LE CLOS VERDUN ESTATE
NORTHERN SECTION
EFFLUENT DISPOSAL ASSESSMENT

Hopkins Consultants
Port Macquarie

GEOTPMAQ00054AA-AC
8 November 2007

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1/37 Jindalee Road Port Macquarie NSW 2444 Australia

8 November 2007

Hopkins Consultants
PO Box 1556
PORT MACQUARIE NSW 2444

Attention: Geraldine Haigh

Dear Geraldine,

RE: LE CLOS - VERDUN ESTATE, NORTHERN SECTION, SANCROX

ON-SITE EFFLUENT DISPOSAL ASSESSMENT

Please find enclosed our assessment of effluent disposal capability for the above site. The report evaluates site conditions in accordance with AS/NZS 1547:2000 On-site Domestic Wastewater Management. Site conditions are evaluated and recommended disposal areas are sized for the types of application system considered feasible.

Due to site limitations in the form of residual clays, proximity to watercourses and small lot sizes, the use of conventional septic tank and absorption trench systems is not recommended for this site.

Potential disposal areas are restricted for 73 lots and due to proximity to buffer areas, 1:20 flood levels and unsuitable geotechnical units. For these lots onsite waste water disposal is possible but would require appropriate system selection and positioning of disposal areas.

The preferred option for treatment and disposal would be primary treatment with a sand or amended soil mound, or secondary treatment by AWTS, sand filter or similar, with nitrogen reducing technology and the treated wastewater disposed of by means of surface or subsurface irrigation. In lots with significant disposal area restrictions the secondary treated wastewater can be disposed of into an amended soil mound system. A cluster type system with secondary treatment occurring on individual lots and then discharge to a common disposal area is recommended for five lots due to buffer area restrictions.

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

For and on behalf of Coffey Geotechnics Pty Ltd

Steve Morton

Principal

CONTENTS

Appendices

1. INTRODUCTION

At the request of Hopkins Consultants, Coffey Geotechnics Pty Ltd (Coffey) has undertaken an assessment of on-site effluent disposal capability for the northern section of the Le Clos Verdun Estate, Sancrox.

It is understood from the supplied drawing titled "Proposed Lot Layout & Zones" dated 8/10/2007, that the development proposed for the site is a rural residential subdivision comprising 144 individual lots on block sizes ranging from 4200m^2 to 15.2ha with varying topographic positions. It is understood that the proposed lots will utilise on-site disposal of effluent and will be connected to town water.

Parts of the site are below the 1 in 100 year and 1 in 20 year flood level. There are watercourses within and adjacent to the proposed development area, which will have a bearing on the type of effluent disposal system to be adopted. Five existing residences on tank water are currently located on the site.

Chandler Geotechnical previously completed a waste water disposal report for the site for Hopkins Consultants (Project 241355) in 2003, assessed by means of a site and soil evaluation (SSE) conducted in accordance with AS/NZS 1547:2000. A Wastewater Management Study (December 2005) for the Sancrox area has been undertaken for Port Macquarie Hastings Council by Whitehead & Associates.

A review of the site layout and previous documentation relating to effluent disposal was undertaken to assess the preferred methods for disposal. From our discussions on the project with Hopkins Consultants the following needed to be considered:

- Options available for effluent disposal
- Identification of lots where standard individual on-site systems are suitable;
- Identification of lots where high performance individual on-site systems are required;
- Identification of lots where a "cluster" system servicing several lots is required;

2. SITE EVALUATION

2.1 Evaluation Procedure

The evaluation involved the following steps:

- Desk top study involving a review of available geological, topographical and soil maps, published information and relevant reports held within Coffey files.
- Summary of conditions at the site and in the immediate surrounding area based on previous reports.

2.2 Site Conditions

The site is bounded by the Hastings River to the north west, and Haydons Creek to the east, the south western and southern boundaries are made up of Riverbend Road and Sancrox Road respectively, see Figure 1. At the time of the field investigation by Chandler Geotechnical in 2003, the majority of the site comprised vineyards in an un-maintained state.

The supplied drawing (6096-Proposed Lot Layout and Zones) shows most of the site is proposed to be zoned Rural 1(r1), apart from the bank of the Hastings River which is shown as proposed 6(a) Open Space and the vegetated areas in the low lying areas near Haydons Creek which are proposed to be 7(h) Environmental Protection Habitat. An isolated area of eucalypt woodland, on a hill in the north west of the site proposed is also proposed as 7(h), Figure 2.

The nearest weather station, in terms of climate, is located at Wauchope State Forest. Data from this station indicates the site would have an average annual rainfall of about 1289mm. The nearest weather station with evaporation data is Taree, which has an annual evaporation of 1427mm

Topographically, the site is centred on a series of undulating hills and gullies that extend northward from Sancrox Road, towards the Hastings River. Side slopes vary from convex to concave and the land surface slopes down from the hills to a narrow floodplain adjacent to the Hastings River to the east and Haydon's Creek to the west.

The highest point is 24m RL and the lowest point on the floodplain near Haydon's Creek, is below 1m RL. The hill slopes generally have a gradient of 5 - 10% before flattening out at the toe of the hill and onto the floodplains. The northern most ridge of the site, has a steeper hill slope of almost 20%, however this slope is restricted to a small area within Lot 54. Lot 14 in the south west corner of the site has a maximum slope gradient of 12%.

The Hastings River forms the north western boundary of the site and flows to the east but is tidally influenced. It is generally fresh but can become saline in dry conditions. Haydons Creek flows north from Sancrox Road through the southwest corner of the proposed subdivision as an intermittent waterway. A smaller intermittent waterway joins Haydons Creek to the east of Lot 86, from where Haydons Creek becomes a permanent tidal waterway that flows into the Hastings River. A small tidal creek is located in the vicinity of Lots 48, 49 and 50, on the narrow floodplain adjacent to the Hastings River.

The proposed lot layout would result in properties having a range of elevated aspects. The site generally has good exposure due to the mostly minimal tree cover and undulating low hills present in an area of relatively low relief.

The site comprises mostly un-maintained vineyards on the hills, with a thick grass cover between the vines. A narrow riparian zone, comprised of eucalypts and native shrubs, occurs along the bank of the Hastings River and there is thick native swamp and riparian vegetation adjacent to Haydon's Creek. Some isolated areas of eucalypt woodland are present across the site.

Trafficability over the site is good on the existing roads and tracks, but is restricted by the vineyards and the low lying areas are probably waterlogged after rainfall. Drainage on the site was judged to be generally by overland flow following the natural contours of the site into intermittent water courses that flow into Hastings River. It is understood that there are three existing dams on the site, as shown in Figure 1. A large dam is also located just outside the boundary of the site in the south west corner.

It is understood that the 1:100 year flood level for the site is 4.5m AHD and the 1:20 year flood level has been previously estimated as 4m AHD. The majority of the proposed lots are situated above the 1:100 year flood level, however approximately one third of them would be affected by a 1:20 year flood.

There was no evidence of erosion or dispersive soils in previous reports.

Areas that may be considered to be environmentally sensitive would include the Hastings River, the riparian vegetation adjacent to Hastings River and the natural swamp/riparian vegetation adjacent to

Haydons Creek. Other areas of timbered habitat zoned as 7(h) may also be considered environmentally sensitive, Figure 2.

