Oaklands Ethanol Production Facility
Water Resources Assessment Report

Final Report

for Agri Energy Limited

June 2007

0056132

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Approved by:	*Geoff Herman*
Position:	Principal Water Resource Engineer
Signed:	
Date:	*June, 2007*

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FINAL REPORT

Agri Energy Limited

Oaklands Ethanol Production Facility

Water Resources Assessment

June 2007

Environmental Resources Management Australia
Building C, 33 Saunders Street
Pyrmont, NSW 2009
Telephone +61 2 8584 8888
Facsimile +61 2 8584 8800
www.erm.com

CONTENTS

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ANNEXES

1 INTRODUCTION

1.1 BACKGROUND

Agri Energy Limited (AEL) seeks project approval for the development of an ethanol production facility at Oaklands, New South Wales (NSW), under Part 3A of the *Environmental Planning and Assessment Act, 1979 (*EP&A Act). The ethanol production facility will be capable of producing 200 megalitres (ML) of ethanol annually and will include several holding dams, an effluent treatment facility and an irrigation area. The irrigation area will be irrigated with process effluent as part of an effluent reuse scheme.

Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by AEL to prepare an environmental assessment for the construction and operation of the ethanol production facility, inclusive of a Water Resources Assessment. This Water Resources Assessment report details the review of water resources issues and potential impacts that has been conducted as part of the environmental assessment.

1.2 SITE OVERVIEW

The site of the proposed ethanol production facility is wholly within the local government area of Urana. It is accessed from Coreen Street at a point approximately 350m northeast of Oaklands. Oaklands is situated in the Murray region of NSW, approximately 615km south west of Sydney and 105km northwest of Albury, as shown in *Figure 1.1*.

The site is approximately 130 hectares (ha) in area and comprises one land parcel, identified as Lot 2 of Deposited Plan (DP) 861032. It is currently used for agricultural cropping (barley) and has sparse scattered trees along the eastern and western site boundaries. Topography is generally flat, as is typical of the surrounding landscape. There is a shallow farm dam positioned near to the northern boundary of the site.

In addition, there will be an offsite pump station, raw water dam and subsurface pipeline which will occupy a portion of Lots 64 and 68 of DP 756402, adjacent to O'Dwyer Main Channel. The pipeline is proposed to run in an east-west direction from the offsite water storage, across Lots 61 and 62 of DP 818505 and pass under the Urana / Oaklands Road and the disused Oaklands – The Rock railway track, before entering the site. The proposed pipeline route is through predominantly flat, cleared agricultural land. The proposed site layout and pipeline route are shown in *Figure 1.2*.

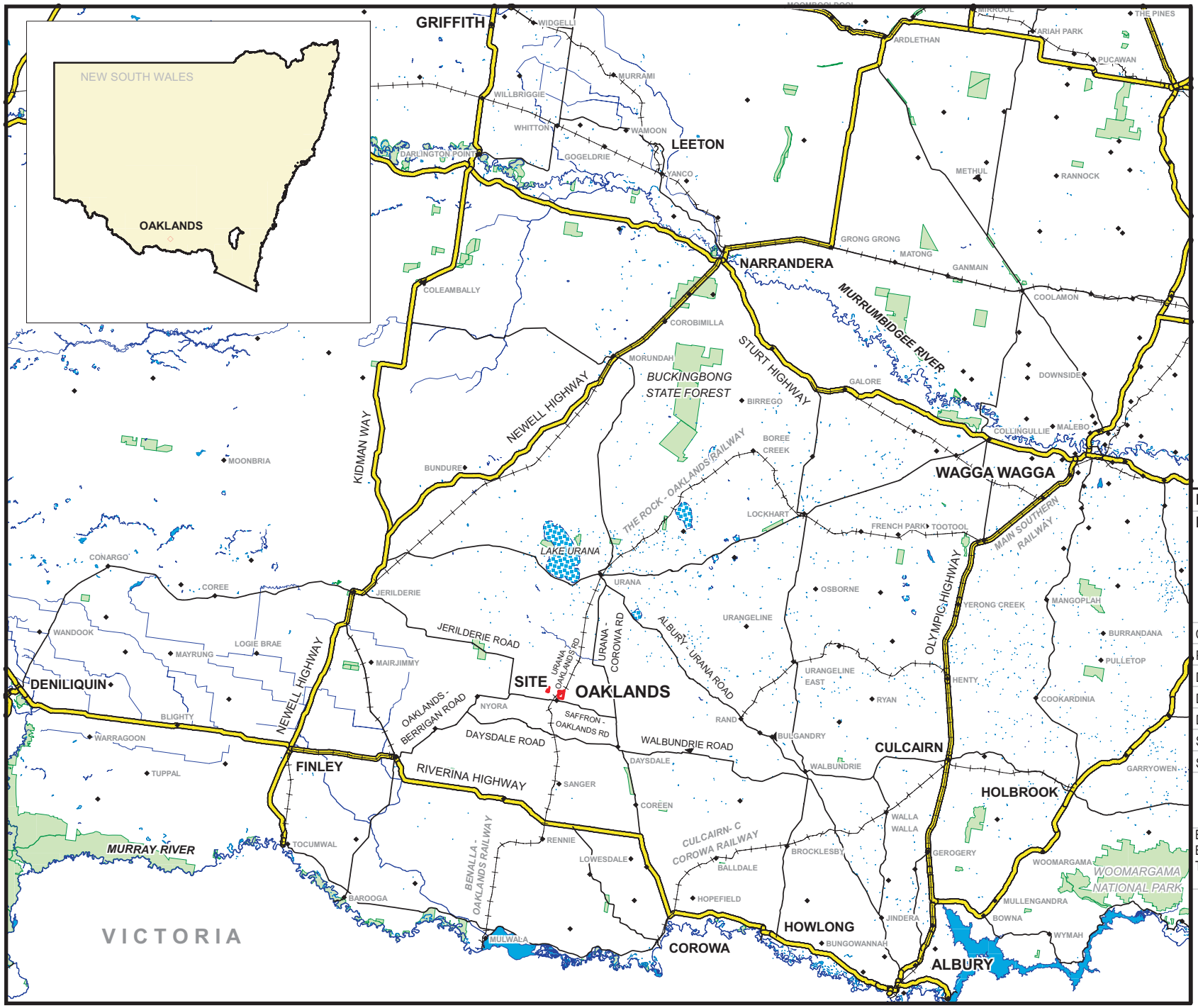

Figure 1.1

Regional Location of Site

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_OA_SW_01	
Date:	16.02.2007	Drawing Size: A4
Drawn By:	ML	Reviewed By: -
Source:	-	
Scale:	Refer to Scale Bar	

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Legend

- 200Ml Raw Water Dam
- 2Ml Stormwater Dam
- 40Ml Effluent Dam
- Irrigation Area
- Salt Evaporation System
- Water Pipeline and Pump Station
- Site Boundary
- Internal Access Road

Figure 1.2

Site Layout

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_OA_SW_02	
Date:	16.02.2007	Drawing Size: A4
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1.3 ASSESSMENT OBJECTIVES

The primary objective of this water resources assessment is to assess the impacts of the proposed ethanol production facility on local and regional water resources. To focus this assessment on environmental issues of primary concern, the following specific objectives have been developed:

- To assess water management across the site. A water balance will detail water demand and consumption, water recycling and effluent reuse across the site.
- To assess any water quality impacts resulting from the proposed ethanol production facility.
- To assess impacts of the proposed development on flood behaviour in the Billabong Creek floodplain and to assess the potential impacts of floods on the development itself.
- To detail mitigation and monitoring requirements to sustainably manage any potential water resources impacts.

1.4 CONSULTATION

1.4.1 *Director General's Requirements*

The Director General's Requirements were issued by NSW Department of Planning (DoP) on 5 October 2006. In relation to water resources, they require:

- a water balance for the site detailing water sources water consumption, water recycling, the quantity and quality of effluent streams and the impact of any water releases from the site on surface and groundwater;
- proposed erosion and sediment controls (during construction) and the proposed stormwater management system (during operations); and
- an assessment of potential impacts from storage of water and effluent and assessment of potential impacts of reusing effluent over the proposed irrigation area.

1.4.2 Department Of Natural Resources

In a letter dated 25 September 2006, the Department of Natural Resources (DNR) identified the following requirements in regards to this water resources assessment:

- Details of effluent and waste management - including details of the proposed effluent management system, details of all methods to reuse and recycle waste streams, details of quality of effluent and assessment of soil salt and nutrient balances associated with irrigation, details of detention or evaporation basins, details of stormwater management;
- Details of water supply - including an approximate water budget, water use requirements, proposed water source, requirements for pumping stations and water supply pipelines;
- Details of soil and water management – including details of sediment and erosion control measures; and
- An assessment of potential impacts of on the functionality of the Billabong Creek floodplain area.

1.4.3 Department Of Environment And Conservation

In a letter dated 15 September 2006, the Department Environment and Conservation (DEC) identified the following requirements in regards to this water resources assessment:

- An assessment of impacts on water quantity and quality – with goals for the project being to ensure that there is no pollution of surface or ground waters; that wastewaters are managed and beneficially reused where practical; and that the project is acceptable in relation to the River Flow Objectives and Water Quality Objectives for the Murray River catchment; and
- Demonstration that the proposed reuse of effluent for irrigation is sustainable.

1.4.4 Urana Shire Council

In a letter dated 25 September 2006, Urana Shire Council identified the following issues for consideration relating to water resources:

- Sewer infrastructure impacts – an assessment of the capacity of Council's sewerage treatment plant to cope with any additional effluent loads; or an assessment of the environmental impacts from and the sites ability to cope with on-site disposal of effluent; and
- Water supply – Council recommends that water supply requirements are guaranteed in writing by the relevant suppliers.

1.5 REPORT STRUCTURE

This report has been structured as follows:

Chapter 1 provides an introduction, outlining the project and objective and context of this report;

Chapter 2 provides a description of the existing water resources environment at and surrounding the site;

Chapter 3 provides details of the proposed site water management system;

Chapter 4 provides an assessment of potential water resources impacts associated with the proposed ethanol production facility, including salt and nutrient balances;

Chapter 5 presents mitigation options and monitoring requirements to ensure potential impacts are reduced; and

Chapter 6 provides a statement of commitments for the proposed development in regards to water resources.

2 EXISTING ENVIRONMENT

2.1 RAINFALL AND EVAPORATION

The nearest long term rainfall gauging station is operated by the Bureau of Meteorology (BoM) and is located at Oaklands Post Office (BoM Station 074088), approximately 0.5km to the south west of the site. The average annual rainfall at this station, based on data collected between 1920 and 2006 is 490mm.

The nearest long term gauging station that records evaporation data is operated by the BoM and is located at Coleambally (BoM Station 074249), approximately 100km to the north west of the site. The average annual evaporation at this station, based on data collected between 1996 and 2006 is 1663mm.

Monthly variations in average rainfall and evaporation are shown in *Figure 2.1* below.

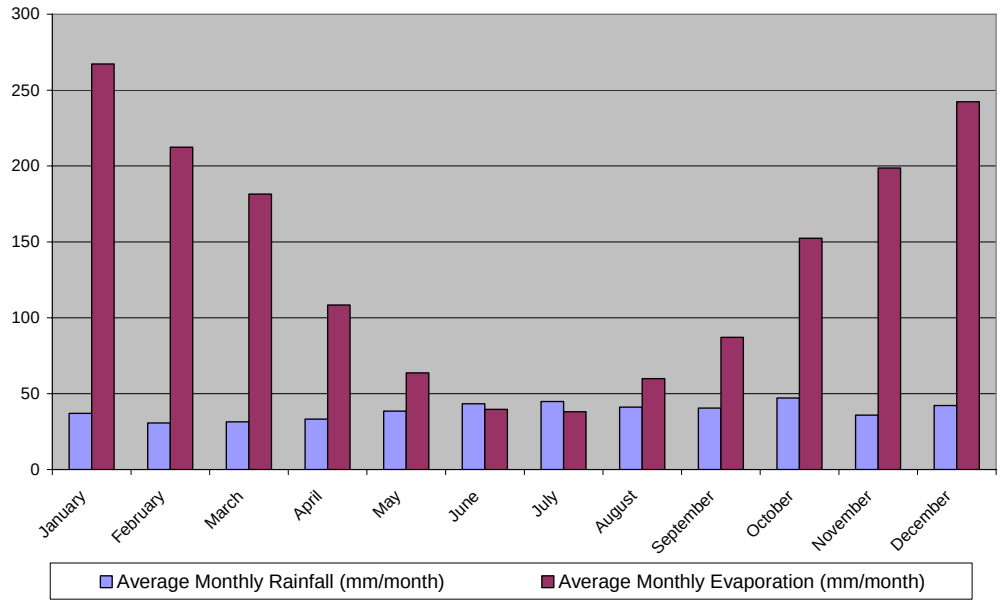

Figure 2.1 Average Monthly Rainfall and Evaporation

2.2 GEOLOGY, SOILS AND LANDFORM

Interpretation of the *Oaklands 1:50 000 Topographic Series Sheet 8126-N (1st Edition)*, indicates that the average site level is approximately 136m above the Australian Height Datum (AHD). The topography is relatively flat varying in level from RL144.3 mAHD near the southwest corner to RL128.95 mAHD near the northwest corner at an average gradient of around 1.2%.

According to the *Jerilderie 1:250 000 Geological Series Sheet S1 55-14 (2nd Edition)*, the site geology comprises predominantly Tertiary residual and colluvial deposits derived from the underlying Tertiary ferricrete, silcrete, poorly consolidated pebbly sandstones and sandstones-mudstones and claystones. Subsurface information shows the presence of thin coaly bands. This landscape grades to Quaternary unconsolidated Riverine deposits of clay, silt, sand and gravel in the northern portion of the site, inclusive of floodplains and black soil plains. These Tertiary and Quaternary deposits are underlain by boulder and pebble clays, sandstone, claystones and shales, possibly of glacial origin and some minor coal bands.

The diversity of soil landscapes in the region means that the soil has variable qualities. In general, silty sands are porous and clays are less permeable except under dry conditions where they are prone to cracking. In addition, the region may be may be affected by salinity and waterlogging due to intensive agriculture and irrigation.

Geotechnical investigations undertaken by GTS indicate that the natural sandy clay material over the site extends to at least 3 to 3.5m below the surface and is considered reactive to moisture variations (swelling when wet and shrinking when dry) (GTS, 2006).

