ADW JOHNSON PTY LIMITED
ABN 62 129 445 398

Sydney
Level 35 One International Towers
100 Barangaroo Avenue
Sydney NSW 2000
02 8046 7411
sydney@adwjohnson.com.au

Central Coast
5 Pioneer Avenue
Tuggerah NSW 2259
02 4305 4300
coast@adwjohnson.com.au

Hunter Region
7/335 Hillsborough Road
Warners Bay NSW 2282
02 4978 5100
hunter@adwjohnson.com.au

Engineering

Working Beyond Expectations

Stormwater Management Plan

Basin C and V6 for Villages 3C and 6 of Jordan Springs

Applicant:

Lendlease

Date:
November 2019

Document Control Sheet

Issue No.	Amendment	Date	Prepared By	Checked By
A	DRAFT	November 2019	JB	ML/MK
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Limitations Statement

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Executive Summary

ADW Johnson has been commissioned by Lendlease to prepare a stormwater management plan and regional basin designs to accompany an Environmental Impact Statement (EIS) and Development Application (DA) in Jordan Springs. The two basins are referred to as Basin C and Bains V6.

This report details the investigation, analysis and modelling for the design of the two (2) regional basins. The basins are intended for water quality and peak flow management for parts of the Village 3 and full Village 6 catchments of Jordan Springs. There are currently four (4) temporary basins servicing these catchments, which will all be decommissioned as they are currently located in proposed residential areas.

The Stormwater Management Plan (SMP) is required by Penrith City Council and is to meet the requirements set out in various Council documents in relation to total water cycle management, erosion and sediment control, water sensitive urban design and pre to post flow requirements. Furthermore, the proposed development is to comply with requirements set out in the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) and the Secretary's Environmental Assessment Requirements (SEARs).

Stormwater detention modelling, undertaken with XP Rafts, demonstrated that the post development flows leaving the site are equal to or less than the existing flows. MUSIC modelling has been completed adopting water sensitive urban design measures to demonstrate compliance with the performance target objectives of PCC's Water Sensitive Urban Design Technical Guidelines.

Two (2) regional basins have been designed and sized accordingly to the modelling performed.

A maintenance plan has been put together for the two basins which incorporates weed control, debris clearing and water level control. Maintenance access tracks and ramps have been proposed.

An erosion and sedimentation control plan has been completed for the proposed basins to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the site to downstream waterways during the construction period.

This report in intended to be read in conjunction with concept engineering drawings attached within Appendix D.

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1.0 Introduction

ADW Johnson has been commissioned by Lendlease to prepare a stormwater management plan and regional basin designs for an existing development in Jordan Springs(St Marys Development Site). This report details the investigation, analysis and modelling for the design of the two regional basins, being basin C and V6. The basins are intended to service catchments 3C1, 3C2, 3C3 and Village 6 of Jordan Springs as shown below in **Figure 1**. There are currently four (4) temporary basins servicing the existing development, which could be decommissioned to allow the completion of residential development following the construction of the regional basins. The decommissioning of these temporary basins is not a part of this application.

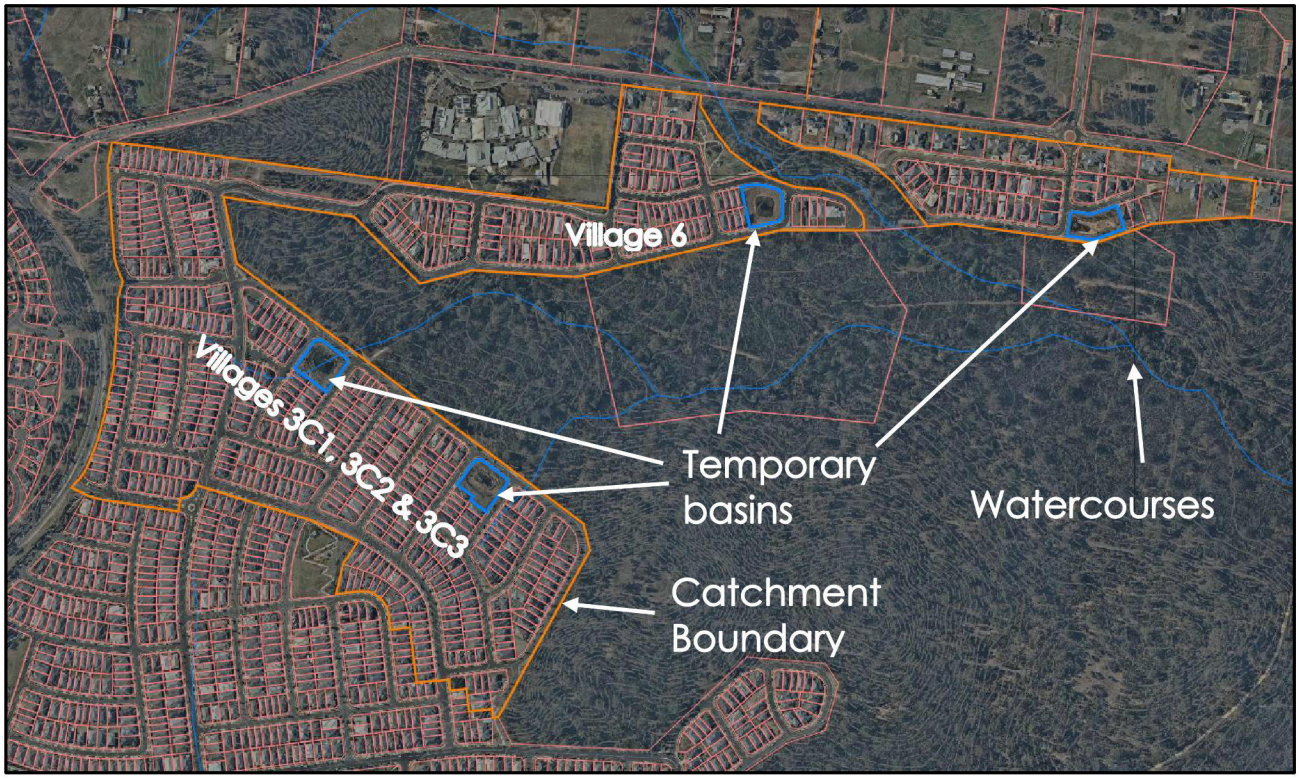


Figure 1. Existing development

The regional basins will provide water quality treatment for the abovementioned catchments to comply with the SREP 30 and SEARs requirements. They will also function as the primary stormwater detention devices for the catchments.

1.1 PROJECT DESCRIPTION

The proposal involves the construction of stormwater Basins C and V6 to detain, treat and attenuate stormwater runoff from the Village 3 and Village 6 Jordan Springs development. The basins are located within the north-western extent of the St Marys Development Site and within the Wianamatta Regional Park. Basins C and V6 will be constructed wetlands and act as water quality improvement basins with the provision for active stormwater detention during high flows.

Basin C will have a surface area of approximately 1.8 hectares and a notional depth of 1.7m. Whereas Basin V6 approximately 0.3 hectares and a notional depth of 1.6m

Each basin is designed to contribute to the water quantity and quality management objectives under the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins will incorporate the features for both water quality treatment and detention including a drainage inlet point, low level culvert outlet, spillway with scour protection and vegetated slopes to provide effective nutrient removal. An access track is proposed on the top of embankment of each basin with access ramps will be constructed, to facilitate ongoing maintenance.

1.2 LITERATURE REVIEW

The site has been subject to a several stormwater reports and management strategies since the rezoning in 2001.

A Literature Review was undertaken by ADW Johnson to summarise the findings of these previous reports and is attached at **Appendix C.** summarizes previous stormwater management reports, as furnished (or where publicly available) to ADW Johnson, and forms the basis of the concept design for the basins.

2.0 Site Description

2.1 CURRENT SITE CONDITIONS

The existing site consists of low-density residential development, typically surrounded by undeveloped bushland and pasture. Four (4) temporary basins currently service the more recently developed catchments Villages 3C1, 3C2, 3C3 and 6. There are three (3) watercourses within the site of which the basins discharge into. **Figure 2** shows and aerial image of the existing site.

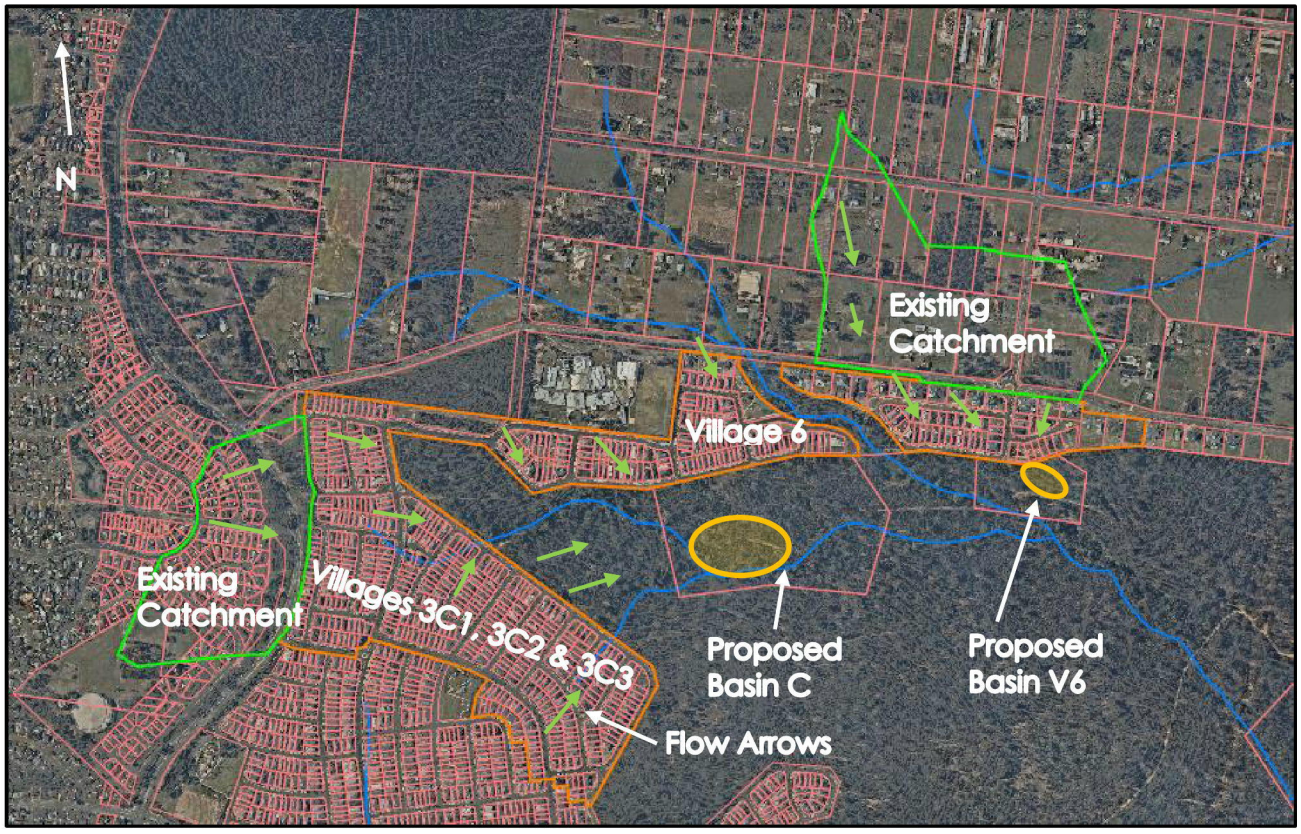


Figure 2. Development Layout and Catchments

The site contains various ridgelines and gullies that convey overland flows east, towards South Creek. This site is relatively flat (generally around 2% grade), particularly at the watercourses. The basins are proposed to be located in bushland area. Several access tracks are located throughout the bushland and likely serve as fire trails.

A detailed analysis of the topography was undertaken to determine the overall catchments draining to the proposed basin areas. These can be seen by the orange and green polygons as above (also included at Appendix D). The green polygons represent existing developments draining towards the basins. The orange polygons represent parts of the recent developed Villages 3C1, 3C2, 3C3 and 6 which drain towards the basins.

The basin for Village 3C catchments has been located online, whereas basin 6 is proposed uphill from an existing defined waterway. Both basin outlets drain to existing defined watercourses and hence legal pint of discharge.

2.2 PREDEVELOPED SITE

For the purposes of stormwater detention modelling it is necessary to consider the site prior to the St Marys Development. For the purposes of this report, the adjacent developments, generally completed prior to 1990 (developments west of Village 3C and the existing rural development to the north of Village 6) have been considered developed in both pre and post development models. These areas are defined by green catchment boundaries in the catchments plan attached at **Appendix D.**

In this case the green catchments from **Figure 2** remain the same, and the orange catchments are assumed as bushland. LiDAR contours of the area pre-development show a moderately undulating terrain with slopes between 2-6%.

2.3 GROUNDWATER

The groundwater level for the area of the proposed basins is between 3.0-3.6m deep from the surface (*refer Geotechnical Site Investigation Report – St Marys Detention Basins C and V6- Construction Sciences).* It can be expected that Groundwater levels can fluctuate based on climate conditions.

The proposed maximum extents of cutting for the regional basins at or above the groundwater table. As such, any impacts on the groundwater table are expected to be minimal.

2.4 SOILS

Geotechnical investigation found soils in the area consist of a thin layer of silty SAND between 0.1-0.5m thick with an underlying layer of silty CLAY. It is anticipated that the existing clay could be used for the basin lining and claycore. Rock was not encountered though the boreholes were terminated at no deeper than 4.5m.

Refer Geotechnical Site Investigation Report – St Marys Detention Basins C and V6-Construction Sciences for further analysis.

2.5 WATER SHARING PLANS

The basins are not intended to be used as a mean of harvesting water, and as such does not form part of a Water Sharing plan.

3.0 Requirements

3.1 COUNCIL REQUIREMENTS

Penrith City Council has multiple documents outlining requirements in relation to stormwater management. These documents are:

- Design Guidelines for Engineering Works for Subdivisions and Developments -November 2013;
- Stormwater Drainage Specification for Building Developments – November 2016;
- Water Sensitive Urban Design (WSUD) Policy – December 2013;
- WSUD Technical Guidelines -June 2015; and
- Penrith Development Control Plan 2014 – Volume 1

These documents outline various requirements for stormwater management including but not limited to:

- Post-development peak flows to be limited to less than or equal to pre-development peak flows for a range of stomrs;
- Management of volume and duration of stormwater flows entering local waterways to protect the geomorphic values of those waterways; and
- Reduction on pollutant loads as per **Table 3.1**.

Table 3.1 – Council's pollutant treatment target rates.

Pollutant	Target Reduction
Gross Pollutants	90%
Total Suspended Solids	85%
Total Phosphorus	65%
Total Nitrogen	45%

3.2 SREP30 REQUIREMENTS

The Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) outlines a specific set of requirements for developments within the St Marys area. These requirements have been acknowledged and are addressed throughout this report. The requirements which affect this report study are outlined in **Table 3.2** below.

Table 3.2 – SREP 30 Clauses relevant to this report.

SREP 30 Clause No.	Requirement	Addressed in Section
28. Watercycle		
28.1	During and following construction, impacts upon water quality are to be minimised, through the utilisation of effective erosion and sediment control measures in accordance with industry standards.	Section 6.0
28.2	The use of the land to which this plan applies is to incorporate stormwater management measures that ensure there is no net adverse impact upon the water quality (nutrients and suspended solids) in South Creek and Hawkesbury-Nepean catchments.	Section 5.0
28.4	Development is to be designed and carried out so as to ensure that there is no significant increase in the water table level and that adverse salinity impacts will not result.	Section 2.5
28.6	Drainage lines are to be constructed and vegetated so that they approximate as natural a state as possible. Where it is necessary to modify existing drainage lines to accommodate increased stormwater runoff from urban areas, this should be done in a manner which maximises the conservation of indigenous flora in and around the drainage lines.	Section 2.0 and Section 7.0
28.7	Development is to be carried out in a manner that minimises flood risk to both people and property.	Section 7.3
28.8	Changes in local flow regimes due to development are to be minimised for rainfall events up to the 50% AEP rainfall event.	Section 4.4
28.9	Gross pollutants are to be collected at, or as close as possible to, their source or at all stormwater outlets, or at both of those places, so that there is no increase in sediment/litter entering the creeks as a result of development.	Section 5.1
29. Soils		
29	Development is to have regard to soil constraints to ensure that the risk of adverse environmental and economic impacts is minimised.	Section 6.0

3.3 SEARS REQUIREMENTS

The Secretary's Environmental Assessment Requirements (SEARs) outlines a further set of requirements which must be adhered to for this development and are addressed within this report. The SEARs requirements which affect this report study are outlined in **Table 3.3** below.

Table 3.3 – SEARs Clauses relevant to this report.

SEARs Clause No.	Requirement	Addressed in Section
8. Flooding		
8.1	The Proponent must assess and (model where required) the impacts on flood behaviour during construction and operation for a full range of flood events up to the probable maximum flood (taking into account sea level rise and storm intensity due to climate change) including: a) any detrimental increases in the potential flood affectation of other properties, assets and infrastructure; b) consistency (or inconsistency) with applicable Council floodplain risk management plans; c) compatibility with the flood hazard of the land; d) compatibility with the hydraulic functions of flow conveyance in flood ways and storage areas of the land; e) downstream velocity and scour potential; f) impacts the development may have upon existing community emergency management arrangements for flooding. These matters must be discussed with the State Emergency Services and Council; and g) any impacts the development may have on the social and economic costs to the community as consequence of flooding.	Addressed in overall report
15. Soils		
15.1	The Proponent must verify the risk of acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Risk Map) within, and in the area likely to be impacted by, the project.	Refer Geotech report
15.2	The Proponent must assess the impact of the project on acid sulfate soils (including impacts of acidic runoff offsite) in accordance with the current guidelines.	Refer Geotech report
15.3	The Proponent must assess whether the land is likely to be contaminated and identify if remediation of the land is required, having regard to the ecological and human health risks posed by the contamination in the context of past, existing and future land uses. Where assessment and/or remediation is required, the Proponent must document how the assessment and/or remediation would be undertaken in accordance with current guidelines.	Refer contamination report
15.4	The Proponent must assess whether salinity is likely to be an issue and if so, determine the presence, extent and severity of soil salinity within the project area.	Refer Geotech report
15.5	The Proponent must assess the impacts of the project on soil salinity and how it may affect groundwater resources and hydrology.	Refer Geotech report
15.6	The Proponent must assess the impacts on soil and land resources (including erosion risk or hazard). Particular attention must be given to soil erosion and sediment transport consistent with the practices and principles in the current guidelines.	**Section 6.0**
21. Water – Hydrology		
21.1	The Proponent must describe (and map) the existing hydrological regime for any surface and groundwater	**Section 2.0** and

	resource (including reliance by users and for ecological purposes) likely to be impacted by the project, including stream orders, as per the FBA.	**Section 6.0**
21.3	The Proponent must assess (and model if appropriate) the impact of the construction and operation of the project and any ancillary facilities (both built elements and discharges) on surface and groundwater hydrology in accordance with the current guidelines, including: a) natural processes within rivers, wetlands, estuaries, marine waters and floodplains that affect the health of the fluvial, riparian, estuarine or marine system and landscape health (such as modified discharge volumes, durations and velocities), aquatic connectivity and access to habitat for spawning and refuge; b) impacts from any permanent and temporary interruption of groundwater flow, including the extent of drawdown, barriers to flows, implications for groundwater dependent surface flows, ecosystems and species, groundwater users and the potential for settlement; c) changes to environmental water availability and flows, both regulated/licensed and unregulated/rules-based sources; d) direct or indirect increases in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses; e) minimising the effects of proposed stormwater and wastewater management during construction and operation on natural hydrological attributes (such as volumes, flow rates, management methods and re-use options) and on the conveyance capacity of existing stormwater systems where discharges are proposed through such systems; and f) water take (direct or passive) from all surface and groundwater sources with estimates of annual volumes during construction and operation.	Addressed in overall report
21.	The Proponent must identify any requirements for baseline monitoring of hydrological attributes.	**Section 5.4**
22. Water – Quality		
22.1	The Proponent must: a) state the ambient NSW Water Quality Objectives (NSW WQO) and environmental values for the receiving waters relevant to the project, including the indicators and associated trigger values or criteria for the identified environmental values; b) identify and estimate the quality and quantity of all pollutants that may be introduced into the water cycle by source and discharge point and describe the nature and degree of impact that any discharge(s) may have on the receiving environment, including consideration of all pollutants that pose a risk of non-trivial harm to human health and the environment;	**Section 5.0**

	c) identify the rainfall event that the water quality protection measures will be designed to cope with; d) assess the significance of any identified impacts including consideration of the relevant ambient water quality outcomes; e) demonstrate how construction and operation of the project will, to the extent that the project can influence, ensure that: – where the NSW WQOs for receiving waters are currently being met they will continue to be protected; and – where the NSW WQOs are not currently being met, activities will work toward their achievement over time; f) justify, if required, why the WQOs cannot be maintained or achieved over time; g) demonstrate that all practical measures to avoid or minimise water pollution and protect human health and the environment from harm are investigated and implemented; h) identify sensitive receiving environments (which may include estuarine and marine waters downstream) and develop a strategy to avoid or minimise impacts on these environments; and i) identify proposed monitoring locations, monitoring frequency and indicators of surface and groundwater quality.	

4.0 Hydrological Analysis

In order to meet the requirements outlined in **Section 3**, the regional basins must detain peak flows in the post-development case to that of or less than the pre-development case for storms up to the 1% AEP.

The modelling analysis was undertaken using a recognised runoff routing method (XPRAFTS) to compute peak design runoff from the catchments.

4.1 MODELLING PARAMETERS

4.1.1 IFD Data

The Rainfall Intensity Frequency Duration (IFD) data adopted was sourced from the Bureau of Meteorology website for the Jordan Springs area.

4.1.2 Losses Data

XPRAFTS modelling was set up using initial and continuing losses. The initial and continuing losses adopted for the model can be found in **Table 4.1** below.

