Annexure F
Onsite Effluent Disposal Report

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Job Number 084320

On-site Effluent Disposal

for

Proposed Caravan Park

235 River Street

Palmers Island, N.S.W.

January 2009

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Executive Summary

This report refers to an effluent disposal study at 235 River Street, Palmers Island, NSW, undertaken as part of a re-zoning application. The purpose of the study was to identify the required area of land to enable effluent disposal from the Proposed Caravan Park, so that sufficient area could be included in the re-zoning application.

It is noted that this development falls outside the scope of the Clarence Valley Council (CVC) guidelines which are designed for effluent disposal from domestic households. However, these guidelines, together with E.P.A. Guidelines (1998), DEC (2004) and AS 1547 are considered to be the best available tools to determine the effluent land disposal area required by the proposed Park.

The site is located adjacent to the Clarence river on Palmers Island. An area to the east of the proposed caravan park site was identified for the effluent land disposal area. Site and soil assessments conducted using EPA (1998) guidelines identified several moderate to significant limitations to be associated with this land. These are discussed in Sections 2 and 3.

The land area required for three typical effluent disposal methods was calculated using the best available data. It is assumed that at least secondary treatment and disinfection are included in the process. It is recommended that at least 3.14Ha of land be included in the rezoning application for the purposes of effluent disposal and associated buffers (20m from Yamba Street and 12m from other property boundaries). It is acknowledged that the ultimate treatment and disposal systems have not yet been designed for this development, however, the identified effluent disposal area of 3.14Ha should enable flexibility in system choice.

Additional recommendations are made in Section 6 and the need for a comprehensive operation and maintenance manual for the Park is detailed in Section 7.

Soil testing results and baseline water quality analysis of the groundwater encountered in boreholes are included in the Appendices.

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Holmes & Holmes Pty. Ltd.

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1 INTRODUCTION

Following a request from Resource Design & Management Pty. Ltd., an effluent disposal study was undertaken for the proposed development of a caravan park (the Park) at 235 River Street, Palmers Island for Mr Paul Reid (the Owner). This investigation forms part of the rezoning application for the proposed Park. It identifies the required land area to dispose of treated wastewater effluent generated by the development. This will allow a suitably sized area to be re-zoned appropriately.

The proposed Park is to be located on the site of an old caravan park on River Street. The development includes 53 cabin style self contained accommodations and 100 caravan sites. The current proposed layout is shown on Figure 1.1.

Discussions with the Owner indicate that reuse of treated effluent within the landscaping of the Park is anticipated, and hence a high level of treatment is proposed. However, the Owner acknowledges that during peak holiday periods there may be a need to dispose of the treated effluent in a dedicated area of land adjacent to the Park. Therefore, this study focuses on identifying the size of a land disposal area suitable for the entire peak wastewater loads of the Park.

A site inspection and field testing and sampling was undertaken on the 2nd December 2008, to determine the required soil parameters and to assess the site conditions in regard to suitability for the satisfactory on-site disposal of domestic-type effluent.

It is noted that this development falls outside the scope of the Clarence Valley Council (CVC) guidelines which are designed for effluent disposal from domestic households. However, these guidelines, together with E.P.A. Guidelines (1998), DEC (2004) and AS 1547 are considered to be the best available tools to determine the effluent land disposal area required by the proposed Park.

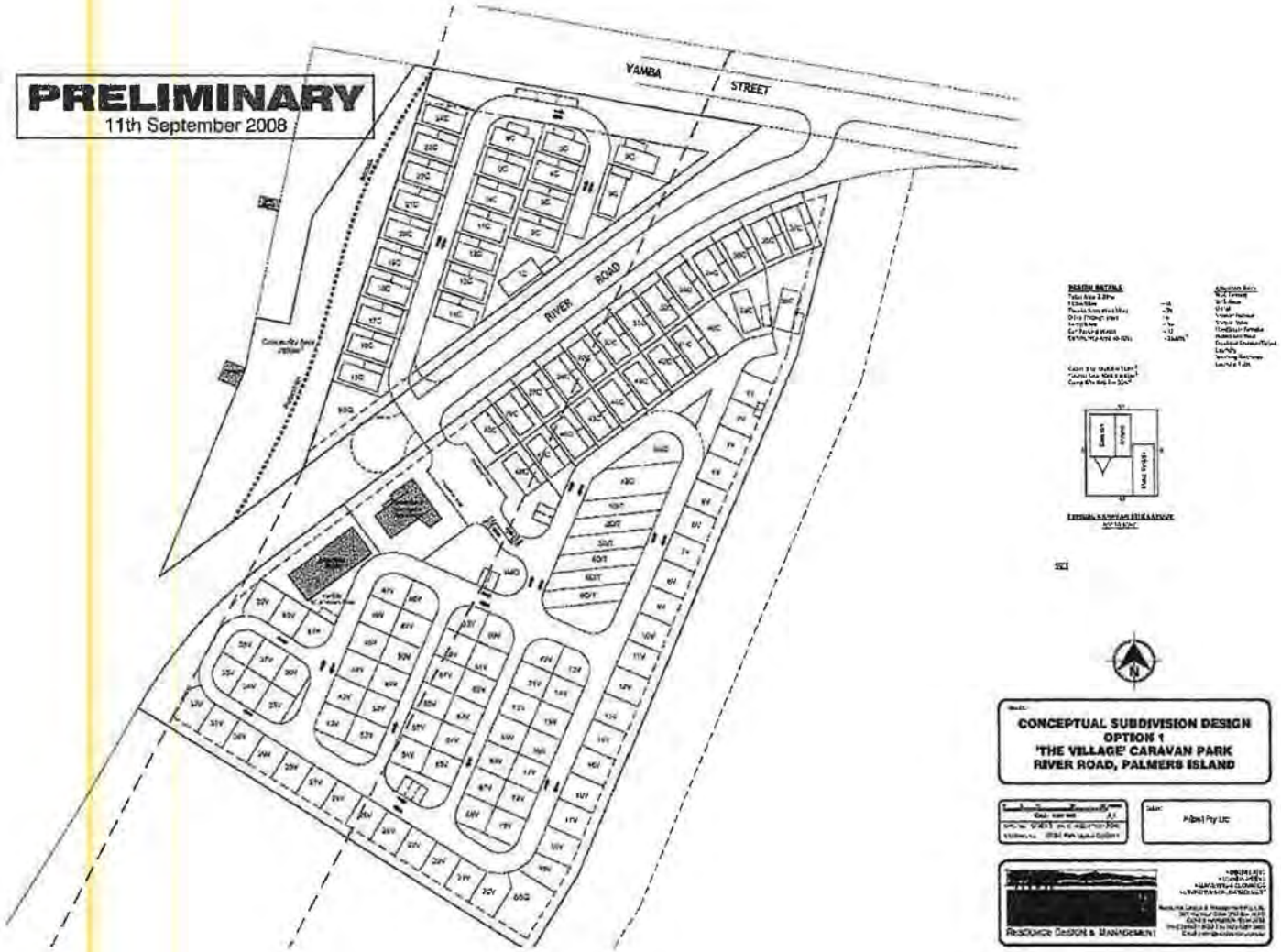


Figure 1.1 Current proposed layout of the Park (Source: RDM)

2 SITE ASSESSMENT

The proposed Park is bounded by the Clarence River along the western boundary and a formed bitumen road along the eastern boundary. To the east of this road is an area of land that has been cultivated with sugar cane for approximately 100 years. This land was identified, in consultation with the Owner, as the area most suitable for effluent disposal. The objective of this study was to identify how much of this land should be set aside for effluent disposal, see Figure 2.1.

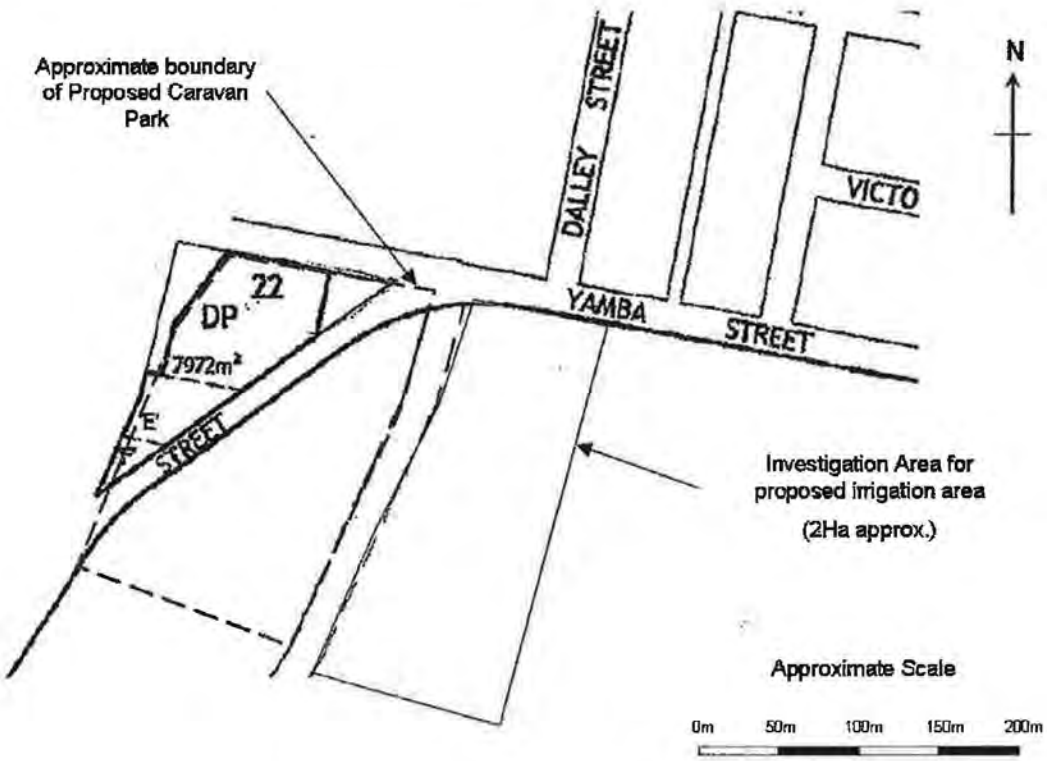


Figure 2.1 Location of land to be used for effluent disposal

The land in this area is very flat (laser levelled) and includes drainage ditches associated with sugar cane production, see Figure 2.2.

