HUMECOAL
PROJECT

VOLUME 2D

Hume Coal Project and Berrima Rail Project

Response to Submissions

Appendix 2

Prepared for Hume Coal Pty Limited
June 2018

EMM

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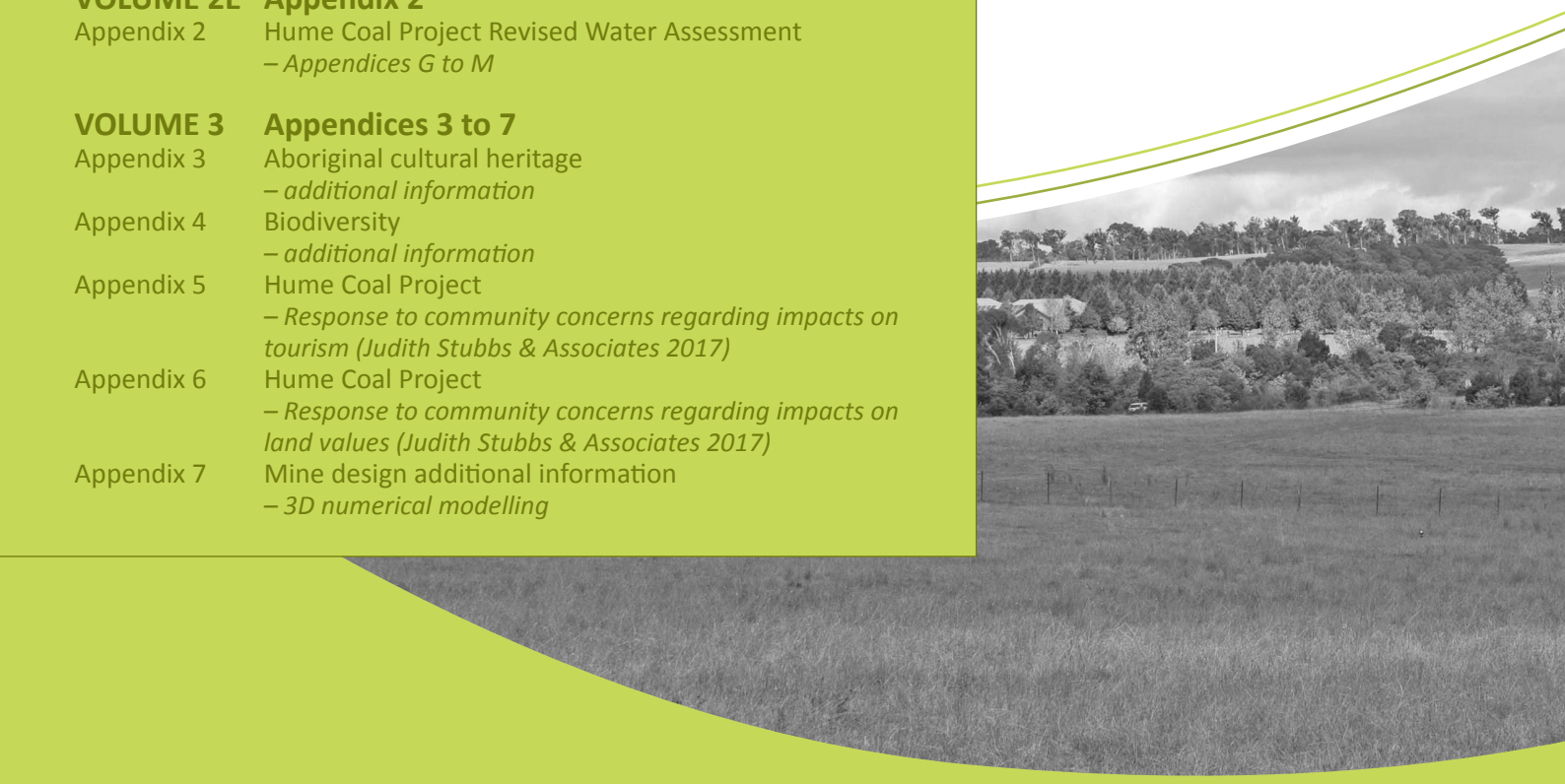

Appendix 2

Hume Coal Project
Revised Water Assessment
– Appendices E to F

Appendix E

Concept on-site wastewater management assessment

REF: 2844WW

VERSION [2.0]

MAY 15, 2018

CONCEPT ON-SITE WASTEWATER MANAGEMENT ASSESSMENT, PROPOSED COAL MINE, BERRIMA

80 MEREWORTH ROAD, BERRIMA, NSW

LGA: Wingecarribee

LOT 2 DP 1138694

CLIENT: Hume Coal Pty Ltd

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VERSION CONTROL

Title	Concept On-site Wastewater Management Assessment, Proposed Coal Mine, Berrima			
Site address	80 Mereworth Road, Berrima, NSW			
Application No	7172			
Created By	Sean Harris			
Date Created	18/04/2018			
Version Number	**Prepared by**	**Description**	**Date Modified**	**Status**
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[2.0]	S.H	Final report	15/05/2018	Final
				-
				-
				-
				-
				-

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1. INTRODUCTION

This Concept On-site Wastewater Management report was prepared by Harris Environmental Consulting at the request of Hume Coal Pty Ltd. The report was prepared for a proposed coal mine at 80 Mereworth Road, Berrima. The property location is shown as Figure 1. The proposed development is shown as Figure 2 and 3.

This report was prepared to respond to matters raised by WaterNSW when assessing the Environmental Impact Statement (EIS) for the proposed development. Water NSW did not believe the EIS addressed their requirements for on-site "domestic" wastewater management to demonstrate a Neutral or Beneficial Effect on Water Quality.

The aspects of the proposed development that are described in the EIS and that have now been addressed in this report include:

- Domestic wastewater treatment system servicing 4-10 people at rail maintenance facility during the construction and operational phase.

- Commercial wastewater treatment system servicing 395 employees during construction phase and 300 employees during operational phase. This includes 395 bed capacity for non-local employees.

2. ASSESSMENT CRITERIA

To address the need for commercial wastewater management, this report identifies **four locations** that would be suitable for this purpose and **a location** for a proposed domestic wastewater management for the proposed rail maintenance facility.

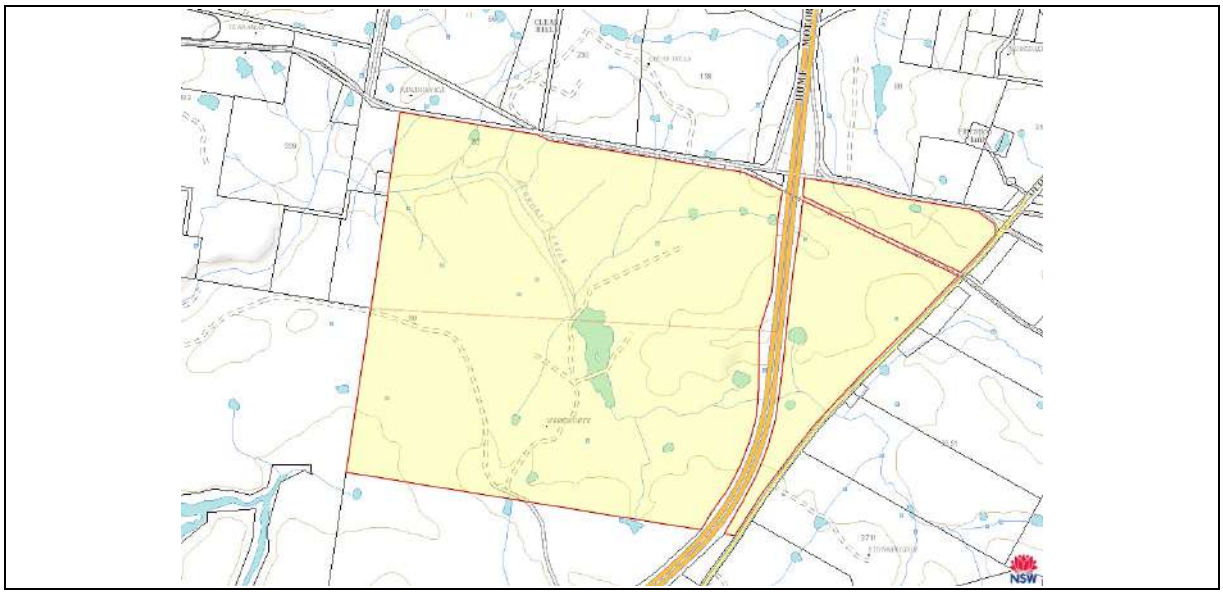
Each site was inspected on the 16th April 2018 and has been further assessed by desktop. This site assessment **did not include any further soil survey and analysis**. The EIS has provided some suitable reference samples that have been used for this desktop assessment.

Further soil testing would be required once the preferred location(s) have been decided during the later stages of the assessment process. It is not expected that the outcome of further soil testing would rule out any one of these four optional areas, but it could be a factor in deciding which of the four is more suitable.

This report was prepared to provide WaterNSW with the level of information they would need to assess whether on site wastewater disposal would have a **Neutral or Beneficial Effect** on water quality. WaterNSW requires the proposal to be prepared in accordance with the following guidelines that are nominated as Current Recommended Practices:

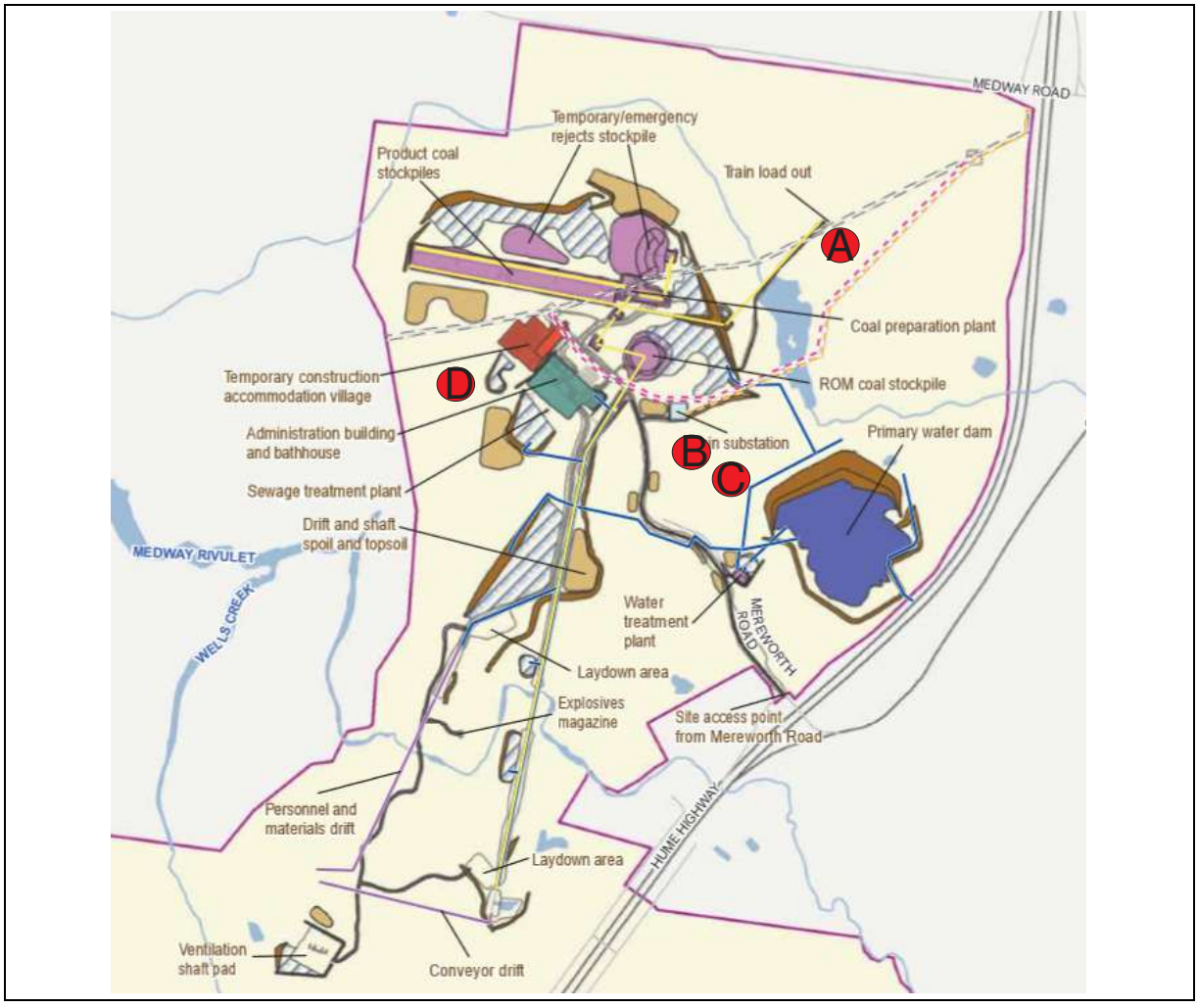
- Department of Environment and Conservation (NSW) (2004), Use of Effluent By Irrigation
- Sydney Catchment Authority (2012), Designing and Installing On Site Wastewater Systems. A Sydney Catchment Authority Current Recommended Practice

FIGURE 1 SITE LOCATION OF THE PROPOSED DEVELOPMENT



Source: SIX Maps NSW

FIGURE 2 HUME COAL FACILITIES (SITES A TO D)



[Source: EMM (2017); EMM (2016); Hume Coal (2016; LPI (2015)]

FIGURE 3 PROPOSED ONSITE WASTEWATER MANAGEMENT (SITE E) MAINTENANCE FACILITY

3. DESIGN WASTEWATER LOAD

The design flow rates were estimated for the workers in the village and railway maintenance facility using the NSW Health Department (2001) "Septic Tank & Collection Well Accreditation Guidelines". See Figure 4.

FIGURE 4 EXTRACT FROM NSW HEALTH ACCREDITATION GUIDELINE (2001)

TYPE OF PREMISES	WASTES	DAILY FLOW Litres/Person/Day	CALCULATION OF DAILY FLOW RATE	REMARKS
Hospitals	WC, urinal, basin WC, urinal, basin, 1 waste WC, urinal, basin, 2 wastes WC, urinal, basin, 3 wastes Non resident staff	55 82 109 136 55	Persons + staff x 55 Persons x 82 + staff x 55 Persons x 109 + staff x 55 Persons x 136 + staff x 55 Staff x 55	Persons = No. of patient beds + resident staff Staff = non resident or casual staff Basic capacity = 1820 Litres Over 50 persons increase to 2730 Litres Septic tank capacity all wastes over 50 persons = persons x 136 + staff x 55 + 2730
Mines	WC WC, urinal, basin WC, urinal, basin, Shower	23 27 45	Persons x 23 Persons x 27 Persons x 45	Persons = total staff/day Septic tank capacity = persons x daily flow + 1550 Litres
Hotels and Motels	WC, urinal, basin WC, urinal, basin, 1 waste WC, urinal, basin, & 2 wastes WC, urinal, basin, & 3 wastes Non-resident staff bar patrons	55 82 109 136 36 14	Persons x 55 + staff x 36 Persons x 82 + staff x 36 Persons x 109 + staff x 36 Persons x 136 + staff x 36 Staff x 36 Patrons x 14 Note: Add daily flow for bar patrons as applicable	Persons = guests + resident staff Staff = non resident or casual staff Bar patrons = estimate patrons/day Dishwasher/glasswasher allowance = 1550L/100 Persons Over 50 Persons Basic Capacity increased to 1820 Litres Septic tank capacity all wastes over 50 persons = persons x 136 + staff x 36 + patrons x 14 + 1820 + dishwasher/glasswasher allowance/100 persons
Factories and offices	WC, urinal, basin WC, urinal, basin, shower WC, urinal, basin, shower, kitchen	27 41 43	Persons x 27 Persons x 41 Persons x 43	Persons = total staff/day Septic tank capacity = daily flow + 1550 Litres

3.1 WORKER VILLAGE

The volume of wastewater will fluctuate with the phases of the development. In the construction phase, there is expected to be a peak of **395 workers** that will be living on site and having access to the commercial kitchen, showers and toilets. The average number of workers that over 7 days is 320 per day. The EIS conservatively allows for 90% of the average workforce to be provided with on-site accommodation (288), meaning that an additional 32 persons (averaged across 7 days) may use toilets and sinks but not have access to showers or mess (kitchen) facilities.