3. SOIL EVALUATION

3.1 Evaluation Procedure

Soil and subsurface profile evaluation involved a desk top study that included a review of geological and soil maps and reports on the site held within Coffey files.

Previous laboratory testing of soil samples was undertaken by Chandler Geotechnical and included:

- Textural Classification in accordance with AS/NZS 1547
- pH and electrical conductivity.
- Cation exchange capacity in top 0.4m of soil
- Exchangeable Sodium Percentage in top 0.4m of soil
- Phosphorous sorption capacity in top 1.0m of soil.

3.2 Soil and Subsurface Conditions

Reference to the Kempsey 1:100,000 Soil Landscape Sheet (Atkinson 1999) indicates that the hills and hill slopes are Kundabung Soil Landscape, which consists of deeply weathered residual soils that overly the Permian mudstones of the Kempsey Beds and Beechwood Beds. Thick alluvial loams and sands of the Austral Eden and Long Flat Landscapes are present along the banks of the Hastings River and the lower reaches of Haydons Creek. The low lying areas adjacent to Haydons Creek consist of unconsolidated estuarine sediments of the Blackmans Point Landscape. The Cairncross Landscape is located at the toe of the hills between the Kundabung and Blackmans Point Landscapes and consists of alluvial and colluvial clays.

The Wauchope –Port Macquarie Acid Sulfate Soil map indicates that the alluvial sediments present on the banks of the Hasting River have a high probability of acid sulfate soil materials located within 1 to 3m of the ground surface. There is also a high probability of acid sulfate soil materials located within 1m of the ground surface near Haydons Creek, which corresponds with the Blackmans Point Landscape. The proposed lot boundaries indicate that the majority of blocks are located outside of the high risk acid sulfate soils, and it is only the lowest sections of some of the blocks that would be affected and it is unlikely that disposal areas would be sited in these areas due to flooding issues.

The previous investigation included 26 test pits and 5 boreholes, taken to a minimum depth of 1.4m or machine refusal. It identified a general soil profile of permeable silty sand alluvium/topsoil overlying residual clays of medium to high plasticity that were considered to be Category 5 or 6 Soils , as per Table 4.1.1 of AS1547:2000. Sandstone bedrock was intersected at shallow depths in four test pits located on hill slopes.

Subsurface materials encountered on site are summarised in Table 1:

TABLE 1 - SUMMARY OF SOIL TYPES

UNIT	SOIL TYPE	SOIL CATEGORY [1]	DESCRIPTION
1	TOPSOIL	1	Silty SAND, low plasticity, fine to coarse grained, dark grey, friable.
2(a)	ALLUVIUM	2	Silty Sandy CLAY to Clayey SAND, low to medium plasticity, brown/grey, fine to medium grained Sand.
2(b)	COLLUVIUM	4	Gravelly Sandy CLAY, medium plasticity, brown/grey, fine to medium grained Sand.
3(a)	RESIDUAL	5	Silty Sandy CLAY, medium plasticity, Grey/Brown with Orange mottling, fine to medium grained Sand, trace fine to medium grained sub-rounded Gravel.
3(b)	RESIDUAL	6	Sandy CLAY to CLAY, medium to high plasticity, Pale Grey with Orange/Red mottles, fine to medium grained Sand.
4	MODERATELY WEATHERED SANDSTONE	6	Sandy GRAVEL, grey, white, orange fractured Sandstone.

[1] Soil Category as presented in Table 4.1.1 A2 (p59) of AS/NZS 1547:2000

Groundwater was not encountered in any of the test pits or boreholes. The groundwater table would be expected to be 2m from surface. Based on the test results and site observations, indicative permeability values have been adopted and the soil categorized in accordance with Appendix 4.2 of AS/NZS 1547:2000. The typical soils profiles have been summarised into geotechnical terrains in Table 2 and shown drawn on Figure 1.

TABLE 2 – SUMMARY OF GEOTECHNICAL TERRAINS

GEOTECHNICAL UNIT	DESCRIPTION	COMMENTS
A	Rounded, moderately undulating hills with even, convex/concave slopes, generally sloping at 0° to 10°. Well drained predominantly by surface run off. Soil depths of Kundabung Soil Landscape are generally less than 1m, comprising topsoil and slopewash underlain by residual clays. Cleared for vineyards.	Residential development feasible. Effluent disposal feasible. Shallow depth to residual clay and proximity to buffer zones will influence selection of disposal system.
B	Lower hill slopes that flatten out into well drained alluvial floodplains, of Long Flat and Austral Eden Soil Landscapes. Alluvial soils can be several metres thick on the floodplain, cleared for cattle grazing.	Effluent disposal feasible but restricted by waterway buffers and 1:20 flood level.
C	Lower hill slopes that flatten onto poorly drained colluvial (Cairncross Landscape) and estuarine (Blackmans Point Landscape) soils. Soil depths on hill slopes are generally less than 1m, comprising topsoil and slopewash underlain by residual clays. Colluvial and estuarine soils are clay dominated and can be several metres thick in low lying areas. Partially cleared for cattle grazing, but also thickly vegetated near Haydons Creek.	Effluent disposal generally not feasible due to water logging, land surface beneath 1:20 flood level, proximity to creeks and environmental protection habitat.

Laboratory test results from Chandler Geotechnical indicated that surface soils, particularly in the lower lying areas are acidic (pH< 4), which generally has a detrimental effect on plant growth. This tendency can be reduced by periodic addition of lime, normally added to the disposal area, to raise the pH to >5.5, which will improve plant growth. Otherwise the laboratory testing identified no major limitations to wastewater disposal.

4. SYSTEM SELECTION

The following systems are commonly used in NSW for disposal of domestic effluent:

- Absorption beds or trenches
- Evapotranspiration assisted trenches or beds.
- Irrigation areas.
- Mound Systems

Limiting factors encountered by the site and soil evaluation will have a strong bearing on the type of system preferred. Factors influencing system selection are summarised in Table 3.

Based on the information contained in Section 2 and 3 of this report and the limiting factors presented in Table 3, the following systems would be considered feasible for the site, dependant on buffer area requirements:

- Surface irrigation in areas of slope less than 5% and above the 1:20 year flood level and other buffer requirements.
- Subsurface irrigation for areas above the 1:20 year flood level or on raised soil mounds above the 1:20 year flood level.
- Wisconsin Mound or amended soil mound systems above the 1:20 year flood level.

Absorption beds or trenches and ETA beds or trenches would not be recommended due to small lot size, low permeability subsoil and high summer rainfall.

TABLE 3: TYPICAL LIMITING FACTORS INFLUENCING SYSTEM SELECTION

SYSTEM	TYPICAL LIMITING FACTOR
Conventional absorption trench/bed or subsurface irrigation system.	Trenches difficult on slopes >5% slope.
	Require soil depth > 1.2m.
	Low permeability (Category 5 or 6) soils require impractical trench lengths particularly for conventional septic tank.
	Require water table >1.2m deep.
	Dispersive soils require impractical trench lengths.
	High rock or cobble content inhibits absorption.
	Large lots required. 100% reserve area required for primary treated effluent disposal (ie. septic tank)
Evapotranspiration assisted irrigation area.	5% recommended maximum slope for bed or surface irrigation.
	Up to 25% slope acceptable for trench or subsoil irrigation.
	Minimum soil depth 1.2m for trench or bed, minimum 0.4m below lines for irrigation.
	Soil categories 4-6 preferred.

