156,540	85,457	248,015	33,399	70,300	65,657	-	-	-	-
Upstream clean catchment	178,163	-	-	3,719	-	-	10,332	-	11,662	220,043
Total catchment	334,703	85,457	248,015	37,118	70,300	65,657	10,332	-	11,662	220,043

4. Soil type

Soil testing has been undertaken in the location of the proposed Riparian Corridor to determine soil erosivity. The results are provided in Table 4-1. The highest value at borehole 2 was used in the calculation of the sediment basin volumes. This is a conservative design approach.

- **Table 4-1 Soil erosivity (K value)**

Borehole	Erosivity (k factor)
1	0.025
2	0.031
3	0.027
4	0.025

5. Peak flow during construction

The 2 year ARI peak flows in each of the drains were calculated using the Rational Method. IFD data was taken from Penrith City Council's Draft Stormwater Drainage Strategy, which is consistent with the Bureau of Meteorology data. For CD2, the RAFTs modelling undertaken for the design of the East West channel was used to determine the 2 year ARI peak flow, rather than the Rational Method. The results of the calculations are given in Table 6-1.

- **Table 5-1 Rainfall and peak flows**

	DD1	DD2	DD3	DD4	DD5	DD6	CD1	CD2	CD3	CD4
IFD 2yr (mm/hr)	65.7	65.7	61.5	90	90	76.9	90	-	84.9	56.4
Runoff coefficient	0.8	0.8	0.8	0.8	0.8	0.8	0.8	-	0.8	0.8
Q_{2yr} (m^3/s)	4.89	1.25	3.39	0.74	1.41	1.12	0.21	7.1	0.22	2.76

6. Temporary drain sizes

The temporary drains have been designed as trapezoidal channels with a base width of 0.5m, minimum grade of 0.5% and 1:2 side slopes. The required depth was calculated using Manning's formula for open channel flow in a trapezoidal channel. An additional freeboard depth of 0.3m was included to determine the required depth of the channel. The resulting depths are shown in Table 8-2.

- **Table 6-1 Temporary drain depths and widths**

	DD1	DD2	DD3	DD4	DD5	DD6	CD1	CD2	CD3	CD4
Depth (m)	1.4	0.9	1.3	0.8	1.0	0.9	0.6	1.6	0.7	1.2
Top width (m)	6.2	4.2	5.5	3.7	4.3	4.1	2.9	6.9	3.4	5.2

The East West channel (DD2) will be built as per the design and will act as a dirty drain during construction. The design dimensions of the East West channel are greater than the required dimension given in Table 6-1 therefore no modifications to the channel are required

As stated previously, DD3 is an existing channel on site that is to be retained for use during construction. The dimensions of the existing channel are greater than the required dimension given in Table 6-1 therefore no modifications to the channel are required.

7. Temporary drain levels

Spot levels for the drains are included on the plan in **Appendix A**. These levels represent the invert level of the drain.

8. Riparian Corridor sediment basin sizing

Sediment basins will be used to treat runoff form the construction area where the calculated total annual soil loss from the disturbed area is more than 150 cubic metres. This is in line with the requirements of the Blue Book, Appendix M, Clause (54) (Landcom 2004 and DECC 2008b).

Sediment basins have been sized using the principles of the Blue Book (Landcom 2004 and DECC 2008). The construction phase controls have been designed for an anticipated duration of less than 24 months, using Blue Book parameters for the design of sediment basins selected for this time frame. The sediment basin have been designed as Type D under the Blue Book (Landcom 2004 and DECC 2008) classifications. The basins would provide a volume for settling and storage. The settling zone volume has been estimated using the appropriate design rainfall depth and catchment areas. The storage zone has been estimated using the Revised Universal Soil Loss Equation (RUSLE). The 85th percentile five day rainfall value has been adopted. The parameters used to size the sediment basins are outlined in Table 8-1.

Table 8-1 Design criteria for sizing the Riparian Corridor sediment basin

Parameter	Value	Comments
Rainfall parameters		
Rainfall depth duration (days)	5	5 day adopted as standard duration
Rainfall percentile	85th	85th adopted for sensitive receiving downstream environment with construction duration between 6 months and 3 years
Rainfall depth (mm) – 5 day	85th =35 mm	
Volumetric runoff coefficient, Cv	0.64	Adopted for expected type of activities on site and compacted surfaces.
Rainfall intensity for 2 year ARI, 6 hr duration	10.15 mm/hr	Refer to rainfall erosivity value below
RUSLE parameters		
Soil/sediment type	D	Soil type to be confirmed during detailed design through site specific soil testing. Type D has been adopted until soil testing results are confirmed
Erodibility, k	0.031	Based on site specific soil testing at borehole 2 (BH2)
Rainfall erosivity, R	2273	Based on site specific rainfall intensityfrom Map10 of the Blue Book
Hydrologic Soil Group	D	For high runoff potential, (refer to Appendix F of Blue Book)
Soil cover, C	1	Corresponding to expected type of activities on site
Soil conservation practices, P	1.3	Corresponding to expected type of activities on site
Length slope factors, LS	0.91	
Sediment yield time period (months)	2 to 6	Depending on site constraints. 6 months adopted as a conservative value

The key sediment basin parameters are given in Table 8-2. A summary calculation sheet is included in **Appendix B**.

- **Table 8-2 Sediment basin parameters**

	Riparian Corridor temporary sediment basin
Total catchment area (ha)	108
Disturbed area (ha)	90
Minimum required Volume (m^3)	27,200
Sediment basin volume provided (m3) in 12d model	Min 46,000 m3 as shown in Appendix A
Water depth (m)	2

9. Local sediment controls

In locations where sediment basins are not used, local erosion and sediment controls will be installed. This is in line with the Blue Book, Section 6.3.2, Clause (d) (Landcom 2004 and DECC 2008b), that states:

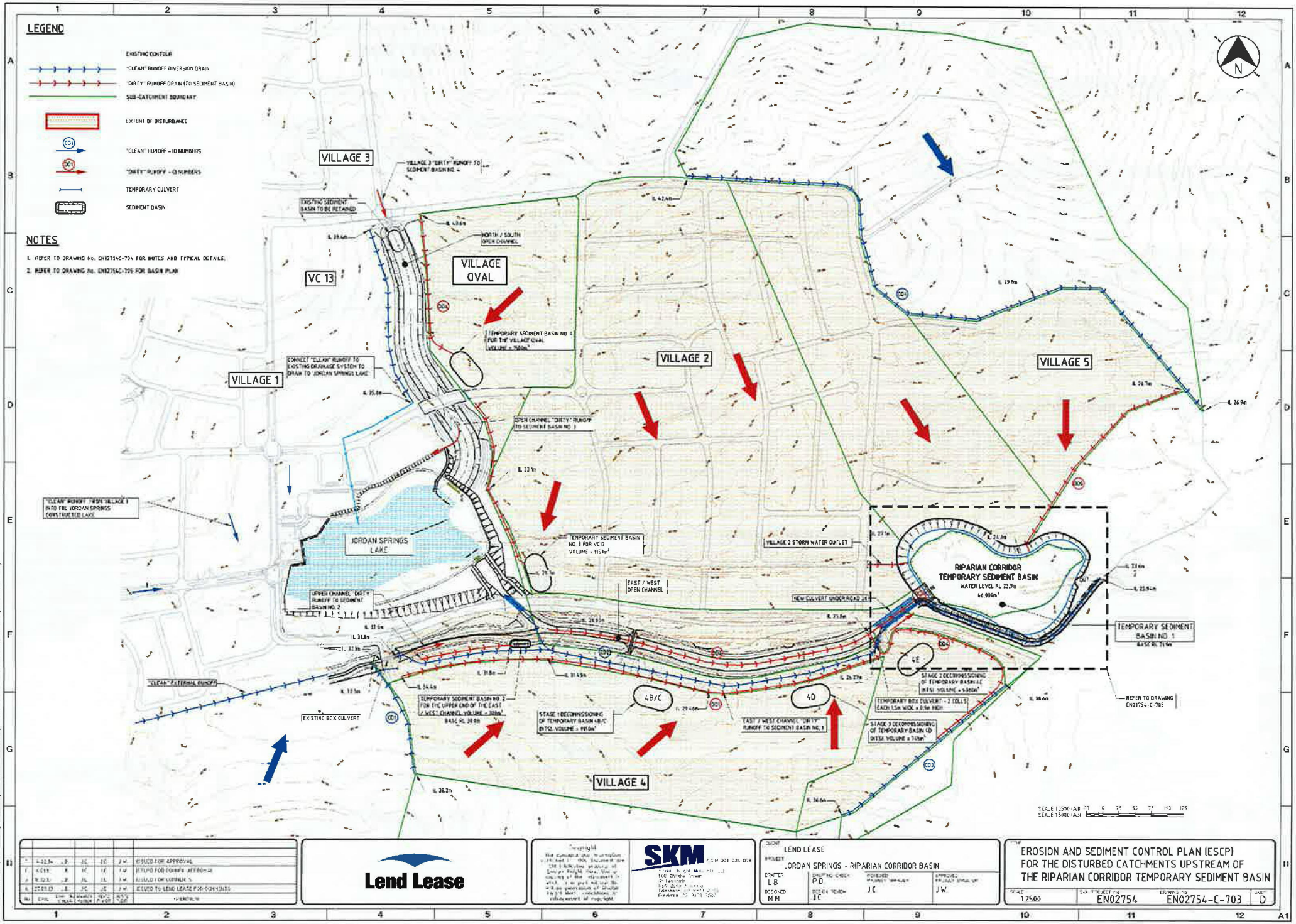
".....the average annual soil loss from the total area of land disturbance can be estimated. Where this is less than 150m^3 per year, the building of a sediment retention basin can be considered unnecessary. In such circumstances, alternate measures may be employed to protect the receiving waters."

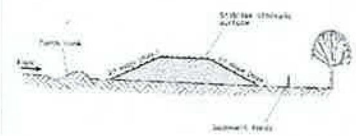
Local sediment controls may include sediment fences and filters, rock check dams and vegetated buffer strips. These will be implemented and managed by the contractor.

10. References

- Landcom 2004, Managing Urban Stormwater: Soils and Construction, Volume 1 (Known as the Blue Book Volume 1), Landcom, Sydney.
- NSW DECC 2008b, Managing Urban Stormwater, Soils and Construction, Volume 2, Main Road Construction (known as the Blue Book Volume 2), NSW Government, Sydney.
- Penrith City Council unknown date, Draft Stormwater Drainage Policy, Accessed from:http://www.penrithcity.nsw.gov.au/uploadedFiles/Content/Website/Our_Services/DraftStormwaterPolicy.pdf

Appendix A - Erosion and sediment control plan

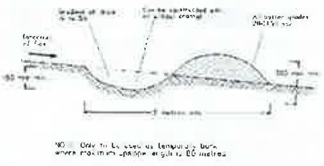




Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

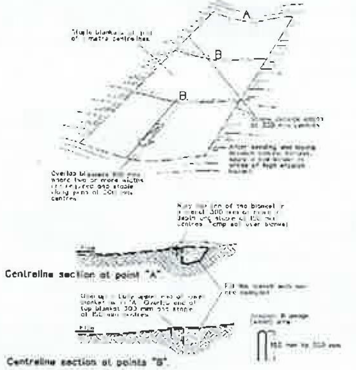
STOCKPILES SD 4-1



Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

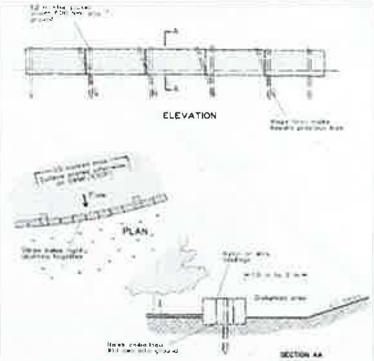
EARTH BANK (LOW FLOW) SD 5-5



Construction Notes

1. Remove any rocks, clods, sticks or grass from the surface before laying matting.
2. Ensure that topsoil is at least 75 mm deep.
3. Complete fertilising and seeding before laying the matting.
4. Ensure fabric will be continuously in contact with the soil by grading the surface carefully first.
5. Lay the fabric in "shingle-fash ion", with the end of each upstream roll overlapping those downstream. Ensure each roll is anchored properly at its upslope end (Standard Drawing 5-7b).
6. Ensure that the full width of flow in the channel is covered by the matting up to the design storm event, usually the 10-year ARI time of concentration storm event.
7. Divert water from the structure until vegetation is stabilised properly.

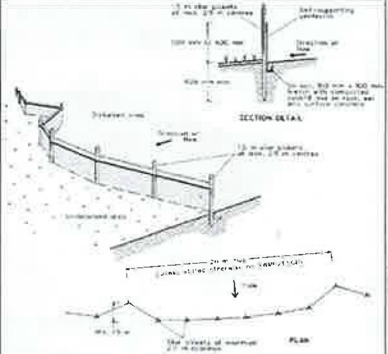
RECP : CONCENTRATED FLOW SD 5-7



Construction Notes

1. Construct the straw bale filter as close as possible to being parallel to the contours of the site.
2. Place bales lengthwise in a row with ends tightly abutting. Use straw to fill any gaps between bales. Straws are to be placed parallel to ground.
3. Ensure that the maximum height of the filter is one bale.
4. Embed each bale in the ground [illegible] and anchor with two 1.2 metre star pickets or stakes. Angle the first star picket or stake in each bale towards the previously laid bale. Drive them 600 mm into the ground and, if possible, flush with the top of the bales. Where star pickets are used and they protrude above the bales, ensure they are fitted with safety caps.
5. Where a straw bale filter is constructed downslope from a disturbed batter, ensure the bales are placed 1 to 2 metres downslope from the toe.
6. Establish a maintenance program that ensures the integrity of the bales is retained - they could require replacement each two to four months.

