Site and Soil Assessment

for

On-Site Wastewater Management

Proposed Car Wash

Lot 3 DP215949

1-21 Cranebrook Road, Cranebrook NSW 2749

Penrith City Council

26th November 2020

Roberts Resources – November 2020

Report Reference: XRSSSSE_0001

This Wastewater Management Report has been prepared by Roberts Resources for the tenants of Number 1-21 Cranebrook Road, Cranebrook NSW 2749 (Lot 3 – DP215949) for purpose and to the scope stated in this report. The services undertaken by Roberts Resources in connection with preparing this report are limited to those specifically detailed in the report.

Should third parties choose to rely on this report they do so at their own risk. Roberts Resources excludes implied warranties and conditions, to the extent legally permissible.

The opinions, conclusions and any recommendations in this report are based on conditions and information reviewed at the date of preparation of the report. Roberts Resources has no responsibility or obligation to update this report to account for events or changes occurring after the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on the information available to and the assumptions made by Roberts Resources, which are described in various sections throughout this report. Roberts Resources disclaims liability arising from any of those assumptions being incorrect.

Roberts Resources has prepared this report based on the information referenced in this report. Roberts Resources has not independently verified or checked that information. Roberts Resources does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Nothing in this report constitutes legal advice and any commentary relating to legislation is for providing context as appropriate to the contents and objectives of the report. Any reader of this report should refer directly to relevant legislation or seek independent legal advice with respect to legal rights, liabilities or implications of any matter relating to the content of this report. This report is not an all-encompassing report dealing with the building and or property from every aspect.

This report is not a Certificate of Compliance with the requirements of any Act, Regulation, Ordinance or by-law.

This report has been developed based on agreed requirements as understood by Roberts Resources at the time of the investigation. It only applies to a specific task on the nominated lands. This task and accompanying report are a ‘Wastewater Management Study ‘only.

This report is based on a single site inspection. The entire property was not assessed and the assessment is limited to those areas and sections of the property requested as well as reasonably accessible and visible to the inspector at the time of the inspection. The inspection did not include earthworks or excavation, mechanical, soil pit sampling, removing or moving objects including but not limited to, vegetation, infrastructure, debris or refuse. The inspector did not dig, gouge, force or perform any other invasive procedures to the area or any part of the property grounds other than hand auger soil testing.

 The sole purpose of this report and the associated services performed by Roberts Resources is to prepare a Wastewater Management Study in accordance with the relevant Australian Standards and Guidelines relevant to Wastewater Management Studies.

Table of Contents

Table index

Figure index

Picture index

Appendix

1.0 Introduction

Roberts Resources Pty Ltd in accordance with AS/NZS 1547:2012 (On-site domestic wastewater management), Penrith City Council 'On-Site Sewage Management and Greywater Reuse' 2014 and the Environment and Health Protection Guidelines 'On-site Sewage Management for Single Households' 1998 as well as other relevant documentation where cited; was commissioned to undertake a Site and Soil Assessment (referred to as 'Wastewater Management Study') in the Penrith City Council Local Government Area.

This Wastewater Management Study has been completed to investigate whether on-site wastewater treatment and disposal can be sustainably accommodated and managed within Lot 3 (1-21) DP215949; Cranebrook Road, Cranebrook, NSW 2749 for the proposed wastewater producing building and infrastructure for a new Development Application.

Development Application on this site is for a new Car Wash.

Existing infrastructure on the site includes a large Service Station (known as the Cross Roads Service Station) and a McDonald's Restaurant that is part of the main building infrastructure.

This site has been extensively studied and tested over the last 10 years or more to support and deliver the technical documents to develop a large Service Station and McDonald's. All wastewater from the Service Station and McDonald's is managed on-site. The wastewater management system is a large commercial scale Treatment Plant with approximately 20,000 litres per day treatment capacity and disposal through a series of Raised Pressure Dosed Absorption Beds of 584m². Roberts Resources investigations showed the Treatment Plant to be operating well and the Absorption Beds to be performing as required with no signs of leakage or adverse effects. The system has been maintained and serviced as required and the Land Application Area is in good health.

Roberts Resources can confirm that our soil and landform investigations and NATA Laboratory Testing showed similar soil profiles and classifications to the numerous soil tests performed through previous consultancies (detailed in appendices / council records) and laboratories results throughout the previous years. We see no point in deviating from the general disposal design concept of Raised Pressure Dosed Absorption Beds for this site as they are clearly well suited to the location, site characteristics and local climatic regime.

The Car Wash contains 1 toilet and 1 hand basin for staff (nominally 1 person per day). The wastewater from the staff toilet will be directed to the existing Wastewater Treatment Plant that services the Service Station and McDonald's; the daily wastewater load from the Toilet represents approximately one tenth of a percent of the maximum total daily loading potential generated by the Service Station and McDonald's and in practical or physical terms will be unrepresented in the large-scale Commercial Treatment Plant that services these buildings. Directing the wastewater produced by the staff toilet will have zero affect to the operating capacity of the existing system. Other than the schematic designs showing distribution of wastewater from the staff toilet to the existing Treatment Plant, the staff toilet is not considered further in this report.

Therefore; wastewater that exists the Carwash once passed through the Oil/Petrochemical separator will include standard potable Reticulated Town Water and 'Off the Shelf' biodegradable/organic washing products only. It will not include any effluent, greywater, bacteria or petrochemicals of any kind. Due to the 'cleanliness' of this type of wastewater its classification is considered of extremely low environmental risk. The wastewater will be contained in large holding tanks and pump well and directed to a series of Raised Pressure Dosed Absorption Beds as detailed and designed in this report.

All work associated with this report was undertaken by Roberts Resources Principal; D. Roberts.

Site assessment was conducted across November 2020.

It must be noted that although all standards listed in the AS/NZS 1547:2012 has been adhered too, it is impossible to ascertain the exact soil profiles/classifications and relationship to bedrock across the entire site without conducting a more thorough exploration project.

2.0 Site Assessment

2.1 Consultant Details

Company:	**Roberts Resources – Independent Geoscience Consultants**
Disciplines:	**Geomorphology – Geology – Soil Science – Hydrogeology**
Service Areas:	**Civil – Environmental – Exploration – Agricultural**
Address:	**'Somerton' Duke Street, Mittagong, NSW 2575**
PH:	**0402 847 311**
Site Assessor:	**Dave Roberts**
Email:	dave@robertsresources.com.au
Field Work Date:	**26th November 2020**
Assessment Ref:	**RPSSE_0001**

2.2 Site Details

Owner:	Anton and Tania Pincevic
Email:	N/A
Phone:	N/A
Address:	1-21 Cranebrook Road, Cranebrook, NSW 2749
Postal Address:	As Above
Lot / DP:	3 / 215949
Report Commissioned By:	Carwash World Pty Ltd. PO Box 653, Castle Hill, NSW 2154

Figure 1: Site Location – 1-21 Cranebrook Road, Cranebrook – Highlighted in Red (Sixx Maps Image)

Coordinates:	33°41'37.51" S - 150°43'37.56"E
Allotment Size:	Approximately 3.27ha
Local Government Authority:	Penrith City Council
Topographic Map:	Penrith 1:25,000

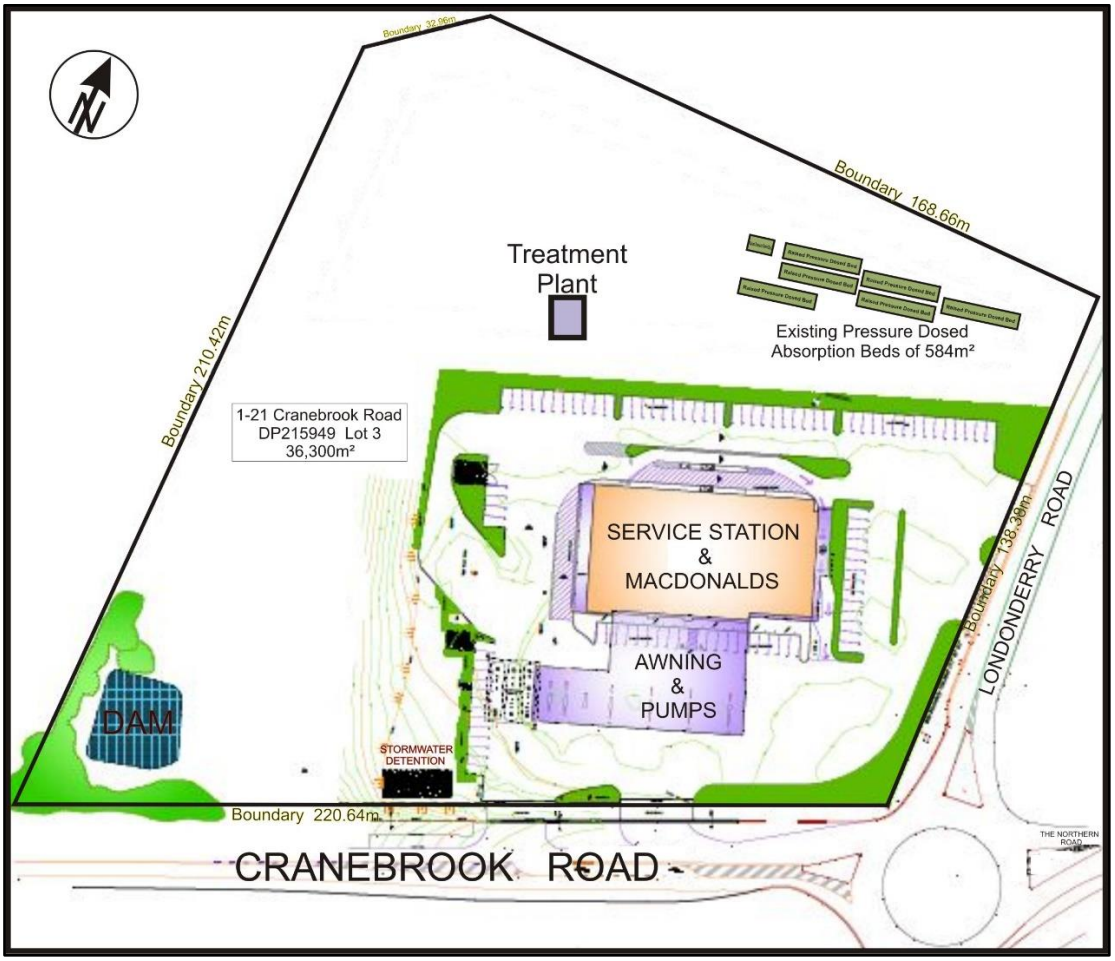


Figure 2: Existing Property Infrastructure **(Base Plan Used Drawn by TMC Building Design Group)**

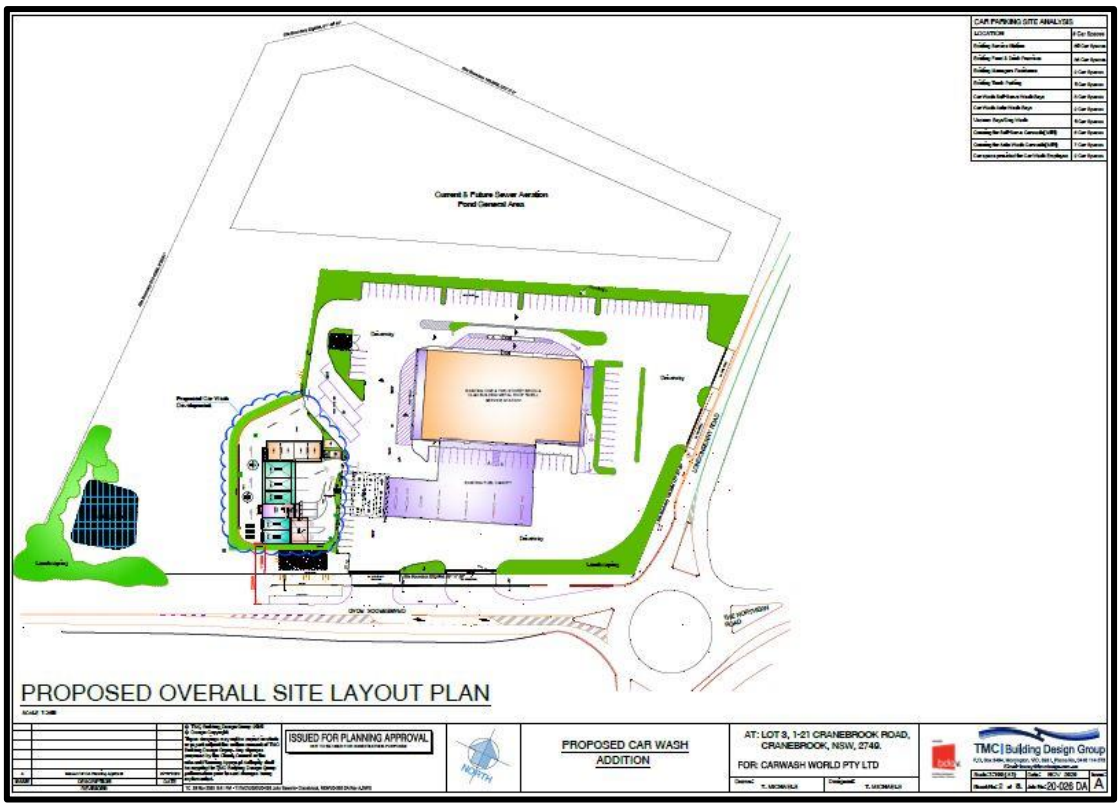


Figure 3: Proposed Car Wash Location **(Plan used courtesy of TMC Building Design Group)**