	Require >1.2m depth to water table. Disposal area must be above 1:20 year flood level
	Dispersive soils a limitation require treatment.
	High cobble or boulder content inhibits infiltration.
	Water balance required.
	Lot size – require sufficient area for disposal and buffer. Partial reserve area recommended for low permeability soils.
Amended Soil Mound Systems	Maximum practical slope 15% steeper slopes require large quantity of imported sand and induce risk of soil seepage.
	Soil depth not important.
	Can be used for all soil categories 1-6.
	Preferred >0.6m to water table. Can design for shallower water table if required. Must be above 1:20 year flood level.
	Cobble, stone or boulder content not important
	Lot Size – can occupy small area on flat land. Require large area or steep slope.

5. SIZING OF DISPOSAL AREAS

Calculations for the sizing of disposal areas are presented in Appendix A. The sizing has been based on Appendix 4.2 of AS/NZS 1547:2000 and assumes effluent production rates of 145 litres per day for town water supply, with standard water reduction facilities and a home occupation rate of 1.6 persons per bedroom.

Specialised treatment systems such as amended soil systems have not been addressed by this assessment. Such systems can be sized using the site criteria presented in Sections 3 and 4 of this report.

Surface or subsurface irrigation areas.

Irrigation areas should only be used to dispose of secondary treated effluent such as that derived from aerated wastewater treatment system (AWTS) or sand filter. The sizing figures for Geotechnical Units A in Table 4 have been based on water balance and nutrient balance calculations presented in Appendix 1 and would apply to the majority of the site.

Nutrient balances for conventional AWTS systems and for systems providing nitrogen-reducing technology result in different disposal area requirements are also shown in Table 4. These figures are provided as a general guide as it is assumed each lot will have sufficient area available for required nutrient absorption.

For the systems sized herein, a reserve area is generally required for low permeability soils to prevent the build-up of a clogging layer. Port Macquarie – Hastings Council has indicated that they require the reserve area to be 100% of the primary area and this can then be used on a rotational basis, if required.

TABLE 4: RECOMMENDED DISPOSAL AREA FOR IRRIGATION SYSTEMS

GEOTECHNICAL UNIT A

CASE	3 BEDROOMS		4 BEDROOMS		5 BEDROOMS	
	Conventional AWTS	Nitrogen Reducing System	Conventional AWTS	Nitrogen Reducing System	Conventional AWTS	Nitrogen Reducing System
MINIMUM AREA FOR NITROGEN (m^2)	902	258	1203	344	1504	430
MINIMUM AREA FOR PHOSPHOROUS (m^2)	343	228	457	305	571	381
MINIMUM AREA REQUIRED TO SATISFY WATER BALANCE (m^2)	298	298	418	418	478	478
MINIMUM REQUIRED IRRIGATION AREA (m^2)	**298**	**298**	**418**	**418**	**478**	**478**
REQUIRED RESERVE AREA	298	298	418	418	478	478
TOTAL REQUIRED AREA (m^2)	**596**	**596**	**836**	**836**	**956**	**956**

A Design Irrigation Rate (DIR) of 15mm/week for a Category 6 soil presented in Table 4.2 A4 (p125) of AS/NZS 1547:2000. The calculations also assumed:

- Nitrogen uptake of 27 mg/ha/day
- Crop factor of 0.8 for perennial grasses (adjust for other crops)
- Runoff coefficient of 0.75 for slopes 6 -19 % as recommended by Council
- Wastewater production rate of 145 L/day per person, equivalent to town water supply with standard water reduction features.
- Occupation rate of 1.6 persons per bedroom
- Soil permeability of <0.06 metres/day
- The calculations for disposal areas underlain by weathered bedrock (>1m from surface) have used the same low permeability value as those underlain by Category 6 soils (clay) as disposal techniques are similar.

Soils in Geotechnical Unit B are suitable for effluent disposal, however as the Unit B soils are located beneath the 1:20 flood level where disposal areas are not permitted, water balance calculations have not been undertaken. Irrigation areas can be placed on raised mounds of soil above the 1:20 flood

level. However the properties of the soil used would need to be assessed on an individual basis to calculate the water balance.

Amended Soil Mound Systems

Primary treated effluent can be disposed of directly into a mound with effluent discharging into the soil directly below the mound. The required effective basal area for mound(s) in Geotechnical Unit A on this site is shown in Table 5 and Geotechnical Unit B in Table 6. The majority of lots are located in Geotechnical Unit A, while flooding is a constraint for Geotechnical Unit B, however the mounds may be raised above the 1:20 flood level. Mound systems would not be recommended in Geotechnical Unit C due to risk of water logging.

TABLE 5: RECOMMENDED BASE AREA FOR MOUNDS

GEOTECHNICAL UNIT A

SITUATION	DESIGN LOADING RATE (MM/D)	REQUIRED DISPOSAL AREA (M^2)		
		3 BDR	4 BDR	5 BDR
LIMITING SOIL HORIZON PRESENT	**4**	**174**	**232**	**290**

TABLE 6: RECOMMENDED BASE AREA FOR MOUNDS

GEOTECHNICAL UNIT B

SITUATION	DESIGN LOADING RATE (MM/D)	REQUIRED DISPOSAL AREA (M^2)		
		3 BDR	4 BDR	5 BDR
LIMITING SOIL HORIZON PRESENT	**8**	**87**	**116**	**145**

6. LOCATION AND CONSTRUCTION

Buffer distance requirements vary with local government regulations. For most areas of NSW, the buffer distances shown in Table 7 would be acceptable.

TABLE 7: TYPICAL BUFFER DISTANCES FOR LOCATION OF DISPOSAL AREA

SYSTEM	
All On-Site Disposal Systems	Disposal areas above 1:20 flood level Electrical and mechanical components, vents and inspection openings above 1:100 flood level.
	100m to permanent surface waters (eg. River, streams, lakes etc).
	250m to domestic groundwater well.
	40m to other waters (eg. Farm dams, intermittent waterways and drainage channels etc).
Spray Irrigation System	6m if area up gradient and 3m if area down gradient of property boundaries and driveways.
	15m from dwellings.
	6m to swimming pools.
	3m to paths and walkways.
Amended Soil Systems and Subsurface/Trickle Irrigation Systems	6m if area up gradient and 3m if area down gradient of property boundaries, buildings and swimming pools and driveways.

Significant restrictions to wastewater disposal area on the site include the 100 metre buffer to permanent waterways (Hastings River and Haydons Creek), 40m buffer to intermittent waterways and those sections of the site below the 1:20 flood level contour (4m AHD), Figure 3. The 1:25,000 Port Macquarie Topographical map was used to define the boundary between permanent and intermittent waterway status for Haydons Creek (near Lot 86).