Chemical analysis of the soil at the site has also been undertaken by GTS (2006). Soils were analysed for pH, cation exchange capacity (CEC) and Exchangeable Sodium. Emerson aggregate tests (EAT) were also completed as part of the geotechnical investigation (GTS, 2006). Comparison of the laboratory results of this assessment to *Table 2.2* of the *Environmental Guidelines: Use of effluent by irrigation* (DEC, 2004) shows that overall the soil chemistry poses moderate limitations to the site for use for irrigation. In summary, the chemical analysis of the soil indicated;

- The Emerson number was found to be 2, indicating that soil has some potential to slake and disperse. Addition of gypsum, lime or organic matter can improve structural stability.

- Soil pH is in the range 5.8 – 9.0. Plants generally grow best and are able to maximise the availability of nutrients when soil pH is between 6 and 7.5.

- The soils samples analysed had variable cation exchange capacity (CEC) (7.7-30). Soils with a CEC in excess of 15 generally have the potential to be more fertile than soils with a lower CEC as they have a greater capacity to hold exchangeable cations such as potassium, calcium, magnesium and hydrogen and are less susceptible to nutrient loss by leaching. Soils with a low CEC can hold less water and cation nutrients and plant growth is hindered. Soils with a low CEC may therefore require conditioning, for instance by addition of organic matter.

- Parameters such as soil salinity, saturated hydraulic conductivity, available water capacity, phosphorous sorption, depth to water table and depth to bedrock are currently unknown.

An analysis of GTS field observations and soil chemistry data conducted by Agsol (2007) (refer *Annex A*) concluded that surface soils are generally suitable for cultivation and are underlain by sodic subsoils which are possibly prone to water logging below the root-zone. These limitations are considered to be manageable.

2.3 REGIONAL DRAINAGE

Oaklands is situated within the Billabong Creek catchment, which forms part of the Murray River catchment. Upstream from Oaklands, the Billabong Creek catchment covers an area of approximately 4,500 km^2. The catchment is predominantly cleared on the lower slopes. Land use is dominated by grazing, with some cropping, particularly on the alluvial flats.

The site is located approximately 700m to the south of Nowranie Creek, which flows in a north west direction for approximately 18km before joining Billabong Creek. The site is also located approximately 2.2km to the east of the O'Dwyer Main Channel, which forms part of the part of the West Corurgan Private Irrigation Stock and Garden Water Supply District. Water is pumped from the Murray River, approximately 10km downstream of Corowa to feed the system.

2.4 LOCAL DRAINAGE

Because the site and immediate surrounding local topography is relatively flat, surface drainage towards Nowranie Creek is not well defined. Site runoff is captured by a shallow farm dam positioned near to the northern boundary of the site. Overflows from this dams cross adjacent properties before reaching the Nowranie Creek, approximately 700m north of the site. It is possible for minor overland flows to enter the site from higher ground to the south.

2.5 FLOODING

The site is located within the designated Billabong Creek floodplain area as defined in the Billabong Creek Floodplain Management Plan (FMP) (DNR, May 2006). Under Section 168B(2) of the *Water Act 1912*, a flood control work is to be assessed as a complying work if DNR is satisfied that the work complies with the FMP for the area in which the work is situated or proposed to be constructed.

As defined in Section 7.5 of the Billabong Creek FMP, a work complies with the FMP if:

- *The work is, or is proposed to be, located outside the Floodplain Management Plan Floodway Network as shown on Figure 4.1 and where described in the recommended measures in Table 5.1 of the Billabong Creek Floodplain Management Plan*

- *The work where applicable is to be modified in accordance with the recommended measures in Table 5.1* (DNR, 2006).

The site for the proposed ethanol production facility is not within the floodway network shown in *Figure 4.1* of the plan (situated approximately 680m from the extent of the floodplain), and none of the measures recommended *Table 5.1* of the plan relates to the site.

Further, as detailed *Figure 6.1* of the Billabong Creek Flood Study report (Brewsher Consulting, 2002), the site is outside the estimated area of land subject to flooding. This estimation was made based on major floods that have occurred over the last 20 years. Furthermore, landholders interviewed as part of the study indicated that in their experience, there is little difference in the extent of flooding for major flood events, with main differences being the duration of inundation (Brewsher Consulting, 2002).

Details of local flooding are not available for the site.

2.6 GROUNDWATER RESOURCES

Groundwater in the vicinity of the site forms part of the Lower Murray Groundwater Management Area.

The DNR groundwater licence database does not include any bores on the site. Historical drill log records from 18 bores within 2.5km of the site indicate that:

- there are up to three water bearing zones, with the shallowest typically intercepted at 43 to 81m below the ground surface, though intercepted at more than 120m below the ground surface at two bores;

- the standing water level in the shallowest aquifer system in the vicinity of the site is variable and is reported to range from 39 to 62m below the ground surface.

The standing water levels within the shallowest water bearing unit are above the top of the water bearing lithology which is indicative of semi-confined aquifer conditions. This is consistent with the lithological logs for the bores in the area, which suggest the presence of a low permeability clay layer above the water bearing unit.

The pits excavated by GTS on the site ranged in depth from 3.0 to 3.5m. No groundwater was encountered within these pits (GTS, 2006).

The DNR groundwater licence database indicates that groundwater from bores in the vicinity of the site is used for industrial, domestic and stock watering purposes. The database also has salinity data for the shallowest water bearing zone from seven bores within 2.5km of the site. This data is from between 1917 and 1981 and so is potentially outdated, however suggests that salinity of groundwater in this area is highly variable, though is potentially of potable water quality (i.e. <1000mg/L TDS) at some locations.

The work summaries from each of these bores and a map showing the location of the bores are included in *Annex B*.

2.7 RETICULATED WATER SUPPLY

No reticulated water supply is currently connected to the site. Oaklands does have a reticulated water supply to which AEL will be able to connect for site potable water.

2.8 SEWER SERVICES

There is a sewerage treatment plant located in Oaklands. The collection pipework to the treatment plant passes in close proximity to the southern boundary of the site and thus there is potential for connection to this reticulated sewerage system. Otherwise, a septic system will be constructed onsite for treatment and management of site sewerage.

3 SITE WATER MANAGEMENT

3.1 OVERVIEW

Three dams will be constructed on site as follows:

- *2Ml stormwater dam* – located adjacent to the production buildings to hold and evaporate runoff from the buildings and hard surface areas. This water will also be available for irrigation or to supplement the raw water supply;
- *40Ml effluent dam* - located east of the production buildings to store process effluent from the facility, for pumping to the irrigation area; and
- *200Ml raw water dam* – located north-east of the production buildings to store water pumped from O'Dwyer Main Channel and supply plant raw water needs.

A pumping station and an additional 200Ml raw water dam will be constructed adjacent to O'Dwyer Main Channel. This dam will be used to supply the facility with water during the winter months when the channel is closed for maintenance. A subsurface pipeline will be constructed from the dam site to the on-site raw water dam.

A significant aspect of the proposed ethanol facility is that the majority of effluent produced by the facility will be treated and recycled back through the production process. The remainder of the effluent will be pumped to the effluent dam for reuse by irrigation, and a small stream of high salt effluent will be diverted and treated via a salt evaporation system. There are no proposed discharges of effluent from the site. Reuse of water within the facility will also ensure demand from external water sources will be minimised.

A water balance for the proposed facility has been prepared detailing water requirements through various processes within the plant, expected effluent volumes, and losses due to evaporation. This water balance is presented in the form of a water flow diagram in *Figure 3.1*. Further details of site water management are provided in the sections below.

3.2 CATCHMENT OBJECTIVES

Water quality objectives for the Murray River catchment (NSW) have been published by the NSW DEC (http://www.environment.nsw.gov.au/ieo). This document identifies the desired beneficial use of the waterways and also provides numerical water quality guidelines to enable these objectives to be achieved. These guideline concentrations are for a range of physical, chemical and biological parameters.

Based on the DEC's classification of the waterways in the vicinity of Oaklands, the water quality objectives are to protect water quality for:

- aquatic ecosystems;
- visual amenity;
- primary and secondary contact recreation;
- livestock, irrigation and homestead water supply;
- drinking water, to be treated through disinfection;
- drinking water – groundwater; and
- aquatic foods.

Numerical limits for protection of these waterway values are also provided in the ANZECC (2000) Water Quality Guidelines. The limits, termed 'trigger values' are provided for a large range of toxicants and physio-chemical parameters. The relevant trigger values for Oaklands are those for a lowland rivers and streams in south-eastern Australia.

The DEC's Murray River catchment (NSW) objectives also provide river flow objectives. For the waters in the vicinity of Oaklands, river flow objectives are to:

- protect pools in dry times;
- protect natural low flows;
- protect important rises in water level;
- maintain wetland and floodplain inundation;
- mimic natural drying in temporary waterways;
- manage groundwater for ecosystems; and
- minimise effects of weirs and other structures.

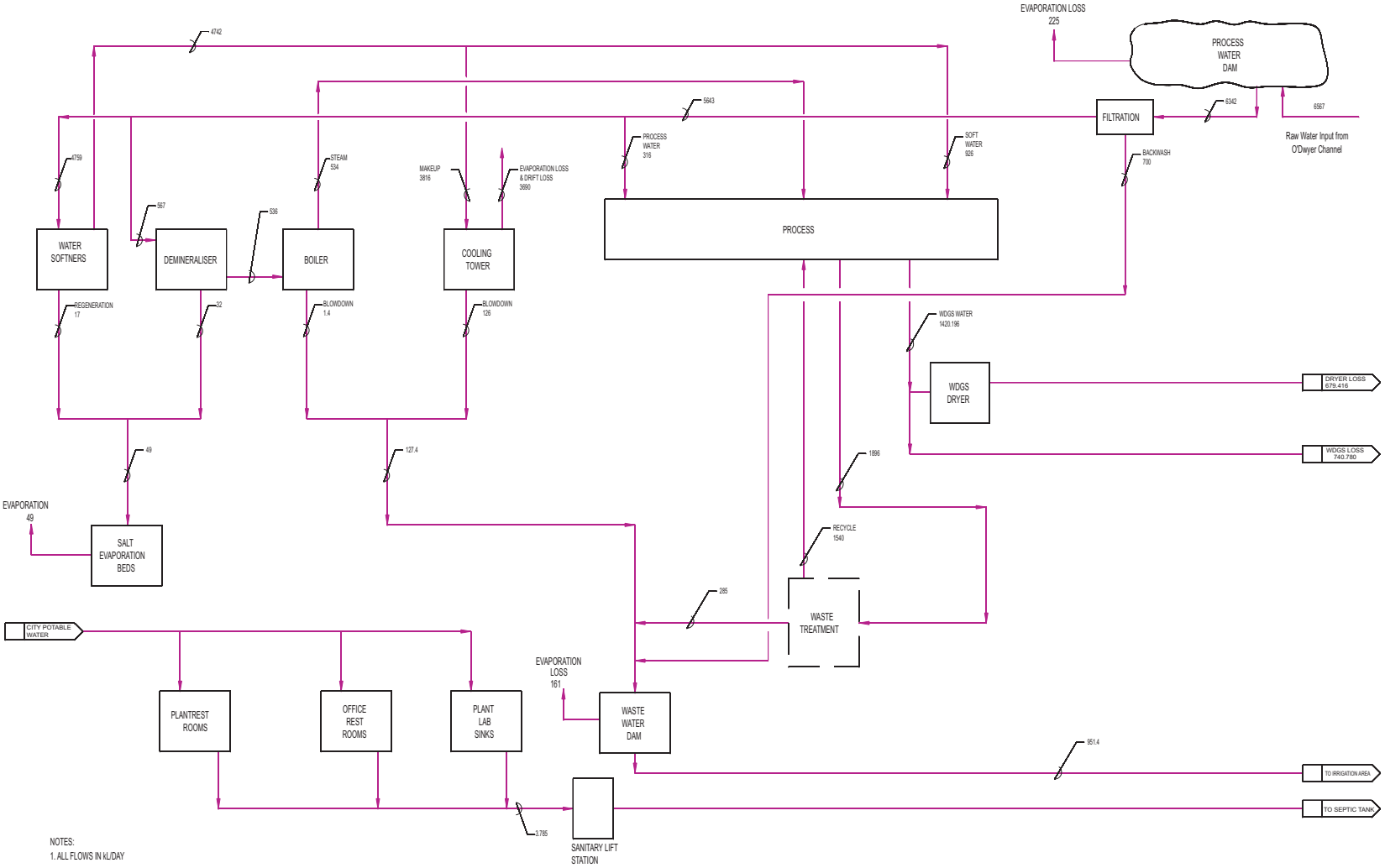

Figure 3.1

Water Flow Diagram

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_OA_SW_03	
Date:	25/07/2007	Drawing size: A4
Drawn by:	GC	Reviewed by: -
Source:	-	
Scale:	N/A	

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Building C, 33 Saunders St, Pyrmont, NSW 2009
Telephone +61 2 8584 8888

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3.3 WATER SUPPLY

3.3.1 Ethanol Production Process

Water is a key input to the ethanol production process. It is predicted that the facility will require 6567 kl of raw water pumped from the O'Dwyer Channel per day, of which the plant will receive approximately 5642 kL of water per day after evaporation and filtration losses are taken into account. Of this plant water, 1540 kL of water will be provided per day by treatment and recycling of process water, as part of the proposed water management system for the plant. Raw water will be extracted from the Murray River via a new pumping station at O'Dwyer Main Channel under a 'high security' water licence sought from DNR under the *Water Act 1912* and in accordance with the *Water Sharing Plan for the New South Wales Murray and Lower Darling regulated rivers water sources 2003*. The high security water licence will ensure an adequate supply of water for the production process.

Investigations into the availability and capacity of water supply for the site included consultation with West Corurgan. A letter received from the Manager, Mr Peter Wallis, confirmed their ability to supply water via O'Dwyer Main Channel during the normal irrigation season (refer to *Annex C*).

It is predicted that on average 6567 kL per day of raw water will be required to be pumped to the raw water dam to ensure adequate supply for the process and allow for backwash from the raw water treatment facility as well as evaporation losses from the raw water dam. This figure is based on the average daily evaporation rate as recorded at BoM Station 074249. Based on the average daily winter evaporation and the average daily summer evaporation, the average raw water demand will vary from 6403 kL/day to 6731 kL/day, respectively, throughout the year.

The proposal includes construction of a 200ML raw water dam on-site to store raw water for the plant, recharged via the subsurface pipeline from O'Dwyer Main Channel. This sizing provides a contingency for up to 30 days supply (based on average daily evaporation rates). The dam is proposed to be 5m deep to minimise evaporation loss.

The O'Dwyer Main channel is closed for maintenance and repair during the winter months (May to August). The additional 200Ml raw water dam adjacent to the channel will ensure water supply for the production process is maintained during these months.