Figure 2.2 Current landuse in the area identified for effluent disposal (View from southeast corner)

A Detailed Site Assessment is shown on Table 2.2 which identifies the main constraints associated with use of the land for effluent disposal. These constraints are discussed and addressed in the following sections.

2.1 Flooding potential

The proximity to the river and the potential for the Park to be flooded can be addressed in the design of the collection and treatment systems (collection systems, settlement tanks, aeration tanks, electrical components, control systems etc.). The potential for the land disposal area to flood presents the possibility of treated effluent re-surfacing and entering the watercourses. This risk is minimised by the fact that the proposed treatment system will be to secondary level with disinfection and hence the health risk posed by the effluent will be reduced. Furthermore, during a flood event the dilution effect of floodwaters in the Clarence on any treated effluent mobilised in the land disposal area will be significant.

2.2 Proximity to groundwater table

The land disposal area is located on the flood plain of the Clarence river and so the groundwater level is close to the surface, at approximately 1.0m depth in the boreholes BH4 and BH5, some 200m from the river. The groundwater levels are approximately 300mm above river level at the time of measurement (high tide). Water levels in Boreholes 1 and 2 were observed to be influenced by the state of tide. The boreholes in the area proposed for effluent disposal (3, 4 and 5) were not visibly influenced by the tide and are more likely to be affected by the drainage ditches in the sugar cane field.

The disposal of effluent on the land area identified has the potential to impact on the water quality of the underlying groundwater. The two principle concerns in this locality are:

- Possible contamination of water used for potable supplies (sand aquifers layers behind natural levee). Groundwater bore searches on the NSW Natural Resource Atlas did not identify any domestic groundwater bores within 250m of the site. However, it is possible that un-licensed bores exist in the vicinity and that bores could be sunk the vicinity in the future. Pathogenic contamination (bacteria/viruses) is likely to be the most important issue to consider in relation to human health.

- Possible localised degradation of water quality of the Clarence river and adverse impacts on aquatic ecosystem. Nutrient loadings are the most important issues to consider for the protection of aquatic ecosystems.

The risk of such contamination is largely dependant on the treatment processes employed. As the Owner proposes to re-use wastewater within the Park, and hence employ a sophisticated treatment system including disinfection, it is assumed that the quality of the final effluent to be disposed of in the land disposal area will not pose a threat to the groundwater.

Two samples of groundwater were made from Boreholes 4 and 5 and were analysed for standard parameters with the view to establish baseline conditions, see Appendix A. The results suggest that the water is moderately acidic in nature, with high iron and manganese levels typical of oxygen deficient groundwater. The ANZECC (2000) default trigger values for the assessment of the risk of adverse effects due to nutrients, biodegradable organic matter and pH in Slightly Disturbed ecosystem are

shown on Table 2.1. The samples of existing groundwater fail to meet the pH, Ammonia, TP and TN criteria of these guidelines.

Table 2.1 Default trigger values for preservation of aquatic ecosystems – Slightly Disturbed condition. (ANZECC, 2000)

Ecosystem type	Chl *a*	TP	FRP	TN	NO_x	NH_4^+	DO (% saturation)[1]		pH	
	(µg L^{-1})	(µg P L^{-1})	(µg P L^{-1})	(µg N L^{-1})	(µg N L^{-1})	(µg N L^{-1})	Lower limit	Upper limit	Lower limit	Upper limit
Estuaries[2]	4[4]	30	5[4]	300	15	15	80	110	7.0	8.5

Notes Chl a = chlorophyll a, TP = total phosphorus, FRP = filterable reactive phosphate, TN = total nitrogen, NOx = oxides of nitrogen, NH4 + = ammonium, DO = dissolved oxygen.

2.3 Poor drainage

The lack of slope and drainage lines at the site will result in a high fraction of rainfall being retained on soil surface. Low permeability soils will lead to surface runoff during high rainfall events and waterlogging. The surface runoff may become contaminated with treated effluent if it has been applied to the surface of the soil or at shallow depth.

The problems associated with surface ponding or runoff containing treated effluent are reduced at this site by the fact that high levels of treatment are proposed. Hence, the quality of the treated effluent is high and health risks to humans from ponded/runoff water will be low.

Table 2.2 Site Assessment Summary: Rating for On-Site systems (Source: *Onsite sewage management for single households* EPA (1998))

Job number: 084320
Project: Proposed Caravan Park at 235 River Street, Palmers Island.
Location: Proposed land disposal area to east of River Street. River flat. Cleared land under sugar cane cultivation. Slope < 1%.

Site Feature	Relevant System(s)	Minor Limitation	Moderate Limitation	Major Limitation	Restrictive Feature
Flood potential	All land application systems	Rare, above 1 in 20 year flood contour		Frequent, below 1 in 20 year flood contour	Transport of wastewater off-site
	All treatment systems	All components above 1 in 100 year flood contour		Any components below 1 in 100 year flood contour	Transport of wastewater off-site. System failure and electrocution hazard
Exposure	All land application systems	High sun and wind exposure		Low sun and wind exposure	Poor evapotranspiration
Slope (%)	Surface irrigation	0-6	6-12	>12	Run-off, erosion
	Sub-surface irrigation	0-10	10-20	>20	Run-off, erosion
	Absorption system	0-10	10-20	>20	Run-off, erosion
Landform	All systems	Hill crests, convex side slopes and plains	Concave side slopes and foot slopes	Drainage plains and incised channels	Groundwater pollution hazard Resurfacing hazard
Run-on and upslope seepage	All land application systems	None - low	Moderate	High - diversion not practical	Transport of wastewater off-site.
Erosion potential	All land application systems	No signs of erosion potential present		Signs of erosion, eg rills, mass movement and slope failure, present	Soil degradation and transport, system failure
Site drainage	All land application systems	No visible signs of surface dampness		Visible signs of surface dampness, such as moisture-tolerant vegetation (sedges and ferns), and seepages, soaks and springs	Groundwater pollution hazard Resurfacing hazard
Fill	All systems	No fill	Fill present		Subsidence. Variable permeability
Buffer distance	Adsorption system	See Section 2.4			Health and pollution risks
Land area	All systems	Area is available		Area is not available	Health and pollution risks
Rocks and rock outcrops (%)	All land application systems	<10	10-20	>20	Limits system performance
Geology / regolith	All land application systems	None		Major geological discontinuities, fractured or highly porous regolith	Groundwater pollution hazard

2.4 Buffer distances

The minimum buffer distances applicable to the effluent disposal areas are:

- 250m from a domestic bore. A search of the NSW Resource Atlas found that no groundwater bores for domestic purposes were located within 250m of the identified disposal area.
- 40m to intermittent watercourses and farm dams. Not relevant
- Permanent watercourse. The proposed effluent disposal area is approximately 120m from the Clarence river at the closest point.
- It is recommended that a buffer of at least 20m be maintained from Yamba Street to reduce the potential impact on residents on the northern side of this street. A buffer of 12m (minimum) should be maintained along the southern and eastern property boundaries of the effluent disposal area. These buffers could include access tracks, drainage channels and vegetation screens.

Given the agricultural nature of this site and the lack of space constraints, the above buffer distances will be able to be achieved for the effluent disposal area.

3 Soil Assessment

Three field permeability tests were carried out in accordance with the procedures outlined in AS 1547 Appendix 4.1F, using a 110mm diameter hole, and a 38.7mm diameter tube. Locations of the permeability tests (P1, P2 and P3) and the investigation boreholes (BH1 to BH5) are illustrated on **Plan A**. Borelogs of all holes are shown on Table 3.1 and the field permeability results are shown on Table 3.2.

The soil conditions across the proposed land disposal area were found to be relatively uniform. A layer of topsoil (200mm to 600mm thick) was found above a layer of yellow/brown/grey silty clay (200mm to 300mm thick) which was located above the water table. The silty clay layer was underlain by a grey/yellow sandy clayey layer located at the level of the water table and became more sandy with depth.

Depths observed to groundwater level are also shown on Plan A. It should be noted that, given the impermeable nature of the soil, groundwater levels will fluctuate seasonally and in response to rainfall.

3.1 Soil Analysis Results

Three sample where analysed for soil parameters: 084320/1 (BH4 300mm-500mm), 084320/2 (BH4 800mm-1000mm) and 084320/3 (P2 200mm-450mm).

- **Upper soil layer:** 084320/1 and 084320/3 are considered to be representative of the material encountered at a depth of 200-500mm across the proposed land disposal area. This soil layer would be directly affected by the application of effluent in the land disposal area. Table 3.3 and Table 3.5 summarises the laboratory test results for these samples and Appendix B contains the full laboratory reports. The major limitations of this soil for effluent disposal use are shown below together with methods of addressing the issues:

- Strongly acidic soil which may limit plant growth. Soil may be improved by the addition of lime. Selection of acid-tolerant vegetation essential.
- A high level of exchangeable Aluminium was also found in this soil which can lead to plant toxicity. Reduction of soil acidity by liming will reduce the levels of available Aluminium. Selection of aluminium-tolerant vegetation essential.
- The soil shows the tendency to be dispersive with high ESP levels and Emerson Class 2 (Sample /1). The addition of gypsum will improve soil structure and permeability. Note the Emerson Class 4 for Sample /3 indicates calcite or gypsum is present in sample, possibly as a result of a previous gypsum application.

- **Lower soil layer:** 084320/2 is indicative of the more sandy material located below the upper layer of silty clays. This material would be affected by effluent percolating through the upper surface layers. The laboratory analysis of this sample is summarised on Table 3.4 and contained in full in Appendix B. The major limitations of this soil for effluent disposal use are shown below together with methods of addressing the issues:

  - Strongly acidic soil which may limit plant growth. Not practical to incorporate lime to this depth. If deep rooted vegetation adopted for disposal area, essential that acid-tolerant species are selected.
  - A moderate level of exchangeable Aluminium. Selection of aluminium-tolerant deep-rooted vegetation essential.
  - The soil shows the tendency to be dispersive with high ESP levels and Emerson Class 5 (dispersion of soil/water solution). The addition of gypsum to upper soil layer will improve soil structure and permeability of the lower layer to a degree.

Note that the soil testing results have been obtained solely for the purposes of this report and should not be regarded as indicative for the property as a whole. Further testing and consultation with a specialist would be required to establish the suitability of the land for the cultivation of specific crops/plants/trees.