Proposed Development:	Car Wash: 2 X Auto Bays, 3 X Self-Serve Wash Bays, Staff Water Closet with Toilet and Hand Basin.
Existing Wastewater Type:	On-site wastewater management system services existing infrastructure and will receive wastewater from the Car Wash Staff Toilet.
Water Supply:	Town (Reticulated)
Current Bedrooms:	N/A
Potential Bedrooms:	N/A
Proposed Pool:	No
Sydney Catchment Area:	No
Neighboring System Types:	Septic Tank / AWTS – Irrigation surface and subsurface, absorption bed type

2.3 Land Application Area - Site Information

Assessment Criteria:	Penrith City Council Development Control Plan – 'On-Site Sewage Management and Greywater Reuse' 2014 AS/NZS 1547:2012 On-site Domestic wastewater management NSW Government Health: Sewage Management Facility Vessel Accreditation Guideline February 2016 NSW Health Department: Septic Tank and Collection Well Accreditation Guideline – Part 4, December 2001 Australian Standard – AS/NZS 1546. 1:2008 Environment and Health Protection Guidelines 'On-site Sewage Management for Single Households' 1998
Design Wastewater Loading:	Daily loadings have been calculated by TMC Building Group who are highly experienced in Car Wash design and operation. Appendix 1 contains the expected volumes increasing over a 3-year period from the start of operations in year 1 to the maximum long term operating volumes produced of 24,370 litres per day in year 3 and onwards. **Grand Total = Rounded to 25,000 litres per day maximum flow**
Climate:	N/A
Height Above Sea Level:	45 meters
Evaporation > Rainfall:	Yes (source BOM, as at December 2011)
Flood Potential:	Flood studies have not been consulted for this assessment. On-site inspection has concluded the following; Proposed treatment system location is above 1:100-year flood level. Proposed Land Application Area (LAA) is above 1:20-year flood level. Both areas are considered a low limitation.
Frost Potential:	This locality is not known to endure long and sustained frosts and as such is considered a low limitation.
Exposure:	East to West. Low limitation
Slope:	~1-3 across LAA. Minor Limitation
LAA Landform:	LAA on open flat ground (Linear divergent / planar). Minor Limitation
Run on:	Low potential. Minor Limitation

Run off & Seepage:	Low potential if designed properly. Minor Limitation
Springs or Seeps:	None observed. Minor Limitation
Erosion/Movement:	None observed. Minor Limitation
Drainage:	Well drained. Minor Limitation
Evidence of Fill:	Slight amount to approximately 30cm depth in the south western property area. Is not in Primary LAA and will not impact wastewater disposal. Minor Limitation.
Outcrop/Surface Rock:	None observed.
Domestic Groundwater:	No Domestic Water Bore on property. Groundwater Bore GW104342 is located south of the property at approximately 250m from the Land Application Area. It is used for domestic irrigation purposes and not domestic drinking water. Minor Limitation
Watercourses/body's	LAA > 40 meters from drainage depression / dam. LAA > 100 meters from permanent/intermittent water stream/river. LAA > 150 meters from named river.
Vegetation:	LAA present vegetation cover – Managed Lawn – exposed soil. Low Limitation
Property Use:	Rural-Residential – Service Station. Low Limitation
Previous Property Use:	Rural – Sustainably worked highly arable farmland with soil improvement. Low Limitation
Soil Compaction:	No cracks or compaction observed. Low Limitation
Salinity:	Not observed.
LAA Availability:	Moderate due to intended property use and system size.
Geology:	Sedimentary (Londonderry Group)
Soil Landscape:	Blacktown / Berkshire Park
Geological/Geotech Hazards:	Unknown in this area.
Environmental Areas:	None known. Low Limitation
Ground Water:	Not intersected. Low Limitation
Mains Sewer Potential:	No known plans.
System Access:	Excellent. Low Limitation

3.0 Soil Assessment

3.1 Method

6 Auger Holes were drilled across the site and Land Application Area. Exposed soils from recent service station excavations and Dam wall soils were also studied. Studies and investigations show soil type and profile is to be continuous across the property.

Representative soil samples were taken and sent to an approved NATA laboratory for testing. Test results are listed in Appendix 2.

The site has had numerous soil studies conducted over the previous years for the development of the Service Station. Roberts Resources can confirm agreement to the overall soil type / classification and applicable wastewater loadings (DLR's / DIR's). Two of these reports are included in the Appendices for reference. Appendix 3; Envirotech On-site Wastewater Management Report, August 2018 Reference: REF-18-6400-A1. Appendix 4: Geotechnique Geotechnical Investigation – Wastewater Management, October 2010 Reference: 12337/1-AB.

A soil classification summary log for the drill holes is presented in Table 1. Table 2 outlines any limitations to the site soils for wastewater disoposal by chemical analysis. An overall soil classification summary relating to the soil horizon/s to be utilized in the LAA is shown in Table 3.

With the exception of the Modified Emerson Aggregate Test and low to moderate permeability category, there are no limitations for treated wastewater application to the site. The Modified Emerson Aggregate presents a low to moderate limitation. This limitation is not considered sufficient to cause any adverse effects to the soil and is addressed in Section 4.2 'Land Application Area Disposal Method Design' with the recommended design modifications allowing for this moderate limitation.

It is worth noting; that the wastewater does not include any bacterial, or effluent derived wastewater product and as such will behave more like clean water when passing through soils. Clogging layers, bio mats or other effluent produced adverse effects to soils in Land Application Areas will not develop ensuring soil health and performance is maintained for longer periods than usually expected with effluent derived wastewater. Soils will perform at a higher level from the outset due to the significant difference (cleanliness) in the wastewater product when compared to treated effluent wastewater from either a Primary or Secondary treated classification. We have applied a DLR of 30mm per day as has been used for the existing Treatment Plant that treats all wastewater from the Service Station and McDonald's. In reality a higher DLR could be used for the Car Wash wastewater due to its cleanliness.

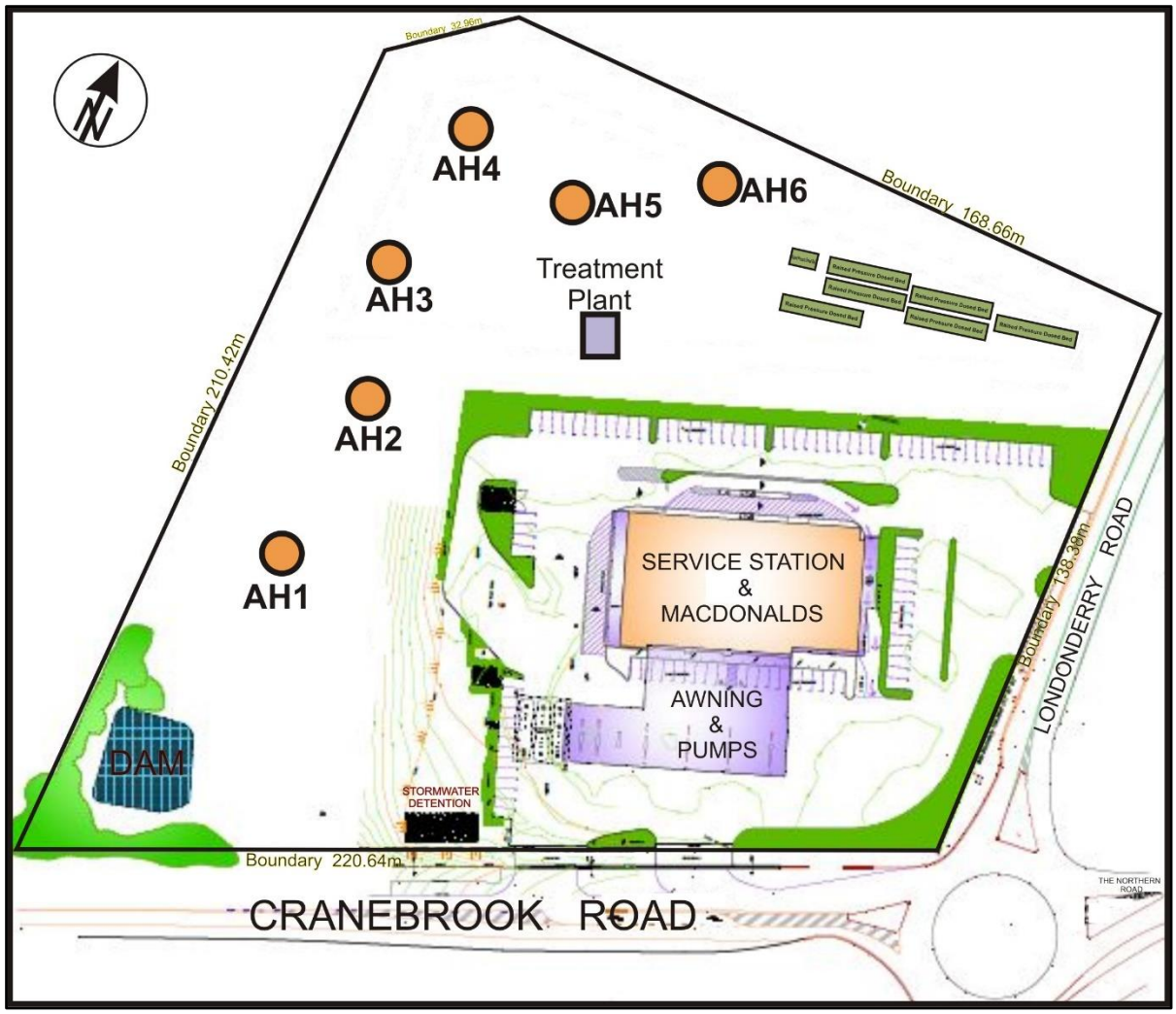


Figure 4: Existing site layout relative to Drill Hole locations

3.2 Soil Classification

Table 1: Soil Classification Log

Layer	Horizon	Test Type	Depth to (mm)	Texture	Moisture	Colour	% Frags	Structure	Consistency	Mottling	Sample Taken	Emerson	PH	EC	Category	Photo	Comment
1	A11	AH	110	LS	D	DB-B	15	S	2	No	Yes	Lab	Lab	Lab	2	Yes	Fill in sth-west zone
2	A12	AH	330	ZL - SL	D	DB-B	15	S	2	No	Yes	Lab	Lab	Lab	2	Yes	Fill in sth-west zone
3	B11	AH	720	SCL - ZL	SM	B	20	S	2	No	Yes	Lab	Lab	Lab	4	Yes	
4	B12	AH	1500	FSC	M	LB	15	S	3	No	Yes	Lab	Lab	Lab	4	Yes	Saprolitic bands / lenses in parts

Table 2: Soil Chemistry Tests and Limitations

Test	Limitiation
Soil Permeability Category	Low - Moderate
Course Fragments (% > 2mm)	Low
Bulk Density	Low
pH CaCl	Low
ph(1:5)	Low
Electrical Conductivity µS/cm	Low
Sodicity (exchangeable sodium percentage)	Low
Cation Exchange Capacity	Low
Emerson Aggregate Test	Low - Moderate
Psorb	Low

Table 3: Soil Classification Summary – Land Application Area

Horizon/s Most Impacted - Utilised in LAA	B11 / B12
Soil Category Adopted	4
Indicative Drainage	Strong / Moderate
Structure	Strong
Texture	Fine Sandy Clay
Indicative Permeability P(m/d) as Ksat	0.5 - 1.5
Recommended DLR (mm/d) (AS/NZS 1547:2012)	30

4.0 System Design and Specifications

4.1 Treatment Plant

Note: The recommended treatment plant below is connected after the recycled water infrastructure and oil-separator. The wastewater entering the treatment plant will only contain water and bio / eco car wash product.

The required minimum daily treatment capacity the Treatment Plant must be capable of processing and treating is 25,000 litres per day, however the recommended system capacity and design capability will process and treat up to 32,000 litres per day. In this way the Treatment Plant does not have to be increased in capacity if the Car Wash operations increase in volume. It should also be noted that should the car wash increase in capacity greater than 32,000 litres per day, then additional tanks can be added sequentially to the recommended.

It should be noted that the disposal area (Raised Pressure Dosed Absorption Beds) has been designed to accommodate 25,000 litres per day maximum and if the operations increase beyond 25,000 litres per day additional Raised Pressure Dosed Absorption Bed/s must be added to the design. A flow meter must be installed and monitored as part of the ongoing maintenance and compliance regime to ensure the car wash is not operating at over capacity.

As there is no biological factor to the wastewater, aeration is not required.

The treatment plant will require a 'multi-tank' treatment system. This will consist of 4 large 10,000 litre concrete tanks, each with 8,000 litres working capacity. Wastewater will flow from Tank 1 to Tank 2, then 3 and finally to Tank 4. Flow between tanks will be passive.

TANK 1: Surge Tank / meshed – Base of tank to be 'v' shaped to encourage dirt and grit to gather in a single location to aid cleaning of the tank. Entire tank to be epoxy coated.

TANK 2: Baffled and meshed – Base of tank to be 'v' shaped to encourage dirt and grit to gather in a single location to aid cleaning of the tank. Entire tank to be epoxy coated.

TANK 3: Baffled and meshed – Base of tank to be 'v' shaped to encourage dirt and grit to gather in a single location to aid cleaning of the tank. Entire tank to be epoxy coated.