Disposal area requirements will vary depending on geotechnical unit present, as summarised in Tables 4 - 6. The majority of sites will be situated in Geotechnical Unit A however, some effluent disposal areas may be raised above flood levels in Geotechnical Unit B. Geotechnical Unit C is not recommended for the locating of disposal areas

The proposed lots have been divided into five groups based on area available for wastewater disposal above 1:20 flood level or outside 100m and 40m waterway buffers as summarised in Table 8. The area available outside the buffers (unencumbered area) was calculated by Hopkins Consultants, and is included in Appendix B.

TABLE 8: AVAILABLE LOT AREA SUMMARY

Lot Group	Lots	Dam/ Waterway Buffer	1:20 Flood Level	Unencumbered Area (m^2)
1	2 – 8, 11 – 18, 22, 25 – 30, 35 – 40, 55, 59 -63, 68, 71 – 78, 90 – 109, 121, 123 – 126, 130, 137-138, Total = 71 lots			>2000
2	1	-	Y	>2000
	30	-	Y	>2000
	42	-	Y	>2000
	56 – 58	-	Y	>2000
	64 – 67	-	Y	>2000
	69	-	Y	>2000
	79 – 82	-	Y	>2000
	116 – 117	-	Y	>2000
	127 – 129	-	Y	>2000
	131	-	Y	>2000
	136	-	Y	>2000
	Total = 21 lots	-	Y	>2000
3	9 – 10	Y	-	>2000
	19	Y	-	>2000
	21	Y	-	>2000
	23 – 24	Y	Y	>2000
	32	Y	Y	>2000
	34	Y	Y	>2000
	41	Y	-	>2000
	43 – 45	Y	Y	>2000
	53 – 54	Y	Y	>2000
	83 -89	Y	Y	>2000
	85 – 89	Y	Y	>2000
	110 – 115	Y	Y	>2000
	118	Y	Y	>2000
	120	Y	Y	>2000
	122	Y	Y	>2000
	132- 135	Y	Y	>2000
	139 – 142	Y	Y	>2000
	144	Y	Y	>2000
	Total = 41 lots	Y	Y	
4	20	Y	Y	980
	33	Y	Y	1790
	46	Y	Y	1860
	52	Y	Y	1950
	119	Y	Y	1930
	143	Y	Y	1575
	Total = 6 lots			
5	47 - 51	Y	Y	Cluster
	Total = 5 lots			

Standard AWTS or sand filter system with subsurface or surface irrigation or amended soil mound type systems are recommended for Lot Group 1, dependant on limiting factors as per Table 3. Sufficient area is available in these lots for wastewater disposal. Internal lot buffers to be adhered to as per Table 7.

Standard AWTS or sand filter system with subsurface or surface irrigation or an amended soil mound type system are recommended for Lot Group 2, dependant on limiting factors as per Table 3. Lot Group 2 has their area disposal area slightly restricted by the 1:20 flood level. An option available for these lots if required, is to raise the disposal area and internal working mechanisms on a mound above the 1:20 flood level, dependant on the storage facility being situated above the 1:100 year flood level. Port Macquarie Hastings Council has previously approved similar disposal areas for sites with 1:20 flood level restrictions. During site development works it may be possible to place surplus fill material in specific lots to raise the available disposal and building area above the 1:20 flood level.

Standard AWTS or sand filter system with nitrogen reducing technology and subsurface or surface irrigation or an amended soil mound type system are recommended for Lot Group 3, dependant on limiting factors as per Table 3. Lot Group 3 have their area disposal area restricted by buffer requirements for waterways and the 1:20 flood level, however there is more than 2000m^2 available in each lot for wastewater management and building envelopes which should be sufficient if lot layouts are planned carefully. If an amended soil mound system is used for the disposal area, the disposal area will be reduced. Similarly to Group 2, it may also be possible to locate the disposal area on a mound raised above the 1:20 flood level.

Onsite wastewater disposal systems are possible for Lot Group 4 however appropriate system selection and careful positioning of the systems is required. The major constraint for these lots is the 100m or 40m buffer to Hastings River or Haydons Creek and consequently the systems will have to be located within these buffers. Port Macquarie – Hastings Council have previously approved systems within waterway buffer areas, dependant on the type of system used and the positioning of the disposal area.

It is therefore recommended for Lot Group 4, that AWTS or sand filter systems with nitrogen reducing technology be used to provide secondary treatment of wastewater. The secondary treated water would then need to be disposed of into an amended soil mound such as a Wisconsin mound, Ecomax or Biolytix system. These amended soil systems are generally designed for treatment of untreated waste water but can be modified to accept secondary treated waste water. With this additional wastewater treatment, the buffers for Lot Group 4 could be relaxed by 50% to 50m for permanent waterways and 20m to intermittent waterways, which would then increase the area of the lots available for wastewater disposal and building footprints to more than 2000m^2.

This approach has been discussed with Council who agree that it would be appropriate for these sensitive sites. The smaller required disposal areas for amended soil mounds would also provide greater flexibility in locating the disposal area on each lot. For sites where the 1:20 flood level may be an additional constraint, the disposal area could also be raised above the flood level as discussed previously for Lot Group 2.

Lot Group 5 consists of five lots located on the bank of the Hastings River that are intersected by a small, permanent tidal creek located at the toe of the hill, Figure 4. The disposal area for these lots would be located within 50m of the permanent creek and disposal of treated wastewater onsite is therefore not recommended. A cluster type disposal system with individual onsite secondary treatment

systems and disposal of treated wastewater to a common disposal area is therefore required for these lots. This has been discussed with Council who have agreed that it would be satisfactory.

Onsite secondary treatment using standard AWTS or sand filter system would be required for Lot Group 5, before the treated water is pumped to a collection pipe that transports the treated water to the common subsurface irrigation disposal area situated at Lot 1. There is 6300m^2 available for effluent disposal which will be sufficient for five lots assuming a five bedroom house is present on each lot, which would require a total disposal area of 4780m^2. It is recommended that the one manufacturer be used for the installation of the individual treatment units and design of the common disposal system. As an example Biolytix have installed a Biowater system that fulfils a similar role at Macleay Island, Queensland.

Environmental Habitat (Land Zoning 7(h)) is proposed in several areas on the site, but may still be used as disposal areas if the disposal area does not impact on the habitat present. As the habitat areas generally represent significant vegetation cover this would reduce individual site exposure and these sites may therefore require a greater disposal area that would need to be assessed on an individual basis.

Approximate costs of secondary treatment effluent disposal systems are summarised in Table 9:

TABLE 9: APPROXIMATE EFFLUENT DISPOSAL SYSTEM COSTS

Unit*	Price (incl. installation)	Annual Maintenance	Comment
Econocycle/ Biocycle / Supertreat AWTS Irrigation Systems 10ep	~ $7500	$260	Can be used for most lots.
Envirotech - secondary Recirculating Sand Filter 10ep	$12-15,000	$100	Robust system.
Envirotech – Secondary Landscape Mound – 10ep	$12- 15,000	$100	Has good reputation in Hastings Shire
Ecomax 8ep* Amended soil mound	~$15,000	$100	Have been used previously within 100m of Hastings River
Biolyitx Wisconsin Soil Mound	$7000	$100	
Biolytix – Secondary 10ep	$10-$12,000	$100	Biological system

*Manufacturers recommend that they be contacted regarding installation of each system to determine exact design and construction requirements.