In the operational phase, the average number of workers will decrease to 300 full-time employees across the 24 hour, 7 day operation. At this time, the accommodation facility will be decommissioned and removed from site. The operational workforce will have access to ablution facilities. Surface workers will also have access to basic lunch room amenities. It is estimated that around 90% of the operations workforce will shower on-site after their shift. Allowing for shift rotations and day-shift-only workforce numbers, the maximum number of

workers rotating through the site on any given day during operations is unlikely to exceed around 200 persons, and the number showering is likely to be around 180 persons. Therefore a system sized for peak construction workforce numbers will also cater for the waste water demands during operations.

There will be a maximum of 395 workers living on site at any one time during construction. These workers will be living in small cabins with toilet, sink and showers. They will have access to kitchen amenities and may use the small laundry that will be available. The amount of wastewater generated from the mine workers living in the simple accommodation is likely to be about 55L/p, but the assumed rate is increased to 82L/p because of the additional wastewater from commercial kitchen.

The actual number of employees will vary throughout the 14 day period (average of 320), but for the purpose of designing the wastewater treatment and disposal system, this has been done for the maximum number of employees, which is 32,390L/d.

TABLE 1 WASTEWATER LOAD

Typical fortnight	Workers live on site	Wastewater volume @ 82L/d
Sun	44	3608
Mon	395	32390
Tue	395	32390
Wed	395	32390
Thur	395	32390
Fri	395	32390
Sat	220	18040
Sun	44	3608
Mon	395	32390
Tue	395	32390
Wed	395	32390
Thur	395	32390
Fri	395	32390
Sat	220	18040

The 40 workers who are living off site will have access to the WC, urinal, basin. These workers are expected to generate 27 L/d, which is equivalent to 1080 L/d.

A contract laundry service will be engaged for cleaning linen and this will also be offered to workers for their own clothing. The accommodation facility would have laundry facilities for incidental clothes washing, however assume that linen is laundered off site.

Total wastewater load to be treated by the commercial wastewater system is estimated to be 32,390 + 1080 = **33,470L/d.**

3.2 RAIL MAINTENANCE FACILITY

There will be up to 10 workers having access to the amenities at the rail maintenance facility. These workers will have access to WC, urinal, basin and shower. The design wastewater load is 10 x 41L/person = **410L/day.** A domestic Aerated Wastewater Treatment System is proposed to treat this wastewater.

4. LAND AVAILABLE FOR WASTEWATER DISPOSAL

Five potential areas for wastewater disposal were initially selected by desktop assessment These areas were initially selected to meet buffers from SCA (2012) and DEC (2004) for low effluent strength, as shown in Table 2, and slope and landform available for wastewater disposal, considering the parameters for a slight limitation shown in Table 3.

TABLE 2 RECOMMENDED BUFFER DISTANCES

ASSESSMENT GUIDELINES	BUFFER DISTANCES		
SCA (2012)	• 100 metres to permanent surface waters (e.g. rivers, creeks, streams, lakes etc.) • 40 metres to other waters (e.g. dams, intermittent water courses, overland flow paths etc.)		
DEC (2004)		**Low effluent strength**	**High effluent strength**
	Where spray irrigation gives rise to aerosols near houses, schools, playing fields, public open spaces and water bodies.	50*m	50m
	Natural water bodies (e.g. rivers and lakes)	50m	50m
	Other waters (e.g. artificial water with beneficial uses, small streams, intermittent streams, water distribution, drainage channels and dams)	Site-specific	Site-specific
	Others sensitive areas (e.g. waters in drinking water catchments, aquatic ecosystems with high conservation value, wetlands, native stands for vegetation)	Site-specific	250m
	Domestic well used for household water supply	Site-specific	250m
	To town water supply bores	Site-specific	1000m

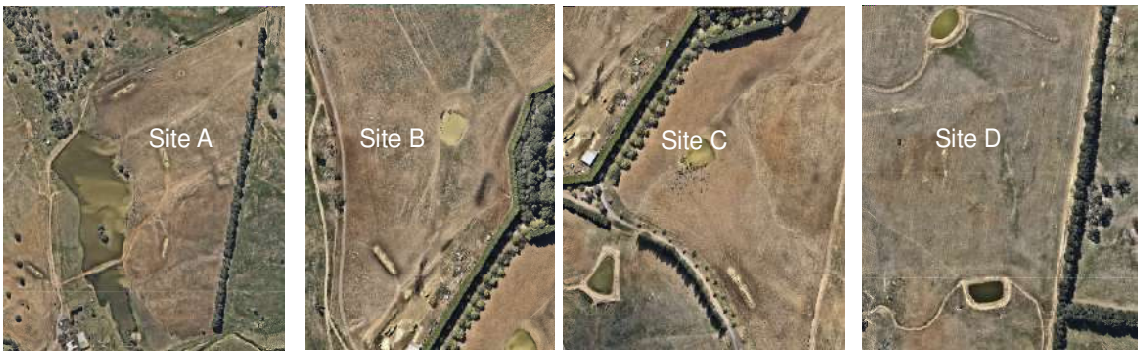
* Recommended in ARMCANZ, ANZECC and NHMRC (2000) for spray application of reclaimed water from sewerage systems.

TABLE 3 LANDFORM REQUIREMENTS FOR EFFLUENT IRRIGATION SYSTEMS

Physical property	Slight limitation	Moderate limitation	Severe limitation	Restrictive feature
Slope % *Surface irrigation* *Sprinkler irrigation* *Trickle/microspray*	 <1 <6 <10	 1-3 6-12 10-20	 >3 >12 >20	Excess runoff and erosion risk
Flooding	non-rare	occasional	frequent	Limited irrigation opportunities
Landform	Crests, convex slopes and plains	Concave slopes and footslopes	Drainage lines and incised channels	Erosion and seasonal water-logging risk
Surface rock outcrop	Nil	0-5	>5	Interferes with irrigation and/or cultivation equipment; risk of runoff

The location of these sites must also be outside of the location of the proposed development, including proposed roads, railway corridors, stockpiles and water storages. The proposed on-site wastewater management locations for Hume Coal facilities are shown on Figure 5 & 6. Figure 7 is shown the slope and landform of Site E for the proposed rail loop & maintenance facility.

FIGURE 5 SITES ASSESSED FOR WASTEWATER DISPOSAL FOR HUME COAL FACILITY



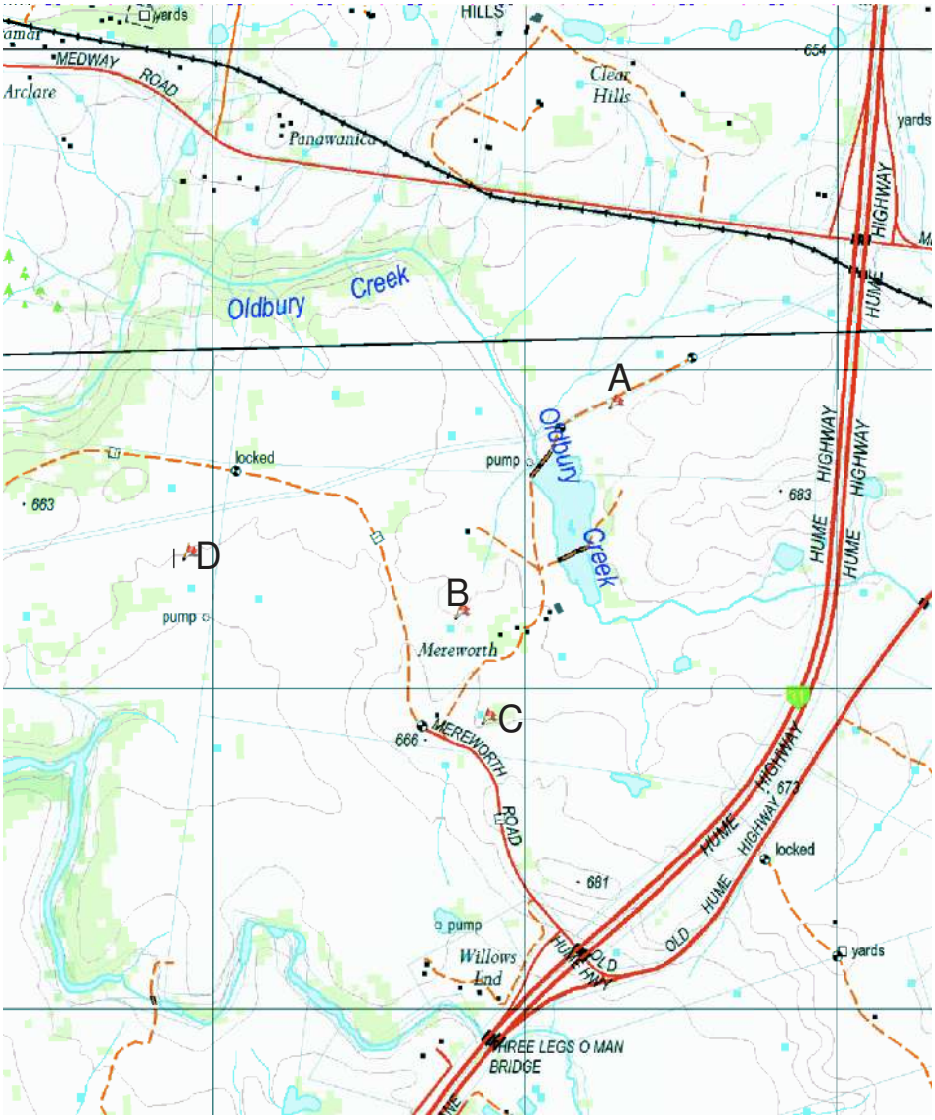


FIGURE 6 SLOPE AND LANDFORM OF PROPOSED LOCATIONS FOR COMMERCIAL WASTEWATER

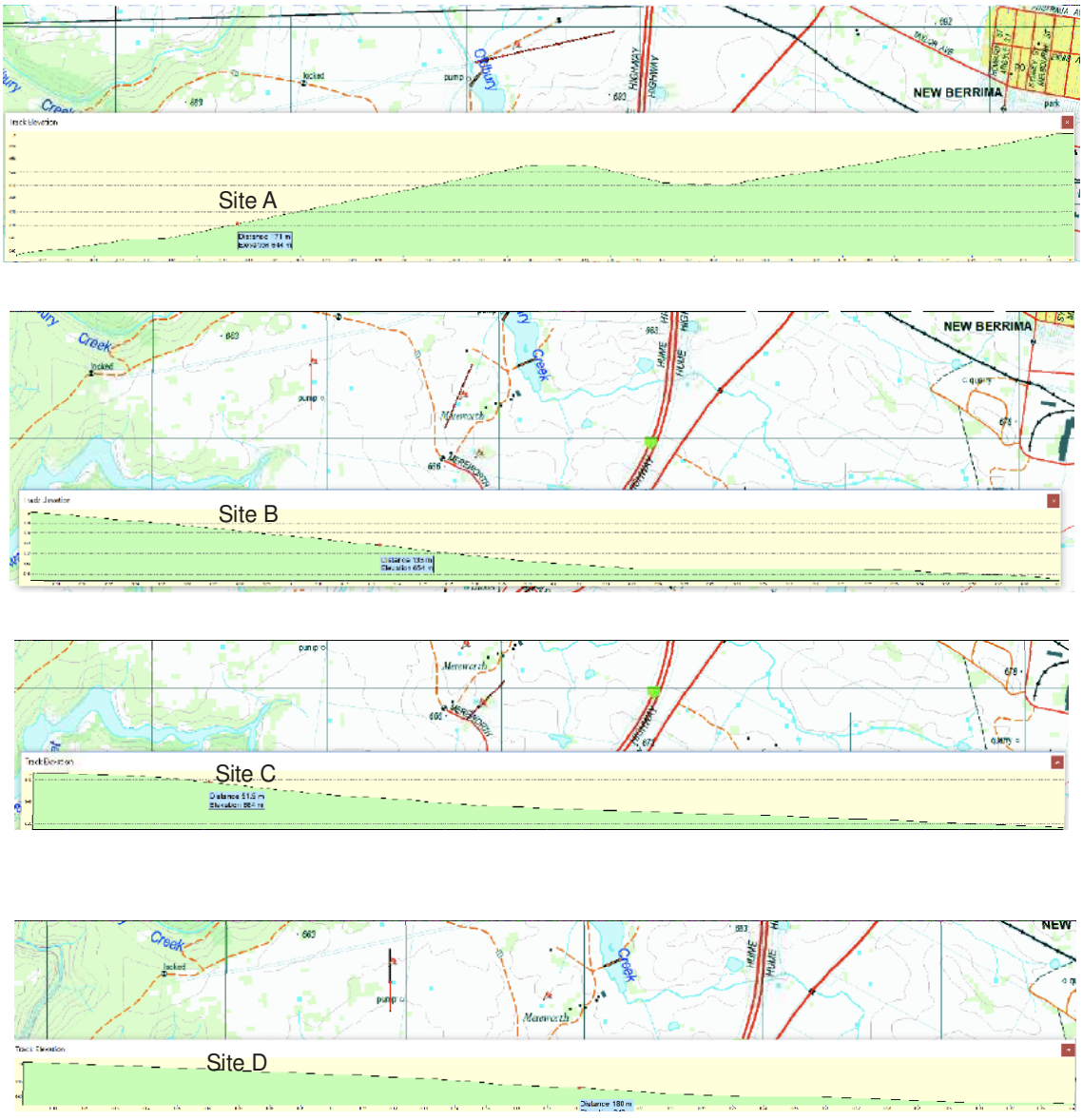


FIGURE 7 SLOPE AND LANDFORM OF SITE E (RAIL LOOP & MAINTENANCE FACILITY)

Photo 1 Proposed effluent disposal area (Site E)

4.1 Summary of Site Assessment

Table 5 presents a summary of the parameters assessed to conclude there are 5 suitable sites for on-site wastewater management. Four of these locations are optional areas suitable for commercial wastewater management. The fifth location is suitable for the proposed railway maintenance facility. Further summary of the key points is provided below:

Slope and drainage are minor limitation for all five locations. For the commercial wastewater, Site C is preferred because there is minimal upslope catchment area so there is no need to divert upslope surface runoff and there is no influence of upslope seepage.

Geology and soil landscape are variable across the five locations. There are no inherent limitations for either of the three soil landscapes that would rule any one of these areas out. The Lower Mittagong Soil Landscape, found on the Wianamatta Shales, is the most suitable of all three soils landscapes soil depth is generally more than 1000mm and the clay loam subsoil has the ideal combination of permeability and phosphorus absorption. The subsoils of the other soil landscapes indicate light to medium clays, which would be even better for phosphorus sorption, but the lower permeability (Design Irrigation Rate) would require a large irrigation area.

Land capability class. The NSW Office of Environment & Heritage *The land and soil capability; assessment scheme - a general rural land evaluation system for New South Wales* describes the four sites as *moderate to high* capability lands.

TABLE 4 TABLE 2 LAND AND SOIL CAPABILITY CLASSES- GENERAL DEFINITIONS.

LSC class	General definition
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)	
1	**Extremely high capability land**: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	**Very high capability land**: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	**High capability land**: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	**Moderate capability land**: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	**Moderate–low capability land**: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)	
6	**Low capability land**: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation
Land generally incapable of agricultural land use (selective forestry and nature conservation)	
7	**Very low capability land**: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	**Extremely low capability land**: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

Salinity hazard. There is no information to suggest a salinity hazard at any one of the proposed sites.