Table 4.1 – Pre-Developed Catchment Parameters

Impervious		Pervious	
Initial	Continuing	Initial	Continuing
1.0 mm	0.5mm	10mm	2.5mm

4.2 SUBCATCHMENTS

4.2.1 Pre-development Catchment Data

Data for the catchments included in the pre-development runoff calculations has been collated and is shown in **Table 4.2** below. The catchment areas are also shown through the plan provided Exhibits 001.

Table 4.2 – Pre-Developed Catchment Parameters

				Impervious			Pervious		
Catchment	Subcatch-ment	Total Area (ha)	Impervious (%)	Area (ha)	Manning's 'n'	Slope (%)	Area (ha)	Manning's 'n'	Slope (%)
Basin C	Existing Development	12.94	60%	7.76	0.014	10%	5.17	0.03	6%
	Predeveloped Village 3	74.26	0%	0	-	-	74.26	0.05	4%
	Total	**87.19**		**7.76**			**79.43**		
Basin V6	Existing Development	18.73	7.5%	1.40	0.014	5%	17.32	0.03	3.5%
	Predeveloped Village 6	4.63	0%	0	-	-	4.63	0.05	2.5%
	Total	**23.35**		**1.40**			**21.95**		

4.2.2 Post-development Catchment data

Data for the post development catchments has been collated and can be found in **Table 4.2.2** below. The overall catchment areas are shown through the plan provided Exhibit 002.

Table 4.2.2 – Post-Development Subcatchments Parameters from North East Precinct Catchment

				Impervious			Pervious		
Catchment	Subcatch-ment	Total Area (ha)	Impervious (%)	Area (ha)	Manning's 'n'	Slope (%)	Area (ha)	Manning's 'n'	Slope (%)
Basin C	Developed Village 3	38.53	0.8	30.83	0.014	10	7.71	0.03	3
	Existing Development	12.94	0.6	7.76	0.014	10	5.17	0.03	6
	School	4.16	0.4	1.66	0.014	5	2.50	0.05	2.5
	Bushland	34.06	0	0.00	-	-	34.06	0.07	3.5
	Total	**89.69**		**40.25**			**49.44**		
Basin V6	Developed Village 6	7.80	0.75	5.85	0.014	10	1.95	0.03	3
	Existing Development	18.73	0.075	1.40	0.014	5	17.32	0.03	3.5
	Total	**26.53**		**7.25**			**19.27**		

4.3 STORMWATER DETENTION RESULTS

The basins were sized to detain peak flows from post-development to be equal to or less than the pre-development peak flows. A two stage low flow (piped outlet) and high flow (weir) was modelled to allow for a staged discharge. This was optimised over a series of iterations such that post developed flow was equal or less than predevelopment flows for all modelled storm events whilst ensuring efficient basin design and allowing for freeboard.

Basin C was found to require approximately 26,000m3 of storage. Basin V6 was found to require approximately 6,200m^3 of storage. The results from the XPRAFTS modelling can be seen in **Tables 4.3** and **4.4** below.

Table 4.3 – XPRAFTS pre-development and post-development modelling results for Basin C.

Basin C						
AEP (%)	Pre-development Peak Flow (m^3/s)	Post-development Peak Flow Undetained (m^3/s)	Pre-development Peak Flow Detained(m^3/s)	Height In Basin* (m)	Freeboard (m)	Storage (Approx.) m3
63	2.819	7.024	2.49	0.396	0.904	7381
50	3.992	9.746	3.874	0.496	0.804	9334
20	5.812	13.514	5.527	0.612	0.688	11627
10	6.891	15.916	6.524	0.677	0.623	12918
5	8.289	19.105	8.056	0.776	0.524	14928
2	10.288	21.51	9.624	0.881	0.419	17072
1	12.074	24.733	11.196	0.979	0.321	19101

*Top of basin at 1.3m height.

Table 4.4 – XPRAFTS pre-development and post-development modelling results for Basin V6.

Basin V6						
AEP (%)	Pre-development Peak Flow (m^3/s)	Post-development Peak Flow Undetained (m^3/s)	Pre-development Peak Flow Detained(m^3/s)	Height In Basin* (m)	Freeboard (m)	Storage (Approx.) m3
63	0.995	1.512	0.984	0.336	1.164	1111
50	1.409	2.378	1.388	0.531	0.969	1823
20	2.237	3.585	2.165	0.719	0.781	2561
10	2.888	4.373	2.669	0.817	0.683	2963
5	3.672	5.496	3.382	0.941	0.559	3492
2	4.446	6.453	4.125	1.057	0.443	4007
1	5.259	7.48	4.889	1.166	0.334	4512

*Top of basin at 1.5m height.

As shown in **Tables 4.3** and **4.4**, post-development peak flows have been detained to less than or equal to the pre-development peak flows through the use of Basins C and V6.

5.0 Water Quality / Water Sensitive Urban Design

The existing stormwater system uses a combination of pit and pipe networks and water sensitive urban design elements to convey stormwater runoff from the site. The existing infrastructure including rainwater tanks and Gross Pollutant Traps (GPT's) has been incorporated into the model to help determine the size for the basin.

5.1 EXISTING TREATMENT DEVICES

The stormwater design for the existing subdivisions are assumed to utilise rainwater tanks as per Penrith City Council requirements. Council standards specify BASIX requirements. As such, 5,000L rainwater tanks have been used within the model for each of the lots within the Villages 3C and 6 catchments.

Construction Certificate documentation also reveals four (4) Humegard GPT's at the end of the line inlet for the existing temporary basins. These have been previously approved by council under Village 3 and Village 6 designs by J. Wyndham Prince and are incorporated into the Water Quality model.

Discussions with the Humegard GPT's suppliers (Humes) have confirmed that Penrith City Council (PCC)has accepted the 41% reduction rates of Total Suspended Solids as reported in the Humegard Technical manual (refer Appendix B).

At the time of writing this report, Humes noted that PCC would accept some treatment of Phosphorus and Nitrogen (TP and TN) from the Humegard GPT's. The HumeGard Technical Manual specifies reductions rates of 35% and 24% for total phosphorus and nitrogen respectively based on scientific testing. As a conservative measure, treatment rates of 17% and 12% have been adopted for phosphorus and nitrogen respectively which are half of what the HumeGard Technical Manual specifies.

5.2 MODELLING

The software used for the water quality modelling is MUSIC Version 6.2. This program is well regarded as industry best practice for analysis of the effectiveness of treatment mechanisms on the quality of stormwater runoff from a development site of this size.

MUSIC-link for Penrith City Council has been used for the modeling for this site. Using PCC's MUSIC-link enables the simplification of the development and assessment of MUSIC models. PCC's MUSIC-link sets PCC's preferred parameters such as rainfall, evapotranspiration data and pollutant generation rates.

The basins have been modelled as wetland nodes in MUSIC and designed in accordance with PCC's MUSIC-link and WSUD Technical Guidelines. The basin size and details can be found in **Section 7.0**. The MUSIC-link report can be found in **Appendix B**.

5.2.1 Catchment Data

The catchment data used is the same as for stormwater detention modelling and can be found in **Section 4.2.**

5.3 RESULTS

In accordance with Council requirements, modelling has been undertaken to demonstrate compliance with water quality objectives for stormwater runoff from the proposed development prior to discharge of stormwater into the downstream waterways. The results of the modelling for each basin are shown below in **Tables 5.2** and **5.3**.

Table 5.2 – Pollutant Loads and Reductions Basin C

Basin C				
Pollutant	Without Treatment (kg/yr)	With Treatment (kg/yr)	Modelled Reduction (%)	Target Reduction (%)
GP	7820	22.7	99.7	90
TSS	50800	5990	88.2	85
TP	82.6	21.5	73.9	65
TN	616	281	54.4	45

The required surface area for Basin C to reach treatment targets is 18500m^2.

Table 5.3 – Pollutant Loads and Reductions Basin V6

Basin V6				
Pollutant	Without Treatment (kg/yr)	With Treatment (kg/yr)	Modelled Reduction (%)	Target Reduction (%)
GP	1580	3.07	99.8	90
TSS	10900	1530	85.9	85
TP	17.7	5.25	70.4	65
TN	132	62.5	52.8	45

The required surface area for Basin V6 to reach treatment targets is 3086m^2.

From **Tables 5.2** and **5.3**, MUSIC modelling indicates compliance with Council's target reduction objectives for the proposed development. The key performance criteria for water quality targets have been met and/or exceeded from Australian Runoff Quality – A Guide to Water Sensitive Urban Design.

5.4 WATER QUALITY MONITORING

It is understood a "Water Quality and Hydrologic Monitoring Program" (WQMP) for the proposed stormwater basins will be required by PCC for the three year period where the basin will be in private ownership.

It is recommended that surface water monitoring is conducted twice a year and twice within two days of a minor rainfall event (<50mm in the prior 24 hour period).A dedicated sampling plan should be prepared by a suitably qualified and experienced person. The sampling plan should:

- locate suitable sampling points,
- provide laboratory analysis including:
  - total suspended solids
  - Total recoverable hydrocarbons;
- Benzene, toluene, ethylbenzene and xylenes;
- Ammonia, chloride, nitrate, nitrite, sulfate, total nitrogen and phosphorus; and
- Heavy metals such as Iron, aluminum, arsenic, cadmium, chromium, copper, lead, manganese, nickel, selenium, zinc and mercury.

Sampling should commence as soon as practical after construction (i.e. once vegetation has been established) and continue until hand over.

6.0 Stream Erosion

Due to the decommissioning of the two western temporary basins servicing Village 3C catchments, there will be an increase in stream erosion between the outlet and the future regional basin. Currently flows are detained back to the pre-development levels by the western temporary basins prior to discharge into the waterway. Upon decommissioning of the basins, the post-development flows will flow directly into the waterways before reaching the regional basin. For the two eastern temporary basins servicing Village 6 there are existing outlet stormwater lines which will feed directly into the future regional basins, making stream erosion and hence the calculation of SEI for this area irrelevant. **Figure 3** below details the stream locations.

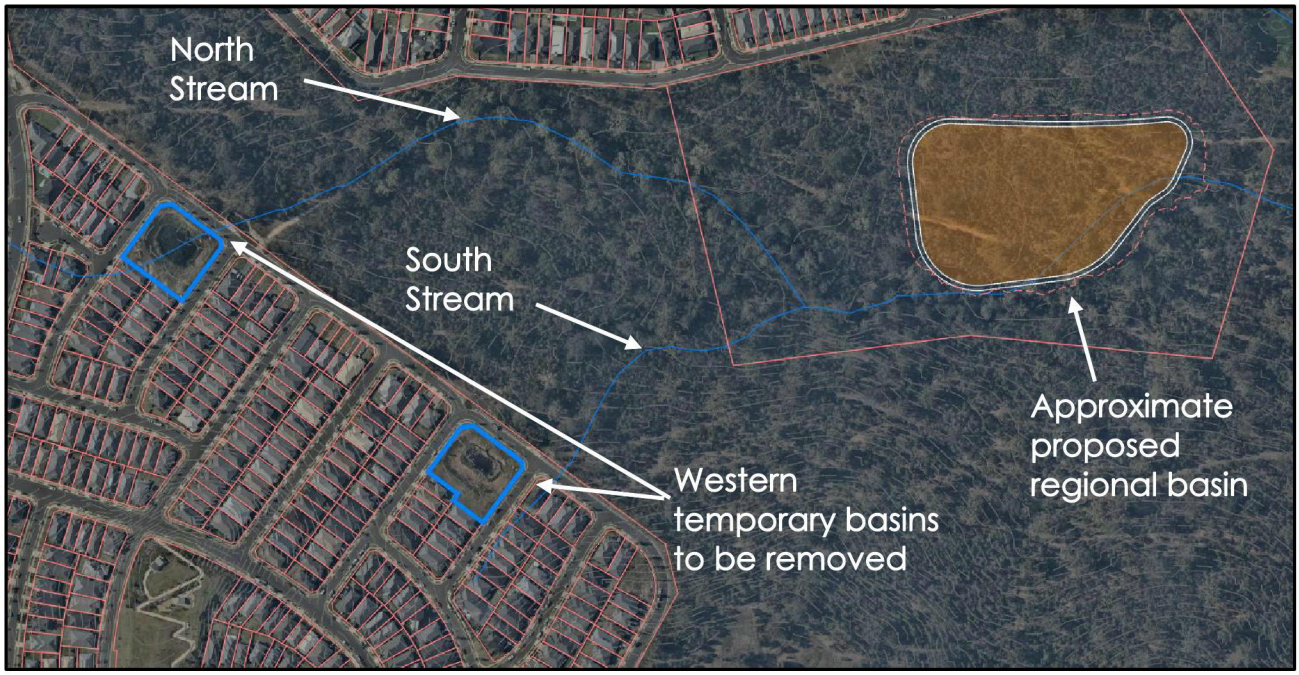


Figure 3. Streams which are affected by the decommissioning of the two western basins.

6.1 STREAM EROSION INDEX (SEI)CALCULATION

Removal of soil particles, or erosion, is a natural process along stream banks. It occurs via scour or by mass failure. Changes to drainage, removal of vegetation and addition of infrastructure can increase stream bank erosion. Drainage management, stabilising the bank toe and restoring vegetation can help combat slumping.

The removal of existing detention basins at the western portion of the two approaching steams to Basin C will cause an increase in both peak flow and volume upstream of Basin C. It is important to analyse the possible impacts of this increased flow on the existing streams to determine if any measures should be put in place to help protect from potential erosion and degradation in the future.

In recent times the procedure for defining a tangible objective for reducing geomorphic impacts of urban streams and waterways have led to a development of a flow analysis methodology known as, the Stream Erosion Index (SEI). (HCCREMS, BMT WBM 2012) The SEI is defined as the ratio of the volume of post development stormwater flows exceeding the 'stream forming flow' to the volume of stormwater flows exceeding the 'stream forming flow' under natural catchment conditions (Brookes and Wong, 2009).

The stream forming flow is determined utilising a number of factors, most notably through an analysis of the existing soil type. The example below summarises typical stream forming flows based on existing soil types ie.

- Sand and silts: 10% of 2 year ARI flow
- Silty clays: 25% of 2 year ARI flow
- Stiff clays: 50% of 2 year ARI flow

The SEI is reported as a ratio of "post" flow volumes to "pre" flow volumes with a target ration of 2 and a "stretch" target of 1.

The data required for estimating SEI can be directly extracted from MUSIC by interrogating a generic node that is added to the treatment train immediately upstream of the receiving waterway or in this case the receiving node. Flows above the critical flow will be passed through the node at the magnitude by which flow exceeds the critical flow, as described below:

Qout = 0 if Qin < Qcritical Qout = Qin - Qcritical if Qout > Qcritical (Blacktown Council, AECOM 2013)

Based on the geotechnical investigation undertaken the stream forming flow adopted will be 50% of the 2 year ARI flow.

The two streams that will be assessed for SEI are shown above in Figure 3, the other discharge locations to the basins are fully piped and hence will not require assessment. For the purposes of the SEI the streams will be identified as "North Stream" and "South Stream". The catchment parameters adopted for both the streams are presented in Table 6.1 below.

Table 6.1– Catchment properties for SEI analysis

Stream	Pre Dev Area (Ha)	Pre Dev % Imp	Post Dev Area (Ha)	Post Dev % Imp
North Stream	47.7	22.7	48.2	58
South Stream	15.5	0	16.65	66

As detailed above the Q Critical has been adopted as 50% of the 2 year ARI predeveloped flow. The values for each of the two streams are as follows:

- North Stream -2.9m3/s
- South Stream – 4.4m3/s

Through the methodology detailed above the sum of the flows above the Qcritcal were summed and the SEI hence have been determined as:

- North Stream - 2.9
- South Stream – 4.4

The analysis has shown that the SEI has exceeded the target of 2 in both cases most notably within the south stream therefore this stream is at higher risk of accelerated erosion. There may be opportunity to include a series of small rock check dams along the south stream to reduce the flow velocities and hence minimise the risk of geomorphic impacts.

Other than improving the streams ability to absorb the increased flow the only other method available would be piping flows from the current outlet through to the inlet of proposed

Basin C. Undertaking this work would significantly increase the amount of clearing required as well as add significant cost and maintenance requirements.

ADW Johnson recommend monitoring the stream within the first few years of the basin being constructed, this will be further documented in the proposed maintenance regime detailed in Section 8 of this report. Any significant works to either the channel or the construction of pipes would only be recommended if the existing stream is showing signs of erosion including modification to the streambank.

7.0 Basins Design

The overall catchments require two (2) wetland/detention basins to meet the requirements set out in **Section 3.0**. It is proposed to provide combined water quantity and quality basins.

Basin plans and details can be seen in the drawing set at **Appendix D**

7.1 BASIN DETAILS

The wetland/detention basins will be accessible from the adjoining road for maintenance purposes.

The basins will be configured as follows:

Basin C:

- Surface area at permanent water level — 18500m^2
- Permanent water level — RL 29.90m (pit weir inlet)
- Pipe Outlet (twin dia. 1200mm pipes) — IL 29.15m
- Basin crest level — RL 31.20m
- Basin Emergency Weir Level — RL 30.90m
- High Flow Outlet (7m weir) — RL 30.30m

Basin V6:

- Surface area at permanent water level — 3086m^2
- Permanent water level — RL 26.80m (pit weir inlet)
- Low Flow Outlet (twin dia. 525mm pipes) — IL 26.05m
- Basin Crest Level — RL 28.30m
- Basin Emergency Weir Level — RL 28.00m
- High Flow Outlet (3m weir) — RL 27.20m

Refer to the plan set for further details.

7.2 INLET/OUTLET CONDITIONS

7.2.1 BASIN C

Flows into Basin C from Village 3 will generally be via an existing watercourse in frequent low intensity storm events, which has been surveyed to be approximately 700mm deep. During intense storm events is overland flow will extend past the banks of the existing watercourse and present a broad relatively shallow flow path.

Basin C has been designed to divert overland flows up to the 1% AEP via berms which will control and direct flows towards two separate (2) inlets. The diversion berm and two inlet locations can be seen in Figure 4 below.

The primary inlet is to the west side of Basin C, and inlet flows will be conveyed via a low flow (sized for approximately the 50% AEP storm event) which will ensure the access track remain dry during minor storms. A low-level narrow diversion is proposed to divert low flows into the wetland for water quality treatment.

During large events, a wide weir has been proposed to allow large flows to enter the basin without causing scour to the basin embankments. A stabilised weir is proposed with a deep-water zone downstream to minimise potential damage to the wetlands. This is shown on the concept plans included at Appendix D.

Village 6 has an existing outlet from the temporary basin which will be modified to discharge into Basin C directly. Flows from upstream in Village 6 will be redirected past the former basin and towards the proposed regional basin.

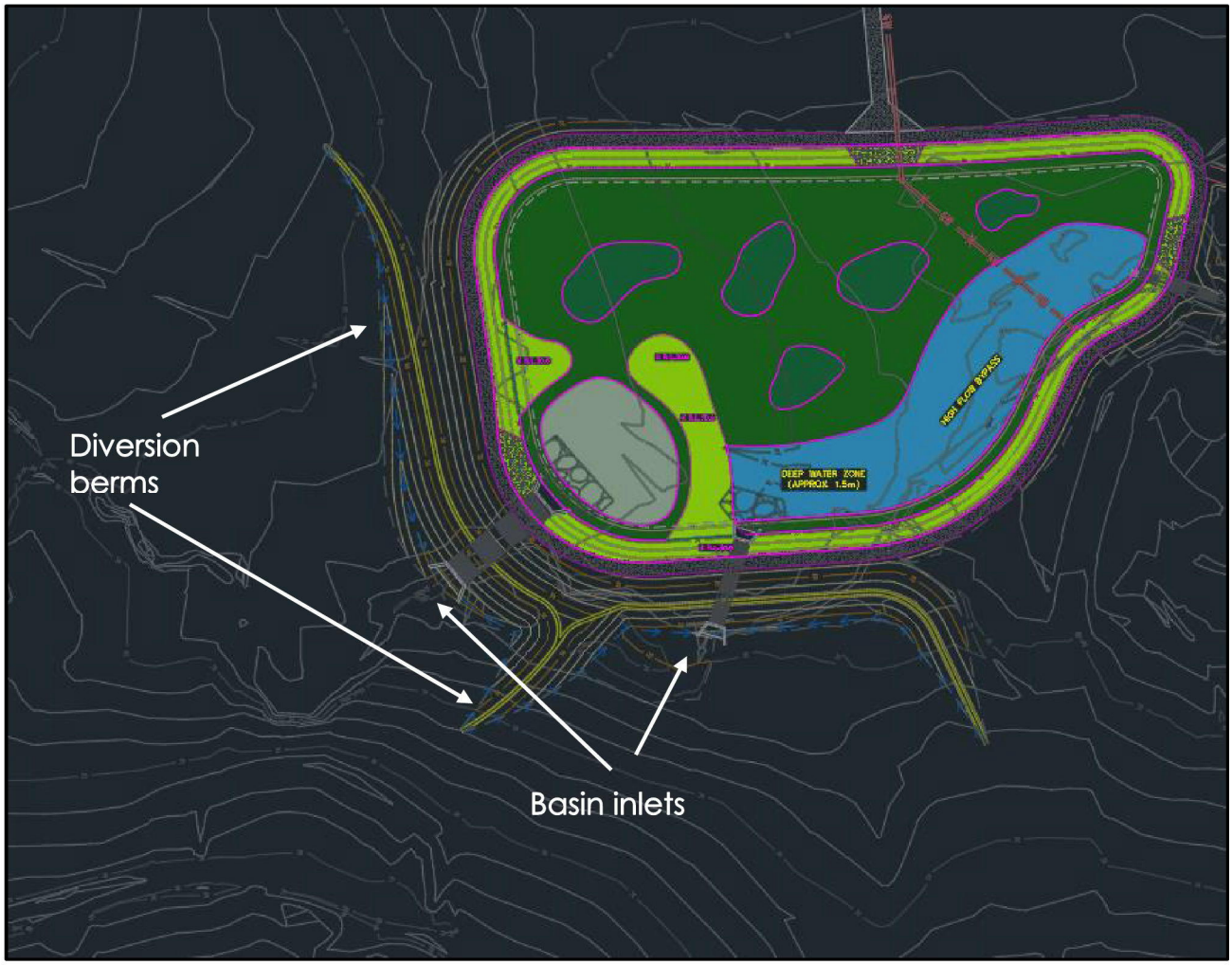


Figure 4. Basin C inlet and berm configuration

As shown in **Figure 4**, there are two (2) inlet locations each with a culvert for low flows up to the 50% AEP storm and a weir for larger storm events at the eastern inlet. The southern inlet has been sized for the 1% AEP storm. The inlets have been sized by dividing the total catchment flows to the basin to the respective inlet location as per Table 7.1 below. Diversion embankments have also been designed, as shown in Figure 4, to direct the flows to their desired inlet location.