3.2 Soil permeability results

The permeability test results are indicative of the upper soil horizon of topsoil and silty clay layers. The insitu permeability of the lower sandy layers was not determined due to the presence of the groundwater table.

The permeability test results on Table 3.2 show that the upper soil layers are highly impermeable and very low infiltration rates would be expected. This was confirmed by the field observation that water was still evident ponding on site several days after rain.

Table 3.1 Borelogs

ID	Depth (mm)	Soil Description
BH 1	00-600	Moist dark brown topsoil
	600-800	Mottled silty clay grey and yellow, moist
	800-1100	Mottled sandy clay, becoming more sandy with depth. Moist to wet.
	1200	End of hole
BH 2	00-600	Moist dark brown topsoil
	600-800	Mottled silty clay grey and yellow, moist
	800-1100	Mottled clayey sand, becoming more sandy with depth. Moist to wet.
	1100	End of hole
BH 3	00-300	Moist dark brown topsoil
	300-900	Mottled silty clay grey and yellow.
	900-1500	Mottled silty clay grey and yellow, moist.
	1500-1700	Mottled grey and yellow clayey sand, becoming more sandy with depth. Wet.
	1700	End of hole
BH 4	00-200	Moist dark brown topsoil
	200-500	Dark brown silty clay, few yellow mottles.
	500-700	Mottled grey and yellow sandy clay, becoming more sandy with depth. Moist to wet.
	700-1000	Mottled grey and yellow clayey sand, becoming more sandy with depth. Wet.
	1000-1600	Mottled grey and yellow sand with some clay. Saturated.
	1600	End of hole
BH 5	00-300	Moist dark brown topsoil
	300-650	Dark brown silty clay, few yellow mottles. Water seeping in at 400.
	650-1400	Mottled grey and yellow sandy clay, becoming more sandy with depth. Moist to wet. Saturated at 1000.
	1400-1500	Mottled grey and yellow clayey sand. Saturated.
	1500	End of hole
P1	00-350	Dark brown topsoil
	350-500	Dark brown and yellow grey silty clay
P2	00-400	Dark brown topsoil
	400-500	Dark brown and yellow grey silty clay
P3	00-450	Dark brown topsoil moist
	450-650	Dark brown and grey silty clay

Table 3.2 Field Permeability results

ID	Observed rate of fall (mm/min)	Calculated permeability K (m/d)
P1	0.16	0.0015
P2	0.03	0.0003
P3	0.03	0.0003

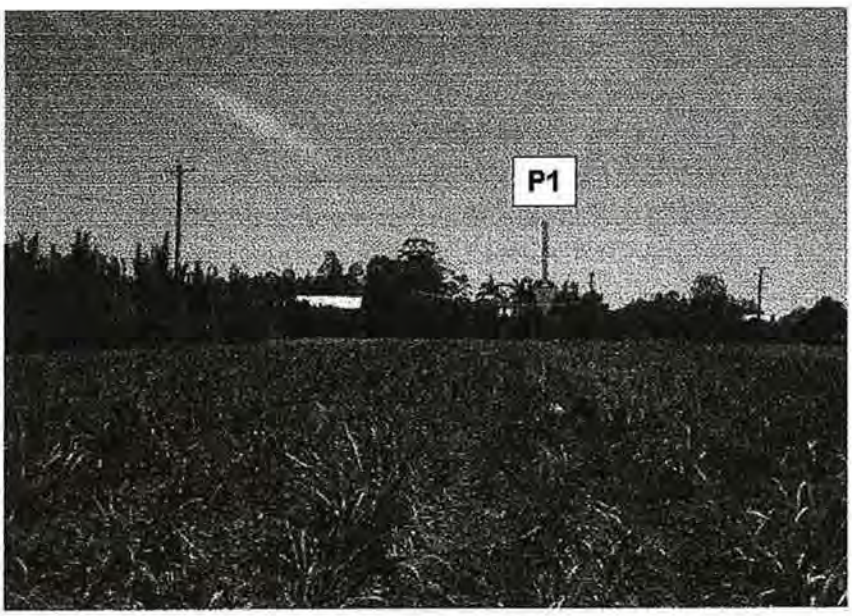


Figure 3.1 Location of permeability test P1 (looking north to Yamba St.)

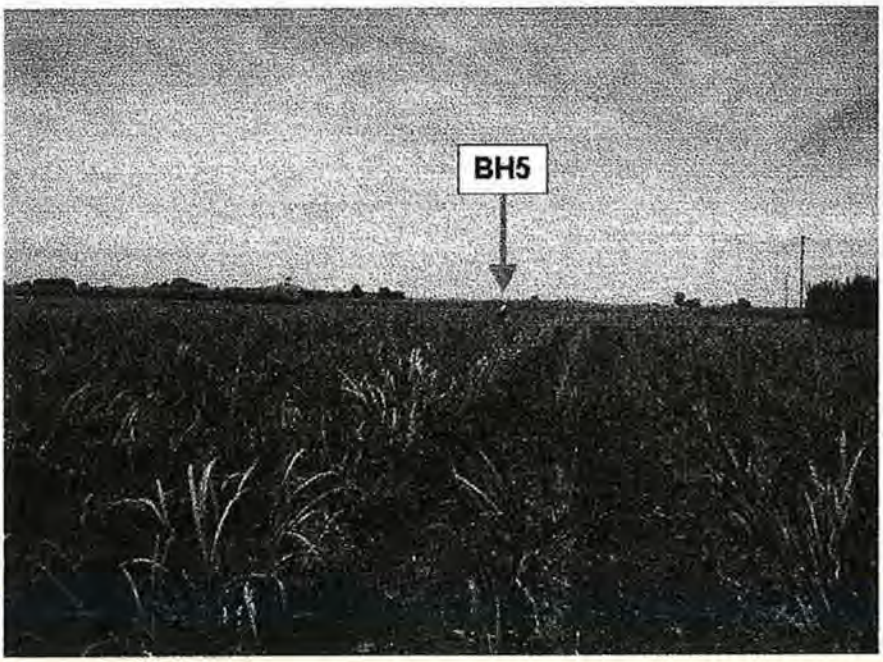


Figure 3.2 Location of borehole BH5 (looking south)

Table 3.3 Soil Assessment : Rating for On-Site systems (Source: *Onsite sewage management for single households* EPA (1998))

Sample: 084320/1
Project: Proposed Caravan Park at 235 River Street, Palmers Island.
Location: **Borehole 4 (300mm - 500mm)**
Soil Description: Dark brown silty clay, few yellow mottles.
Soil permeability category: 5c

Soil Feature	Relevant System(s)	Minor Limitation	Moderate Limitation	Major Limitation	Restrictive Feature
Depth to bedrock or hardpan (m)	Surface irrigation Sub-surface irrigation	>1.0	0.5-1.0	<0.5	Restricts plant growth (trees), excessive runoff, waterlogging
	Absorption	>1.5	1.0-1.5	<1.0	Groundwater pollution hazard Resurfacing hazard
Depth to high Episodic seasonal water-table (m)	Surface irrigation Sub-surface irrigation	>1.0	0.5-1.0	<0.5	Groundwater pollution hazard Resurfacing hazard
	Absorption	>1.5	1.0-1.5	<1.0	Potential for groundwater Pollution
Soil permeability category	Surface irrigation Sub-surface irrigation	2b, 3 and 4	2a, 5	1 and 6	Excessive run-off, waterlogging, percolation
	Absorption	3 and 4		1,2,5, and 6	
Coarse fragments	All land application systems	0-20%	20% - 40%	>40%	May restrict plant growth, affect trench installation
Bulk density (g/cm3)	All land application systems				Restricts plant growth, indicator of permeability
Sandy Loam		<1.8		>1.8	
Loam & clay loam		<1.6		>1.6	
Clay		<1.4		>1.4	
pH CaCl	All land application systems	>6.0	4.5-6.0	<4.5	Reduces optimum plant growth
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Excessive salt may restrict plant growth
Sodicity (exchangeable Sodium percentage)	Surface and sub-surface irrigation (0-40cm)	0-5	5-10	>10	Potential for structural degradation
	Absorption system (0-1.2m)				Potential for structural degradation
Cation exchange capacity (CEC) (cmol+/kg)	Surface irrigation Sub-surface irrigation	>15	5-15	<5	Unable to hold plant nutrients
Phosphorus sorption 100cm depth (kg/ha)	All land application systems	>6000	2000-6000	<2000	Unable to immobilise any excess P

Table 3.4 Soil Assessment : Rating for On-Site systems (Source: *Onsite sewage management for single households* EPA (1998))

Sample: 084320/2
Project: Proposed Caravan Park at 235 River Street, Palmers Island.
Location: **Borehole 4 (800mm - 1000mm)**
Soil Description: Mottled grey and yellow clayey sand, becoming more sandy with depth. Wet.
Soil permeability category: 3c

Soil Feature	Relevant System(s)	Minor Limitation	Moderate Limitation	Major Limitation	Restrictive Feature
Depth to bedrock or hardpan (m)	Surface irrigation Sub-surface irrigation	>1.0	0.5-1.0	<0.5	Restricts plant growth (trees), excessive runoff, waterlogging
	Absorption	>1.5	1.0-1.5	<1.0	Groundwater pollution hazard Resurfacing hazard
Depth to high Episodic seasonal water-table (m)	Surface Irrigation Sub-surface irrigation	>1.0	0.5-1.0	<0.5	Groundwater pollution hazard Resurfacing hazard
	Absorption	>1.5	1.0-1.5	<1.0	Potential for groundwater Pollution
Soil permeability category	Surface irrigation Sub-surface irrigation	2b, 3 and 4	2a, 5	1 and 6	Excessive run-off, waterlogging, percolation
	Absorption	3 and 4		1,2,5, and 6	
Coarse fragments	All land application systems	0-20%	20% - 40%	>40%	May restrict plant growth, affect trench installation
Bulk density (g/cm3)	All land application systems				Restricts plant growth, indicator of permeability
Sandy Loam		<1.8		>1.8	
Loam & clay loam		<1.6		>1.6	
Clay		<1.4		>1.4	
pH CaCl	All land application systems	>6.0	4.5-6.0	<4.5	Reduces optimum plant growth
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Excessive salt may restrict plant growth
Sodicity (exchangeable Sodium percentage)	Surface and sub-surface irrigation (0-40cm)	0-5	5-10	>10	Potential for structural degradation
	Absorption system (0-1.2m)				Potential for structural degradation
Cation exchange capacity (CEC) (cmol+/kg)	Surface irrigation Sub-surface irrigation	>15	5-15	<5	Unable to hold plant nutrients
Phosphorus sorption 100cm depth (kg/ha)	All land application systems	>6000	2000-6000	<2000	Unable to immobilise any excess P