TABLE 5 SUMMARY OF THE SITES LANDFORM SUITABILITY

Site	Slope and drainage	Geology /Soil landscape	Soil type likely to be found below 500mm and soil depth	Land & soil capability; (See App IV- Table 6.2 & Sheet 8)	Salinity hazard	Catchment
Site A	Convex slope < 6% Low slope of land in the catchment of a large online dam on Oldbury Creek. A 100m buffer is required from an online dam, which is easily available.	Hawkesbury Sandstone Moss Vale Soil Landscape 3 LSC Class- High capability land; moderate limitations and is capable of sustaining high-impact land uses.	Dermosol Medium clay is expected at 500mm Soil depth 0.4 -0.75m	3	No Low Constraint Area (SCA)	Oldbury Creek
Site B	Convex slope < 10% No catchment area above the site to be managed. Undulating terrain on side slopes may be difficult to irrigate using automated irrigation system	Wianamatta Group Moss Vale & Lower Mittagong Soil Landscapes 3-4 LSC Class- High to moderate capability land; capable of sustaining high-impact land uses.	Kandosol Light clay is expected at 500mm Soil depth 0.4 -0.9m	5	No Low Constraint Area (SCA)	Oldbury Creek
Site C	Convex slope < 6%; No catchment area above the site to be managed.	Wianamatta Group Lower Mittagong & Moss Vale Soil Landscapes 3-4 LSC Class- High to moderate capability land; moderate limitations and is capable of sustaining.	Kandosol Clay loam is expected at 500mm Soil depth >0.9m	*5	No Low Constraint Area (SCA)	Oldbury Creek
Site D	Convex slope 2-5%; No catchment area above the site to be managed.	Hawkesbury Sandstone Moss Vale & Soapy Flat Soil Landscapes 0-5% surface rock, moderate limitation 3-4 LSC Class- High to moderate capability land; moderate limitations and is capable of sustaining.	Tenosol Loamy sand is expected at 500mm Soil depth 0.4 -0.9m	4	No Low Constraint Area (SCA)	Medway Rivulet (upstream of dam formerly used as water supply for Berrima)
Site E	Convex slope < 10% No catchment area above the site to be managed. More than 50m from downslope existing dam.	Hawkesbury Sandstone Lower Mittagong Soil Landscapes 4 LSC Class- Moderate capability land; capable of sustaining high-impact land uses.	Dermosols Silty loam- silty clay loam is expected at 500mm Soil depth >0.9m	4	No Low Constraint Area (SCA)	Oldbury Creek

* Land & Soil Capability Class 3 according to the *Office of Environment & Heritage; The land and soil capability; assessment scheme; A general rural land evaluation system for New South Wales; Table 2 Land and soil capability classes- general definitions.*
Note: Sites Assessment for Hume Coal Facility are Site A to D. Site E is for the proposed rail loop & maintenance facility.

Photo 2 Proposed effluent disposal area (Site A)

Photo 3 Proposed effluent disposal area (Site B)

Photo 4 Proposed effluent disposal area (Site C)

Photo 5 Proposed effluent disposal area (Site D)

5. SOIL SUITABILITY FOR WASTEWATER DISPOSAL

The Department of Environment and Conservation (NSW) Environmental Guidelines, Use of Effluent (2004) provide criteria for evaluating a site for irrigation with effluent. The DEC (2004) guidelines recommend a range of soil and site parameters that are also required to meet SCA requirements. The parameters listed in Table 6 from DECC (2004).

Site specific soil testing will need to be undertaken for the preferred site at a later stage in the development assessment. However, based on the information that could be used to consider the likely level of limitations, this assessment concludes that the results from soil testing have a *low to moderate* soil limitations for the limitations noted in Table 5. The information that was reviewed includes:

- Data collected in the EIS for representative soil locations,
- Soil Landscapes of the Sydney Catchment Authority Hydrological Catchments; and
- Site analysis and design tool Sydney Drinking Water Catchment

TABLE 6 PARAMETERS FOR SOIL AND SITE INVESTIGATION

Parameter	Limitation			Restrictive feature
	Nil or slight	Moderate	Severe	
Exchangeable Sodium % (0-40cm)	0-5	5-10	>10	Structural degradation
Exchangeable Sodium % (40-100cm)	0-10	>10	-	Structural degradation
Salinity measures as electrical conductivity	<2	2-4	>4	Excess salt may restrict plant growth
Salinity measures as electrical conductivity	<4	4-8	>8	Excess salt may restrict plant growth, potential
Depth to top of seasonal high water table (metres)	>1	0.5-1	<0.5	Poor aeration, restricts plant growth, risk to groundwater
Depth to bedrock or hardpan (metres)	>1	0.5-1	<0.5	Restricts plant growth, excess runoff, waterlogging
Saturated hydraulic conductivity (Ks, mm/hr, 0-	20-80	5-20	<5	Excess runoff, waterlogging, poor infiltration
Available water capacity (AWC, mm/m)	>100	<100 with careful	-	Little plant-available water in reserve, risk to groundwater
Soil pH_{cacl2} (surface layer)	>6-7.5	3.5 - 6	<3.5	Reduces optimum plant growth
Effective cation exchange capacity (ECEC, cmol	>15	3-15	<3	Unable to hold plant nutrients
Emerson aggregate test (0-100cm)	4,5,6,7,8	2,3	1	Poor structure
Phosphorus (P) sorption (kg/ha at total 0-100cm)	high	moderate	low	Unable to immobilise any excess phosphorus

6. COMMERCIAL WASTEWATER MANAGEMENT

6.1 Installing Commercial Sewage Management Facility

A commercial sewage management facility with capacity to treat more than 33,470L/d shall be installed. The Environmental Protection License will require the applicant to have selected a manufacturer and provide the necessary plans and specifications including tank dimensions and capacity, operation and maintenance details, plus installers name, address, phone number and license number.

The commercial treatment system will be installed and maintained in accordance with Section 5 of the guidelines "Use of Effluent by Irrigation, DEC (2004). Upon approval, the applicant is to enter into a servicing contract with an approved servicing agent for the life of the system and begin a thorough environmental monitoring program. Copies of the written service and monitoring reports will be made following each quarterly service and following environmental monitoring.

6.2 Risk Assessment

The treated wastewater will be applied using spray irrigation. Wastewater will not be re-used for any other purpose. The commercial sewerage management facility will provide secondary and tertiary treatment. After wastewater is applied by spray irrigation, there is a low risk of human contact and it is consistent with the DWE definition of a **low level** of risk (DWE, 2008). A low exposure risk level is proposed as the end uses have a low level of human contact. This includes:

a) Urban irrigation with enhanced restricted access and application irrigation, which assumes:

- no access after irrigation (1-4 hours or until dry);
- minimum buffer zones to the nearest point of public access;
- spray drift controls; or

b) Agricultural irrigation.

The commercial sewage management facility will be designed to meet and exceed the effluent compliance values for low level risk, which includes the compliance values listed in Table 7:

TABLE 7 EFFLUENT COMPLIANCE VALUES FOR LOW LEVEL RISK EXPOSURE (DWE, 2008)

E.coli	<1000cfu/100ml
BOD	<20mg/L
SS	< 30mg/L
pH	6.5-8.5
Disinfection (if used) *	Cl:0.2-2.0 mg/L residual UV (TBA)

6.3 Effluent Quality

Further to DWE (2008) compliance values for low risk effluent, the DEC (2004) sets out the classification of effluent for environmental management based on strength. The commercial sewage management facility will be designed to meet the DEC (2004) compliance values for low strength effluent. Where these values are in conflict with the DWE (2008) compliance

values, the lesser value is to be used to assess the effluent. Exceedance of these values will require corrective action and further environmental management controls.

TABLE 8 CLASSIFICATION OF EFFLUENT FOR ENVIRONMENTAL MANAGEMENT. DEC (2004)

	Strength (Average concentration mg/L)[1]		
Constituent	**Low[2]**	**Medium**	**High**
Total Nitrogen	<50	50-100	>100
Total Phosphorus	<10	10-20	>20
BOD_5	<40	40-1,500	>1,500
TDS[3]	<600	600-1,000	>1,000-2,500
Other pollutants	Effluent with more than five time[4] the ANZECC and ARMCANZ (2000) long-term water quality trigger values for irrigation waters must be considered high strength for the purpose of establishing a strength class for runoff and discharge controls and will require close examination to ensure soil is not contaminated.		
Grease & Oil	Effluent with more than 1,500mg/L of grease and oil must be considered high strength and irrigation rates and practices must be managed to ensure soil and vegetation is not damaged.		

6.4 Method of Irrigation

There are 4 suitable sites that could be used for treated wastewater disposal area. This report includes further design specifications for Site C as this may be one of the most suitable locations (See *Table 5: Summary of the sites landform suitability*).

Site C is proposed for spray irrigation, located at the surface infrastructure section (Lot 2 DP 1138694), to the west of the proposed primary water dam. The effluent disposal area is 40m from the nearest drainage depression and 100m from Oldburry Creek. The existing farm dam upslope of the irrigation area could be used for wet weather storage as the dam is not essential for livestock or for any other purpose. See Appendices XVI & XVII for the proposed location.

Effluent will be applied using a method of spray irrigation that generates a low plume and coarse droplet to minimise the risk of wind drift. The required irrigation area is approximately 1.75-ha and this land is to be used for hay production to maximise nutrient uptake. Therefore, the method of irrigation will need to be appropriate for the intended agricultural use.

A travelling irrigator will be required for irrigation. There are numerous manufacturers of these irrigation systems. The design will need to enable a coarse droplet to avoid spray drift and a calibrated application rate so the entire irrigation area can be irrigated over a 24 hour period.

7. DOMESTIC WASTEWATER FROM RAIL LOOP & MAINTENANCE FACILITY

A domestic AWTS with a capacity to treat more than **410L/day** shall be installed. The owner must provide the relevant authority with the AWTS manufacturer's specifications of the Sewage Management Facility. (Information on proposed AWTS can be obtained from the manufacturer or NSW Heath Register of Accredited Sewage Management Systems at http://www.health.nsw.gov.au/publichealth/environment/water/waste_water.asp).

The AWTS manufacturer will provide the necessary plans and specifications including NSW Health Accreditation, tank dimensions and capacity, operation and maintenance details, plus Licensed Plumber's name, address, phone number and license number.

The AWTS will be installed and maintained in accordance with Section 5 of the guidelines 'On-site Sewage Management for Single Households' (Department of Local Government, 1998) and AS/NZS 1547-2012 'On-site Domestic Wastewater Management' (Standards Australia, 2012).

The applicant will be required to enter into a servicing contract with an approved servicing agent for the life of the system. Copies of the written service reports will be made following each quarterly service.

AWTS installation must comply with the manufacturer's recommendations, AS/NZS 3500.2:2015 Plumbing and Drainage Part 2 Sanitary Plumbing and Drainage'.

The sewer pipe between the building, AWTS and irrigation area must be buried at a depth that provides protection against mechanical damage or deformation, in accordance with 'AS/NZS 3500(Set):2015 Plumbing and Drainage Set'.

7.1 Method of irrigation

The proposed wastewater management (Site E) is located at the south west of the proposed office facility on Lot 2 DP 1138694, in a location that is complaint with buffers and setback distances by Sydney Catchment Authority (SCA). The effluent disposal area is 40m from the nearest drainage depression and more than 100m from Oldburry Creek. See Appendices XVIII & XVIIII for the proposed location.

8. SIZING EFFLUENT DISPOSAL AREA

8.1 Commercial wastewater

The irrigation area needed to manage the flow regulated volume of **33,470L /d** was calculated using a monthly water and nutrient balance, following the method described in DLG (1998). Soil texture classification for Design Irrigation Rate is from ASNZ1547(2012).

The ***water balance*** requires a **17,470m^2** irrigation area based on the following variables:

- Moss Vale (Hoskins Street) median monthly rainfall (724.2mm);
- SCA Zone 4 monthly average evaporation (1270mm); and
- Application rate of 24.5mm/week or 3.5mm/day for clay loam subsoils.
- Crop factors for Fescue Grass (Appendix II)
- Runoff coefficient of 0.9

The ***nitrogen balance*** requires a **16,289m^2** irrigation area based on the following variables:

- Treatment system will reduce Total Nitrogen to 56mg/L; and
- Vegetative uptake rate of 336kg.N/ha/year for managed Fescue pasture

The ***phosphorus balance*** requires an area of **16,584m^2** irrigation area based on the following variables:

- Treatment system will reduce Total Phosphorus to 12mg/L;
- P-sorption of 300mg/kg for clay loam subsoils;
- Soils will be effective to retain 0.3% of predicted sorption for a soil depth of 1.2m.
- Crop uptake is assumed to be 56kg/ha/year for Fescue pastures. (Appendix I)
- 50 year design life of system (conservative estimate, project life ~25yrs).
- Bulk density of 1.5g/cm^3 for intermediate soil types

The largest of the three methods (most limiting) is required, see appendices V to VII. For this site, the largest of the three methods is **17,470m^2.**

8.2 Rail Loop & Maintenance Facility

The irrigation area needed to manage the flow regulated volume of **410L /d** was calculated using a monthly water and nutrient balance, following the method described in DLG (1998). Soil texture classification for Design Irrigation Rate is from ASNZ1547(2012).

The ***water balance*** requires a **214m^2** irrigation area based on the following variables:

- Moss Vale (Hoskins Street) median monthly rainfall (724.2mm);
- SCA Zone 4 monthly average evaporation (1270mm); and
- Application rate of 24.5mm/week or 3.5mm/day for clay loam subsoils.
- Crop factors for Fescue Grass. (Appendix II)
- Runoff coefficient of 0.9

The ***nitrogen balance*** requires a **150m^2** irrigation area based on the following variables:

- AWTS will reduce Total Nitrogen to 30mg/L; and
- Vegetative uptake rate of 240kg.N/ha/year for managed pasture

The ***phosphorus balance*** requires an area of **288m^2** irrigation area based on the following variables:

- AWTS will reduce Total Phosphorus to 12mg/L;
- P-sorption of 300mg/kg for clay loam subsoils;
- Soils will be effective to retain 0.3% of predicted sorption for a soil depth of 1.2m.
- Crop uptake is assumed to be 30kg/ha/year.
- 50 year design life of system (conservative estimate, project life ~25yrs).
- Bulk density of 1.5g/cm^3 for intermediate soil types

The largest of the three methods (most limiting) is required, see appendices V to VII. For this site, the largest of the three methods is **288m^2.**

9. VIRAL DIE-OFF METHOD

To assist WaterNSW to undertake their NORBE assessment, the viral die off method described by Cromer, Gardner & Beavers (2001) was applied to each site. The model generates setback distances that consider pathogen levels in wastewater, groundwater temperature, aquifer characteristics and the sensitivity of the receiving environment.

The viral die-off method applies to wastewater moving in saturated soils, such as a shallow groundwater beneath an effluent disposal area. The setback distances apply to subsurface wastewater movement, rather than surface runoff.

The results have shown that the minimum *setback distance* for:

- Site A is less than 0.05 m downslope buffers.
- Site B is less than 0.32 m downslope buffers.
- Site C is less than 3.90 m downslope buffers.
- Site D is less than 9.83 m downslope buffers.
- Site E is less than 3.90 m downslope buffers.

FIGURE 8 VIRAL DIE OFF METHOD- RESULTS

CALCULATING SETBACK DISTANCES	SITE				
Parameter	**SITE A**	**SITE B**	**SITE C**	**SITE D**	**SITE E**
Sub soil identified	Medium clay	Light clay	Clay loam	Loamy sandy	Clay loam
Permeablity (Ksat)	0.06	0.12	1.5	3	1.5
Porosity (P)	0.5	0.4	0.3	0.2	0.3
Slope/groundwater gradient (i)	0.06	0.1	0.06	0.05	0.06
Distance to water table/impermeable layer (d_v)	0.75	0.75	0.75	0.75	0.75
Groundwater temperature (T)	19	19	19	19	19
Order of magnitude reduction (M)	3	3	3	3	3
Vertical gradient (i_v)	1	1	1	1	1
Time for wastewater to infiltrate watertable (t_v)	6.25	2.50	0.15	0.05	0.15
k	0.525	0.525	0.525	0.525	0.525
Days required for viral reduction (t)	13	13	13	13	13
Estimate setback distance					
Setback distance (d_g)	0.05	0.32	3.90	9.83	3.90

10. WET WEATHER STORAGE

The commercial wastewater management system will require a storage tank or dam to store wastewater during wet weather when irrigation is not possible because soils are saturated. This is not required for the domestic wastewater management system.

Option 1: Sealed storage tank

In this option, wet weather storage would be incorporated into the design of the wastewater treatment system. The manufacturer would provide a sealed storage tank that has enough provide capacity to store wastewater for 7 days. This will provide storage for wet weather, but may also be needed if there is equipment failure that prevents treatment of wastewater.

TABLE 9 WET WEATHER STORAGE TANKS

Days	Workers live on site (82L/p/d)	Workers on site (27L/p/d)	Total design Inflow (L)
Sun	44	0	3608
Mon	395	40	33470
Tue	395	40	33470
Wed	395	40	33470
Thur	395	40	33470
Fri	395	40	33470
Sat	220	40	19120
		7 days of stage required:	
		Total storage (L)	**190078**

A 200,000 storage tank would be required to store wastewater for 7 days.