Table 7.1 – Inlet sizing for Basin C

Inlet	50% AEP flow (m^3/s)	Box Culvert Size	100% AEP Flow – 50% AEP Flow (m^3/s)	Weir Size
Eastern	9.31	3 x 750mm x 2100mm	14.01	55m
Southern	0.44	3 x 300mm x 1200mm	0.98	Emergency Weir Only

7.2.2 BASIN V6

Basin V6 has been designed with inlet pipe coming from the existing Village 6 temporary basin outlet once it is decommissioned. Flows upstream will be redirected past the former temporary basin towards the proposed regional basin. Outlet configuration for the basin is as per **Section 7.1** and further details can be found in the drawing set.

7.3 DAM SAFETY

The Dam Safety Committee has three criteria for declared (previously prescribed) dams. That is:

- a dam having a dam wall that is more than 15 metres high
- an existing or proposed dam that Dams Safety NSW is reasonably satisfied would result in a major or catastrophic level of severity of damage or loss were there to be a failure of the dam
- dams that were 'prescribed' under the old Dams Safety Act (1978) became declared dams upon commencement of the new Act.

Source: https://www.damsafety.nsw.gov.au/dams-in-nsw/

The proposed regional basins embankment heights average between 2-4m, which is less than the Dam Safety Authority 15m height for prescribed dams.

The basins are located in bushland, and discharge from the basins flows directly to South Creek. There is no urban development or significant infrastructure downstream of the basins. Risk of failure is considered low due to several stability features including a clay core, stabilised outlet and emergency weirs incorporated into the design.

As such, in the event of an embankment failure, there is no risk of catastrophic damage or loss.

As new basins, these basins have not been previously prescribed by the dam safety committee.

For the abovementioned reasons, under Dam Safety Authority requirements the development is not a prescribed dam. An application the to DSC to confirm the above has been made.

8.0 Sediment and Erosion Control

The loss of soil from a construction site can be costly in terms of remediation and replacement. Sediment deposition and suspension in water bodies impacts on water quality and aquatic life. There are two different types of erosion and sediment controls:

- permanent controls (for example, diversion drains, batter chutes and sediment basins) that are designed into the road project
- temporary controls (for example, check dams and sediment fences) that are regularly updated as the construction work progresses.

The permanent controls within Basin C and 6, including inlet and outlet scour protection, basin area and volume as well as GPTs and are detailed elsewhere within the report with the following section only pertaining to the controls required from works commencing to the basin becoming fully stabilised.

8.1 STAGING OF WORKS AND CONTROLS

The most critical element of undertaking works in and around an existing watercourse is to keep clean water flows free of disturbed areas as much as possible. The staging of works will be a key element to ensure that rain events that occur during construction will cause minimal impacts downstream. All controls need to be designed in accordance with *'Managing Urban Stormwater – Soils & Construction Volume 1'* (Landcom, 2004) – 'Blue Book'.

Staging of works are recommended to occur in the following order with proposed mitigation measures at each point also included.

Site clearing – Initially a small strip of clearing should occur along the extents of the site, in particular the downstream portion utilising smaller machinery where possible. This will allow construction of the downstream sediment fence to occur prior to the remainder of the site being cleared and hence becoming disturbed. It is also important to construct.

Clear water diversion – Undertaking measures to direct clean water flows through or around the site is critical. This is particularly critical for Basin C that is situated directly within a significant existing flow path. The clear water diversion can be set up a number of ways including constructing a temporary channel with geofabric overlayed or temporarily piping low flows around the proposed extents of the disturbed area. Currently the most effective methodology for creating a clean water diversion through basin C is to construct a raised grated surface inlet pit (900mm x 900mm) pit near the entry of the existing stream to the disturbed area that allows for a minimum of 0.5m ponding. From this pit it is proposed to run a temporary 300mm PE pipe around the extents of the disturbed area in a location determined by the civil contractor that will outlet just downstream of the proposed extent of works.

Bulk earthworks – Both basins involve significant bulk earthworks, in particular large quantities of cut that will need to be stockpiled, locations of the stockpiles will need to be managed carefully and sediment fence should be constructed on the downstream side of each stockpile where practical. Due to the large extent of disturbed area within each basin footprint it is important that storage capacity is created to retain adequate rainfall volumes in in accordance with *'Managing Urban Stormwater – Soils & Construction Volume 1'* (Landcom, 2004) – 'Blue Book'. The overall volume within each basin is far larger than that

required by the blue book as the basin is essentially the limit of the disturbed area. As rain events occur it is also important to flocculate the water and test it to ensure it meets council's quality requirements prior to discharge back into the system. The permanent water storage within the basins should be treated as "dirty water" as far as flocculation, testing and pumping up until a point where the entire site is determined to be fully stabilised.
Interim measures during bulk earthworks that will assist in reducing the impacts of erosion and sediment as well as dust control will include:

- Running of water carts, particularly during dry or windy periods
- The reuse of mulch from clearing within the site for both dust suppression and to limit the movement of sediments downstream
- Diversion drains to limit water movement down any of the embankments or the use of geofabric where determined necessary

Revegetation – The basins will also involve significant planting including batter treatments, macrophyte planting as well as associated rock scour protection. It is important that these works are undertaken as soon as practical and appropriate early maintenance is carried out to ensure the basins stabilise as soon as possible.

8.2 ADDITIONAL RECOMMENDATIONS

The use of appropriately qualified contractors and erosion and sediment specialists during construction will be required to achieve the desired outcome and this should be emphasised during construction tendering of the project. It is important that an erosion and sediment plan is developed for each stage of construction and kept on site in an easily accessible location for all workers on site, furthermore, this plan should be updated a minimum of every 2 weeks to detail the proposed erosion and sediment controls as well as the existing controls that will require maintenance.

The successful civil contractor should have appropriate checklists and processes in place that require the inspection and maintenance of erosion and sediment control devices after each rainfall event. These checklists should be reviewed prior to tender award and should be fully enforced by both council and the site superintendent regularly during the entire construction program.

9.0 Maintenance

Maintenance of the Basins is critical to the long term water quality performance of the basins. The proposed basins have the following maintenance features:

- A 4 metre wide sealed access track;
- Concrete access ramps at inlet locations;
- Proposed inlet zones to enable the easy clearing of coarse sediment;
- Outlet structures that can dewater water the basins via a series of sealed screw caps (up to 750mm due the topography constraints);
- Scour protection at all points where erosion is considered likely; and
- Monitoring of the existing stream discharge upstream of the basin for sign of erosion.

A proposed maintenance program is attached at **Appendix E.**

10.0Conclusion

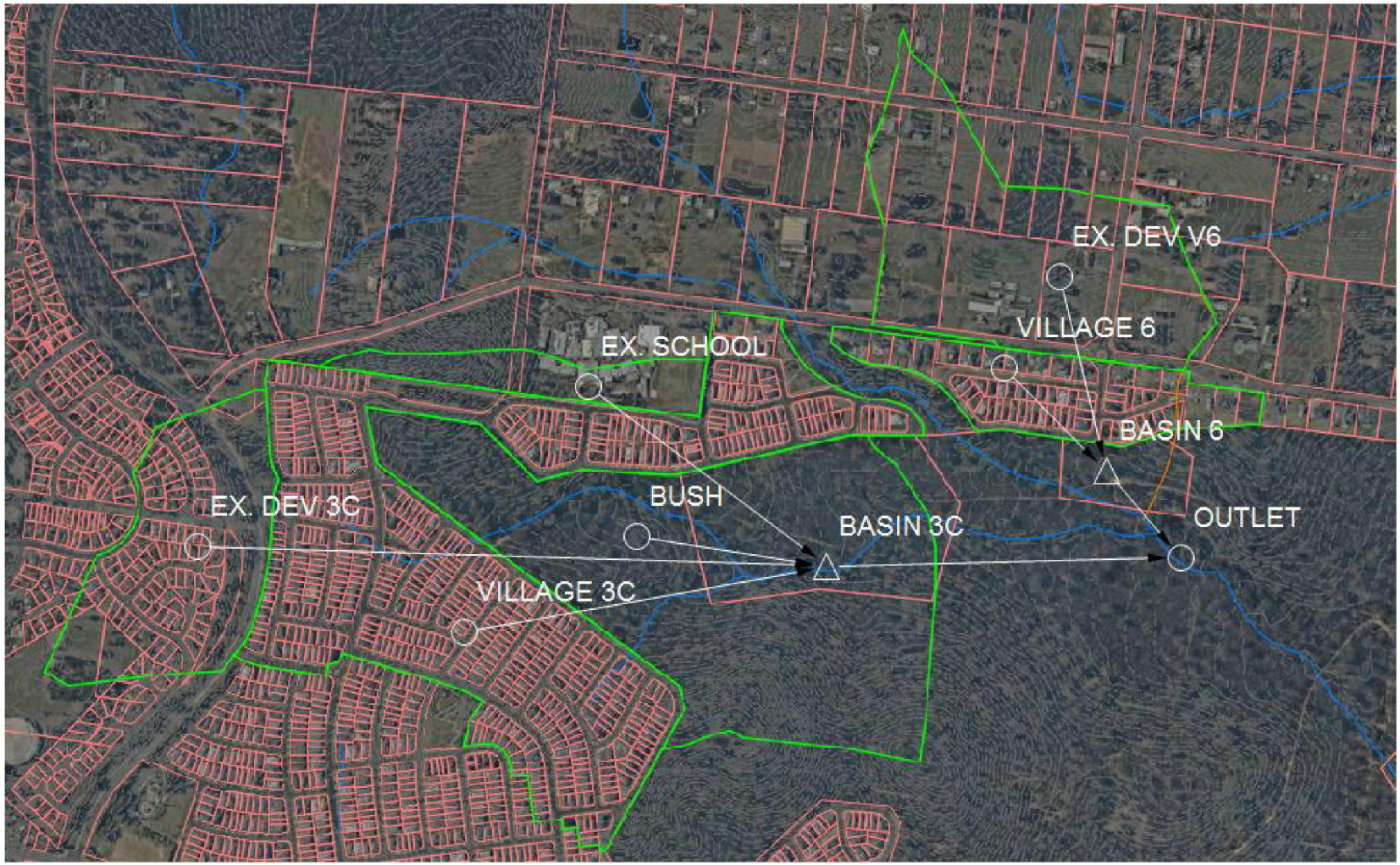
Two (2) regional basins have been designed to accommodate for the removal of four (4) temporary basins servicing Villages 3 and 6 of Jordan Springs. At the conclusion of the basin works, the temporary basins can be removed and developed.

The Stormwater Management Plan demonstrates how the requirements set out in the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) and the Secretary's Environmental Assessment Requirements (SEARs) and more broadly the PCC standards are met.

Each basin is designed to effectively treat the water quantity and quality management objectives under the Sydney Regional Environmental Plan No. 30 – St Marys (SREP 30) and Penrith City Council's (Council) Water Sensitive Urban Design Policy (December 2013). The basins incorporate a drainage inlet point, low level culvert outlet, spillway with scour protection and vegetated slopes to provide effective nutrient removal. Maintenance features including access tracks, ramps and levels control have bene prosed and can be further developed in details design.

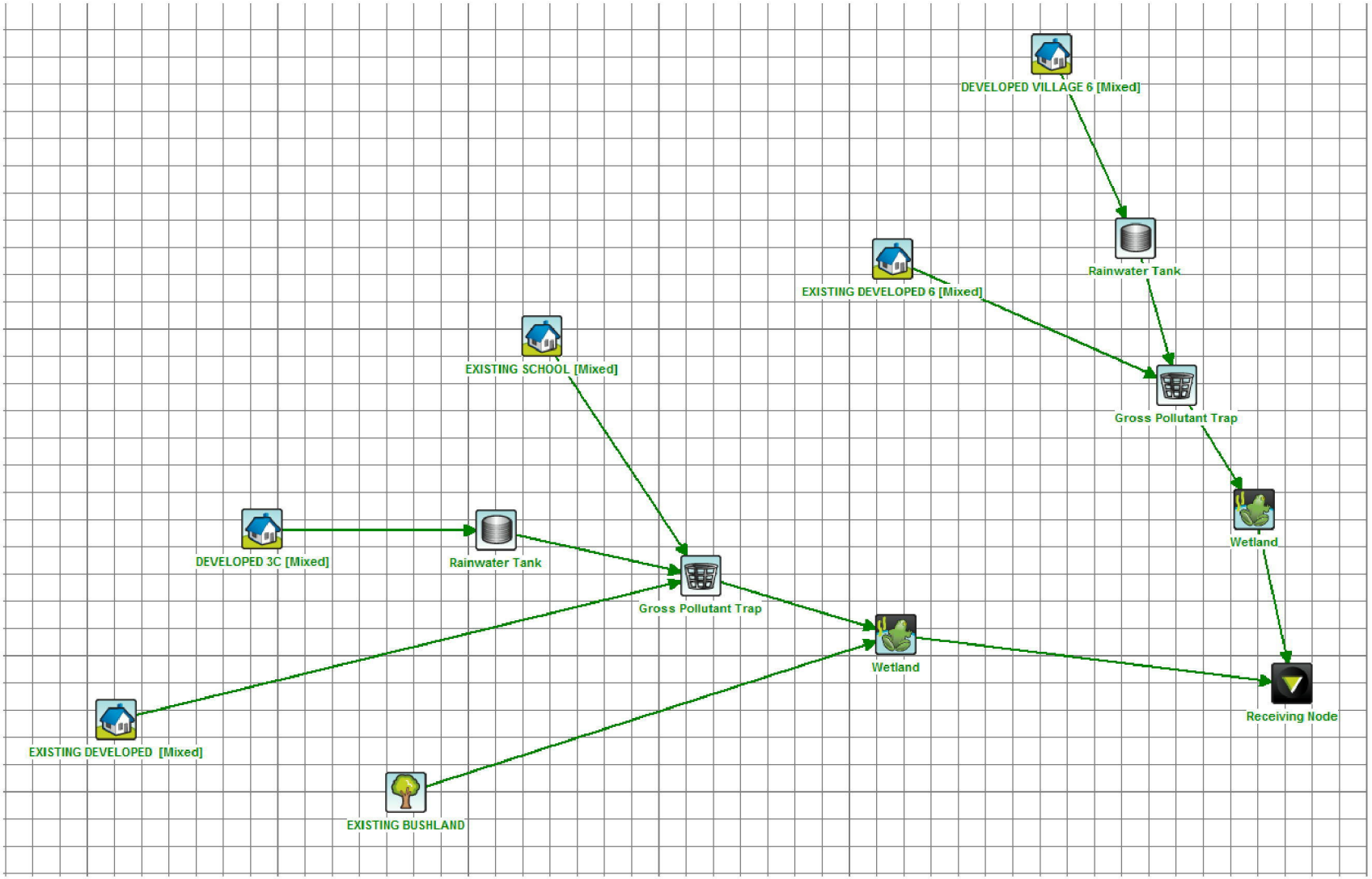
Appendix A

XPRAFTS STORMWATER DETENTION MODELLING



Appendix B

MUSIC STORMWATER QUALITY MODELLING



From: Damien Kim [mailto:damien.kim@lafargeholcim.com]
Sent: Monday, 18 November 2019 2:48 PM
To: Joshua Bagus <joshuab@adwjohnson.com.au>
Cc: Kevin Li <kevin.li@lafargeholcim.com>; Charles Kelly <charles.kelly@lafargeholcim.com>
Subject: Re: Request from Humes website

Joshua,

As per our discussion, I was able to get in touch with Environmental Manager from Penrith City Council.

He stated that he was aware of 41% removal efficiency for TSS and currently waiting for confirmation on TN and TP.

I will speak to you again once the confirmation is received. For the time being, please find attached our Humegard technical manual for your reference.

Do not hesitate to contact me should you have any questions.

Regards

Damien Kim
B.Eng (Civil & Environmental)

Water Solutions Manager - SNSW
Holcim (Australia) Pty Ltd
Humes concrete products
Lot 1 Woodstock Avenue, Rooty Hill 2766

P:+61 2 9832 5518 | F:+61 2 9625 5200 | M:+61 419 477 516
damien.kim@lafargeholcim.com
www.humes.com.au

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On Thu, Nov 14, 2019 at 8:15 AM Joshua Bagus <joshuab@adwjohnson.com.au> wrote:

Hi Damien,

Sorry I think you misunderstood my question a little bit.

I am not trying to size and purchase a GPT.

Please note:

- The development I am modelling in MUSIC is already built using Humegard GPT's
- The purpose of my modelling is to design downstream regional basins.
- I am looking to meet Penrith City Council treatment targets which are:

Pollutant	Reduction Target
Total Suspended Solids	85%
Total Phosphorus	60%
Total Nitrogen	45%

As well as Gross Pollutants: 90%

The problem I am having is the following from Penrith City Council WSUD guidelines:

Gross pollutant traps  GPT	High flow bypass for the device = 3-month ARI peak flow. Gross pollutant removal should be obtained for the specific GPT type proposed from the supplier – preferably independently verified. • TSS removal = 0 (unless a CDS-type system, when TSS removal can be up to 70% for inflow concentrations greater than 75 mg/L). • TP removal = 0 (unless a CDS-type system, when TP removal can be up to 30% for inflow concentrations greater than 0.5 mg/L). • TN removal = 0.

They are saying that for any GPT type other than CDS, all treatment rates are 0 (excluding Gross Pollutants).

I was wondering if anyone had any further information, or if there are any agreements with Penrith Council for Humegard GPT's?

Regards,

Josh Bagus

Civil Engineer

Tuggerah Office

Ph: 02 4305 4300

Email : joshuab@adwjohnson.com.au

Website: www.adwjohnson.com.au

ADW Johnson Pty Limited

Hunter	7/335 Hillsborough Road, Warners Bay NSW 2282	Ph. 02 4978 5100
Central Coast	5 Pioneer Avenue, Tuggerah NSW 2259	Ph. 02 4305 4300
Sydney	Level 35 One International Towers, 100 Barangaroo Avenue, Sydney NSW 2000	Ph. 02 0846 7411

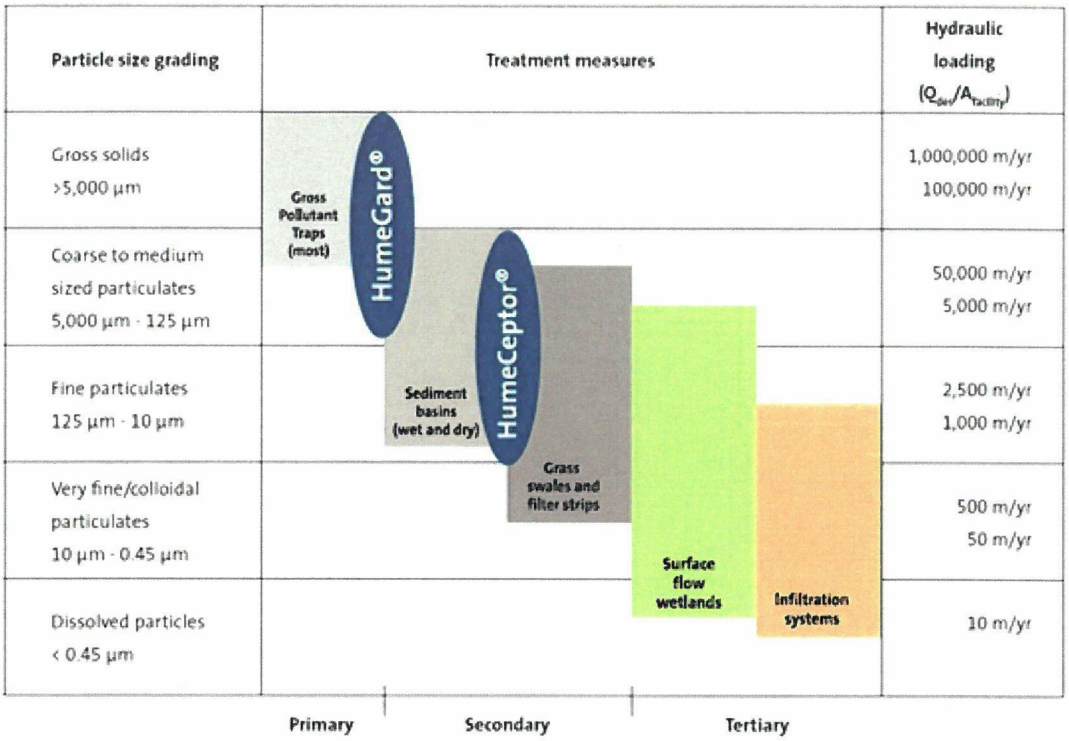
From: Damien Kim [mailto:damien.kim@lafargeholcim.com]
Sent: Wednesday, 13 November 2019 3:55 PM
To: Joshua Bagus <joshuab@adwjohnson.com.au>
Cc: Kevin Li <kevin.li@lafargeholcim.com>; Kali Uele <kali.uele@lafargeholcim.com>; Laura Catalano <laura.catalano@lafargeholcim.com>
Subject: Fwd: Request from Humes website

Joshua,

Thank you for contacting Humes.

We have Humegard and Humeceptors that can treat GP, TSS, TP and TN. See below for product selection criteria.

Treatment measure selection guide (adapted from Ecological Engineering 2003)



We will be more than happy to assist you in your project if you can email us with;

- Type of development
- Project drawings with pipe in/out, grade of pipe, catchment area, % impervious
- MUSIC model
- Treatment performance requirements - GP, TSS, TN and TP for Penrith council

Otherwise, I can come into your office for a discussion.

Do not hesitate to contact me should you have any questions.