The disposal area calculations for the sites have been for dwellings with standard water reduction facilities and it is recommended that this be a requirement for all buildings in the subdivision.

Construction of the systems should comply with Appendix 4.5 of AS/NZS 1547:2000. Wet weather storage should comply with Port Macquarie Hastings Council's On-Site Sewage Management Code.

Further advice on the uses and limitations of this report is presented in the attached document, *Important Information about your Coffey Report*.

For and on behalf of

COFFEY GEOTECHNICS PTY LTD

Steve Morton

Principal

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

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SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.
Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

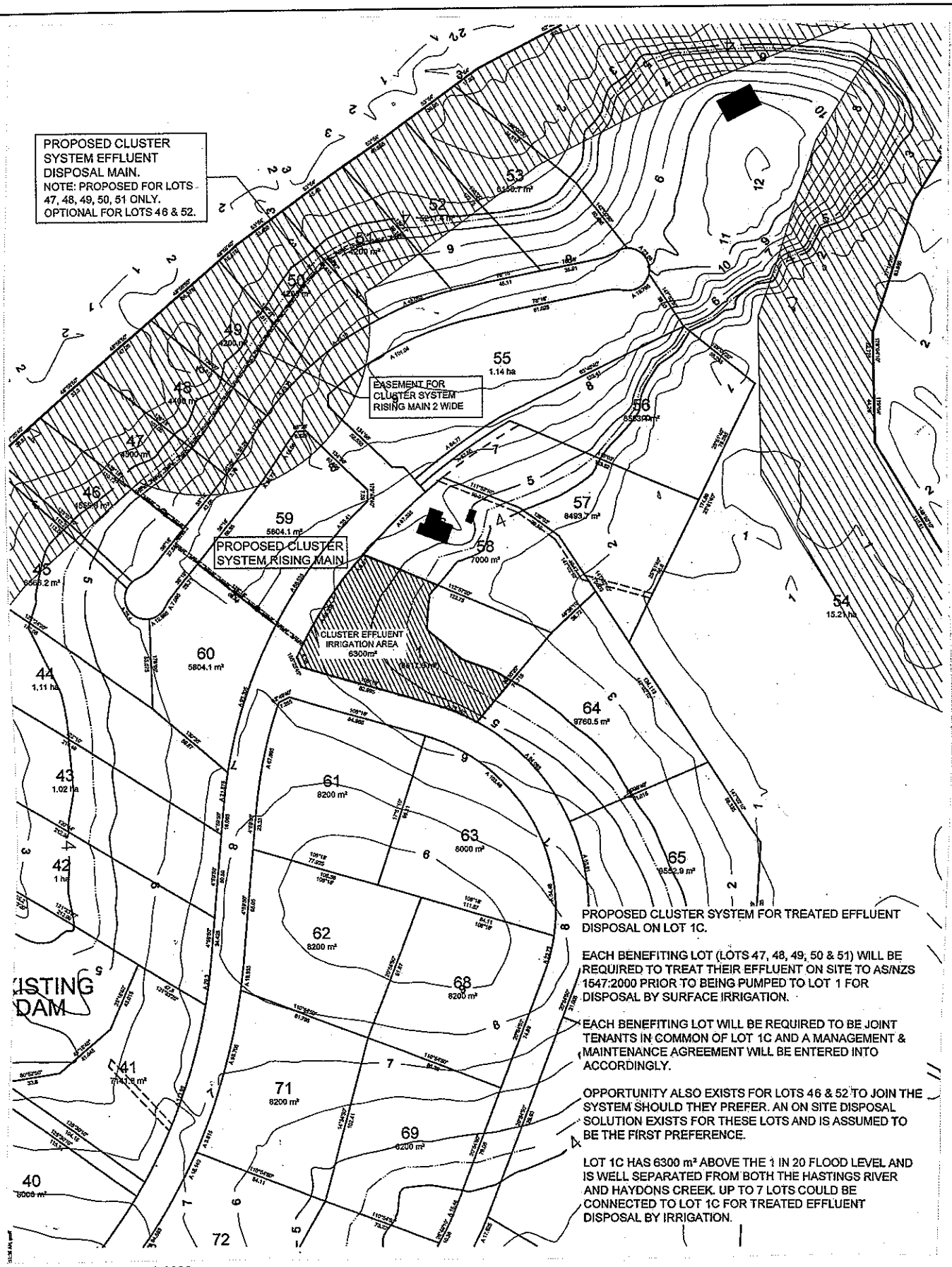
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures



Base on supplied drawing 6096-0002

drawn	JGP
approved	
date	05.11.07
scale	1 : 3300
original size	A3

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client: **HOPKINS CONSULTANTS**

project: **LE CLOS VERDUN ESTATE - SANCROX**

EFFLUENT DISPOSAL ASSESSMENT

title: PROPOSED CLUSTER TREATED EFFLUENT DISPOSAL SYSTEM

project no: **GEOTPMAQ0054AA**

figure no: **FIGURE 4**

Appendix A

Disposal Area Calculations

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Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 μm to 2.36 mm
	medium	200 μm to 600 μm
	fine	75 μm to 200 μm

MOISTURE CONDITION

Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.

Moist Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.

Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH S_u (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 - 35
Medium Dense	35 - 65
Dense	65 - 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous layers of lenticular shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material — Structure and fabric of parent rock visible.

Residual soil — Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

Aeolian soil — Deposited by wind.

Alluvial soil — Deposited by streams and rivers.

Colluvial soil — Deposited on slopes (transported downslope by gravity).

Fill — Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.

Lacustrine soil — Deposited by lakes.

Marine soil — Deposited in ocean basins, bays, beaches and estuaries.

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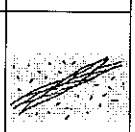
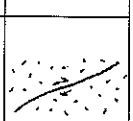
Soil Description Explanation Sheet (2 of 2)

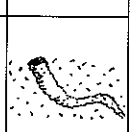
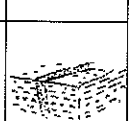
SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)							USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)			GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes missing			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
		SILTS & CLAYS Liquid limit less than 50	**DRY STRENGTH**	**DILATANCY**	**TOUGHNESS**			
			None to Low	Quick to slow	None		ML	SILT
			Medium to High	None	Medium		CL	CLAY
			Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium		MH	SILT
			High	None	High		CH	CLAY
			Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS		Readily identified by colour, odour, spongy feel and frequently by fibrous texture.					Pt	PEAT

• Low plasticity – Liquid Limit W_L less than 35%. • Modium plasticity – W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	DEFINITION	DIAGRAM
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

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Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Rock Substance In engineering terms roch substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.

Defect Discontinuity or break in the continuity of a substance or substances.

Mass Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME Simple rock names are used rather than precise geological classification.

PARTICLE SIZE Grain size terms for sandstone are:

Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm

FABRIC Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:

Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	**RS**	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	**XW**	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	**HW**	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	**MW**	The whole of the rock substance is discoloured, usually by iron staining or bleaching , to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	**SW**	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Fresh Rock	**FR**	Rock substance unaffected by weathering.