TANK 4: Pump Tank – Tank will contain 4 or 5 pumps. Each pump will be assigned 1 or 2 Pressure Dosed Absorption Beds to service (pump to). This way if a pump breaks the other pumps will continue working and pumping to their 'Beds' as normal in the pumping schedule. Pumps will be utilising electronic sequencing. Additionally, if times of peak load occur electronic floats will enable 2 or more pumps to be active at the same time to quickly drop tank volumes. As the pumps are only linked to their individual service beds there is no risk of overloading the Beds' (Land Application Area). Entire tank to be epoxy coated.

Pumps must be set up so they cannot distribute more than the maximum allowable daily wastewater potential of 25,000 litres to the Land Application Area. There are 10 Pressure Dosed Absorption Beds that are connected to the Treatment Plant; each Bed cannot receive more than 2,500 litres of wastewater across a 24-hour period.

Alarms and flashing lights must be fitted to each tank to indicate if the high-water level has been reached or a blockage has occurred.

Immediately after the treated wastewater exits the treatment plant a 100-150-micron filter is installed and as this is a commercial sized system a daily flow meter to record and track daily flow amounts. There should also be a valve or outlet so treated effluent samples can be easily obtained for testing as required.

The system is expected to operate 24 hours per day, 7 days per week and 365 days per year to enable even dosing to the Land Application Area.

Roberts Resources recommends the treatment plant to be an ECONOCYCLE – 4 Concrete Tank System.

It is critical that a flow meter is fitted immediately after the wastewater exits Tank 4 in order to gain 'hard data' on the daily flows occurring at the Car Wash. This way if for any reason the daily loadings are different to the nominated design loadings proactive design changes can be undertaken to ensure the continued sustainability of the On-Site Wastewater Management System.

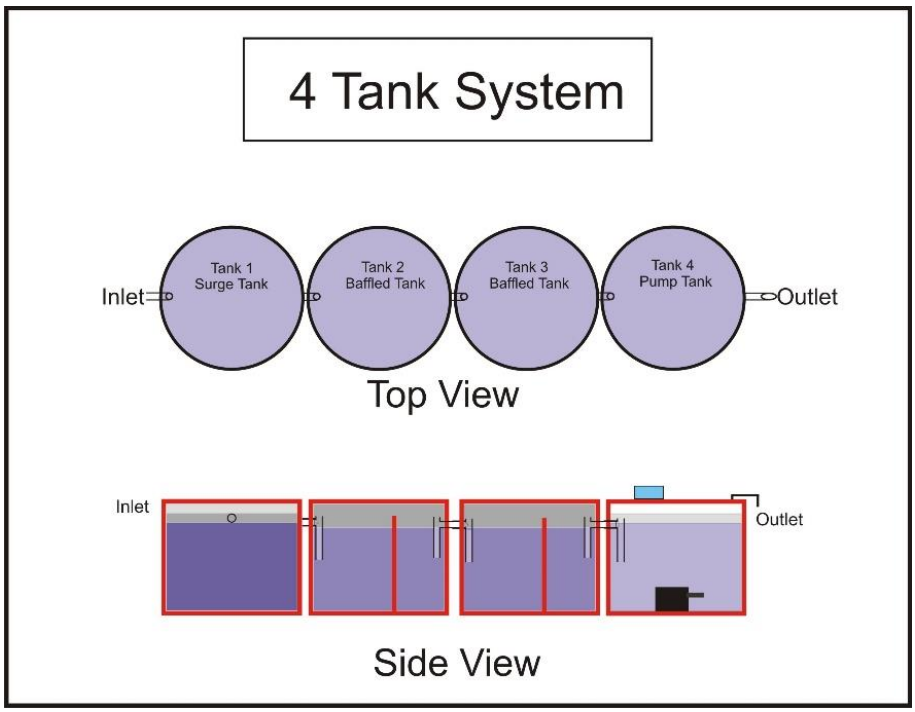


Figure 5: 4 Tank System **(Base diagramme courtesy of Econocycle Pty Ltd)**

4.2 Land Application Area Disposal Method Design

The serviceable life of the Land Application Area (LAA) will be compromised if the prescribed daily calculated design flow of 25,000 litres is exceeded.

Any changes to the proposed Building Envelope, Land Application Areas, Design Sizing Calculations, proposed buildings, prior to or post building and installation will require a re-assessment of this site. Adjustments or changes to the wastewater management system must be reviewed and approved by Roberts Resources.

Due to existing and planned infrastructure, property use and size of the required Land Application Area and 100% Reserve Area, available land for wastewater disposal is extremely limited.

A large size (commercial) Treatment Plant (treating almost 20,000 litres per day) and disposal area utilising 'Raised Pressure Dosed Absorption Beds' are on site. This system services the existing infrastructure which includes a large Service Station and full-size McDonald's. The existing system is working well and the Absorption Beds also performing correctly with no adverse effects noted within the Land Application Area. It is clear that this type of disposal method is well suited to this site's location and site and soil characteristics.

Roberts Resources investigations and studies show that this style of wastewater disposal is appropriate for this site and as such recommend a similar style system to service the Car Wash.

The LAA is best suited to separated fields containing 'Raised - Pressure Dosed Absorption Beds'.

Penrith City Council DCP requires a 100% reserve area available relative to the primary Land Application Area.

The site has sufficient room for a 100% reserve area.

Design Sizing Calculations are provided and tabulated in Table 4.

The Raised Pressure Dosed Absorption Bed specifications are detailed in Table 5 and Figure 6.

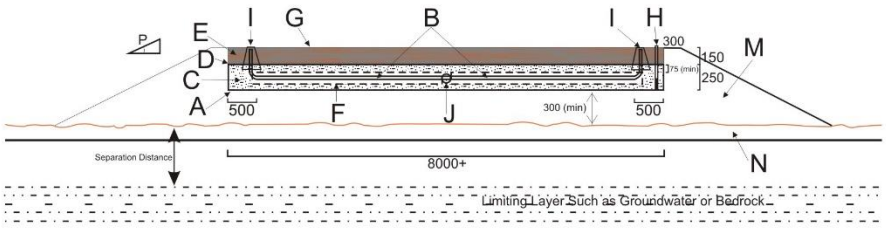
Table 4: Design Sizing Calculation – Raised Pressure Dosed Absorption Bed

	Raised Pressure Dosed Absorption Bed
DLR (mm/day)	30
Design wastewater loading	Reticulated
Design Flow (lt/day)	25000
Total Area Required (m²)	833
Configuration	Ten Raised Pressure Dosed Absorption Beds
	Each Bed 20.83m long and 4.0m wide
	Each Bed Area = 83.32sqm
Reserve Area Required (m²)	833

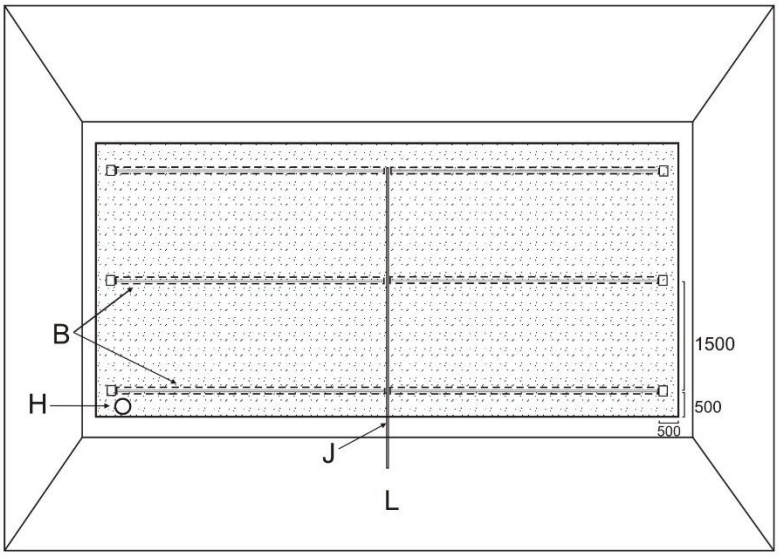
Table 5: System Type and Disposal Method Specifications

Treatment Plant	ECONOCYCLE - 4 Tank System
Wastewater System Circulation and Flow	Passive to Pump: Pump must be capable of delivering the total flow rate required for all laterals whilst providing a 1.5 residual head (i.e. squert height) at the highest oriface (with no more than 10% variation in squirt height across the while bed). For Bed laterals no more than 10m long, it it acceptable to adopt a flow rate of 3.5-4L/min/lineal metre. Total dynamic head (including friction loss) will need to be determined on a site specific basis.
Tank Size (minimum)	Each Tank 10000 litres
Minimum Daily Flow Capability (lt/d)	25000
DLR (mm)	30
Dose Rate	Demand - Sequenced through pumps. Each pump delivers the prescribed daily dose it its nominated bed/s, once that pump has delivered its maximum daily dose the next pump in the sequence switches on and delivers its prescribed daily dose to its nominated bed/s. This sequence continues across the 24 hour period before starting back at pump 1 again the next day to begin the next 24 hours of pumping sequenced schedule.
Disposal Method	Raised Pressure Dosed Absorption Beds
Disposal Area Required (m²)	833
Configuration - Length & Width	Ten Raised Pressure Dosed Absorption Beds at 20.83m long X 4.0m wide (83.32sqm) each
Filter Required	Must be 100-150 micron positioned immediately after final tank outlet - prior to Distribution Pipe
Distribution Pipe - From Tank	90 - 100mm PVC or Polyethylene
Manifold	40mm dosing manifold located through centre of bed / laterals OR testing prior to commissioning may show a different pipe size is required or oriface reducers at lateral connection points
Distribution Laterals in bed	25mm PVC pipe with 3mm holes (debured) at 400mm centres facing upwards. Where a dosing device is used in place of a pump, holes will need to be 4-5mm depending on flow rate achieved. NOTE: WaterNSW manadates that drilling holes within PVC pipe makes them non-compliant with the AS/NZS 3500, as it impacts the structural integrety of the pipe
Lateral Housing	90mm slotted PVC or slotted agricultural pipe over laterals
Lateral distance from bed edges	500mm
Lateral separation distance within bed	1500mm
Absorption Bed Base	Must be level to ensure even distribution of effluent. Levels should be checked with a laser-level
Base	The base of each absorption bed is raised to a height of 300mm above the final ground surface (total bed height is 700mm). Compaction should be minimised when installing the bed. The fill must be a loam to sany loam with minimal clay content
Distribution Aggregate	250mm thick of 20 or 40mm aggregate
Geotextile Cloth Required	Yes - on top of aggregate
Top Soil	Required: 150mm thickness. Must be clean and uniform grade (Sandy Loam to Loam)
Flush Points	Required: Individual flush points for each lateral. May be a screw cap fitting on a 90 degree elbow level with the bed surface or a pressure controlled flush valve (such as those used for subsurface irrigation systems) inside an irrigation control box. Manual flushing should be carried out every 12 months as a minimum
Inspection Ports	Required: on downhill side of bed. Made from 50mm PVC pipe with perforations in the aggregate level of the bed. Must be insect proof.
Total Bed Thickness	Fill, Bed and Top Soil Inclusive: 700mm
Shape	Top of bed surface is mounded to encourage shedding of rainwater. Top Soil tickness installed should also take into consideration settling rates. Additional 100mm of Top Soil may be necessary
Batter	Batter Slope of 1 (vertical) : 3 (horizontal) maximum
Gypsum Required	At maximum application rate for clay on bed base (natural ground surface)
Air Flow Vents Required	Yes (must be insect proof) and can be incorporated into Inspection Ports
System Flush	Flush return line must be incorporated
Field Flush Vale	Required
Non-Return Valves / pressure reducing valves	Required
Air/Vacume Release Valves	Not essential but preferable to have at least one
Filter Flush Valve	Required
Sample Port Required	Yes; must be positioned after final treatment tank and before ETA Bed Manifold
Grass Required	By time of certification and must be heavy water feeder
Upslope Diversion Drains Required	Yes
Hydraulic Capacity	Pump must be sized correctly to deliver required head and flow rate throughout entire bed. Successful testing must be undertaken prior to signoff. This means the system must be run with clean water for a period equivalent to the 'timed dose'. The installer or certifier must document and photograph the process. The entire system must work as required meaning all distribution pipes / laterals are delivering the required flow evenly across all dispribution pipes / laterals at the prescribed dosage for the dose period.
Additional Comments 1	During installation; if any changes in ground conditions are encountered that are different to recorded in this report. Contact Roberts Resources for discussion and further planning prior to finalising the installation
Additional Comments 2	Do not operate machines in trench/bed. This will compact the soil and inhibit efficient trench/bed wokings. Do not construct beds during rain or immediately after rains.
Additional Comments 3	All infrastructure and materials used in the system must comply with all relevant standards and guidelines I.E. they must be effluent quality specific
Additional Comments 4	Test workings of system throughout installation. Make sure pipes are loading and distributing evenly before adding layers and building up bed profiles
Additional Comments 5	Water NSW notes that drilling holes within PVC pipe makes them non-compliant with the AS/NZS 3500 as it impacts the structural integrety of the pipe
Additional Comments 6	Ensure the Beds are not positioned under any canopy of existing or planned trees and roots can not encroach into the Bed area
Additional Comments 7	Fully document all stages of build and infrastructure installation with notes and photographs. This is required for documentation and certification procedure. Installation to be undertaken by appropriately qualified and licensed personnel only.
Additional Comments 8	Pumps and filters must not allow any suspended soilids, materials or particles into main distribution line leading to Bed infrastructure
Additional Comments 9	entire system to be serviced every 3 months minimum
Additional Comments 10	Ensure grass coverage across the bed area to encourage evapotranspiration. Seeding of topsoil (top dressing) recommended yearly followed by oversowing