Table 3.5 Soil Assessment : Rating for On-Site systems (Source: *Onsite sewage management for single households* EPA (1998))

Sample: 084320/3
Project: Proposed Caravan Park at 235 River Street, Palmers Island.
Location: **P2 (200mm - 450mm)**
Soil Description: Dark brown topsoil
Soil permeability category: 5c

Soil Feature	Relevant System(s)	Minor Limitation	Moderate Limitation	Major Limitation	Restrictive Feature
Depth to bedrock or hardpan (m)	Surface irrigation Sub-surface irrigation	>1.0	0.5-1.0	<0.5	Restricts plant growth (trees), excessive runoff, waterlogging
	Absorption	>1.5	1.0-1.5	<1.0	Groundwater pollution hazard Resurfacing hazard
Depth to high Episodic seasonal water-table (m)	Surface irrigation Sub-surface irrigation	>1.0	0.5-1.0	<0.5	Groundwater pollution hazard Resurfacing hazard
	Absorption	>1.5	1.0-1.5	<1.0	Potential for groundwater Pollution
Soil permeability category	Surface irrigation Sub-surface irrigation	2b, 3 and 4	2a, 5	1 and 6	Excessive run-off, waterlogging, percolation
	Absorption	3 and 4		1,2,5, and 6	
Coarse fragments	All land application systems	0-20%	20% - 40%	>40%	May restrict plant growth, affect trench installation
Bulk density (g/cm3)	All land application systems				Restricts plant growth, indicator of permeability
Sandy Loam		<1.8		>1.8	
Loam & clay loam		<1.6		>1.6	
Clay		<1.4		>1.4	
pH CaCl	All land application systems	>6.0	4.5-6.0	<4.5	Reduces optimum plant growth
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Excessive salt may restrict plant growth
Sodicity (exchangeable Sodium percentage)	Surface and sub-surface irrigation (0-40cm)	0-5	5-10	>10	Potential for structural degradation
	Absorption system (0-1.2m)				Potential for structural degradation
Cation exchange capacity (CEC) (cmol+/kg)	Surface irrigation Sub-surface irrigation	>15	5-15	<5	Unable to hold plant nutrients
Phosphorus sorption 100cm depth (kg/ha)	All land application systems	>6000	2000-6000	<2000	Unable to immobilise any excess P

4 TREATMENT AND LAND DISPOSAL OPTIONS

It is recommended that, as a minimum, secondary treatment with disinfection be adopted for the proposed Park's wastewater treatment system. The benefits of adopting a high level of treatment for the Park include:

- Enabling partial re-use of wastewater within landscaping of the Park. Thus reducing the overall water demands of the Park.
- Reduced risk of odours being generated in the land disposal area.
- Reduced risk of contamination of the Clarence river during flood events as if treated effluent is re-mobilised from the land disposal area it will be of a high quality and hence impact on overall river-water quality less.
- Reduced risk of contamination of the Clarence river during non-flood periods via groundwater seepage, as the applied effluent will be of higher quality and the disinfection will remove the potential for pathogen contamination.

This investigation assumes that the treatment works for the Park will be designed and constructed in accordance with relevant standards and CVC conditions and will produce an effluent of secondary treatment standard. Current CVC guidelines indicate that secondary treatment must produce and effluent with less than 20mg/L BOD and less than 30 mg/L total suspended solids. DEC (2004) guidelines indicate that thermotolerant coliforms readings should be less than 10 ctu/100mL in effluent that is spray irrigated in unrestricted areas, which is appropriate for the proposed land disposal area.

Assuming that the effluent achieves the required levels of secondary treatment and disinfection, and after considering the site and soils assessment, possible land disposal options were reviewed:

- Above-ground spray irrigation: Not recommended due to proximity to proposed Park and existing residences in Yamba Street.

- Drippers under mulch: Not recommended due to the large area required and the potential for surface ponding.

- Sub-surface spray irrigation (SSI): Irrigation systems installed at shallow depth which distribute treated effluent evenly across disposal area, either for grasses/turf systems or discrete trees/shrubs. Proprietary systems are available and may be gravity-fed or pumped utilising pipework, indexing valves, scour valves, emitters etc. Sub-surface irrigation systems are assumed to be designed in accordance with AS1547 and specific CVC conditions. Typical section assumed to be 100mm of topsoil over 200mm depth of distribution medium (sand).

- Micro-trenching (MT): Modified form of sub-surface irrigation utilising shallow, narrow trenches filled with aggregate. These systems are assumed to be designed in accordance with CVC specification and AS1547. Typical section assumed to be 100mm of topsoil over 200mm depth of aggregate in a trench 300mm wide. 25m maximum length for trench if system pressurised, 10m maximum length if gravity fed. Parallel trenches are assumed to be at a spacing of 1000mm sidewall-to-sidewall.

- Evapotranspiration/Adsorption (ETA) beds: Utilising evapotranspiration via vegetation plantings and soil adsorption characteristics. Evapotranspiration beds are assumed to be constructed in accordance with AS1547 and specific CVC conditions. The typical section assumed consists of a 450mm deep bed (100mm topsoil over 200mm sand, over 200mm gravel, over 50mm sand) in a bed

1500mm wide. Minimum of two distribution pipes per 1500mm wide bed. Maximum length of bed 20m (centrally fed) 15m (end fed). Parallel beds are assumed to be at a spacing of 1000mm sidewall-to-sidewall.

- Adsorption trenches – Not recommended due to poor soil characteristics.

It is noted that the above list is not exhaustive and has been designed to identify an appropriate (and conservative) land disposal area required to meet the re-zoning objective of this investigation.

5 Estimation of Land Area Required for Effluent Disposal

5.1 Wastewater Loads

The maximum domestic effluent loadings for this development were derived assuming the Park would contain 53 cabin style self contained accommodations and 100 caravan sites (as proposed at time of reporting). The Park will be connected to town water and is expected to be fully serviced. Peak loadings (assuming full occupancy) were developed using AS1547 and are summarised on Table 5.1.

Note that the loading recommended by AS1547 has been increased from 100 to 130l/p/d for the cabin accommodations as a conservative measure, based on local experience.

It is assumed that the cabin accommodations and the shared amenity blocks in the Park will be fitted with standard water saving devices.

It is noted that the loadings for the Park are expected to be seasonal which will provide the opportunity to rest parts of the effluent disposal field.

Table 5.1 Assumed effluent loadings

Unit	Assumed Occupancy (p/unit)	Number of units	AS1547 Loading (l/unit/d)	Total daily load (l/d)
Cabin	3	53	390	20 670
Caravan site	3	100	300	30 000
			Total	**50 670**

5.2 Soil Design Loading Rates

The insitu permeability measurements, soil descriptions and AS1547 were used to estimate a Design Loading Rate (DLR) for each disposal system, see Table 5.2.

Table 5.2 Design Loading Rates adopted

Design K (m/d)	AS1547 Soil Category	Subsurface Irrigation	Micro Trenching	ETA Beds
		DLR (mm/week)	DLR (mm/d)	DLR (mm/d)
0.0007	5c	15	5	5

5.3 Land disposal area sizing

Full water balance calculation was performed as per the Nominated Area Method (EPA, 1998) to determine appropriate effluent disposal area based on the hydraulic loading for each of the options considered. The climate data used consisted of the long term rainfall statistics averaged from Grafton Research Stn (1917-2008) and Ballina Airport (1992-2008), see Figure 5.1. Evaporation data from Coffs Harbour was used. Full calculations are shown on Figure 5.2 to Figure 5.4.

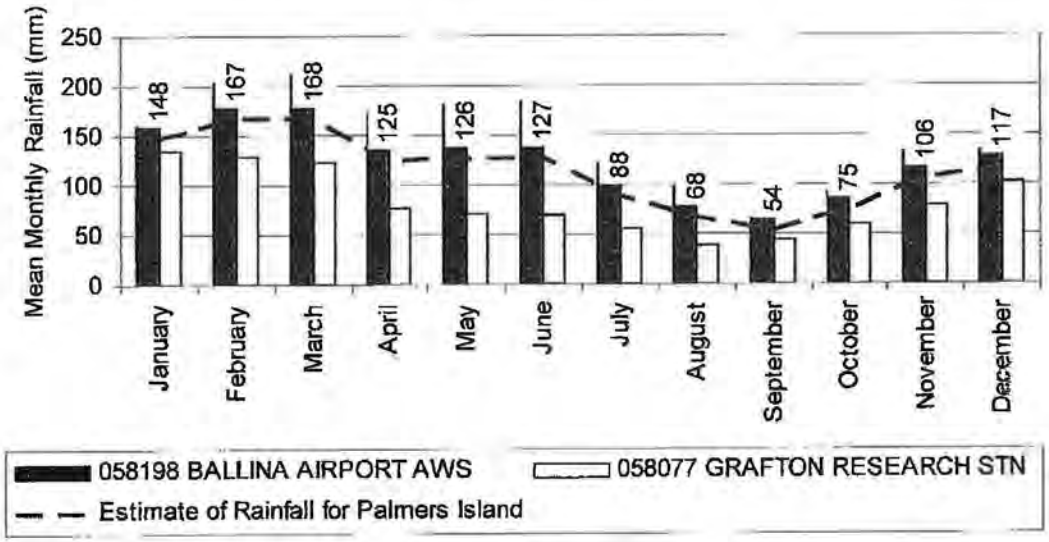


Figure 5.1 Long term monthly rainfall estimates for Palmers Island

These results summarised on Table 5.3 also include a calculations of the typical "footprint" of the land disposal area (ie. including sidewall-to-side wall spacing for micro-trenches etc.) based on the typical arrangements detailed in Section 4, and assuming an area of land 200m long is available.