Option 2: Wet Weather Storage Dam

The existing dam upslope of the irrigation area in Site C is 2100m^3. This dam could be used as a wastewater storage dam to retain treated wastewater from the treatment system during high rainfall events. The treated wastewater would be applied to the irrigation area when soils are no longer saturated. The period when storage is required is when average rainfall exceeds average evaporation. See Table 10 and Appendix III for calculation.

TABLE 10 WET WEATHER STORAGE DAM

Aspect	Result
Dam Type	Circular Dam
Lining	Clay Lined
Predicted Storage Period	June to July
Total Predicted Inflow Volume (m^3)	2041.7
Dam Volume (Inc. Free Board) (m^3)	2109.9

Radius of Water Surface (m)	20
Free Board (m)	0.3
Permanent Depth (m)	2
Radius of Floor (m)	14

11. SITE ACCESS AND SIGNAGE

Public access will be restricted from the commercial and domestic wastewater irrigation areas to prevent direct human contact with effluent. The irrigation areas will be fenced and sign posted. In all areas where the wastewater treatment or pipes run within areas of public access, all pipes and taps must be colour coded and/or signs marked, for example: 'EFFLUENT - NOT FOR DRINKING'. International diagram signs for non-English speakers will be necessary. Childproof taps should be used to prevent children from drinking non-potable water. Signs should be visible from the main point of access advising the type of reuse and any relevant restrictions to the public. Australian Standard, AS 1319–1994, Safety Signs in the Occupational Environment (Standards Australia 1994) should be referred to.

12. PLANTING & CROPPING SCHEDULE

The major nutrient removal mechanisms in effluent irrigation systems are uptake by vegetation in addition to soil sorption by chemical precipitation and adsorption to soil particles.

The effluent quality, hydraulic capacity, soil quality, climatic conditions and salt sensitivity of plants generally influence the type of plants to be grown.

The nutrient balance for the commercial wastewater disposal area was calculated using the nutrient removal rates for fescue produced for hay production. Alternative grasses could be used to achieve these rates of nutrient removal.

The grass being irrigated by the domestic wastewater management system will need to be mown and grass clippings are removed.

TABLE 11 PLANTING/CROPPING REGIME

Yield and Nutrient Content of Crops in NSW for Cultivation Under Irrigation with Effluent					
Grain crop	**Area/season**	**Average yield (t/ha/dry matter)**	**Nitrogen (%)**	**Phosphorus (%)**	**Potassium (%)**
Fescue	All Year	14	2.4	0.4	2.1

13. MONITORING REQUIREMENTS (COMMERCIAL WASTEWATER)

Monitoring of the commercial wastewater disposal area from workers village will be conducted in accordance Section 5 of DEC (2004). Monitoring results will assist in demonstrating due diligence and include:

- Validation and verification that the system design and equipment is adequate for the necessary treatment;
- Confirmation of the ongoing operational performance of the treatment system to protect human health and the environment; and

- Detection of any potential or actual failures on the treatment system and implement the appropriate corrective actions.

13.1 Monitoring Program

An effluent, soil & groundwater monitoring program will report on the performance of the effluent irrigation scheme for the life of the system. This will be prepared in consultation with Water NSW.

The monitoring program will include soil and groundwater monitoring points located within the effluent disposal area and downslope of the wet weather storage dam. Effluent samples will be taken directly from the outlet of the sewerage management facility to ensure it meets the requirements for low strength and low risk effluent. A guide to the frequency and constituents to be tested are presented as follows within Tables 12 to 14. Monitoring points are shown on Site Plans in Appendix XVI & XVII.

Monitoring will include baseline soil and groundwater conditions downslope of the irrigation area and from within the proposed effluent disposal area itself. Baseline groundwater samples will be obtained immediately downslope of the proposed irrigation area.

13.2 Confirm Performance

Monitoring will occur monthly for the first year of operation to ensure the design of the wastewater treatment system and surface water management procedures are effective in both wet and dry seasons. The results will be provided to the relevant authority and used to confirm performance and whether any adjustments are required. After this, monitoring will be conducted on an annual or event-only basis, the results will be provided to the relevant authority and used to confirm performance and whether any adjustments are required.

13.3 Non-Conformance and Complaints

Any non-compliance, complaints or incidents will be handled in accordance non-compliance and complaints procedures. This includes recording the informants name, contact details, details of the event including cause, who received the complaint and follow up action taken.

TABLE 12 RECOMMENDED EFFLUENT SAMPLING STRATEGY

	Frequency of sampling		
Constituent	**Low Strength**	**Medium Strength**	**High Strength**
TSS	Quarterly	Quarterly	Monthly
Oil and grease	Biannually	Quarterly	Quarterly
Total P	Biannually	Quarterly	Quarterly
Total N	Biannually	Quarterly	Quarterly
BOD_5	Quarterly	Quarterly	Monthly
pH	Quarterly	Quarterly	Monthly
EC (dS/m); TDS	Quarterly	Quarterly	Monthly
Cations	Quarterly	Quarterly	Quarterly
SAR (√(meq/L))	Quarterly	Quarterly	Quarterly
Metals	yearly	Yearly[2]	Yearly[2]
Ocs	Yearly	Yearly[2]	Yearly[2]
Herbicides	Yearly	Yearly[2]	Yearly[2]
Thermotolerant coliforms (cfu/100ml)	Use specific[3]	Use specific[3]	Use specific[3]
Flow rate (L/d)	Monthly	Monthly	Monthly
Other	Advice should be sought from the Department of Industry and Water or WaterNSW [4]	Advice should be sought from the Department of Industry and Water or WaterNSW [4]	Advice should be sought from the Department of Industry and Water or WaterNSW [4]
Notes:	1. Units are in mg/L unless otherwise stated. 2. Higher frequencies will be required where these constituents are the constituents that determine the medium or high strength classification 3. Other effluents may not require monitoring for thermotolerant coliforms. Obtain advice from NSW-Health and/or NSW Department of Primary Industries. 4. Seek advice from the appropriate regulatory authority 5. BOD_5 may be replaced by tests such as chemical oxygen demand provided the relationship between the two measures is established.		

TABLE 13 RECOMMENDED SOIL MONITORING STRATEGY

	Frequency of sampling	
Constituents[1]	**Surface soil**	**Soil profile at four depth increments**
pH	Yearly	Yearly
EC (dS/m)	Yearly	Yearly
Nitrate-N	Yearly	Yearly
Total N	After 3 years	N/A
Available P	Yearly	N/A
Total P	After 3 years	After 3 years
Exchangeable sodium % (ESP)	Yearly	After 3 years
Heavy Metals and pesticides.	After 10 years[3]	N/A
P sorption capacity[2] (kg/ha)	After 3 years (site-specific)	After 3 years (site-specific)
Notes:	1. Units are in mg/L unless otherwise stated 2. As recommended by an accredited laboratory or soil specific 3. Or more frequently if any are identified/calculated as a risk factor.	

At least two groundwater monitoring dipwells will be installed at strategic locations to allow measurements of groundwater to be taken for testing in accordance with Table 14.

TABLE 14 RECOMMENDED GROUNDWATER MONITORING STRATEGY

Constituents[1]	**Frequency of sampling[1,2]**
Groundwater height	Quarterly
pH	Quarterly
EC (dS/m)	Quarterly
Cations (mg/L)	Yearly
Nitrate-N	Yearly
Total N	Yearly
Available P	Yearly
Total P	Yearly
Notes:	1. Groundwater need only be monitored if it is within 10m of ground surface and/or if existing groundwater quality at risk from the effluent irrigation scheme. 2. Groundwater sampling should occur on the established enterprises before crop planting, during the middle of the crop growth and quarterly/yearly thereafter (as above).

The owner shall arrange for the wastewater treatment system and effluent irrigation area to be inspected by an employee at least once a week to look for signs of failure, which could include ponding of effluent or odors. Appropriate action is to be taken.

14. SUMMARY

This report assesses the suitability of the soil and site more generally for on site wastewater management. This assessment includes an estimate of the potential volume of wastewater that could be generated from the proposed development and sizes the required area for wastewater disposal at a suitable location that complies with the relevant assessment criteria. The specific outcomes of this report include:

Hume Coal Facilities (Workers Village):

- Installation of a commercial sewage management facility with capacity to treat at least 33,470L of wastewater per day to a secondary standard;
- Installation of 200,000L (7-Days) of wet weather storage, using sealed tanks or existing dams;
- The commercial wastewater disposal area will use a spray irrigation system to cover 17,470m^2, to be fenced and off limits to employees;
- Stormwater diversion measures to divert clean water away from the proposed irrigation area;
- Cropping of fescue pasture for hay production; and
- Monitoring program to include wastewater quality, soils and groundwater.

Rail loop & Maintenance facility:

- Install a domestic Aerated Wastewater Treatment System to treat wastewater from proposed office;
- Install 288m^2 irrigation, as shown on Site Plans.

15. REFERENCES

Department of Local Government (1998) On-site Sewage Management for Single *Households*. NSW Government.

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Designing and Installing On Site Wastewater Systems. A Sydney Catchment Authority Current Recommended Practice (May 2012).

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APPENDIX I YIELD AND NUTRIENT CONTENT OF CROPS IN NSW

Yield and Nutrient Content of Crops in NSW for Cultivation Under Irrigation with Effluent					
Grain crop	**Area/season**	**Average grain yield (t/ha/dry matter)**	**Nitrogen (%)**	**Phosphorus (%)**	**Potassium (%)**
Barely	State-wide	3.5	1.8	0.4	0.69
Canola	Central-west South-west Slopes	2.8 2.8	4.6	(0.7)[1]	(0.7)
Faba beans	North-west Riverina	2.0 2.0	4.1	0.5	1.5
Grain sorghum	North-west Central-west Riverina	2.5 2.5 2.8	2.1	0.3	0.3
Lupins	Central-west Couth-west	1.5 1.5	5.0	0.5	0.8
Maize	North-west Central-west Riverina Coastal	5.8 5.6 7.0 7.0	1.6	0.3	0.5
Oats	State-wide	4.0	1.7	0.4	0.4
Field pea	State-wide	1.0	4.0	0.2	1.4
Soybean	North-west Riverina	3.2 3.2	6.6	0.6	1.7
Summer Grain Legumes: Cowpeas, Mungbeans Piegeon peas	State-wide	1.0	4.0	0.2	1.4
Sunflower	North-west Riverina	1.2 1.7	5.2	(0.6)	(0.7)
Triticale	Central-west South-west	2.3 2.1	2.0	0.4)	0.6
Wheat	State-wide	4.0	1.9	0.4	0.6
Forage millet (pennesetum)	State-wide	10	1.7	(0.2)	(1.9)
Forage sorghum	State-wide	15	1.8	0.3	1.9
Maize	State-wide	25	1.1	(0.2)	(1.0)
Summer grain legumes	North	3.0	1.7	(0.4)	(2.4)
Winter cereals	State-wide	5.0	1.5	0.3	1.4
Winter grain legumes	State-wide	4.0	2.7	0.3	1.6
Wheat straw	State-wide	5.0	0.5	0.1	1.3
barely straw	State-wide	14.0	0.5	0.1	0.4
oat straw	State-wide	5.0	0.7	0.1	2.4
Lupin straw	State-wide	0.5	0.6	0.05	0.9
Pea straw	State-wide	0.5	1.1	0.1	0.5
Triticale	Central-west South-west	6.0 6.0	0.5	0.1	0.5
Grain sorghum	North-west Central-west Riverina	3.0 3.0 3.5	(1.2)	(0.2)	(1.2)
Maize	North-west Central-west Riverina Coastal	7.0 7.0 9.0 9.0	(0.9)	(0.3)	(2.2)
Soybean	North-west Riverina	5.0 5.0	(0.8)	(0.1)	(0.6)
Kikuyu	Sept-Mar	20	2.6	0.3	2.8
Phalaris	Mar-Nov	12	1.1	0.3	2.8
Perrenial ryegrass	Mar-Dec	12	3.5	0.3	2.0
Fescue	All Year	14	2.4	0.4	2.1
Lucerne	All Year	20	3.5	0.4	2.5
White Clover	Sept-Feb	20	3.7	0.4	2.6
Source:	NSW Agriculture (1997)				
Notes:	The likely yield and growth period will vary between districts and will be affected by such factors as irrigation efficiency, soil type, variety, nutrition and grazing, management where appropriate. Figures in brackets are estimate values Nutrient removal may be estimated by multiplying nutrient concentration by yield.				

APPENDIX II CROP FACTORS[1] FOR SOME CROPS, TREES AND PASTURE

Crop Factors for Some Crops, Trees and Pastures												
Crop	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Lucerne	.95	.90	.85	.80	.70	.55	.55	.65	.75	.85	.95	1.00
Citrus	.55	.55	.55	.55	.50	.50	.50	.50	.55	.55	.55	.55
Grape-vines	.60	.60	.50	.40	.25	.20	.15	.20	.25	.40	.55	.60
Deciduous Orchard	.75	.65	.45	.25	.15	.10	.15	.20	.30	.50	.70	.75
Pasture	.70	.70	.70	.60	.50	.45	.40	.45	.55	.65	.70	.70
Eucalypt plantation	.78	.84	.94	1.17	1.21	1.15	1.13	1.33	1.33	1.26	.99	.83
Notes:	1. Crop factors are expressed as the ratio of crop evapotranspiration to pan evaporation 2. At Wagga Wagga – Source: Meyers et al. (1999). Humidity has a profound influence on the crop factors of eucalyptus and values only suit climates similar to Wagga Wagga.											

APPENDIX III WET WEATHER STORAGE DAM

WET WEATHER STORAGE

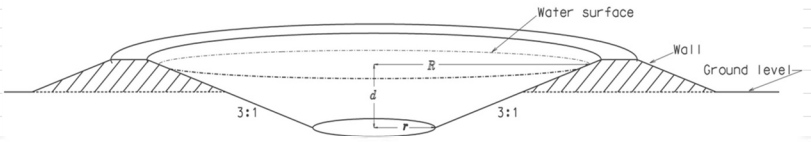
INPUT DATA

Effluent Applied	Q	33470	L/day
Rainfall Data	Moss Vale (Hoskins Street)		
Evaporation Data	SCA zone 4		

	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CLIMATE DATA														
Days in month	days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	mm/month	78.6	71.8	72.6	65.6	48.9	69.3	52.3	38.8	44.7	57.6	63.9	60.1	**724.2**
Evaporation	mm/month	195	150	127	78	50	33	37	59	84	121	147	189	**1270**
INPUTS														
Effluent	mm/month	1037570	937160	1037570	1004100	1037570	1004100	1037570	1037570	1004100	1037570	1004100	1037570	**12216550**
OUTPUTS														
Total output	mm/month	1037454	937082	1037516	1004088	1037569	1004136	1037585	1037550	1004061	1037507	1004017	1037441	**12216004.2**
CAPTURE VOLUME	m^3/month	1037.45	937.082	1037.52	1004.09	1037.57	1004.14	1037.59	1037.55	1004.06	1037.51	1004.02	1037.44	**12216.0**

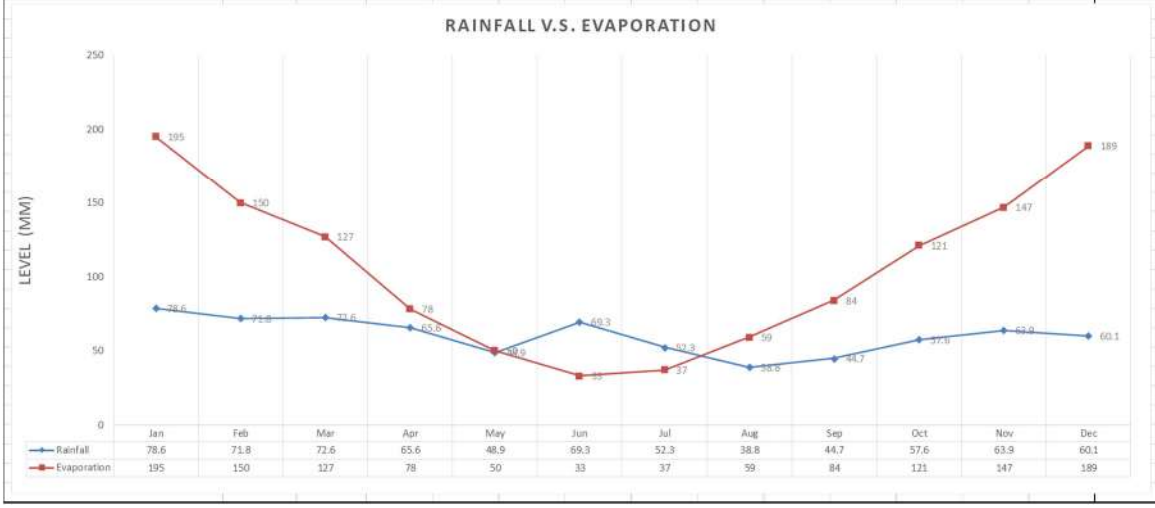
DAM SIZING

Dam Type	Circular Dam	
Lining	Clay lined	
Side Slopes	H:V	3:1
Stoage Period	Months	Jun-July
Inflow Volume	m^3	2041.7
Dam Volume (V)	m^3	2109.9
Radius of Water Surface (R)	m	20
Free Board	m	0.3
Permanent Depth (d)	m	2
Radius of Floor (r)	m	14