RAISED PRESSURE DOSED ABSORPTION BED CONSTRUCTION



Cross Section View



Plan View

KEY

A - Base of bed must be level to ensure even distribution of effluent. Base levels should be checked with a laser level.
B - Pressurised dosing laterals consisting of 25mm PVC pipe with 3mm holes (deburred) at 400mm centres facing upwards. It is essential that effluent is distributed evenly across the distribution bed. A residual head (or squirt height) of 1.5m should be achieved across the distribution laterals. The squirt height across the laterals must be tested prior to covering with slotted pipe, with no more than 10% variation in height observed. Consideration must be given to static head and friction loss when sizing pumps. Full hydraulic design must be carried out.
C - 20 to 40mm distribution aggregate.
D - Geotextile filter cloth.
E - Clean local or imported topsoil (sandy loam to loam).
F - 90mm slotted PVC or agricultural pipe over laterals.
G - Grass to be established across the area as soon as possible. Bed surface to be slightly mounded to shed rainwater.
H - Inspection port on downhill side of bed. Made from 50mm PVC pipe with perforations in the aggregate level of the bed.
I - Individual flush points for each lateral. May be a screw cap fitting on a 90 degree elbow level with the bed surface or a pressure controlled flush valve (such as those used for subsurface irrigation systems) inside an irrigation control box.
J - PVC or polyethylene dosing manifold. System may require different pipe sizes / orifice reducers at lateral connection point.
L - Pump dosed wastewater from treatment system (minimum primary treatment with an outlet filter).
M- The base of each absorption bed is to be raised to a height of 300mm above the final ground surface (total bed height 700) Compaction should be minimised when installing the bed. The fill must be loam to sandy loam with minimal clay content.
N - Prepare the site by clearing the ground of all shrubs, regolith, trees and boulders. Stumps to be ground out and backfilled with premium topsoil. Scarify the natural ground/soils across entire basal area to 200mm minimum depth without compacting the ground area in the process. This should extend to at least 1m beyond all perimeters.
P - Batter slope 1 (vertical) : 3 (horizontal) maximum.

Figure 6: Raised pressure Dosed Absorption Bed Design

4.3 Wastewater Management System Location

The location of the nominated Land Application Area (LAA) that will accommodate the Raised Pressure Dosed Absorption Beds is shown in Figure 7.

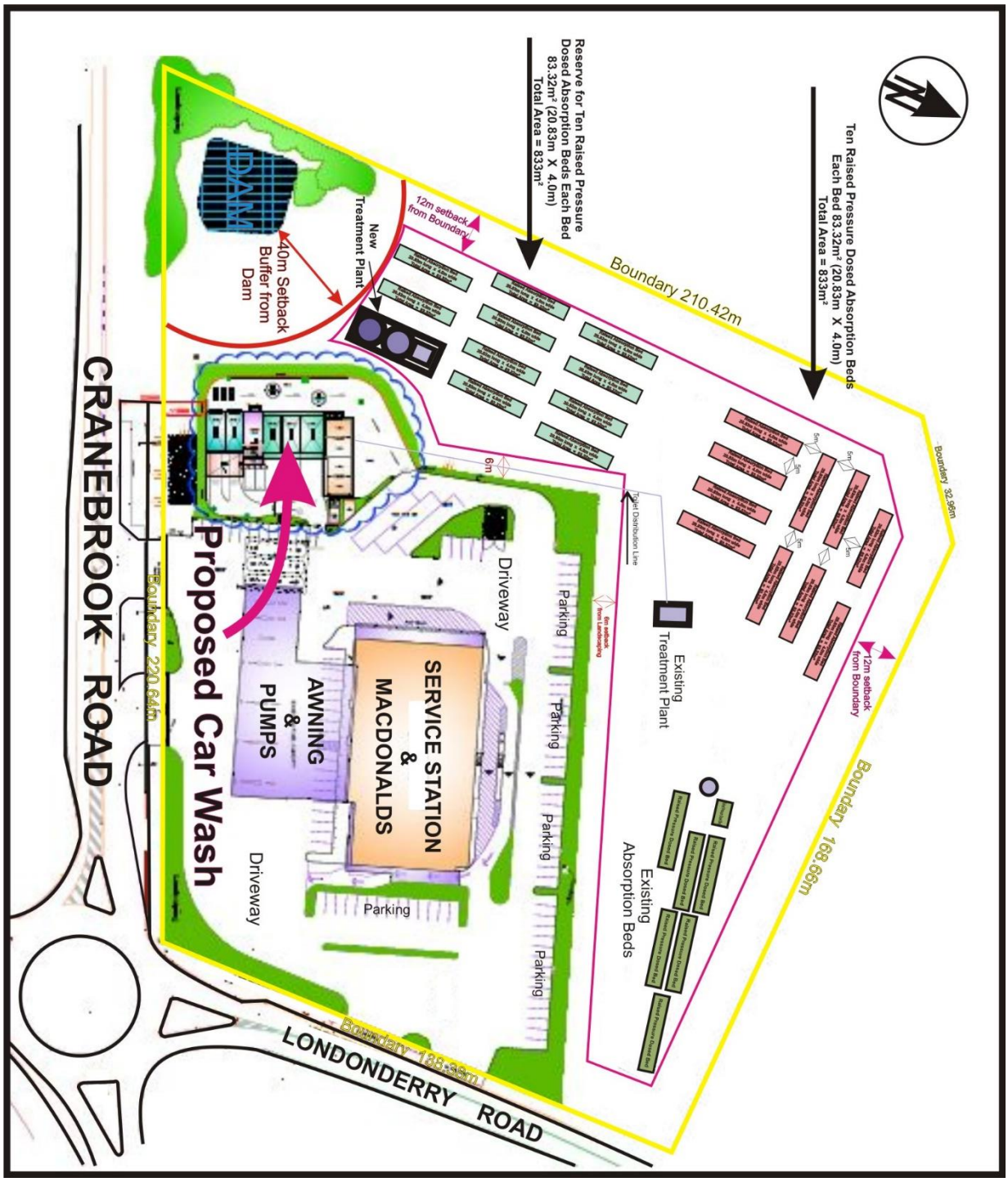


Figure 7: Land Application Area and Site Design

It is proposed in the design calculations that the 10 Raised Pressure Dosed Absorption Beds be designed at a 4.0-meter width and 20.83-meters long with appropriate batter grades on all outer edges.

The ten, 20.83-meter-long, 4.0-meter-wide Bed's will give a total of 833m² disposal area.

Sufficient reserve area is available for an additional 10 Raised Pressure Dosed Absorption Beds with the applicable standoffs and setbacks.

All Bed surfaces to be mounded (150mm minimum) above the adjacent / top bed surface to shed rainwater away from area and inhibit pooling of rainwater on bed surface. Mounding and mounding thickness should also consider potential for short and long-term subsidence affects. It is common that post grassing / vegetating and activation of treated wastewater throughout the bed system the upper mound requires top dressing to reinstate the mound to a suitable thickness and shape.

The site requires an adequately sized retention mound/diversion drain on all upslope areas surrounding the Land Application Area and Treatment Plant infrastructure. This may be constructed as a single large-scale diversion drain or a system of separate diversion drains that achieve the same result.
A diversion drain /s on the up-slope side of the treatment plant must be large enough to stop all potential ingress of rainwater surface flow into the Tank areas. It is recommended that the diversion drain be adequately 'keyed' into the subsoil to reduce the risk of percolation of water under the mound itself and tracking/flowing at the interface of soil horizons or soil/bedrock.

Figure 8 shows the basic design for the Diversion Drain.

It must be noted that the diversion drain construction on this site will be of sufficient size to require conformity to the NSW 'Blue Book'. An erosion and sedimentation control plan is recommended for the construction phase of the On-site wastewater management system.

The Land Application Area is not to be used for any other means and should remain separate from the rest of the property. For example; it should never be driven over and used as a vehicle access path. Warning signs are required around and across the area in order to keep pedestrian traffic off this space. If there is any doubt, the area should be fenced off.

The Land Application Area and Reserve Area are restricted from any other usage, activities and infrastructure. The Reserve Area is expected to have grass covering only and be mowed at regular intervals. It is essentially left as land put aside for wastewater disposal use if required in the future. The Land Application Area must be maintained in keeping with the installers Operational Management Plan and Maintenance Schedule.

Discussion with the installer as to the intended usual use of the area / surrounding area will help establish appropriate distribution pipe depths.

The Land Application Area must at all times remain open to the natural climate, ensuring the required amount of sun and wind is captured. Building on top of or immediately adjacent to this area will lessen the positive effects the sun and wind has on the plants and area itself.

Land Application Area is to be planted with compatible grasses of suitable vegetation by time of certification.

Figure 8 shows the basic design for the Diversion Drain.

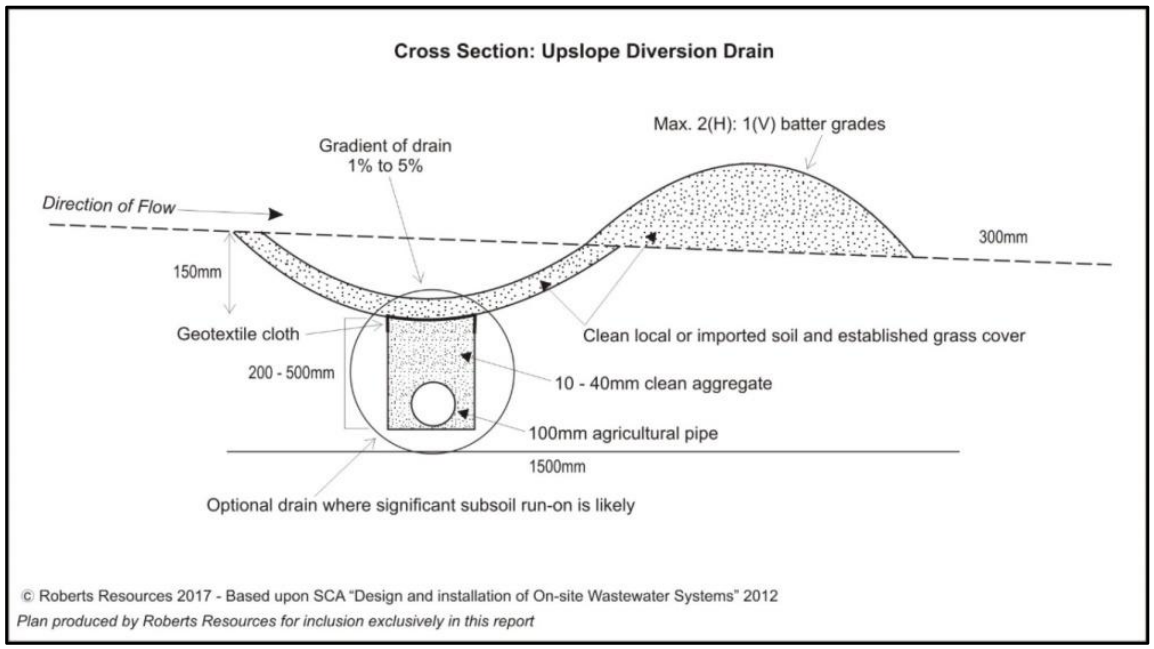


Figure 8: Diversion Drain Design

5.0 Setback Requirements

All regulations and set back requirements can be met on this site. There is no need to encroach into any on-site wastewater infrastructure positioning to either the AS/NZS 1547:2012 or other relevant guidelines or standards.

Table 6: Recommended Setback Distances

SITE FEATURE	SETBACK DISTANCES (m) AS/NZS 1547:2012 Table R1	Comment
Property Boundary	1.5 – 50	-
Buildings / Houses	2.0 - >6.0	-
Surface Water	15 – 100	-
Bore / Well	15 – 50	-
Recreational Areas	3.0 – 15	-
In-ground Water Tank	4.0 – 15	-
Retaining Wall	3.0 or 45° angle from toe of wall	-
Embankments, escarpments, cuttings	3.0 or 45° angle from tow of wall	-
Groundwater	0.6 – 1.5	-
Hardpan or bedrock	0.5 - ≥1.5	-

NOTE: The local government authority may upon considering the public health and environmental risks reduce or increase the distances in the above table.

6.0 Comments and Conclusions

This Wastewater Management Report concludes that it is possible to treat wastewater produced by the proposed Car Wash Facility with on-site disposal to the guidelines, parameters and recommendations stipulated within this report. This can be undertaken in a sustainable and environmentally compliant process.

This site is suitable for an on-site wastewater treatment through an Econocycle Commercial Sized 4-Treatment Tank Plant system utilizing Raised Pressure Dosed Absorption Bed disposal method as detailed in this report.

Treated wastewater disposal must be kept within the nominated Land Application Area.

Design calculations have shown 833m² disposal area is required. Penrith DCP stipulates the same amount of reserve area as the primary disposal area must be available. This site has ample reserve area available and an additional 833m² reserve area shown as Raised Pressure Dosed Absorption Beds.

The Raised Pressure Dosed Absorption Beds designs should remain within the stipulated design configuration, calculations and guidelines detailed in this report.

System installer to provide the system owner with complete instruction manual that demonstrates best practice when owning and maintaining this On-site Wastewater Management System. This will aid the owner to ensure the system operates efficiently, cleanly and reduces risk of overloading and contamination.

A flow meter must be fitted to the treatment plant and flow rates recorded in the servicing schedule and presented to council along with the quarterly servicing records.