Water will be pumped from the on-site raw water dam to a raw water treatment facility prior to being pumped to the plant. Raw water will undergo the following treatment steps prior to use in the plant:

- filtration to remove suspended material;
- softening, using a zeolite softener, or similar, to remove calcium and magnesium hardness (the zeolite softener will be regenerated with salt); and
- de-mineralisation using reverse osmosis or a mixed resin bed.

3.3.2 Ancillary Facilities

Ancillary facilities which will require water include:

- plant rest rooms;
- office rest rooms; and
- plant lab sinks.

Potable water will be supplied by connecting the site to the main Oaklands reticulated water supply. It is expected that these facilities will use an average of 3.8 kL of potable water per day.

3.4 WATER RECYCLING

Effluent generated the ethanol production process will be separated into two waste streams with the majority pumped to a secondary anaerobic digestion treatment system included within the plant and a small amount diverted to a salt evaporation system adjacent to the plant. An estimated 1896 kL per day of effluent will be generated and treated within the secondary treatment system. Of this effluent, 1540 kL per day (approximately 80%) will be recycled back to the process with the remainder being pumped to the effluent dam for reuse on the proposed irrigation area.

The anaerobic digestion treatment system will treat the water to the quality outlined in *Table 3.1*. The limits shown in this table provide the acceptable water quality for water used in the production process.

Table 3.1 Water Quality Limits for Recycle Stream

Parameter	Unit	Value
Total Germs	No./mL	Less than 100
E Coli	No./mL	Nil
Coliform Bacteria	No./mL	Nil
Hydrogen Sulfide	mg/L	Nil
Chemical Oxygen Demand	mg/L	Less than 100
Biochemical Oxygen Demand	mg/L	Less than 30
Total Suspended Solids	mg/L	Less than 100
pH	pH units	7.5-9.0
Total Dissolved Solids	mg/L	Less than 500
Odour		Odourless

1. Source: Praj Industries Ltd, Revision 06S012-4-BEF 908

3.5 EFFLUENT MANAGEMENT

3.5.1 Irrigation of Effluent

The majority of wastewater from the production process will be stored in an effluent dam prior to reuse by irrigation. The effluent to be used for irrigation includes:

- backwash from the raw water treatment process (approximately 700 kL/day);
- the stream from the secondary anaerobic digestion treatment system which is not recycled (approximately 285 kL/day); and
- blowdown from the cooling tower and the boiler (approximately 127 kL/day).

It is proposed that a 40 ML effluent dam be located to the east of the production buildings to store process effluent from the facility. The surface area of the effluent dam will be maximised to increase evaporation losses and reduce requirements for disposal of effluent through irrigation. The dam is proposed to be approximately 6ha in area and 0.7m deep.

Agsol (2007) noted that maximising evaporation from the effluent dam would increase the low salinity of the effluent and that shallow dams are prone to algae growth, which can clog irrigation equipment and impact on effluent quality. These factors should also be taken into account during final dam design. Agsol (2007) suggested that to manage potential salinity and nutrient accumulation, final dam configuration could be a combination of deep and shallow sections to be used as appropriate during irrigation and non-irrigation periods.

A detailed assessment of the required size of this dam has been undertaken as part of the water balance (refer to *Section 4.2.2*), which indicates that 40ML will be adequate to store effluent during wet periods, thus minimising potential for uncontrolled discharges.

From the effluent dam, water will be pumped to an irrigation area with a crop such as barley or lucerne. Lucerne has a high requirement for water and can use 7-10 ML/ha of irrigation water over a full irrigation season, in addition to normal rainfall (Bourchier, 1998). Lucerne has medium salt tolerance and a high nutrient uptake while barley has a high salt tolerance and a moderate nutrient uptake (DEC, 2004). A minimum area of approximately 55ha has been set aside on the site for irrigation.

3.5.2 Salt Evaporation System

Approximately 49kL of effluent per day will be generated from the regeneration streams of the water softener unit and the membrane treatment. This separate waste stream will be diverted to a salt evaporation system adjacent to the proposed ethanol production plant and the irrigation water storage pond. Effluent from the softening and demineralising processes of the facility will be produced with water quality parameters as shown in *Table 3.2,* notably with a high concentration of salts (EC 30,000-35,000 µS/cm).

Table 3.2 Water Quality Parameters of High Concentration Effluent Stream

Parameter	Unit	Value
pH	-	7 - 9
Electrical Conductivity	mS / cm	30,000-35,000
Total Dissolved Solids	ppm	25611
Total Suspended Solids	ppm	0
Turbidity	NTU	0.35
Total Hardness as CaCO3	ppm	4200.4
Total Alkalinity as CaCO3	ppm	3259.0
Calcium as Ca2+	ppm	909.6
Magnesium as Mg2+	ppm	789.5
Chlorides as Cl-	ppm	17793.0
Active Chlorine as Cl2	ppm	0.0
Total Iron	ppm	418.4
Total Manganese	ppm	9.7
Silica as SiO2 (reactive)	ppm	313.8
Silica as SiO2 (filter sand)	ppm	0.7
Sodium as Na+	ppm	11699.6
Potassium as K+	ppm	241.4
Sulphates as SO42-	ppm	241.4
Nitrates/Nitrites (NO3 - NO2)	ppm	7.1
Fluorides as F-	ppm	7.2
E Coli	no/ml	27.8
Total Coliform Bacteria	no/ml	364.2
Total Phosphorus as P	ppm	0.078
Boron as B	ppm	0
BOD 5	ppm	0
COD	ppm	0
Total Nitrogen (Kjeldahl)	ppm	1.71
Ammonia as NH4+	ppm	0

Source: Agri Energy Limited (2007)

Conceptually, based on an annual evaporation rate of 1663mm and an annual rainfall of 490mm at Oaklands, and applying an efficiency factor of 85%, the salt bed system will require a total net surface area of 17,939m^2 (130m x 130m). Overall dimensions of the entire system would be approximately 190m x 130m, including bunds, separated into a series of evaporation cells (six) with net surface areas of 60m x 60m. These cells will have an operating range of 0.5m in depth plus flood storage buffer and will be used on a rotational basis for complete drying and recovery of salt.

A perimeter containment bund would be conservatively designed to be either 300mm freeboard above the 100yr flood level, or 500mm freeboard above the critical 100yr rainfall event, whichever is higher. This level will be determined at the detailed design stage during the preparation of the site EMP. During extreme rainfall events, overflow will flow over low partition walls and into adjoining cells. The entire system would be clay lined to prevent seepage into surrounding soils and bund wall condition monitored as part of the site EMP.

The annual salt (NaCl) production of the proposed evaporation system will equate to 527 tonnes (11700ppm Na^+ and 17793ppm Cl^-), which will be harvested and stored in high density concrete bins within a small undercover storage area. The salt will then either be sold or offered for commercial purposes.

3.5.3 Sewerage

Sewerage from these facilities will be collected, treated and disposed of through connection to the Oaklands reticulated sewerage network or an on-site septic system. It is expected that the facility will create an average of 3.8kL of sewerage per day.

3.6 STORMWATER MANAGEMENT

The basic stormwater management requirements are described below. A more detailed stormwater management plan will be developed to provide concept design and sizes of stormwater drainage elements in future. This plan will include the following basic requirements:

- Stormwater runoff from all roofs and hard surface areas will be directed towards a 2Ml stormwater dam adjacent to the production buildings. This water will be disposed of via evaporation, and there will also be a pump installed in the stormwater dam to enable use of this water for irrigation, or to supplement the raw water dam (the quality is expected to be satisfactory for ethanol production). The pump will enable draw down of water levels (by pumping to the raw water dam) to below the designated top water level within a 48 hour period after rain so there will be no intentional discharges. The dam will also serve as emergency spill containment and will require at least 60kL of reserve capacity between top water level and spillway level. The stormwater dam will be designed to fully retain the 90th percentile rainfall event and the 20 year, 2 hour storm runoff is selected as the minimum design criteria (this is a commonly used criteria for detention in other locations around NSW). Overflows in extreme rainfall events are expected to be sufficiently diluted to meet ANZECC and ARMCANZ (2000) guidelines for receiving waters (Nowranie Creek). Event sampling and testing will be undertaken to confirm this expectation.

- An oil-grit separator will be installed to treat water from carpark and road areas prior to it entering the stormwater dam. This will remove coarse sediments and hydrocarbons prior to discharge to the stormwater dam.

- Internal roads and areas where storage, transfer or processing of potentially contaminating material is proposed will be paved and graded to direct runoff and potential spills to the stormwater drainage system. Gutters, bunds, swales and pipe networks will be installed to direct flows from these areas to the stormwater dam.

- Bunds will be constructed around all portions of the site in which potentially contaminating materials are stored, handled or processed. Wherever practical, these areas will be roofed or otherwise covered and will include a fully contained drainage system. Bunds will prevent entry of runoff from surrounding areas for all events up to the 100 year ARI storm and will fully contain any potential spill within the bunded areas. Design of bunding, drainage and pump-out systems etc. will be in accordance with the relevant Australian Standards.

4 IMPACT ASSESSMENT

4.1 CONSTRUCTION

Minor excavations will occur during the construction phase of the project. The key soil disturbances will result from construction of plant structures, construction of the raw water dams, effluent dam, stormwater dam, salt evaporation cells and laying of pipelines to connect the site to water and other utilities.

Potential impacts associated with these activities include:

- movement of sediment laden runoff from the site due to stormwater flowing over excavated or disturbed areas, including any temporary stockpile areas;
- soil erosion; and
- spills of fuels or chemicals.

During construction and excavation activities, best management practices will be implemented to ensure the risk of soil erosion and transport of sediment laden run-off from the work area is minimal. Details of erosion and sediment control measures are provided in *Section 5.*

4.2 OPERATION

4.2.1 Water Supply

Water for use in the ethanol production facility will not impact on other local water users as it will be drawn from the source (O'Dwyer Main Channel) in association with licence conditions.

The raw water dam on site has been sized to allow for approximately 38 day contingency supply, based on average daily evaporation rates. Therefore there should not be an impact on operations should water be unavailable from the source for a period of up to 38 days. During periods where the O'Dwyer Main Channel is closed for maintenance, the additional 200ML dam to be constructed adjacent to the channel will provide for approximately 60 days supply in conjunction with the on site raw water storage. Furthermore, there will be a supply of water in O'Dwyer Main Channel during this time. AEL could use this as a contingency supply if necessary; this water would supply an estimated additional ten days of plant water requirements. Thus, there is considered sufficient capacity to supply plant raw water requirements during the scheduled closure of O'Dwyer Main Channel.

Given the sandy nature of the subsoil and the limited volume of clay in the area as found in the geotechnical investigations undertaken by GTS (2006), a High Density Polyethylene (HDPE) liner or similar will be required to retain water in the dams.

Potable water demand on the site will not be high and should not, in itself, place significant demands on the existing Oakland water supply.

4.2.2 *Effluent Irrigation*

Effluent from the ethanol production process that is not recycled or diverted to the salt evaporation beds will be reused for irrigation. Uncontrolled discharges of effluent have the potential to adversely affect receiving waters and associated flora and fauna unless treated or sufficiently diluted.

Unless irrigation is carefully planned and monitored adverse impacts may occur due to:

- excess irrigation water of unacceptable quality percolating to groundwater (potentially affecting beneficial groundwater uses) and/ or running off irrigation areas and entering receiving waters;
- excess irrigation water percolating to groundwater and leading to elevation of the groundwater table;
- insufficient irrigation water causing crop growth problems;
- nutrient build up which can be leached to groundwater;
- salt build up causing crop growth health problems and potential leaching to groundwater.

Irrigation Strategy

The site irrigation strategy has been developed to ensure sustainable irrigation of effluent. A basic element of this plan will be that effluent will be applied at a rate that will maintain a soil moisture deficit while meeting targets for nutrient uptake, water use and salt flushing that are a function of soil conditions, climate and crop type. This will ensure that effluent does not runoff the irrigation area, potentially polluting Nowranie Creek.

The frequency of irrigation in the water balance was determined by the rate of change in soil moisture content. The irrigation strategy is designed to avoid excessively frequent irrigation of the soil and thereby minimising runoff and/or percolation. In the water balance, irrigation water is applied when the soil deficit equalled the daily effluent volume to be applied. If the application of effluent to the irrigation area exceeds this estimated deficit, there is potential for it to migrate beyond the root zone to groundwater.

The daily effluent flow from plant operations to the effluent storage dam for irrigation is 1.15Ml/day and the available irrigation area is a minimum of 55ha. Therefore, the modelled application rate, for 1.15Ml/day effluent flow and irrigating 55 hectares of lucerne is an average of 2.1mm/day.

It should also be noted that a leaching allowance for effluent irrigation is required to allow leaching of any accumulated salts to below the crop root zone. *Section 4.2.4* details this requirement.

Effluent Classification

The effluent was classified, based on criteria outlined in *Environmental Guidelines: Use of Effluent by Irrigation* (DEC, 2004), to assess environmental management requirements. The proposed quality of effluent from the ethanol production process and a classification rating is shown in *Table 4.1*. The expected characteristics of the effluent indicate that it will be need to be classed as medium strength due to the TDS concentration. An analysis of the expected effluent quality by Agsol (2007) indicated that as the TDS concentration only exceeds the guideline for low strength by 42mg/L and this concentration may include nutrients, it is reasonable to consider the efluent to be low strength. Nevertheless, effluent was conservatively classified as medium strength for the purposes of this assessment.

Typical effluent quality data was obtained from PDF and AEL (2007), and is summarised in *Table 4.1*. This is the result of predicted effluent quality from the ethanol plant and waste water treatment vendors as well as water quality data from the main water supply sourced from the Murray River. The key parameters as well as those used in the DEC's (2004) effluent strength classification are discussed below.

The full suite of the calculated effluent quality results are presented in *Annex D*.

Table 4.1 Predicted Effluent Quality

Parameter	Units	Average Concentration
pH		8
EC	dS/m	0.15-0.2
TDS	mg/L	642
TSS	mg/L	168.4
BOD_5	mg/L O_2	33.88
Oil and Grease	mg/L	1.44
TP	mg/L	0.078
TN	mg/L	14.97
TKN	mg/L	3.0 approx
NO_x	mg/L	10.69 (total NO_2 + NO_3)
NH_3	mg/L	1.28
Ortho Phosphate	mg/L	No data
Coliform	cfu/100mL	No data
Chlorophyll "a"	mg/L	No data

Source: Process Design & Fabrication Pty. Ltd, M06062-CA-003

Organic matter in effluent is measured by 5-day Biochemical Oxygen Demand (BOD_5). Organic matter is removed from effluent by land application, with loading rates greatly influencing the resting period for soil re-aeration and infiltration rates due to clogging of soil pores. The BOD_5 level of the untreated effluent is low at 33.88 mg/L.