Regards

Damien Kim

B.Eng (Civil & Environmental)

Water Solutions Manager - SNSW
Holcim (Australia) Pty Ltd
Humes concrete products
Lot 1 Woodstock Avenue, Rooty Hill 2766

P:+61 2 9832 5518 | F:+61 2 9625 5200 | M:+61 419 477 516
damien.kim@lafargeholcim.com
www.humes.com.au

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7. CHECKLISTS

7.1. Development Application Checklist (lodged with DA)

Water Sensitive Urban Design
Development Application Checklist

Site/ Project Name	Regional Basin C on V6		
Lot and DP Number:	1/1216994	**DA Number:**	TBA

	Information Required with DA Submission:	**Y**	**N**
1	Has a Water Sensitive Urban Design Strategy been submitted as part of the development application?	✓	
2	Is a BASIX Certificate required? If so, Yes - Attach certificate with DA		✓
3	Has the digital version of MUSIC and report on the MUSIC model using data prescribed outlined in Council's Technical Guideline been attached? Have stormwater quality retention criteria (TSS 85%, TP 60%, and TN 45%) and water quantity / drainage requirements been met and documented in the WSUD Strategy? If relevant, have the Water Conservation, Quantity and quantity targets been achieved?	✓ ✓ ✓	
4	Does WSUD Strategy contain the following information? • Review of the **WSUD principles** and ensure that these are considered throughout development of the WSUD strategy. • Confirmation of the **WSUD objectives** that are relevant to the development application. • Confirmation of the **WSUD targets** for potable water conservation, stormwater quality management and stormwater quality management that are relevant to the development application. • Complete a **site analysis** to evaluate the site characteristics that potentially will impact on the feasibility of WSUD for the site. • **WSUD measures** that would be appropriate for the development considering the development scale, site characteristics, stormwater quality management function and stormwater quantity management function. • A **preliminary WSUD strategy** that positions the selected WSUD measures in appropriate locations and arranges the measures in an appropriate series. • **Numerical modelling** utilising MUSIC software to evaluate appropriate sizes of the WSUD measures. • **Concept designs** of the WSUD measures. • **WSUD strategy report** that summarises the methodology and WSUD outcomes, and provide this with the development application for the site.	✓ ✓ ✓ ✓ ✓ (already complete) ✓ ✓	✓
5	Have the conceptual plans of the proposed stormwater treatment measures been included on the plans? (Detailed engineering plans will be required for the construction certificate)	✓	

6	Has a Draft Operation and Maintenance Plan which includes details on the following been provided? • Site description (area, imperviousness, land use, annual rainfall, topography etc) • Site access description • Likely pollutant types, sources and estimated loads • Locations, types and descriptions of measures proposed • Operation and maintenance responsibility (council, developer or owner) • Inspection methods • Maintenance methods (frequency, equipment and personnel requirements including Work Health and Safety requirements) • Landscape and weed control requirements • Operation and maintenance costs • Waste management and disposal options, and • Reporting.	✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓

Appendix C

LITERATURE REVIEW

Our Ref: MK:NW:300225

6 November 2019

Dael Palte

Assistant Development Manager
Communities
Level 2, 88 Phillip Street
Parramatta NSW 2150

Dear Dael,

RE: LITERATURE REVIEW AND PROPOSED DESIGN BASIS FOR BASINS C AND V6 AT THE ST MARYS DEVELOPMENT SITE, PENRITH.

I refer to our discussion 31 October 2019, in which Lend Lease requested a summary of previous stormwater management strategies relevant to the Basin C and V6 design at the St Marys Development Site, Penrith.

Basins C and V6 are proposed on land located within the Hawkesbury-Nepean River Catchment and will be positioned approximately 2.5 km west of South Creek, which traverses the St Marys Development Site in a north-south alignment. The proposed basins are both located to the immediate south of existing residential development in Jordan Springs, referred to as Village 3 and the Ninth Avenue (or Village 6).

The site has been subject to a several reports since the rezoning in 2001.

The below summarises previous stormwater management reports, as furnished (or where publicly available) to ADW Johnson.

ADW JOHNSON PTY LIMITED
ABN 62 129 445 398

Sydney
Level 35 One International Towers
100 Barangaroo Avenue
Sydney NSW 2000
02 8046 7411
sydney@adwjohnson.com.au

Central Coast
5 Pioneer Avenue, Tuggerah NSW 2259
PO Box 3717, Tuggerah NSW 2259
02 4305 4300
coast@adwjohnson.com.au

Hunter
7/335 Hillsborough Road,
Warners Bay NSW 2282
02 4978 5100
hunter@adwjohnson.com.au

www.adwjohnson.com.au

Literature Review – St Mary Development Site – Stormwater reports

St Mary's Central Precinct Plan: Water, Soil and Infrastructure Report – May 2009, Revised September 2017 , Jacobs

This report was prepared to inform how the Central Precinct Plan would meet the requirements of the Sydney Regional Environmental Plan No 30 – St Marys (SREP 30). The SREP 30 forms the planning framework for development. The report is broad in nature and does not specifically provide a concept design for basin C and V6.

The original report was approved in May 2009.

In 2017 it was proposed to amend the precinct plan to allow for two basins, being Basin C and V6 rather than a singular basin ("Basin C2") downstream to provide better access to the basins and a reduced impact on a proposed regional park.

Thus, the report was updated in 2017 to make it consistent with the proposed amendments to the basins/

The report concluded:

- That detention (or the absence of) would not impact flood levels at South Creek a due to the lag between peak runoff hydrographs.

- Water quality modelling found that a strategy involving basins in both the Central and Western Precincts would achieve the overall water quality objectives of the SREP30 and Penrith City Council (PCC) guidelines in South Creek. Water quality objectives were obtained from PCC WSUD (2013/2015).

Pollutant	Reduction Target
Total Suspended Solids	85%
Total Phosphorus	60%
Total Nitrogen	45%

Jordan Springs Development – Village 3 and Ninth Avenue (Village 6) Stormwater Management Plan, August 2013 SKM –

This Stormwater Management plan was prepared on the basis of singular basin downstream of Village 3 and the Ninth Avenue site, report was a concept design report of basin. It was prepared prior to the amendment of SREP 30 to allow for two basins.

The report:

- Provided a concept design of Basin C2.
- Cited quality objectives – obtained from the 'South Creek Stormwater Management Plans' document and the 'Draft Policy of PCC on Stormwater Quality Control' as below:

Pollutant	Reduction Target
Total Suspended Solids	80%
Total Phosphorus	45%
Total Nitrogen	45%

- It is noted the Phosphorus reduction target differs from that of previous reports.
- Concluded that meeting the above criteria would also satisfy the SREP 30 requirements of also reduce pollutant loads from pre-existing conditions (i.e. prior the St Marys Development).
- Nominated post development peak discharge requirement to pre-existing levels.
- Nominated C2 as a bio-filtration basin.

J Wyndham Prince - Interim Stormwater Management Strategy Report, October 2014 (to support DA)

This report included Investigation into interim stormwater management for Village 6 at Jordan Springs only to support residential development, whilst the ultimate basin confirmation was determined.

The report:

- Determine size of basins for quantity control. As per the SKM Stormwater Management Plan, detention targets were nominated post development peak discharge to pre-existing levels.
- Included concept design of interim basins.
- The basins to be converted to interim detention basins at the completion of housing construction if the regional basins have not been constructed (which is the case now).
- Did not propose quality basins, though did include Gross Pollutant Traps and sedimentation storage.

Other key documents:

Other key documents informing the design include:

- Penrith City Council DCP, C3 Water management and WSUD Technical manual (https://www.penrithcity.nsw.gov.au/images/documents/building-development/planning-zoning/planning-controls/Penrith_DCP_2014_Part_C3_Water_Management.pdf)
- Sydney Regional Environmental Plan No 30—St Marys, Part 28 Watercycle Management.
- Managing Urban Stormwater: Soils and construction - Volume 1.

Design basis

Based on a review of the above documentation it is proposed to prepare a concept design to perform the following high level objectives:

- Limit Post development peak discharge to pre-existing levels *(Source: Penrith City Council DCP, C3 Water management and SKM Stormwater Management Plan).*
- Meet the following Water Quality objectives:

Pollutant	Reduction Target
Total Suspended Solids	85%
Total Phosphorus	60%
Total Nitrogen	45%

(Source: Penrith City Council DCP, C3 Water management and Jacobs Soil, Water and Infrastructure report)

- Manage Sediment and Erosion control as per Managing Urban Stormwater: Soils and construction - Volume 1 and SREP 30.
- Minimise changes in in local flow regimes for rainfall events up to the 50% AEP rainfall event (Source: SREP 30)
- Collect Gross pollutants as close as possible to their source or at all stormwater outlets, or at both of those places, so that there is no increase in sediment/litter entering the creeks as a result of development (Source: SREP 30)

There are numerous other design criteria that will be adopted during the concept design, and later the detailed design as part of good WSUD design principals.

Please contact the undersigned should you require any further information.

Yours faithfully

Mark Kelly
Engineer
ADW Johnson Pty Ltd

Appendix D

CONCEPT ENGINEERING DRAWINGS

300225-CENG-001

CONCEPT ENGINEERING PLANS OF ' JORDAN SPRINGS REGIONAL BASINS - C & V6 ' LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

LOCALITY SKETCH
NOT TO SCALE

INDEX OF DRAWINGS

DIAL 1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

100mm AT FULL SIZE

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: COVER SHEET, INDEX OF DRAWINGS & LOCALITY SKETCH

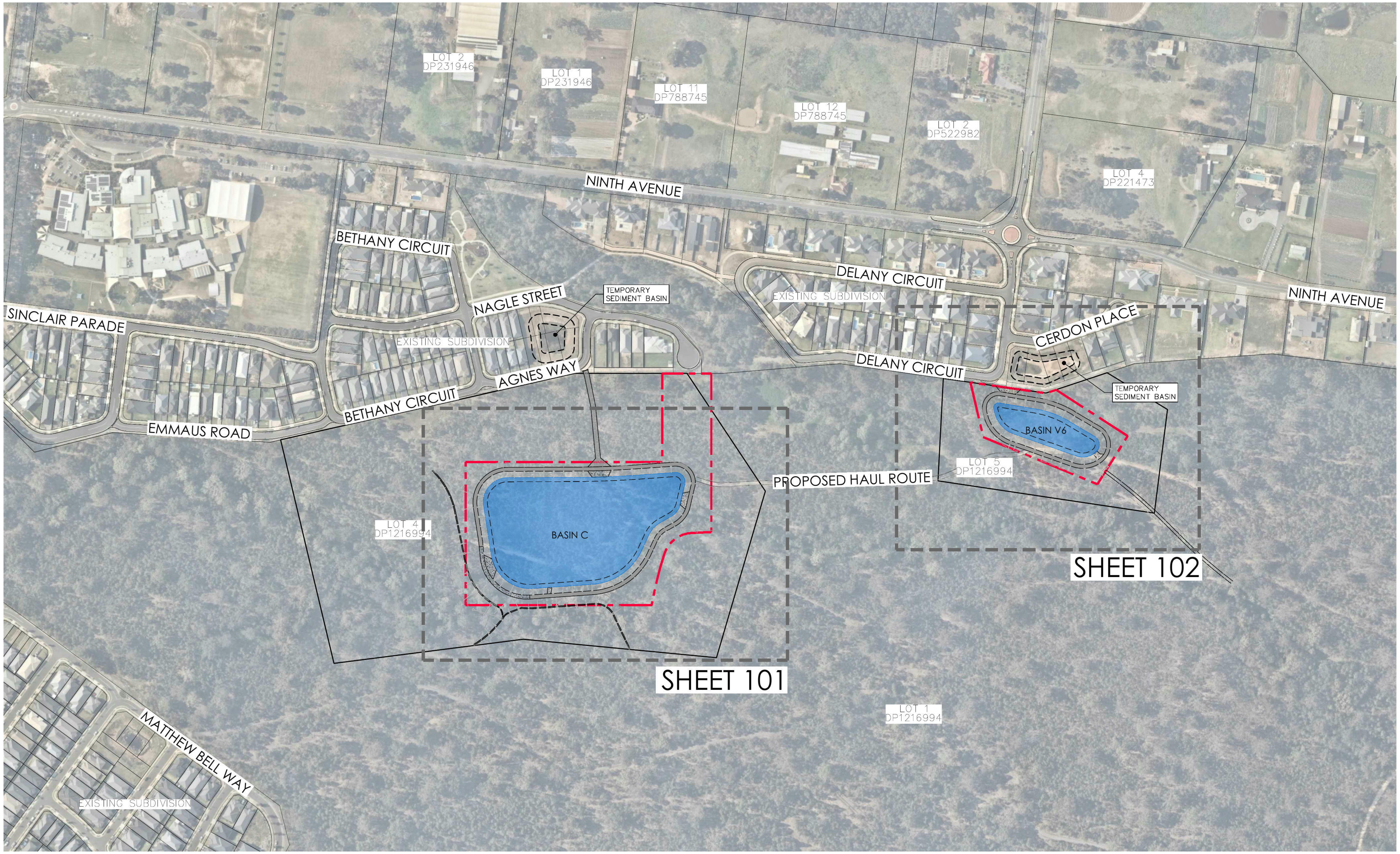
DRAFT

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	001	A

Plotted By: Jeremy Dick Plot Date: 18/11/19 7:26:31PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-001.DWG

300225-CENG-003

M.G.A.



OVERALL PLAN

SCALE 1:2000

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY

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DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

SCALES: A1 1:2000 — 0 — 50 — 100m — A3 1:4000

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adw johnson

Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: OVERALL SITE PLAN

DRAFT

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	003	A

Plotted By: [illegible] Dick Plot Date: 18/11/19 7:26:39PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-003.DWG

300225-CENG-101

M.G.A.

REFER INSET PLAN

LOT 4
DP1216994

CONSTRUCT HEADWALL TO EXISTING 2x⌀900 PIPES AT INV. 29.9 TO ALLOW PIPE FLOWS TO ENTER BASIN

PROPOSED 4m WIDE ACCESS TRACK 200mm DGS20. SINGLE COAT 7mm SEAL

PROPOSED 4m WIDE ACCESS TRACK 200mm DGS20. SINGLE COAT 7mm SEAL (TYP.)

DIVERSION BERM

1% AEP F.W.L. 34.5m (APPROX.)

1% AEP F.W.L. 30.9m

CONCRETE ACCESS RAMP TO INLET ZONE

DEMOLISH & REMOVE EXISTING STORMWATER PIPES & PITS

PROPOSED HAUL ROUTE

PATH/RAMP TO OUTLET STRUCTURE

1 / 401

PROPOSED 4m WIDE ACCESS TRACK 200mm DGS20. SINGLE COAT 7mm SEAL (TYP.)

PROPOSED 4m WIDE CONCRETE ACCESS TRACK TO PROHIBIT SCOURING BENEATH HIGH FLOW WEIR

4 / 401

CONCRETE ACCESS RAMP TO INLET ZONE

2 / 401

3 / 401

FILL GULLY & EXTEND OUTLET PIPES

DEMOLISH EXISTING STORMWATER PIPES AND INTEGRATE WITH PROPOSED 2x⌀1200 BASIN OUTLET PIPES. MAINTAIN ACCESS TRACK OVER

LOW FLOW INLET 3x750x1200 RCBC

RESHAPE EXISTING TO SUIT BASIN INLET HEADWALL

2 / 401

4 / 401

RIP-RAP SCOUR PROTECTION

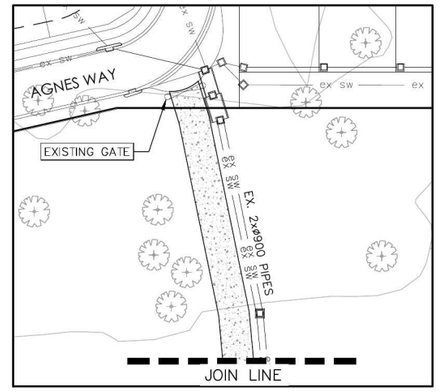
3 / 401

DIVERSION BERM

DIVERSION BERM

1% AEP

DETAIL PLAN
SCALE 1:500



INSET PLAN
SCALE 1:500

LEGEND
- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER
- EXISTING STORMWATER (TO BE REMOVED)
- EXISTING RISING MAIN
- ROCK LINED DIVERSION DRAIN
- 1% AEP LINE
- PROPOSED SW PIT
- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING LINTEL
- EXISTING HEADWALL
- RIP-RAP SCOUR PROTECTION

CONTOUR INTERVAL = 0.5m

GENERAL NOTES:-

1. SETOUT INFORMATION IS TO BE VERIFIED BY THE CONTRACTOR AGAINST THE PLAN VIEW, LONGITUDINAL SECTIONS AND ELECTRONIC 12D DATA BEFORE BEING USED. IF THERE IS A DISCREPANCY THE SUPERINTENDENT IS TO BE NOTIFIED AND DIRECTION TO BE PROVIDED IN WRITING BEFORE PROCEEDING.

CAUTION:

1. IT IS THE RESPONSIBILITY OF THE CIVIL WORKS CONTRACTOR TO DETERMINE THE LOCATION & LEVEL OF EXISTING SERVICES USING NON DESTRUCTIVE METHODS PRIOR TO COMMENCING WORKS ON SITE.

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A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 (0, 12.5, 25.0m) A3 1:1000

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adw Johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: DETAIL PLAN BASIN C

DRAFT

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	101	A

Designed: B.C. Drawn: M.F. Check Plot Date: 18/11/19 7:26:49PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-101.DWG

100mm AT FULL SIZE

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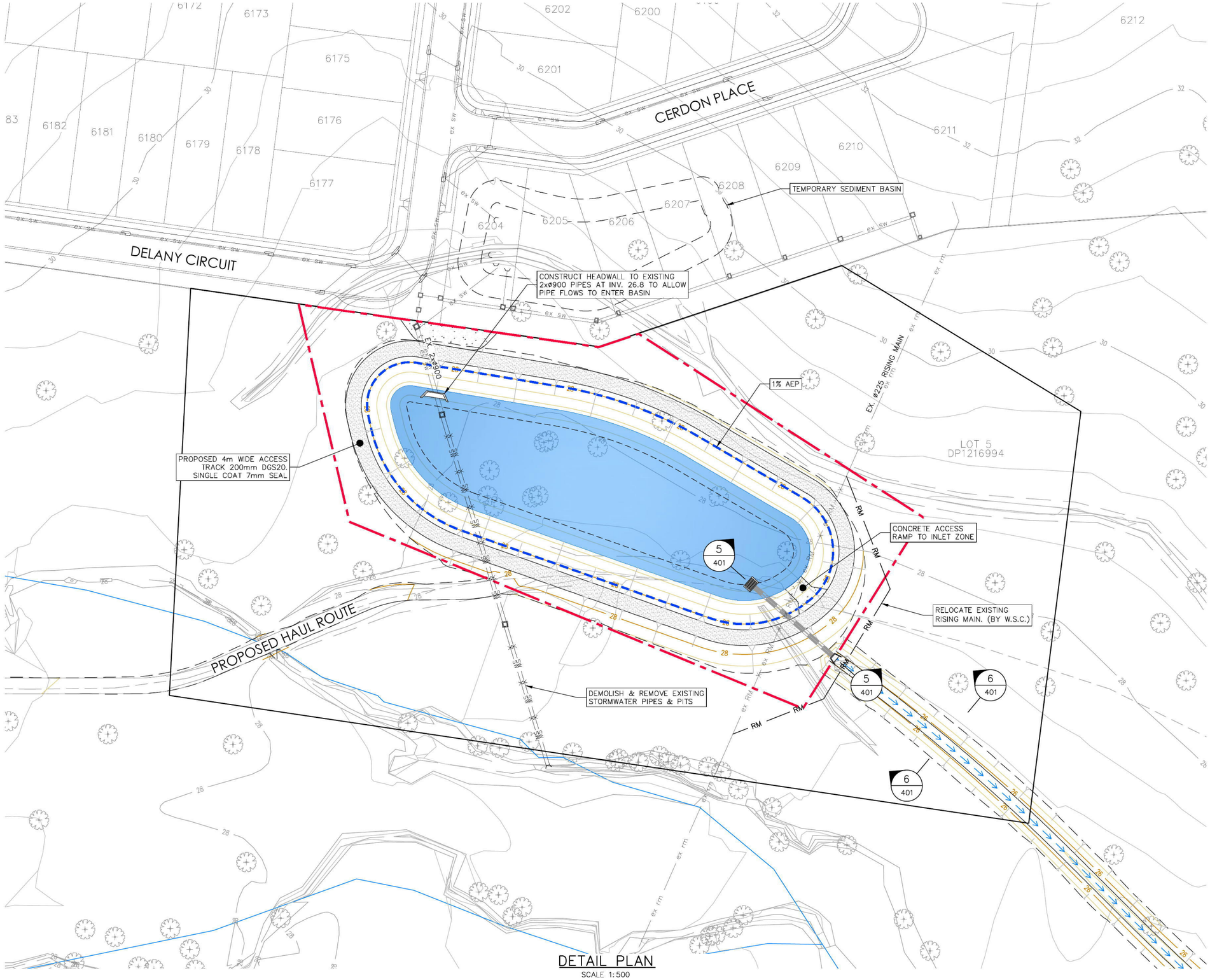
300225-CENG-102



M.G.A.

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER
- EXISTING STORMWATER (TO BE REMOVED)
- EXISTING RISING MAIN
- EXISTING RISING MAIN (TO BE REMOVED)
- PROPOSED RISING MAIN
- ROCK LINED DIVERSION DRAIN
- 1% AEP LINE
- PROPOSED SW PIT
- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING LINTEL
- EXISTING HEADWALL

CONTOUR INTERVAL = 0.5m

DETAIL PLAN

SCALE 1:500

GENERAL NOTES:-

1. SETOUT INFORMATION IS TO BE VERIFIED BY THE CONTRACTOR AGAINST THE PLAN VIEW, LONGITUDINAL SECTIONS AND ELECTRONIC 12D DATA BEFORE BEING USED. IF THERE IS A DISCREPANCY THE SUPERINTENDENT IS TO BE NOTIFIED AND DIRECTION TO BE PROVIDED IN WRITING BEFORE PROCEEDING.