NOTES:

1) SUFFICIENT DAM CAPACITY TO CAPTURE INFLOW VOLUME
2) PROPOSED DIMENSIONS ARE CONSISTENT WITH GEOMETRY OF A ROUND DAM



APPENDIX IV SUMMARY OF LSC CLASSES ACROSS THE PROJECT AREA (TABLE 6.2)

According to *Hume Coal Project EIS Appendix F- Soil and Land Assessment- Par 2 of 3; Table 6.2 Summary of LAC classes across the project area*:

Site	Ref. proposed locations according to soil assessment data (Table 6.2) SMUs	Water erosion LSC Class	Wind erosion LSC Class	Soil structural decline LSC Class	Soil acidification LSC Class	Salinity LSC Class	Waterlogging LSC Class	Shallow soils and rockiness LSC Class	Mass movement LSC Class	Overall LSC class
A	616- Kandosol	3	3	3	3	1	2	3	1	3
	620- Dermosol	4	3	3	3	1	1	7	1	7
B	614- Kandosol	4	3	3	2	1	3	6	1	6
C	627- Kandosol	3	4	3	3	1	5	4	1	5
	629- Kandosol	4	3	3	2	1	2	6	1	6
D	532- Tenosol	3	4	3	4	1	1	3	1	4

APPENDIX V WATER BALANCE

Minimum Area Water Balance & wet Weahter Storage Calcs

Site Address: **Hume Coal Project (worker village)**

INPUT DATA

Design Wastewater Flow	Q	33470	L/day
Design DIR (from AS/NZ 1547,2000)	DIR	24.5	mm/week
Daily DIR		3.5	mm/day
Runoff Coefficient	RC	0.9	Unitless
Crop factor	C	0.4-0.7	Unitless
Nominated Land Application Area	L	17470	m sq
Rainfall Data	Moss Vale (Hoskins Street)		
Evaporation Data	SCA zone 4		

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D	\	days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	R	\	mm/month	78	71.9	72.4	65.6	48.9	69.3	52.3	38.8	44.7	57.4	64.1	59.8	**723.2**
Evaporation	E	\	mm/month	195	150	127	78	50	33	37	59	84	121	147	189	**1270**
Crop Factor	C			0.70	0.70	0.70	0.60	0.50	0.45	0.40	0.45	0.55	0.65	0.70	0.70	
INPUTS																
Precipitation	(P)		mm/month	70.2	64.71	65.16	59.04	44.01	62.37	47.07	34.92	40.23	51.66	57.69	53.82	723.2
Effluent Irrigation	(W)	(Q x D) / L	mm/month	59.4	53.6	59.4	57.5	59.4	57.5	59.4	59.4	57.5	59.4	57.5	59.4	**699.28735**
Inputs		(P+W)	mm/month	129.6	118.4	124.6	116.5	103.4	119.8	106.5	94.3	97.7	111.1	115.2	113.2	1350.2
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	137	105	89	47	25	15	15	27	46	79	103	132	**818.45**
Percolation	B	(DIR/7)xD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	**1277.5**
Outputs		ET+B	mm/month	245.0	203	197.4	151.8	133.5	119.9	123.3	135.1	151.2	187.2	207.9	240.8	**2096.0**
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage	S	(P+I)-(ET+B)	mm/month	-115.4	-84.6	-72.8	-35.3	-30.1	0.0	-16.8	-40.7	-53.5	-76.1	-92.7	-127.6	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Largest M	**(V)**		mm	**0.00**												
		(V x L)/1000	m^3	**0.0**												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	5936	6777	7846	10825	11594	17469	13611	10362	9048	7658	6685	5549	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: **17468.7** m^2

Minimum Area Water Balance & wet Weahter Storage Calcs

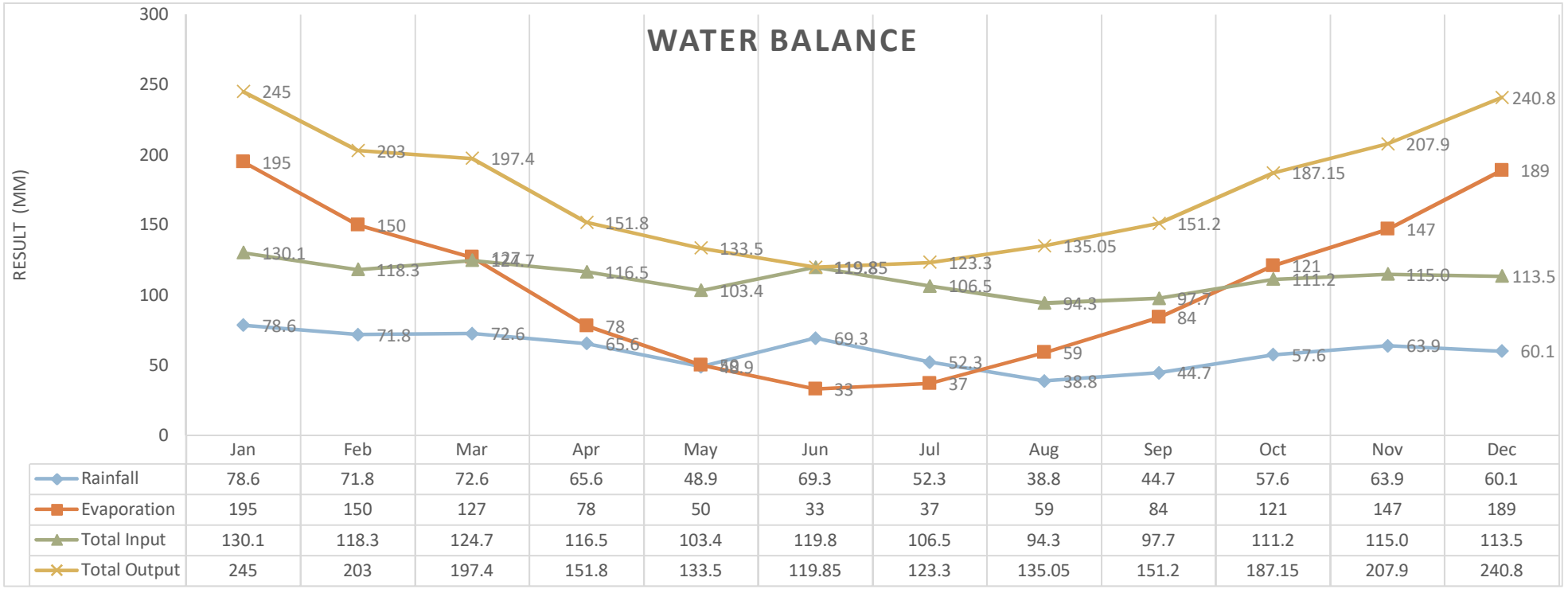
Site Address: **Hume Coal Project (Rail Loop & Maintenance Facility)**

INPUT DATA

Design Wastewater Flow	Q	410	L/day
Design DIR (from AS/NZ 1547,2000)	DIR	24.5	mm/week
Daily DIR		3.5	mm/day
Runoff Coefficient	RC	0.9	Unitless
Crop factor	C	0.4-0.7	Unitless
Nominated Land Application Area	L	214	m sq
Rainfall Data	Moss Vale (Hoskins Street)		
Evaporation Data	SCA zone 4		

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D	\	days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	R	\	mm/month	78	71.9	72.4	65.6	48.9	69.3	52.3	38.8	44.7	57.4	64.1	59.8	**723.2**
Evaporation	E	\	mm/month	195	150	127	78	50	33	37	59	84	121	147	189	**1270**
Crop Factor	C			0.70	0.70	0.70	0.60	0.50	0.45	0.40	0.45	0.55	0.65	0.70	0.70	
INPUTS																
Precipitation	(P)		mm/month	70.2	64.71	65.16	59.04	44.01	62.37	47.07	34.92	40.23	51.66	57.69	53.82	723.2
Effluent Irrigation	(W)	(Q x D) / L	mm/month	59.4	53.6	59.4	57.5	59.4	57.5	59.4	59.4	57.5	59.4	57.5	59.4	**699.29907**
Inputs		(P+W)	mm/month	129.6	118.4	124.6	116.5	103.4	119.8	106.5	94.3	97.7	111.1	115.2	113.2	1350.2
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	137	105	89	47	25	15	15	27	46	79	103	132	**818.45**
Percolation	B	(DIR/7)xD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	**1277.5**
Outputs		ET+B	mm/month	245.0	203	197.4	151.8	133.5	119.9	123.3	135.1	151.2	187.2	207.9	240.8	**2096.0**
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage	S	(P+I)-(ET+B)	mm/month	-115.4	-84.6	-72.8	-35.3	-30.1	0.0	-16.8	-40.7	-53.5	-76.1	-92.7	-127.6	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Largest M	**(V)**		mm	**0.00**												
		(V x L)/1000	m^3	**0.0**												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	73	83	96	133	142	214	167	127	111	94	82	68	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: **214.0** m^2



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	78.6	71.8	72.6	65.6	48.9	69.3	52.3	38.8	44.7	57.6	63.9	60.1
Evaporation	195	150	127	78	50	33	37	59	84	121	147	189
Total Input	130.1	118.3	124.7	116.5	103.4	119.8	106.5	94.3	97.7	111.2	115.0	113.5
Total Output	245	203	197.4	151.8	133.5	119.85	123.3	135.05	151.2	187.15	207.9	240.8

APPENDIX VI NITROGEN BALANCE

	APPENDIX II NITROGEN BALANCE			
	SITE ADDRESS	**Hume Coal Project (worker village)**		
	1. DETERMINE THE DAILY N LOAD			
(a)	Effluent concentration TN	56	mg/L	
(b)	Daily hydraulic load	33470	L/day	
(c)	(a) x (b) =	1874320	mg/day	
	2.DETERMINE THE ANNUAL N LOAD			
(d)	(c) x 365 days	684,126,800	mg	
	3. ALLOW 20% LOSS THROUGH DENITRIFICATION, VOLATIZATION, MICROBIAL ATTACK ETC			
	(d) x 0.8	547,301,440	mg/yr	
(e)	Annual N load	547,301	kg/yr	
	3. ALLOW FOR PLANT UPTAKE	**Managed Fescue Pasture**		
(f)	Vegetation N Uptake	336	kgN/ha/yr	
(g)	Which equates to (c) / (h)	115.0684932	$mg/m^2/day$	
	5. DIVIDE THE ANNUAL N LOAD X APPLICATION RATE			
(g)	(e) / (f)	1.6289	ha	
	MINIMUM AREA FOR P UPTAKE	**16289 m^2**		

	APPENDIX II NITROGEN BALANCE			
	SITE ADDRESS	**Hume Coal Project (Rail Loop & Maintenance Facility)**		
	1. DETERMINE THE DAILY N LOAD			
(a)	Effluent concentration TN	30	mg/L	
(b)	Daily hydraulic load	410	L/day	
(c)	(a) x (b) =	12300	mg/day	
	2.DETERMINE THE ANNUAL N LOAD			
(d)	(c) x 365 days	4,489,500	mg	
	3. ALLOW 20% LOSS THROUGH DENITRIFICATION, VOLATIZATION, MICROBIAL ATTACK ETC			
	(d) x 0.8	3,591,600	mg/yr	
(e)	Annual N load	3,592	kg/yr	
	3. ALLOW FOR PLANT UPTAKE	**Managed area**		
(f)	Vegetation N Uptake	240	kgN/ha/yr	
(g)	Which equates to (c) / (h)	82.19178082	$mg/m^2/day$	
	5. DIVIDE THE ANNUAL N LOAD X APPLICATION RATE			
(g)	(e) / (f)	0.0150	ha	
	MINIMUM AREA FOR P UPTAKE	**150 m^2**		

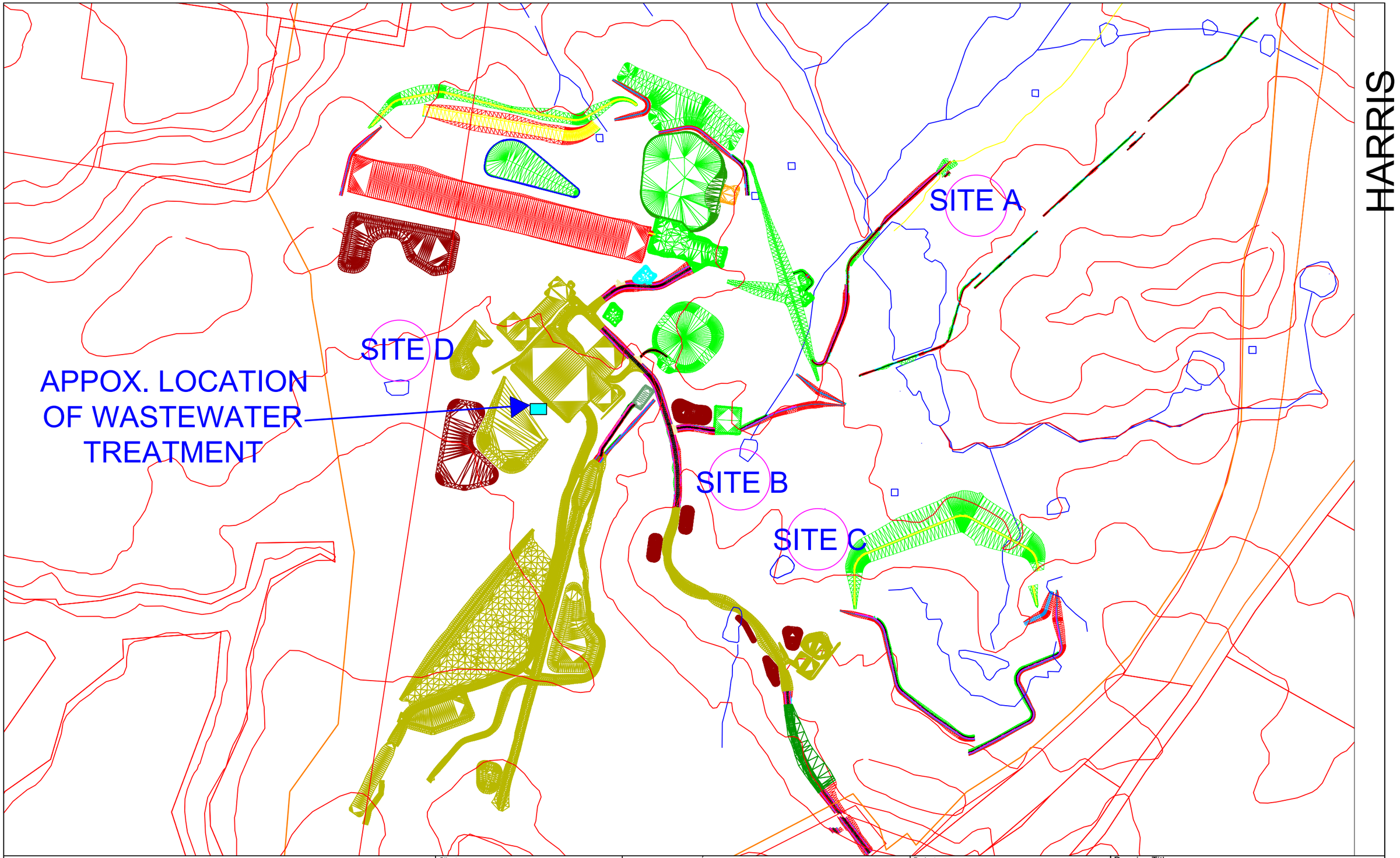
APPENDIX VII PHOSPHORUS BALANCE

APPENDIX III PHOSPHORUS BALANCE

SITE ADDRESS	**Hume Coal Project (worker village)**							
Daily hydraulic load	33470	L/day						
Effluent P Concentration	12	mg/L						
Design Life of System	50	years						
Crop P uptake (Fescue)	56	kg/ha/yr	which equals	15	$mg/m^2/day$			
P sorption of soils								
P-sorption result	300	mg/kg	which equals	5400	kg/ha			
			which equals	0.54	mg/m^2			
Bulk density	1.5	g/cm^2						
Depth of soil	1.2	m						
% of Predicted P-sorp	0.3	Decimal						
Nominated EMA	16584	m^2						
Daily P Load	0.4016	kg/day	→	Phosphorus generated over life of system		7329.9	kg	
Daily Uptake	0.254432579	kg/day	→	Phosphorus vegetative uptake for life of system		0.280	kg/m^2	
Measured p-sorption capacity	0.54	kg/m^2						
Assumed p-sorption capacity	0.162	kg/m^2	→	Phosphorus adsorbed in 50 years		0.162	kg/m^2	
Site P-sorption capacity	2686.54	kg	→	Desired Annual P Application Rate		53.7	kg/yr	
MINIMUM AREA FOR P UPTAKE	**16584**	**m^2**						