Total dissolved salts (TDS) is a measure of salinity. Levels between 600-1,000mg/L are considered medium strength. The average value of TDS for the effluent is 642mg/L, at the low end of the 'medium' range.

The range of **pH** of the effluent is 7-9, which is suitable for effluent irrigation without adjustment.

The **total suspended solids** (TSS) average value is expected to be 168.4mg/L in effluent. This is relatively low however SS needs to remain at a low level to avoid clogging sprinkler nozzles and soil pores and the coating of leaf surfaces.

Nutrients, are very low for both nitrogen (N) and phosphorus (P).

The strength of the effluent is important when determining the wet weather storage volume requirements. The untreated effluent falls into the 'medium strength' category according to DEC 2004 guidelines although this is solely as a result of the concentration of TDS.

Table 4.2 Effluent Strength Classification

Parameter	Approximate Effluent Concentration mg/L	Effluent Strength Classification (DEC, 2004)
BOD_5	33.88	LOW
TN	14.97	LOW
TP	0.78	LOW
TDS	642	MEDIUM
Oil and grease	1.44	LOW
TSS	168.4	*N/A*
EFFLUENT STRENGTH		**MEDIUM**

1. Classification is based on Table 3.1 of the DEC (2004) *Environmental Guidelines: Use of Effluent by Irrigation*

The DEC guidelines suggest that for full reuse schemes with medium strength effluent, the allowable frequency of uncontrolled discharges which inevitably occur as a result of prolonged rainfall events should be limited to 75% of years (DEC, 2004). As described in the following section, preliminary investigations indicate that sizing of the effluent dam at 40ML meets this requirement.

Water Balance

It is important to ensure that sufficient land and wet weather storage is available when designing a effluent irrigation scheme to avoid unnecessary discharges to the environment. Detailed water balances are used to ensure that sufficient land and storage is available throughout the year.

A daily water balance has been prepared in accordance with the DEC (2004) *Environmental Guidelines: Use of Effluent by Irrigation* to ensure that the effluent irrigation system will provide an efficient and sustainable means of managing effluent from the production process (refer to *Annex E*). The approach for the irrigation area water balance has also been adapted from the nominated area method outlined in *Environment & Health Protection Guidelines* (1998).

Lucerne cropping was investigated to determine the wet weather storage requirements for the predicted effluent volumes produced.

In an effluent irrigation scheme, the volume of effluent that can be applied to a site plus the rainfall should generally equal the amount of water able to be used by plants when natural runoff and percolation is taken into account. This minimises problems associated with runoff and waterlogging of soil. The maximum amount of effluent that can be applied can be calculated from the following formula:

Effluent applied = evapo-transpiration + deep drainage + surface runoff – precipitation

If soil moisture is too high, for example during periods of wet weather, the effluent is detained in the wet weather storage pond.

The variables used in the daily water balance model were:

- *Effluent applied*: the effluent available for irrigation is the total of the daily effluent produced (1150kL) minus the evaporation loss from the effluent dam.

- *Precipitation and Evapo-transpiration:* Daily rainfall records from the BoM stations 074088 and 074249 were analysed for the 90th percentile rainfall year (1931), to ensure that the storage is large enough to ensure any uncontrolled discharges are limited to 10% of years.

- Crop Factors provided in *Table 4.1* of the DEC's 2004 *Effluent Irrigation Guidelines* and the daily evaporation recorded at BoM station 074249 were used.

- *Plant Root Depth and Available Soil Water*: The plant root depth was taken to be 0.3m for lucerne. Plant available soil water was based on this value and the soil types at the site, and was calculated to be 200mm/m.

- *Surface Runoff and Drainage (Percolation)*: Surface runoff was modelled to occur when the soil saturation limit was reached. It was assumed that rainfall throughout the year would provide the necessary percolation required to leach salts from the effluent out of the root zone. Percolation through soil at the design rates for saturated hydraulic conductivity was conservatively taken to be zero.

A spreadsheet water balance model was used in accordance with the DEC (2004) *Guidelines*, using daily historical data over one year.

Effluent Storage Requirements

Any excess effluent which cannot be applied to the irrigation area will be stored in the effluent dam and used on days when there is a soil moisture deficit and additional effluent can be sustainably applied.

A daily water balance was used to assess the wet weather storage requirements (refer to *Annex E*). Daily data provides more accurate and realistic results than a monthly water balance and reduces over-design, which can occur in a monthly water balance where the effects of uneven distribution of rainfall over the month is not taken into account, reducing the potential for irrigation over more days throughout the year.

A spreadsheet model using daily historical data for one year (1931) classified as a 75th percentile rainfall year was used to assess a worst-case scenario. Based on the water balance model, during the 75th percentile rainfall year there is a maximum of 32 continuous days for which effluent will be required to be stored. The 75th percentile daily effluent storage volume required based on this data and sufficient to limit uncontrolled discharges such that they occur only during only 1 in 4 of years is 36.8Ml.

Based on this calculation, a conservative volume was determined to allow for additional hydraulic retention time should irrigation be delayed for an unusually long period of time. Five weeks (35 days) of effluent storage volume has been provided in the effluent dam to a volume of 40Ml. This is able to account for the extended periods of approximately 32-days where irrigation is not possible (as modelled in the daily water balance), with additional 3 days' allowance for system 'down-time' such as for maintenance or pump or system failure and extended periods during the months of June-July where cooler weather may limit, although not necessarily preclude, effluent irrigation.

The 40Ml of storages will ensure that be no discharges of effluent from the site up to the 75th percentile rainfall event, at which time overflows are expected to be sufficiently diluted to meet ANZECC and ARMCANZ (2000) guidelines for receiving waters (Nowranie Creek).

Given the nature of soils on the site, the effluent dam will require a HDPE liner or similar to ensure effluent does not percolate through to groundwater.

4.2.3 *Size and Suitability of Irrigation Area*

The potential irrigation area was calculated based on a combination of calculated effluent flows and NSW DEC (2004) recommended buffer areas, including:

- 20m from all property boundaries bordering the edge of the irrigation area; and
- more than 50m from all houses, roads, existing grazed vegetation and drainage lines.

The total area available for irrigation of treated effluent, taking into account the buffers described above, is a minimum of 55 hectares and is illustrated in *Figure 1.2.*

Agsol (2007) conducted an independent review of the proposed irrigation scheme, including the suitability of the soils to accommodate an effluent irrigation scheme (refer *Annex A*). This report indicated that the irrigation area will be suitable for a sustainable effluent irrigation scheme. The limited soils data suggests that the soils have only manageable limitations including sodicity and possibly below plant root zone waterlogging.

Agsol (2007) considered it likely that a suitable crop management system can be put in place which could immobilise the nutrient content of the effluent (Agsol, 2007). Calculated effluent quality data show that concentrations of nutrients and electrical conductivity can be managed as required given the low concentrations of these constituents as outlined below.

Agsol (2007) stated that if groundwater is not present within three metres of the ground surface and there is a barrier to groundwater movement (such as clay subsoil) risks to any underlying groundwater resource should be minimal. The review of borelog information indicates that groundwater at the site is unlikely to be present within 30m of the ground surface. Geotechnical and hydraulic investigations undertaken for the development of the irrigation plan will enable identification of potential barriers to groundwater movement provided by the subsoils. However, it is likely that low permeability sediments are present between the shallowest water bearing zone and ground surface, which could impede percolation to groundwater.

4.2.4 *Water Quality*

The likely pollutants of concern during operation of the facility are those associated with the effluent. A full assessment of expected effluent quality has been conducted and the expected nutrient concentrations in effluent are very low. The moderate salt levels (represented as EC and TDS) are of primary concern solely because this is the component of the effluent that creates a 'medium strength' effluent.

Salt Balance

The DEC guidelines recommend that when using effluent that contains more than 500mg/L of TDS, a higher level of salinity control to maintain a viable and lasting system is required. A detailed salt balance for the irrigation area has been undertaken to ensure salinity is appropriately managed.

The EC value of the effluent was taken into account by calculating a leaching requirement for removal of salts out of the root zone. This was calculated to be 17mm per year which would be easily achievable through a heavy rain event. It is therefore concluded that rainfall will provide adequate leaching.

Complete salt balances are provided in *Annex F*.

Nutrient Balances

The principal objective in an effluent irrigation scheme is to use or immobilise the added nutrients quickly to prevent potential contamination of ground and surface waters. To achieve this, the amount of each nutrient applied in the effluent must be less than or similar to the amount removed from the site by the particular agricultural activity, as well as the fixing of phosphorous by the soil and gaseous losses of nitrogen to the atmosphere.

Nitrogen and phosphorus were examined in the nutrient balances. Inputs to the nutrient balances included:

- the crop to be used;
- average annual dry matter yield;
- average annual effluent application rate;
- average nutrient concentrations in the effluent;
- annual load of nutrients and the proportion available to plants; and
- the approximate quantity of nutrients exported from the site each year through grazing, leaching, or immobilisation in soil , depending on the nutrient.

Phosphorus

Results from phosphorus modelling in accordance with the DEC guidelines (see *Annex F*) show that the quantities of phosphorous that would accumulate in the soil will continue to result in a net deficit for the modelled life of the ethanol plant of 80 years. Modelling using an estimated and extremely conservative phosphorus sorption capacity of site soils at the proposed irrigation area shows that the life of the soil for phosphorus uptake with the predicted concentration in the effluent is in the order of 3000 years.

Nitrogen

The level of nitrogen deficiency in the soils, low nitrogen content of the effluent and the extent of nitrogen uptake and decomposition is such that additional fertiliser would be required to provide long-term nutrition to boost pasture or crop production further.

After a ten year application the soils indicate a net nitrogen deficit of approximately 102kg/ha for a lucerne cropping enterprise.

No leaching or soil accumulation is predicted to occur based on the nutrient modelling. The complete nutrient budgets are presented in *Annex F*.

Stormwater Management

The proposed effluent management system ensures no discharges of effluent from the site up to the 75th percentile rainfall event. Sizing of the effluent dam will prevent unavoidable discharges that may occur during wet periods in at least 75% of years, which meets DEC (2004) guidelines (refer to *Section 4.2.2*). Hence effluent is not expected to have any significant impacts upon downstream water quality.

The stormwater management system will capture runoff from all hard surfaces across the site. Water from road and carpark areas will be treated via an oil/grit separator and then captured in a stormwater dam along with water from roof areas. This water will be disposed of via evaporation, or will be irrigated or used to top up the raw water supply for the ethanol production process. The quality of this water is expected to be satisfactory for ethanol production and, because all water contained in the dam will be pumped to the raw water dam within 48 hours, there will be no intentional discharges and hence no water quality impacts downstream of this dam. Overflows in extreme rainfall events are expected to be sufficiently diluted to meet ANZECC 2000 guidelines for receiving waters (Nowranie Creek). Event sampling and testing will be undertaken to confirm this expectation.

There is potential for chemicals and materials stored, handled or processed on site to spill, thus potentially polluting local waterways. Installation of bunds around all portions of the site in which potentially contaminating materials are stored, handled or processed, will ensure that this risk is appropriately managed.

If an on-site septic system is constructed, there is potential for groundwater and surface water quality impacts as a result of failure of this system. Most systems are designed to have a life of 20-30 years, with regular maintenance required to remove sludge that has built up. If properly maintained, in accordance with recommendations of the septic system supplier, the system should not impact on the quality of ground and surface water.

There is potential for leakage from the effluent and stormwater dams to contaminate groundwater unless dams are lined or soil permeability is sufficiently low ($< 10^{-11}$ m/s).

4.2.5 Flooding

As detailed in *Section 2.5*, the site is situated within the designated Billabong Creek floodplain area but is not within the area of land estimated to be subject to flooding. Details of localised flooding are not known.

The proposed development is not expected to be impacted by large flood events within the Billabong Creek floodplain. Further, the development is not expected to impact flood behaviour in areas surrounding the site.

5 MITIGATION AND MONITORING

5.1 MITIGATION

5.1.1 Construction Phase

A Soil and Water Management Plan will be prepared prior to any construction activities in accordance with *Managing Urban Stormwater – Soils and Construction* (Landcom, 2004). Measures to prevent impacts to water resources during construction will include:

- installation of temporary erosion and sediment control structures such as straw bales and sediment fences to prevent the movement of sediment from construction areas;
- installation of sediment basins and/or use of existing dams to contain sediment laden water, allow sufficient settlement time and flocculation if required and discharge of water following testing to confirm water quality meets relevant guidelines (eg < 50 mg/L suspended solids, no visible oils and greases etc);
- minimisation of time excavated surfaces are left exposed;
- restriction of traffic to defined internal roads;
- ensuring chemicals are appropriately stored and bunded;
- if required, cleaning soil adhered to tyres by hosing down in bunded areas prior to departure from the site; and
- regular inspection and maintenance of erosion/siltation control devices to ensure effectiveness for the entire construction period.

5.1.2 Operation Phase

Water Supply

The proposed water management system has been designed to maximise recycling and beneficial use of site water. All water discharged from the ethanol production process will be either recycled for further use within the plant following treatment, used for irrigation, or evaporated in salt beds. Recycling will minimise demand for raw water from off-site.

In the event of mechanical failure or interruption of power supply to the secondary water treatment plant, effluent would be directed to the effluent dam resulting in a small increase in BOD levels. Mitigation of the impacts of such a malfunctioning would involve the short-term use of an aerator in the effluent storage dam (approx. 2 – 3 days) to reduce the BOD while repairs are carried out to the plant. Monthly water quality monitoring of the effluent dam would monitor this level.

Storages

All storages containing effluent or potentially contaminated water will be designed to fully contain effluent/ runoff for the 75th percentile of all rainfall events. In addition, the stormwater dam will be designed to fully retain the 20 year, 2 hour storm runoff (this is a commonly used criteria for detention in other locations around NSW). Clean water storages will generally be designed to contain flows up to the 10 year, 2 hour ARI event with spillways designed to convey the 100 year ARI overflows. All dams will be constructed with a HDPE liner or similar to prevent seepage loss from the dams and avoid groundwater impacts.

Agsol (2007) suggested that to manage potential salinity and nutrient accumulation, final dam configuration could be a combination of deep and shallow sections to be used as appropriate during irrigation and non-irrigation periods.

Stormwater Management

A detailed stormwater management plan will be developed for the facility. It will incorporate the concepts outlined in *Section 3.6*. Stormwater runoff from potentially dirty areas e.g. carparks, will be fully retained on-site to avoid potential discharges and impacts on receiving waters. Runoff from clean areas i.e. undeveloped parts of the site, will be diverted around dirty areas to retain clean water flows to receiving waters.