Table 5.3 Summary of land disposal area sizes

Land Disposal Method	DLR (mm/d)	Disposal Surface required (m^2)	Typical Layout and Footprint required
SSI	2.14	31800	Area required = 3.18Ha (200m x 159m) (D_{tot} = 300mm)
Micro trenches	5	11400	Total footprint = 2.45Ha (200m x 123m) (D_{tot} = 300mm, W = 300mm, Spacing 1000mm)
ETA	5	10600	Total footprint = 1.42Ha (200m x 71m) (D_{tot} = 500mm, W = 3000mm, Spacing 1000mm)

The results show that up to approximately 3.2Ha of land could be required for effluent disposal, depending on the system adopted.

Project	**084320 - Onsite Effluent Disposal by: Sub Surface Irrigation.**
Location	Palmers Island, NSW
Date	Site Visit 2nd December 2008
Method	Nominated Area Method (EPA, 1998)
Sample Number	**084320/1 and 084320/3**
Soil Description	Topsoil and silty clay
Field Permeability	0.0007m/d (average of P1, P2 and P3)
Soil Permeability Category	5c (EPA, 1998)
Notes	Rainfall Average of BOM record for Grafton Research Stn (1917-2008) and Ballina Airport (1992-2008). Pan Evaporation Coffs Harbour (1968-2008)

Parameter	Units	Value	
Design Wastewater Flow	l/d	50760	All wastewater from: 53 cabins (3 p/cabin @ 130l/p/d) 100 sites (3p/site @ 100l/p/d)
Design Percolation Rate	mm/d	2.14285714	15mm/week
Area	m2	31779	
Fraction of rainfall retained		0.8	

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Raw Precipitation	mm/month	147.8	166.7	167.7	124.9	126.1	127.2	88.0	68.2	54.3	75.5	106.1	116.8
Retained Precipitation	mm/month	118.2	133.4	134.2	99.9	100.8	101.8	70.4	54.6	43.4	60.4	84.8	93.4
Evaporation	mm/month	195.3	159.6	151.9	120.0	85.8	72.0	77.5	108.5	138.0	164.3	174.0	188.4
Crop Factor		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
INPUTS													
Effluent irrigation	mm/month	49.5	44.7	49.5	47.9	49.5	47.9	49.5	49.5	47.9	49.5	47.9	49.5
Net Input	mm/month	167.8	178.1	183.7	147.8	150.4	149.7	119.9	104.1	91.4	109.9	132.8	142.9
OUTPUTS													
Effective Evaporation	mm/month	136.7	111.7	106.3	84.0	60.8	50.4	54.3	76.0	96.6	115.0	121.8	138.9
Percolation	mm/month	66.4	60.0	66.4	64.3	66.4	64.3	66.4	66.4	64.3	66.4	64.3	66.4
Net Outputs	mm/month	203.1	171.7	172.8	148.3	127.2	114.7	120.7	142.4	160.9	181.4	186.1	205.3
STORAGE													
Storage	mm/month	-35.4	6.4	10.9	-0.4	23.2	35.0	-0.8	-38.3	-69.5	-71.6	-53.3	-62.4
Cumulative Storage	mm/month	0.0	6.4	17.3	16.8	40.0	75.0	74.2	35.9	0.0	0.0	0.0	0.0

Max depth	mm	75.0	
Volume	m3	2383.22	
Assumed effective porosity (n)		0.3	For trench material (Blue metal or similar)
Total depth required	mm	250	Max depth of effluent
Assumed DEPTH OF IRRIGATIO	m	0.3	
Assumed FREEBOARD	m	0.05	Depth is greater than D + Freeboard

Figure 5.2 Water Balance calculation: Sub-Surface Irrigation

Project	**084320 - Onsite Effluent Disposal by: Micro Adsorption Trench**
Location	Palmers Island, NSW
Date	Site Visit 2nd December 2008

Method	Nominated Area Method (EPA, 1998)
Sample Number	**084320/1 and 084320/3**
Soil Description	Topsoil and silty clay
Field Permeability	0.0007m/d (average of P1, P2 and P3)
Soil Permeability Category	5c (EPA, 1998)
Notes	Rainfall Average of BOM record for Grafton Research Stn (1917-2008) and Ballina Airport (1992-2008). Pan Evaporation Coffs Harbour (1968-2008)

Parameter	Units	Value	
Design Wastewater Flow	l/d	50760	All wastewater from: 53 cabins (3 p/cabin @ 130l/p/d) 100 sites (3p/site @ 100l/p/d)
Design Percolation Rate	mm/d	5	
Area	m2	11396	
Fraction of rainfall retained		0.8	

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Raw Precipitation	mm/month	147.8	166.7	167.7	124.9	126.1	127.2	86.0	68.2	54.3	75.5	106.1	116.8
Retained Precipitation	mm/month	118.2	133.4	134.2	99.9	100.9	101.8	70.4	54.6	43.4	60.4	84.8	93.4
Evaporation	mm/month	195.3	159.6	151.9	120.0	86.8	72.0	77.5	108.5	138.0	164.3	174.0	198.4
Crop Factor		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
INPUTS													
Effluent Irrigation	mm/month	138.1	124.7	138.1	133.6	138.1	133.6	138.1	138.1	133.6	138.1	133.6	138.1
Net Input	mm/month	256.3	258.1	272.2	233.5	238.9	235.4	208.4	192.8	177.1	198.4	218.5	231.5
OUTPUTS													
Effective Evaporation	mm/month	136.7	111.7	106.3	84.0	60.8	50.4	54.3	76.0	96.6	115.0	121.8	138.9
Percolation	mm/month	155.0	140.0	155.0	150.0	155.0	150.0	155.0	155.0	150.0	155.0	150.0	155.0
Net Outputs	mm/month	291.7	251.7	261.3	234.0	215.8	200.4	209.3	231.0	246.6	270.0	271.8	293.9
STORAGE													
Storage	mm/month	-35.4	6.4	10.9	-0.5	23.2	35.0	-0.8	-38.3	-69.5	-71.6	-53.3	-62.4
Cumulative Storage	mm/month	0.0	6.4	17.3	16.8	40.0	75.0	74.1	35.8	0.0	0.0	0.0	0.0

Max depth	mm	75.0	
Volume	m3	854.23	
Assumed effective porosity (n)		0.3	For trench material (Blue metal or similar)
Total depth of trench required	mm	250	Max depth of effluent
Assumed DEPTH	m	0.3	
Assumed FREEBOARD	m	0.05	Trench depth is greater than D + Freeboard
Assumed WIDTH	m	0.3	
Length of trench	m	18993	Required trench length (L=A/(W+D)) (m) for TRENCH

Figure 5.3 Water Balance calculation: Micro Trenches

Project	**084320 - Onsite Effluent Disposal by: Evapotranspiration Adsorption (ETA) Bed**
Location	Palmers Island, NSW
Date	Site Visit 2nd December 2008
Method	Nominated Area Method (EPA, 1998)
Sample Number	**084320/1 and 084320/3**
Soil Description	Topsoil and silty clay
Field Permeability	0.0007m/d (average of P1, P2 and P3)
Soil Permeability Category	5c (EPA, 1998)
Notes	Rainfall Average of BOM record for Grafton Research Stn (1917-2008) and Ballina Airport (1992-2008). Pan Evaporation Coffs Harbour (1968-2008)

Parameter	Units	Value											
Design Wastewater Flow	l/d	50760	All wastewater from: 53 cabins (3 p/cabin @ 130l/p/d) 100 sites (3p/site @ 100l/p/d)										
Design Percolation Rate	mm/d	5											
Area	m2	10597											
Fraction of rainfall retained		0.8											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Raw Precipitation	mm/month	**147.8**	**166.7**	**167.7**	**124.9**	**126.1**	**127.2**	**88.0**	**68.2**	**54.3**	**75.5**	**106.1**	**116.8**
Retained Precipitation	mm/month	**118.2**	**133.4**	**134.2**	**99.9**	**100.8**	**101.8**	**70.4**	**54.6**	**43.4**	**60.4**	**84.8**	**93.4**
Evaporation	mm/month	**195.3**	**156.6**	**151.9**	**120.0**	**86.8**	**72.0**	**77.5**	**108.5**	**138.0**	**164.3**	**174.0**	**198.4**
Crop Factor		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
INPUTS													
Effluent Irrigation	mm/month	148.5	134.1	148.5	143.7	148.5	143.7	148.5	148.5	143.7	148.5	143.7	148.5
Net Input	mm/month	266.7	267.5	282.7	243.6	249.3	245.5	219.9	203.1	187.1	208.9	226.5	241.9
OUTPUTS													
Effective Evaporation	mm/month	136.7	111.7	106.3	84.0	60.8	50.4	54.3	76.0	96.6	115.0	121.8	138.9
Percolation	mm/month	155.0	140.0	155.0	150.0	155.0	150.0	155.0	155.0	150.0	155.0	150.0	155.0
Net Outputs	mm/month	291.7	251.7	261.3	234.0	215.8	200.4	209.3	231.0	246.6	270.0	271.8	293.9
STORAGE													
Storage	mm/month	-25.0	15.8	21.3	9.6	33.6	45.1	9.6	-27.9	-59.5	-61.2	-43.3	-52.0
Cumulative Storage	mm/month	0.0	15.8	37.1	46.7	80.3	125.3	134.9	107.0	47.6	0.0	0.0	0.0
Max depth	mm	134.9											
Volume	m3	**1429.92**											
Assumed effective porosity (n)		**0.3**	For trench material (Blue metal or similar)										
Total depth of trench required	mm	**450**	Max depth of effluent										
Assumed DEPTH	m	**0.5**	500mm deep bed (100mm topsoil over 150mm sand, over 200mm gravel, over 50mm sand)										
Assumed FREEBOARD	m	**0.05**	Trench depth is greater than D + Freeboard										
Assumed WIDTH	m	**3**											
Length of bed	m	3532	Required trench length (L=A/(W)) (m) for BEDS										

Figure 5.4 Water Balance calculation: Evapotranspiration/Adsorption Beds

6 CONCLUSIONS AND RECOMMENDATIONS

This investigation concludes that the disposal of domestic type effluent from the Proposed Park is possible on an area of land to the east of the Park. The wastewater treatment works should treat the effluent to at least secondary levels and a disinfection system should be employed. The analysis has shown that up to 3.2Ha could be required for the effluent disposal area. However, given the significant site and soil constraints of this site the final design of a suitable land disposal area is likely to comprise of a specialised system. This system is likely to utilise primarily evapotranspiration to remove the volume of treated effluent, plant uptake to remove nutrients and a filter medium (eg. sand layers in an ETA bed or mound system) to assist in polishing the effluent. Therefore it is considered likely that less than the 3.2Ha will be required for effluent disposal. It is recommended that a minimum 2.5Ha be set aside for an effluent disposal field (say, 200m X 125m) and a further 0.64Ha (approximately) will be required for the buffers on the northern (20m buffer), southern (12m buffer) and eastern (12m buffer) boundaries. Hence, at least 3.14Ha in total should be included in the rezoning application, for effluent disposal purposes. This should allow flexibility in the ultimate land disposal method adopted for the Park.