This is a commercial sized system and it is expected the system manufacturer and installer provided the system owner with a maintenance schedule for reference and compliance. This should also be help on the Local Council database for this property.

The recommendations included in this report assume that at least three-star plumbing fixtures are used throughout the building.

Regular servicing and maintenance of the system must be adhered too.

It is advised to check the condition of the Treatment Plant and LAA at least monthly for the first 12 months' post installation. It is essential to identify any negative issues prior to them becoming an environmental hazard.

7.0 References

- Australian/New Zealand Standard – On-site domestic wastewater management (AS/NZS 1547:2012)
- NSW Government (Sydney Catchment Authority) Designing and Installing On-site Wastewater Systems "A Sydney Catchment Authority Current Recommended Practice" 2012.
- Penrith City Council Development Control Plan – 'On-Site Sewage Management and Greywater Reuse' 2014
- NSW Government Health: Sewage Management Facility Vessel Accreditation Guideline February 2016
- NSW Health Department: Septic Tank and Collection Well Accreditation Guideline – Part 4, December 2001
- Australian Standard – AS/NZS 1546. 1:2008
- Environment and Health Protection Guidelines 'On-site Sewage Management for Single Households' 1998

Appendix 1

Year 1 **PEAK DAY EXPECTED 100% CAPACITY; Use rates -v- Time of Day**

	Auto Wash Bay*	Self-Serve Wash	Toilet, Sink, Basin	Total System Capacity	Discharge Capacity	Holding Tank Storage	Water Supply (L/sec)	Water Demand	Water Storage
	120 L/wash	70 L/wash	27L/day	(L/hr)	(L/hr)	(L)		(L/sec)	(L/sec)
1am				0	1,200			0.00	0
2am				0	1,200			0.00	0
3am				0	1,200			0.00	0
4am	1			120	1,200			0.03	0
5am	2	1		310	1,200			0.09	0
6am	3	2		500	1,200			0.14	0
7am	5	2		740	1,200			0.21	0
8am	7	3		1050	1,200			0.29	0
9am	9	5		1430	1,200	230		0.40	0
10am	12	8		2000	1,200	1,030		0.56	1
11am	15	10		2500	1,200	2,330		0.69	1
12pm	12	9	1	2070	1,200	3,200		0.58	1
1pm	11	8		1880	1,200	3,880		0.52	1
2pm	9	7		1570	1,200	4,250		0.44	0
3pm	7	6		1260	1,200	4,310		0.35	0
4pm	7	3		1050	1,200	4,160		0.29	0
5pm	5	2		740	1,200	3,700		0.21	0
6pm	4	1		550	1,200	3,050		0.15	0
7pm	3	1		430	1,200	2,280		0.12	0
8pm	2	1		310	1,200	1,390		0.09	0
9pm	2	1		310	1,200	500		0.09	0
10pm	2			240	1,200	-460		0.07	0
11pm	1			120	1,200	-1,540		0.03	0
12pm	1			120	1,200	-2,620		0.03	0
Wash Total	120	70	1	18870	22,800	29,690	0.00	5.36	5.36

* With Recycling 70%, Reducing the water usage from 400L/wash to 120L/wash

Year 2-3 **PEAK DAY EXPECTED 100% CAPACITY; Use rates -v- Time of Day**

	Auto Wash Bay*	Self-Serve Wash	Toilet, Sink, Basin	Total System Capacity	Discharge Capacity	Holding Tank Storage	Water Supply (L/sec)	Water Demand	Water Storage
	120 L/wash	70 L/wash	27L/day	(L/hr)	(L/hr)	(L)		(L/sec)	(L/sec)
1am				0	1,200			0.00	0
2am				0	1,200			0.00	0
3am				0	1,200			0.00	0
4am	1			120	1,200			0.03	0
5am	2	1		310	1,200			0.09	0
6am	3	2		500	1,200			0.14	0
7am	5	2		740	1,200			0.21	0
8am	7	3		1050	1,200			0.29	0
9am	8	6		1380	1,200	180		0.38	0
10am	13	9		2190	1,200	1,170		0.61	1
11am	16	10		2620	1,200	2,590		0.73	1
12pm	18	10	1	2860	1,200	4,250		0.79	1
1pm	15	10		2500	1,200	5,550		0.69	1
2pm	11	9		1950	1,200	6,300		0.54	1
3pm	11	7		1810	1,200	6,910		0.50	1
4pm	10	4		1480	1,200	7,190		0.41	0
5pm	5	3		810	1,200	6,800		0.23	0
6pm	4	1		550	1,200	6,150		0.15	0
7pm	3	1		430	1,200	5,380		0.12	0
8pm	2	1		310	1,200	4,490		0.09	0
9pm	2	1		310	1,200	3,600		0.09	0
10pm	2			240	1,200	2,640		0.07	0
11pm	1			120	1,200	1,560		0.03	0
12pm	1			120	1,200	480		0.03	0
Wash Total	140	80	1	21970	22,800	65,240	0.00	6.22	6.22

* With Recycling 70%, Reducing the water usage from 400L/wash to 120L/wash

Year 3+ **PEAK DAY EXPECTED 130% CAPACITY; Use rates -v- Time of Day**

	Auto Wash Bay*	Self-Serve Wash	Toilet, Sink, Basin	Total System Capacity	Discharge Capacity (L)	Holding Tank Storage	Water Supply (L/sec)	Water Demand	Water Storage
	120 L/wash	70 L/wash	27L/day	(L)		(L)		(L/sec)	(L/sec)
1am				0	1,200	1,530		0.00	0
2am				0	1,200	330		0.00	0
3am				0	1,200	-870		0.00	0
4am	1			120	1,200			0.03	0
5am	2	1		310	1,200			0.09	0
6am	3	2		500	1,200			0.14	0
7am	5	2		740	1,200			0.21	0
8am	8	3		1170	1,200	-30		0.33	0
9am	11	6		1740	1,200	510		0.48	0
10am	14	9		2310	1,200	1,620		0.64	1
11am	18	10		2860	1,200	3,280		0.79	1
12pm	18	10	1	2860	1,200	4,940		0.79	1
1pm	18	10		2860	1,200	6,600		0.79	1
2pm	12	9		2070	1,200	7,470		0.58	1
3pm	12	7		1930	1,200	8,200		0.54	1
4pm	12	4		1720	1,200	8,720		0.48	0
5pm	8	3		1170	1,200	8,690		0.33	0
6pm	6	1		790	1,200	8,280		0.22	0
7pm	4	1		550	1,200	7,630		0.15	0
8pm	2	1		310	1,200	6,740		0.09	0
9pm	2	1		310	1,200	5,850		0.09	0
10pm	2			240	1,200	4,890		0.07	0
11pm	1			120	1,200	3,810		0.03	0
12pm	1			120	1,200	2,730		0.03	0
Wash Total	160	80	1	24370	22,800	90,920	0.00	6.89	6.89

* With Recycling 70%, Reducing the water usage from 400L/wash to 120L/wash

Appendix 2

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: EW2005379	Page	: 1 of 6
Client	: ROBERT RESOURCES	Laboratory	: Environmental Division NSW South Coast
Contact	: MR DAVE ROBERTS	Contact	: Glenn Davies
Address	: PO BOX 558 MITTAGONG 2575	Address	: 1/19 Ralph Black Dr, North Wollongong 2500 4/13 Geary Pl, North Nowra 2541 Australia NSW Australia
Telephone	: ---	Telephone	: 02 42253125
Project	: X ROADS CRANEBROOK	Date Samples Received	: 27-Nov-2020 12:58
Order number	: ---	Date Analysis Commenced	: 29-Nov-2020
C-O-C number	: ---	Issue Date	: 08-Dec-2020 19:15
Sampler	: DAVE ROBERTS		
Site	: ---		
Quote number	: EN/333		
No. of samples received	: 7		
No. of samples analysed	: 7		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Dian Dao	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

RIGHT SOLUTIONS | RIGHT PARTNER

ALS

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **Analytical work for this work order will be conducted at ALS Sydney.**
- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity ($H^+ + Al^{3+}$).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	AH1 - 1	AH2 - 3	AH3 - 4	AH4 - 6	AH5 - 8
			Sampling date / time	27-Nov-2020 00:00	27-Nov-2020 00:00	27-Nov-2020 00:00	27-Nov-2020 00:00	27-Nov-2020 00:00
Compound	CAS Number	LOR	Unit	EW2005379-001	EW2005379-002	EW2005379-003	EW2005379-004	EW2005379-005
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	---	0.1	pH Unit	6.0	6.4	6.2	6.3	6.4
EA002: pH 1:5 (Soils)								
pH Value	---	0.1	pH Unit	6.3	6.8	6.6	6.5	6.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	---	1	µS/cm	283	214	220	302	147
EA058: Emerson Aggregate Test								
Color (Munsell)	---	-	-	Yellowish Brown (10YR 5/4)	Yellowish Brown (10YR 5/4)	Brown (10YR 4/3)	Yellowish Brown (10YR 5/4)	Yellowish Brown (10YR 5/4)
Texture	---	-	-	Medium Heavy Clay	Light Clay	Medium Clay	Medium Heavy Clay	Medium Clay
Emerson Class Number	EC/TC	-	-	4	2	4	2	4
ED007: Exchangeable Cations								
Exchangeable Calcium	---	0.1	meq/100g	3.8	2.2	4.6	---	3.8
Exchangeable Magnesium	---	0.1	meq/100g	9.8	3.0	6.0	---	7.2
Exchangeable Potassium	---	0.1	meq/100g	0.3	0.3	0.6	---	0.7
Exchangeable Sodium	---	0.1	meq/100g	1.2	0.9	0.9	---	1.1
Cation Exchange Capacity	---	0.1	meq/100g	15.1	6.4	12.2	---	12.5
Exchangeable Aluminium	---	0.1	meq/100g	<0.1	<0.1	<0.1	---	<0.1
Exchangeable Sodium Percent	---	0.1	%	8.1	14.3	7.6	---	8.5
Exchangeable Magnesium Percent	---	0.1	%	66.2	48.1	48.4	---	57.4
Exchangeable Potassium Percent	---	0.1	%	1.8	4.7	5.1	---	5.5
Exchangeable Calcium Percent	---	0.1	%	24.8	34.9	37.9	---	28.8
Calcium/Magnesium Ratio	---	0.1	-	0.4	0.7	0.8	---	0.5
Magnesium/Potassium Ratio	---	0.1	-	36.3	9.9	9.6	---	10.4
ED008: Exchangeable Cations								
Exchangeable Calcium	---	0.1	meq/100g	---	---	---	8.5	---
Exchangeable Magnesium	---	0.1	meq/100g	---	---	---	3.4	---
Exchangeable Potassium	---	0.1	meq/100g	---	---	---	0.8	---
Exchangeable Sodium	---	0.1	meq/100g	---	---	---	0.2	---
Exchangeable Aluminium	---	0.1	meq/100g	---	---	---	<0.1	---
Cation Exchange Capacity	---	0.1	meq/100g	---	---	---	10.8	---
Exchangeable Calcium Percent	---	0.1	%	---	---	---	59.7	---
Exchangeable Magnesium Percent	---	0.1	%	---	---	---	31.6	---
Exchangeable Potassium Percent	---	0.1	%	---	---	---	7.3	---
Exchangeable Sodium Percent	---	0.1	%	---	---	---	1.5	---

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	AH1 - 1	AH2 - 3	AH3 - 4	AH4 - 6	AH5 - 8
			Sampling date / time	27-Nov-2020 00:00	27-Nov-2020 00:00	27-Nov-2020 00:00	27-Nov-2020 00:00	27-Nov-2020 00:00
Compound	CAS Number	LOR	Unit	EW2005379-001	EW2005379-002	EW2005379-003	EW2005379-004	EW2005379-005
				Result	Result	Result	Result	Result
ED008: Exchangeable Cations - Continued								
Exchangeable Aluminium Percent	---	0.1	%	---	---	---	<0.1	---
Calcium/Magnesium Ratio	---	0.1	-	---	---	---	1.9	---
Magnesium/Potassium Ratio	---	0.1	-	---	---	---	4.8	---
EK072: Phosphate Sorption Capacity								
Phosphate Sorption Capacity	---	250	mg P sorbed/kg	1380	1240	1640	2080	1900