Notes on Weathering:

1. AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.
2. Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

ROCK SUBSTANCE STRENGTH TERMS

Term	Abbrev-iation	Point Load Index, I_S50 (MPa)	Field Guide
Very Low	**VL**	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	**EH**	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

Notes on Rock Substance Strength:

1. In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
2. The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.
3. The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index (Is50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

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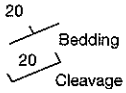
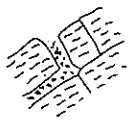
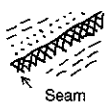
Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.			 (Note 2)
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			 (Note 2)
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.			

DEFECT SHAPE TERMS

Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

ROUGHNESS TERMS

Slickensided	Grooved or striated surface, usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS

Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

BLOCK SHAPE TERMS

Blocky	Approximately equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greate than cross section

Notes on Defects:

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.
3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

72710 / 07-06

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ON-SITE EFFLUENT DISPOSAL BY IRRIGATION
AS/NZS 1547:2000

CLIENT	Hopkins Consultants	**PROJECT NO:**	GEOTPMAQ00054AA	**DATE**	28-March-2007
PROJECT	Le Clos - Verdun	**LOCATION**	Sancrox - Geotechnical Unit A	**REPORT NO**	GEOTPMAQ00054AA-AB

Hydraulic loading (Q)	L/day	1160	**8 occupants @145 litres/person/day (5 bedroom residence, town water, standard water reduction fixtures)**
Design Loading Rate (R)	mm/week	15	**From AS1547-2000 Table 4.2A4 - CLAY, Category 6**

Parameter	Formula	Units	Jan	Feb	March	April	May	Jum	July	August	Sept	Oct	Nov	Dec	Total	
Days in the Month (D)	-	days	31	28	31	30	31	30	31	31	30	31	30	31	365	
Precipitation (P)	-	mm/month	151.3	183.6	155.1	144.5	85.2	116.6	43.3	93.3	43.1	96.2	84.5	92.6	1289.3	
Evaporation (E)	-	mm/month	176.7	145.6	133.3	99	65.1	54	62	83.7	114	145.7	159	189.1	1427.2	
Crop Factor (C)	-	-	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	-	
Outputs																
Evapotranspiration (ET)	E x C	mm/month	132.5	109.2	100.0	74.3	48.8	40.5	46.5	62.8	85.5	109.3	119.3	141.8		
Percolation (B)	R / 7 x D	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		
Outputs	ET + B	mm/month	199.0	169.2	166.4	138.5	115.3	104.8	112.9	129.2	149.8	175.7	183.5	208.3		
Inputs																
Precipitation (P)	-		151.3	183.6	155.1	144.5	85.2	116.6	43.3	93.3	43.1	96.2	84.5	92.6		
Retained Precipitation (RP)	0.75		113.475	137.7	116.325	108.375	63.9	87.45	32.475	69.975	32.325	72.15	63.375	69.45		
Potential Effluent Production (w)	(ET + B) - P	mm/month	85.5	31.5	50.1	30.2	51.4	17.3	80.5	59.2	117.5	103.6	120.2	138.8	885.6 (H)	
Actual Effluent Production (i)	H / 12	mm/month	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8		
Inputs	(P + I)	mm/month	225.1	257.4	228.9	218.3	159.0	190.4	117.1	167.1	116.9	170.0	158.3	166.4		
Storage (s)	(P + I) - (ET + B)	mm/month	26.1	88.2	62.5	79.8	43.7	85.6	4.2	37.9	-32.9	-5.7	-25.2	-41.9		
Cumulative Storage (m)	-	mm														

IRRIGATION AREA (I) 365 x Q / H **478.1 m2**

Notes.

Rainfall & Evaporation figures courtesy of Bureau of Meteorolgy web site
Rainfall figures used taken from Wauchope State Forest averages
Evaporation figures used taken from Taree records

Typical Hydraulic Loads as per AS/NZS 1547:2000, Appendix 4.2D
Population Equivalent for number of bedrooms as per AS/NZS 1547:200 Table 4.3A1
Retained Precipitation (RP) of 0.75 for slopes between 6% and 19% as recommended by PMHC

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ON-SITE EFFLUENT DISPOSAL BY IRRIGATION AS/NZS 1547:2000

CLIENT	Hopkins Consultants	**PROJECT NO:**	GEOTPMAQ00054AA	**DATE**	28-March-2007
PROJECT	Le Clos - Verdun	**LOCATION**	Sancrox - Geotechnical Unit A	**REPORT NO**	GEOTPMAQ00054AA-AB

Hydraulic loading (Q)	L/day	1015	**7 occupants @145 litres/person/day (4 bedroom residence, town water, standard water reduction fixtures)**
Design Loading Rate (R)	mm/week	15	**From AS1547-2000 Table 4.2A4 - CLAY, Category 6**

Parameter	Formula	Units	Jan	Feb	March	April	May	Jum	July	August	Sept	Oct	Nov	Dec	Total
Days in the Month (D)	-	days	31	28	31	30	31	30	31	31	30	31	30	31	365
Precipitation (P)	-	mm/month	151.3	183.6	155.1	144.5	85.2	116.6	43.3	93.3	43.1	96.2	84.5	92.6	1289.3
Evaporation (E)	-	mm/month	176.7	145.6	133.3	99	65.1	54	62	83.7	114	145.7	159	189.1	1427.2
Crop Factor (C)	-	-	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	-
Outputs															
Evapotranspiration (ET)	E x C	mm/month	132.5	109.2	100.0	74.3	48.8	40.5	46.5	62.8	85.5	109.3	119.3	141.8	
Percolation (B)	R / 7 x D	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	
Outputs	ET + B	mm/month	199.0	169.2	166.4	138.5	115.3	104.8	112.9	129.2	149.8	175.7	183.5	208.3	
Inputs															
Precipitation (P)	-		151.3	183.6	155.1	144.5	85.2	116.6	43.3	93.3	43.1	96.2	84.5	92.6	
Retained Precipitation (RP)	0.75	mm/month	113.475	137.7	116.325	108.375	63.9	87.45	32.475	69.975	32.325	72.15	63.375	69.45	
Potential Effluent Production (w)	(ET + B) - RP	mm/month	85.5	31.5	50.1	30.2	51.4	17.3	80.5	59.2	117.5	103.6	120.2	138.8	885.6 (H)
Actual Effluent Production (I)	H / 12	mm/month	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	
Inputs	(P + I)	mm/month	225.1	257.4	228.9	218.3	159.0	190.4	117.1	167.1	116.9	170.0	158.3	166.4	
Storage (s)	(P + I) - (ET + B)	mm/month	26.1	88.2	62.5	79.8	43.7	85.6	4.2	37.9	-32.9	-5.7	-25.2	-41.9	
Cumulative Storage (m)	-	mm													

IRRIGATION AREA (I) 365 x Q / H **418.3 m2**

Notes.