Irrigation Area

A detailed irrigation schedule and monitoring program will be determined before any irrigation with reclaimed water occurs, prepared as part of the site Construction Environmental Management Plan. The plan is included in the Statement of Commitments will also detail monitoring of the irrigation area (see *Section 5.2*).

Adherence to the detailed irrigation plan, including seasonal application rates, developed for the project will ensure that excess effluent is not applied to the irrigation area and hence infiltration to groundwater does not occur. For this purpose, maintenance of a soil moisture deficit, to the extent that any specific crop irrigation requirements allow, will be one of the requirements of the detailed irrigation plan. This will also prevent inefficient use of water.

Agsol (2007) indicated the need for a detailed soil survey of the proposed irrigation area on the site, undertaken for the typical 0-20, 20-40 and 40-100cm soil materials, with analysis of pH, salinity, sodicity, CEC and phosphorus sorption capacity and estimates of saturated hydraulic conductivity and available water holding capacity. The results of this survey would also feed into the irrigation plan.

Sewerage

If an on-site septic system is constructed, it will be regularly maintained to ensure it continues to operate efficiently.

5.2 MONITORING

5.2.1 Effluent Monitoring

Effluent from the ethanol production facility will be monitored as soon as practical after commencement of operations to characterise its quality. This characterisation will include analysis of the parameters listed in *Table 5.1*. *Table 5.1* also shows the recommended monitoring frequency for the effluent for ongoing operations.

Table 5.1 Effluent Monitoring

Parameter	Monitoring Frequency
Total Suspended Solids	Monthly
Oil and grease	Quarterly
Total Phosphorous	Quarterly
Total Nitrogen	Quarterly
Biochemical Oxygen Demand	Monthly
pH	Monthly
Total Dissolved Solids	Monthly
Cations	Quarterly
Sodium Adsorption Ratio	Quarterly
Metals	Yearly

Based on recommendation in DEC 2004. Monitoring frequency and parameters should be assessed on a regular basis and reviewed based on previous monitoring results.

5.2.2 *Soil Monitoring*

The NSW Department of Primary Industries has recommended a soil sampling strategy for surface and profile samples (DEC, 2004). This includes:

- a composite soil sample of 40 soil cores per 1-2 ha, taken at depth of 0-10cm; and
- composite soil samples of 5 cores at four depth intervals to 1 metre within a 5 meter diameter plot (the four depth intervals should be within 0-20, 20-40, 40-70 and 70-100cm depth increments and positioned within major soil layers).

Soils will be monitored in accordance with this procedure for the parameters outlined in *Table 5.2* annually for the first three years of operation. Monitoring requirements will be reviewed after this time.

Table 5.2 Soil Monitoring

Parameter	Sampling Frequency	
	Surface Soil	**Soil at four depth increments**
pH	Annually	Annually
Electrical Conductivity	Annually	Annually
Nitration – N	Annually	Annually
Total N	After 3 years	N/A
Available P	Annually	N/A
Total P	After 3 years	Every 3 years
Exchangeable sodium percentage	Annually	Every 3 years
Heavy metals and pesticides	After 10 years	N/A
P sorption capacity	After 3 years	Every 3 years

Based on Table 5.2 DEC, 2004

5.2.3 *Groundwater*

The *Environmental Guidelines: Use of Effluent by Irrigation* (DEC, 2004) recommends groundwater monitoring if groundwater is located within 10m of the ground surface or if the proposed irrigation scheme has the potential to put groundwater quality at risk. Data from historical bore logs in the region indicates that there is no potential for groundwater within 10m of the ground surface. Due to the depth of groundwater, quality of irrigation water, the presence of clay layers above the shallowest water bearing unit and the fact that irrigation scheduling will be designed to prevent excess water migrating beyond the root zone, it is unlikely that the effluent irrigation scheme would put groundwater at risk. Therefore it is unlikely that groundwater monitoring is required. This will be confirmed during preparation of the detailed irrigation plan and following determination of the hydraulic properties of the shallow subsurface geology.

6 STATEMENT OF COMMITMENTS

From the assessment presented above, the following form commitments of AEL in regards to water resources:

- Erosion and sediment controls will be implemented during construction in accordance with *Managing Urban Stormwater – Soils and Construction* (Landcom, 2004).
- Detailed design and operation of the salt evaporation system will be determined during the preparation of the site EMP.
- A detailed irrigation plan will be developed following a full analysis of effluent quality, nutrient and salt balances and the soil infiltration rates and hydraulic conductivity at the irrigation area. It will detail aspects such as:
  - types of crops and cropping methods;
  - soil salt and nutrient balances to ensure that the proposed irrigation will be sustainable and in particular that salinity is appropriately managed;
  - fertiliser management and details of any required treatments to address potentially limiting soil conditions e.g. application of gypsum;
  - the method and scheduling of irrigation (in accordance with DEC (2004) *Environmental Guidelines: Use of Effluent by Irrigation*), including application rates and how soil moisture deficit will be maintained (typically at five to ten millimetres) and monitored to ensure excess effluent is not applied to the area (resulting in infiltration of excess effluent to groundwater and/or runoff to receiving waters of Nowranie Creek);
  - a detailed assessment of the required size of the effluent dam;
  - the level and intensity of monitoring required;
  - triggers for cessation of irrigation;
  - responsibilities for operation of the effluent irrigation scheme; and
  - incident and emergency response procedures e.g. in advent of equipment failure.
- AEL will incorporate monitoring, as specified in *Section 5.2* into their site operational procedures.
- All onsite dams will be constructed with appropriate liners (HDPE liner or similar) to ensure water retention within the dams.
- If an on-site septic system is constructed, it will be regularly maintained.

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Annex A

Agsol Report

Proposed Ethanol Plant at Oaklands- Suitability for Effluent Reuse by Irrigation

Agsol Pty Limited

Prepared for Environmental Resources Management Australia Pty Ltd and Agri Energy Limited

March 2007

Proposed ethanol plant at Oaklands- Suitability for effluent reuse by irrigation.

Background

ERM have requested Agsol to review the irrigation issues for three proposed ethanol plants at Coleambally, Oaklands and Condobolin. ERM have provided lab results, a soils description and extracts from the Environmental Assessment Report related to wastewater and irrigation. A geotechnical report undertaken by GTS (2006) was also provided.

Specifically ERM have requested that Agsol:

- review the data;
- provide advice on expected ranges of irrigation parameters and criteria;
- advise what additional data will be required for a detailed irrigation plan (expected to be completed following consent, as a condition of approval);
- advise if the scheme is feasible;
- comment on appropriate crops, irrigation methods, adequacy of irrigation area; and
- produce a shot report summarising the above.

This report undertakes the above for the proposed ethanol plant at Oaklands, located approximately 100 km south west of Wagga Wagga.

Wastewater characteristics

ERM have provided data on the probable characteristics of the wastewater as shown in Table 1 below. This data has been used to provide a preliminary indication of the acceptability of the effluent quality for irrigation of crops. A detailed assessment will be undertaken once further details of the wastewater quality are known.

Table 1 Probable characteristics of wastewater

Parameter	Expected Concentration	Classification[1]
BOD_5	362 mg/L	Medium Strength
Total Dissolved Solids	1010 mg/L	High Strength
Nutrients	No data is currently available	-

1. Classification is based on Table 3.1 of the DEC (2004) *Environmental Guidelines for Use of Effluent by Irrigation*
2. Source: Process Design & Fabrication Pty. Ltd, M06062-CA-003

Classification of effluent is an important consideration as it dictates the acceptable frequency of discharge to surface waters from any storage. Agsol notes that whilst the wastewater is classified as high strength in Table 1 due to the concentration of total dissolved solids (TDS), the TDS concentration only exceeds the guideline for medium strength by 10 mg/l. DEC (2004) guidelines take into account that TDS may include nutrients such as nitrogen, and that it is reasonable to reduce the TDS accordingly. Hence Agsol concludes that in the absence of data on nitrogen and phosphorus the recycled water could be considered medium strength. To be classified as medium

strength, nitrogen concentrations would need to be less than 100 mg/l and phosphorus less than 20 mg/l. DEC (2004) also notes that the criteria for effluent strength relates to the quality of discharge, not the quality in the storage or what is produced.

Without appropriate treatment processes, effluent generated from ethanol production is typically high in BOD and may produce an unacceptable pH (i.e. pH >8.5 and/or less than 6.5). It may also have high levels of nitrogen and phosphorus. Ideally the effluent should have a pH in the range of 6.5 to 7.5 and a Sodium Absorption Ratio (SAR) of less than 6. Acceptable levels of nitrogen and phosphorus will be determined by the capacity of the irrigated crop to uptake these nutrients.

Wastewater storage requirements

Wastewater from the production process will be stored in a storage dam prior to reuse by irrigation. The wastewater to be used for irrigation includes:

- backwash from the raw water treatment process (approximately 18 kL/day);
- the stream from the secondary anaerobic digestion treatment system which is not recycled (approximately 1546 kL/day);
- blowdown from the cooling tower and the boiler (approximately 52 kL/day) ; and
- regeneration streams from the water softener unit and the membrane treatment (approximately 244 kL/day).

Agsol concludes that the total potential volume of wastewater is 1860 kL/day.

For medium strength effluents DEC (2004) guidelines recommend that storage dams should not discharge to surface waters except in the one in four wettest year. Agsol notes that the evaporation potential for Oaklands is relatively high and that the dam design could include maximising the surface area to maximise evaporation potential thereby reducing the storage requirement and the requirements for disposal of wastewater through irrigation. However, shallow dams are also prone to algae growth. Algae can clog irrigation equipment and impact on irrigation water quality. Furthermore promoting evaporation also increases the salinity of the effluent and hence there is a risk that any discharged effluent would become ‘high strength’ requiring a design of no discharges except in the one in ten wettest year.

The current proposal is for a 40 ML effluent dam to be located to the east of the production buildings to store process wastewater from the facility. The dam is proposed to be approximately 6ha in area and 0.7m deep. A detailed assessment of the required size of this dam will be undertaken during development of the detailed irrigation plan for the facility. Final dam configuration could be a combination of deep and shallow sections to be used as appropriate during irrigation and non-irrigation seasons to manage salinity and nutrient (nitrogen and phosphorus) accumulation. Agsol notes that the dam volume could be increased by increasing the height of the walls if a detailed assessment showed that more storage was needed. .

Land area for irrigation

From the effluent dam, it is proposed that water will be pumped to an irrigation area with a crop such as barley or lucerne. Lucerne has a high requirement for water and can use 7-10 ML/ha of irrigation water over a full irrigation season, in addition to normal rainfall (Bourchier, 1998). Lucerne has medium salt tolerance and a high nutrient uptake while barley has a high salt tolerance and a moderate nutrient uptake (DEC, 2004).

Agsol concludes that the land area (55ha) will be suitable provided nitrogen and phosphorus levels fall within the medium strength category and a crop is grown which is harvested regularly and removed off site. The site management should minimise periods when the soil is bare. A specific crop recommendation cannot be made until more is known about the likely quantity of nitrogen and phosphorus in the effluent as well as other factors such as pH. Nonetheless it is likely that a suitable crop management system can be put in place which immobilises the nutrient content of the effluent.

Soil Landscape

The site of the proposed ethanol production plant is located approximately 350m north east of Oaklands township. GTS (2006) described the site as typical grain growing country. The landscape is flat with a slight fall. The land is relatively clear with few mature trees.

There appears to be no soil landscape mapping of the area. GTS (2006) describes the site as predominantly Aeolian with sandy ridges and deep lunettes.

Aeolian soil landscapes including the Currawarna and Belfrayden soil landscapes are included on the Wagga Wagga soil landscape map, for an area approxmately 100 km to the north east of the site.

The soils of the Currawarna soil landscape are described as small undulating rises and gently inclined benches of wind blown sand. This landscape includes areas of partly cemented and mottled clayey sands. Limitations are described as low available water holding capacity, and low fertility.

The Belfrayden soil landscape is a mixture of alluvial and wind blow sequences. The soils are moderately deep Mesotrophic red chromosols and Eutrophic Red Dermosols. Limitations are described as localised waterlogging, strong acidity and localised hardsetting soil.

GTS excavated 6 pits at the site to a depth of up to 3.5m.

GTS (2006) described the typical soil profile as:

- 0-20 cm Sandy silty topsoil grey/brown
- 20-60 cm Clayey sand, brown orange of low plasticity
- 60cm to 350 cm Sandy clay pale brown /yellow with low plasticity.

A photograph provided by GTS consulting suggested the typical soil was a red chromosol or red dermosol as described for the Belfrayden soil landscape.

No groundwater was encountered during the survey. Agsol notes that if groundwater is not present in the top 3 metres and there is a barrier to groundwater movement (such as clay subsoil) risks to any underlying groundwater resource should be minimal. Nonetheless the potential for shallow groundwater resources (i.e. less than 10 metres below ground surface) should be investigated during the detailed design.

Soil samples collected by GTS were sent to Ecowise laboratories for analysis. The results of this analysis are summarised in Table 2.

Table 2 Soil laboratory data at the site

Sample number	Pit	Depth cm	texture	pH	EC dS/m	ECse dS/m	CEC mequiv/100g	Exch Na mg/kg	ESP
4325A	1	30	Clayey sand						
4325G	1	350	Sandy clay plus gravel	8.9	.024	0.24	22	740	15
4325I	1	20	Clayey sand	6.2	.011	0.17	7.7	41	2.3
4325B	2	30	Clayey sand						
4325H	2	100	Sandy clay plus gravel	8.7	.02	0.2	20	470	10
4325J	3	30	Clayey sand	8.9	.079	0.79	26	1000	17
4325D	4	30	Clayey sand						
4325K	4	200	Sandy clay plus gravel	9.0	0.095	0.95	30	1200	17
4325L	4	2600	Sandy clay plus gravel	9	0.077	0.77	25	1100	19
4325M	5	100	Sandy clay plus gravel	8.1	0.044	0.44	13	350	12
4325N	6	30	Clayey sand	6.7	0.013	0.2	9.6	53	2.4
4325 TP1	1	n.d	n.d.	5.8	.018	?	9	87	4.2
4325 TP3	3	n.d.	n.d.	6.2	.009	?	10	52	2.3
4325 TP5	5	n.d.	n.d.	6.6	.010	?	8.5	40	2

The laboratory data suggest sandy surface soils probably suitable for cultivation underlain by very sodic sandy/gravely clay subsoils which are not saline. The high sodicity/low salinity would make subsoils prone to water logging. Surface soil pH is slightly acid and ideally should be increased to between 6.5 and 7.0.