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	AH5 - 9	AH6 - 11	---	---	---
			Sampling date / time	27-Nov-2020 00:00	27-Nov-2020 00:00	---	---	---
Compound	CAS Number	LOR	Unit	EW2006378-006	EW2006378-007	----	----	----
				Result	Result	---	---	---
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	---	0.1	pH Unit	6.9	6.6	---	---	---
EA002: pH 1:5 (Soils)								
pH Value	---	0.1	pH Unit	6.3	6.8	---	---	---
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	---	1	µS/cm	194	383	---	---	---
EA058: Emerson Aggregate Test								
Color (Munsell)	---	-	-	Light Olive Brown (2.5Y 5/4)	Yellowish Brown (10YR 5/4)	---	---	---
Texture	---	-	-	Medium Clay	Medium Heavy Clay	---	---	---
Emerson Class Number	EC/TC	-	-	2	2	---	---	---
ED007: Exchangeable Cations								
Exchangeable Calcium	---	0.1	meq/100g	0.7	---	---	---	---
Exchangeable Magnesium	---	0.1	meq/100g	10.1	---	---	---	---
Exchangeable Potassium	---	0.1	meq/100g	0.3	---	---	---	---
Exchangeable Sodium	---	0.1	meq/100g	2.3	---	---	---	---
Cation Exchange Capacity	---	0.1	meq/100g	13.3	---	---	---	---
Exchangeable Aluminium	---	0.1	meq/100g	<0.1	---	---	---	---
Exchangeable Sodium Percent	---	0.1	%	17.1	---	---	---	---
Exchangeable Magnesium Percent	---	0.1	%	75.8	---	---	---	---
Exchangeable Potassium Percent	---	0.1	%	2.2	---	---	---	---
Exchangeable Calcium Percent	---	0.1	%	5.0	---	---	---	---
Calcium/Magnesium Ratio	---	0.1	-	<0.1	---	---	---	---
Magnesium/Potassium Ratio	---	0.1	-	34.8	---	---	---	---
ED008: Exchangeable Cations								
Exchangeable Calcium	---	0.1	meq/100g	----	4.0	---	---	---
Exchangeable Magnesium	---	0.1	meq/100g	----	8.1	---	---	---
Exchangeable Potassium	---	0.1	meq/100g	----	0.4	---	---	---
Exchangeable Sodium	---	0.1	meq/100g	----	0.4	---	---	---
Exchangeable Aluminium	---	0.1	meq/100g	----	<0.1	---	---	---
Cation Exchange Capacity	---	0.1	meq/100g	----	13.0	---	---	---
Exchangeable Calcium Percent	---	0.1	%	----	30.7	---	---	---
Exchangeable Magnesium Percent	---	0.1	%	----	62.6	---	---	---
Exchangeable Potassium Percent	---	0.1	%	----	3.6	---	---	---
Exchangeable Sodium Percent	---	0.1	%	----	3.2	---	---	---

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	AH5 - 9	AH6 - 11	---	---	---
			Sampling date / time	27-Nov-2020 00:00	27-Nov-2020 00:00	---	---	---
Compound	CAS Number	LOR	Unit	EW2006378-006	EW2006378-007	----	----	----
				Result	Result	---	---	---
ED008: Exchangeable Cations - Continued								
Exchangeable Aluminium Percent	---	0.1	%	----	<0.1	---	---	---
Calcium/Magnesium Ratio	---	0.1	-	----	0.5	---	---	---
Magnesium/Potassium Ratio	---	0.1	-	----	18.0	---	---	---
EK072: Phosphate Sorption Capacity								
Phosphate Sorption Capacity	---	250	mg P sorbed/kg	1110	1400	---	---	---

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: EW2005379	Page	: 1 of 4
Client	: ROBERT RESOURCES	Laboratory	: Environmental Division NSW South Coast
Contact	: MR DAVE ROBERTS	Contact	: Glenn Davies
Address	: PO BOX 558 MITTAGONG 2575	Address	: 1/19 Ralph Black Dr, North Wollongong 2500 4/13 Geary Pl, North Nowra 2541 Australia NSW Australia
Telephone	: ---	Telephone	: 02 42253125
Project	: X ROADS CRANEBROOK	Date Samples Received	: 27-Nov-2020
Order number	: ---	Date Analysis Commenced	: 29-Nov-2020
C-O-C number	: ---	Issue Date	: 08-Dec-2020
Sampler	: DAVE ROBERTS		
Site	: ---		
Quote number	: EN/333		
No. of samples received	: 7		
No. of samples analysed	: 7		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Dian Dao	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

ALS

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: SOIL

						Laboratory Duplicate (DUP) Report			
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 3400117)									
E02041819-001	Anonymous	EA001: pH (CaCl2)	---	0.1	pH Unit	7.8	7.7	1.41	0% - 20%
E02042178-078	Anonymous	EA001: pH (CaCl2)	---	0.1	pH Unit	8.1	8.0	0.00	0% - 20%
EA002: pH 1:5 (Soils) (QC Lot: 3395123)									
EW2005379-003	AH3 - 4	EA002: pH Value	---	0.1	pH Unit	6.6	6.6	0.00	0% - 20%
E02042178-078	Anonymous	EA002: pH Value	---	0.1	pH Unit	8.7	8.7	0.00	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 3395124)									
E02042178-078	Anonymous	EA010: Electrical Conductivity @ 25°C	---	1	µS/cm	557	586	5.07	0% - 20%
ME2001868-006	Anonymous	EA010: Electrical Conductivity @ 25°C	---	1	µS/cm	11	11	0.00	0% - 50%
ED007: Exchangeable Cations (QC Lot: 3402780)									
EW2005379-001	AH1 - 1	ED007: Calcium/Magnesium Ratio	---	0.1	-	0.4	0.4	0.00	No Limit
		ED007: Magnesium/Potassium Ratio	---	0.1	-	35.3	35.4	0.00	0% - 20%
		ED007: Exchangeable Calcium Percent	---	0.1	%	24.8	24.9	0.00	0% - 20%
		ED007: Exchangeable Magnesium Percent	---	0.1	%	65.2	65.2	0.00	0% - 20%
		ED007: Exchangeable Potassium Percent	---	0.1	%	1.8	1.8	0.00	0% - 50%
		ED007: Exchangeable Sodium Percent	---	0.1	%	8.1	8.1	0.00	0% - 20%
		ED007: Exchangeable Calcium	---	0.1	meq/100g	3.8	3.8	0.00	0% - 20%
		ED007: Exchangeable Magnesium	---	0.1	meq/100g	9.8	9.9	1.08	0% - 20%
		ED007: Exchangeable Potassium	---	0.1	meq/100g	0.3	0.3	0.00	No Limit
		ED007: Exchangeable Sodium	---	0.1	meq/100g	1.2	1.2	0.00	0% - 50%
		ED007: Cation Exchange Capacity	---	0.1	meq/100g	15.1	15.2	1.12	0% - 20%
		ED007: Exchangeable Aluminium	---	0.1	meq/100g	<0.1	<0.1	0.00	No Limit
ED008: Exchangeable Cations (QC Lot: 3405223)									
EW2005379-004	AH4 - 6	ED008: Calcium/Magnesium Ratio	---	0.1	-	1.9	1.9	0.00	0% - 20%
		ED008: Magnesium/Potassium Ratio	---	0.1	-	4.3	4.3	0.00	0% - 20%

Sub-Matrix: SOIL

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Laboratory Duplicate (DUP) Report: Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED008: Exchangeable Cations (QC Lot: 3405223) - continued									
EW2005379-004	AH4 - 6	ED008: Exchangeable Sodium Percent	---	0.1	%	1.5	1.5	0.00	0% - 20%
		ED008: Exchangeable Calcium	---	0.1	meq/100g	6.5	6.5	0.00	0% - 20%
		ED008: Exchangeable Magnesium	---	0.1	meq/100g	3.4	3.4	0.00	0% - 20%
		ED008: Exchangeable Potassium	---	0.1	meq/100g	0.8	0.8	0.00	0% - 20%
		ED008: Exchangeable Sodium	---	0.1	meq/100g	0.2	0.2	0.00	0% - 20%
		ED008: Exchangeable Aluminium	---	0.1	meq/100g	<0.1	<0.1	0.00	0% - 20%
		ED008: Cation Exchange Capacity	---	0.1	meq/100g	10.8	10.9	0.00	0% - 20%
EK072: Phosphate Sorption Capacity (QC Lot: 3390565)									
EW2005379-001	AH1 - 1	EK072: Phosphate Sorption Capacity	---	250	mg P sorbed/kg	1380	1500	8.16	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: SOIL

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EA010: Conductivity (1:5) (QCLot: 3395124)								
EA010: Electrical Conductivity @ 25°C	---	1	µS/cm	<1	1412 µS/cm	100	92.0	108
ED007: Exchangeable Cations (QCLot: 3402780)								
ED007: Exchangeable Calcium	---	0.1	meq/100g	<0.1	1 meq/100g	102	75.8	120
ED007: Exchangeable Magnesium	---	0.1	meq/100g	<0.1	1.67 meq/100g	105	74.9	115
ED007: Exchangeable Potassium	---	0.1	meq/100g	<0.1	0.51 meq/100g	108	80.0	120
ED007: Exchangeable Sodium	---	0.1	meq/100g	<0.1	0.87 meq/100g	109	80.0	120
ED007: Cation Exchange Capacity	---	0.1	meq/100g	<0.1	---	---	---	---
ED007: Exchangeable Aluminium	---	0.1	meq/100g	<0.1	---	---	---	---
ED007: Exchangeable Calcium Percent	---	0.1	%	<0.1	---	---	---	---
ED007: Exchangeable Magnesium Percent	---	0.1	%	<0.1	---	---	---	---
ED007: Exchangeable Potassium Percent	---	0.1	%	<0.1	---	---	---	---
ED007: Exchangeable Sodium Percent	---	0.1	%	<0.1	---	---	---	---
ED007: Calcium/Magnesium Ratio	---	0.1	-	<0.1	---	---	---	---
ED007: Magnesium/Potassium Ratio	---	0.1	-	<0.1	---	---	---	---
ED008: Exchangeable Cations (QCLot: 3405223)								
ED008: Exchangeable Calcium	---	0.1	meq/100g	<0.1	1 meq/100g	106	82.0	128
ED008: Exchangeable Magnesium	---	0.1	meq/100g	<0.1	1.67 meq/100g	101	82.0	120
ED008: Exchangeable Potassium	---	0.1	meq/100g	<0.1	0.51 meq/100g	104	70.0	140
ED008: Exchangeable Sodium	---	0.1	meq/100g	<0.1	0.87 meq/100g	106	78.0	136
ED008: Exchangeable Aluminium	---	0.1	meq/100g	<0.1	---	---	---	---
ED008: Exchangeable Sodium Percent	---	0.1	%	<0.1	---	---	---	---
ED008: Calcium/Magnesium Ratio	---	0.1	-	<0.1	---	---	---	---
ED008: Magnesium/Potassium Ratio	---	0.1	-	<0.1	---	---	---	---
ED008: Cation Exchange Capacity	---	0.1	meq/100g	<0.1	---	---	---	---

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EW2005379	Page	: 1 of 5
Client	: ROBERT RESOURCES	Laboratory	: Environmental Division NSW South Coast
Contact	: MR DAVE ROBERTS	Telephone	: 02 42253125
Project	: X ROADS CRANEBROOK	Date Samples Received	: 27-Nov-2020
Site	: ---	Issue Date	: 08-Dec-2020
Sampler	: DAVE ROBERTS	No. of samples received	: 7
Order number	: ---	No. of samples analysed	: 7

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- NO Method Blank value outliers occur.
- NO Duplicate outliers occur.
- NO Laboratory Control outliers occur.
- NO Matrix Spike outliers occur.
- For all regular sample matrices, NO surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- NO Quality Control Sample Frequency Outliers exist.

Outliers : Analysis Holding Time Compliance

Matrix: SOIL

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA002: pH 1:5 (Soils)						
Snap Look Bag AH1 - 1, AH2 - 3, AH3 - 4, AH4 - 6, AH5 - 8, AH5 - 9, AH6 - 11	---	---	---	03-Dec-2020	02-Dec-2020	1

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: SOIL

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA001: pH in soil using 0.01M CaCl extract							
Snap Look Bag (EA001) AH1 - 1, AH2 - 3, AH3 - 4, AH4 - 6, AH5 - 8, AH5 - 9, AH6 - 11	27-Nov-2020	03-Dec-2020	04-Dec-2020	✓	03-Dec-2020	03-Dec-2020	✓
EA002: pH 1:5 (Soils)							
Snap Look Bag (EA002) AH1 - 1, AH2 - 3, AH3 - 4, AH4 - 6, AH5 - 8, AH5 - 9, AH6 - 11	27-Nov-2020	01-Dec-2020	04-Dec-2020	✓	03-Dec-2020	02-Dec-2020	×
EA010: Conductivity (1:5)							
Snap Look Bag (EA010) AH1 - 1, AH2 - 3, AH3 - 4, AH4 - 6, AH5 - 8, AH5 - 9, AH6 - 11	27-Nov-2020	01-Dec-2020	04-Dec-2020	✓	03-Dec-2020	29-Dec-2020	✓

Matrix: SOIL — Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA058: Emerson Aggregate Test								
Snap Lock Bag (EA058)								
AH1 - 1, AH3 - 4, AH5 - 8, AH6 - 11	AH2 - 3, AH4 - 6, AH5 - 9,	27-Nov-2020	—	—	—	02-Dec-2020	26-May-2021	✓
ED007: Exchangeable Cations								
Snap Lock Bag (ED007)								
AH1 - 1, AH3 - 4, AH5 - 9	AH2 - 3, AH5 - 8,	27-Nov-2020	04-Dec-2020	25-Dec-2020	✓	04-Dec-2020	25-Dec-2020	✓
ED008: Exchangeable Cations								
Snap Lock Bag (ED008)								
AH4 - 6,	AH6 - 11	27-Nov-2020	07-Dec-2020	25-Dec-2020	✓	07-Dec-2020	25-Dec-2020	✓
EK072: Phosphate Sorption Capacity								
Snap Lock Bag (EK072)								
AH1 - 1, AH3 - 4, AH5 - 8, AH6 - 11	AH2 - 3, AH4 - 6, AH5 - 9,	27-Nov-2020	—	—	—	29-Nov-2020	26-May-2021	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was/were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: SOIL — Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type / Analytical Methods	Method	Count: QC	Count: Regular	Rate (%): Actual	Rate (%): Expected	Evaluation	Quality Control Specification
Laboratory Duplicates (DUP)							
Electrical Conductivity (1:5)	EA010	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	5	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	1	2	50.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
P Sorption Index & P Sorption Capacity	EK072	1	7	14.28	10.00	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Electrical Conductivity (1:5)	EA010	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Electrical Conductivity (1:5)	EA010	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Lyons 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
pH (1:5)	EA002	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Emerson Aggregate Test	EA058	SOIL	In house: Referenced to AS1289.3.8.1. Testing is performed only on soils with suitable aggregates; sands and gravels are usually unsuitable for this test. The test classifies the behaviour of soil aggregates, when immersed, on their coherence in water.
Exchangeable Cations	ED007	SOIL	In house: Referenced to Rayment & Lyons Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations with pre-treatment	ED008	SOIL	In house: Referenced to Rayment & Lyons Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
P Sorption Index & P Sorption Capacity	EK072	SOIL	In house: Referenced to Rayment & Lyons Method 9H1 & 9I1. Soil is bought to equilibrium with a solution of P at known concentration. P absorbed, released is determined by FIA analysis of the final solution.