CAUTION:

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DIAL 1100 BEFORE YOU DIG

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
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SCALES: A1 1:500 — 0, 12.5, 25.0m — A3 1:1000

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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adw Johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: DETAIL PLAN BASIN V6

DRAFT

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	102	A

Plotted By: Matthew Mack Plot Date: 18/11/19 7:26:57PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-102.DWG

300225-CENG-111

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER
- EXISTING STORMWATER (TO BE REMOVED)
- EXISTING RISING MAIN
- ROCK LINED DIVERSION DRAIN
- PROPOSED SW PIT
- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING LINTEL
- EXISTING HEADWALL
- DEEP WATER 1–1.5m DEEP
- EPHEMERAL ZONE 0–0.5m ABOVE P.W.L.
- DEEP MARSH 0.3–0.5m BELOW P.W.L.
- SHALLOW MARSH 0.1–0.3m BELOW P.W.L.
- INLET ZONE 1–1.5m DEEP

CONTOUR INTERVAL = 0.5m

CONCEPT ONLY – FOR DETAILED DESIGN

OSD ZONE PLAN
SCALE 1:500

GENERAL NOTES:–

1. SETOUT INFORMATION IS TO BE VERIFIED BY THE CONTRACTOR AGAINST THE PLAN VIEW, LONGITUDINAL SECTIONS AND ELECTRONIC 12D DATA BEFORE BEING USED. IF THERE IS A DISCREPANCY THE SUPERINTENDENT IS TO BE NOTIFIED AND DIRECTION TO BE PROVIDED IN WRITING BEFORE PROCEEDING.

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SCALES: A1 1:500 / A3 1:1000 (0, 12.5, 25.0m)

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Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: LANDSCAPE ZONE PLAN SHEET 1 BASIN C

DRAFT

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	111	A

Plot Date: 18/11/19 7:27:06PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-111.DWG

300225-CENG-112

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER
- EXISTING STORMWATER (TO BE REMOVED)
- EXISTING RISING MAIN
- ROCK LINED DIVERSION DRAIN
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- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING LINTEL
- EXISTING HEADWALL
- DEEP WATER 1–1.5m DEEP
- EPHEMERAL ZONE 0–0.5m ABOVE P.W.L.
- DEEP MARSH 0.3–0.5m BELOW P.W.L.
- SHALLOW MARSH 0.1–0.3m BELOW P.W.L.
- INLET ZONE 1–1.5m DEEP

CONTOUR INTERVAL = 0.5m

CONCEPT ONLY – FOR DETAILED DESIGN

OSD ZONE PLAN

SCALE 1:500

GENERAL NOTES:–

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CAUTION:

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SCALES: A1 1:500 / A3 1:1000 (0 – 12.5 – 25.0m)

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Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ | DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: LANDSCAPE ZONE PLAN SHEET 2 BASIN V6

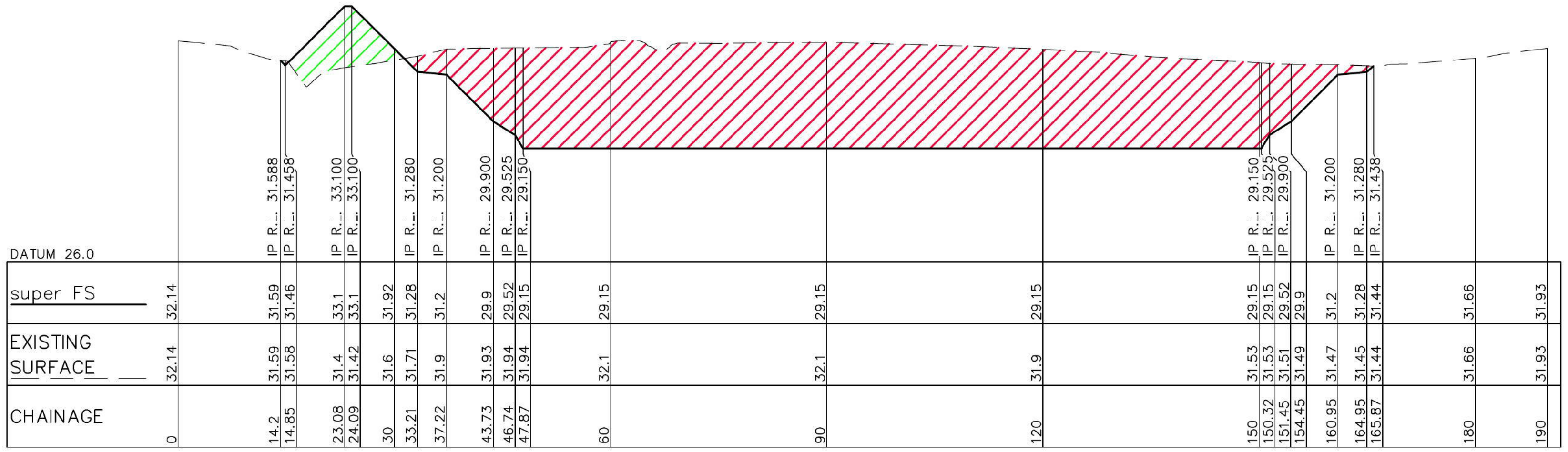
DRAFT

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	112	A

Plot Date: 18/11/19 7:27:14PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225–CENG–112.DWG

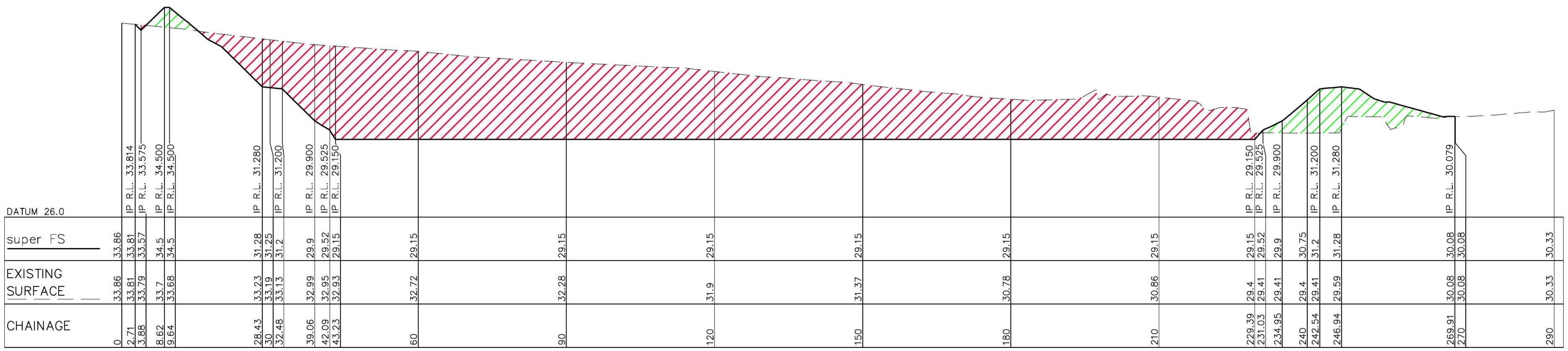
300225-CENG-201

LEGEND
- CUT
- FILL



BASIN C – SITE SECTION A

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



BASIN C – SITE SECTION B

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

DIAL 1100 BEFORE YOU DIG

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DRAFT

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SCALES: A1 1:500 / A3 1:1000 (0, 12.5, 25.0m); A1 1:100 / A3 1:200 (0, 2.5, 5.0m)

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DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

Plot Date: 18/11/19 7:27:18PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-201.DWG

adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
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Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ | DATUM: A.H.D.

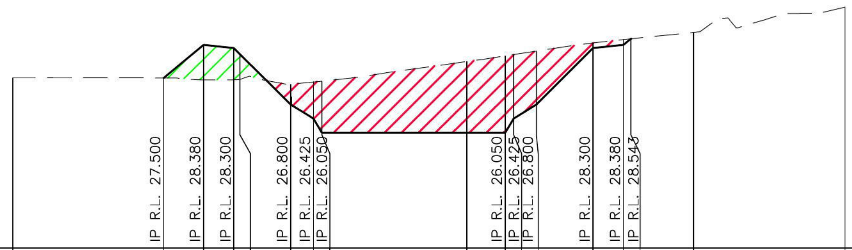
PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: CROSS SECTIONS BASIN C

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	201	A

300225-CENG-202

LEGEND
- CUT
- FILL

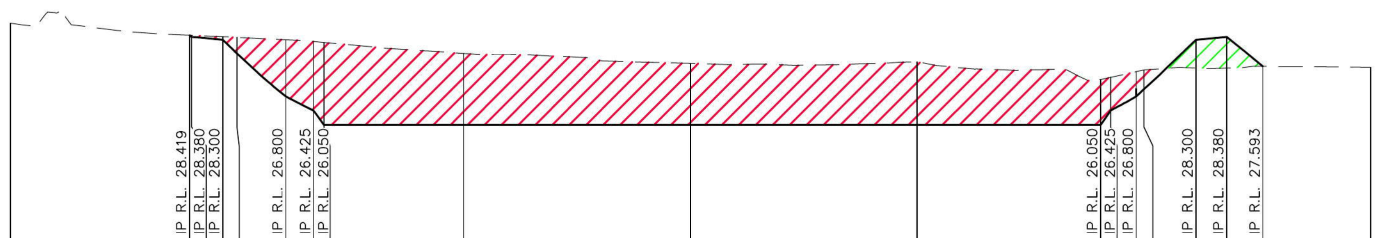


DATUM 23.0

super FS	27.5	27.5	28.38	28.3	28.14	26.8	26.42	26.05	26.05	26.05	26.42	26.8	28.3	28.38	28.54	28.71	29.38
EXISTING SURFACE	27.5	27.5	27.45	27.45	27.47	27.33	27.4	27.42	27.94	28.09	28.12	28.22	28.43	28.52	28.54	28.71	29.38
CHAINAGE	0	19.92	25.2	29.21	30	36.72	39.72	40.85	60	65.08	66.2	69.2	76.71	80.71	81.68	90	110

BASIN V6 – SITE SECTION A

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



DATUM 23.0

super FS	28.74	28.42	28.38	28.3	27.94	26.8	26.42	26.05	26.05	26.05	26.05	26.05	26.43	26.8	26.99	28.3	28.38	27.59	27.57
EXISTING SURFACE	28.74	28.42	28.42	28.38	28.36	28.3	28.25	28.23	27.94	27.68	27.72	27.25	27.31	27.46	27.5	27.55	27.55	27.59	27.57
CHAINAGE	0	23.74	23.98	28.11	30	36.46	40.13	41.5	60	90	120	144.28	145.59	148.99	150	156.88	160.98	165.77	180

BASIN V6 – SITE SECTION B

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

DIAL 1100 BEFORE YOU DIG

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100mm AT FULL SIZE

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SCALES
A1 1:500, A3 1:1000: 0 – 12.5 – 25.0m
A1 1:100, A3 1:200: 0 – 2.5 – 5.0m

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project
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www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT
lendlease

PROPERTY DESCRIPTION
LOT 4 & LOT 5 IN D.P. 1216994
JORDAN SPRINGS

SURVEYED ADWJ | DATUM A.H.D.

PROJECT
PROPOSED BASINS C & V6

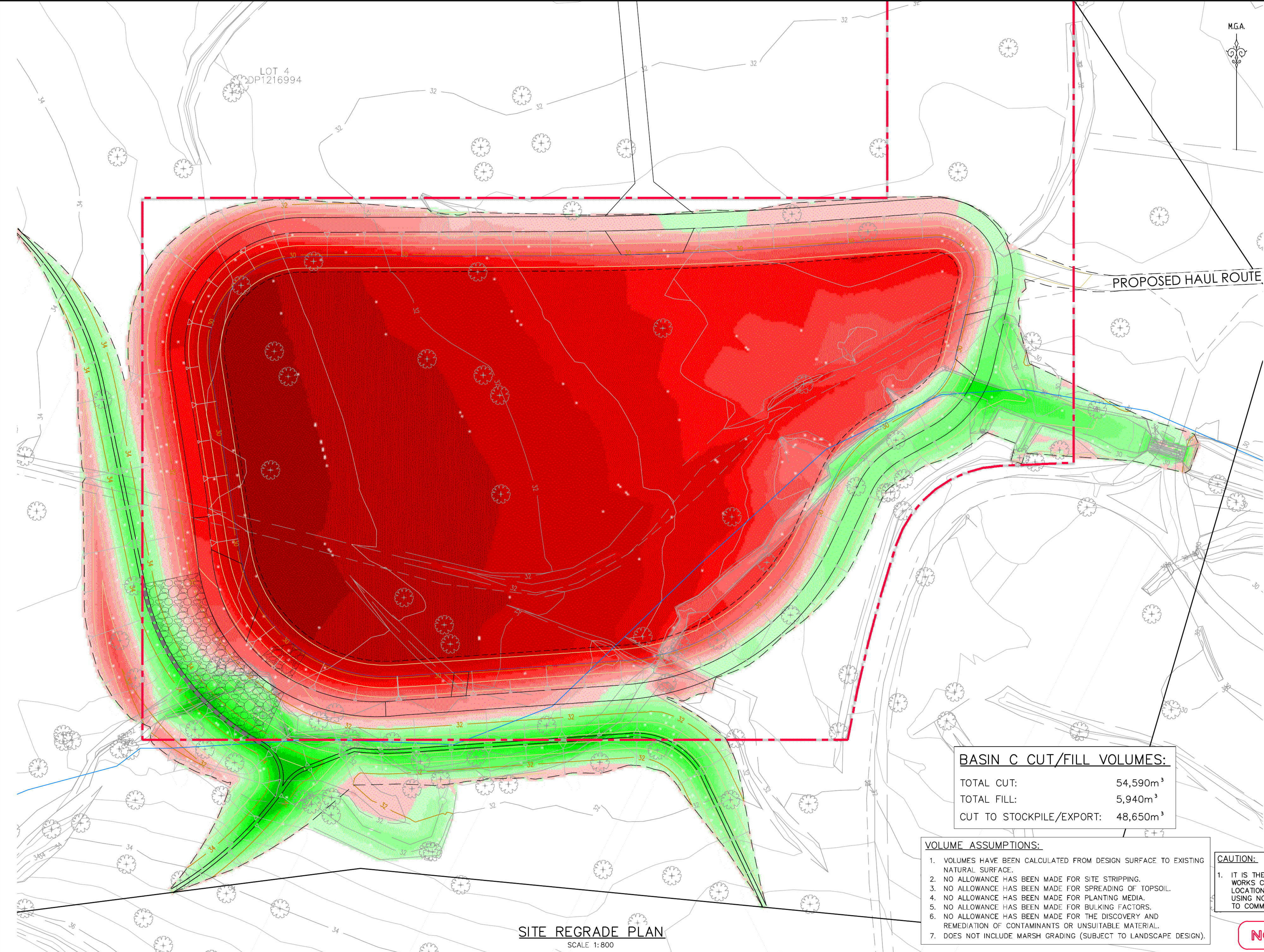
PLAN TITLE
CROSS SECTIONS
BASIN V6

DRAFT

PROJECT No. 300225 – DISCIPLINE CENG – NUMBER 202 | REV. A

Plot Date: 18/11/19 7:27:21PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-202.DWG

300225-CENG-301



SITE REGRADE PLAN

SCALE 1:800

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER

CONTOUR INTERVAL = 0.5m

LEGEND (+ FILL - CUT)

Lower_value		Upper_value		Colour
-9999	to	-4	m	
-4	to	-3.5	m	
-3.5	to	-3	m	
-3	to	-2.5	m	
-2.5	to	-2	m	
-2	to	-1.75	m	
-1.75	to	-1.5	m	
-1.5	to	-1.25	m	
-1.25	to	-1	m	
-1	to	-0.75	m	
-0.75	to	-0.5	m	
-0.5	to	-0.25	m	
-0.25	to	0	m	
0	to	0.250	m	
0.250	to	0.5	m	
0.500	to	0.75	m	
0.75	to	1	m	
1	to	1.25	m	
1.25	to	1.5	m	
1.5	to	1.75	m	
1.75	to	2	m	
2	to	2.5	m	
2.5	to	3	m	
3	to	3.5	m	
3.5	to	4	m	
4	to	99999	m	

BASIN C CUT/FILL VOLUMES:

TOTAL CUT:	54,590m³
TOTAL FILL:	5,940m³
CUT TO STOCKPILE/EXPORT:	48,650m³

VOLUME ASSUMPTIONS:

1. VOLUMES HAVE BEEN CALCULATED FROM DESIGN SURFACE TO EXISTING NATURAL SURFACE.
2. NO ALLOWANCE HAS BEEN MADE FOR SITE STRIPPING.
3. NO ALLOWANCE HAS BEEN MADE FOR SPREADING OF TOPSOIL.
4. NO ALLOWANCE HAS BEEN MADE FOR PLANTING MEDIA.
5. NO ALLOWANCE HAS BEEN MADE FOR BULKING FACTORS.
6. NO ALLOWANCE HAS BEEN MADE FOR THE DISCOVERY AND REMEDIATION OF CONTAMINANTS OR UNSUITABLE MATERIAL.
7. DOES NOT INCLUDE MARSH GRADING (SUBJECT TO LANDSCAPE DESIGN).

CAUTION:

1. IT IS THE RESPONSIBILITY OF THE CIVIL WORKS CONTRACTOR TO DETERMINE THE LOCATION & LEVEL OF EXISTING SERVICES USING NON DESTRUCTIVE METHODS PRIOR TO COMMENCING WORKS ON SITE.

DIAL 1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

100mm AT FULL SIZE

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500, A3 1:1000 (0, 12.5, 25.0m)

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ | DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: SITE REGRADE PLAN SHEET 1 BASIN C

DRAFT

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	301	A

Plot Date: 18/11/19 7:27:28PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-301.DWG

300225-CENG-302

DELANY CIRCUIT

PROPOSED HAUL ROUTE

LOT 5
DP1216994

M.G.A.

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER

CONTOUR INTERVAL = 0.5m

LEGEND (+ FILL - CUT) Lower_value		Upper_value		Colour
-9999	to	-4	m	
-4	to	-3.5	m	
-3.5	to	-3	m	
-3	to	-2.5	m	
-2.5	to	-2	m	
-2	to	-1.75	m	
-1.75	to	-1.5	m	
-1.5	to	-1.25	m	
-1.25	to	-1	m	
-1	to	-0.75	m	
-0.75	to	-0.5	m	
-0.5	to	-0.25	m	
-0.25	to	0	m	
0	to	0.250	m	
0.250	to	0.5	m	
0.500	to	0.75	m	
0.75	to	1	m	
1	to	1.25	m	
1.25	to	1.5	m	
1.5	to	1.75	m	
1.75	to	2	m	
2	to	2.5	m	
2.5	to	3	m	
3	to	3.5	m	
3.5	to	4	m	
4	to	99999	m	

BASIN V6 CUT/FILL VOLUMES:

TOTAL CUT:	6,960m³
TOTAL FILL:	1,000m³
CUT TO STOCKPILE/EXPORT:	5,960m³

VOLUME ASSUMPTIONS:

1. VOLUMES HAVE BEEN CALCULATED FROM DESIGN SURFACE TO EXISTING NATURAL SURFACE.
2. NO ALLOWANCE HAS BEEN MADE FOR SITE STRIPPING.
3. NO ALLOWANCE HAS BEEN MADE FOR SPREADING OF TOPSOIL.
4. NO ALLOWANCE HAS BEEN MADE FOR PLANTING MEDIA.
5. NO ALLOWANCE HAS BEEN MADE FOR BULKING FACTORS.
6. NO ALLOWANCE HAS BEEN MADE FOR THE DISCOVERY AND REMEDIATION OF CONTAMINANTS OR UNSUITABLE MATERIAL.
7. DOES NOT INCLUDE MARSH GRADING (SUBJECT TO LANDSCAPE DESIGN).

SITE REGRADE PLAN

SCALE 1:500

CAUTION:

1. IT IS THE RESPONSIBILITY OF THE CIVIL WORKS CONTRACTOR TO DETERMINE THE LOCATION & LEVEL OF EXISTING SERVICES USING NON DESTRUCTIVE METHODS PRIOR TO COMMENCING WORKS ON SITE.

DIAL1100 BEFORE YOU DIG

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0 12.5 25.0m — A3 1:1000

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adw Johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

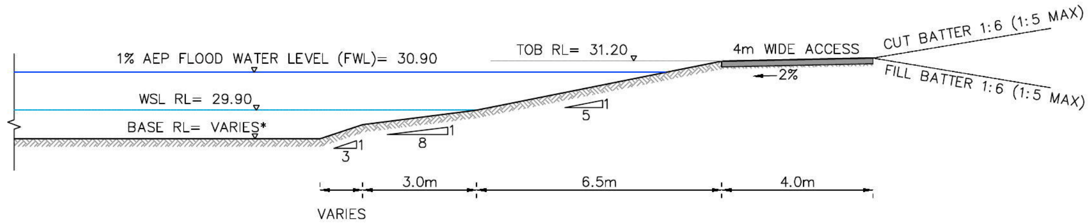
PLAN TITLE: SITE REGRADE PLAN SHEET 2 BASIN V6

DRAFT

PROJECT No.		DISCIPLINE		NUMBER	REV.
300225	–	CENG	–	302	A

Plot Date: 18/11/19 7:27:35PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-302.DWG

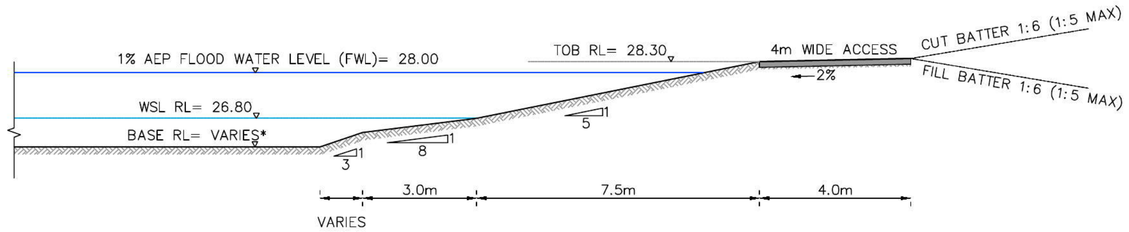
300225-CENG-311



TYPICAL BASIN C SECTION

SCALE 1:100

*REFER LANDSCAPE ZONE PLAN FOR DEPTH



TYPICAL BASIN V6 SECTION

SCALE 1:100

*REFER LANDSCAPE ZONE PLAN FOR DEPTH

100mm AT FULL SIZE

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SCALES: A1 1:100, A3 1:200 (0 – 2.5 – 5.0m)

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adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
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CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

SURVEYED: ADWJ

DATUM: A.H.D.