APPENDIX III PHOSPHORUS BALANCE

SITE ADDRESS	**Hume Coal Project (Rail Loop & Maintenance Facility)**							
Daily hydraulic load	410	L/day						
Effluent P Concentration	12	mg/L						
Design Life of System	50	years						
Crop P uptake (Fescue)	30	kg/ha/yr	which equals	8	$mg/m^2/day$			
P sorption of soils								
P-sorption result	300	mg/kg	which equals	5400	kg/ha			
			which equals	0.54	mg/m^2			
Bulk density	1.5	g/cm^2						
Depth of soil	1.2	m						
% of Predicted P-sorp	0.3	Decimal						
Nominated EMA	288	m^2						
Daily P Load	0.0049	kg/day	→	Phosphorus generated over life of system		89.79	kg	
Daily Uptake	0.002365385	kg/day	→	Phosphorus vegetative uptake for life of system		0.150	kg/m^2	
Measured p-sorption capacity	0.54	kg/m^2						
Assumed p-sorption capacity	0.162	kg/m^2	→	Phosphorus adsorbed in 50 years		0.162	kg/m^2	
Site P-sorption capacity	46.62	kg	→	Desired Annual P Application Rate		0.9	kg/yr	
MINIMUM AREA FOR P UPTAKE	**288**	**m^2**						



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

North

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Wastewater | Bushfire | Stormwater

Project

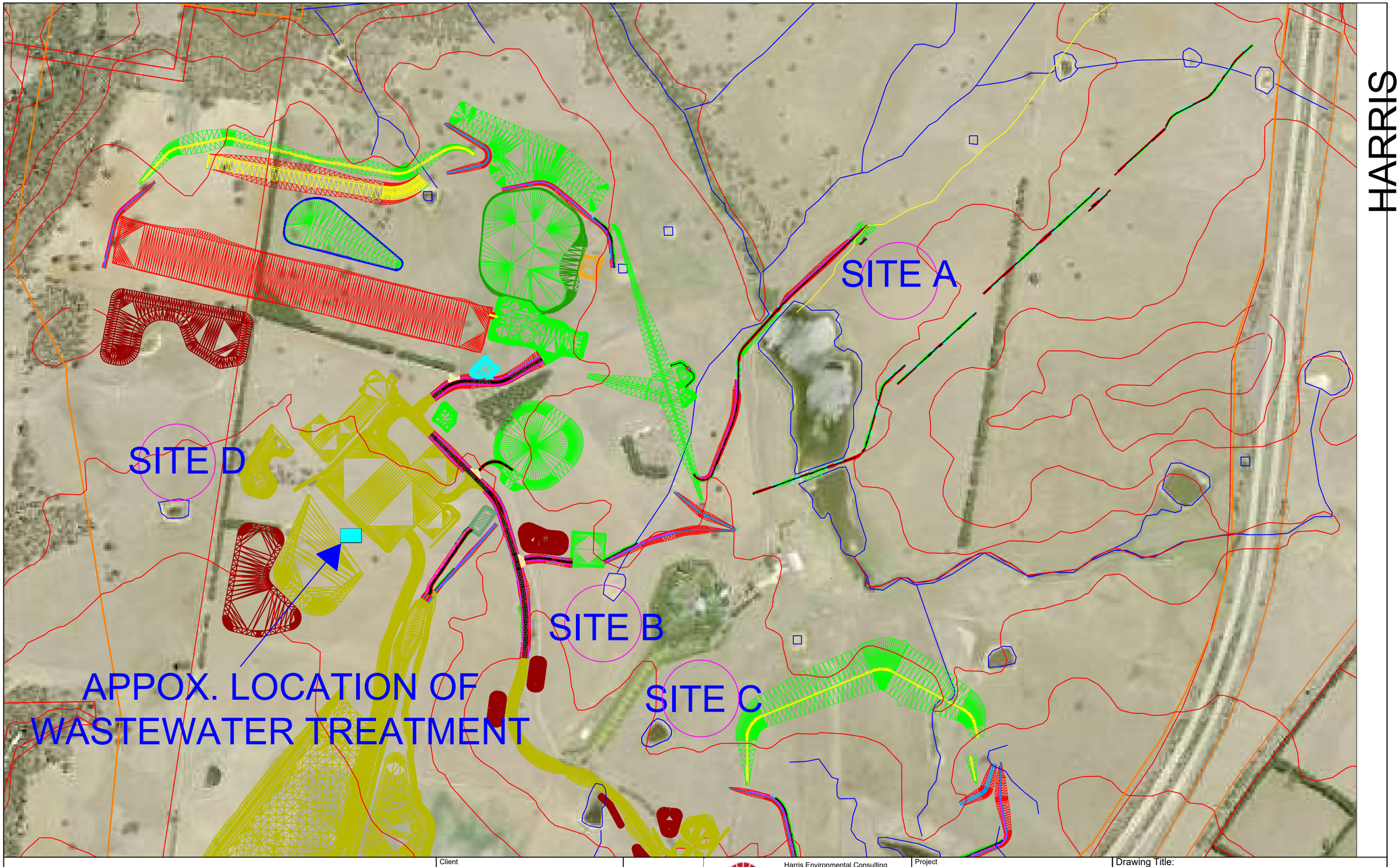
PROPOSED HUME
COAL PROJECT

HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title:

ON-SITE WASTEWATER MANAGEMENT
PROPOSED LOCATIONS SHEET 1

Drawn:	Date:	Scale:	Q.A. Check:	Date:
PS	14/05/2018	NTS		14/5/2018
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#1	A



HARRIS

Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

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Project

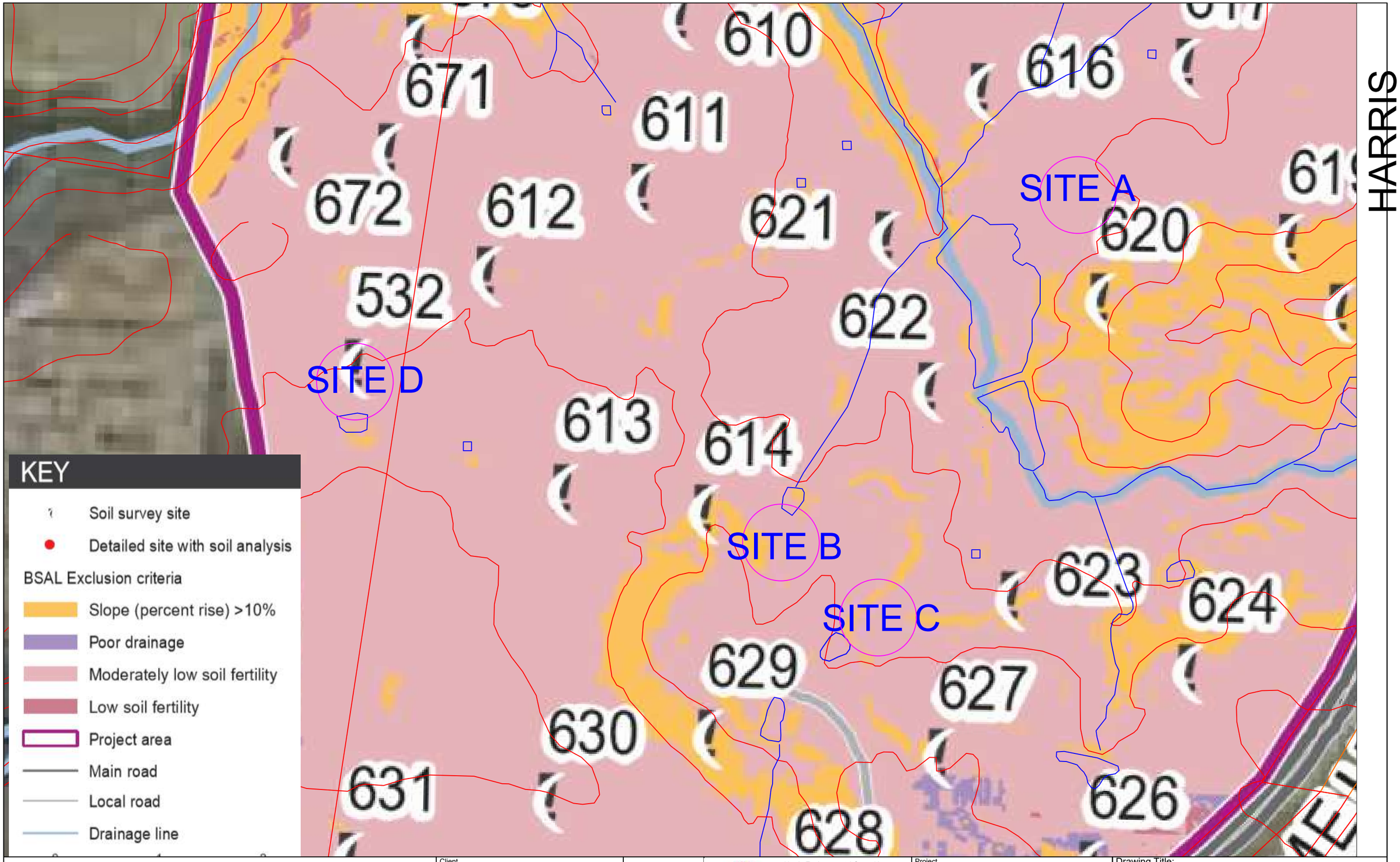
PROPOSED HUME
COAL PROJECT

HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title:

ON-SITE WASTEWATER MANAGEMENT
PROPOSED LOCATIONS SHEET 2

Drawn:	Date:	Scale:	Q.A. Check:	Date:
PS	14/05/2018	NTS		14/5/2018
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#2	A



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

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Project: PROPOSED HUME COAL PROJECT
HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title: ON-SITE WASTEWATER MANAGEMENT PROPOSED LOCATIONS SHEET 3

Drawn:	Date:	Scale:	Q.A. Check:	Date:
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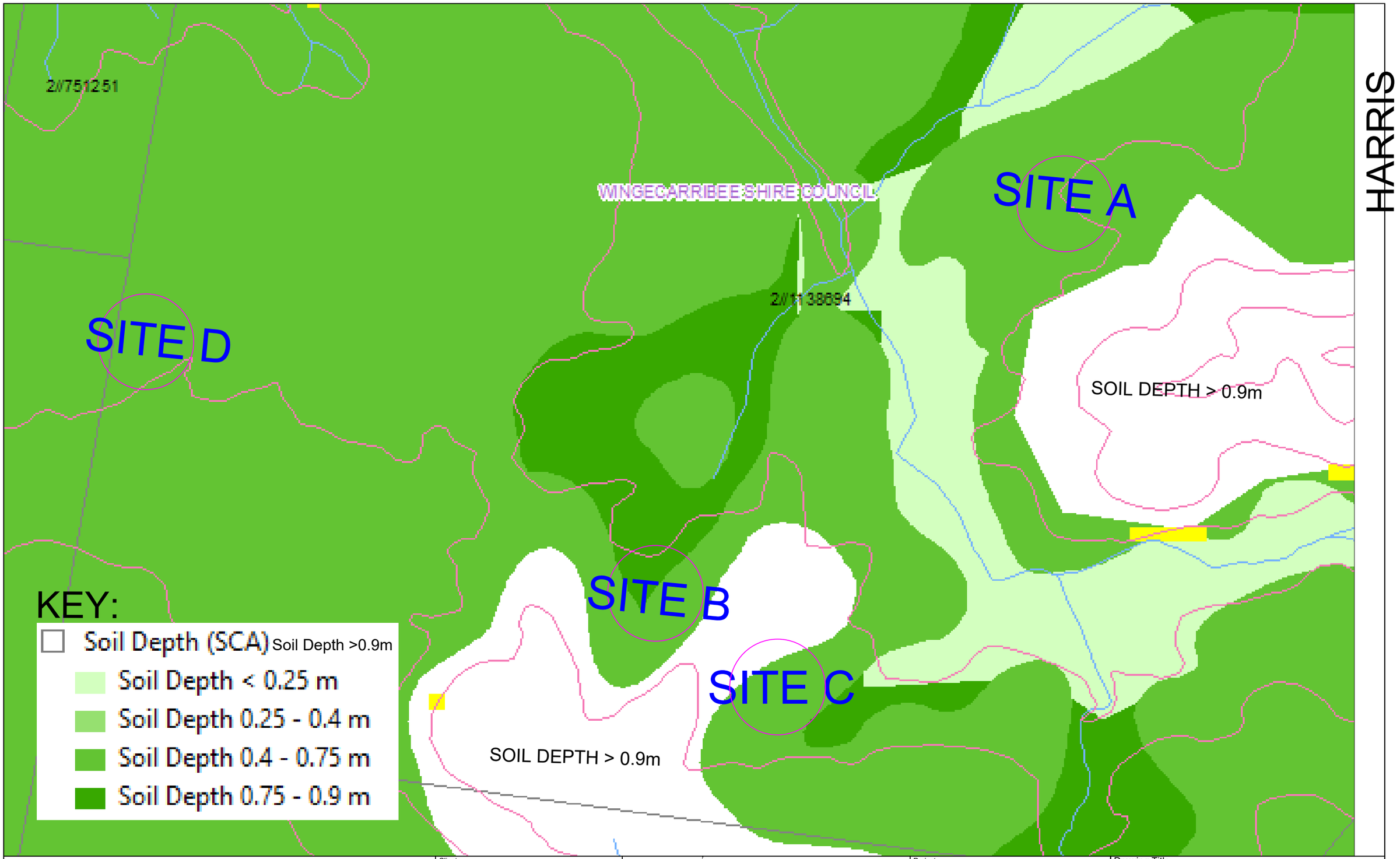
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#3	A



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

North: N

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Project: PROPOSED HUME COAL PROJECT
HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title: ON-SITE WASTEWATER MANAGEMENT PROPOSED LOCATIONS SHEET 4