Rainfall & Evaporation figures courtesy of Bureau of Meteorolgy web site
Rainfall figures used taken from Wauchope State Forest averages
Evaporation figures used taken from Taree records

Typical Hydraulic Loads as per AS/NZS 1547:2000, Appendix 4.2D
Population Equivalent for number of bedrooms as per AS/NZS 1547:200 Table 4.3A1
Retained Precipitation (RP) of 0.75 for slopes between 6% and 19% as recommended by PMHC

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ON-SITE EFFLUENT DISPOSAL BY IRRIGATION
AS/NZS 1547:2000

CLIENT	Hopkins Consultants	**PROJECT NO:**	GEOTPMAQ00054AA	**DATE**	28-March-2007
PROJECT	Le Clos - Verdun	**LOCATION**	Sancrox - Geotechnical Unit A	**REPORT NO**	GEOTPMAQ00054AA-AB

Hydraulic loading (Q)	L/day	725	**5 occupants @145 litres/person/day (3 bedroom residence, town water, standard water reduction fixtures)**
Design Loading Rate (R)	mm/week	15	**From AS1547-2000 Table 4.2A4 - CLAY, Category 6**

Parameter	Formula	Units	Jan	Feb	March	April	May	Jum	July	August	Sept	Oct	Nov	Dec	Total	
Days in the Month (D)	-	days	31	28	31	30	31	30	31	31	30	31	30	31	365	
Precipitation (P)	-	mm/month	151.3	183.6	155.1	144.5	85.2	116.6	43.3	93.3	43.1	96.2	84.5	92.6	1289.3	
Evaporation (E)	-	mm/month	176.7	145.6	133.3	99	65.1	54	62	83.7	114	145.7	159	189.1	1427.2	
Crop Factor (C)	-	-	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	-	
Outputs																
Evapotranspiration (ET)	E x C	mm/month	132.5	109.2	100.0	74.3	48.8	40.5	46.5	62.8	85.5	109.3	119.3	141.8		
Percolation (B)	R / 7 x D	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		
Outputs	ET + B	mm/month	199.0	169.2	166.4	138.5	115.3	104.8	112.9	129.2	149.8	175.7	183.5	208.3		
Inputs																
Precipitation (P)	-		151.3	183.6	155.1	144.5	85.2	116.6	43.3	93.3	43.1	96.2	84.5	92.6		
Retained Precipitation (RP)	0.75	mm/month	113.475	137.7	116.325	108.375	63.9	87.45	32.475	69.975	32.325	72.15	63.375	69.45		
Potential Effluent Production (w)	(ET + B) - RP	mm/month	85.5	31.5	50.1	30.2	51.4	17.3	80.5	59.2	117.5	103.6	120.2	138.8	885.6 (H)	
Actual Effluent Production (i)	H / 12	mm/month	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8	73.8		
Inputs	(P + I)	mm/month	225.1	257.4	228.9	218.3	159.0	190.4	117.1	167.1	116.9	170.0	158.3	166.4		
Storage (s)	(P + I) - (ET + B)	mm/month	26.1	88.2	62.5	79.8	43.7	85.6	4.2	37.9	-32.9	-5.7	-25.2	-41.9		
Cumulative Storage (m)	-	mm														

IRRIGATION AREA (I) 365 x Q / H **298.8 m2**

Notes.

Rainfall & Evaporation figures courtesy of Bureau of Meteorolgy web site
Rainfall figures used taken from Wauchope State Forest averages
Evaporation figures used taken from Taree records

Typical Hydraulic Loads as per AS/NZS 1547:2000, Appendix 4.2D
Population Equivalent for number of bedrooms as per AS/NZS 1547:200 Table 4.3A1
Retained Precipitation (RP) of 0.75 for slopes between 6% and 19% as recommended by PMHC

SIZING OF MOUND

Waste water flow allowance in Litres / person/day

	Tank supply	Reticulated supply
1. Household with standard facilities	140	180
2. Household with standard water reduction features	115	145
3. House with extra wastewater producing facilities	170	220

Input Parameters:

Permeability of CLAY (K_{sat})	**0.06**	m / day	(from Chandler Report 23082)
Design Loading Rate (DLR)*	**4**	mm/day	
Inflow per bedroom	**232**	litres / day	(Assumes 1.6 persons per bedroom)

* Adopt Design Loading Rate from values in Table 4.2A3 (P.121) of AS/NZS 1547:2000

Required bed area or trench length:

No of Bedrooms	**3**	**4**	**5**
q (litres / day)	696	928	1160
Base Area of mound (m^2)	174	232	290

NUTRIENT BALANCE - SIZING DISPOSAL AREA FOR SECONDARY TREATED EFFLUENT

(e.g. Output from conventional AWTS or from sand filter)

Effluent Quality Parameters Assumed

		Primary Treated Effluent	**Secondary Treated Effluent**	Nitrogen reducing systems
BOD	(mg/L)	150	**<20**	<20
Total N	(mg/L)	50 - 60	**25 - 50**	10
Total P	(mg/L)	10 - 15	**10 - 15**	8

Organic Loading $Ao = C\,q / Lo$

where Lo = 3000 ($mg/m^2/d$)

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**20**	**20**	**20**
Ao (m^2)	**5**	**6**	**8**

Nitrogen Loading $Ax = C\,q / Lx$

where $Lx = Ln$ = 27 ($mg/m^2/d$)
(Perenial pasture assumed)

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**35**	**35**	**35**
An (m^2)	**902**	**1203**	**1504**

Phosphorous Loading where $Lx = Lp =$ $P_{adsorbed} + P_{uptake}$ (kg/m^2/50 years)

Psorption=	**1000**	(mgP/kg)	
Active Depth =	300	(mm) - Recommended	
Soil Bulk Density=	**1.3**	(t/m^3)	
$P_{adsorbed}$ =	0.39	(kg/m^2/50 years)	
$P_{adsorbed}$ =	3900	(kg/ha/50 years)	
P_{uptake} =	0.05	L_{pu} (365 x 50)1x 10^{-6} kg	(kg/m^2/50 years)
L_{pu} =	3	(mg/m^2/d)	(Perennial Pasture)
L_{pu} =	**0.03**	(kg/ha/day)	

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**12**	**12**	**12**
Required Disposal Area (m^2)	**343**	**457**	**571**

NUTRIENT BALANCE - SIZING DISPOSAL AREA FOR NITROGEN REDUCING SYSTEM

(e.g. Output from Envirocycle NR10 or similar enhanced treatment system)

Effluent Quality Parameters Assumed

		Primary Treated Effluent	Secondary Treated Effluent	Nitrogen reducing systems
BOD	(mg/L)	150	<20	**<20**
Total N	(mg/L)	50 - 60	25 - 50	**10**
Total P	(mg/L)	10 - 15	10 - 15	**8**

Organic Loading

Ao = C q / Lo

where Lo = 3000 (mg/m^2/d)

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**10**	**10**	**10**
Ao (m^2)	**2**	**3**	**4**

Nitrogen Loading

Ax = C q / Lx

where Lx = Ln 27 (mg/m^2/d)

(Perenial pasture assumed)

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**10**	**10**	**10**
An (m^2)	**258**	**344**	**430**

Phosphorous Loading

where Lx = Lp = $P_{adsorbed} + P_{uptake}$ (kg/m^2/50 years)