The soil findings suggest that the most likely concern is poor subsoil drainage due to the effects of sodicity. However, high subsoil sodicity is less of a concern when subsoil salinity is also high as under these circumstances the soils tendency to disperse on wetting is reduced. This means that the soil is at less risk from water logging. Application of moderately saline effluent to the site could therefore increase subsoil saturated hydraulic conductivity and unless carefully managed locally raise groundwater levels.

The suitability of these soils for cultivation will depend on the interaction of the effluent with the soil and the ability to ameliorate the soil (e.g. with gypsum to overcome sodicity). A relatively high pH effluent (say 8.5) will have a positive impact, as would an effluent with a low SAR (say 3 or less). It will also be important that salt in the soil and effluent is able to drain away from the irrigation site to an appropriate ground or surface water resource without negatively impacting on that resource.

Agsol notes that the sampling strategy used to obtain results is not appropriate to describe agricultural /irrigation potential and it would be prudent to re-evaluate the soil during the detailed design stage. In particular the phosphorus sorption potential of the soil needs to be established and the extent and severity of sodicity and any existing salinity needs to be established.

Conclusions

The cropping area and effluent storage site identified are likely to be sufficient for a sustainable effluent irrigation scheme. The limited soils data provided suggests that the soils are suitable with manageable limitations including sodicity and possibly below plant root water logging. The effluent is likely to be classified by DEC as 'medium strength' although data on likely levels of phosphorus and nitrogen would need to be provided to confirm this. This means that the irrigation scheme would likely need to be designed so as not to discharge to the environment except in the one in four wettest years.

Recommendations

- A detailed soil survey of the site should be undertaken to determine the agricultural potential of the site. Tests should be taken of the typical 0-20 cm, 20-40 and 40-100 cm soil materials and include calculations of pH, salinity, sodicity, cation exchange capacity, phosphorus sorption capacity and estimates of saturated hydraulic conductivity and available water holding capacity.
- If high levels of soil sodicity occur within the plant root zone of the proposed crop, gypsum should be applied to the soil at a suitable rate.
- Sufficient effluent storage will need to be provided that meets DEC requirements for acceptable effluent discharges to the environment.
- The storage size will need to be determined from a daily water balance which takes into account daily rainfall data, estimates of daily evapo-transpiration, the type of crop grown, the soil type, irrigation system and harvesting arrangements.
- To enable classification of wastewater as medium strength the following effluent quality should be achieved:
    - Nitrogen <100 mg/l
    - Phosphorus <20 mg/l
    - BOD <1500 mg/l
    - Total dissolved solids – 'fertiliser component' <1000 mg/l
- To ensure a good quality crop the pH of the effluent should be between 6.5 and 8.5.

- To minimise odours from irrigation, the BOD should be reduced so that no more than 1500kg/ha is applied in any one month.
- To minimise the salinity of effluent, evaporation from the storage should be regulated through dam design.
- The crop management system should ensure that all nitrogen and phosphorus in effluent is immobilised by the crop/soil system. A nutrient budget will need to be undertaken once the likely nitrogen and phosphorus concentration of the final effluent is known. If the levels are still too high, consideration will need to be given to further treatment of the effluent.
- The crop management system should minimise the incidences of bare soil.
- A salt balance should be undertaken to determine the likely contribution of salt to the wider environment and if a concern a management system put in place to minimise salt impacts.

References

Bourchier J. (1998) **Agriculture Notes: Irrigation of lucerne for hay**, AG0230, ISSN 1329-8062, March 1998.
http://www.dpi.vic.gov.au/dpi/nreninf.nsf/9e58661e880ba9e44a256c640023eb2e/06c8ce682794697eca256f160011a71a/$FILE/AG0230.pdf

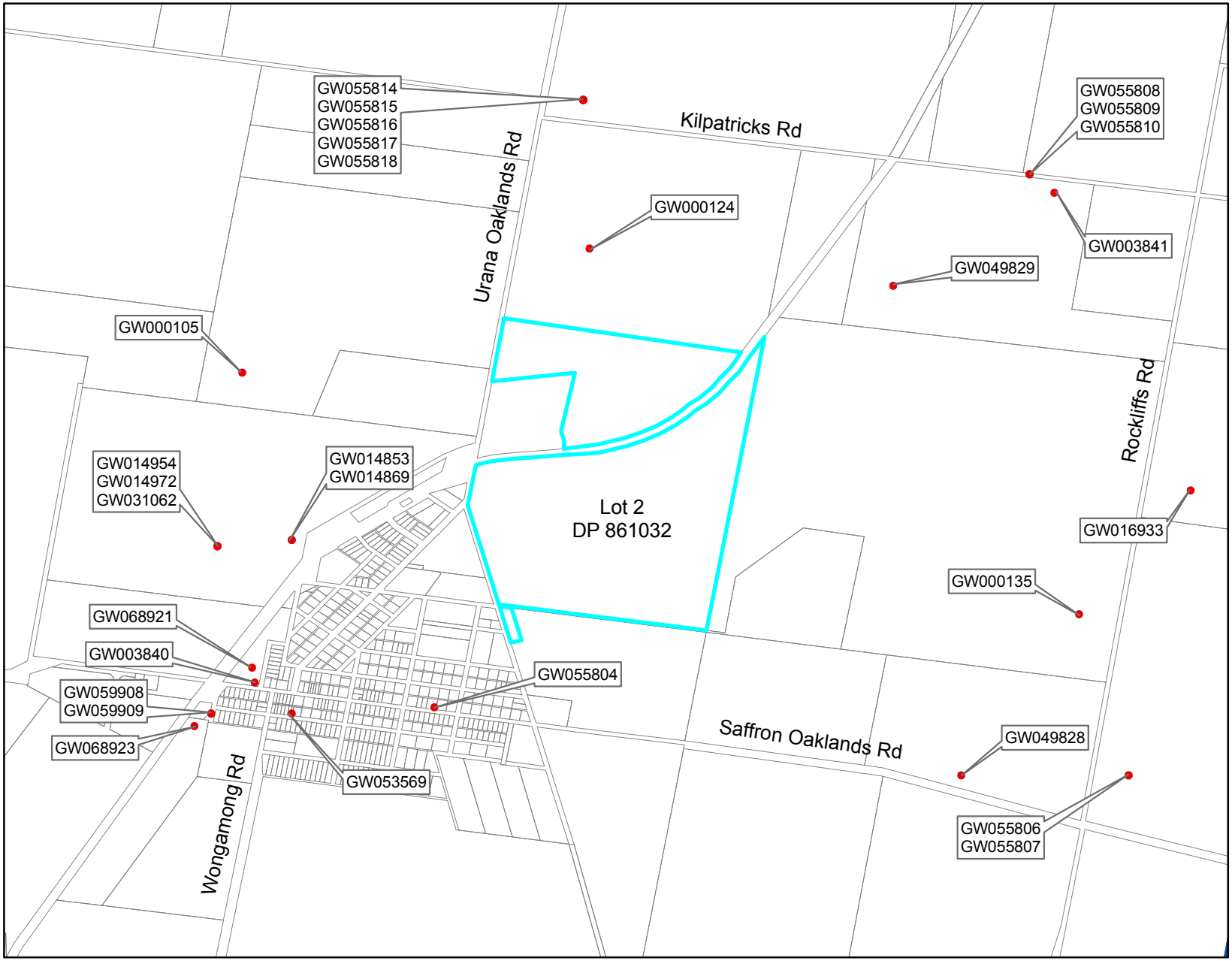
DEC (2004) **Environmental Guidelines: Use of Effluent by Irrigation** Department of Environment and Conservation (NSW), Sydney.

Geotechnical Testing Services (2006) **Condobolin Ethanol Site – Preliminary Geotechnical Investigation.** Prepared for Agri Energy Limited, December 2006.

Annex B

Bore Logs

Groundwater Bores in the Area



N

Legend

- Groundwater Bores
- Cadastre Parcels
- Parish

0 0.5 1 2 3 4 Kilometers

NSW Government
DEPARTMENT OF NATURAL RESOURCES

Produced by the Department of Natural Resources
Information Sciences Branch, Orange
Date: October 2006 Project Number: PN00799 WR2006-257B
Projection : [Geographic] Datum : [GDA94]

SOURCES
This map has been compiled from data supplied by the:
Department of Natural Resources, NSW
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Date/Time :09-Oct-2006 1:52 PM
User :VMARTIN
Report :RMGW001D.QRP
Executable :S:\G5\PROD32\Ground.exe
Exe Date :30-Aug-2006
System :Groundwater
Database :Edbp

NSW Government
DEPARTMENT OF NATURAL RESOURCES

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW000105

Converted From HYDSYS

Licence :
Licence Status
Authorised Purpose(s) **Intended Purpose(s)**
NOT KNOWN

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Cable Tool
Owner Type : Private

Commenced Date : **Final Depth :** 68.60 m
Completion Date :01-Jul-1917 **Drilled Depth :** 68.60 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : **Standing Water Level :**
GWMA : **Salinity :** Good
GW Zone : **Yield :**

Site Details

Site Chosen By **County** **Parish** **Portion/Lot DP**
Form A :URANA CLEAR HILL 6
Licensed :

Region :50 - MURRAY **CMA Map :**8126-N OAKLANDS
River Basin :410 - MURRUMBIDGEE RIVER **Grid Zone :**55/2 **Scale :**1:50,000
Area / District :

Elevation : **Northing :**6066220 **Latitude (S) :**35° 32' 41"
Elevation Source :(Unknown) **Easting :**424000 **Longitude (E) :**146° 9' 42"

GS Map :0080A3 **AMG Zone :**55 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	11.00	102			(Unknown)
1	1	Casing	Threaded Steel	0.00	48.50	127			(Unknown)
1	1	Opening	Screen - Gauze/Mesh		11.00	102		1	SL: 0mm; A: 0mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
53.30	53.30	0.00	Unconsolidated	43.30		0.38			Good

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.52	1.52	Loam Sandy	Loam	
1.52	7.62	6.10	Clay	Clay	
7.62	17.98	10.36	Sand	Sand	
17.98	24.38	6.40	Clay Sandy	Clay	
24.38	38.71	14.33	Pipe Clay Sand	Pipe Clay	
38.71	52.43	13.72	Pipe Clay	Pipe Clay	
52.43	59.13	6.70	Sand Coarse Water Supply	Sand	
59.13	64.31	5.18	Pipe Clay Sand	Pipe Clay	
64.31	68.58	4.27	Sand	Sand	

Remarks

***** End of GW000105 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW000124

Converted From HYDSYS

Licence :

Licence Status

Authorised Purpose(s) | **Intended Purpose(s)**

Work Type : Bore | NOT KNOWN

Work Status : (Unknown)

Construct. Method : Cable Tool

Owner Type : Private

Commenced Date : | **Final Depth :** 62.80 m

Completion Date : 01-Aug-1917 | **Drilled Depth :** 62.80 m

Contractor Name :

Driller :

Assistant Driller's Name :

Property : | **Standing Water Level :**

GWMA : | **Salinity :** 0-500 ppm

GW Zone : | **Yield :**

Site Details

Site Chosen By | **County** | **Parish** | **Portion/Lot DP**

Form A : URANA | CLEAR HILL | 13

Licensed :

Region : 50 - MURRAY | **CMA Map :** 8126-N OAKLANDS

River Basin : 410 - MURRUMBIDGEE RIVER | **Grid Zone :** 55/2 | **Scale :** 1:50,000

Area / District :

Elevation : | **Northing :** 6066830 | **Latitude (S) :** 35° 32' 21"

Elevation Source : (Unknown) | **Easting :** 425405 | **Longitude (E) :** 146° 10' 38"

GS Map : 0080A3 **AMG Zone :** 55 **Coordinate Source :** GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	5.40	102			(Unknown)
1	1	Casing	Threaded Steel	0.00	56.10	127			(Unknown)
1	1	Opening	Screen - Gauze/Mesh		5.40	102		1	SL: 0mm; A: 0mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
50.00	50.00	0.00	Unconsolidated	44.50		0.25			0-500 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	2.44	2.44	Ironstone	Ironstone	
2.44	5.79	3.35	Sand Rock Red	Sand Rock	
5.79	8.84	3.05	Rock	Rock	
8.84	19.20	10.36	Sand	Sand	
19.20	30.48	11.28	Pipe Clay	Pipe Clay	
30.48	40.84	10.36	Pipe Clay	Pipe Clay	
40.84	49.38	8.54	Pipe Clay	Pipe Clay	
49.38	49.99	0.61	Sand Water Bearing	Sand	
49.99	62.79	12.80	Sand Water Supply	Sand	

Remarks

***** End of GW000124 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW000135

Converted From HYDSYS

Licence :

Licence Status

Authorised Purpose(s)

Intended Purpose(s)
NOT KNOWN

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Cable Tool
Owner Type : Private

Commenced Date :
Completion Date :01-Sep-1917

Final Depth : 64.00 m
Drilled Depth : 64.00 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : Good
Yield :

Site Details

Site Chosen By

County
Form A :URANA
Licensed :

Parish
CLEAR HILL

Portion/Lot DP
90

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :8126-N OAKLANDS
Grid Zone :55/2
Scale :1:50,000

Elevation :
Elevation Source :(Unknown)

Northing :6065050
Easting :427425

Latitude (S) :35° 33' 20"
Longitude (E) :146° 11' 57"

GS Map :0080A3 **AMG Zone :**55

Coordinate Source :PR.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	60.20	152			(Unknown)

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
54.90	56.70	1.80	Unconsolidated	50.30		0.46			Good

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	6.10	6.10	Clay	Clay	
6.10	54.56	48.46	Pipe Clay	Pipe Clay	
54.56	56.39	1.83	Gravel Coarse Water Supply	Gravel	
56.39	60.05	3.66	Pipe Clay	Pipe Clay	
60.05	64.01	3.96	Clay Yellow Stiff	Clay	

Remarks

***** End of GW000135 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW003840

Converted From HYDSYS

Licence :

Licence Status
Authorised Purpose(s) | **Intended Purpose(s)**
NOT KNOWN

Work Type : Bore
Work Status : (Unknown)
Construct. Method : Cable Tool
Owner Type : Federal Govt

Commenced Date : | **Final Depth :** 71.60 m
Completion Date : 01-May-1943 | **Drilled Depth :** 71.60 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : Good
Yield :

Site Details

Site Chosen By

County | **Parish** | **Portion/Lot DP**
Form A : URANA | CLEAR HILL | 39
Licensed :

Region : 50 - MURRAY
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8126-N OAKLANDS
Grid Zone : 55/2 **Scale :** 1:50,000

Elevation :
Elevation Source : (Unknown)

Northing : 6064670 **Latitude (S) :** 35° 33' 31"
Easting : 424070 **Longitude (E) :** 146° 9' 44"