STRAW BALE FILTER SD 6-7



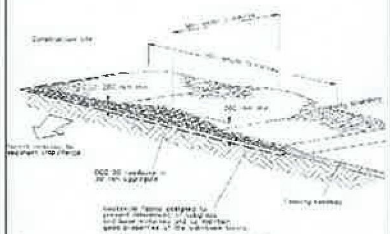
Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150 mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE SD 6-8

NOTES

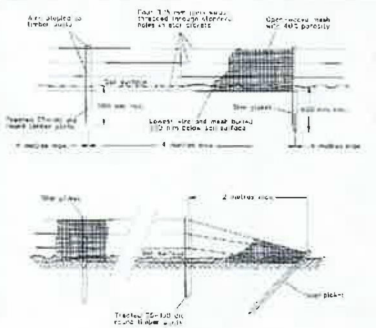
1. THE SEQUENCE OF CONSTRUCTION SHALL BE AS FOLLOWS
   A) THE CONSTRUCTION OF THE SEDIMENT BASINS Nos 1,2 AND 3 WITH ALL ASSOCIATED EROSION AND SEDIMENT CONTROLS.
   B) IDENTIFY LOCATION OF ALL PROPOSED EROSION AND SEDIMENT CONTROL MEASURES ON SITE.
   C) INSTALLATION OF BARRIER AND SEDIMENT FENCES.
   D) INSTALLATION OF ALL DIVERSION DRAINS AND LEVEL SPREADERS.
   E) INSTALLATION OF ALL REMAINING EROSION AND SEDIMENT CONTROLS.
   F) CLEARING AND REGRADING OF OPEN CHANNEL, TO BULK EARTHWORKS PLAN.
   G) DEWATERING IF REQUIRED.
2. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH THE RECOMMENDATIONS FOR "EROSION AND SEDIMENT CONTROL DCP AND CODE OF PRACTICE" ON DEVELOPMENT SITES OF PENRITH CITY COUNCIL AND IN ACCORDANCE WITH THE REQUIREMENTS OF THE "BLUE BOOK", SOILS AND CONSTRUCTION LANDCOM 2004, DECCW 2008 VOLUMES 1 AND 2, AND ANY ADDITIONAL REQUIREMENTS BY PENRITH CITY COUNCIL.
3. REFER TO ALL TYPICAL SWMP DETAILS IN BLUE BOOK (EG. SD6-3) FOR CONSTRUCTION DETAILS. ALSO REFER TO MOST RELEVENT TYPICAL DETAILS ON DRAWING EN02754-C-702.
4. WIND EROSION CONTROLS (NOT SHOWN ON THIS PLAN) SHALL BE CONSTRUCTED AS REQUIRED BY THE SITE SUPERINTENDENT. REFER TO SD6-15 TYPICAL DETAIL ON DRAWING EN02754-C-702.
5. ESCP DETAILS ON THIS LAYOUT ARE SCHEMATIC ONLY. ANY ADDITIONAL INFORMATION REQUIRED IS TO BE OBTAINED FROM THE SITE SUPERINTENDENT. ADDITIONAL CONTROLS AND CHANGES TO THIS PLAN MAY BE NECESSARY DURING THE PROCESS OF IMPLEMENTATION OF THE ESCP. ONGOING INSPECTIONS BY A QUALIFIED SUPERINTENDENT ARE REQUIRED TO PROVIDE RELEVANT CHANGES, AS REQUIRED. THE ESCP IDENTIFIES THE EROSION AND SEDIMENT CONTROLS NEEDED ON SITE, BUT ARE NOT CONSTRUCTION DRAWINGS. REFERENCE NEEDS TO BE MADE TO TYPICAL DETAILS IN THE BLUE BOOK.
6. PROVIDE JUTE MESH LINING FOR ALL DIVERSION DRAINS AND THE OPEN CHANNELS AND SPRAY WITH BITUMEN EMULSION.
7. IF STRAW BALES ARE USED IN CONJUNCTION AND IN ADDITION TO SEDIMENT FENCES, THE STRAW BALES SHALL BE WEED FREE.
8. ALL DISTURBED AND REGRADED AREAS INCLUDING EMBANKMENTS THAT ARE EXPOSED FOR LONGER THAN 2 WEEKS, SHALL BE REHABILITATED AS SOON AS POSSIBLE BY HYDROSEEDING OR AS DIRECTED BY THE SITE SUPERINTENDENT.
9. WATER CAPTURED IN THE EAST SEDIMENT BASIN WILL BE USED FOR REUSE ON SITE FOR DUST SUPPRESSION PURPOSES OR DISCHARGED DOWNSTREAM WITH APPROVAL. GYPSUM FLOCCULATION MAY BE REQUIRED IF SETTLEMENT OF SOIL PARTICLES DOES NOT OCCUR IN THE SEDIMENT BASIN.
10. THIS EROSION AND SEDIMENT CONTROL PLAN IS FOR THE OPEN CHANNELS ONLY.
11. SEDIMENT BASIN NO. 1 WILL BE DESIGNED TO TREAT ALL THE "DIRTY" RUNOFF FROM THE EAST / WEST CHANNEL AND VILLAGE 2.
12. ALL EXTERNAL RUNOFF TO BE DIVERTED AROUND THE CONSTRUCTION AREAS, AS REQUIRED.
13. ALL DETAILS SHOWN ON THIS DRAWING ARE REFERENCED FROM "THE BLUE BOOK" - MANAGING URBAN STORMWATER (MUS): SOILS AND CONSTRUCTION BY LANDCOM. IT IS THE RESPONSIBILTY OF THE CONTRACTOR ON SITE TO HAVE THE LATEST PUBLICATION.
14. ALL TEMPORARY SEDIMENT BASINS USED FOR THE CONSTRUCTION STAGE WILL NEED TO BE DECOMMISSIONED AND ADEQUATELY BACKFILLED AND REHABILITATED. THIS IS TO BE UNDERTAKEN AFTER ITS UPSTREAM CATCHMENT IS FULLY STABILISED OR IF LOCAL EROSION AND SEDIMENT CONTROLS ARE ADEQUATELY IMPLEMENTED AT THE SOURCE, FOR INSTANCE AT THE LOTS.



Construction Notes

1. Strip the topsoil, level the site and compact the subgrade.
2. Cover the area with needle-punched geotextile.
3. Construct a 200 mm thick pad over the geotextile using road base or 30-mm aggregate.
4. Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
5. Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence.

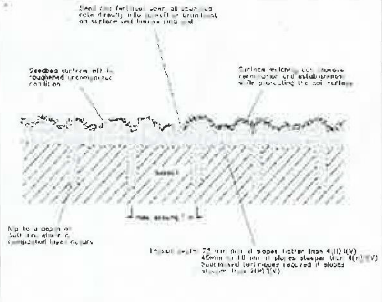
STABILISED SITE ACCESS SD 6-14



Construction Notes

1. Install the fence to the height specified in the ESCP/SWMP.
2. Cut a channel 200 mm deep along the fence line.
3. Place wire and light resilient, open-weave polymer mesh with 40 percent porosity on the prevailing wind side of fence.
4. Fasten the mesh to all wires using ring fasteners at 100 mm to 150 mm intervals on top wire and 300 mm intervals on other wires.
5. Use one 75-mm to 100-mm diameter treated round timber post every 20 metres.
6. Where star pickets are used, ensure they are fitted with safety caps.

CONTROL OF WIND EROSION SD 6-15



Construction Notes

1. Loosen compacted soil before sowing any seed. If necessary, rip the soil to a depth of 300 mm. Avoid rotary hoe cultivation.
2. Work the ground only as much as necessary to achieve the desired tilth and prepare a good seedbed.
3. Avoid cultivation in very wet or very dry conditions.
4. Cultivate on or close to the contour where possible, not up and down the slope.

SEEDBED PREPARATION SD 7-1

Rev	Date	Drafting Check	Design Review	Rev'd P.MGR	App'd P.DIR	Amendment
B	18.12.13	L.B.	J.C.	J.C.	J.W.	ISSUED FOR D.A.
A	27.09.13	L.B.	J.C.	J.C.	J.W.	ISSUED TO LEND LEASE FOR COMMENTS

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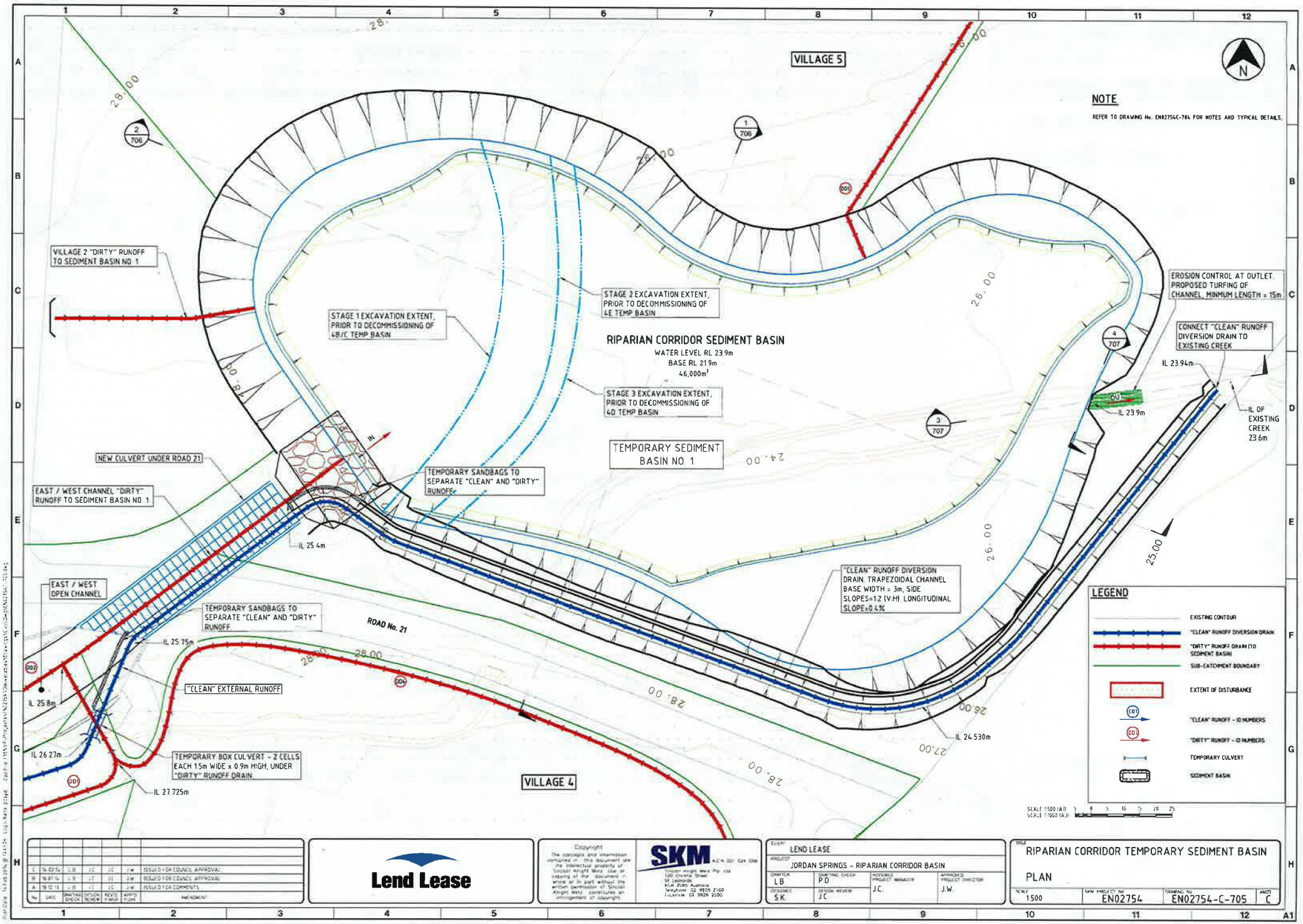
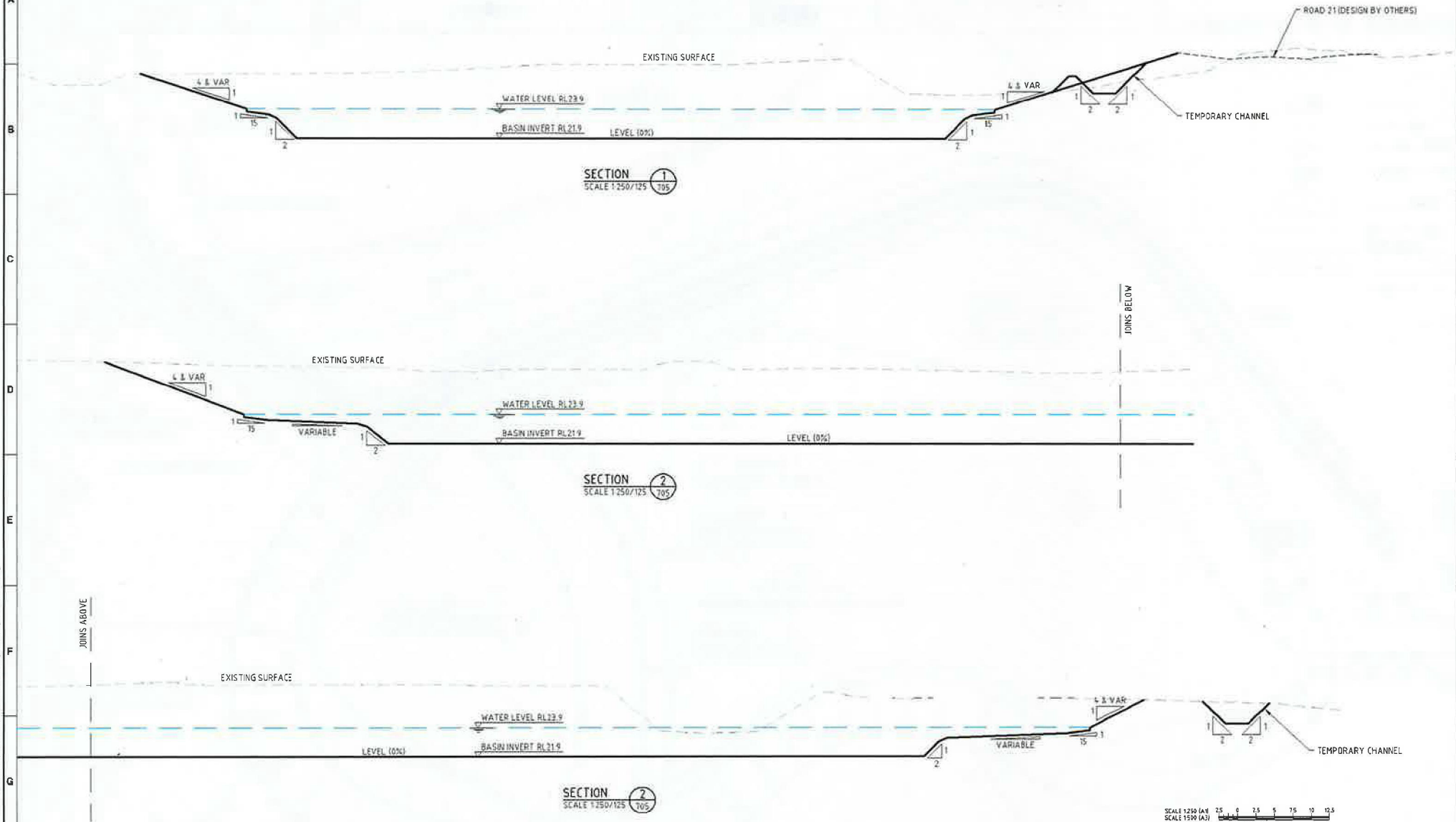
CLIENT: LEND LEASE
PROJECT: JORDAN SPRINGS - EAST LAKE BASIN
DRAFTER: L.B. | DRAFTING CHECK: | REVIEWED PROJECT MANAGER: J.C. | APPROVED PROJECT DIRECTOR: J.W.
DESIGNED: - | DESIGN REVIEW: J.C.

TITLE: EROSION AND SEDIMENT CONTROL DETAILS

SCALE: NTS | SKM PROJECT No: EN02754 | DRAWING No: EN02754-C-704 | AMDT: B

A1





	DATE	DRAFTING CHECK	DESIGN REVIEW	REVIS'D PROJECT MANAGER	APPR'D PROJECT DIRECTOR	AMENDMENT
B	14.05.14	L.B.	J.C.	J.C.	J.W.	ISSUED FOR COUNCIL APPROVAL
A	18.12.13	L.B.	J.C.	J.C.	J.W.	ISSUED FOR COMMENTS

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CLIENT: LEND LEASE			
PROJECT: JORDAN SPRINGS – RIPARIAN CORRIDOR BASIN			
DRAWN: L.B.	DRAFTING CHECK: P.D.	REVIEWED PROJECT MANAGER: J.C.	APPROVED PROJECT DIRECTOR: J.W.
DESIGNED: S.K.	DESIGN REVIEW: J.C.		