Psorption=	**1000**	(mgP/kg)	
Active Depth =	300	(mm) - Recommended	
Soil Bulk Density=	**1.3**	(t/m^3)	
$P_{adsorbed}$ =	0.39	(kg/m^2/50 years)	
$P_{adsorbed}$ =	3900	(kg/ha/50 years)	
P_{uptake} =	0.05	L_{pu} (365 x 50)1x 10^{-5} kg	(kg/m^2/50 years)
L_{pu} =	3	(mg/m^2/d)	(Perennial Pasture)
L_{pu} =	**0.03**	(kg/ha/day)	

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**8**	**8**	**8**
Required Disposal Area (m^2)	**228**	**305**	**381**

SIZING OF MOUND

Waste water flow allowance in Litres / person/day

	Tank supply	Reticulated supply
1. Household with standard facilities	140	180
2. Household with standard water reduction features	115	145
3. House with extra wastewater producing facilities	170	220

Input Parameters:

Permeability of SOIL (K_{sat})	1	m / day	(fFor Cateogry 4 Soil)
Design Loading Rate (DLR)*	8	mm/day	
Inflow per bedroom	232	litres / day	(Assumes 1.6 persons per bedroom)

* Adopt Design Loading Rate from values in Table 4.2A3 (P.121) of AS/NZS 1547:2000

Required bed area or trench length:

No of Bedrooms	**3**	**4**	**5**
q (litres / day)	696	928	1160
Base Area of mound (m^2)	87	116	145

NUTRIENT BALANCE - SIZING DISPOSAL AREA FOR SECONDARY TREATED EFFLUENT

(e.g. Output from conventional AWTS or from sand filter)

Effluent Quality Parameters Assumed

		Primary Treated Effluent	**Secondary Treated Effluent**	Nitrogen reducing systems
BOD	(mg/L)	150	**<20**	<20
Total N	(mg/L)	50 - 60	**25 - 50**	10
Total P	(mg/L)	10 - 15	**10 - 15**	8

Organic Loading Ao = C q / Lo

where Lo = 3000 (mg/m^2/d)

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**20**	**20**	**20**
Ao (m^2)	**5**	**6**	**8**

Nitrogen Loading Ax = C q / Lx

where Lx = Ln 27 (mg/m^2/d)
(Perenial pasture assumed)

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**35**	**35**	**35**
An (m^2)	**902**	**1203**	**1504**

Phosphorous Loading where Lx = Lp = $P_{adsorbed} + P_{uptake}$ (kg/m^2/50 years)

Psorption=		**1000**	(mgP/kg)
Active Depth =		300	(mm) - Recommended
Soil Bulk Density=		**1.3**	(t/m^3)
$P_{adsorbed}$ =		0.39	(kg/m^2/50 years)
$P_{adsorbed}$ =		3900	(kg/ha/50 years)
P_{uptake} =		0.05	L_{pu} (365 x 50)1x 10^{-6} kg (kg/m^2/50 years)
L_{pu} =		3	(mg/m^2/d) (Perennial Pasture)
L_{pu} =		**0.03**	(kg/ha/day)

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**12**	**12**	**12**
Required Disposal Area (m^2)	**343**	**457**	**571**

NUTRIENT BALANCE - SIZING DISPOSAL AREA FOR NITROGEN REDUCING SYSTEM

(e.g. Output from Envirocycle NR10 or similar enhanced treatment system)

Effluent Quality Parameters Assumed

		Primary Treated Effluent	Secondary Treated Effluent	Nitrogen reducing systems
BOD	(mg/L)	150	<20	**<20**
Total N	(mg/L)	50 - 60	25 - 50	**10**
Total P	(mg/L)	10 - 15	10 - 15	**8**

Organic Loading

Ao = C q / Lo

where Lo = 3000 (mg/m^2/d)

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**10**	**10**	**10**
Ao (m^2)	**2**	**3**	**4**

Nitrogen Loading

Ax = C q / Lx

where Lx = Ln 27 (mg/m^2/d)

(Perenial pasture assumed)

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	**10**	**10**	**10**
An (m^2)	**258**	**344**	**430**

Phosphorous Loading

where Lx = Lp = $P_{adsorbed} + P_{uptake}$ (kg/m^2/50 years)

Psorption=	**1000**	(mgP/kg)	
Active Depth =	300	(mm) - Recommended	
Soil Bulk Density=	**1.3**	(t/m^3)	
$P_{adsorbed}$ =	0.39	(kg/m^2/50 years)	
$P_{adsorbed}$ =	3900	(kg/ha/50 years)	
P_{uptake} =	0.05	L_{pu} (365 x 50)1x 10^{-6} kg	(kg/m^2/50 years)
L_{pu} =	3	(mg/m^2/d)	(Perennial Pasture)
L_{pu} =	**0.03**	(kg/ha/day)	

No of Bedrooms	**3**	**4**	**5**
q(L/d)	696	928	1160
C(mg/L)	8	8	8
Required Disposal Area (m^2)	**228**	**305**	**381**

Appendix B

Disposal Area Restrictions – Lot Area Available

Lot Area Inside (A) 1:20 Year 4m Flood Level (B) 100m Buffer

Lot No.	A - 1 in 20 year	B - 100m Buffer	C - 40m Buffer	Unencumbered Area (m^2) RED	Area Between Buffer and (1:20 Year Flood) (m2) ORANGE
19	X	X		5625	5300
20	X	X		980	4035
23	X	X		6545	620
24	X			6760	
31	X			7515	
32	X	X		6145	1610
33	X	X		1790	8535
34	X	X		3370	2750
1 - Private Recreation	X	X		8035	230
42	X			4770	
43	X			4910	
44	X			5175	
45	X	X		4035	195
46	X	X		1860	355
47	X	X		575	1270
48		X			1675
49		X			1775
50	X	X		29	2500
51	X	X		1020	1655
52	X	X		1950	535
53	X			2390	
56	X			3265	
57	X			3015	
58	X			3150	
1 - Effluent Lot	X			6300	
64	X			3335	
65	X			3965	
66	X			4180	
67	X			4395	
69	X			7170	
70	X			7725	
79	X			3635	
80	X			3875	
81	X			4295	
82	X			4605	
83	X	X		5175	1260
84	X	X		2375	5065
85	X	X		2485	4995
86	X	X		3010	2655
87	X	X		6365	30
88	X		X	6700	925
89	X		X	5785	240
110	X			5180	
111	X			2760	
112	X			3720	

Lot Area Inside (A) 1:20 Year 4m Flood Level (B) 100m Buffer

Lot No.	A - 1 in 20 year	B - 100m Buffer	C - 40m Buffer	Unencumbered Area (m^2) RED	Area Between Buffer and (1:20 Year Flood) (m2) ORANGE
113	X			3740	
114	X			5724	
115	X			6315	
116	X			7175	
117	X			10225	
118	X			4940	
119	X		X	1930	1020
120	X		X	2510	9930
127	X			6958	
128	X			7410	
129	X			7061	
131	X			5710	
132	X			9115	
133	X			10050	
134	X			4290	
135	X			5030	
136	X			8518	
139	X			6685	
140	X			6370	
141	X			2530	
142	X		X	2360	185
143	X		X	1575	1425
144	X		X	2670	2050