Drawn:	Date:	Scale:	Q.A. Check:	Date:
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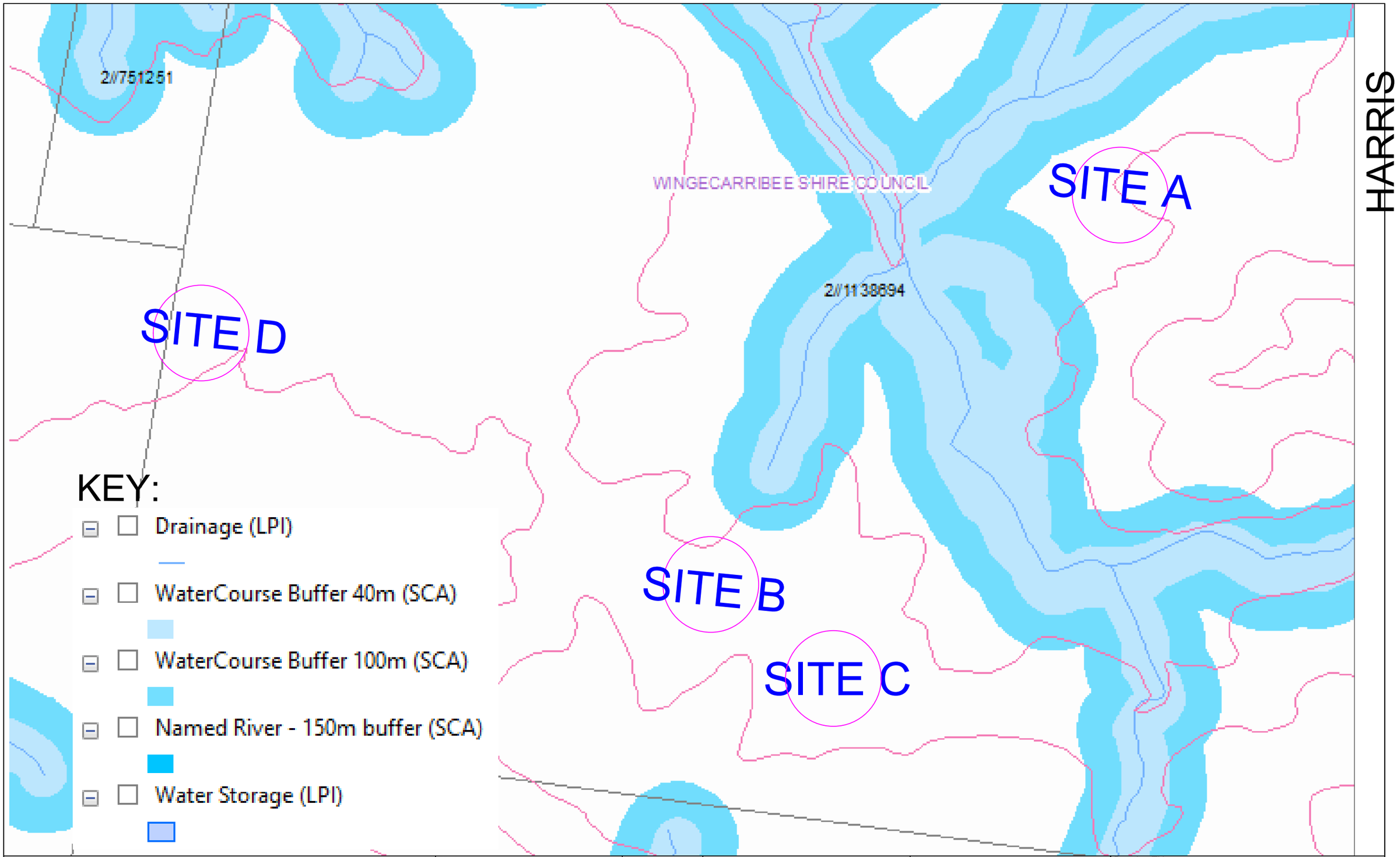
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#4	A



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

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Project: PROPOSED HUME COAL PROJECT
HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title: ON-SITE WASTEWATER MANAGEMENT PROPOSED LOCATIONS SHEET 5

Drawn:	Date:	Scale:	Q.A. Check:	Date:
PS	14/05/2018	NTS		14/5/2018
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#5	A

Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

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Wastewater | Bushfire | Stormwater

Project

PROPOSED HUME COAL PROJECT

HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title:

ON-SITE WASTEWATER MANAGEMENT SOIL LANDSCAPES OF SITE SHEET 6

Drawn:	Date:	Scale:	Q.A. Check:	Date:
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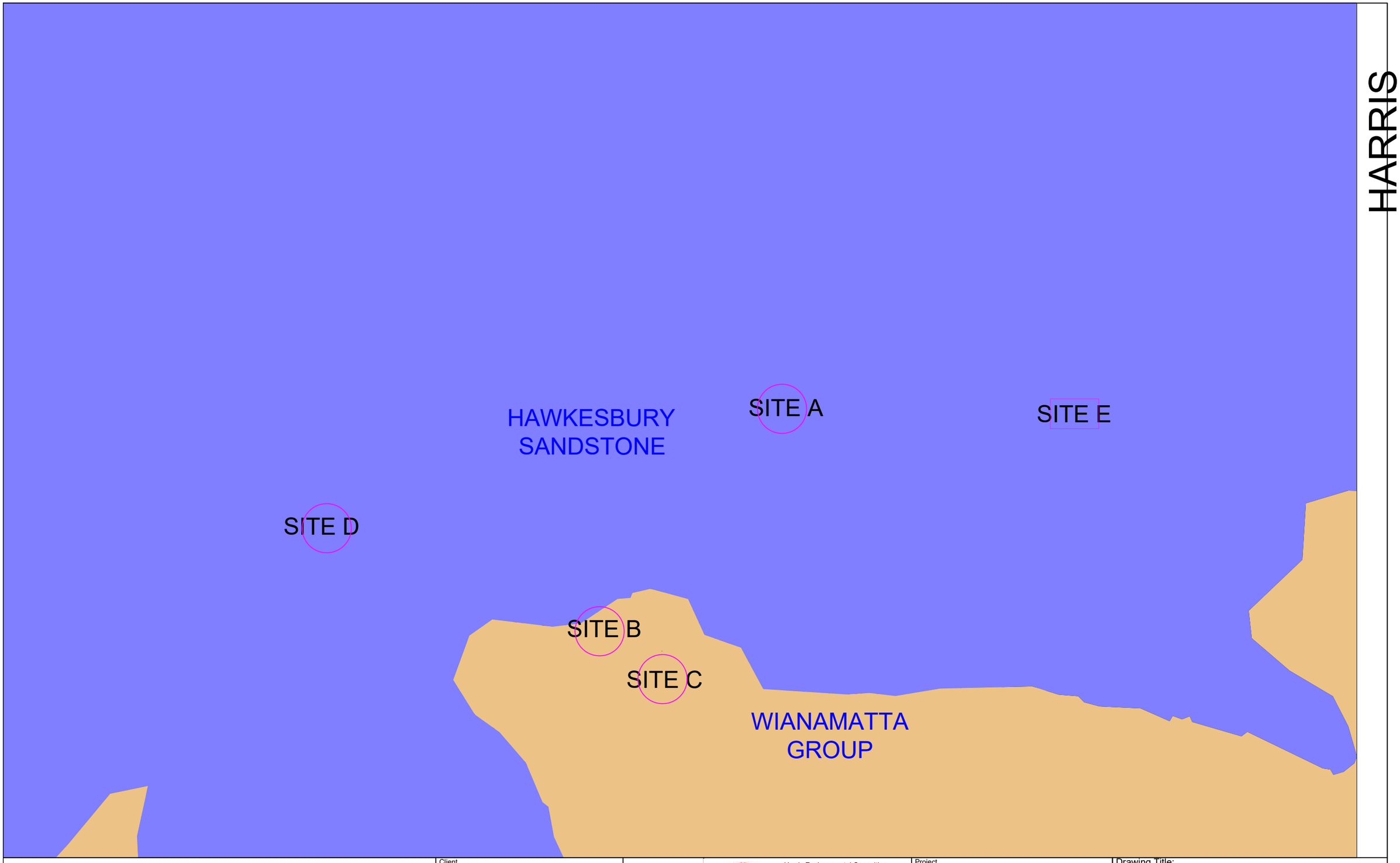
PS	2844ww		#6	A



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

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Wastewater | Bushfire | Stormwater

Project

PROPOSED HUME COAL PROJECT

HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title:

ON-SITE WASTEWATER MANAGEMENT GEOLOGY OF SITE SHEET 7

Drawn:	Date:	Scale:	Q.A. Check:	Date:
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Designed:	Our reference:		Dwg. No.	Issue:
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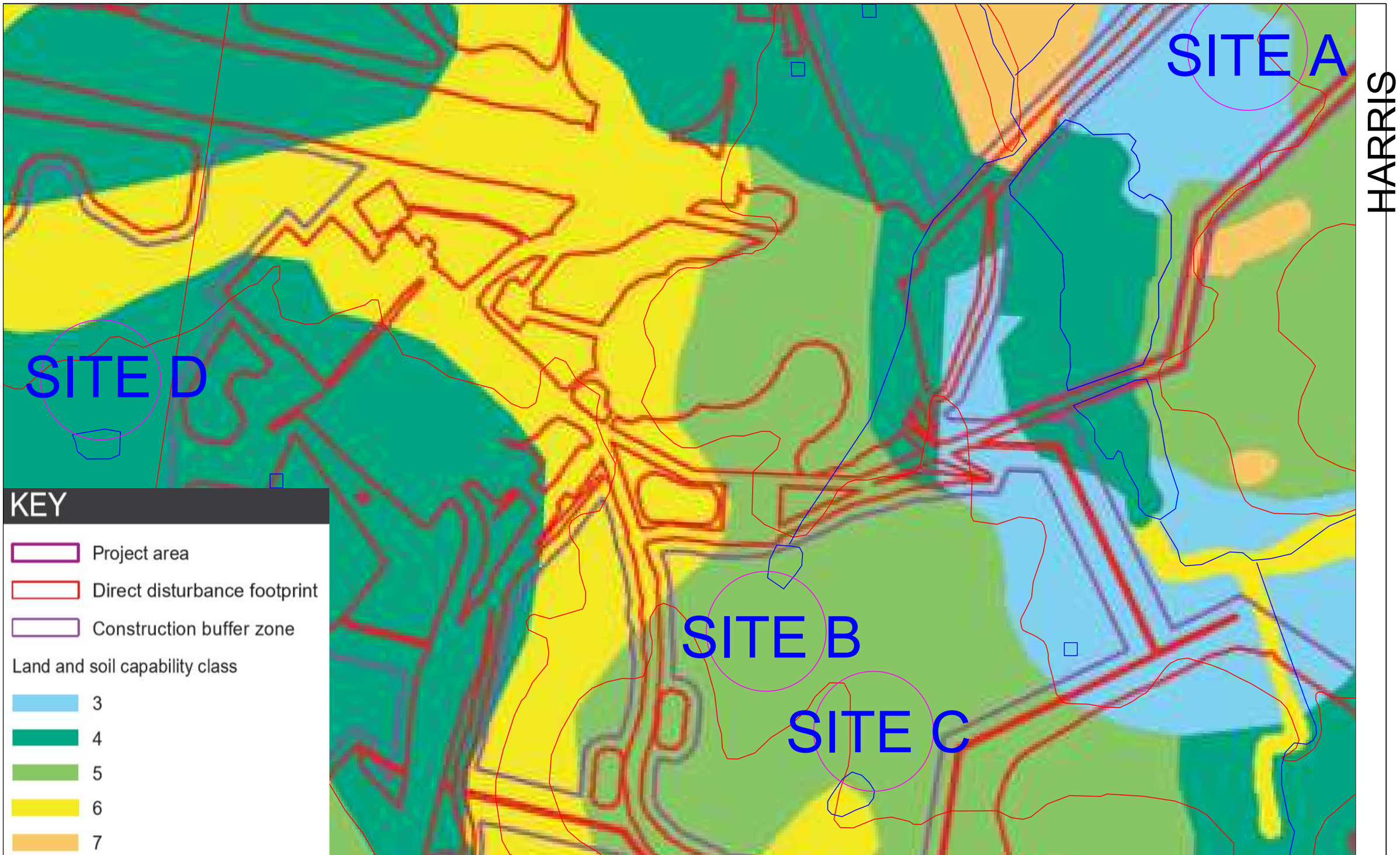

Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

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Project
PROPOSED HUME COAL PROJECT
HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title:
ON-SITE WASTEWATER MANAGEMENT
LAND CAPABILITY CLASS SHEET 8

Drawn:	Date:	Scale:	Q.A. Check:	Date:
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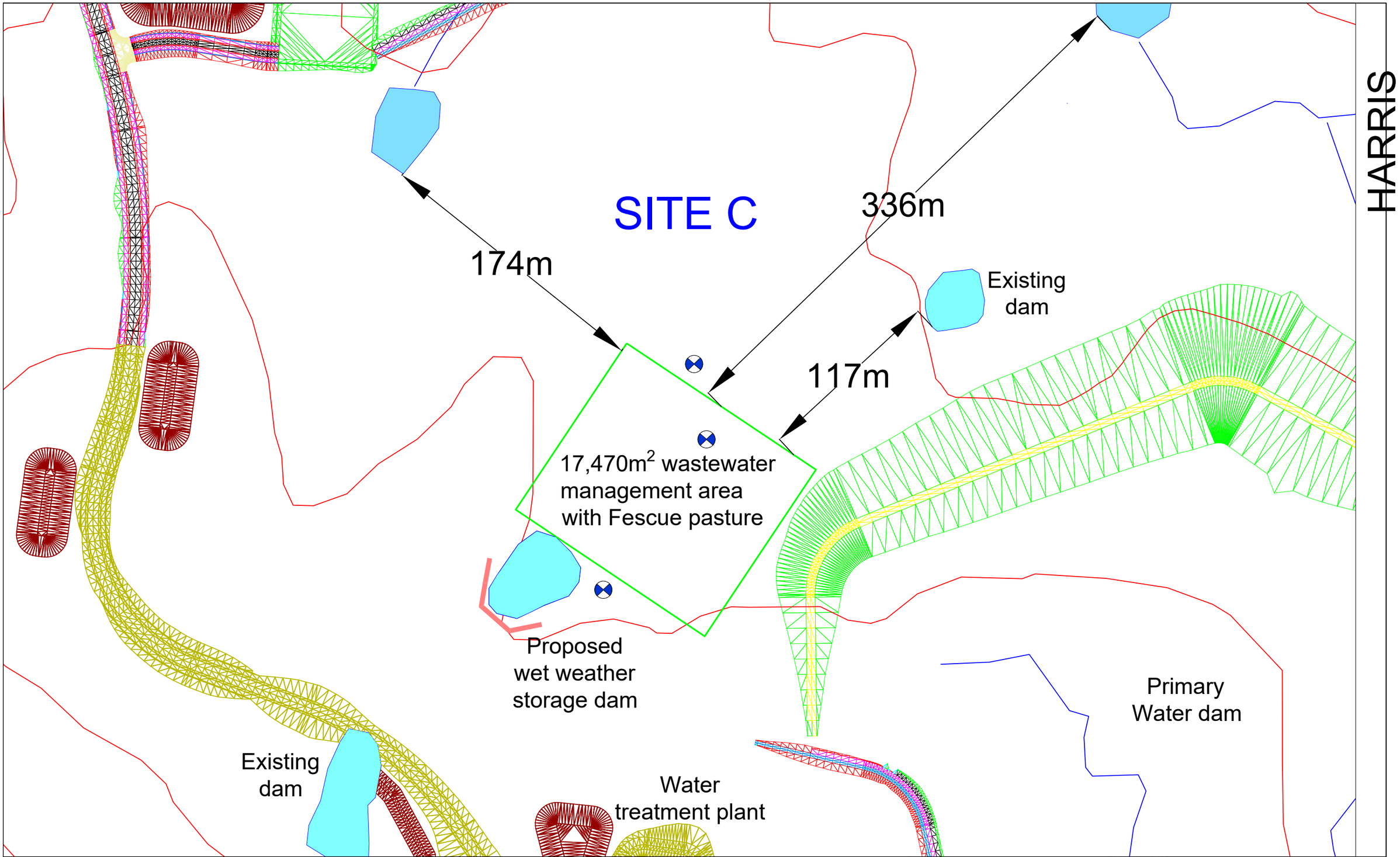
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#8	A