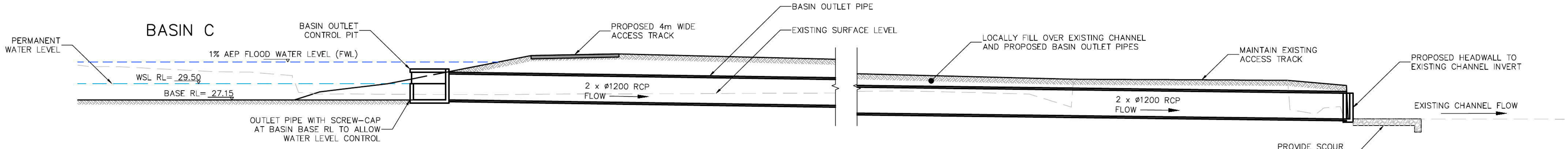
PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: TYPICAL SECTIONS BASIN C

DRAFT

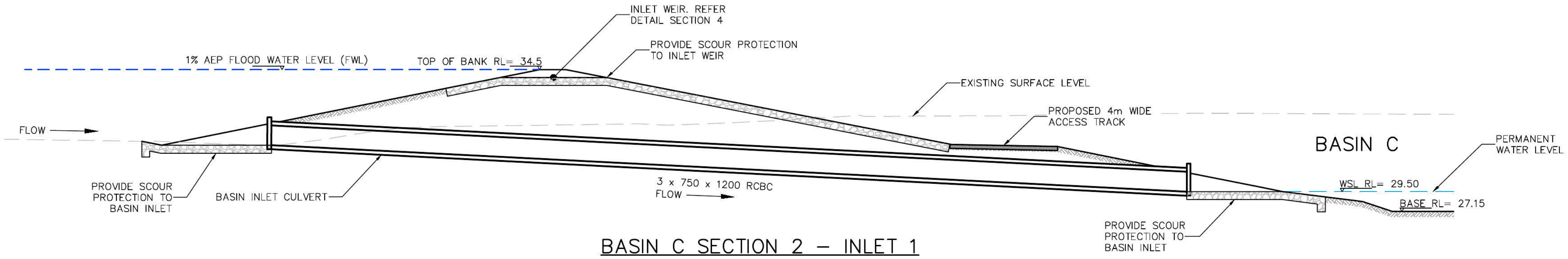
PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	311	A

Plotted By: ... Plot Date: 18/11/19 7:27:39PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-311.DWG



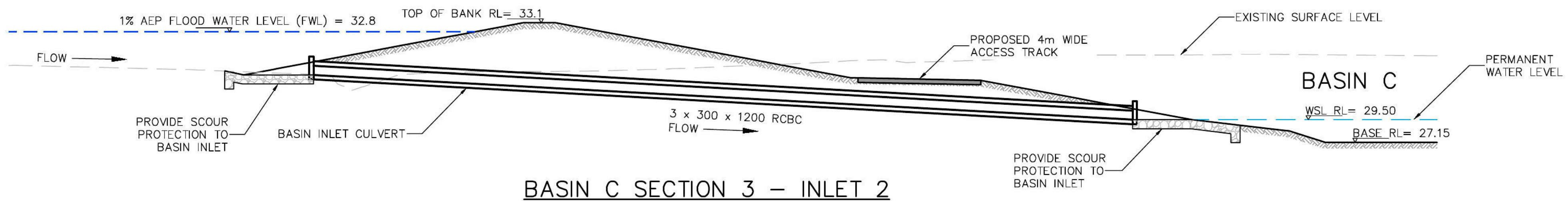
BASIN C SECTION 1 – OUTLET

SCALE 1:100



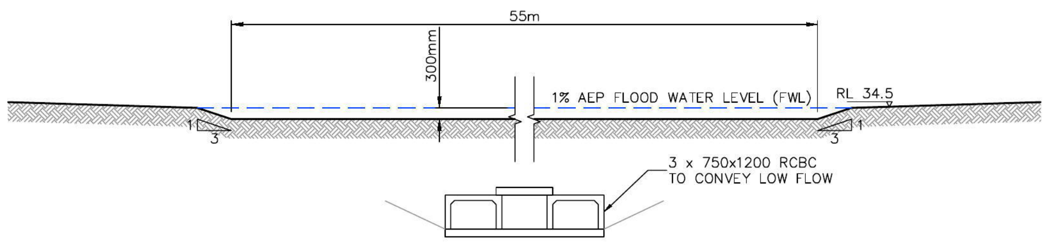
BASIN C SECTION 2 – INLET 1

SCALE 1:100



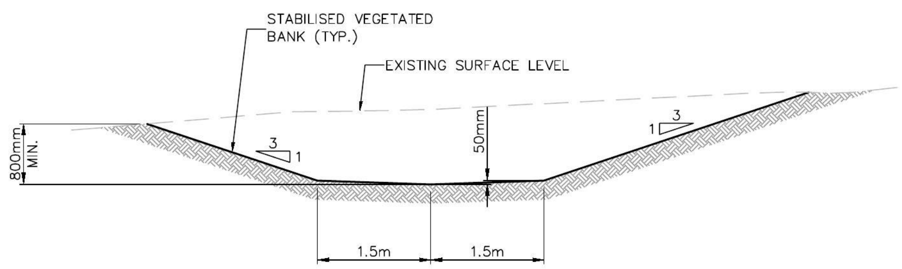
BASIN C SECTION 3 – INLET 2

SCALE 1:100



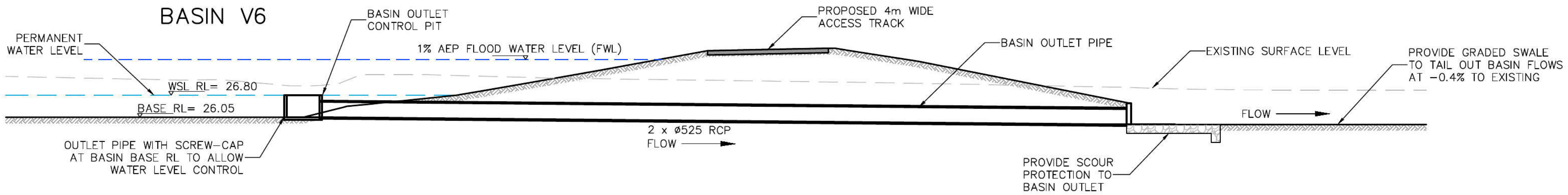
BASIN C SECTION 4 – INLET WEIR

SCALE 1:100



BASIN V6 SECTION 6 – OUTLET SWALE

SCALE 1:50



BASIN V6 SECTION 5 – OUTLET

SCALE 1:100

DIAL 1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

DRAFT

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
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SCALES: A1 1:100, A3 1:200

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adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ | DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: TYPICAL DETAILS

PROJECT No. 300225 – DISCIPLINE CENG – NUMBER 401 – REV. A

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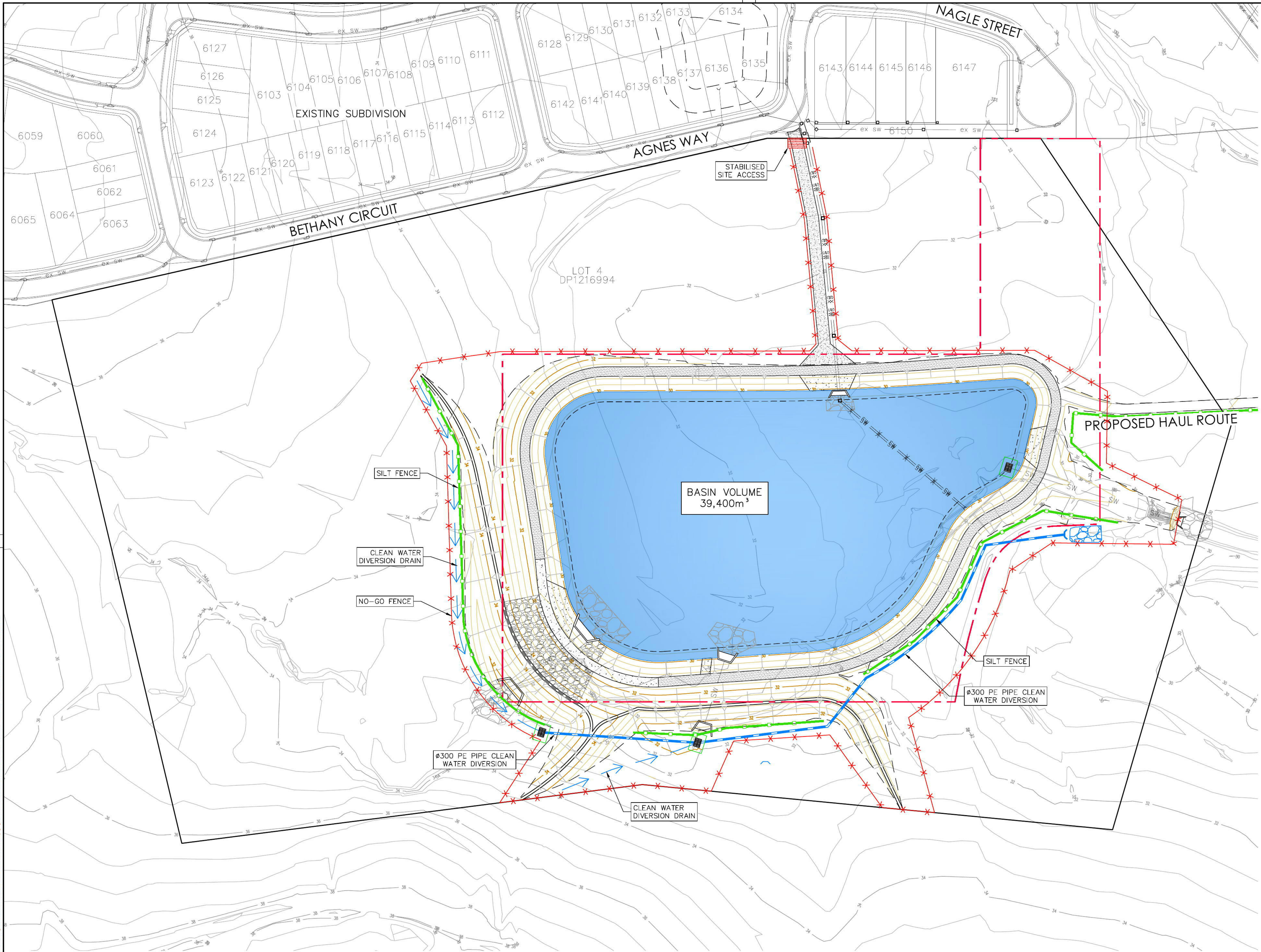
100mm AT FULL SIZE

Plot Date: 18/11/19 7:27:42PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-401.DWG

300225-CENG-501



LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- FUTURE LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER
- ROCK LINED DIVERSION DRAIN
- PROPOSED SW PIT
- PROPOSED HEADWALL
- EXISTING SW PIT
- EXISTING HEADWALL
- EXISTING LINTEL
- SEDIMENT/SILT FENCING
- NO-GO FENCING
- TEMPORARY SWALE
- PROPOSED PIT INLET FILTER
- PROPOSED LINTEL INLET FILTER
- STRAWBALES
- SITE ACCESS/SHAKER RAMP
- STOCKPILE LOCATION

CONTOUR INTERVAL = 0.5

DIAL 1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

EROSION & SEDIMENT CONTROL PLAN

SCALE 1:800

100mm AT FULL SIZE

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REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500, A3 1:1000 (0, 12.5, 25.0m)

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

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adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ | DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: EROSION & SEDIMENT CONTROL PLAN SHEET 1 BASIN C

DRAFT

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	501	A

Plotted By: ... Plot Date: 18/11/19 7:27:49PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-501.DWG

300225-CENG-502

DELANY CIRCUIT

EXISTING SUBDIVISION

6204 6205 6206 6207

STABILISED SITE ACCESS

NO-GO FENCING

SILT FENCE

BASIN VOLUME 10,200m³

LOT 5 DP1216994

PROPOSED HAUL ROUTE

CLEAN WATER DIVERSION DRAIN

SILT FENCE

M.G.A.

LEGEND

- PROPOSED REZONING BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARY
- FUTURE LOT BOUNDARY
- MAJOR CONTOURS
- MINOR CONTOURS
- NATURAL MAJOR CONTOURS
- NATURAL MINOR CONTOURS
- EXISTING KERB
- EXTENTS OF BATTER
- PROPOSED STORMWATER
- EXISTING STORMWATER
- EXISTING SW PIT
- EXISTING HEADWALL
- EXISTING LINTEL
- SEDIMENT/SILT FENCING
- NO-GO FENCING
- DIVERSION DRAIN
- TEMPORARY SWALE
- PROPOSED PIT INLET FILTER
- PROPOSED LINTEL INLET FILTER
- STRAWBALES
- SITE ACCESS/SHAKER RAMP
- STOCKPILE LOCATION

CONTOUR INTERVAL = 0.5

DIAL1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

EROSION & SEDIMENT CONTROL PLAN

SCALE 1:500

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:500 — 0 12.5 25.0m — A3 1:1000

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Central Coast
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P.O. Box 3717,
Tuggerah N.S.W. 2259
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CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: EROSION & SEDIMENT CONTROL PLAN SHEET 2 BASIN V6

DRAFT

SURVEYED	DATUM	PROJECT No.	DISCIPLINE	NUMBER	REV.
ADWJ	A.H.D.	300225	CENG	502	A

Plotted By: Danny Lack Plot Date: 18/11/19 7:27:55PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-502.DWG

100mm AT FULL SIZE

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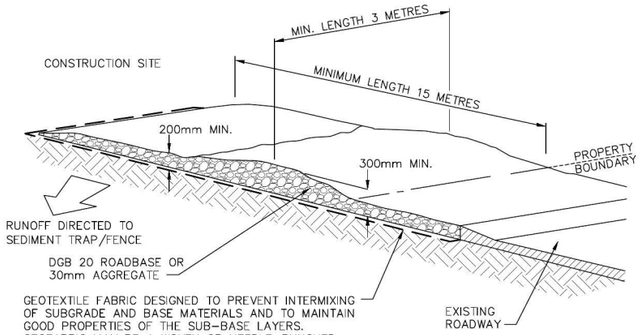
300225-CENG-511

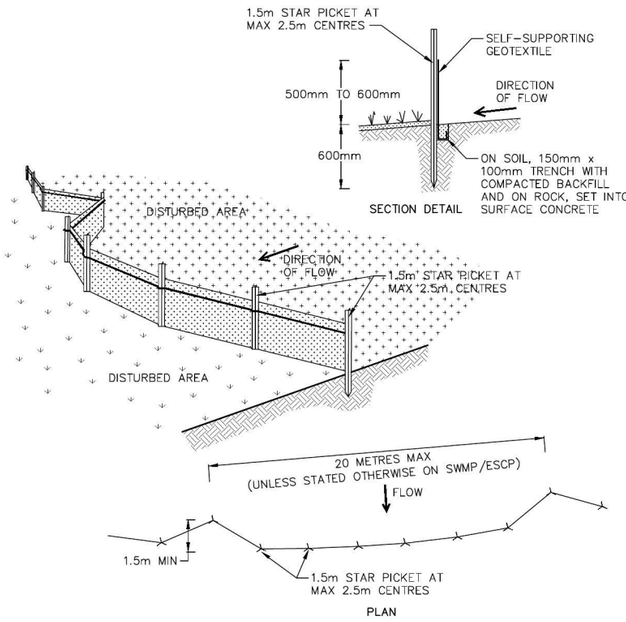
1. EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE CONSISTENT WITH THE NSW GOVERNMENT'S "MANAGING URBAN STORMWATER: SOILS AND CONSTRUCTION".
2. THE ARRANGEMENT SHOWN ON THE PLANS IS DIAGRAMMATIC ONLY. AMENDMENTS MAY NEED TO BE MADE DURING CONSTRUCTION.
3. ALL SEDIMENT AND EROSION CONTROL MEASURES, INCLUDING BASINS AND DIVERSION DRAINS, ARE TO BE IN PLACE PRIOR TO STRIPPING OF SITE.
4. MAINTAIN ALL EROSION AND SEDIMENT CONTROL MEASURES UNTIL COMPLETE REHABILITATION IS ACHIEVED.
5. DISTURBED AREAS ARE TO BE KEPT TO A MINIMUM. NO MORE THAN **2.5ha** OF THE SITE SHALL BE EXPOSED TO EROSION AT ANY ONE TIME.
6. ALL TOPSOIL IN SITE REGRADING AREAS AND ROAD RESERVES TO BE STOCKPILED ON SITE AS SHOWN.
7. STOCKPILE LOCATIONS INDICATIVE ONLY. CONTRACTOR TO IDENTIFY LOCATIONS AND SEEK APPROVAL FROM SUPERINTENDENT.
8. STOCKPILE AREA TO BE FULLY FENCED WITH SILT PROOF FABRIC AT ALL TIMES.
9. IMPORTED MATERIAL TO BE PLACED DIRECTLY INTO SITE REGRADING AREAS. IMPORTED MATERIAL IS NOT TO BE STOCKPILED.
10. STOCKPILES ARE TO BE REMOVED AS SOON AS PRACTICABLE AND SITES REINSTATED WITHIN *timeframe.*
11. CONSERVE ALL TOPSOIL, STOCKPILE AND PROTECT FOR RE-USE ON SITE.
12. STOCKPILES OF MATERIAL ARE TO BE PLACED AWAY FROM DRAINAGE FLOW PATHS AND HEAVILY TRAFFICABLE AREAS AND ARE TO BE SURROUNDED BY SILT FENCING AT ALL TIMES.
13. PROTECT ALL DISTURBED AREAS FROM EROSION.
14. MINIMISE SEDIMENTATION.
15. CONSTRUCT STABILISED EARTH BERMS TO DIRECT CLEAN RUNOFF FROM ENTERING THE DISTURBED SITE
16. CONSTRUCT STABILISED DIVERSION BANKS TO COLLECT RUNOFF FROM DISTURBED AREAS AND DIRECT IT TO A SEDIMENT CONTROL PIT.
17. ERECT AND MAINTAIN SILT FENCES AT THE DOWNSLOPE SIDE OF DISTURBED AREA/S DURING CONSTRUCTION.
18. PLACE SEDIMENT INLET TRAPS AROUND ALL PITS WITHIN, AND DOWNSTREAM OF, THE DEVELOPMENT.
19. PROVIDE GRAVEL BAGS AS REQUIRED.
20. SILT FENCES AND HAY BALING TO BE PLACED WHERE DIRECTED BY COUNCIL'S ENGINEER AND MAINTAINED AT ALL TIMES.
21. ALL DISTURBED AREAS ARE TO BE STABILISED IMMEDIATELY UPON FINISHING CONSTRUCTION ON THAT AREA WITH BITUMEN STABILIZED STRAW MULCH.
22. WHERE EVIDENCE OF SILT LEAVING THE SITE IS FOUND, CONTRACTOR IS TO CLEAR ALL SEDIMENT (INCLUDING THAT IN STORMWATER INFRASTRUCTURE) AT THEIR OWN COST.
23. FOLLOWING RAIN EVENTS, ALL SEDIMENT AND EROSION CONTROL MEASURES ARE TO BE AUDITED AND REINSTATED IF NECESSARY.
24. CONTROL CLEAN WATER FROM ABOVE THE SITE, THROUGH THE SITE.
25. KEEP CLEAN WATER SEPARATE FROM DIRTY WATER.
26. KEEP RUNOFF FROM DISTURBED AREAS, WHERE POSSIBLE, SEPARATE FROM DIRTY WATER.
27. ALL DISTURBED AREAS ARE TO BE RE-VEGETATED OR OTHERWISE PROTECTED AS SOON AS PRACTICAL.
28. ALL NATURAL VEGETATION AREAS OUTSIDE THE BOUNDARIES OF THE PROPOSED DEVELOPMENT WILL BE FENCED WITH NO GO FENCING TO KEEP THE AREAS FREE FROM DISTURBANCE OF MACHINERY, PARKED VEHICLES AND WASTE MATERIAL.
29. AREAS OUTSIDE THE BOUNDARIES OF THE PROPOSED DEVELOPMENT WILL BE FENCED WITH NO GO FENCING TO KEEP THE AREAS FREE FROM DISTURBANCE OF MACHINERY, PARKED VEHICLES AND WASTE MATERIAL.
30. TREES TO BE RETAINED WITHIN THE CONSTRUCTION AREAS ARE TO BE PROTECTED BY TREE PROTECTION FENCING IN ACCORDANCE WITH THE APPROVED LANDSCAPE MANAGEMENT PLANS
31. ESTABLISH A RESTRICTION BOUNDARY AROUND PROTECTED PLANT WITH PARAWEB FENCING. TEMPORARILY RELOCATE FENCE TO ALLOW CONSTRUCTION OF REQUIRED WORKS AND RE-ESTABLISH PROTECTION ZONE AFTER WORKS COMPLETES.



STABILISED SITE ACCESS (SD6-14)

N.T.S.