TITLE: RIPARIAN CORRIDOR TEMPORARY SEDIMENT BASIN
TYPICAL SECTIONS

SCALE	SKM PROJECT NO	DRAWING NO	SHEET
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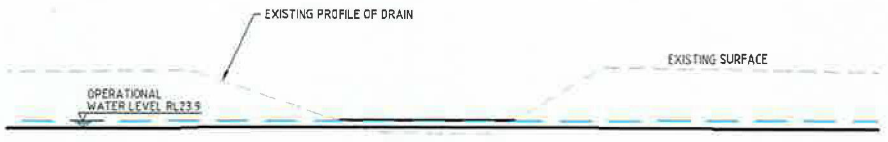

SECTION 4/705
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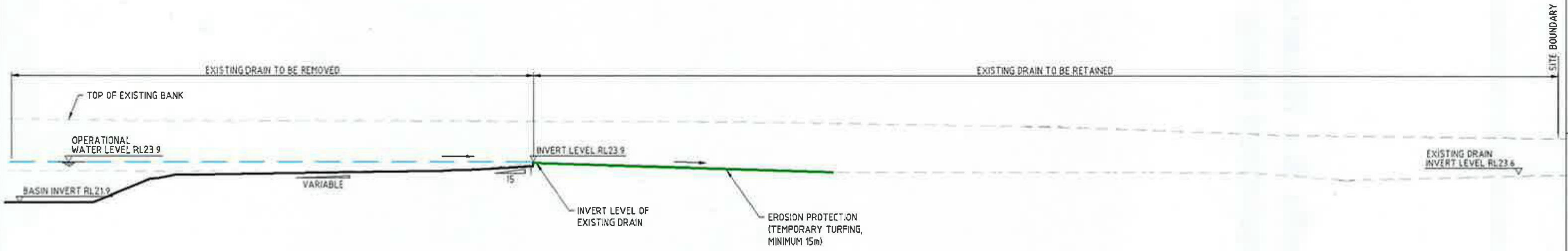

SECTION 3/705
SCALE 1:250/125

SCALE 1:250 (A1) SCALE 1:500 (A3) HORIZONTAL
SCALE 1:125 (A1) SCALE 1:250 (A3) VERTICAL

No	DATE	DRAFTING CHECK	DESIGN REVIEW	REV'D P.MGR	APP'D P.DIR	AMENDMENT
A	14.02.14	LB	JC	JC	JW	ISSUED FOR COUNCIL APPROVAL

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CLIENT: LEND LEASE
PROJECT: JORDAN SPRINGS - RIPARIAN CORRIDOR BASIN
DRAFTER: LB | DRAFTING CHECK: PD | REVIEWED PROJECT MANAGER: JC | APPROVED PROJECT DIRECTOR: J.W.
DESIGNED: SK | DESIGN REVIEW: JC.

TITLE: RIPARIAN CORRIDOR TEMPORARY SEDIMENT BASIN
TYPICAL SECTIONS

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A1

Document Set ID: 6888276
Version: 1, Version Date: 16/10/2015

Appendix B – Riparian Corridor temporary sediment basin sizing summary calculations

Job Description:	Riparian Corridor sediment basin
Job Number:	EN04189

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Design of Sediment Basin (construction phase) - Output summary

Project data

Sediment Basin No:	**Riparian Corridor**
Receiving creek name:	South Creek
Location:	Western Precinct

Sedimentation basin dimensions

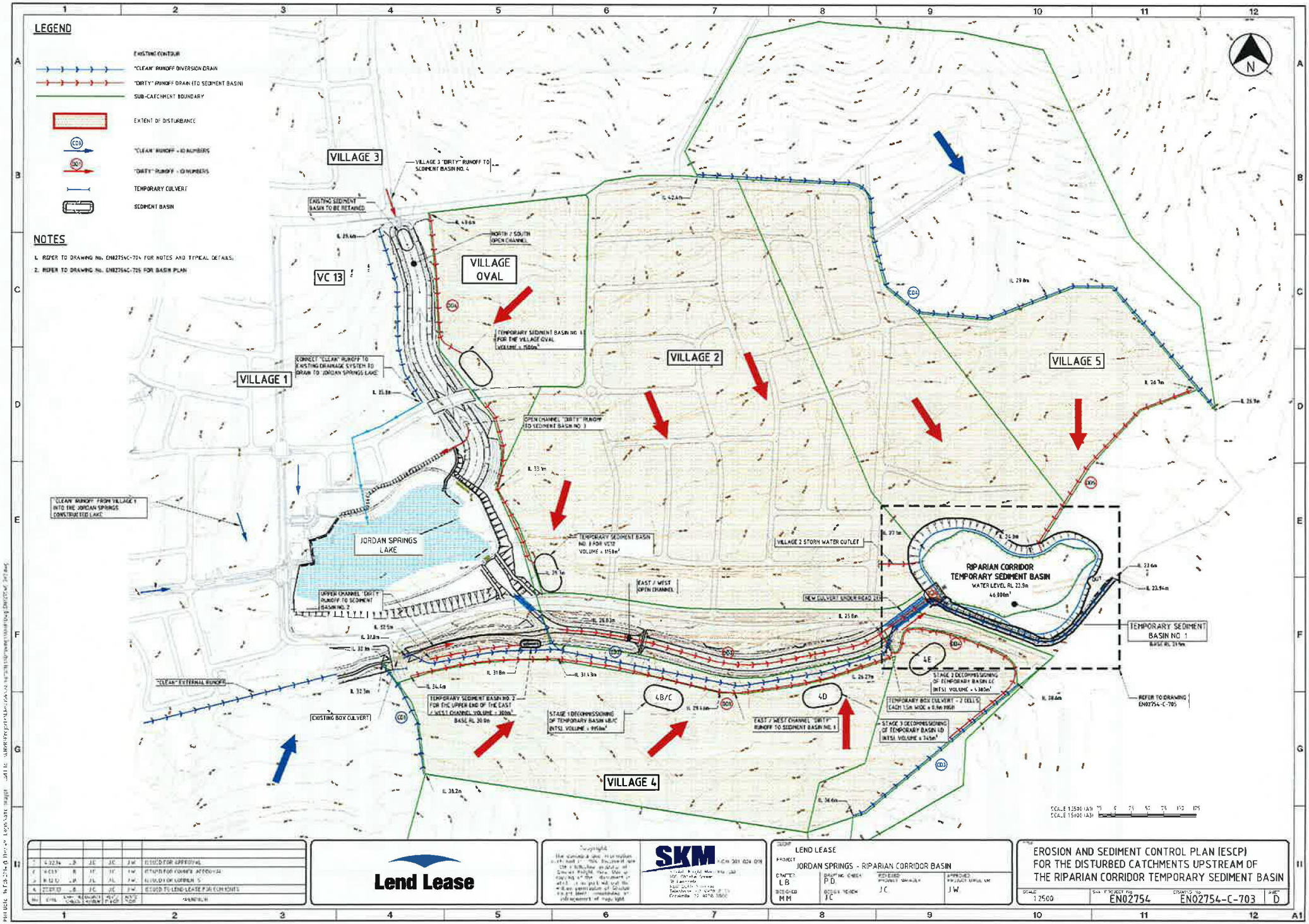
Basin Volume (at water line) :	**27203 m3**	12D model volume provided = **46,000m3**
Basin Surface Area (at water line):	14700 m2	
Length incl 0.5m freeboard (Approx)	212 m	
Width incl 0.5m freeboard (Approx)	72 m	
Max depth incl 0.5m freeboard:	2.5 m	
Length at water line:	210 m	
Width at water line:	70 m	
Max water depth:	2 m	
Basin Side slopes, incl free board slopes:	2 :1 side slopes H:V	
Length to width ratio of basin	3.0 to 1 (L:W)	

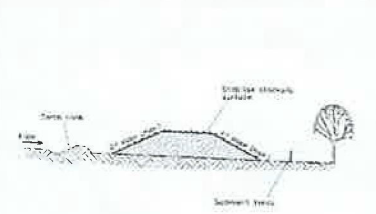
Site specific input parameters

	Total area		Steep batters component
Catchment Area:	108 ha		
Disturbed Area:	90 ha		0.9 ha or 1% of total area
Soil Type:	D		
5 Day, 85 %ile rainfall depth	**35**	**mm**	For sensitive receiving environment
2 year ARI, 6 hour rainfall intensity	10.16	mm/hr	
Rainfall Erosivity (R)	2273	From Map 10 of Blue Book	
Volumetric runoff coefficient (Cv)	0.64		
Soil Hydrologic Group	D	*Moderate to High* ' to *'High* ' runoff potential	
Soil Erodibility (K)	0.031	*Moderate* From soil test pit No:	**BH2**
Sediment Yield Time Period:	6 months		dated Aug 2013
Main area gradient:	4%		
Steep area/ road embankment gradient:	50%	1 in 2 V:H	

Estimated data

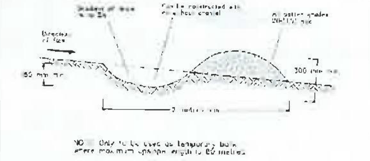
	Main area	**Steep batters**
Soil Loss class, a per Blue Book classifications	1	6
Soil Erosion Hazard:	Very Low	Very High





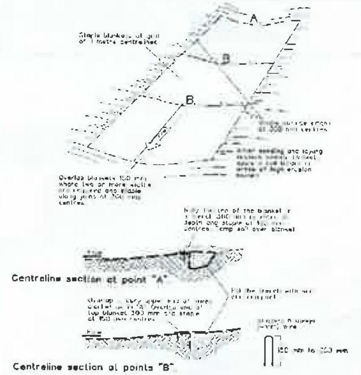
Construction Notes

STOCKPILES SD 4-1



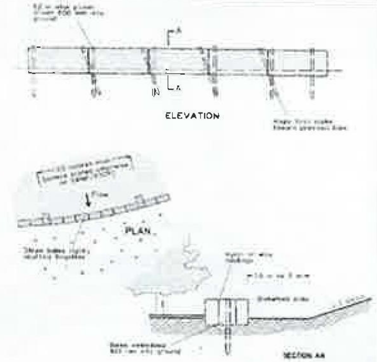
Construction Notes

EARTH BANK (LOW FLOW) SD 5-5



Construction Notes

RECP : CONCENTRATED FLOW SD 5-7



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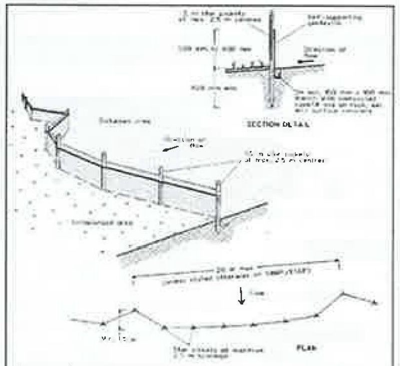
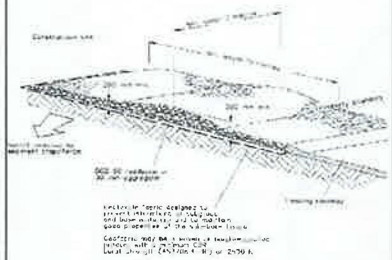
STRAW BALE FILTER SD 6-7



Construction Notes

SEDIMENT FENCE SD 6-8



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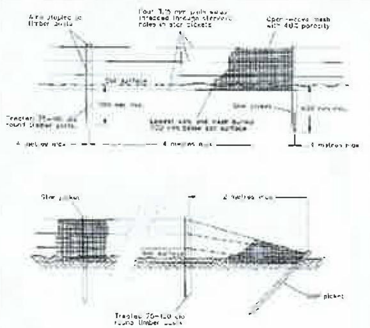
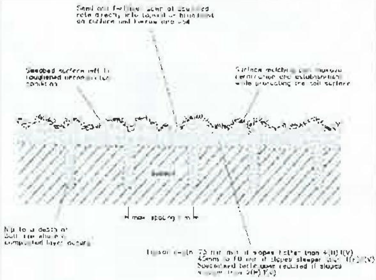
STABILISED SITE ACCESS SD 6-14



Construction Notes

CONTROL OF WIND EROSION SD 6-15



Construction Notes

SEEDBED PREPARATION SD 7-1

NOTES

1. THE SEQUENCE OF CONSTRUCTION SHALL BE AS FOLLOWS
   A) THE CONSTRUCTION OF THE SEDIMENT BASINS Nos 1,2 AND 3 WITH ALL ASSOCIATED EROSION AND SEDIMENT CONTROLS.
   B) IDENTIFY LOCATION OF ALL PROPOSED EROSION AND SEDIMENT CONTROL MEASURES ON SITE.
   C) INSTALLATION OF BARRIER AND SEDIMENT FENCES.
   D) INSTALLATION OF ALL DIVERSION DRAINS AND LEVEL SPREADERS.
   E) INSTALLATION OF ALL REMAINING EROSION AND SEDIMENT CONTROLS.
   F) CLEARING AND REGRADING OF OPEN CHANNEL, TO BULK EARTHWORKS PLAN.
   G) DEWATERING IF REQUIRED.
2. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH THE RECOMMENDATIONS FOR "EROSION AND SEDIMENT CONTROL DCP AND CODE OF PRACTICE" ON DEVELOPMENT SITES OF PENRITH CITY COUNCIL AND IN ACCORDANCE WITH THE REQUIREMENTS OF THE 'BLUE BOOK', SOILS AND CONSTRUCTION LANDCOM 2004, DECCW 2008 VOLUMES 1 AND 2, AND ANY ADDITIONAL REQUIREMENTS BY PENRITH CITY COUNCIL.
3. REFER TO ALL TYPICAL SWMP DETAILS IN BLUE BOOK (EG. SD6-3) FOR CONSTRUCTION DETAILS. ALSO REFER TO MOST RELEVENT TYPICAL DETAILS ON DRAWING EN02754-C-702.
4. WIND EROSION CONTROLS (NOT SHOWN ON THIS PLAN) SHALL BE CONSTRUCTED AS REQUIRED BY THE SITE SUPERINTENDENT. REFER TO SD6-15 TYPICAL DETAIL ON DRAWING EN02754-C-702.
5. ESCP DETAILS ON THIS LAYOUT ARE SCHEMATIC ONLY. ANY ADDITIONAL INFORMATION REQUIRED IS TO BE OBTAINED FROM THE SITE SUPERINTENDENT. ADDITIONAL CONTROLS AND CHANGES TO THIS PLAN MAY BE NECESSARY DURING THE PROCESS OF IMPLEMENTATION OF THE ESCP. ONGOING INSPECTIONS BY A QUALIFIED SUPERINTENDENT ARE REQUIRED TO PROVIDE RELEVANT CHANGES, AS REQUIRED. THE ESCP IDENTIFIES THE EROSION AND SEDIMENT CONTROLS NEEDED ON SITE, BUT ARE NOT CONSTRUCTION DRAWINGS. REFERENCE NEEDS TO BE MADE TO TYPICAL DETAILS IN THE BLUE BOOK.
6. PROVIDE JUTE MESH LINING FOR ALL DIVERSION DRAINS AND THE OPEN CHANNELS AND SPRAY WITH BITUMEN EMULSION.
7. IF STRAW BALES ARE USED IN CONJUNCTION AND IN ADDITION TO SEDIMENT FENCES, THE STRAW BALES SHALL BE WEED FREE.
8. ALL DISTURBED AND REGRADED AREAS INCLUDING EMBANKMENTS THAT ARE EXPOSED FOR LONGER THAN 2 WEEKS, SHALL BE REHABILITATED AS SOON AS POSSIBLE BY HYDROSEEDING OR AS DIRECTED BY THE SITE SUPERINTENDENT.
9. WATER CAPTURED IN THE EAST SEDIMENT BASIN WILL BE USED FOR REUSE ON SITE FOR DUST SUPPRESSION PURPOSES OR DISCHARGED DOWNSTREAM WITH APPROVAL. GYPSUM FLOCCULATION MAY BE REQUIRED IF SETTLEMENT OF SOIL PARTICLES DOES NOT OCCUR IN THE SEDIMENT BASIN.
10. THIS EROSION AND SEDIMENT CONTROL PLAN IS FOR THE OPEN CHANNELS ONLY.
11. SEDIMENT BASIN NO. 1 WILL BE DESIGNED TO TREAT ALL THE "DIRTY" RUNOFF FROM THE EAST / WEST CHANNEL AND VILLAGE 2.
12. ALL EXTERNAL RUNOFF TO BE DIVERTED AROUND THE CONSTRUCTION AREAS, AS REQUIRED.
13. ALL DETAILS SHOWN ON THIS DRAWING ARE REFERENCED FROM "THE BLUE BOOK" - MANAGING URBAN STORMWATER (MUS): SOILS AND CONSTRUCTION BY LANDCOM. IT IS THE RESPONSIBILTY OF THE CONTRACTOR ON SITE TO HAVE THE LATEST PUBLICATION.
14. ALL TEMPORARY SEDIMENT BASINS USED FOR THE CONSTRUCTION STAGE WILL NEED TO BE DECOMMISSIONED AND ADEQUATELY BACKFILLED AND REHABILITATED. THIS IS TO BE UNDERTAKEN AFTER ITS UPSTREAM CATCHMENT IS FULLY STABILISED OR IF LOCAL EROSION AND SEDIMENT CONTROLS ARE ADEQUATELY IMPLEMENTED AT THE SOURCE, FOR INSTANCE AT THE LOTS.