Preparation Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Lyons 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Lyons method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

Appendix 3

envirotech
Environmental and Engineering
Consultancy Services

PO Box 3088 East Bayland NSW 2774
P: 1300 888 324 F: 02 4739 3394
W: www.envirotech.com.au
E: info@envirotech.com.au

'ON-SITE WASTEWATER MANAGEMENT REPORT'

For:

1-21 CRANEBROOK ROAD, CRANEBROOK NSW 2749

CLIENT: Jim Siarakas

REFERENCE: REF-18-6400-A1

DATE: 14 August 2018

[redacted]

Alvi Syed BE (Civil) (Hons.)
Civil Engineer (U)
ENVIROTECH PTY. LTD.

Simon Doberer BS(Env)
Environmental Scientist – Team Leader
ENVIROTECH PTY. LTD.

Document Management				
Version	Date	Author	Reviewed	Author
A	11-July-18	AS	11-July-18	SD
A1	14-August-18	AS	14-August-18	SD

TABLE OF CONTENTS

INTRODUCTION

EnviroTech Pty. Ltd. has been engaged by the client to undertake an 'onsite wastewater management study' at the above mentioned site address. This report presents the results of that study.

Objective

The objective of the 'onsite wastewater management study' is to investigate the relevant site, soil, public health and economic factors that can impact on the selection, location and design of an on-site wastewater management system to determine:

- Whether or not the site is suitable for an on-site wastewater management system
- The best practical on-site wastewater management system for the specific site and proposed development.

This study has been prepared in accordance with:

- Australian Standard AS1547: 2012" On-site Domestic Wastewater Management"
- Dept. Local Government 1998, On-site Sewage Management for Single Households,
- Relevant Council Development Control Policies

Scope of Works

The scope of works undertaken for this site evaluation included:

- *Desktop Study:* An initial investigation to collate relevant information about the site and proposed development prior to the site inspection.
- *Site Assessment:* An on-site inspection by an engineer or scientist to record land surface, site features, identify potential site constraints and define the most appropriate land application area.
- *Soil Assessment:* A subsoil investigation by an engineer or scientist to record the soil profile and relevant soil properties within the land application area to determine potential soil limitations.
- *System Design:* An evaluation of the expected wastewater flowrate, site and soil limitations to select, size and position a waste treatment unit and land application system that will provide the best practical option.
- *Operation & Maintenance / Construction & Installation Guidelines*

DESKTOP INFORMATION

Address	1-21 Cranebrook Road, Cranebrook
Council	Penrith
Proposed Development	*Service Station Developments*
Intended Water Supply Source	*Town Water*
Equivalent Population (Proposed Residence)	*6 people (3 bed rooms)*
Design Wastewater Flowrate	McDonalds Restaurant: • *12,000L/Day* *First Floor Residence* • *1500L/Day* IGA Supermarkets: • *2000L/Day* *Petrol Station Facility:* • *1000L/Day* *Petrol Station Facility:* • *1000L/Day*
Rainfall Station	067113- Penrith Lakes AWS
Evaporation Station	067113- PENRITH LAKES AWS

*flowrate design utilized Burgess, Arnott and Grava within Appendix B.

5

SITE ASSESSMENT

This following relevant site features were recorded and given a rating in terms of their potential constraints to onsite wastewater management. The three ratings are minor limitation, moderate limitation or major limitation. Only those site features that are rated as being a major limitation to onsite wastewater management are further discussed in the 'Site Assessment Discussion'.

Landform Description

The landform is described by first dividing an area into landform elements of approximately 40-m diameter. A description of these elements is then provided. These landform elements define the boundaries of this site assessment.

Element	*Approx. Slope Tangent (%)*	*Slope Class*	*Morphological Type*	*Relative Inclination*		*Instability Risk*
1	0.8	Very Gently Inclined	Flat	Waxing	Divergent	1

Vegetation

The vegetation is described by dividing the study area into vegetation elements. Each vegetation element has a unique set of properties.

Element	*Growth Form*	*Height Class*	*Cover Class*	*Structural Formation*
A	Grass	Low	Mid-dense	Closed Grassland

Element	*Exposure*	*Existing Erosion*		*Landform Element (s)*
		State	*Type*	
A	Excellent	Stabilised	-	1

6

Overland Flow

Run-on and run-off potential is largely determined by slope, surface cover and soil infiltration rate.

Landform element.	*Run-on*	*Run-off*	*Soil - Water Status*
1	Slow	Slow	Dry

Site & Soil Disturbance

The site assessor noted the following disturbance within the effluent application envelope:

None

Description: -

Rocky Outcrops

The site assessor noted the following rocky-outcrops within the effluent application envelope:

None

Description:

Setbacks

The following setbacks from the effluent application area have been proposed after considering Appendix R of AS1547:2012 'On-site Domestic Wastewater Management'. This Appendix provides a recent guide on how to determine setbacks distances based on site-specific constraints identified in this site assessment.

The constraint factors associated with each site feature (refer to Table R1) have been qualitatively assessed using Table R2 and a suitable setback then chosen from within the range stated in Table R1.

Site Feature	*Setback Range*	*Constraint Factors*	*Proposed Setback*
Buildings, Property Boundaries	3 – 6 m	LOW	>3 m(downslope) >6m (upslope)
Groundwater Bore (GW104342)	250 m	HIGH	173 m

Site Assessment Discussion

The "Environment & Health Protection Guidelines: On-site Sewage Management for Single Households" (the silverbook) recommends the following buffer distances between land application areas and the following:

Groundwater bore (GW104342): > 250-m

Due to land availability these buffer distances are not attainable. The justification for the reduced buffer distance is as follows:

- 'Secondary-level' wastewater treatment is proposed via an AWTS. This presents a significantly lower pollution risk to adjacent groundwater bores than other primary treatment systems (e.g. a conventional septic tank).
- With regards to nutrients entering the watercourse, the land application area has been sized so that nutrient uptake (by vegetation and soil adsorption) exceeds nutrient application.

- The proposed AWTS effluent has a significantly lower pathogen concentration (measured as thermotolerant coliforms) of less than 30 cfu/100ml when compared to other primary treatment systems (e.g. conventional septic tank effluent is in the range of 10^6 - 10^7 cfu/100ml).
- A Viral Die-Off calculation with conservative values was produced with a minimum setback of 1.24 m.
- The proposed effluent area is down slope of neighboring bores.

Figure 1.- Indicative landform of proposed EDA

Soil Assessment

The location of the borehole excavated during the site inspection is shown on the attached site plan. Physical and chemical soil properties were recorded on a soil profile log (see attached). On each property two boreholes are performed, the first analyses soil features listed below, and the second serves a confirmatory borehole. If soil properties found in the two boreholes on site differ, then both samples are taken for analysis.

The following properties were recorded for each soil horizon:

- Horizon depth and type	- Mottling	- Colour
- Structural stability	- Groundwater depth	- Bedrock depth
- Texture	- pH	- Phosphorus Sorption
- Electrical Conductivity	- Coarse Fragments	

Erodability / Erosion Hazard

Soil erodability is the susceptibility of the topsoil to detachment and transport of soil particles. It is a characteristic of the soil surface and varies with time, soil / water status and land use. Soil erodability classification is stated as low, moderate or high.

Erosion hazard is the susceptibility of an area of land to the prevailing agents of erosion. It is a function of climate, soil erodability, vegetation cover and topography.

Refer to the site classification (Pacific Environmental) report for more information about the boreholes and type of soil. See appendix C.

Salinity & Drainage

Salinity is the concentration of water-soluble salts contained within a soil. Increases in soil salinity (i.e. salinisation) can occur as a result of irrigation water raising the level of an already saline groundwater. Management of potential salinisation problems involve ensuring that salts introduced to the soil surface are removed (by crop uptake or subsoil leaching) and by ensuring the irrigation area provides adequate subsoil drainage to prevent raising of saline groundwaters into root zones.

Drainage is a statement describing the site and soil drainage that is likely to occur most of the year. It is influenced by soil permeability, water source, landform description, evapotranspiration, slope gradient and slope length.

The drainage of this site should be adequate for the leaching of salts and ensure the groundwater level does not reach the root zone.

A major adverse effect of high soil salinity is the restrictive effects on plant growth. However, for this site the soil salinity levels (as indicated by the electrical conductivity values) are low enough that the adverse effects on plant growth will be minimal.

Soil Assessment Discussion

A range of soil properties that commonly place limitations on on-site wastewater management have been assessed and classified. In accordance with the Environmental and Health Protection Guidelines all soil properties have been shown to present no major limitations to on-site wastewater management.

ON-SITE WASTEWATER MANAGEMENT SYSTEM DESIGN

The design process adopted here involves an evaluation of the expected wastewater flow, site limitations and soil limitations, to select, size and position a waste treatment unit and land application system that will provide the best practical option.

Wastewater Treatment:

This report proposes wastewater treatment using a NSW Health accredited (or equivalent) Aerated Wastewater Treatment System (AWTS) as it will produce a high quality effluent suitable for irrigation purposes.

Effluent Application:

This report proposes that effluent application be via a low-pressure irrigation system. EnviroTech recommends all of the following methods of irrigation (presented below as numbered options) are suitable for installation on this site.

1. Pressure dosed absorption bed
2. Pressure dosed absorption trench

Any irrigation system must be installed within the proposed irrigation shown on the site plan or within the 'available irrigation envelope' (if an envelope is shown on your site plan).

If Council prefers the client install one particular method of irrigation (i.e. only one of our recommended options be available to the client) then consultation between client and Council may be required.

Effluent Application Area Sizing

The results were as follows:

Proposed Design Irrigation Rate (DIR):

Highly Structured Clay Loam 30 mm/ day (Table M1, AS 1547:2012)

Minimum Irrigation Areas: Flowrate/DIR= 17500/30=584 m^2

Site Modifications Recommended

- construct a raised land application area at least 400 mm above current natural ground level using a uniform dark brown topsoil (category 1 or 2), moderately permeable with a loam texture and containing composted organics. Fill placement and compaction should be even and controlled.
- Side batter applied shall be in the ratio of 1:3.
- Refer to drawing to additional detailing.

13

RECOMMENDATIONS

- Installation of an Aerated Wastewater Treatment System (AWTS) with capacity to treat the design flowrate (17500 L/ d/ house) to a secondary treatment standard with disinfection. Conversion of existing septic tanks may be utilized within this process.
- Model, schematics and associated documentation of the above treatment type to be provided by client upon consultation with installer/plumber. Schematics and documentation of selected model to be attached upon submission with this report.
- Installation of a low-pressure effluent irrigation system. This area shall be designated for effluent application only.
- EnviroTech recommends all of the following irrigation types are suitable for installation on this site:

Irrigation System Type	*Minimum area Required*
Pressure dosed absorption beds	584m^2
Pressure Dosed Absorption Trench	584m^2

- Once the client's septic application has been approved, the client shall choose whichever of the above options best suits their needs in consultation with Council.
- Further site-specific irrigation details (for example, accurate sprinkler and distribution line positioning within the proposed irrigation area), if required, may be determined in consultation with your plumber / irrigation installer.
- Each absorption system must be installed within the proposed land application area shown on the site plan or within the 'available absorption envelope' (if an envelope is shown on your site plan).
- Please refer to Appendix T for further detailed Pressure Dosed beds and trenches descriptions and standard drawings for guidance during construction and installation.

14

- The Pressure Dosed Beds shall be maintained in accordance with the attached "Operation and Maintenance Guidelines" (Appendix F).

LIMITATIONS

Envirotech Pty Ltd has prepared this report for the exclusive use of our client, for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Envirotech, does so entirely at its own risk and without recourse to Envirotech for any loss or damage.