GS Map : 0080A3 **AMG Zone :** 55 **Coordinate Source :** GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.30	68.50	152			Suspended in Clamps

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
61.60	62.80	1.20	Unconsolidated	61.30		0.03			Good
68.60	71.60	3.00	Unconsolidated	61.30		0.83			Good

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	Loam Sandy	Loam	
0.30	2.44	2.14	Sand Cemented	Sand	
2.44	7.62	5.18	Clay Red Sandy	Clay	
7.62	18.29	10.67	Sand	Sand	
18.29	20.73	2.44	Sand Red	Sand	
20.73	26.82	6.09	Sand White	Sand	
26.82	28.04	1.22	Clay Sandy	Clay	
28.04	32.31	4.27	Sand	Sand	
32.31	33.53	1.22	Clay Sandy	Clay	
33.53	36.58	3.05	Sand	Sand	
36.58	61.57	24.99	Clay White Sandy	Clay	
61.57	62.79	1.22	Sand Wet Soak	Sand	
62.79	68.58	5.79	Clay White Very Soft Sandy	Clay	
68.58	71.63	3.05	Sand Wet Water Supply	Sand	
71.63	71.64	0.01	Clay Sandy	Clay	

Remarks

SUNK FOR THE ARMY

***** End of GW003840 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW003841

Converted From HYDSYS

Licence :

Licence Status

Authorised Purpose(s) | **Intended Purpose(s)**

Work Type : Bore | INDUSTRIAL
Work Status : (Unknown)
Construct. Method : Cable Tool
Owner Type : Federal Govt

Commenced Date : | **Final Depth :** 125.00 m
Completion Date : 01-Aug-1943 | **Drilled Depth :** 125.00 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : (Unknown)
Yield :

Site Details

Site Chosen By | **County** | **Parish** | **Portion/Lot DP**

Form A : URANA | CLEAR HILL | 84
Licensed :

Region : 50 - MURRAY
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8126-N OAKLANDS
Grid Zone : 55/2 **Scale :** 1:50,000

Elevation :
Elevation Source : (Unknown)

Northing : 6067140 **Latitude (S) :** 35° 32' 12"
Easting : 427300 **Longitude (E) :** 146° 11' 53"

GS Map : 0080A3 **AMG Zone :** 55 **Coordinate Source :** GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.20	42.20	152			Suspended in Clamps
1	1	Casing	Concrete	50.60	52.10	0			(Unknown)

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
43.30	47.00	3.70	Consolidated	40.50		1.21			Good Stock
69.20	71.30	2.10	(Unknown)	40.50		3.03			Salty
91.70	93.20	1.50	(Unknown)	40.50		3.03			Salty

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.91	0.91	Clay Red	Clay	
0.91	8.53	7.62	Clay Yellow Very Tight Tough	Clay	
8.53	23.47	14.94	Clay Red Very Tight Tough	Clay	
23.47	32.00	8.53	Clay Yellow	Clay	
32.00	39.62	7.62	Clay Yellow Sandy	Clay	
39.62	43.28	3.66	Kaolin White	Kaolin	
43.28	46.94	3.66	Sandstone Water Supply	Sandstone	
46.94	60.35	13.41	Clay Yellow White Sandy	Clay	
60.35	69.19	8.84	Clay Grey	Clay	
69.19	71.32	2.13	Gravel Sand Water Supply	Gravel	
71.32	71.63	0.31	Clay Black	Clay	
71.63	80.16	8.53	Sand Gravel Dry	Sand	
80.16	81.99	1.83	Clay Sandy	Clay	
81.99	91.74	9.75	Clay Yellow White Sandy	Clay	
91.74	93.27	1.53	Sand Water Supply	Sand	
93.27	93.88	0.61	Shale Black Or Coal	Shale	
93.88	109.88	16.00	Coal	Coal	
109.88	110.95	1.07	Mudstone	Mudstone	
110.95	114.15	3.20	Sandstone	Sandstone	
114.15	124.97	10.82	Shale Grey Very Tough	Shale	

Remarks

CASNO 2 IS CEMENT BRIDGE SEALING OFF SALTY WATER

***** End of GW003841 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW014853

Converted From HYDSYS

Licence :

Licence Status

Authorised Purpose(s) | **Intended Purpose(s)**

Work Type : Bore | GENERAL USE

Work Status : (Unknown)

Construct. Method : Cable Tool

Owner Type : Federal Govt

Commenced Date : | **Final Depth :** 0.00

Completion Date : 01-Mar-1963 | **Drilled Depth :** 97.50 m

Contractor Name :

Driller :

Assistant Driller's Name :

Property : | **Standing Water Level :**

GWMA : | **Salinity :** (Unknown)

GW Zone : | **Yield :**

Site Details

Site Chosen By | **County** | **Parish** | **Portion/Lot DP**

Form A : URANA | CLEAR HILL | 7

Licensed :

Region : 50 - MURRAY | **CMA Map :** 8126-N OAKLANDS

River Basin : 410 - MURRUMBIDGEE RIVER | **Grid Zone :** 55/2 | **Scale :** 1:50,000

Area / District :

Elevation : | **Northing :** 6065375 | **Latitude (S) :** 35° 33' 8"

Elevation Source : (Unknown) | **Easting :** 424230 | **Longitude (E) :** 146° 9' 50"

GS Map : 0080A3 **AMG Zone :** 55 **Coordinate Source :** PR.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	0.00	97.50	152			
1	1	Opening	Screen	63.90	66.50	102		2	SL: 0mm; A: .51mm
1	1	Opening	Slots		0.00	127		1	SL: 0mm; A: 0mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
62.50	67.10	4.60	(Unknown)	58.20		0.76			501-1000 ppm
73.80	89.00	15.20	(Unknown)	57.20		1.40			1001-3000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.52	1.52	Soil	Soil	
1.52	9.14	7.62	Sand	Sand	
9.14	11.28	2.14	Sand Yellow Gravel	Sand	
11.28	28.96	17.68	Sand Yellow	Sand	
28.96	52.43	23.47	Sand White	Sand	
52.43	62.48	10.05	Clay White Some Sand	Clay	
62.48	67.06	4.58	Sand White Or Water Supply	Sand	
62.48	67.06	4.58	Soft Sandstone		
67.06	74.68	7.62	Clay White Sandy Water Supply	Clay	
74.68	85.95	11.27	Sandy Water Supply	(Unknown)	
85.95	89.00	3.05	Sandstone	Sandstone	
89.00	91.44	2.44	Clay Sand	Clay	
91.44	92.05	0.61	Sandstone	Sandstone	
92.05	95.10	3.05	Clay Sand	Clay	
95.10	96.32	1.22	Sand Or	Sand	
95.10	96.32	1.22	Soft Sandstone		
96.32	97.54	1.22	Clay Sand	Clay	

Remarks

ATTEMPTS TO STABILIZE AQFRS FAIL

***** End of GW014853 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW014869

Converted From HYDSYS

Licence :

Licence Status
Authorised Purpose(s) **Intended Purpose(s)**
GENERAL USE

Work Type : Bore
Work Status : Reconditioned Bore
Construct. Method : Cable Tool
Owner Type : Federal Govt

Commenced Date : **Final Depth :** 66.50 m
Completion Date : 01-Feb-1963 **Drilled Depth :** 66.80 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : 501-1000 ppm
Yield :

Site Details

Site Chosen By

County **Parish** **Portion/Lot DP**
Form A : URANA CLEAR HILL 7
Licensed :

Region : 50 - MURRAY
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8126-N OAKLANDS
Grid Zone : 55/2 **Scale :** 1:50,000

Elevation :
Elevation Source : (Unknown)

Northing : 6065375 **Latitude (S) :** 35° 33' 8"
Easting : 424230 **Longitude (E) :** 146° 9' 50"

GS Map : 0080A3 **AMG Zone :** 55 **Coordinate Source :** PR.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.90	64.40	152			Suspended in Clamps
1	1	Casing	Threaded Steel	0.90	65.70	152			(Unknown)
1	1	Opening	Screen	62.40	64.90	0		1	Cook; Copper Alloy; SL: 0mm; A: .51mm
1	1	Opening	Screen	64.00	66.60	0		2	Cook; Copper Alloy; SL: 0mm; A: .51mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
63.70	66.70	3.00	(Unknown)	56.10		1.52			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	5.49	5.49	Sand Red Some Clay	Sand	
5.49	24.38	18.89	Sand Red Compacted	Sand	
24.38	59.74	35.36	Sand White	Sand	
24.38	59.74	35.36	Some Clay Streaks		
59.74	63.70	3.96	Kaolin White	Kaolin	
63.70	66.45	2.75	Sand White Water Supply	Sand	
66.45	66.75	0.30	Sand White	Sand	
66.45	66.75	0.30	Some Clay Streaks		

Remarks

R/C '76 SURGED & BAILED Changed from 65.2m to 64.77m on 01/09/76 CAS & SCN REMOVED & REINSERTED

***** End of GW014869 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW014954

Converted From HYDSYS

Licence :

Licence Status
Authorised Purpose(s) **Intended Purpose(s)**
GENERAL USE

Work Type : Bore
Work Status : Bore with Sandy Supply
Construct. Method : Cable Tool
Owner Type : Federal Govt

Commenced Date : **Final Depth :** 81.70 m
Completion Date : 01-Nov-1963 **Drilled Depth :** 85.30 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : **Standing Water Level :**
GWMA : **Salinity :** 1001-3000 ppm
GW Zone : **Yield :**

Site Details

Site Chosen By **County** **Parish** **Portion/Lot DP**
Form A : URANA CLEAR HILL 7
Licensed :

Region : 50 - MURRAY **CMA Map :** 8126-N OAKLANDS
River Basin : 410 - MURRUMBIDGEE RIVER **Grid Zone :** 55/2 **Scale :** 1:50,000
Area / District :

Elevation : **Northing :** 6065340 **Latitude (S) :** 35° 33' 9"
Elevation Source : (Unknown) **Easting :** 423910 **Longitude (E) :** 146° 9' 38"

GS Map : 0080A3 **AMG Zone :** 55 **Coordinate Source :** PR.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	81.70	85.40	0			
1	1	Casing	Threaded Steel	0.00	24.00	152			(Unknown)

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
75.30	75.60	0.30	Unconsolidated	62.20					1001-3000 ppm
77.40	83.20	5.80	Unconsolidated	59.70					1001-3000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.52	1.52	Clay Red Sandy	Clay	
1.52	3.96	2.44	Clay Reddish Sandy	Clay	
3.96	8.84	4.88	Sand White Fine	Sand	
8.84	11.58	2.74	Sand Pink	Sand	
11.58	14.94	3.36	Sand White Coarse	Sand	
14.94	15.54	0.60	Sand Yellow	Sand	
15.54	17.37	1.83	Sand White Fine	Sand	
17.37	19.20	1.83	Sand Pink	Sand	
19.20	19.81	0.61	Sand White	Sand	
19.81	21.03	1.22	Sand Yellow	Sand	
21.03	22.56	1.53	Sand White Fine	Sand	
22.56	23.16	0.60	Clay White	Clay	
23.16	24.08	0.92	Sand White	Sand	
24.08	25.60	1.52	Sand Pink	Sand	
25.60	26.21	0.61	Clay White	Clay	
26.21	27.43	1.22	Sand White	Sand	
27.43	28.65	1.22	Clay White	Clay	
28.65	32.00	3.35	Sand White	Sand	
32.00	37.49	5.49	Sand White Clay Bands	Sand	
37.49	74.68	37.19	Clay White Sandy	Clay	
74.68	75.29	0.61	Clay White Fine Sandy	Clay	
75.29	75.59	0.30	Sand White Water Bearing	Sand	
75.59	76.20	0.61	Clay White Fine Sandy	Clay	
76.20	77.42	1.22	Clay White Fine Sandy	Clay	
77.42	83.21	5.79	Sand Clay Bands Water Supply	Sand	
83.21	85.34	2.13	Clay White Fine Sandy	Clay	

Remarks

OAKLANDS COMMONWEALTH RESERVE CAS 2 PARTED WHEN ATTEMPTING TOWITHDRAW

***** End of GW014954 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW014972

Converted From HYDSYS

Licence :

Licence Status
Authorised Purpose(s) **Intended Purpose(s)**
GENERAL USE

Work Type : Bore
Work Status : (Unknown)
Construct. Method : Cable Tool
Owner Type : Federal Govt

Commenced Date : **Final Depth :** 66.90 m
Completion Date : 01-Dec-1963 **Drilled Depth :** 68.60 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : **Standing Water Level :**
GWMA : **Salinity :** 501-1000 ppm
GW Zone : **Yield :**

Site Details

Site Chosen By **County** **Parish** **Portion/Lot DP**
Form A : URANA CLEAR HILL 7
Licensed :

Region : 50 - MURRAY **CMA Map :** 8126-N OAKLANDS
River Basin : 410 - MURRUMBIDGEE RIVER **Grid Zone :** 55/2 **Scale :** 1:50,000
Area / District :

Elevation : **Northing :** 6065340 **Latitude (S) :** 35° 33' 9"
Elevation Source : (Unknown) **Easting :** 423910 **Longitude (E) :** 146° 9' 38"

GS Map : 0080A3 **AMG Zone :** 55 **Coordinate Source :** PR.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	66.90	68.60	0			
1	1	Casing	Threaded Steel	-0.60	64.30	152			(Unknown)
1	1	Opening	Screen	64.40	66.90	102		1	Cook; Stainless Steel; SL: 0mm; A: .51mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
57.60	61.60	4.00	Unconsolidated						(Unknown)
65.20	67.00	1.80	Unconsolidated	55.80		0.91			501-1000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.91	0.91	Clay Sandy	Clay	
0.91	2.74	1.83	Clay	Clay	
2.74	4.57	1.83	Clay Dark Orange Sandy	Clay	
4.57	7.62	3.05	Clay Light Orange Sandy	Clay	
7.62	10.67	3.05	Sand Yellow	Sand	
10.67	13.72	3.05	Sand White	Sand	
13.72	15.24	1.52	Sand Pink	Sand	
15.24	16.46	1.22	Sand Orange Clay Bands	Sand	
16.46	17.37	0.91	Sand White	Sand	
17.37	18.90	1.53	Sand Pink	Sand	
18.90	20.12	1.22	Sand White	Sand	
20.12	20.73	0.61	Sand Pink	Sand	
20.73	21.34	0.61	Clay Pink	Clay	
21.34	22.86	1.52	Sand Pink Coarse	Sand	
22.86	23.77	0.91	Sand White	Sand	
23.77	24.99	1.22	Sand Pink	Sand	
24.99	29.87	4.88	Sand White Fine	Sand	
29.87	30.48	0.61	Sand White White Clay Bands	Sand	
30.48	57.61	27.13	Clay White Sandy	Clay	
57.61	61.57	3.96	Clay Sandy Water Bearing	Clay	
61.57	65.23	3.66	Clay White Puggy	Clay	
65.23	65.68	0.45	Sand White Water Supply	Sand	
65.68	67.06	1.38	Sand Bands Water Supply	Sand	
65.68	67.06	1.38	Clay White	Clay	
67.06	68.58	1.52	Clay White Sandy	Clay	