Other issues relevant to the wastewater treatment and effluent disposal systems for the proposed Park are briefly detailed below and may require further investigation prior to design/construction:

- Given various site and soil constraints identified at this location, it is recommended that the development of the Park should implement all methods of reducing wastewater loads including, but not limited to:
  - Installing the highest level of water efficient devices (showers, toilets, washing machines etc.)
  - Maximising reuse of treated effluent within the landscaping of the Park
  - Consideration should be given to installing a split grey/blackwater system to enable more efficient re-use and reduced disinfection requirements.
- All components of the wastewater treatment and disposal systems should be designed to manage seasonal fluctuations in wastewater loads (holiday periods etc.).
- All components of the wastewater treatment and disposal systems should be designed in light of the significant flood potential of the site.
- All components of the wastewater treatment and disposal systems should be designed and constructed in accordance to relevant CVC conditions, Australian Standards and NSW Health regulations.
- The soils at this location are acidic, low permeability soils with a tendency to be dispersive. Improvement of the soils will be required over the land disposal area and may include; import of sandy material (to improve the soil texture), addition of lime (to reduce acidity) and addition of gypsum (to reduce potential for dispersion). Vegetation species for evapotranspiration-assisted disposal systems should be chosen to suit the specific soil conditions on site.
- The land disposal area should be operated in a number of sections, to allow areas to be "rested" during low loading periods.
- Given the flat nature of the land, irrigation systems and gravity-fed disposal systems must be designed to ensure an even distribution of effluent over the entire land disposal area.
- Buffers of 12m should be maintained around the land disposal area and a buffer of 20m should be maintained from Yamba Street. These buffers should be planted with suitable vegetation to assist in nutrient removal and also provide screening. They may also contain access track and drainage.

- There is a potential for acid sulphate soils to exist at this location. Appropriate investigations may be required prior to excavations on-site.

7 Management, Operation and Maintenance

The management, maintenance and monitoring of the wastewater treatment and effluent disposal system for the Park will be critical to the its successful operation. It is essential that a comprehensive operation and maintenance manual be developed to accompany the final systems adopted. The manual should include emergency plans to cover possible system failure scenarios. Monitoring regimes should be developed in consultation with the relevant authorities to ensure the quality of the effluent is maintained and the receiving environment is not adversely impacted.

References

E.P.A. Guidelines. (1998). "Environment & Health Protection Guidelines: Onsite sewage management for single households".

Australian Standard 1547 (2000). Onsite domestic wastewater management.

Department of Environment and Conservation (DEC) NSW. (2004). "Environmental Guidelines: Use of Effluent by Irrigation".

Appendix A

Water quality test results from groundwater sampled at Borehole 4 and 5

COFFS HARBOUR LABORATORY

HOMLES AND HOLMES
P.O. BOX 7159
COFFS HARBOUR NSW 2450

BATCH NUMBER: 08/2361
No. of SAMPLES: 2
DATE COLLECTED: 2/12/08
DATE RECEIVED: 3/12/08
TIME RECEIVED: 10:30

ANALYTICAL REPORT

SAMPLE REFERENCE	SAMPLE DESCRIPTION
08/2361/1	BORE HOLE 4
08/2361/2	BORE HOLE 5

ANALYSIS	METHOD NO	UNITS	08/2361/1	08/2361/2
pH	APHA 4500-H+ B	pH unit	6.3	5.0
Temperature		°C	21	21
Total Dissolved Solids	EL7D	mg/L	222	186
Conductivity	APHA 2510 B	µS/cm	443	371
Salinity	EL6	ppt	0.3	0.3
Turbidity	APHA 2130 B	NTU	> 5,000	> 5,000
Calcium Hardness as $CaCO_3$	APHA 3125 B	mg CaCO3/L	116	24
Alkalinity as CaCO3	APHA 2320 B	mg/L	113	12
Nitrite Nitrogen	APHA 4500-NO3 I	mg/L	0.54	<0.05
Nitrate Nitrogen	APHA 4500-NO3 I	mg/L	1.69	0.17
Oxidized Nitrogen	APHA 4500-NO3 I	mg/L	2.23	0.17
Ammonia Nitrogen	APHA 4500-NH3 H	mg/L	0.93	0.07
Total Nitrogen	APHA 4500-N C	mg/L	43.1	13.3
Total Phosphorus	APHA 4500-P H	mg/L	1.50	0.39
Iron	APHA 3125 B	mg/L	108	201
Manganese	APHA 3125 B	mg/L	0.72	0.98
Copper	APHA 3125 B	mg/L	0.38	0.34
Faecal Coliforms	APHA 9222 D	cfu/100mL	**	**
Langelier Index			-1.5	-4.5

Comments

This Amended report replaces report signed 03.10.07.
* Sample Over range due to high turbidity and will be re sampled and repeated.
**Due to high turbudity and percentage solids in samples, unable to perform membrane filtration technique.
Sample(s) collected by client and analysed as received.
Analysis performed according to "Standard Methods for the Examination of Water & Wastewater", 21st Edition. 2005. APHA.
Raw data sheets stating analysis dates are available upon request.

Approved: _____ 5 January 2009

B J Wadleigh
Laboratory Manager

NATA

This document is issued in accordance with NATA's accreditation requirements

Accredited for compliance with ISO/IEC 17025
[Accreditation Numbers 12569 (Chemical) & 14565 (Microbiological)]

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Appendix B: Soil Laboratory Results

WASTEWATER DISPOSAL SOIL ASSESSMENT (Page 1 of 1)

3 soil sample from Holmes and Holmes supplied on 5th December, 2008 - Lab Job No. A1309
Analysis requested by Matt. Your Reference:4320

	SITE 1 4320/1- 300-500	SITE 2 4320/2- 800-1000	SITE 3 4320/3- 200-450
Job No.	*A1309/1*	*A1309/2*	*A1309/3*
Description	Heavy Clay	Sandy Clay	Clay Loam
Modified Emerson Aggregate Test [note 12]	Aus. Std. Class 2	Aus. Std. Class 5	Aus. Std. Class 4
Soil pH (1:5 $CaCl_2$)	4.20	4.35	4.13
Soil Conductivity (1:5 water dS/m)	0.079	0.055	0.065
Soil Conductivity (as EC_e dS/m) [note 10]	1.106	0.770	0.910
Native NaOH Phosphorus (mg/Kg P)	10	0	7
Residual phosphorus remaining in solution from the initial phosphate phosphorus			
Initial Phosphorus concentration (ppm P)	30	30	30
72 hour - 3 Day (ppm P)	12.81	17.48	7.72
120 hour - 5 Day (ppm P)	11.77	16.95	6.73
168 hour - 7 Day (ppm P)	11.21	15.81	6.39
Equilibrium Phosphorus (ppm P)	10.06	14.96	5.36
EXCHANGEABLE CATIONS			
Calcium ($cmol^+$/Kg)	6.17	3.00	5.50
Magnesium ($cmol^+$/Kg)	3.51	2.33	4.27
Potassium ($cmol^+$/Kg)	0.28	0.17	0.22
Sodium ($cmol^+$/Kg)	0.54	0.60	0.41
Aluminium ($cmol^+$/Kg)	1.40	0.61	2.30
Hydrogen ($cmol^+$/Kg)	0.60	0.38	0.94
ECEC (effective cation exchange capacity)($cmol^+$/Kg)	12.51	7.07	13.64
Exchangeable Calcium %	49.4	42.4	40.3
Exchangeable Magnesium %	28.1	32.9	31.3
Exchangeable Potassium %	2.2	2.4	1.6
Exchangeable Sodium % (ESP)	4.3	8.5	3.0
Exchangeable Aluminium %	11.2	8.6	16.9
Exchangeable Hydrogen %	4.8	5.3	6.9
Calcium/ Magnesium Ratio	1.76	1.29	1.29

Notes:
1: ECEC = Effective Cation Exchange Capacity = sum of the exchangeable Mg, Ca, Na, K, H and Al
2: Exchangeable bases determined using standard Gilman and Sumpter (1989) digest (Method 15E1) with no pretreatment for soluble salts. When Conductivity ≥0.25 dS/m soluble salts are removed (Method 15E2).
3. ppm = mg/Kg dried soil
4. Insitu P determined using 0.1M NaOH and shaking for 24 hrs before determining phosphate
5. Soils were crushed using a ceramic grinding head and mill; five 1g subsamples of each soil were used to which 40ml of 0.1M NaCl with Xppm phosphorus was added to each. The samples were shaken on an orbital shaker
6. Exchangeable sodium percentage (ESP) is calculated as sodium ($cmol^-$/Kg) divided by ECEC
7. All results as dry weight DW - soils were dried at 60C for 48hrs prior to crushing and analysis.
8. Phosphorus Capacity method from Ryden and Pratt, 1980.
9. Aluminium detection limit is 0.05 $cmol^+$/Kg; Hydrogen detection limit is 0.1 $cmol^+$/Kg. However for calculation purposes a value of 0 is used
10. For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm; EC_e conversions: sand loam 14, loam 9.5; clay loam 8.6; heavy clay 5.8
11. 1 $cmol^-$/Kg = 1 meq/100g
12. Now changed to Australian Standard 1289.3.8.1-1997 but with using the SARS solution.