REV	DATE	DRAFTING CHECK	DESIGN REVIEW	REV'D P.MGR	APP'D P.DIR	AMENDMENT
B	18.12.13	LB	JC	JC	JW	ISSUED FOR DA
A	27.09.13	LB	JC	JC	JW	ISSUED TO LEND LEASE FOR COMMENTS

Lend Lease

SKM A.C.N. 001 024 096
Sinclair Knight Merz Pty. Ltd
100 Christie Street
St Leonards
NSW 2065 Australia
Telephone 02 9928 2100
Facsimile 02 9928 2500

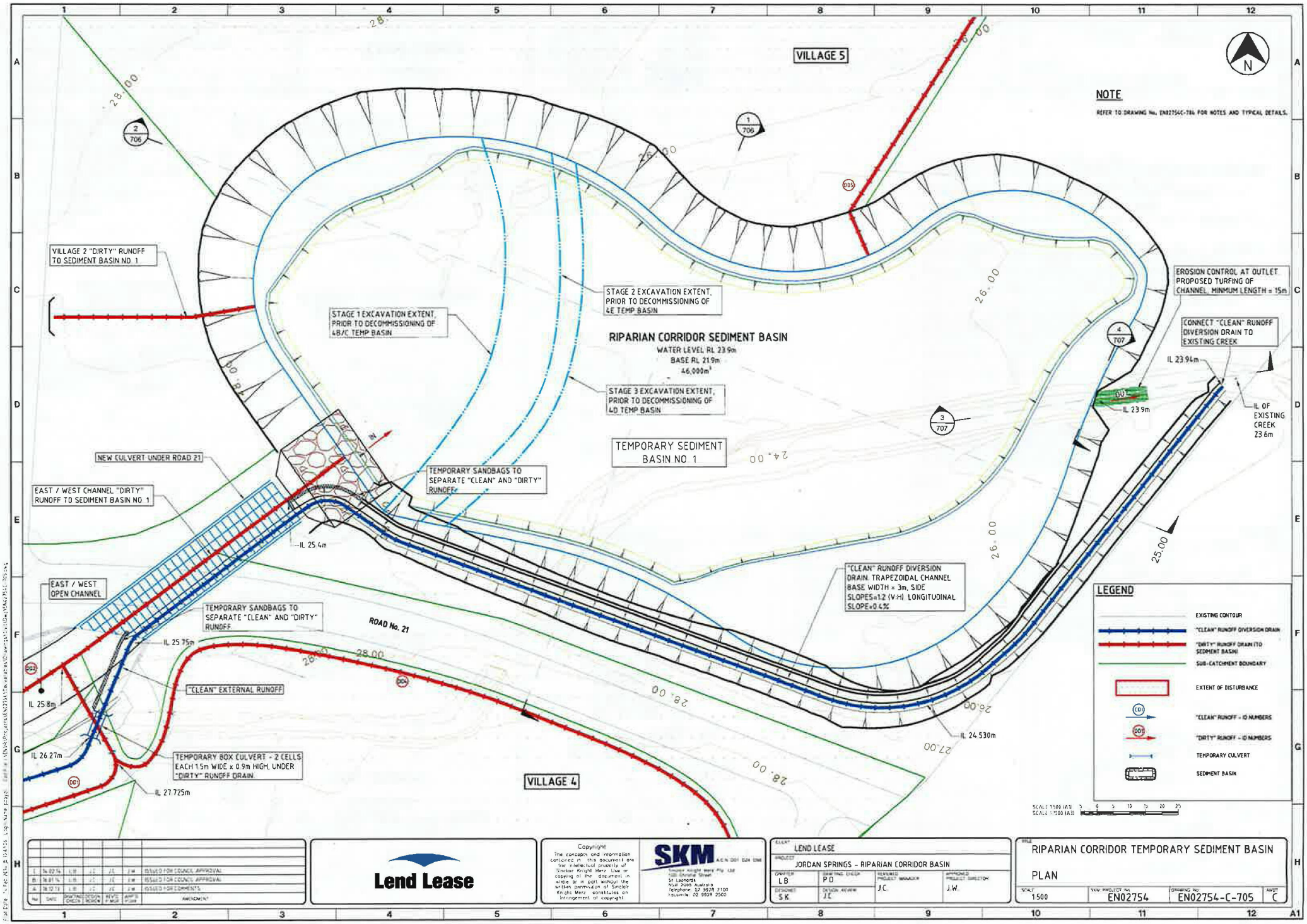
CLIENT: LEND LEASE
PROJECT: JORDAN SPRINGS - EAST LAKE BASIN

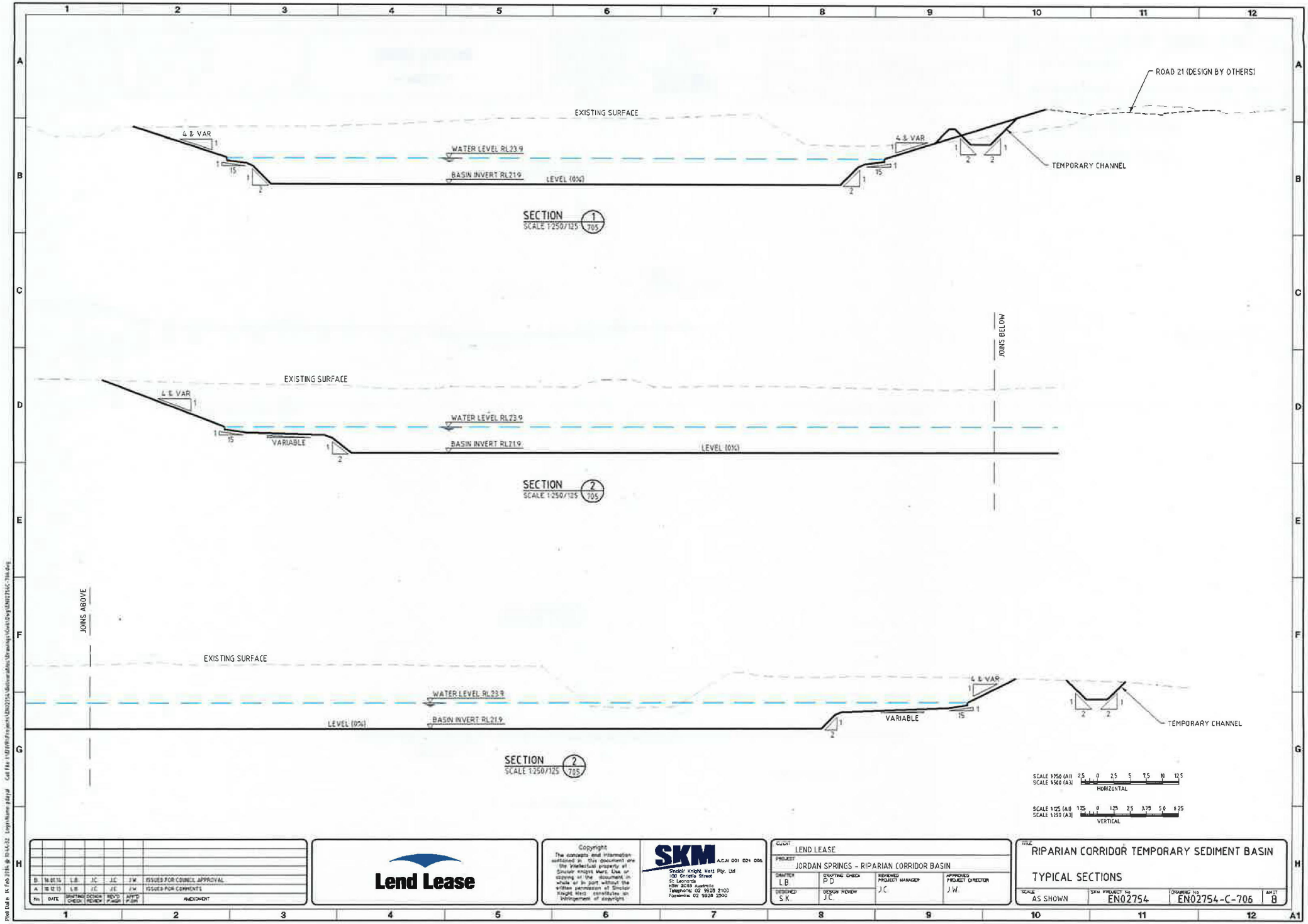
DRAFTER	DRAFTING CHECK	REVIEWED PROJECT MANAGER	APPROVED PROJECT DIRECTOR
LB		JC	J.W.
DESIGNED: -	DESIGN REVIEW: JC		

TITLE: EROSION AND SEDIMENT CONTROL DETAILS

SCALE	SKM PROJECT No	DRAWING No	AMDT
NTS	EN02754	EN02754-C-704	B

A1





No	DATE	DRAFTING CHECK	DESIGN REVIEW	REVD PM/DM	APPD PD/JW	AMENDMENT
B	16.01.14	L.B.	J.C.	J.C.	J.W.	ISSUED FOR COUNCIL APPROVAL
A	18.12.13	L.B.	J.C.	J.C.	J.W.	ISSUED FOR COMMENTS

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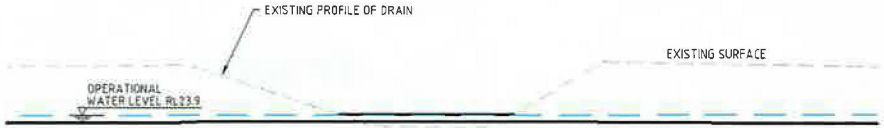
CLIENT: LEND LEASE
PROJECT: JORDAN SPRINGS - RIPARIAN CORRIDOR BASIN

DRAFTER	DRAFTING CHECK	REVIEWED PROJECT MANAGER	APPROVED PROJECT DIRECTOR
L.B.	P.D.	J.C.	J.W.
DESIGNED	DESIGN REVIEW		
S.K.	J.C.		

TITLE: RIPARIAN CORRIDOR TEMPORARY SEDIMENT BASIN
TYPICAL SECTIONS

SCALE	SKM PROJECT No	DRAWING No	AMDT
AS SHOWN	EN02754	EN02754-C-706	B



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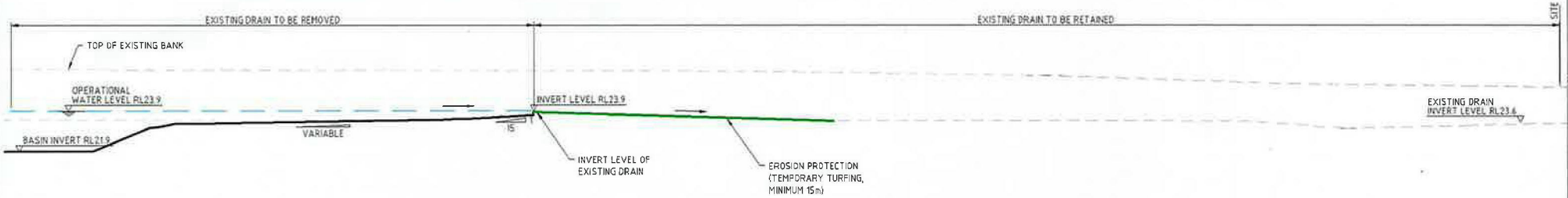

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SCALE 1:500 (A3)
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HORIZONTAL

SCALE 1:125 (A1)
SCALE 1:250 (A3)
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VERTICAL

No	DATE	DRAFTING CHECK	DESIGN REVIEW	APP'D PROJ	APP'D PSM	AMENDMENT
A	16.02.14	LB	JC	JC	JW	ISSUED FOR COUNCIL APPROVAL

Lend Lease

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CLIENT: LEND LEASE			
PROJECT: JORDAN SPRINGS - RIPARIAN CORRIDOR BASIN			
DRAFTED: L.B.	DRAFTING CHECK: P.D.	REVIEWED PROJECT MANAGER: J.C.	APPROVED PROJECT DIRECTOR: J.W.
DESIGNED: S.K.	DESIGN REVIEW: J.C.		

TITLE: RIPARIAN CORRIDOR TEMPORARY SEDIMENT BASIN
TYPICAL SECTIONS

SCALE	SKM PROJECT No	DRAWING No	ISSUE
AS SHOWN	EN02754	EN02754-C-707	A

ANNEXURE B – East Lake Stormwater Mangement Report dated 1 October 2014 by Jacobs (SKM)

Lend Lease

East Lake

Stormwater Management

Final

1 Oct 2014

JACOBS

East Lake

Project no:	EN04189
Document title:	East Lake
Document no:	EN04189
Revision:	Final
Date:	1 Oct 2014
Client name:	Lend Lease
Client no:	LL
Project manager:	John Constandopoulos
Author:	Mahala McLindin / Shane Ruscheinsky
File name:	I:\ENVR\Projects\EN04189\Deliverables\Reports\Final report\Final\Final Report East Lake Rev2 Oct 2014.docx

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Document history and status

Revision	Date	Description	By	Review	Approved
0	16 Aug 2013	Draft	MM/SR	JC	JW
1	29 Aug 2014	Final Draft	MM/SR	JC	JW
2	1 Oct 2014	Final	MM/SR	JC	JW

Contents

Executive Summary

This report has been prepared to support the Development Application (DA) of the East Lake at the Western Precinct of the Lend Lease site at Jordan Springs. The assessment focuses on the permanent stormwater management component of the Lake. It includes calculations of the required detention volume in the lake to provide peak flow mitigation and an assessment of water quality. To meet the detention and water quality requirements, a lake of approximately 3 hectares is proposed.