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

North

N

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Project

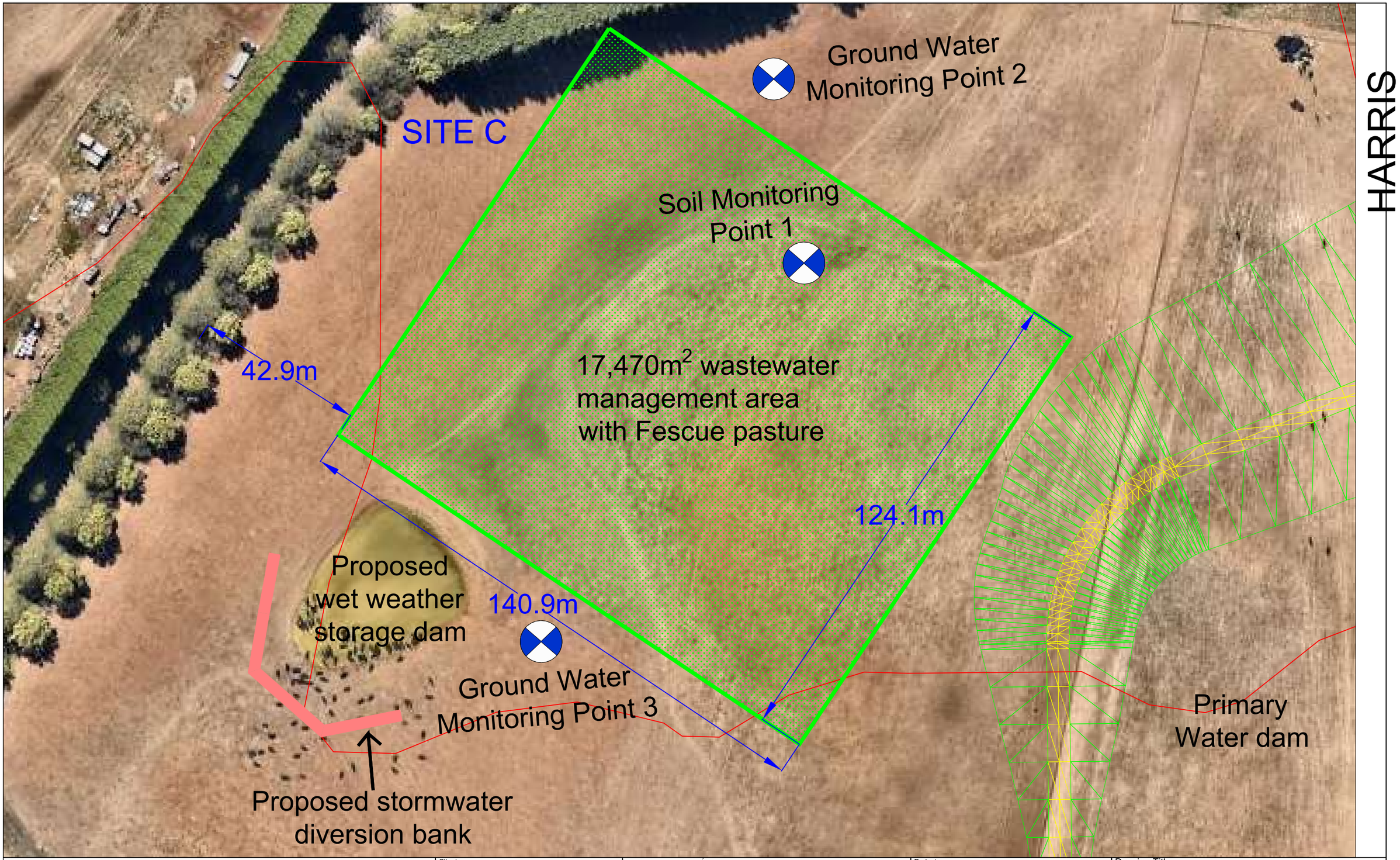
PROPOSED HUME
COAL PROJECT

HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title:

ON-SITE WASTEWATER MANAGEMENT
PROPOSED LOCATION C - SHEET 9

Drawn:	Date:	Scale:	Q.A. Check:	Date:
PS	14/05/2018	as noted		14/5/2018
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#9	A



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

North

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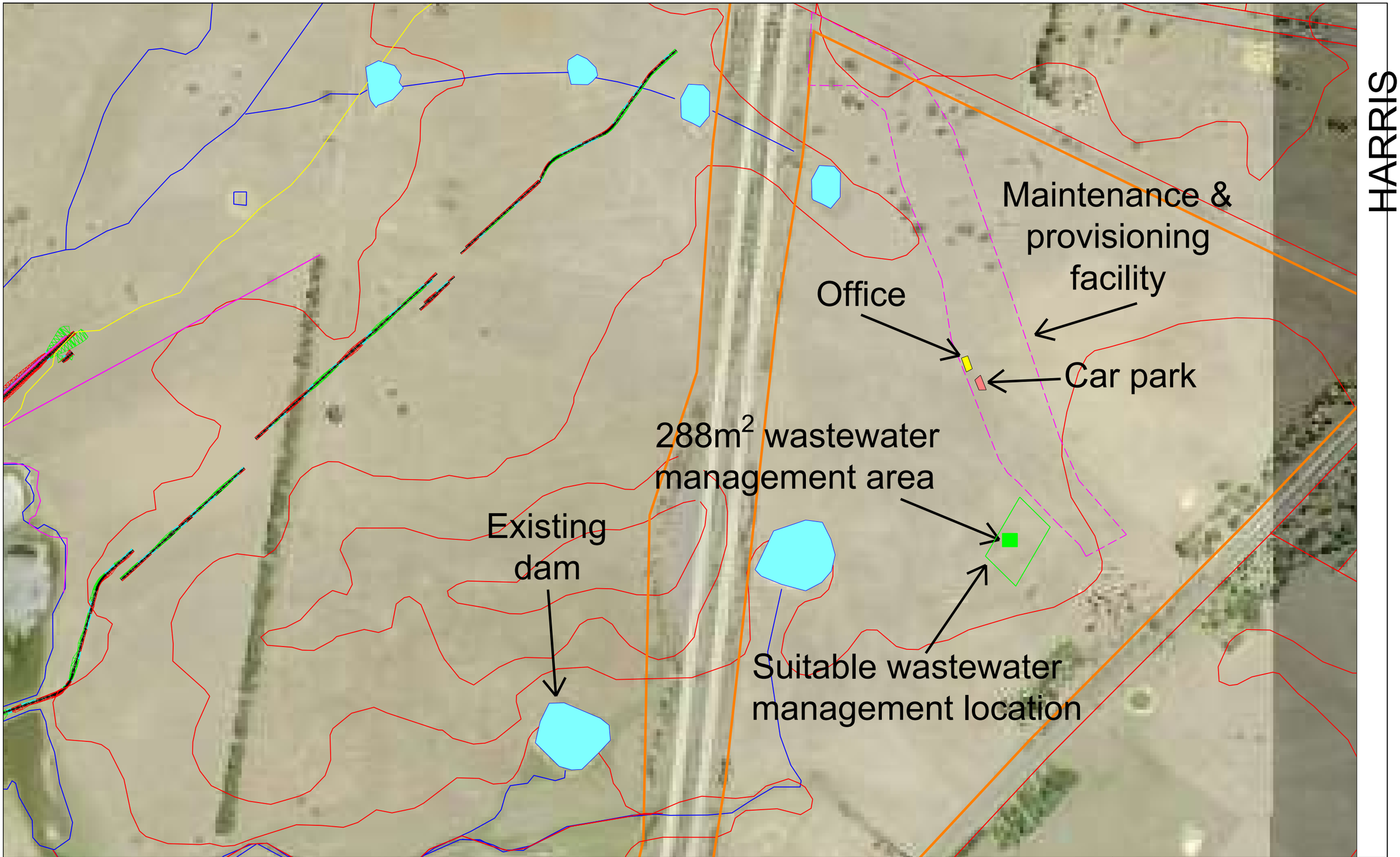
Project: PROPOSED HUME COAL PROJECT
HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title: ON-SITE WASTEWATER MANAGEMENT PROPOSED LOCATION C - SHEET 10

Drawn:	Date:	Scale:	Q.A. Check:	Date:
PS	14/05/2018	as noted		14/5/2018
Designed:	**Our reference:**		**Dwg. No.**	**Issue:**
PS	2844ww		#10	A



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

North

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Wastewater | Bushfire | Stormwater

Project
PROPOSED RAIL LOOP & MAINTENANCE FACILITY
HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title:
ON-SITE WASTEWATER MANAGEMENT PROPOSED LOCATION- SHEET 11

Drawn:	Date:	Scale:	Q.A. Check:	Date:
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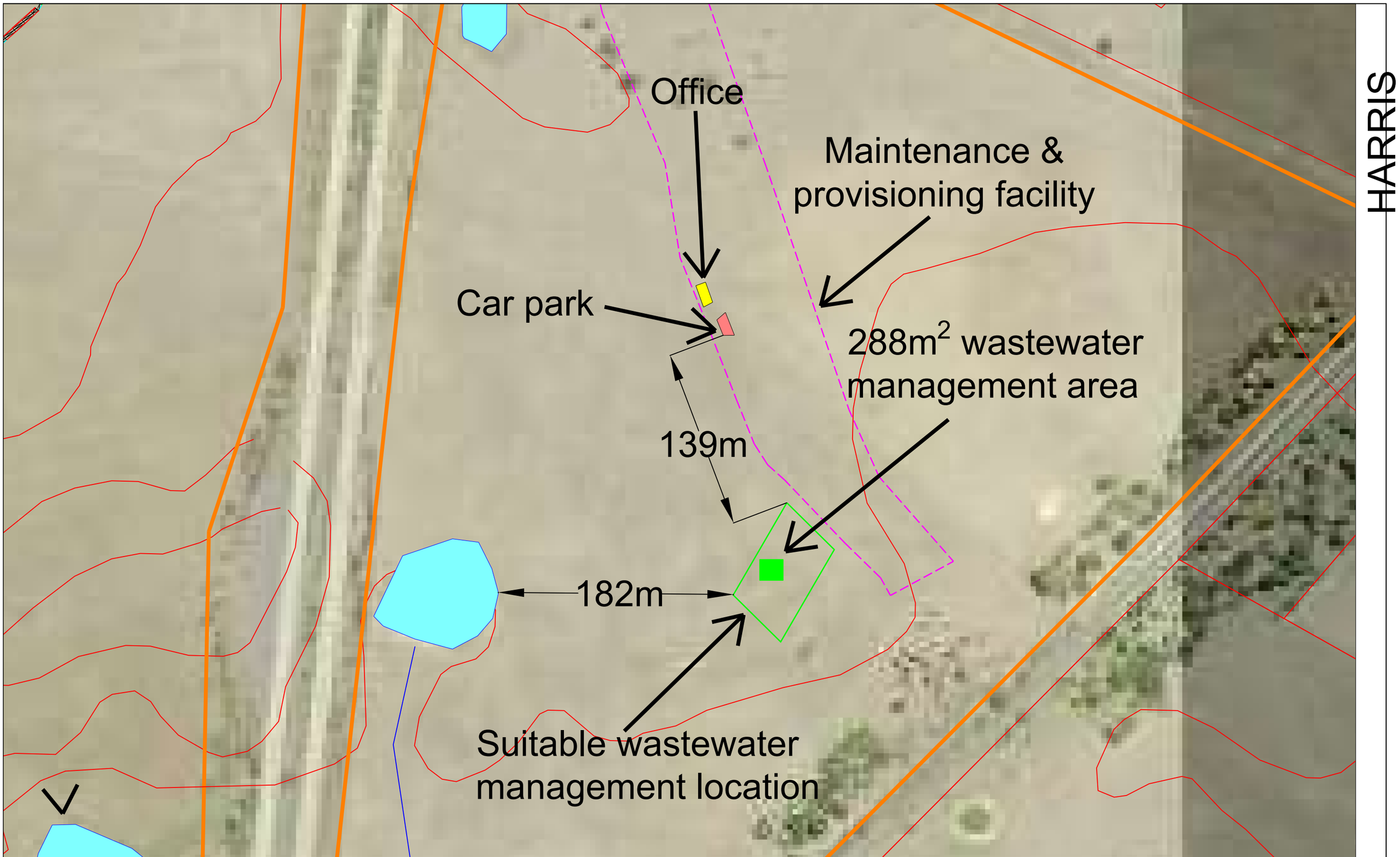
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#11	A



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

North

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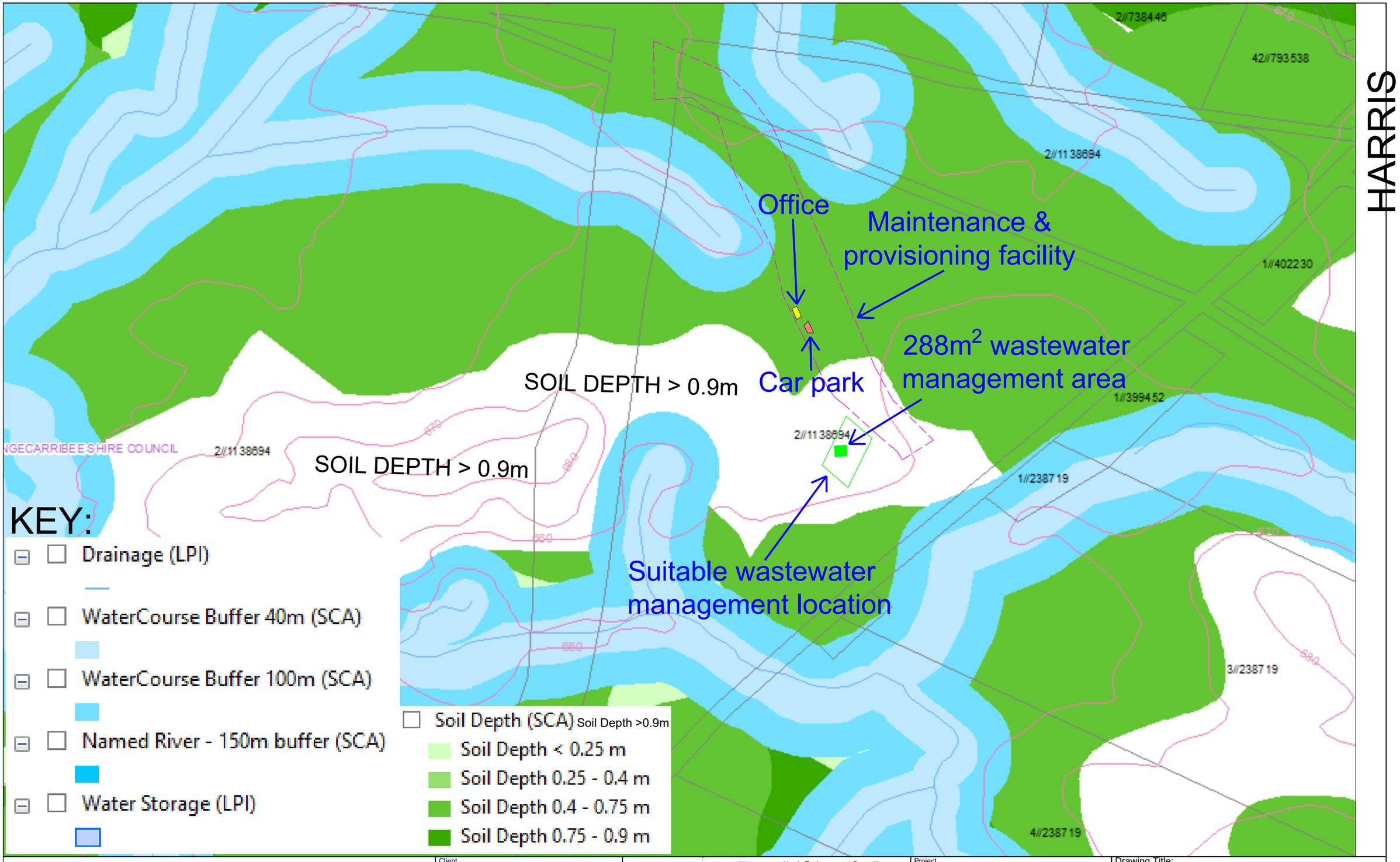
ABN: 6156 3609 153
Wastewater | Bushfire | Stormwater

Project
PROPOSED RAIL LOOP &
MAINTENANCE FACILITY
HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title:
ON-SITE WASTEWATER MANAGEMENT
PROPOSED LOCATION - SHEET 12

Drawn:	Date:	Scale:	Q.A. Check:	Date:
PS	14/05/2018	as noted		14/5/2018
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#12	A



Issue:	Description:	Date	Drawn	Approved
A	HEC Standard Drawing	14/05/18	PS	SH

North

Client
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ABN: 6156 3609 153
Wastewater | Bushfire | Stormwater

Project
PROPOSED RAIL LOOP & MAINTENANCE FACILITY
HUME HIGHWAY, SUTTON FOREST, NSW
LGA: WINGECARRIBEE

Drawing Title:
ON-SITE WASTEWATER MANAGEMENT PROPOSED LOCATION - SHEET 13

Drawn:	Date:	Scale:	Q.A. Check:	Date:
PS	14/05/2018	as noted		14/5/2018
Designed:	Our reference:		Dwg. No.	Issue:
PS	2844ww		#13	A