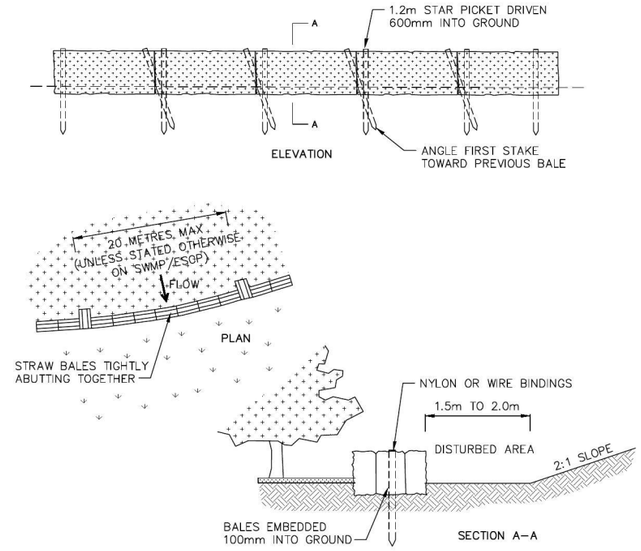
CONSTRUCTION NOTES:
1. STRIP THE TOPSOIL, LEVEL THE SITE AND COMPACT THE SUBGRADE.
2. COVER THE AREA WITH NEEDLE-PUNCHED GEOTEXTILE.
3. CONSTRUCT A 200mm THICK PAD OVER THE GEOTEXTILE USING ROAD BASE OR 30mm AGGREGATE.
4. ENSURE THE STRUCTURE IS AT LEAST 15 METRES LONG OR TO BUILDING ALIGNMENT AND AT 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.



SEDIMENT FENCE (SD6-8)

N.T.S.

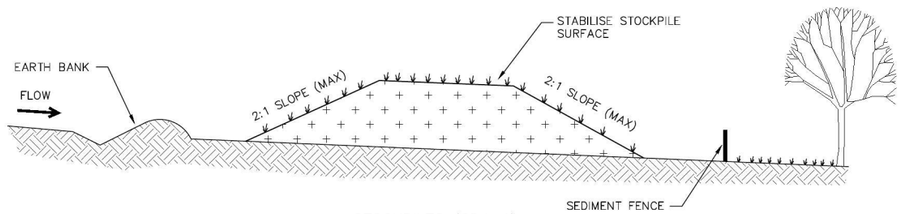
CONSTRUCTION NOTES:
1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10-YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5m LONG STAR PICKETS INTO GROUND AT 2.5 METRE INTERVALS (MAX) AT 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 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.



STRAW BALE FILTER (SD6-7)

N.T.S.

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 75mm TO 100mm AND ANCHOR WITH TWO 1.2m STAR PICKETS OR STAKES. ANGLE THE FIRST STAR PICKET OR STAKE IN EACH BALE TOWARDS THE PREVIOUSLY LAID BALE. DRIVE THEM 600mm IN 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 PLACES 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.



STOCKPILES (SD4-1)

N.T.S.

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.

DIAL1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE

adw Johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994, JORDAN SPRINGS

SURVEYED: ADWJ

DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

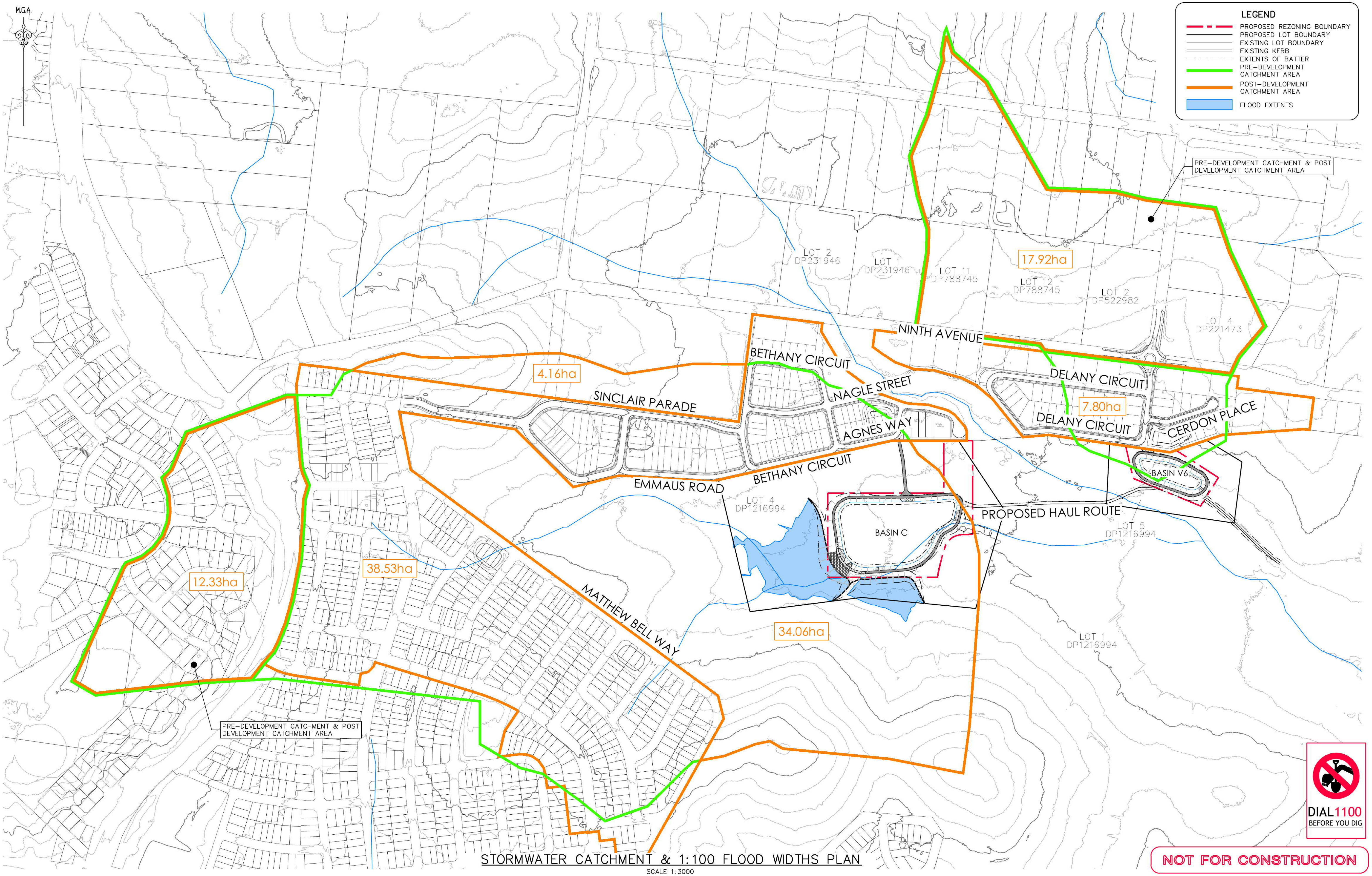
PLAN TITLE: EROSION & SEDIMENT CONTROL DETAILS & NOTES

DRAFT

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	511	A

Plot Date: 18/11/19 7:27:59PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-511.DWG

300225-CENG-601



STORMWATER CATCHMENT & 1:100 FLOOD WIDTHS PLAN

SCALE 1:3000

100mm AT FULL SIZE

This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

REV.	DATE	AMENDMENT	DESIGN	DRAWN	CHECKED	APPROVED
A	18.11.2019	PRELIMINARY ISSUE	B.C.	M.F.	M.L.	M.K.

SCALES: A1 1:3000 / A3 1:6000 (0, 60, 120, 150m)

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE.

DESIGN FILE S:\300225\DESIGN\12D\DA BASIN DESIGN.project

Plot Date: 18/11/19 7:28:06PM Cad File: S:\300225\DWG'S\ENGINEERING\CIVIL\CENG\300225-CENG-601.DWG

adw johnson
Central Coast
5 Pioneer Avenue,
P.O. Box 3717,
Tuggerah N.S.W. 2259
Phone: (02) 4305 4300
Fax: (02) 4305 4399
email: coast@adwjohnson.com.au
www.adwjohnson.com.au
ABN 62 129 445 398

CLIENT: lendlease

PROPERTY DESCRIPTION: LOT 4 & LOT 5 IN D.P. 1216994 JORDAN SPRINGS

SURVEYED: ADWJ — DATUM: A.H.D.

PROJECT: PROPOSED BASINS C & V6

PLAN TITLE: STORMWATER CATCHMENT & 1:100 FLOOD WIDTHS PLAN

DRAFT

PROJECT No.	DISCIPLINE	NUMBER	REV.
300225	CENG	601	A

Appendix E

MAINTENANCE PLAN

Our Ref: ML300225

18/11/2019

Development Engineer
Penrith City Council
PO Box 60
Penrith NSW 2310

ATTENTION: STORMWATER ENGINEERS / COUNCIL MAINTENANCE STAFF

To whom it may concern,

RE: OPERATION AND MAINTENANCE PLAN
BASIN C and V6
JORDAN SPRINGS

1.0 INSPECTION AND MAINTENANCE OF STORMWATER QUALITY IMPROVEMENT DEVICES

Typically during the establishment of the contributing catchment, it is expected that the gross pollutant and sediment loading will be elevated through house construction and reestablishment of vegetation. Therefore an increased schedule of inspections would normally be adopted for the period of development within the catchment. In the case of the basin C and V6 the catchment is nerly 100% developed hence the level and rate of inspections post construction should not be as onerous as per a more conventional program where the basin is constructed with the upstream development.

1.1 Proposed Inspection Program

As a guide the following inspection regime should be adopted for the proposed basins. It is possible however that the results of inspections may require additional inspections and possible maintenance visits.

Establishment of Catchment (80% of houses complete) – Current State

Inspections should be carried out:

- Periodic inspections at 3 month interval; and
- Episodic inspections after significant rainfall (6 month storm, or 50mm)

1.2 Inspection Checklists – Note a preliminary inspection and maintenance checklist has been included as an attachment to this report

Gross Pollutants Trap Inspection Checklist (HumeGard inspection and maintenance guide has been attached to this report)

An inspection checklist is to be completed at each inspection of the gross pollutant traps. This is to include at least the following;

- Reason for inspection (periodic, episodic, response to complaint);
- Presence of odours surrounding the GPT and near adjacent properties;
- Estimate and document the volume of gross pollutants retained within the GPT to confirm if cleaning is required. Estimated volume to be compared with a pre-defined level to confirm if cleaning should be initiated (typically around 50-75% of the active storage volume);
- Visual observation of water quality to ascertain if system has become anaerobic;
- Check access has not been compromised through vandalism;
- Check surrounding ground in good repair, free of settlement;
- Check inlet, outlet and bypass mechanism for blockages;
- Check that the filtration mechanism is not more than 30% blocked where possible;
- Check the filtration mechanism for structural damage;
- Condition of external and internal component of unit in good repair;
- Confirm if any animals are trapped and arrange for their release by trained personnel; and
- Quick Inspection of catchment if large amount of sediment present in unit.

Pond/Wetland Inspection Checklist (Preliminary inspection and maintenance checklists included as an attachment to this report)

An inspection checklist is to be completed at each inspection of the Pond area. This is to include at least the following;

- Reason for inspection (periodic, episodic, response to complaint);
- Check any inlet structures for accumulations of litter and debris. Inspect inlet and outlet structures to ensure they are not blocked by debris. Any debris should be removed at the time of inspection if practical;
- Check inlets and outlets for areas of concentrated erosion;
- Check for accumulated deposits of sediment, litter, rocks and/or organic debris;
- Check that the weed coverage and algal growth is not more than 10% of the surface area;
- Check the depth and/or area of sediment annually to confirm the volume of sediment within the pond. When sediment storage exceeds 25% of the storage volume removal, the Pond should be dewatered (if required) and sediment removed;
- Check embankments and spillways for erosion, cracks, seepage or other signs of instability;
- Check the health of aquatic and landscaping vegetation;
- Check for offensive odours during inspections as these can often indicate low oxygen conditions;

- Check accesses and fencing are in good repair; and
- Inspection of upstream catchment if large amount of sediment present in basin.

1.3 Proposed Maintenance Program

Gross Pollutants Trap Maintenance

The Maintenance of the Hume guard GPT unit requires the use of an eductor truck which uses a vacuum to suck the pollutant material from the unit. The activities to be completed as part of routine maintenance are;

- Check weather forecast prior to scheduling personnel and equipment to ensure dry weather during cleaning;
- Provide safety barricading around the GPT access;
- Ensure confined spaces access equipment, qualified personnel and procedure available for GPT;
- Temporarily block inlets where possible;
- Remove covers using manual lifting equipment or machinery;
- Trained personnel to release any trapped animals;
- Removing and recording the volume/mass of waste trapped;
- Decant liquids to an appropriate treatment measure or area adjacent to the GPT; to the sewer under a trade waste agreement; or transport from the site for disposal at an approved liquid waste management facility;
- Removal of any standing water and/or odours;
- Clean filtration mechanisms by agitation, rakes, brooms, pressure hoses or other appropriate method to clear the mechanism openings;
- Clearing the inlet/outlet and bypass of any blockages;
- Check and repair any damage to structural components (repairing walls, access covers, base, welds, fittings etc); and
- Check and repair GPT adjacent vegetation and trafficked areas.

'"Hume Gard GPT Inspection and Maintenance Guide" by Humes outlines Humes monitoring, cleaning, maintenance and reporting procedures. The *GPT Inspection and Maintenance Guide* has been attached to supplement this document.

The frequency of maintenance and cleaning of the Hume Gard GPT unit is dependent on the findings of the routine inspections. As a guide it is expected that the unit will need to be cleaned half yearly (6 months) as outlined in *'"Hume Gard GPT Inspection and Maintenance Guide"*

Pond/Wetland Maintenance

Maintenance tasks for the Pond may include the following:

- Check weather forecast to confirm that maintenance is scheduled during dry weather;
- Check site prior to locating maintenance equipment on site;
- Clear drainage structures of any blockages;
- Remove any accumulated litter and debris;
- Remove invasive plant species, weeds or any other unwanted vegetation from the Pond and surrounding landscaped surfaces;
- Remove accumulated sediment from the Pond using a backhoe or other appropriate machinery. A dewatering system is to be provided to enable the water level to be manually lowered, although water levels should only be lowered when turbidity is acceptable;
- Prune and/or remove dead branches from trees and shrubs in landscaping surrounding the pond;
- Place sediment, litter and organic debris in a designated secure area for drying (if required) prior to transport and disposal;
- Cut grass using mowers;
- Use line trimmers to trim landscaping vegetation in areas inaccessible by mowers;
- Regrade and replant bare areas;
- Repair damage due to vandalism as required;
- If pests are present, implement appropriate non-toxic measures to control;
- Repair destabilised banks and areas showing signs of erosion. Identified structural bank instability areas should be inspected by a geotechnical engineer and in some circumstances may require reconstruction of the embankments;
- Repair inlet and outlet structures if necessary;
- Rectification of trafficked areas;
- Rectification of areas of scour; and
- Replacement or addition of scour protection.

The frequency of maintenance and cleaning of the Pond will be dependent on the findings of the routine inspections. As a guide it is expected that the basin will need maintenance every 3-6 months for the initial years as the catchment is being developed and bi-annual once the majority of homes have been completed and vegetation has re-established in disturbed areas.

1.4 Maintenance Reporting

A Cleaning and Maintenance reporting checklist is to be completed at each cleaning operation.

Gross Pollutants Trap Maintenance Reporting

For the GPT, the maintenance reporting is to include at least the following;

- Reason for cleaning (periodic, episodic, response to complaint);
- Time and duration of clean;
- Volume or weight of material removed;
- Composition of captured pollutants;
- Removal of blockage from inlet and outlet;
- Repairs required to outlet or surround and details;
- Repairs required to areas of scour or trafficked areas; and
- Replacement of vegetation.

Pond/Wetland Maintenance Reporting

For the Pond, the maintenance reporting is to include at least the following;

- Reason for cleaning (periodic, episodic, response to complaint);
- Time and duration of clean;
- Volume or weight of material removed;
- Composition of captured pollutants;
- Removal of blockage from inlet and outlet;
- Presence of vandalism/damage;
- Repairs required to outlet or surround and details;
- Repairs required to areas of scour or trafficked areas;
- Vegetation condition;
- Replanting of vegetation;
- Evidence of dumping; and
- Mowing/trimming requirements.

Yours Sincerely,

Mark Littlefield
SENIOR CIVIL AND ENVIRONMENTAL ENGINEER
ADW JOHNSON PTY LTD
Central Coast Office

Attachments

1. Preliminary Maintenance and Inspection Checklists
2. GPT Maintenance Guide by Ecosol

ATTACHMENT 1: Preliminary Maintenance and Inspection Checklists

Proposed Basin C and V6 – Maintenance Checklists – (1 of 4)

		Proposed Basin C and V6 – Maintenance Checklists PHYSICAL/SEDIMENT DEPOSITION/TRASH	Inspection Date: Weather/incident:	
Item	Report Status (1-5) (Refer Legend below)	Details of Maintenance required	Responsibility	Due date
1. GPT's				
2. Trash racks				
3. Sediment Pond/Open water Zones				
4. Macrophyte zones				
5. Water depth in macrophyte zone				
6. Batter / embankment erosion				
7. Incoming drainage channels				

Report Status Legend
1 – Exceptional - New or close to new, No action required, current Maintenance program acceptable
2- Good – Slight defects, No action required, current Maintenance program acceptable
3-Average – Minor defects, may require minor maintenance or forecast maintenance, current Maintenance program acceptable
4-Poor – Significant defects, requires maintenance as per checklists, current Maintenance program may not be acceptable
5-Very Poor – Significant defects and damage, requires maintenance and or repairs, current Maintenance program may not be acceptable

Proposed Basin C and V6 – Maintenance Checklists – (2 of 4)

		Proposed Basin C and V6 – Maintenance Checklists STRUCTURAL	Inspection Date: Weather/incident:	
Item	Report Status (1-5) (Refer Legend below)	Description of maintenance works/action and location within wetland	Responsibility	Due date
1. GPT's				
2. Trash racks				
3. Sediment Pond/Open water Zones				
4. Macrophyte zones				
5. Water depth in macrophyte				
6. Batter / embankment erosion				
7. Incoming/outlet drainage channels				

Report Status Legend
1 – Exceptional - New or close to new, No action required, current Maintenance program acceptable
2- Good – Slight defects, No action required, current Maintenance program acceptable
3-Average – Minor defects, may require minor maintenance or forecast maintenance, current Maintenance program acceptable
4-Poor – Significant defects, requires maintenance as per checklists, current Maintenance program may not be acceptable
5-Very Poor – Significant defects and damage, requires maintenance and or repairs, current Maintenance program may not be acceptable

Proposed Basin C and V6 – Maintenance Checklists – (3 of 4)

		BIOLOGICAL	Inspection Date: Weather/incident:	
Item	Report Status (1-5) (Refer Legend below)	Description of maintenance works/action and location within wetland	Responsibility	Due date
1. Weeds introduced sp.				
2. Nuisance plants				
3. Replanting				
4. Waterfowl				
5. European carp				
6. Mosquitoes				
7. Algae				

Report Status Legend
1 – Exceptional - New or close to new, No action required, current Maintenance program acceptable
2- Good – Slight defects, No action required, current Maintenance program acceptable
3-Average – Minor defects, may require minor maintenance or forecast maintenance, current Maintenance program acceptable
4-Poor – Significant defects, requires maintenance as per checklists, current Maintenance program may not be acceptable
5-Very Poor – Significant defects and damage, requires maintenance and or repairs, current Maintenance program may not be acceptable

Proposed Basin C and V6 – Maintenance Checklists – (4 of 4)

		Proposed Basin C and V6 – Maintenance Checklists **PUBLIC SAFETY**	**Inspection Date:** **Weather/incident:**	
Item	**Action Class**	**Description of maintenance works/action and location within wetland**	**Responsibility**	**Due date**
1. Safety signage				
2. Safety fencing				
3. Inhibitive littoral planting				
4. Inhibitive macrophyte planting				
5. Depth markers				
6. Bridge walkway access				

Report Status Legend
1 – Exceptional - New or close to new, No action required, current Maintenance program acceptable
2- Good – Slight defects, No action required, current Maintenance program acceptable
3-Average – Minor defects, may require minor maintenance or forecast maintenance, current Maintenance program acceptable
4-Poor – Significant defects, requires maintenance as per checklists, current Maintenance program may not be acceptable
5-Very Poor – Significant defects and damage, requires maintenance and or repairs, current Maintenance program may not be acceptable

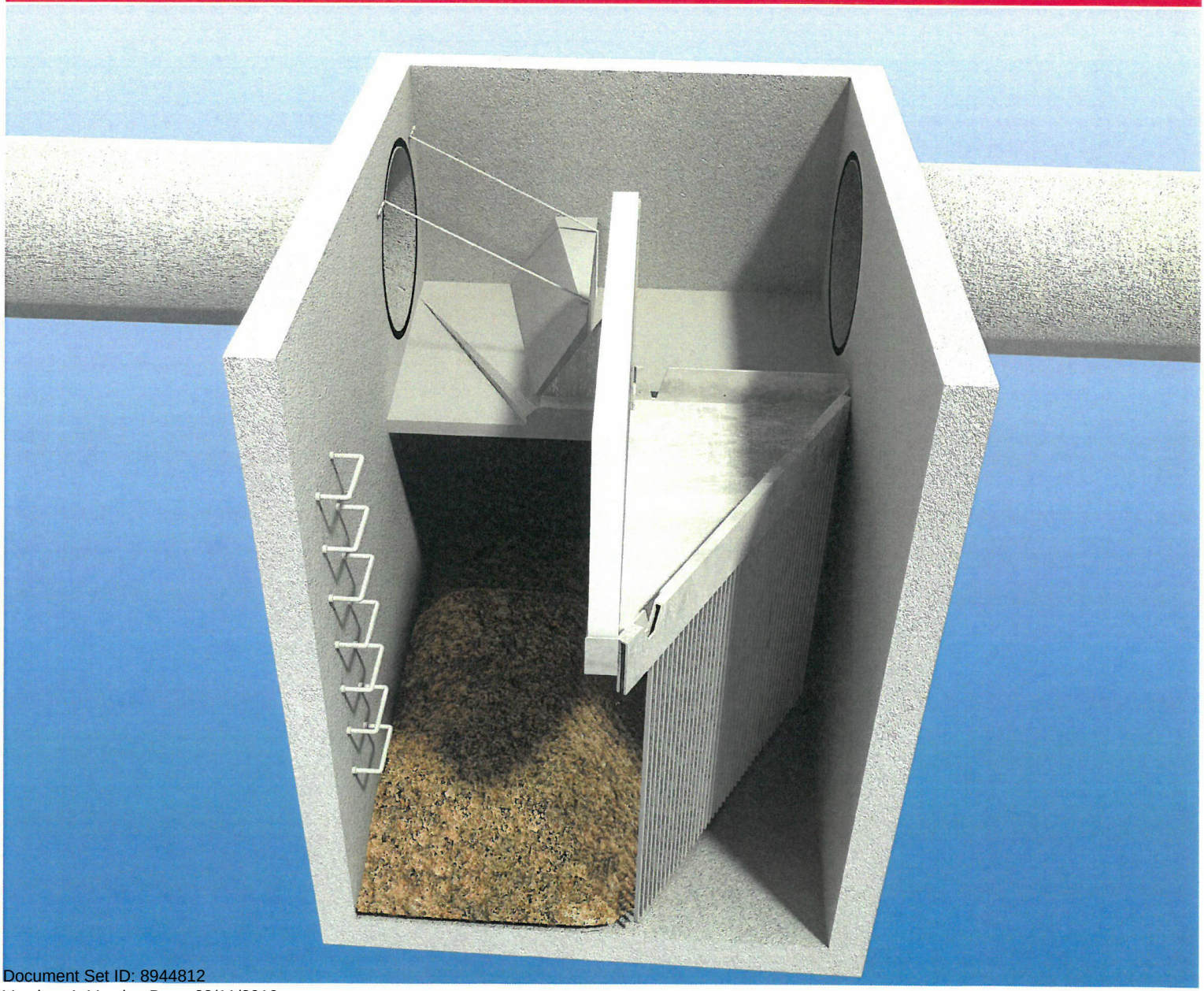
ATTACHMENT 2: GPT MAINTENANCE GUIDE BY HUMES

Humes

Strength. Performance. Passion.