A maintenance procedure has also been prepared to outline the appropriate wetland management strategies for the Lake.

This report is to be read in conjunction with the following stormwater management DA drawings:

- **Table 1 Drawing list**

Drawing number	Drawing title
EN04189-ECC-DG-0001	COVER SHEET AND DRAWING INDEX
EN04189-ECC-DG-0006	GENERAL NOTES
EN04189-ECC-DG-0011	EAST LAKE LAYOUT PLAN
EN04189-ECC-DG-0012	EAST LAKE DETAILED SPILLWAY PLAN
EN04189-ECC-DG-0016	BULK EARTHWORKS PLAN
EN04189-ECC-DG-0021	EAST LAKE SECTIONS – SHEET 1
EN04189-ECC-DG-0022	EAST LAKE SECTIONS – SHEET 2
EN04189-ECC-DG-0026	EAST LAKE DETAILED SECTIONS
EN04189-ECC-DG-0028	EAST LAKE DETAILIED SPILLWAY SECTIONS

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to determine the stormwater management requirements in accordance with the scope of services set out in the contract between Jacobs and Lend Lease. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

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1. Introduction

The purpose of this report is to support the East Lake stormwater management DA drawings. The main purpose of the Lake is to provide detention, water quality treatment and improve the aesthetic qualities of the area.

The emphasis in this report and associated drawings will be on the Lake area inside the water edge line but will include details of the proposed spillway at the outlet of the Lake. For all areas above the permanent water line, reference is to be made to the landscaping and subdivision drainage plans by others.

2. Site description

The proposed East Lake will be located south of the Village 5 residential area. When built, the Lake will occupy an area of approximately 3 ha and contain a permanent water body of approximately 46 ML. Stormwater collected in the drainage system of the proposed upstream residential areas will enter the Lake via culverts under Road 21 and other drainage inlet discharge points from Villages 2 and 5.

The Lake will comprise of a deep water zone, and a macrophyte zone which will consist of reed beds along the southern edges and the north east and north west corners of the Lake. The Lake will provide detention, facilitate nutrient suspended solids removal and provide a habitat for wildlife.

The Landscape drawings of the Lake provide the outline of the Lake, the proposed landscaping around the Lake, trees, footpaths, drainage headwalls, and other structures.

3. Stormwater detention

A hydrological assessment has been undertaken to determine peak flow rates for existing conditions at the location of the proposed Lake at its downstream end. This was followed by an assessment of peak flow rates for a fully developed catchment which generated an increase in peak flows. The detention volume of the Lake and its outlet have been designed to provide sufficient peak flow mitigation such that the peak flows from the fully developed catchment do not exceed current peak flow rates. The detention volume is situated above the permanent water level in the Lake. **Appendix A** provides a more detailed description of the methodology, parameters used and results of the hydrological and detention basin modelling. A Stream Erosion Index (SEI) assessment has not been undertaken at this stage given detention will provide peak flow mitigation and adequate erosion protection will be provided at the basin outlet.

4. Water quality

The water quality objectives for the East Lake are to achieve the target reductions of pollutant loads generated from a fully developed catchment upstream of the Lake. The design criteria and target reductions for new urban areas were obtained from the Penrith City Council's *Water Sensitive Urban Design (WSUD) Policy* (December 2013).

A water quality assessment was undertaken using the eWater MUSIC model to estimate the reduction in water pollution by the proposed Lake. The main purpose of the modelling was to demonstrate that the proposed water quality management controls (East Lake/water quality pond) would meet the water quality objectives of reducing the annual pollutant loads generated from the future urbanised catchment. **Appendix B** provides a more detailed description of the methodology, parameters used and results of the water quality modelling.

The results of the modelling indicate that the proposed size of the Lake would meet these objectives.

5. Maintenance

The proposed Lake will comprise of a deep water zone and a macrophyte zone which will consist of reed beds on the southern side and around the perimeter of the Lake on the northern side. It will facilitate nutrient and suspended solids removal and provide a habitat for wildlife. Water quality ponds and wetlands provide a very

effective means of treating stormwater in urban areas. However, ongoing maintenance is essential in maintaining the water quality performance of the Lake.

A maintenance procedure has been prepared to outline the maintenance and operational requirements associated with the East Lake.

Appendix C provides a more detailed description of the required maintenance regime, noxious weeds management and routine inspections of the Lake.

Appendix A. Hydrologic and detention basin assessment

A.1 Introduction

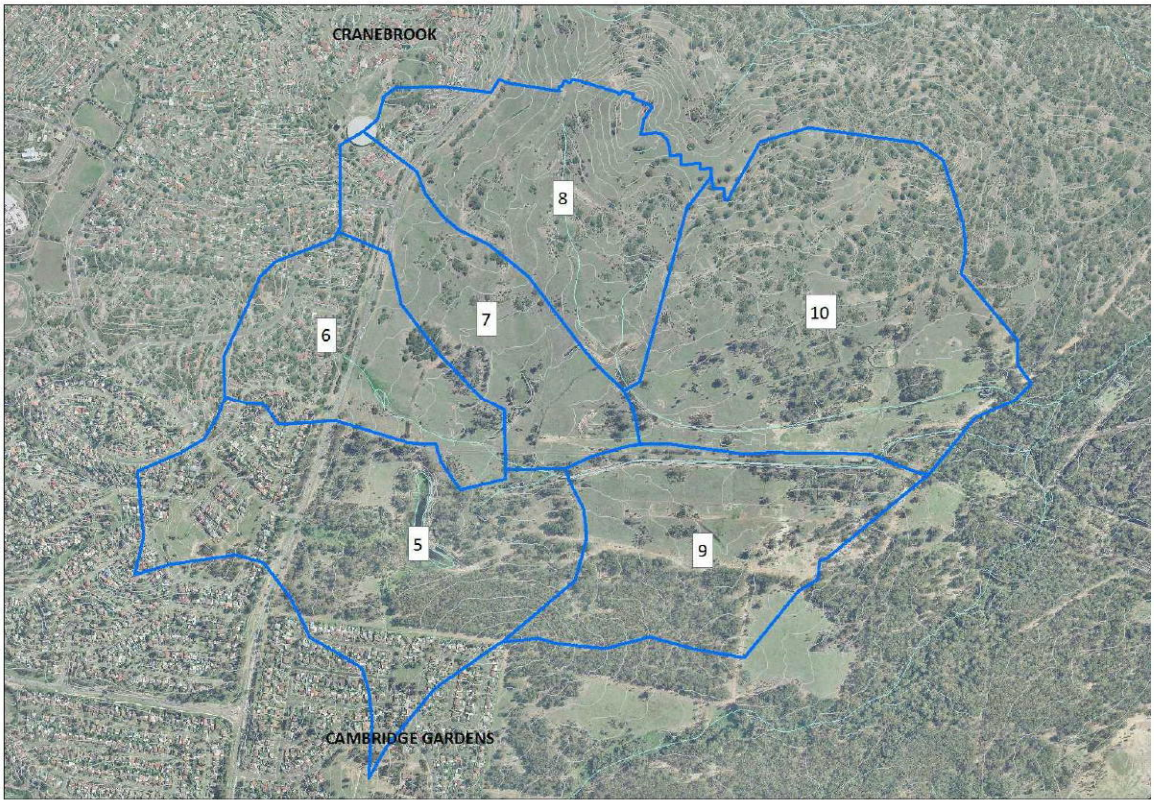
This section summarises work undertaken to assess detention requirements for the development the catchments upstream of the proposed East Lake. It provides details of the hydrological modelling work undertaken using the XP-RAFTS model to assess the existing and developed cases, in order to determine the detention volume requirements. It also provides details of HEC-RAS modelling undertaken to determine the basin outlet configuration that considered downstream flooding impacts.

A.2 Study area

The study area includes a total catchment area of 292 hectares draining to the proposed East Lake, which is located in the south-east corner of the Western Precinct. The Jordan Springs Lake is located within the study area and this captures an area of 109 hectares. The existing catchment areas are predominantly undeveloped, with some urban development on the western fringes of the catchment.

The study area, showing the catchment boundary used in this assessment is shown in **Figure A.1**.

- **Figure A.1 Study area showing catchment boundary**



A.3 Objective

The objective of the assessment is to mitigate the peak flows under the developed conditions such it is less than the existing peak flow for a range of design storms from 2 to 100 year average recurrence intervals (ARI). The assessment has used the XP-RAFTS model to provide the required detention volume and outlet configuration.

A.4 Design criteria (hydrology and detention) and model set up

A.4.1 Catchment areas

The study area has been divided into 6 sub-catchments which are shown in **Figure A.1**. Delineation of the catchments was undertaken as part of the *St Marys Western Precinct Plan – Water, Soils and Infrastructure Report* (May, 2009). Some minor improvements were made to the catchments following a review of this work. The catchment characteristics as modelled in XP-RAFTS are provided in in **Table A. 1.**

- **Table A. 1 Sub catchment details (refer to Figure A.1)**

Sub-catchment	Total area (ha)	Existing		Developed		Slope (%)
		Pervious sub area(ha)	Impervious sub area (ha)	Pervious sub area(ha)	Impervious sub area (ha)	
5	64.24	50.95	13.28	50.95	13.28	1.89
6	32.00	24.30	7.70	12.68	19.32	2.11
7	28.70	26.80	1.90	9.37	19.33	2.22
8	48.00	46.70	1.30	14.92	33.08	1.41
9	43.18	43.18	0.00	30.50	12.68	1.37
10	77.88	77.88	0.00	41.05	36.83	1.53

The pervious and impervious sub area values estimated for each sub catchment are based on the following assumptions:

- No development will occur in the park areas therefore percentage impervious does not change;
- Areas allocated for urban development will have varying impervious percentages between 50-70%. For the purpose of the assessment 70% has been adopted for all areas which is conservative and is consistent with previous hydrologic assessment undertaken for the Jordan Springs Lake; and
- Existing urban areas external to the site will be unchanged from existing, i.e. 50% impervious.

A.4.2 Rainfall intensities and loss parameters

Design rainfall Intensity-Frequency-Duration (IFD) data was generated for the site location following the procedure outlined in Australian Rainfall & Runoff (ARR, 1987). The design rainfall data was used in the RAFTS model and a suite of storm durations were input for each ARI rainfall event. The site IFD data is shown in **Table A. 2.** The site IFD data is very similar to IFD values provided in Penrith City Council's *Stormwater Drainage for Building Developments* guidelines.

- **Table A. 2 Site IFD rainfall data**

Duration (min)	2yr ARI	5yr ARI	10yr ARI	20yr ARI	50yr ARI	100yr ARI
20	52.82	69.66	79.08	91.89	108.85	121.9
30	42.83	56.47	64.09	74.46	88.19	98.75
60	29.05	38.28	43.43	50.44	59.72	66.86
90	23.04	30.31	34.36	39.89	47.19	52.81
120	19.48	25.6	29	33.65	39.79	44.51
180	15.33	20.12	22.78	26.41	31.21	34.89
360	10.16	13.3	15.04	17.42	20.56	22.97
720	6.75	8.81	9.95	11.51	13.57	15.15

An initial and continuing loss model was applied to the XP-RAFTS model. Loss parameters used in the model are outlined in **Table A. 3.**

- **Table A. 3 Loss parameters**

Land use	Initial loss (mm)	Continuing loss (mm)
Impervious	1.0	0.5
Pervious	10.0	2.5

The loss parameters are consistent with previous work undertaken by SKM for Jordan Springs. A Bx factor of 1.0 was adopted in the model which is also consistent with previous modelling.

A.4.3 Roughness coefficients

Manning's 'n' values adopted in the model for different land uses are provided in **Table A. 4** for the existing and developed case. These values are consistent with previous assessments undertaken.

- **Table A. 4 Roughness values**

Land use	Manning's 'n' value
Impervious	0.015
Pervious - urban	0.04
Pervious - rural	0.07

A.4.4 Channel routing

Channel routing was applied in the XP-RAFTS model to represent the change in flood attenuation that would occur as a result of the proposed East-West channel. The proposed channel details were obtained from the latest design drawings.

A.5 Model Results

The XP-RAFTS model was run for a range of durations from 15 minutes to 18 hours to assess and compare the existing peak flows to the developed peak flows with and without detention at the catchment outlet.
A comparison of peak flows for the 2 year and 100 year events is are shown in **Table A.** 5.

- **Table A. 5 Peak flows**

Design storm (ARI)	Peak flow existing (m^3/s)	Peak flow developed (m^3/s) no detention	Peak flow developed (m^3/s) with detention
2 year	9.8	24.9	8.9
100 year	29.6	60.4	27.0

The results in **Table A.5** indicate that the developed peak flow with detention is less than the existing peak flow for the 2 year and 100 year events. The reduction in peak flows is 9% and 13% respectively. There is also a significant reduction in developed peak flows with the detention basin when compared to the unmitigated peak flows.

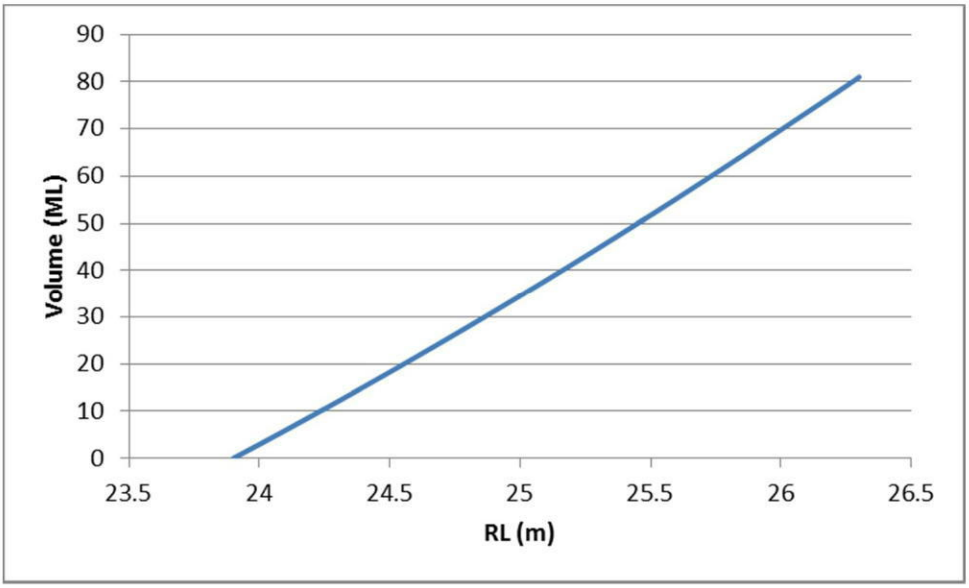
The results indicate that a minimum detention volume of approximately 55,000 m3 (55 ML) at East Lake provides adequate detention for the proposed developments with an acceptable freeboard. Details of the detention basin are provided in **Section A6**.