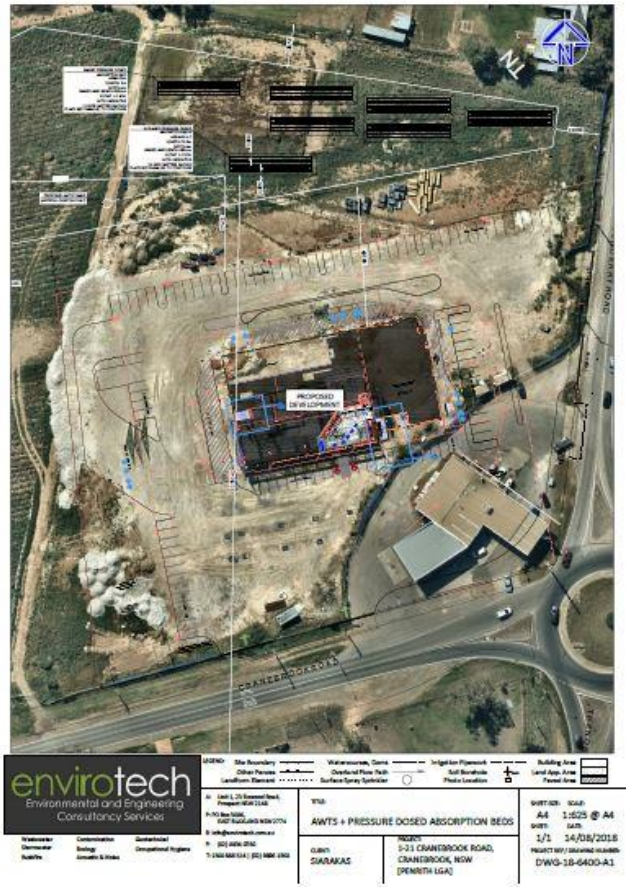
In preparing this report Envirotech has necessarily relied upon information provided by the client and/or their Agents. The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Under no circumstances can it be considered that these findings represent the actual state of the site at all points. Subsurface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after Envirotech's field testing has been completed.

Envirotech's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by Envirotech in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

Should any site conditions be encountered during construction that vary significantly from those outlined and discussed in this report, Envirotech should be advised and a plan outlining the need for potential action developed accordingly.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. Envirotech cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Envirotech. This is because this report has been written as advice and opinion rather that instructions for construction.



Appendix 4

GEOTECHNIQUE PTY LTD

Member of Australian Contaminated Land Consultants Association Inc

ABN 64 002 841 063

Job No: 12337/1
Our Ref: 12337/1-AB
21 October 2010

Service Station Developments
P O Box 365
PENRITH NSW 2751

Attention: Mr J Sarp

Dear Sir

re: **United Service Station**
Londonderry Road, Cranebrook
Geotechnical Investigation – Wastewater Management

This report provides the results of a geotechnical investigation at the above location. The work was carried out as per emails dated 8 and 21 September 2010.

We understand that an on-site wastewater treatment and disposal system is proposed for the above site. It is also understood that the system should be appropriate for wastewater loading of 4000l/day. Therefore, a geotechnical investigation was required for the following:

- To ascertain whether the proposed site is suitable for on-site effluent treatment and disposal systems.
- To provide geotechnical recommendations for design of on-site effluent treatment and disposal systems, if appropriate.

Regional Geology
Based on the Geological Map of Penrith (1:100,000), the site is underlain by Londonderry Clay, comprising clay, patches of ferruginized, consolidated sand.

Reference to the (1:100,000) Penrith Landscape map indicates that the site belongs to the Berkshire Park Group, which is characterised by dissected, gently undulating low rises on Tertiary terraces of the Nepean and Hawkesbury River systems. Soils in this landscape comprise clay and clayey sands, with ironstone nodules and silcrete and impermeable subsoils, which are susceptible to gully, sheet and rill erosion and waterlogging.

Field Work
Field work for geotechnical investigation was conducted on 14 and 27 September 2010 and consisted of the following:

- A walk over survey of the site to assess existing surface conditions.
- Drilling three (3) boreholes using a bobcat equipped with an auger. The boreholes were terminated at about 2.5m on bedrock. The approximate borehole locations are indicated on the attached Drawing No 12337/1-1. The borehole logs are also attached.
- Three (3) Dynamic Cone Penetration (DCP) tests were conducted adjacent to drilled boreholes to assess strength characteristics of sub-surface soils. These results are shown on the borehole logs.
- Recovery of representative soil samples for visual assessment and laboratory testing.
- Measuring depths to groundwater level or seepage in test pits, where encountered.

Lemko Place, Penrith NSW 2750 PO Box 880, Penrith NSW 2751
Telephone (02) 4722 2700 Facsimile (02) 4722 2777
e-mail: info@geotech.com.au www.geotech.com.au

- Conducting field permeability testing in three boreholes to assess conductivity of sub-surface soils in areas visually assessed to be suitable for disposal of treated wastewater. The test method principally involves the following (Reference 1):
  - Drilling a borehole of known diameter and depth (about 0.5m) using a hand auger.
  - Saturating the sub-surface soils in the vicinity of the borehole by repeatedly refilling the borehole with water until a constant rate of water level drawdown was achieved.
  - Filling the borehole with water and measuring the drop in water level over a period of time.
  - Analysing measurements in water level drawdown for known borehole dimension, to estimate permeability of soils in the vicinity of the borehole.

Field work was supervised by a Field Engineer from this company, responsible for nominating borehole locations, sampling, testing and preparation of borehole logs.

Site Conditions
A wastewater treatment and disposal system will be constructed on the western side of the United Service Station, Londonderry Road, Cranebrook. The ground surface across at the site is generally flat and grass covered.

Sub-surface materials encountered in the three boreholes are detailed in the attached borehole logs and summarised below in Table 1.

TABLE 1

Borehole	Termination Depth (m)	Topsoil / Fill(m)	Natural Soils (m)	Bedrock (m)
1	2.5	0.0 – 1.2	1.2 – 2.5	=>2.5
2	2.5	0.0 – 0.3	0.3 – 2.5	=>2.5
3	2.5	0.0 – 0.1	0.1 – 2.5	=>2.5

In general, sub-surface materials encountered in the boreholes are described as follows:

Topsoil	Sandy Silty Clay, low plasticity, dark brown, traces of roots and ironstone
Fill	Silty Clay, medium to high plasticity, yellow-brown, with inclusions of siltstone and rounded ironstone
	Silty Clay, low plasticity, dark brown, with inclusion of rounded ironstone
Natural Soils (Alluvial & Residual)	Sandy Clayey Silt, low plasticity, dark brown, yellow, with inclusion of rounded ironstone
	Silty Clay, high plasticity, yellow brown, trace of ironstone

DCP tests generally indicated the fill to be variably compacted and the natural soils to be stiff to very stiff in consistency.

Groundwater or seepage was not encountered within the drilled depth of the boreholes. It should be noted that fluctuations in the level of groundwater might occur due to variations in rainfall and/or other factors.

Permeability Testing
Estimates of soil permeability based on field tests are presented below in Table 2.

TABLE 2

BH	Permeability (m/s)	Permeability (m/day)
1	2.0×10^{-7}	0.0173
2	3.6×10^{-7}	0.0259
3	4.3×10^{-7}	0.0346

The above values are consistent with the type of material encountered in the drilled boreholes

Laboratory Testing
Representative soil samples recovered from the boreholes were tested to assess chemical properties. The samples for chemical tests were collected from different types of soils encountered across the site. Tests were carried out in the NATA accredited laboratory of SGS Australia Pty Ltd, in accordance with relevant Australian Standards. Detailed laboratory test results are attached and summaries are presented in Table 3.

TABLE 3

BH	Depth (m)	EC (dS/m)	pH	Phosphorous Absorption (mg P sorped /kg)	Cation Exchange Capacity (meq%)	Exchangeable Sodium Percentage (%)
1	0.0 – 0.5	0.25	9.1	280	19	10
2	0.5 – 1.0	0.11	7.7	720	9.5	4
3	1.0 – 1.5	0.14	6.5	500	11	2

Scope of Geotechnical Investigation
The scope of the present investigation was aimed at assessing the suitability of the site for on-site disposal of treated wastewater and estimating the disposal area required. This involved the following:

- Analysis of site and soil conditions
- Estimating effluent load
- Analysis of climatic conditions
- Water and nutrient balance calculation

Site and Soil Assessments
The Environmental and Health Protection Guidelines (Reference 2) provide site and soil assessment ratings for on-site wastewater disposal systems with irrigation and/or absorption. The site features relevant for site assessment and assessed limitations imposed by each feature in the site are presented in Table 4.

TABLE 4

Site Features	Assessed Conditions	Assessed Limitation for Irrigation	Assessed Limitation for Absorption
Flood Potential	Rare, above 1 in 20 year flood contour	Minor to Major	Minor to Major
Exposure	High sun exposure	Minor	Minor
Slope	1-2%	Minor	Minor
Landform	Plain	Minor	Minor
Run-on and upslope seepage	None	Minor	Minor
Erosion potential	No sign of erosion	Minor	Minor
Site drainage	No surface dampness except in flood plain	Minor to Major	Minor to Major
Fill	Fill Present	Moderate	Moderate
Rock outcrops	<10%	Minor	Minor

The soil features relevant for soil assessment and assessed limitations imposed by each soil feature are presented in Table 5.

TABLE 5

Soil Features	Assessed Conditions	Assessed Limitation for Irrigation	Assessed Limitation for Absorption
Depth to bedrock	2.5m	Minor	Minor
Depth to groundwater	>2.5m	Minor	Minor
Soil permeability	0.017 – 0.035 m/day	Minor to Major	Minor to Major
Coarse fragments	About 0-10%	Minor	Minor
Bulk density	About 17.5t/m^3	Minor	Minor
pH	6.5-9.1	Minor	Minor
Electrical conductivity	0.11-0.25 dS/m	Minor	Minor
Exchangeable Sodium Percentage (ESP)	2-10%	Moderate	Minor to Moderate
Cation Exchange Capacity (CEC)	9.5-19.0meq/%	Minor to Moderate	Minor to Moderate
Phosphorus sorption	280-720mg/kg	Minor	Minor

Information presented in Tables 4 and 5 indicates the following:

- Site features listed in Table 4 are unlikely to impose major limitations for on-site disposal of effluent by both irrigation and absorption systems, provided areas in the vicinity of drainage lines or creeks and flood plains (area below 1 in 100 years flood level) are avoided.
- Depths to bedrock and groundwater level are unlikely to impose major limitations for on-site disposal of effluent by both irrigation and absorption systems.
- Physical properties of soils, in terms of coarse fragments and density, are unlikely to impose major limitations for on-site disposal of effluent by both irrigation and absorption systems.
- Clayey soils across the site are assessed to have low permeability and are generally poorly drained. However structural defects like shrinkage cracks might result in relatively high permeability locally.
- Chemical properties of soils listed in Table 5 do not impose major limitations for both irrigation and absorption systems.

In summary, site and soil features listed in Tables 4 and 5 do not impose major limitations for on-site effluent disposal by both irrigation and absorption systems, provided the disposal areas are above the 1 in 100 years flood level.

It should be noted that the site should have a suitable effluent disposal area of adequate size after allowing for adequate buffer distances. Recommended buffer distances for disposal areas, from site features such as boundaries, waterbodies, buildings, etc., are provided in Reference 2 and reproduced in Table 6.

TABLE 6

Disposal System	Feature	Recommended Buffer Distance (m)
All Land Application Systems	Permanent surface waters, (e.g. rivers, streams, lakes etc)	100
	Domestic groundwater well	250
	Other waters (e.g. farm dams, intermittent waterways, drainage channels etc)	40
Surface Spray Irrigation	Up-gradient of driveways and property boundaries	6
	Down-gradient of driveways and property boundaries	3
	Dwellings	15
	Paths and walkways	3
	Swimming pools	6
Surface Drip or Trickle Irrigation and Sub-surface Irrigation	Up-gradient of swimming pools, property boundaries, driveways and buildings	6
	Down-gradient of swimming pools, property boundaries, driveways and buildings	3

Climatic Conditions
A climatic survey was carried out from available data compiled by the Bureau of Meteorology publication "Sydney Climatic Survey 1991" (Reference 3), which included median (50 percentile) monthly rainfall and evaporation. As climatic data is not available for Cranebrook, published climatic data for the nearest monitoring station (Richmond) are presented below in Table 7.

TABLE 7

Month	Median Rainfall (mm)	Evaporation (mm/day)
January	73	6.5
February	65	5.6
March	65	4.6
April	52	3.6
May	28	2.2
June	41	1.8
July	32	2.2
August	24	3.1
September	34	4.3
October	44	5.3
November	60	6.1
December	54	7.6

On-site Effluent (Wastewater) Treatment and Disposal Alternatives
The options available for treatment and disposal of domestic wastewater/effluent are as follows:

- Septic tank and absorption/evapotranspiration trench
- Septic tank and Amended Soil Mould (Ecomax type) System
- Mechanically aerated system and irrigation area or evapotranspiration trench
- Composting wet or dry type toilet with absorption trench and/or further treatment for grey water

However, we understand that an Ecomax Type of wastewater treatment system will be used. Such systems utilise an amended soil mound that absorbs and chemically reacts with contaminants in the wastewater, producing treated water with very low levels of contaminants. Consequently, a nutrient balance is not required. Vegetation cover then takes up the treated water over the amended soil mound.

Allowance is made in the design of such systems for internal storage of effluent, with potential discharge of treated effluent during periods of wet weather, to be taken up in the soils adjacent to the mound. Consequently, it is considered that additional wet weather storage is not required. Due to the high quality of the treated effluent, it is considered that buffer zones are not required. Therefore, it is our assessment that the site and soil conditions are suitable for treatment and disposal of wastewater with an Ecomax System. Specifications and design of this system, appropriate for wastewater loading of 4000L/day, should be provided by the supplier of the system.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

[redacted]

ZIAUDDIN AHMED
Senior Geotechnical Engineer

Attached Drawing No 12337/1-1 Borehole Location
Borehole Logs
Explanatory Notes
Laboratory Test Results

References
1. Australian Standard AS/NZS1547 – 2000 "On-site Domestic Waste Water Management".
2. The Environmental and Health Protection Guidelines "On-site Wastewater Management System for Single Households".
3. The Bureau of Meteorology Publication "Sydney Climatic Survey – 1991"