PHOSPHORUS SORPTION TRIAL (Page 1 of 1)

3 soil sample from Holmes and Holmes supplied on 5th December, 2008 - Lab Job No. A1309
Analysis requested by Matt. Your Reference:4320

Calculations for Equilibrium Absorption Maximum for Soil provided

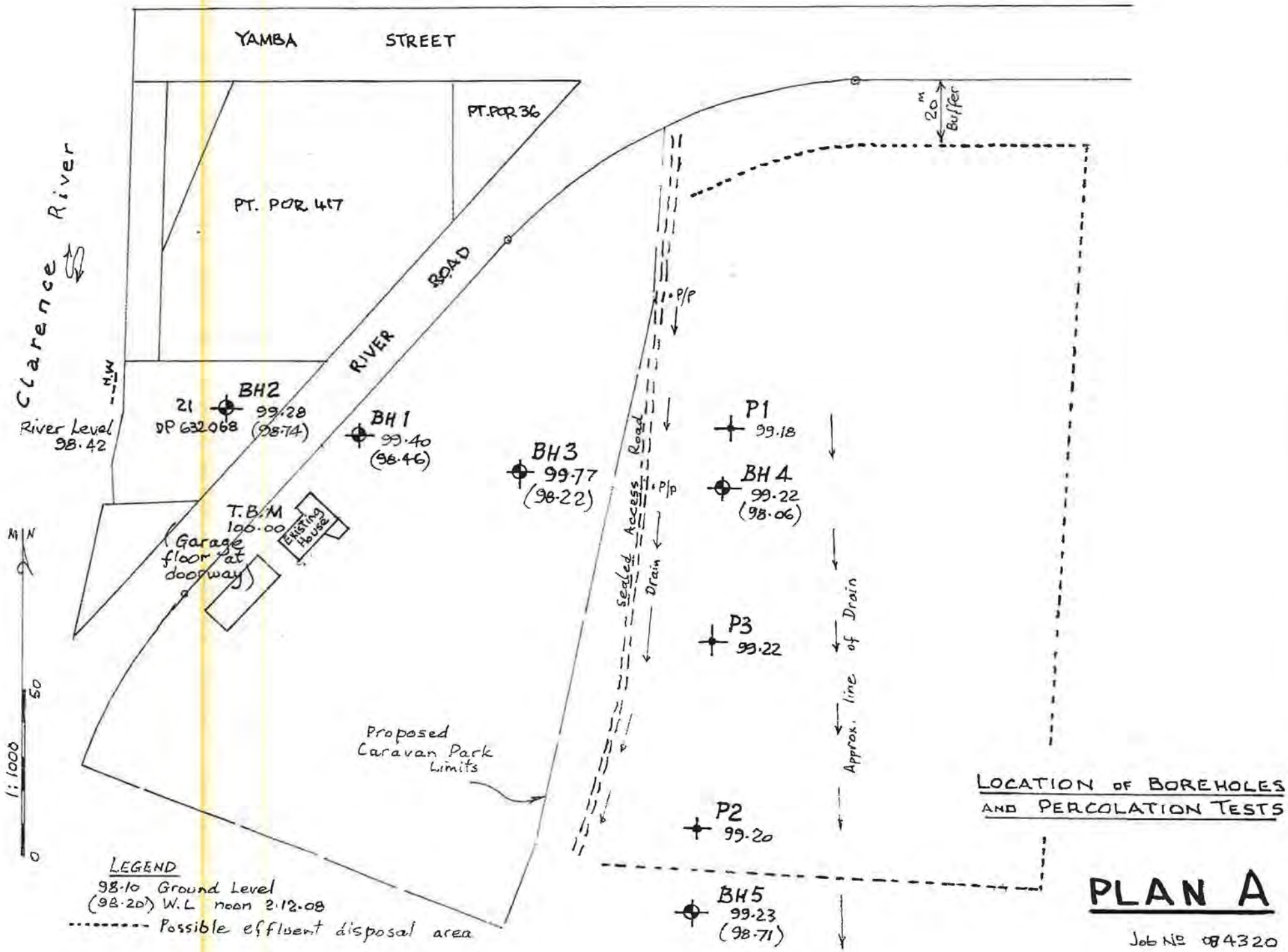
I.D.	JOB NO.	Equilibrium P mg P/L (in solution)	Added P mg P/L	P Sorb at Equil. mg P/Kg	Native P mg P/Kg	Equilibrium P Sorption Level µg P/g soil	Divide Ø (from Table)	Equilibrium Absorption Maximum (B) µg P/g soil
4320/1- 300-500	A1309/1	10.06	30	798	9.60	807	0.77	1,047
4320/2- 800-1000	A1309/2	14.96	30	602	0.00	602	0.84	718
4320/3- 200-450	A1309/3	5.36	30	986	6.80	993	0.68	1,470

Calculations for phosphorus sorption capacity

	JOB NO.	Equilibrium Absorption Maximum (B) µg P/g soil	multiply by theta of wastewater to be applied (=X)	minus the native P (=Y)	Kg P sorption / hectare (to a depth of 15cm) (1.95 is a correction factor for density, etc)	Kg P sorption / hectare (to a depth of 100cm) (1.95 is a correction factor for density, etc)
4320/1- 300-500	*A1309/1*	1047	(=B x theta)	(=X -native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
4320/2- 800-1000	*A1309/2*	718	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
4320/3- 200-450	*A1309/3*	1470	(=B x theta)	(=X -native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)

EXAMPLE 1 - Calculations for phosphorus sorption capacity using a wastewater phosphorus of 15mg/L P

	JOB NO.	Equilibrium Absorption Maximum (B) µg P/g soil	multiply by theta of wastewater to be applied (ie. 0.84)	minus the native P (=Y)	Kg P sorption / hectare (to a depth of 15cm) (1.95 is a correction factor for density, etc)	Kg P sorption / hectare (to a depth of 100cm) (1.95 is a correction factor for density, etc)
4320/1- 300-500	*A1309/1*	1047	879	870	1,696	11,306
4320/2- 800-1000	*A1309/2*	718	603	603	1,175	7,837
4320/3- 200-450	*A1309/3*	1470	1235	1228	2,395	15,968


YAMBA STREET
PT. POR 36
PT. POR 417
Clarence River
RIVER ROAD
M.W.
River Level 98.42
BH2
21 DP 632068
99.28
(98.74)
BH1
99.40
(98.46)
BH3
99.77
(98.22)
T.B.M
100.00
Garage floor at doorway
EXISTING House
P1
99.18
BH4
99.22
(98.06)
P3
99.22
P2
99.20
BH5
99.23
(98.71)
P/P
Access Road
Sealed Drain
Approx. line of Drain
20m Buffer
Proposed Caravan Park Limits
N
1:1000
50
0
LEGEND
98.10 Ground Level
(98.20) W.L noon 2.12.08
Possible effluent disposal area
LOCATION OF BOREHOLES AND PERCOLATION TESTS
PLAN A
Job No 084320

Annexure G
Draft Flood Evacuation Plan

Proposed Caravan Park

Palmers Island

Lot 27 DP 1130643

Flood Evacuation Plan

28 April 2011

RESOURCE DESIGN & MANAGEMENT PTY LTD

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361 Harbour Drive
PO Box 4430
COFFS HARBOUR JETTY NSW 2450
www.resdesman.com.au

Contents

Annexure

1. Caravan Park Details

1.1 Contact Details

Name:
Address:
Postal Address:
Caravan Park Telephone Number:
24hr Telephone Number:
Contact Personnel:

NOTE: These details will be completed prior to the Park commencing operation.

1.1 Emergency Contacts

Name	Number
Park Owner	
Park Operator	
Staff Contact Details	
Local Police Station	Yamba Police Station 47 Wooli Street Yamba Ph 6603 0199
Local Ambulance Station	Yamba Ambulance Station Treelands Drive, Yamba Ph 131233
Local Fire Station	Yamba Fire Station 14 River Street Yamba Ph 6646 2058
Local SES	Clarence Nambucca Regional HQ 26 Induna Street Grafton Ph 6641 6900
Others Emergency Contact	

NOTE: These details will be completed prior to the Park commencing operation.

2. Preparedness

2.1 The Flood History

Date of Event	Flood Level at Caravan Park (mAHD)	Gauge height at Prince Street Grafton	Consequences experienced at Caravan Park

NOTE: These details will be completed prior to the Park commencing operation.

2.2 Flood Height Data

PARK FEATURES **Mclean Flood Gauge**	**GROUND LEVEL (mAHD)**	**Depth of inundation over ground level at Palmers Island**			
		5 yr ARI **1.77m AHD**	**20yr ARI** **2.44m AHD**	**100 yr ARI** **2.86m AHD**	**500 yr ARI** **3.09 AHD**
Reception					
Amenities Block					
Maintenance Building					
Van/Vehicle storage area					
Utilities Infrastructure (eg underground electricity / switchboards)					
Park Entrance					
Lowest site in park – No.					
Highest site in park – No.					
Evacuation Route height					

NOTE: These details will be completed prior to the Park commencing operation.

2.3 Elements at Risk

Risks	Total	Approximate No. of occupants (Peak season)	Approximate No. of occupants (Low season)
Total Number of sites	133	744	351
Number of Powered sites (for tourist hire)	85		
Number of Un-powered sites (for tourist hire)	0		
Total Number Permanent sites	0	0	0
Number of moveable structures on permanent sites	48		
Average number of stored caravans	0		

2.4 Warning Systems

Gauge Name	Flood Classification levels (State Flood Plan)			Method of Reading gauge (Website/Manual/ other)
	Minor	Moderate	Major	
Maclean Flood Gauge	1.5m	2.1	2.5	Bureau of Meteorology Website and Radio 2GF, FM 104.7 and ABC North Coast.

2.5 Key Triggers

Trigger	Key Action	Resources	Time Required
Flood watch issued	Be alert to the possibility of a pending evacuation and monitor websites and radio.	Use o f Park Office	30mins
Flood waters rises to 1m at the Maclean Flood Gauge.	Advise all park occupants of a possible flood evacuation if the water rises to 2m at the Maclean Flood Gauge. Ensure all park occupants are aware of the safe evacuation routes and encouraged to leave if possible.	Park staff to approach all occupants and verbally advise of the possible flood and evacuation. Hand out maps of the safe evacuation routes.	2hrs
Flood waters rises to 1.5m at the Maclean Flood Gauge.	Commence packing and move all items to higher ground in preparation for flooding and evacuation.	Park Staff and occupants	2hrs
Flood waters rises to 2m at the Maclean Flood Gauge.	Commence evacuation of the Park	Park Staff and occupants	4hrs

2.6 Flood Consequences

Consequence	Local Indicator	Level at park (m AHD)	Reference Gauge height
Evacuation route cut			
Flooding commences at Parks lowest point			
Caravan Park inundate at 2.95mAHD			
Caravan Park to be evacuated			

NOTE: These details will be completed prior to the Park commencing operation.