A.6 Detention basin details

A.6.1 Basin geometry

A stage-volume relationship of the basin was developed from the 3D (12d) model of the proposed lake shape and dimensions. The derived relationship is shown in **Figure A. 2.**

- **Figure A. 2 Stage-Volume relationship for East Lake**

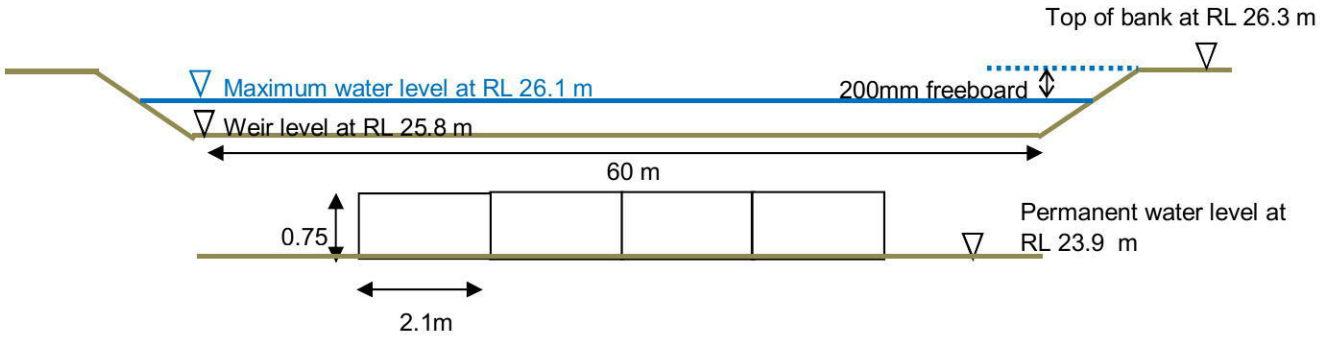


A.6.2 Outlet configuration

Model runs have been undertaken assuming the details shown below and the outlet configuration shown in **Figure A. 3:**

- 4 x box culverts, 2.1m width x 0.75m height with an upstream invert level of 23.9m
- 60m weir at an elevation of 25.8m. The elevation and width of the weir has been determined from HEC-RAS modelling of the basin weir and downstream channel and floodplain for the 100 year ARI event.

- **Figure A. 3 Outlet configuration**



Results for the 2 year and 100 year design events are summarised in **Table A. 6.**

- **Table A. 6 Detention details**

Design storm (ARI)	Detention volume required (ML)	Proposed Maximum stage (m)	Maximum depth over weir (mm)
2 year	27.7	25.0	0
100 year	55.0	26.1	300

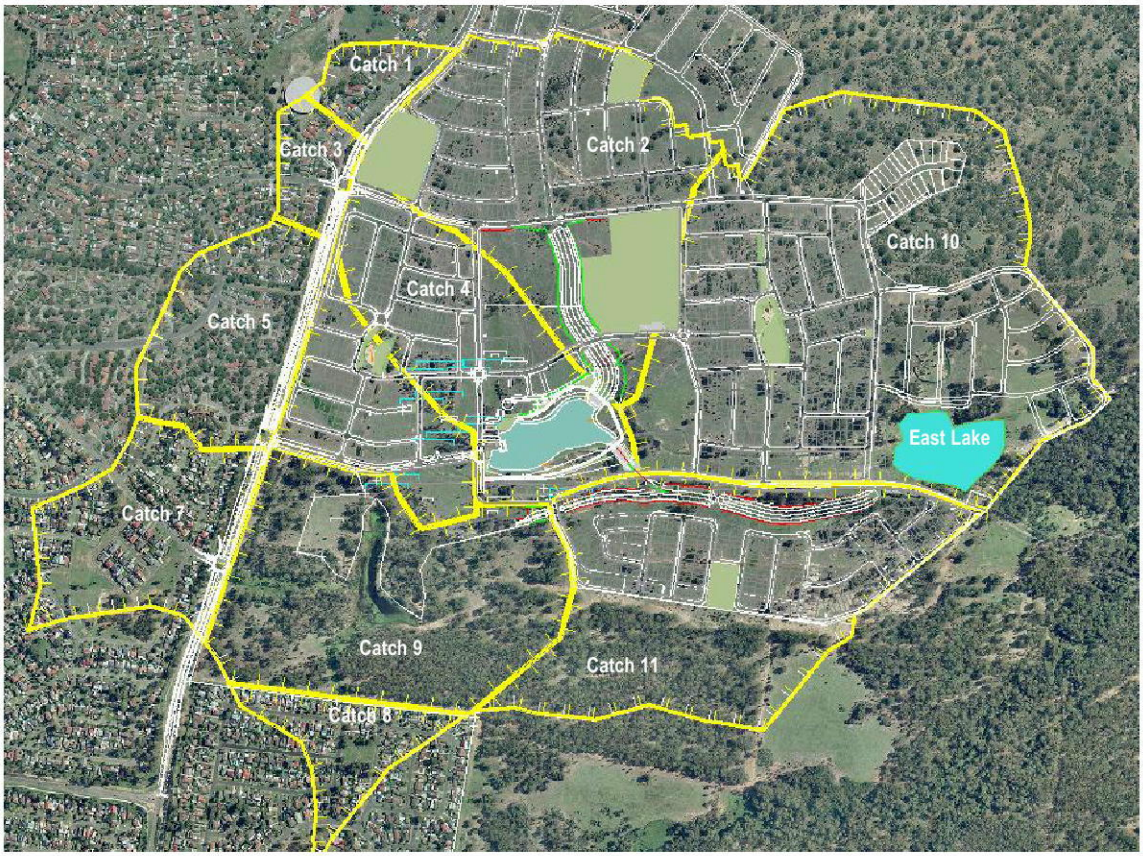
The 100 year ARI maximum stage and depth of flow over the weir has been obtained from HEC-RAS modelling of the basin weir and downstream channel. The HEC-RAS model better simulates the impact of downstream flooding conditions on the behaviour of the detention basin compared to the XP-RAFTS model. **Figure A2** and **Table A6** indicate that the minimum required detention volume of 55ML has been satisfied.

Appendix B. Water quality assessment

B.1 Purpose

The purpose of this report is to provide a water quality assessment of the proposed East Lake. The runoff generated from the proposed development area requires water quality treatment prior to being discharged into the Regional Park.

- **Figure B. 1 Location of the proposed East Lake and the associated upstream catchments**



B.2 Stormwater quality management objectives

The stormwater quality management objectives for the proposed development are to provide sufficient water quality treatment to reduce the Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) loads from the proposed development catchments. The objectives that have been used were obtained from Penrith City Council's *Water Sensitive Urban Design (WSUD) Policy* document (Penrith City Council, 2013). These criteria and water quality objectives for new urban areas are described on **Table B. 1.**

- **Table B. 1 Stormwater treatment objectives for new urban areas**

Pollutant	Pollutant load reductions
Total Suspended Solids (TSS)	85% reduction in the post development mean annual load
Total Phosphorus (TP)	60% reduction in the post development mean annual load
Total Nitrogen (TN)	45% reduction in the post development mean annual load
Gross Pollutants (greater than 5mm)	90% reduction in the post development mean annual load

B.3 Water quality strategy

The water quality treatment strategy for the proposed development includes:

- Conveying runoff by swales, where possible.
- Initial treatment of the proposed development areas with Gross Pollutant Traps (GPT)
- Capturing runoff in the East Lake where treatment would occur through natural processes prior to discharging into the Regional Park.

The topography of the site means that runoff from some existing upstream catchments would flow to the lake and would therefore also receive treatment.

B.4 Water quality MUSIC modelling

A stormwater quality assessment was undertaken using the MUSIC model (Version 6) to estimate the reduction in water pollution by the proposed Lake. The main purpose of the modelling was to demonstrate that the proposed GPTs and East Lake would meet the water quality objectives of reducing the annual pollutant loads generated from the future urbanised catchment. Whilst swales provide additional water quality treatment, they have not been considered in the modelling. This is considered to be a conservative approach.

The MUSIC modelling was undertaken following the procedures and recommendations in Penrith City Council's *WSUD Technical Guidelines* (Penrith City Council, 2014). The following section provides information on the MUSIC modelling inputs and process.

B.4.1 Climate

Pluviograph data for use in the model was obtained from the Bureau of Meteorology for station AWS 67113 at Penrith Lakes for the period January 1999 to December 2008. The ten year period was entered to the MUSIC model and the model was run at six minute time steps.

B.4.2 Soils

Site specific soil testing has been undertaken to confirm soil conditions in the location of the Lake.

Average laboratory testing results were found to be 0.0013 mm/hr while average field test results were 1.4 mm/hr. This is a significant difference that may be caused by the methodology of testing or variations in the soils or local fractures. Further site tests are likely to be undertaken once the lake is excavated to determine the most appropriate permeability value to be adopted in the range of 0.0013 to 1.4mm/hr. If the lake is to be lined with clay lining or a geosynthetic clay liner, the permeability would be reduced to nil. The water quality model has assumed a conservative design of 0.1mm/hr permeability. A more representative permeability would be in the order of 0.36mm/hr or higher.

B.4.3 Pollutants

In deriving data for pollutants generated by the urban catchments, data from Penrith City Council's *WSUD Technical Guidelines* (Penrith City Council, 2014) was used.

For the forested catchment areas, the *Draft NSW MUSIC Modelling Guidelines* (Sydney Metropolitan Catchment Management Authority, 2010) were reviewed. The recommended typical values for TSS, TP and TN were adopted as the Event Mean Concentrations (EMC) in the MUSIC model.

The values are given in **Table B. 2** and **Table B. 3**

- **Table B. 2 EMC values adopted for the urbanised catchments**

Pollutant	Base EMC (mg/L)	Storm EMC (mg/L)
TSS	15.8	141
TP	0.14	0.25
TN	1.29	2.0

- **Table B. 3 EMC values adopted for the forested catchments**

Pollutant	Base EMC (mg/L)	Storm EMC (mg/L)
TSS	6.0	39.8
TP	0.03	0.08
TN	0.30	0.89

B.4.4 Catchment areas

The total catchment area flowing to the East Lake is approximately 292 ha. The total developed area flowing to the East Lake, including existing urban areas is approximately 185 ha. A breakdown of the catchment characteristics is provided in **Table B. 4**.

- **Table B. 4 Catchment areas and characteristics (refer to Figure B. 1)**

Catchment	Area (ha)	Land use
1	4.7	Existing urban residential catchment at Cranebrook
2	39.8	Proposed urban residential catchment with some area being used as playing fields.
3	5.0	Existing urban residential catchment at Cranebrook
4	26.4	Proposed urban residential catchment and Jordan Springs Lake
5	16.8	Existing urban residential catchment at Cranebrook
6	14.0	Proposed urban residential catchment
7	18.4	Existing urban residential catchment at Cranebrook
8	8.2	Existing urban residential catchment at Cambridge Gardens
9	37.7	Regional Park to be retained
10	43.2	Proposed urban residential catchment with some area of the Regional Park to be retained
11	77.9	Proposed urban residential catchment and Jordan Springs Lake with some area of the Regional Park to be retained
Total	**292 ha**	

B.4.5 Rainwater tanks

The effect of rainwater tanks has been included in the model. The number of tanks in use has been estimated based on the requirement for properties over 400m^2 requiring rainwater tanks. The rainwater tanks would be used for irrigation of landscaped areas only. The irrigation demand on tanks has been taken from Council's *WSUD Technical Guidelines* (Penrith City Council, 2014). Rainwater tanks would not be plumbed to dwellings for internal use. The parameters used for modelling the rainwater tanks were are shown in **Table B.5**.

- **Table B.5 Rainwater tanks**

Parameter	Value
Estimated total number of tanks	1071
Size of each tank	2 kL
Estimated tank dimensions (length x width)	2210 mm x 700 mm
Average daily internal demand	-
Average annual irrigation demand	75 kL/yr/lot

B.4.6 Treatment nodes

Treatment would be provided by GPTs and the East Lake, all of which have been included in the MUSIC model. The GPTs included in the MUSIC model are two CDS units (one of which is already constructed upstream of Jordan Springs Lake) and a Humeguard device. The GPT removal rates used in the model were selected from Council's *WSUD Technical Guidelines* (Penrith City Council, 2014) and the manufacturer documentation, and are outlined in **Table B. 6.**

- **Table B. 6 GPT removal rates**

Pollutant	CDS Unit	Humeguard
Gross pollutants	95%	85%
TSS	70%	0%
TP	30%	0%
TN	0%	0%

The East Lake has been modelled as a water quality pond. The design parameters used in the model to represent the Lake are outlined in **Table B. 7.** The values of surface area and volume were obtained from 3d modelling of the proposed Lake.

- **Table B. 7 East Lake design parameters**

Parameter	Value
Surface area	29,400m² or 2.94ha
Extended detention depth	0.5m
Volume	46,554m^3
Exfiltration rate	0.1mm/hr – conservative estimate based on soil test results

B.4.7 Model layout

A screenshot of the MUSIC model is shown overleaf in **Figure B. 2.**

A portion of the undeveloped catchment 11a shown in **Figure B.2** (approximately 50%) may bypass the East Lake once the detailed drainage design is developed for the CC stages of the project. The water quality modelling in this report has assumed that the undeveloped catchment discharges into the Lake which is a conservative assumption that produces conservative results.

B.5 Results

The MUSIC model includes GPTs and the East Lake which has a proposed surface area of 2.94 ha, an estimated volume of 46.5ML. The model also includes the already constructed Jordan Springs Lake which provides water quality treatment to some upstream areas of the catchment.

The results for the MUSIC modelling are given in **Table B. 8**. This shows the annual pollutant loads for TSS, TP and TN generated by the upstream catchments. The residual annual loads after treatment are also shown. The percentage reduction in annual pollutant loads is deduced and compared to the water quality criteria.