HumeGard® GPT
Inspection and maintenance guide

Issue 1



Purpose of this guide

This guide outlines the maintenance procedures and requirements for HumeGard® GPT units.

Where the contents of this guide differ from project specifications and drawings, supervisory personnel should consult with a Humes engineer. In the event of any conflict between the information in this guide and local legislative requirements, the legislative requirements will take precedence.

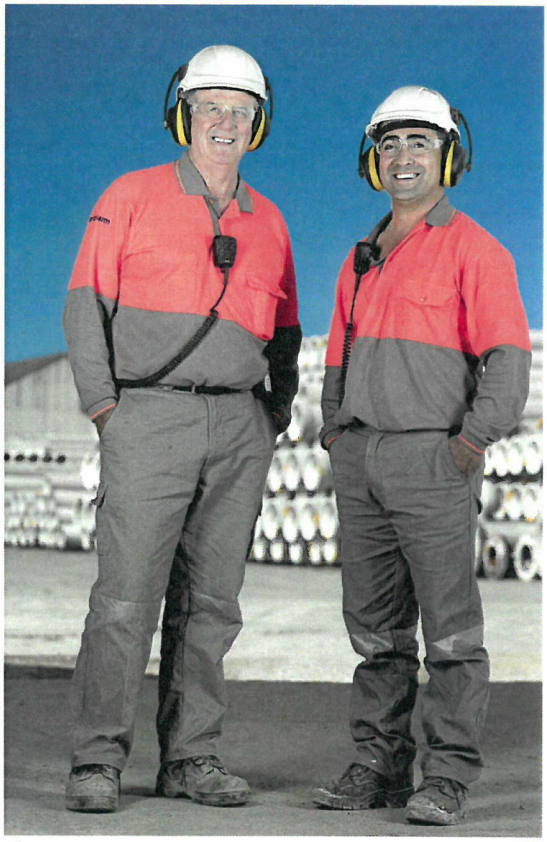
It is the responsibility of the site owner and its contractors to determine the site's suitable access and location for maintenance plant and equipment.

Nothing in this guide is to be construed as a representation, endorsement, promise, guarantee or warranty whether expressed or implied.

Humes makes no representation or warranty, implied or otherwise that, amongst others, the content of this guide is free from errors or omissions or in relation to the adequacy of the information contained in this guide and where appropriate you will seek verification from an independent third party before relying on any information in this guide. Humes is not liable or responsible to any person for any use or reliance of any information arising out of or in connection with this guide.

Safety advice

The HumeGard® GPT must be maintained in accordance with all relevant health and safety requirements, including the use of PPE and fall protection where required.



Confined space entry

Maintenance of the HumeGard® should not require entry, however, if entry into the unit is required, then the device is deemed a confined space. As such, if entering the unit, all equipment and training must comply to SHE regulations. It is the responsibility of the contractor or person/s entering the unit to proceed safely at all times.

Personal safety equipment

The contractor is responsible for the provision of appropriate personal protection equipment including, but not limited to safety boots, hard hat, reflective vest, protective eyewear, gloves and fall protection equipment. Make sure all equipment is used by trained and certified personnel, and is checked for proper operation and safety features prior to use.

Handling

The customer, or their contractor, is responsible for the removal of access lids from the HumeGard® unit. The customer or contractor should familiarise themselves with the device and site constraints, and particular attention should be given to safety hazards such as overhead power lines and other services in the vicinity when considering the position of plant and equipment.

Maintenance overview

To ensure ongoing long-term environmental protection HumeGard® needs to be maintained (generally annually). The actual on-going maintenance frequency requirements will be determined through quarterly inspections undertaken during the first year. However, only an annual maintenance period is anticipated for most HumeGard® units installed within drainage infrastructure.

Inspection can be performed by anyone, and procedures for inspection are provided in this document.

Generally, comprehensive maintenance is performed from the surface via vacuum truck. Companies capable of performing this maintenance can be found in the Yellow Pages or online by searching sewer cleaning or liquid waste removal.

Additionally large litter items may also be removed utilizing the optional stainless steel basket arrangement within the HumeGard®. Alternatively the litter can be removed during eduction/vacuum clean out, which will be required in order to remove the sediment component of the stormwater pollution.

HumeGard® operation

The HumeGard® GPT utilises the processes of physical screening and floatation/sedimentation to separate the litter and coarse sediment from stormwater runoff. It incorporates an upper bypass chamber with a floating boom (or broad-crested weir for small units) that diverts treatable flows into a lower treatment chamber for settling and capturing coarse pollutants from the flow. There are two types of HumeGard® - the super-critical version, which incorporates a broad-crested weir approach for treatment flow diversion, and a larger, standard version, which incorporates a floating boom arrangement to divert treatable flows.

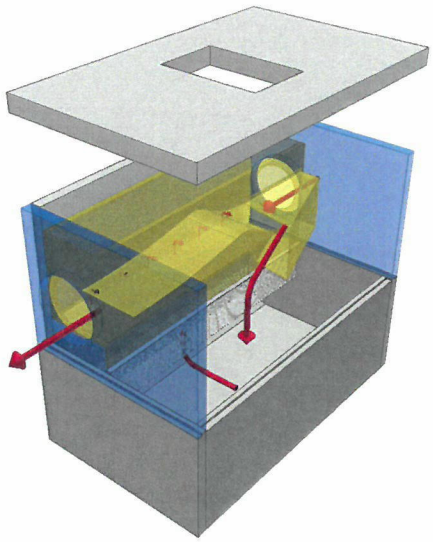
Super-critical HumeGard® (HG12 & HG15)

The super critical Humegard® consists of an internal broad crested weir and holding chamber.

A specially designed patented broad crested weir diverts material entrained in the flow into the adjacent holding chamber. This consists of the holding sump and another baffle/weir/channel arrangement designed to retain floating material while guiding flow through to the outlet.

- **Low/Treatment flow operation**
  During low to moderate flows, the weir diverts all flows into the sump area where pollutants are captured and retained. The velocity in this sump is controlled and never exceeds a maximum average velocity of 0.2m/s.
- **High/Bypass flow operation**
  During high flows, the weir diverts up to the treatable flowrate into the sump and any excess flow is able to flow over the hump and through to the outlet. This ensures that the previously caught pollutants are not disturbed, resuspended and diverted out of the outlet pipe.

Figure 1 – Super-critical HumeGard® GPT



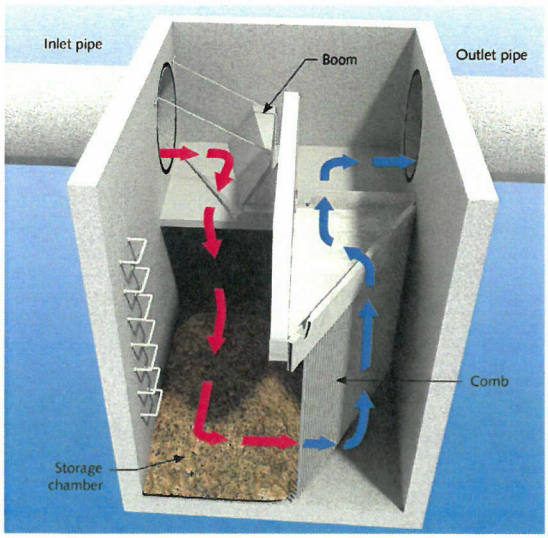
Standard HumeGard® (HG18 – HG45)

The standard HumeGard® consists of an internal separation channel and holding chamber.

A specially shaped boom, which is supported by hangers hinged to the upstream wall, diverts material entrained in the flow from the separator to the adjacent, off line, holding chamber. This consists of the holding sump and another baffle/weir/channel arrangement designed to retain floating material while guiding flow through to the outlet.

- **Low/Treatment flow operation**
  During low to moderate flows, the boom remains on the floor of the separation channel and imparts an upward and sideways motion to the incoming flow. This action causes deflection into the holding chamber, where heavy and saturated materials settle to the bottom of the sump, while buoyant material is trapped behind the baffle wall arrangement.
- **High/Bypass flow operation**
  During infrequent high flows, the boom lifts, which permits the flow to pass beneath it while continuing to deflect buoyant material to the holding chamber. Once the pipeline flows full, the boom lifts clear, allowing unobstructed flow through the unit, whilst at the same time retaining the floating materials on the upstream side of the device.

Figure 2 – Standard HumeGard® - low flow conditions



Maintenance frequency

It is recommended and good practice for an inspection of the HumeGard® to be carried out on a quarterly basis. The quarterly inspection is to check the operation of the boom, volume of pollutants in the holding sump, etc. But generally, only an annual maintenance period for cleaning is anticipated.

It is important during the quarterly inspections to check that the operation of the boom is satisfactory. The boom should not be impeded by large pieces of litter i.e. logs, etc. or have objects lodged underneath the boom or between it and the baffle plate that may prevent it from rising, or sitting flat on the false floor.

Cleaning maintenance frequency requirements will vary with the amount of stormwater pollution generated in your catchment (amount of litter, sediment, etc.). So it is recommended that as the 3-monthly inspections are performed, the frequency of maintenance be increased or reduced based on local conditions and pollutant capture rates.

The need for maintenance can be determined easily by inspecting the unit from the surface by:

- Checking if litter can be readily seen in the holding chamber once the cover has been removed.
- Using a dipstick or sludge judge (sediment sampling tube) to assess how much sediment or organic material has been captured in the bottom of the holding chamber. A sediment depth over 400mm would indicate cleaning is recommended to minimise the potential for scour.

Sediment sampling tubes are available for purchase from Humes (contact your local sales rep for more details).

Occasionally it may be beneficial to only remove captured litter and not siphon the entire contents of the holding chamber.

Maintenance procedure

Maintenance of Humegard® units is generally performed using vacuum/eduction trucks.

No entry into the unit is required for maintenance. The vacuum service industry is a well-established sector, that services underground tanks, sewers and catch basins.

HumeGard® units are cleaned by adhering to the following steps:

1. Complete a Job Hazard Analysis (JHA) and a Work Method Statement (WMS) before undertaking the maintenance procedure.
2. Prepare the site around the Humegard for cleaning. This involves establishing the job site (traffic control if required), assembling cleaning equipment, positioning the vacuum truck and ensuring correct equipment is available to use (including PPE).
3. Remove the rectangular lid above the holding chamber and conduct a visual inspection to assess the condition of the Humegard® and note if there are any blockages or lodged debris.
4. Lower the suction hose to the surface of the water in the holding tank and skim across the top to capture floating litter.
5. Lower the suction hose to the base of the holding chamber to remove sediment, organic matter and litter which has sunk.
6. Dislodge materials trapped in the screen using a water jet or brush/broom.
7. Remove the second rectangular access cover over the diversion boom and ensure there is no debris trapped underneath the boom.
8. Clean the interior of the pit using water jet.
9. Replace lids, ensuring they are firmly and securely in place.

It may be convenient on larger units to de-water some of the water in the holding chamber. This will minimise maintenance costs as disposal of essentially clean stormwater can be avoided. Often this can be done onto adjacent ground or into the council sewer system. However, this should only be done with the appropriate authorities' consent.

If a HumeGard® has been fitted with an optional removable basket, the basket can be used to periodically remove litter in between scheduled eduction/vacuum maintenance visits. The baskets must also be removed prior to vacuuming/educting the HumeGard® for the sediment load.

Maintenance cost

The costs to clean out a HumeGard® will vary based on the size of the unit, pollutant volume/type and transportation distances.

A typical cost (equipment and personnel) is estimated to be approximately $1500-$3500 (based on best information at time of installation) - exclusive of disposal costs.

This estimated cost is based on the clean out of a single unit. Economies of scale will be achieved where there are multiple units for a given location. The time to clean a single unit is approximately 3-4 hours (including transportation and cleaning).

Disposal costs are estimated to be in the order of $350-$600 dependent upon volume and type of pollutants removed from the holding sump.

Removal of hazardous material

A wide range of hazardous materials may be intercepted by the HumeGard® gross pollutant trap, although instances of this have been minimal. Hazardous materials may include high levels of heavy metals accumulated within the collected sediments, certain inorganic chemicals, used syringes, glass, and other matter.

As noted, the potential presence of hazardous material is primarily the reason why eduction is the preferred cleaning method, since this minimises the potential for maintenance personnel and nearby communities to come into contact with such material. Where baskets are required, the majority of the collected material will fall from the basket into the maintenance truck upon opening of the trap door. Any and all contact with the basket should be undertaken with suitable protective clothing, including heavy duty hand protection. If material is caught within the basket, it should be removed using suitable equipment.

Removal of this material by hand is not recommended. It is noted that it is not necessary to have the sumps/ baskets completely clean. The removal of 95% of the material is satisfactory, and the prospect of completely removing every piece of material increases the occupational health and safety risks.

The presence of certain toxicants may need to be considered for the disposal of material and appropriate locations. If elevated levels of toxicants are suspected, then analytical screening of material should be completed to determine an appropriate disposal response according to local and state government regulations.

Example Job Safety Analysis (JSA)/Work Method Statement (WMS)

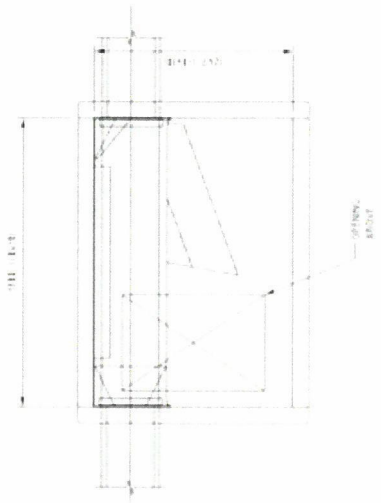
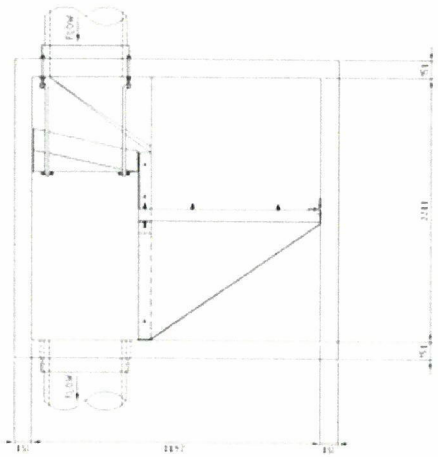
The following JSA/WMS is a guide only. It is the responsibility of the cleaning contractor or asset owner to develop their own JSA/WMS in line with their own WHS requirements and constraints. It also assumes that there will be no entry into the unit during maintenance.

Project/ Address:				**Date:**	
Job: Clean out of HumeGard unit				**Operator:**	
Risk Level:	1 - Extreme	2 - High	3 - Medium	4 – Low	5 - Negligible
Consequence:	Likely to cause very serious harm	Clear potential for serious harm	Similar to risk of driving a car	Little likelihood of any harm	Virtually Harmless
Response:	STOP THE JOB	STOP and Reassess to find better way	Control & ensure controls work	Monitor to ensure risk remains low	Continue work

PROCEDURE	POSSIBLE HAZARDS	INITIAL RISK	CONTROLS	PERSON RESPONSIBLE	END RISK
1. Preliminaries: • Confirm GPT locations and types • Familiarise with GPT technical manual	Nil	-	Refer to relevant manuals	Operator	-
2. Plan the Job: • Room to access & work on the GPT without impacting other property or vehicles • Consider water flows & if excessive note & move onto next job • Condition & status of GPT • Identify water fill point • Identify waste dump point	• Climbing in/out/around of truck • All GPT have a high risk of containing syringes	3 4	• Refer to safety plan on moving around vehicles • Wear PPE and never reach into or lift accumulated matter with hands. If a needle stick injury occurs, wash the affected area with soap & water & report the incident to the branch and seek medical attention ASAP.	Operator	4 5
3.Establish Job Site: • Over 60 km/hr will require traffic management • Within 6.4m of overhead power lines will require spotter	• Traffic • Pedestrians • Overhead power lines	3	• Devise a relevant Traffic Management WMS • Ensure barriers and signs redirect pedestrians • Ensure spotter is present	Operator	5
4. Assemble Cleaning Equipment • Position vacuum hose to remove debris from GPT	• Infection • Sharp edges • Manual handling • Falling equipment • High pressure water	3	• Personal hygiene (wash hands prior to smoking/eating) • Wear gloves & remove sharp edges/burrs on equipment • Follow a manual handling WMS • Store equipment securely on vehicle • Inspect vacuum hose fittings firmly secured • Inspect hose daily 7 ensure it has been tested (6 monthly) • Never cap jetting hose • Inspect jetting hose for damage • Never adjust pump pressures or regulators • Maximum reducer on 1" hose is ¾" • No reducers on ½" hose • Fittings to be firmly secured using a spanner	Operator	5
5. Open the GPT Cover • Remove lid using the manhole lifting procedure • If lid is mass concrete & exceeds safe lifting limits, use mechanical lifting device	• Manual Handling • Open Manholes	3	• Refer to a SWP for manual handling • Refer to a SWP for manhole lifting	Operator	5
6. Start Cleaning • Position bottom end of vacuum hose to remove debris from GPT • Run vacuum prior to remove debris • If there is any requirement to enter the pit for any reason, confined Space Entry Procedure is to be followed • Vacuum all material out of the sump until empty clear 7 clean • Dislodge materials trapped in the screen using water jet ot brush/broom • Remove access cover over diversion boom/weir, ensure there are no debris trapped underneath boom/around weir • Clean the interior of the pit using water jet &/or brush/broom • Vacuum all materials out of the pit	• Manual handling • Eye injury from flying debris • Noise • People inside exclusion zone • Confined Space Entry (If required)	3	• Follow a SMP for manual handling • Wear eye protection • Wear hearing protection • Stop operation until area clear. Only essential personnel within exclusion zone • Ensuring minim slack in hose to prevent whipping • Refer to confined space manuals and SWPs	Operator	5
7. Finish Cleaning • Replace lid ensuring it is fimly & securely in place • Ensure all waste is vacuumed and site is clean prior to packing up • Complete the CWS recording all details and any problems	• Manual handling	3	• Follow a SMP for manual handling	Operator	5

HumeGard® unit maintenance record

Customer details			
Company		Phone	
Contact name		Email	
Address		Date	
State		Operator name	
HumeGard® unit details			
Model		Type (circle one)	Small (weir) | Standard (boom)
Cleaning method (circle one)	Vacuum | Eduction	Lid type	

Plan view (circle one)	
Small HumeGard® (weir)	Standard HumeGard® (boom)
	

Pollutant removal results			
Estimated volume of water removed (L)		Litter (%)	
Estimated volume of pollutants (m^3)		Vegetation (%)	
Percentage of pollutant content (%)		Sediments (%)	
Percentage of pollutant capacity (%)		**Total volume (%)**	

Any evidence of hydrocarbons (grease/oil) contamination?	YES	NO
Any evidence of sewage contamination?	YES	NO
Any evidence of any other unexpected contamination?	YES	NO
Describe unexpected contamination (if any):		
Any problems cleaning the HumeGard® unit (describe briefly):		
If problems were experienced were they thenresolved satisfactorily (describe briefly):		

Contact information

National sales 1300 361 601

humes.com.au

info@humes.com.au

Head Office

18 Little Cribb St
Milton 4064 QLD
Ph: (07) 3364 2800
Fax: (07) 3364 2963

Queensland

Ipswich/Brisbane
Ph: (07) 3814 9000
Fax: (07) 3814 9014

Rockhampton
Ph: (07) 4924 7900
Fax: (07) 4924 7901

Townsville
Ph: (07) 4758 6000
Fax: (07) 4758 6001

New South Wales

Grafton
Ph: (02) 6644 7666
Fax: (02) 6644 7313

Newcastle
Ph: (02) 4032 6800
Fax: (02) 4032 6822

Sydney
Ph: (02) 9832 5555
Fax: (02) 9625 5200

Tamworth
Ph: (02) 6763 7300
Fax: (02) 6763 7301

Victoria

Echuca
Ph: (03) 5480 2371
Fax: (03) 5482 3090

Melbourne
Ph: (03) 9360 3888
Fax: (03) 9360 3887

Tasmania

Launceston
Ph: (03) 6335 6300
Fax: (03) 6335 6330

South Australia

Adelaide
Ph: (08) 8168 4544
Fax: (08) 8168 4549

Western Australia

Gnangara
Ph: (08) 9302 8000
Fax: (08) 9309 1625

Perth
Ph: (08) 9351 6999
Fax: (08) 9351 6977

Northern Territory

Darwin
Ph: (08) 8984 1600
Fax: (08) 8984 1614

Humes

National sales 1300 361 601
humes.com.au
info@humes.com.au

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