2.7 Arrangements for the Evacuation of the Caravan Park

ADVISING PROCEDURES

Caravan Park proprietors will ensure that the owners and occupiers of cabins and sites are:

1. Made aware that the caravan park is flood liable by:
   - Handing a printed notice to occupiers taking up residence. The notice will indicate that the caravan park is liable to flooding and outline the evacuation arrangements as detailed in this Flood Evacuation Plan.
   - Displaying this notice prominently in each cabin.

The SES Local Controller will ensure that the managers of caravan parks are advised of flood warnings and the details of any evacuation order.

EVACUATION OF OCCUPANTS AND RELOCATION OF VANS

1. Caravan park proprietors will install flood depth indicators and road alignment markers within their caravan parks.
2. When an evacuation order is give guests and their vans are to be evacuated from the Park.
3. Caravan park managers will:
    - Ensure that their caravan park is capable of being evacuated within[Insert time frame] .
    - Advise the Local Controller of, the number of people requiring transport, details of any medical evacuations required, whether additional assistance is required to effect the evacuation.
    - Inform the SES Local Controller when the evacuation of the caravan park has been completed.
    - Provide the SES Local Controller with a register of people that have been evacuated.

RETURN OF OCCUPANTS AND VANS

The SES Local Controller, using council resources as necessary, will advise when it is safe for the caravan parks to be re-occupied.

3. Response

3.1 Evacuations

	Comment
Method of communicating flood warning/s	Park staff to advise all occupants of possible flooding and pending evacuation when floodwaters rise to 1m at the Maclean Flood Gauge.
Method of communicating evacuation warnings / orders	Park staff to advise all occupants of possible flooding and commence preparations for an evacuation when floodwaters rise to 1.5m at the Maclean Flood Gauge.
Evacuation Assembly Point (on-site)	
Alternate Evacuation Assembly Point (on-site)	
Evacuation Routes	All vehicles are to be evacuated via Yamba Street to Yamab Road then to the Pacific Highway and then north along the Pacific Highway to non flood prone areas.
Location of Evacuation Centre	
Location of caravan/vehicle/boat storage	

NOTE: These details will be completed prior to the Park commencing operation.

Evacuation Route
Comment:

3.1.1 Preparation – Prior to Emergency

PREPARATION – PRIOR TO EMEGENCY				
Action	***When***	***Responsibility (identify staff member)***	***Resources***	***Completed***
Maintain Emergency Plan and Provide copy to Emergency Organisations				□ ***SES*** □ ***POLICE*** □ ***OTHER***
Maintain a flood emergency kit (as per SES advice)				□
Back up records, accounts and computer files and store off site and out of floodplain				□
Document OH&S procedures for a flood				□
Display evacuation procedures in office, amenities block/s, other locations				□
Check un-moveable structures for safety				□
Check moveable structures ensuring moveable status remains current				□
Practise evacuation procedures (staff and/or occupants)				□
Flood proof infrastructure				□

NOTE: These details will be completed prior to the Park commencing operation.

3.1.2 Response – Emergency Warnings Issued

RESPOND – EMERGENCY WARNINGS ISSUED				
Action	***When***	***Responsibility (identify staff member)***	***Resources***	***Completed***
Access relevant information regarding emergency eg; website, local intelligence, radio stations				☐
Check availability of staff and others to assist in emergency				☐
Check availability of equipment to assist in evacuation and re-location (eg trucks)				☐
Communicate threat assessment to park occupants and staff				☐
Complete park occupant registration				☐
Communicate assembly points, evacuation route and evacuation centre				☐
Organise possible transport to evacuation centres for those occupants without private transport				☐
Continue updating evacuation registration				☐
Ensure sufficient non-perishable supplies are stored in flood safe area.				☐
Liaise with Local SES				☐

NOTE: These details will be completed prior to the Park commencing operation.

3.1.3 Response – Emergency Occurring

RESPOND – EMERGENCY OCCURING				
Action	***When***	***Responsibility (identify staff member)***	***Resources***	***Completed***
Continue to obtain information regarding emergency from relevant agencies (eg Police, SES)				☐
Issue Evacuation Order and record evacuee's				☐
Manage evacuation of occupants without private transport				☐
Provide occupant list and evacuee registration list to emergency personnel				☐
Relocate moveable structures and/or van and boats to flood safe area.				☐
Lift/store items to flood safe height or area				☐
Check items previously secured to prevent floatation				☐
Block toilets, sinks and floor wastes with sandbags				☐
Relocate Hazardous materials to flood safe area				☐
Turn off electricity, gas and water				

NOTE: These details will be completed prior to the Park commencing operation.

3.1.4 Recover – All Clear Given

RECOVER – ALL CLEAR GIVEN				
Action	***When***	***Responsibility (identify staff member)***	***Resources***	***Completed***
*Obtain **'ALL CLEAR'** status from emergency organisation*				☐
Clean, disinfect and remove debris from park				☐
Return any vans/vehicles moveable structures back on-site.				☐
Have utilities including gas and electricity certified safe				☐
Communicate 'All Clear' status to park occupants and staff				☐

NOTE: These details will be completed prior to the Park commencing operation.

4. Grafton & Lower Clarence FRMP

The Grafton & Lower Clarence FRMP made a number of recommendations on the future of caravan parks in Palmers Island. Each recommendation is responded to below.

- *A distinction should be drawn between tourist related developments (traditional caravan parks which often evolve into modern tourist complexes) and permanent housing (residential parks and manufactured home estates).*

Response;

The proposed caravan park is only for tourists only, no permanent residences are proposed. This lessens the risk to human life from flooding.

- *The flood related development controls that would normally apply to standard residential housing, should at a minimum be applied to residential parks (e.g., ground and floor level controls). It could be argued that more stringent controls should be imposed, since residents tend to be less equipped to cope with flooding. This must be balanced against the social cost of discouraging affordable housing.*

Response;

The park design is at initial stages and complies with the same minimum floor levels required by Council for residential houses in flood prone areas.

- *Conversely, lower standards could be applied to purely tourist related developments on the basis that the social and economic consequences of flooding would be less than those associated with permanent housing. This position recognises the economic planning imperative of locating tourist related developments in proximity to natural features such as rivers.*

Response;

The proposed caravan park will comply with the same minimum floor levels required by Council for residential houses in flood prone areas.

- *There should be no distinction between tourist parks and residential parks when considering risk to human life. If depths and velocities are high, and if the rate of rise of floodwaters is such that people could be trapped in dangerous conditions, then development should not be permitted.*

Response;

Due to the nature of flooding upstream from Palmers Island there is adequate flood monitoring, warnings and time to evacuate all park personnel and guests well before any threat to human life is apparent. This is documented in Section 2.5 Key Triggers. All persons remaining at the park when the Maclean Flood Gauge reaches 2m will be evacuated along the designated evacuation route attached at Annexure B.

- *The specific structural characteristics of caravans, rigid annexes and manufactured homes need to be individually recognised within planning controls. Measures to prevent structures floating away during floods, and to minimise physical damage, need to be employed, requiring engineering solutions.*

Response;

The park design is at initial or strategic stages however park facilities and buildings will comply with a higher structural standard suitable for buildings in flood prone areas if required by Council. Further details on the structural standard will be included with the Development Application for the Caravan Park for assessment and approval from Council.

- *More needs to be done to require managers of all flood-prone caravan parks to advise occupants of the risk and to prepare current, site-specific, written Flood Action Plans. An approval system could provide a mechanism to implement, monitor and review awareness programs and evacuation strategies. Means of raising awareness of flood risk include constructing flood markers and displaying the Flood Action Plan in all dwellings. Among other points, plans should take into account the unique circumstances of each park: the extent and depth of the 20 year, 100 year and probable maximum floods; the number and manoeuvrability of dwellings; the number and mobility of tourists and residents; and the route, resources and time required to achieve a safe evacuation.*

Response;

This Draft Flood Evacuation Plan documents a broad approach to flood evacuation planning for this specific site and shows that there is a considerable amount of time available for evacuation between the onset of a flood threat and any risk to human life.

This Flood Evacuation Plan highlights a numbers of Flood Height Triggers (Section 2.5 Key Triggers) which require an action from Caravan Park Staff and Guests with regards to flood evacuation. These trigger heights have been provided by the State Emergency Service and a based on their flood intelligence data.

Inundation of the park occurs at a flood height of 2.95 metres at the Maclean Flood Gauge, by this time in accordance with this Flood Evacuation Plan all persons will have be evacuated from the park and well away from the park and any risk of flooding from the Clarence River.

This current Flood Evacuation Plan is a Draft only, due to the early stage of this project. The remaining parts of this plan will be completed at each stage of the development process, concluding with an approval for a Caravan Park with a comprehensive site specific Flood Evacuation Plan.

Annexure A –

Proposed Caravan Park Layout

PRELIMINARY
4th February 2009

NOTE
- The dimensions, areas and numbers of lots shown hereon are subject to field survey and to the requirements of Council and any other authority under any legislation.
- In particular, no reliance should be placed on the information on this plan for any financial dealings or detailed engineering design involving the land.
- Resource Design and Management Pty Ltd therefore disclaims any liability for any loss or damage whatsoever incurred arising from any party who uses or relies upon this plan for any purpose other than as a document prepared for the sole purpose of making a Development Application to Council and which may be subject to alteration for reasons beyond the control of Resource Design and Management Pty Ltd.
- This plan is not a plan of an approved subdivision.
- This note is an integral part of this plan and the plan must not be reproduced without this note.

PROJECT:
CONCEPTUAL SUBDIVISION DESIGN
OPTION 1
'THE VILLAGE' CARAVAN PARK
RIVER ROAD, PALMERS ISLAND

SCALE - 1:1000 @ A1
DWG No. 07081/5 DATE: September 2008
CAD DWG No. 07081 Park Layout Option 1

CLIENT: Pridel Pty Ltd

RESOURCE DESIGN & MANAGEMENT

- ENGINEERING
- TOWN PLANNING
- SURVEYING & GEOMATICS
- ENVIRONMENTAL MANAGEMENT

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Annexure B –

Evacuation Routes


Park Location
Evacuation Route
Harwood
Palmers Island
Micalo Island
James Creek
Clarence River
Yamba Rd
Pacific Hwy
North Arm Rd
Palmers Channel
North Bank Rd
Palmers Channel South Bank Rd
Palmers Island Middle Rd
James Creek Rd
2km
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