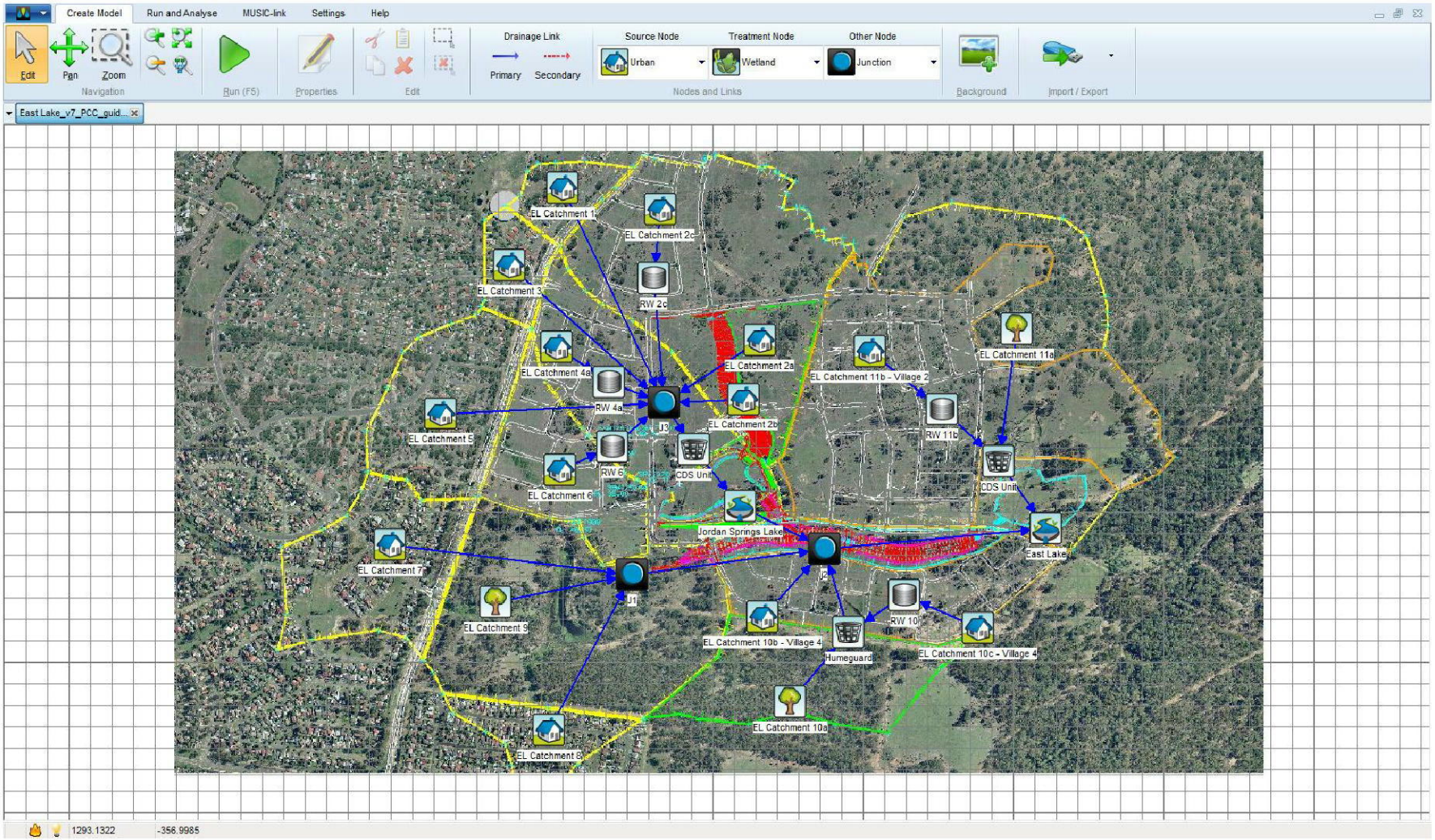
The results indicate that the proposed Lake will provide sufficient water quality treatment for the runoff generated from the developed upstream area. Although the MUSIC modelling suggests 100% of gross pollutants would be trapped by the treatment train, a reduction of 90 to 95% is considered more realistic as some floatable pollutants may not be captured during times of high flow.

- **Table B. 8 Pollutant loads and reductions achieved by the Lake system**

Pollutant	Average annual loads (kg/yr)	Residual annual loads (kg/yr)	Reduction (%)	Water quality reduction criteria (%)
TSS	92,800	10,900	88.3	85
TP	154	46.8	69.6	60
TN	1,150	585	49	45
Gross Pollutants	18,900	0	100	90

A sensitivity test adopting a 0 mm/hr exfiltration rate in East Lake was undertaken using the MUSIC model. The results showed there would be a minor decrease in the pollutant reduction rates achieved however the water quality targets would still be met.

- **Figure B. 2 MUSIC model layout**



B.6 Lake maintenance

Maintenance is an essential part of a healthy lake system that continues to provide an aesthetic environment as water quality treatment. A maintenance procedure for the Lake has been prepared to provide all essential tasks needed to undertake a good maintenance regime. Refer to **Appendix C.**

B.7 Conclusion

The size of the proposed East Lake would provide adequate water quality treatment to the proposed urbanised area. To ensure optimum water quality treatment the Lake would require adequate ongoing maintenance.

B.8 References

Penrith City Council (2005), *Draft Stormwater Quality Control Policy*, Penrith City Council, Sydney.

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Stormwater Trust (2000), *South Creek Stormwater Management Plan*, NSW Government, Sydney.

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Appendix C. Maintenance for the East Lake

C.1 Purpose

Wetlands provide a very effective means of treating stormwater in urban areas. However, wetlands constructed in urban environments are subject to external factors and hence, will not behave like natural systems without regular maintenance. Therefore, this Maintenance section has been prepared to outline the maintenance and operational requirements associated with the proposed stormwater wetland at East Lake. The main purpose of the wetland is to facilitate water quality treatment and to improve the aesthetic qualities of the area.

C.2 Wetland Management

C.2.1 Wetland function

Constructed wetland ecosystems are vitally important and regarded as valuable environmental management tools with key qualities being that wetlands:

- Decrease stormwater pollution
- Provide habitat for native flora and fauna
- Act as a buffer for the protection of natural aquatic ecosystems

Wetlands function through a variety of biological, chemical and physical processes which interact to increase nutrient removal and uptake by wetland flora, the breakdown of harmful chemicals in stormwater and the action of wetland physical processes which slow down the velocity of running stormwater. Wetlands are vitally important and when successfully implemented provide attractive public amenity.

C.2.2 The role of vegetation

Vegetation plays an important role in the effective functioning of a wetland. The reed beds and littoral areas in the macrophyte zone enhance the stormwater treatment process by filtering the sediment from the water, facilitating nutrient removal and providing a habitat for wildlife. The reed beds also provide a substrate for microbial biofilms and enhance the transfer of oxygen to the substrate. The open water area provides increased exposure to sunlight, thus increasing the level of water treatment.

The macrophytes to be planted in the wetland will be selected by the Landscape Architects at the detailed design stage. A preliminary list of macrophytes supplied by the Landscape Architects includes:

- Eleocharis sphacelata,
- Eleocharis acuta,
- Bolboschoenus fluviatilis
- Bolboschoenus caldwellii
- Baumea rubiginosa,
- Baumea articulata
- Lepironia articulata
- Schoenoplectus validus
- Schoenoplectus mucronatus
- Triglochin procerum
- Ludwigia peploides
- Philydrum lanuginosum

- Juncus usitatus
- Carex appressa
- Cyperus exaltatus
- Gahnia sieberiana
- Lomandra longifolia

Pest plant species

A number of undesirable weed species could potentially grow in the wetland. Therefore, maintenance staff must be familiar with the species originally planted in the wetland to enable identification of any foreign plant species. If any introduced weeds are observed, they must be removed as soon as possible to prevent infestation. Undesirable weed species could include

- Isolepris prolifera
- Cumbungi Typha spp
- Salvinia Salvinia molesta
- Water Hyacinth
- Eichhornia crassipes
- Cabomba Cabomba caroliniana
- Elodea Elodea canadensis
- Alligatorweed Alternanthera philoxeroides
- Primrose Willow Ludwigia peruviana
- Mexican Waterlily Nymphaea mexicana
- Dense Waterweed Egeria densa.

For a complete description of these weed species and their controls please refer to **Section 5** of this report.

Algal growth

Algal blooms tend to develop in warm, nutrient enriched waters. The presence of algae may cause deterioration in water quality and restrict light penetration into the water column. Algae may grow in the form of filamentous algae, such as *Enteromorpha* sp., *Spirogyra* sp. and *Cladophora* sp., which forms dense floating mats or in the form of blue-green algae, such as *Microcystis* and *Anabaena,* which forms on the surface of the water and in the water column.

Regular monitoring and maintenance of the wetland will help to minimise the likelihood of algal growth. Aquatic plants need to be maintained to enhance nutrient uptake and sediments captured in the sedimentation pond should be regularly removed to prevent the mobilisation of nutrients.

Algal blooms can be prevented using strategies such as:

- Changing conditions in the water body so that algae are less likely to bloom (e.g. oxygenation, treating the sediments)
- Harvesting macroalgae in shallow water or on beaches to keep the shoreline clean
- Increasing flushing so that more nutrients are lost from the water body

Algal blooms can be actively managed using the following management techniques (DNR 2010):

- Artificial destratification – altering the thermal layers within a waterbody which may be beneficial for algal blooms.
- Biomanipulation.
- Water treatment - Algae can be removed from wetlands using a number of strategies including coagulation using aluminium and ferric iron salts or organic polymers, filtration of the water body, and the use of algicides to remove any algal blooms present.

C.3 Wildlife management

C.3.1 Wildlife habitat

Constructed wetlands provide a sanctuary for birds and other animals. Feeding, nesting and breeding activities are enhanced within the wetland area and the abundance and diversity of wildlife can improve the aesthetic characteristics of the wetland basin.

C.3.2 Pest animal species

Animal species which could potentially pose a threat to the wetland environment are mosquitoes, mosquito fish, European Carp and introduced waterbirds.

Mosquitos

Mosquitoes pose the greatest risk to human health as they may transmit disease.
A variety of design and management strategies can be employed to minimise the likelihood of large mosquito populations. These include:

- Creating a water disturbance such as a jet or cascade operated by a submersible pump to disturb the mosquito breeding cycle and kill off populations
- Vary water levels during the breeding cycle to kill populations of mosquitoes
- Implementing a deep wetland design which allows wind wave disturbance and incorporates a steep bank slope to reduce habitat sites.

If present in an artificial wetland mosquito populations can be managed using aerial larvicide application. This application can be conducted by a suitably qualified operator using a hand based applicator or in large scale cases a small helicopter. The application process should be preceded by a pre-treatment survey to determine mosquito abundance and distribution and by a post-treatment survey to determine the success of the larvicide application.

The application of larvicide is heavily dependent upon local weather conditions and environmental characteristics and should only be conducted by a certified operator.

C.4 Wetland maintenance operations

C.4.1 Routine maintenance tasks

A routine inspection of the wetland is required to be undertaken monthly and after storm events or any other events such as floods, fire and chemical spills that may affect the wetland's function. It is recommended that most items be inspected monthly, however, some items only require attention three-monthly, bi-annually or annually. **Table C.** 1 outlines the frequency at which each item should be inspected and the appropriate maintenance activities associated with that item.

- **Table C. 1 Description of routine inspection tasks**

Item	Inspection frequency	Maintenance required
Physical		
Debris and litter removal, including at the inlet, outlet and overflow structures	Monthly and immediately after storm events	Hand removal and appropriate disposal of material.
Signage	As required	Inspect signs for vandalism. Replace and/or repair signs as necessary.
Sedimentation	As required	Remove sediment from the basin when 0.3m deep using an excavator.
Erosion	Monthly or after storm events	Check the verges and record the location and extent of any erosion. Stabilise erosion sites as necessary.
Water Level	Monthly	Record any changes in water level.
Biological		
Weeds	Monthly or after storm events	Hand removal of any introduced species before the infestation becomes difficult to control.
Mosquitoes	Three-monthly	Check for presence of mosquitoes at dawn and dusk. Check for larvae in pooled water and in shallow sections of the wetland. Check for the presence of invertebrates and small fish, which help to control mosquitoes.
Birds and other animals	Three-monthly	Record the presence of animals, including evidence of their existence such as droppings or tracks.
Blue-green algae	Monthly	Check for presence of green surface film, scum, discolouration or new odours.
Water quality	Bi-annually	Take water samples every 6 months or as necessary, depending on water quality testing results.
Change in waterplants	Annually	Record diagrammatically the location and abundance of waterplants and compare with original records. Note any discolouration, disease or death.
Replanting	As required	Replace plants as necessary, according to location and abundance of species.

C.4.2 Maintenance checklist

A maintenance checklist has been developed which will enable all aspects of the maintenance program, both physical and biological, to be completed and verified. A copy of the maintenance checklist is attached in **Appendix C1**.

Data collected at the wetland should be recorded in a database to assist in the long-term monitoring of the site. Any information recorded in field notes taken during routine inspections and associated maintenance work, as

well as results of laboratory testing should be stored in this database. Detailed descriptions of any changes to the wetland will assist management in identifying future needs and maintenance priorities.

Aquatic vegetation

Over time, there may be some changes in the distribution and abundance of aquatic species found in the wetland. Undesirable plants should be removed by hand as soon as possible to minimise further spreading and to avoid the use of pesticides.

A thorough annual inspection is recommended to document the precise location and abundance of aquatic vegetation, however, any significant changes to the wetland vegetation should be recorded when observed. The results of the inspection should be illustrated diagrammatically and compared with the initial planting guide. The condition of the plants, particularly any signs of disease, pests or stunted growth should also be noted.

Water quality

Water quality changes can be accessed through physical and chemical testing. Measurements of suspended solids; nutrients including total phosphorus, total nitrogen and ammonia; heavy metals; hydrocarbons including oils and grease; organics; pathogens including faecal coliforms; oxygen demand; pH and temperature should be recorded bi-annually, after the initial establishment of plants.

Basin shape and size

The capacity of the wetland to hold and treat stormwater is dependent upon the shape and size of the basin. Changes to embankment slope and depth may affect the volume of runoff which can be contained in the wetland. Embankments should be inspected monthly to assess any changes which may have occurred as a result of erosion, scouring or changes to vegetation cover. Any changes in water level and basin depth due to changed flow conditions, evaporation or sedimentation should also be recorded. Weed management

C.5 Weed management

There are many definitions to describe what a weed is. A suitable description of a weed is an unwanted plant growing in a given area which, to reduce its effect on the economy, the environments, human health and amenity requires some form of action control or management action. Weeds are also known as invasive plants. (DEWHA 2010a, NSW DPI 2010). Weeds are among the most serious threats to Australia's natural environment and primary production industries. They displace native species, cause significant land degradation, and reduce farm and forest productivity, and generally interfere with the natural balance of ecological communities (DEWHA 2010b).

C.5.1 Weed control methods

As weeds have such a great economical and environmental impact, appropriate control and management measures are required to minimise any possible weed impacts. The most effective means of weed control is through early detection and eradication where necessary.

Herbicide use and safety

As described above weed infestations can be controlled using herbicide supplication. When spraying weed infestations with weeds caution should be used at all times as any ‘over-spray’ may have negative impacts upon non-targeted vegetation and the local environment. The following parameters must be employed when using herbicide to control weed infestation:

- Only licensed operators may undertake herbicide spraying.
- Only use herbicides according to the product label instructions.
- Use only non-residual herbicide (e.g. Biactive Roundup).

- Ensure all personal protective equipment (PPE) is worn; including, overalls, covered shoes, gloves, glasses and mask.
- Monitor local weather conditions and do not spray on days which are windy, days of rain, or when rain is expected in the proceeding days.

Employees working in the wetland are advised to minimise skin contact with water in the wetland basin. Either waterproof boots, thigh boots or gum boots should be worn at all times. Other protective clothing, sunscreen and insect repellent should be provided by Council for all staff working in and around the wetland area. The Occupational Health and Safety Act 2000 was established to protect the health, safety and welfare of people at work.

C.5.2 Common aquatic weeds

Common aquatic weeds which may be present include:

- Isolepris prolifera,
- Cumbungi (*Typha* spp,)
- Salvinia (*Salvinia molesta*)
- Water Hyacinth (*Eichhornia crassipes*)
- Cabomba (*Cabomba caroliniana*)
- Elodea (*Elodea canadensis*)
- Alligatorweed (*Alternanthera philoxeroides*)
- Primrose Willow (*Ludwigia peruviana*)
- Mexican Waterlily (*Nymphaea mexicana*) and
- Dense Waterweed (*Egeria densa*)

C.5.3 Noxious weeds

The outlet from the East Lake discharges into South Creek which is a tributary of the Hawkesbury River. A list of declared noxious weeds in the control area of Hawkesbury River County Council is included in **Appendix C1**.

C.6 References

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Appendix C1 – Noxious Weeds

Weed	Class	Legal requirements
African boxthorn [*Lycium ferocissimum*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
African feathergrass [*Pennisetum macrourum*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
African olive [*Olea europaea subspecies cuspidata*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
African turnipweed [*Sisymbrium runcinatum*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
African turnipweed [*Sisymbrium thellungii*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Alligator weed [*Alternanthera philoxeroides*]	3	The plant must be fully and continuously suppressed and destroyed
Anchored water hyacinth [*Eichhornia azurea*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Annual ragweed [*Ambrosia artemisiifolia*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Arrowhead [*Sagittaria montevidensis*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Artichoke thistle [*Cynara cardunculus*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Athel pine [*Tamarix aphylla*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Bathurst/Noogoora/Hunter/South American/Californian/cockle burr [*Xanthium* species]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority

Bear-skin fescue [*Festuca gautieri*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Black knapweed [*Centaurea nigra*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Blackberry [*Rubus fruticosus* aggregate species] except cultivars Black satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smoothstem, Thornfree	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed This is an All of NSW declaration
Bridal creeper [*Asparagus asparagoides*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Broomrapes [*Orobanche* species] Includes all Orobanche species except the native O. cernua variety australiana and O. minor	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Burr ragweed [*Ambrosia confertiflora*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Cabomba [*Cabomba caroliniana*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Cayenne snakeweed [*Stachytarpheta cayennensis*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Chilean needle grass [*Nassella neesiana*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Chinese violet [*Asystasia gangetica* subspecies *micrantha*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Clockweed [*Gaura parviflora*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Columbus grass [*Sorghum x almum*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Corn sowthistle [*Sonchus arvensis*]	5	The requirements in the Noxious Weeds Act

		1993 for a notifiable weed must be complied with This is an All of NSW declaration
Crofton weed [*Ageratina adenophora*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Dodder [*Cuscuta* species] Includes All Cuscuta species except the native species C. australis, C. tasmanica and C. victoriana	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
East Indian hygrophila [*Hygrophila polysperma*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Espartillo [*Achnatherum brachychaetum*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Eurasian water milfoil [*Myriophyllum spicatum*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Fine-bristled burr grass [*Cenchrus brownii*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Fountain grass [*Pennisetum setaceum*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Gallon's curse [*Cenchrus biflorus*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Giant Parramatta grass [*Sporobolus fertilis*]	3	The plant must be fully and continuously suppressed and destroyed
Glaucous starthistle [*Carthamus glaucus*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Golden dodder [*Cuscuta campestris*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Golden thistle [*Scolymus hispanicus*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Green cestrum [*Cestrum parqui*]	3	The plant must be fully and continuously suppressed and destroyed
Harrisia cactus [*Harrisia* species]	4	The growth and spread of the plant must be

		controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed This is an All of NSW declaration
Hawkweed [*Hieracium* species]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Horsetail [*Equisetum* species]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Hygrophila [*Hygrophila costata*]	2	The plant must be eradicated from the land and the land must be kept free of the plant
Hymenachne [*Hymenachne amplexicaulis*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Italian bugloss [*Echium* species]		See Paterson's curse, Vipers bugloss, Italian bugloss
Johnson grass [*Sorghum halepense*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Karoo thorn [*Acacia karroo*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Kochia [*Bassia scoparia*] except Bassia scoparia subspecies trichophylla	1	except B.scoparia subspecies trichophylla The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Lagarosiphon [Lagarosiphon major]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Lantana [Lantana species]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Leafy elodea [Egeria densa]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Lippia [Phyla canescens]	4	The plant must not be sold, propagated or knowingly distributed by any person other than a person involved in hay or lucerne production. The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control

		authority. This is an All of NSW declaration
Long-leaf willow primrose [*Ludwigia longifolia*]	3	The plant must be fully and continuously suppressed and destroyed
Long-leaf willow primrose [*Ludwigia longifolia*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Ludwigia [*Ludwigia peruviana*]	3	The plant must be fully and continuously suppressed and destroyed
Mexican feather grass [*Nassella tenuissima*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Mexican poppy [*Argemone mexicana*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Miconia [*Miconia* species]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Mimosa [*Mimosa pigra*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Mossman River grass [*Cenchrus echinatus*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Mother-of-millions [*Bryophyllum* species and hybrids]	3	The plant must be fully and continuously suppressed and destroyed and the plant may not be sold, propagated or knowingly distributed
Noogoora burr [*Xanthium* species]		See Bathurst/Noogoora/Hunter/South American/Californian/cockle burr
Onion grass [*Romulea* species] Includes all Romulea species and varieties except R. rosea var. australis	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Oxalis [*Oxalis* species and varieties] Includes all Oxalis species and varieties except the native species O. chnoodes, O. exilis, O. perennans, O. radicosa, O. rubens, and O. thompsoniae	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Pampas grass [*Cortaderia* species]	3	The plant must be fully and continuously suppressed and destroyed
Parthenium weed [*Parthenium hysterophorus*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration

Paterson's curse, Vipers bugloss, Italian bugloss [*Echium* species]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Pellitory [*Parietaria judaica*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Pond apple [*Annona glabra*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Prickly acacia [*Acacia nilotica*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Prickly pear [*Cylindropuntia* species]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed This is an All of NSW declaration
Prickly pear [*Opuntia* species except *O. ficus-indica*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed This is an All of NSW declaration
Privet (Broad-leaf) [*Ligustrum lucidum*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Privet (Narrow-leaf/Chinese) [*Ligustrum sinense*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Red rice [*Oryza rufipogon*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Rhus tree [*Toxicodendron succedaneum*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority This is an All of NSW declaration
Rubbervine [*Cryptostegia grandiflora*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration

Sagittaria [*Sagittaria platyphylla*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Salvinia [*Salvinia molesta*]	3	The plant must be fully and continuously suppressed and destroyed
Sand oat [*Avena strigosa*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Senegal tea plant [*Gymnocoronis spilanthoides*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Serrated tussock [*Nassella trichotoma*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Siam weed [*Chromolaena odorata*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Smooth-stemmed turnip [*Brassica barrelieri* subspecies *oxyrrhina*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Soldier thistle [*Picnomon acarna*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Spiny burrgrass [*Cenchrus incertus*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Spiny burrgrass [*Cenchrus longispinus*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Spotted knapweed [*Centaurea maculosa*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
St. John's wort [*Hypericum perforatum*]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Texas blueweed [*Helianthus ciliaris*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration

Water caltrop [*Trapa* species]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Water hyacinth [*Eichhornia crassipes*]	3	The plant must be fully and continuously suppressed and destroyed
Water lettuce [*Pistia stratiotes*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Water soldier [*Stratiotes aloides*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Willows [*Salix* species] Includes all Salix species except S. babylonica, S. x reichardtii, S. x calodendron	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Witchweed [*Striga* species] Includes all Striga species except native species and Striga parviflora	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Yellow burrhead [*Limnocharis flava*]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Yellow nutgrass [*Cyperus esculentus*]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration

Appendix C2 – Maintenance Checklist

Inspection Checklist

Name …… Signature ……
Date ……

Item	Action Required			Comments[4]	Action Taken[5]
	None[1]	Soon[2]	Urgent[3]		
Physical					
Debris and litter					
Signage					
Sedimentation					
Erosion					
Water Level					
Biological					
Weeds					
Mosquitoes					
Birds / Other Animals					
Blue-green Algae					
Water Quality					
Change in Waterplants					
Replanting					

[1] The item is in good condition and no additional maintenance is required
[2] The item is in reasonable condition; however, further maintenance is required prior to the next inspection.
[3] The item is in poor condition and requires immediate action
[4] Describe any additional work required
[5] Describe the date and action taken to rectify the issue

ANNEXURE C – 9343/03DA04 Village 5 Stormwater Layout Plan and 9343/03CC36 Village 5 Catchment Plan

REGIONAL PARK

CATCH DRAIN 1, REFER TYPICAL DETAIL ON DA02

RCBC ESTIMATED TO BE APPROX. 1 x 2.1 x 0.75m UNIT

ROAD 1

ROAD 2

ROAD 3

ROAD 4

ROAD 5

ROAD 6

ROAD 7

ROAD 8

GREENWOOD PKWY

EXISTING STAGE 2

REGIONAL PARK

GPT

VILLAGE 2 GPT TO BE CONSTRUCTED OUTSIDE OF WATERMAIN EASEMENT

PROPOSED SEDIMENT BASIN AS APPROVED IN DA 13-0065

REFER RIGHT FOR CONTINUATION

REFER LEFT FOR CONTINUATION

LAKESIDE PDE

LEGEND

- PROPOSED STORMWATER DRAINAGE LINE AND PIT
- EXISTING STORMWATER DRAINAGE LINE AND PIT
- GPT — GROSS POLLUTANT TRAP
- 1:100YR ARI FLOW PATH
- PROPOSED CDL EASEMENT
- LIMIT OF WORKS
- 29.0 — DESIGN CONTOUR
- 35.0 — EXISTING CONTOUR
- CATCH DRAIN

1:1000 (AT A1)

20 10 0 10 20 30 40 50 60 70 80 90 100

METRES

	AMENDMENT	DES	DRN	CKD	APR	DATE
F	RE-ISSUE FOR DA APPROVAL	AS	TG	AM	MS	02/10/14
E	LOT NUMBERS UPDATED	TG	TG	DJH	RO	20/08/14
D	ISSUE FOR DA APPROVAL	AS	TG	KN	MS	15/07/14
C	PRE-DA ISSUE	AS	AS			17/06/14
B	NOT ISSUED					
A	NOT ISSUED					

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
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P 02 4720 3300 F 02 4721 7638 W www.jwprince.com.au E jwp@jwprince.com.au

AZIMUTH: MGA

DATUM: AHD

ORIGIN:

CLIENT: Lend Lease

THIS DRAWING MUST NOT BE USED FOR CONSTRUCTION UNLESS SIGNED AS PART OF AN APPROVED CONSTRUCTION CERTIFICATE.

ISSUED FOR DA APPROVAL
NOT FOR CONSTRUCTION

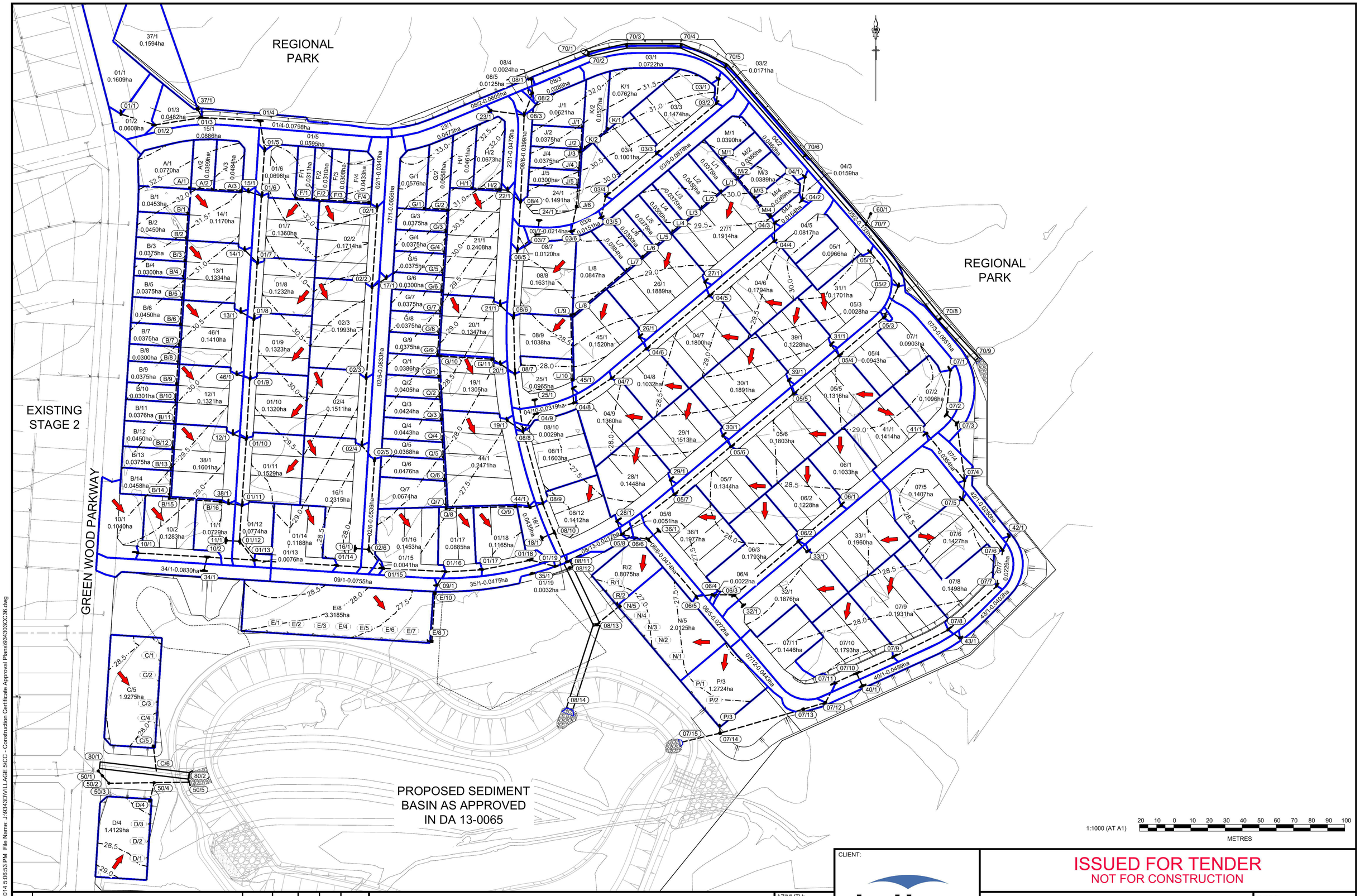
JORDAN SPRINGS
VILLAGE 5
STORMWATER LAYOUT PLN

PLAN No: 9343/03DA04 F

FILE No: 934303DA04

SHEET SIZE: A1 ORIGINAL

Plotted: 2 October, 2014 12:05:51 PM File Name: J:\9343\DVILLAGE 5\DA - Development Application Approval Plans\934303DA04.dwg



A	ISSUED FOR TENDER	AS	TG	DJH	RO	03/10/14
	AMENDMENT	DES	DRN	CKD	APR	DATE

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AZIMUTH: MGA
DATUM: AHD
ORIGIN:

CLIENT: Lend Lease

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ISSUED FOR TENDER
NOT FOR CONSTRUCTION

JORDAN SPRINGS
VILLAGE 5
CATCHMENT PLAN

PLAN No: 9343/03CC36 A
FILE No: 934303CC36
SHEET SIZE: A1 ORIGINAL

Plotted: 3 October , 2014 5:06:53 PM File Name: J:\9343DV\VILLAGE 5\CC - Construction Certificate Approval Plans\934303CC36.dwg