Remarks

OAKLANDS COMMONWEALTH RESERVE

***** End of GW014972 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW016933

Converted From HYDSYS

Licence : 50BL007444
Licence Status Active

Work Type : Bore
Work Status : (Unknown)
Construct. Method : Cable Tool
Owner Type : Private

Authorised Purpose(s)
DOMESTIC
STOCK

Intended Purpose(s)
GENERAL USE

Commenced Date :
Completion Date : 01-Jan-1958
Final Depth : 61.00 m
Drilled Depth : 61.00 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - ULLINA
GWMA : 016 - LOWER MURRAY (D/S COROWA)
GW Zone : 001 - MURRAY - CALIVIL RENMARK

Standing Water Level :
Salinity : V.Salty
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	110
Licensed :	URANA	CLEAR HILL	110

Region : 50 - MURRAY
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8126-N OAKLANDS
Grid Zone : 55/2 **Scale :** 1:50,000

Elevation :
Elevation Source : (Unknown)

Northing : 6065650
Easting : 427870

Latitude (S) : 35° 33' 0"
Longitude (E) : 146° 12' 15"

GS Map : 0080A3 **AMG Zone :** 55

Coordinate Source : GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details

(No Construction Details Found)

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
53.30	53.60	0.30	(Unknown)			0.00			(Unknown)
54.90	61.00	6.10	Unconsolidated						V.Salty

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	2.74	2.74	Clay Sandy	Clay	
2.74	10.67	7.93	Sand	Sand	
10.67	12.80	2.13	Kaolin Brittle	Kaolin	
12.80	15.85	3.05	Sand	Sand	
15.85	18.29	2.44	Kaolin Hard	Kaolin	
18.29	23.77	5.48	Sand	Sand	
23.77	26.82	3.05	Kaolin Hard	Kaolin	
26.82	30.48	3.66	Sand	Sand	
30.48	33.53	3.05	Kaolin Hard	Kaolin	
33.53	44.20	10.67	Kaolin Sandy	Kaolin	
44.20	45.72	1.52	Sand	Sand	
45.72	53.34	7.62	Kaolin Sandy	Kaolin	
53.34	53.64	0.30	Soak	(Unknown)	
53.64	54.86	1.22	Coal Black	Coal	
54.86	60.96	6.10	Sand Water Supply	Sand	
60.96	60.98	0.02	Coal	Coal	

Remarks

***** End of GW016933 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW031062

Converted From HYDSYS

Licence :50BL023216
Licence Status Active

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Cable Tool
Owner Type : Federal Govt

Authorised Purpose(s)
DOMESTIC
FIRE FIGHTING

Intended Purpose(s)
GENERAL USE

Commenced Date :
Completion Date :01-Jan-1969
Final Depth : 66.80 m
Drilled Depth : 66.80 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A (VICGRAIN)
GWMA :016 - LOWER MURRAY (D/S COROWA)
GW Zone :001 - MURRAY - CALIVIL RENMARK

Standing Water Level :
Salinity : Good
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	7
Licensed :	URANA	CLEAR HILL	1 193156

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :8126-N OAKLANDS
Grid Zone :55/2 **Scale :**1:50,000

Elevation :
Elevation Source :(Unknown)

Northing :6065340 **Latitude (S) :**35° 33' 9"
Easting :423910 **Longitude (E) :**146° 9' 38"

GS Map :0080A3 **AMG Zone :**55 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	-0.60	64.90	152			(Unknown)
1	1	Opening	Screen	64.90	66.60	152		1	Willscreen; SL: 0mm; A: 3.81mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
57.60	61.60	4.00	(Unknown)						(Unknown)
65.20	66.70	1.50	Unconsolidated	54.30		0.64			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.91	0.91	Clay Sandy	Clay	
0.91	2.74	1.83	Clay	Clay	
2.74	7.62	4.88	Clay Orange Sandy	Clay	
7.62	10.67	3.05	Sand Yellow	Sand	
10.67	13.72	3.05	Sand White	Sand	
13.72	15.54	1.82	Sand Pink	Sand	
15.54	16.46	0.92	Clay Orange	Clay	
15.54	16.46	0.92	Sand Bands	Sand	
16.46	17.37	0.91	Sand White	Sand	
17.37	20.73	3.36	Sand Pink	Sand	
20.73	21.64	0.91	Clay Pink	Clay	
21.64	22.86	1.22	Sand Pink Coarse	Sand	
22.86	23.77	0.91	Sand White	Sand	
23.77	24.99	1.22	Sand Pink	Sand	
24.99	30.48	5.49	Sand White	Sand	
24.99	30.48	5.49	Clay Bands	Clay	
30.48	36.58	6.10	Sand White	Sand	
36.58	57.61	21.03	Sand White Clay	Sand	
57.61	61.57	3.96	Clay Sandy	Clay	
61.57	65.23	3.66	Clay White Puggy	Clay	
65.23	66.75	1.52	Sand White Water Supply	Sand	

Remarks

SUNK TO REPLACE B/N 14972 (SILTED UP)

***** End of GW031062 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW049828

Converted From HYDSYS

Licence :

Licence Status Active

Authorised Purpose(s) | **Intended Purpose(s)**

Work Type : Bore | MINERAL XPLORE

Work Status : Test Hole

Construct. Method :(Unknown)

Owner Type : Private

Commenced Date : | **Final Depth :** 0.00

Completion Date :01-Jan-1970 | **Drilled Depth :** 108.00 m

Contractor Name :

Driller :

Assistant Driller's Name :

Property : | **Standing Water Level :**

GWMA : | **Salinity :** (Unknown)

GW Zone : | **Yield :**

Site Details

Site Chosen By | **County** | **Parish** | **Portion/Lot DP**

Form A :URANA | CLEAR HILL | 40

Licensed :

Region :50 - MURRAY | **CMA Map :**8126-N OAKLANDS

River Basin :410 - MURRUMBIDGEE RIVER | **Grid Zone :**55/2 | **Scale :**1:50,000

Area / District :

Elevation : 138.00 m (A.H.D.) | **Northing :**6064245 | **Latitude (S) :**35° 33' 46"

Elevation Source :R.L. at Surface | **Easting :**426945 | **Longitude (E) :**146° 11' 38"

GS Map :0080A3 | **AMG Zone :**55 | **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Poured Concrete	0.00	108.00	0			(Unknown)

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	3.05	3.05	Soil	Soil	
3.05	6.10	3.05	Sand	Sand	
6.10	57.91	51.81	Clay Grey White Some Sand	Clay	
57.91	59.44	1.53	Clay Dark Grey	Clay	
59.44	60.96	1.52	Clay Black	Clay	
60.96	74.68	13.72	Sand Coarse	Sand	
74.68	79.25	4.57	Clay Black Some Sand	Clay	
79.25	82.30	3.05	Sand Coarse Gravel	Sand	
79.25	82.30	3.05	Clay Black	Clay	
82.30	83.82	1.52	Clay Black	Clay	
83.82	85.34	1.52	Gravel Coarse	Gravel	
85.34	87.78	2.44	Clay Black	Clay	
87.78	105.16	17.38	Coal	Coal	
105.16	108.00	2.84	Sandstone Fine	Sandstone	

Remarks

AAC-28 BORE

***** End of GW049828 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW049829

Converted From HYDSYS

Licence :

Licence Status Active

Authorised Purpose(s) | **Intended Purpose(s)**

Work Type : Bore | MINERAL XPLORE

Work Status : Test Hole

Construct. Method :(Unknown)

Owner Type : Private

Commenced Date : | **Final Depth :** 0.00

Completion Date :01-Jan-1970 | **Drilled Depth :** 109.70 m

Contractor Name :

Driller :

Assistant Driller's Name :

Property : | **Standing Water Level :**

GWMA : | **Salinity :** (Unknown)

GW Zone : | **Yield :**

Site Details

Site Chosen By | **County** | **Parish** | **Portion/Lot DP**

Form A :URANA | CLEAR HILL | 84

Licensed :

Region :50 - MURRAY | **CMA Map :**8126-N OAKLANDS

River Basin :410 - MURRUMBIDGEE RIVER | **Grid Zone :**55/2 | **Scale :**1:50,000

Area / District :

Elevation : 129.00 m (A.H.D.) | **Northing :**6066660 | **Latitude (S) :**35° 32' 27"

Elevation Source :R.L. at Surface | **Easting :**426640 | **Longitude (E) :**146° 11' 27"

GS Map :0080A3 | **AMG Zone :**55 | **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Poured Concrete	0.00	109.60	0			(Unknown)

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.52	1.52	Soil Sandy	Soil	
1.52	6.10	4.58	Clay	Clay	
6.10	21.34	15.24	Clay Dark Red Some Sand	Clay	
21.34	24.38	3.04	Clay Red Some Sand	Clay	
24.38	35.05	10.67	Clay Light Brown White Some Sand	Clay	
35.05	36.58	1.53	Sand	Sand	
36.58	45.72	9.14	Clay White Some Sand	Clay	
45.72	53.34	7.62	Sand Some Clay	Sand	
53.34	56.39	3.05	Clay Grey	Clay	
56.39	65.53	9.14	Clay Dark Grey	Clay	
65.53	79.25	13.72	Sand	Sand	
65.53	79.25	13.72	Clay Gravel	Clay	
79.25	82.30	3.05	Clay Black Some Sand	Clay	
82.30	91.44	9.14	Sand	Sand	
91.44	109.65	18.21	Coal	Coal	

Remarks

AAC-29 BORE

***** End of GW049829 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW053569

Converted From HYDSYS

Licence : 50BL117845
Licence Status Cancelled
Authorised Purpose(s) INDUSTRIAL
Intended Purpose(s) RECREATION (GROUNDWATER)

Work Type : Bore
Work Status : (Unknown)
Construct. Method : Rotary Mud
Owner Type : Local Govt

Commenced Date :
Completion Date : 01-Nov-1980
Final Depth : 90.00 m
Drilled Depth : 90.00 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : 014 - BILLABONG CREEK (U/S MAHONGA)
GW Zone : -
Standing Water Level :
Salinity : 0-500 ppm
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	L11 DP3728 (SEC 29)
Licensed :	URANA	CLEAR HILL	LT6 DP3728 SEC29

Region : 50 - MURRAY
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :
CMA Map : 8126-N OAKLANDS
Grid Zone : 55/2
Scale : 1:50,000

Elevation :
Elevation Source : (Unknown)
Northing : 6064525
Easting : 424230
Latitude (S) : 35° 33' 36"
Longitude (E) : 146° 9' 50"

GS Map : 0080A3
AMG Zone : 55
Coordinate Source : GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	P.V.C.	-0.80	90.00	152			Seated on Bottom
1	1	Opening	Slots - Vertical	60.00	87.00	152		1	SL: 0mm; A: 3mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
60.00	87.00	27.00	(Unknown)	61.10		5.05			0-500 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	24.00	24.00	Sand	Sand	
24.00	27.00	3.00	Mudstone	Mudstone	
27.00	72.00	45.00	Sandstone Water Supply	Sandstone	
72.00	80.00	8.00	Clay Sandstone Water Supply	Clay	
80.00	90.00	10.00	Sand Water Supply	Sand	

Remarks

LOT 11 SECTION 29 TOWN OF OAKLANDS TDS = 350 MG/L

***** End of GW053569 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055804

Converted From HYDSYS

Licence : 50BL121093
Licence Status Lapsed
Authorised Purpose(s) TEST BORE
Intended Purpose(s) G/WATER XPLORE

Work Type : Bore
Work Status : (Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date : 01-Nov-1981
Final Depth : 152.00 m
Drilled Depth : 175.00 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : 7001-10000 ppm
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	L8 (SEC 16)
Licensed :	URANA	CLEAR HILL	L8

Region : 50 - MURRAY
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8126-N OAKLANDS
Grid Zone : 55/2
Scale : 1:50,000

Elevation : 142.90 m (A.H.D.)
Elevation Source : R.L. at Surface

Northing : 6064560
Easting : 424800

Latitude (S) : 35° 33' 35"
Longitude (E) : 146° 10' 13"

GS Map : 0080A3
AMG Zone : 55

Coordinate Source : GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	152.00	175.00	130			
1		Casing	Casing Protector	0.00	0.00	0			(Unknown)
1	1	Casing	Pressure Cemented Casing	0.00	124.00	50			(Unknown)
1	1	Casing	P.V.C.	0.00	150.00	50			Seated
1	1	Casing	Other	124.00	125.00	50			(Unknown)
1	1	Casing	Other	151.00	152.00	50			(Unknown)
1	1	Opening	Slots	126.00	150.00	50		1	SL: 0mm; A: 0mm
1	1	Annulus	(Unknown)	125.00	151.00	130			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
124.00	152.00	28.00	(Unknown)	56.10		1.25			7001-10000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	2.00	2.00	Clay Red Very Plastic Geologist	Clay	
0.00	2.00	2.00	Some Fine-medium Sand Geologist		
2.00	6.00	4.00	Clay Very Plastic Geologist	Clay	
2.00	6.00	4.00	Sand Yellow Fine-coarse Some Gravel Micaceous Geologist	Sand	
6.00	13.00	7.00	Sandstone Orange Light Grey Fine-coarse Geologist	Sandstone	
13.00	34.00	21.00	Sandstone Light Grey Fine-coarse Clayey Micaceous Geologist	Sandstone	
13.00	34.00	21.00	Small Gravel Bands Geologist		
34.00	35.00	1.00	Claystone Light Grey Some Fine-coarse Sand Geologist	Claystone	
35.00	40.00	5.00	Sandstone Fine-coarse Some Gravel Geologist	Sandstone	
40.00	45.00	5.00	Sandstone Claystone Interlayere Geologist	Sandstone	
40.00	45.00	5.00	Sand Light Grey Fine-coarse Some Gravel Geologist	Sand	
45.00	80.00	35.00	Sandstone Light Grey Buff Fine-coarse Medium-coarse Geologist	Sandstone	
45.00	80.00	35.00	Gravel Clayey Interlayere Geologist		
80.00	86.00	6.00	Sandstone Clayey Geologist	Sandstone	
80.00	86.00	6.00	Claystone Sandy Some Gravel Interlayere Geologist	Claystone	
86.00	87.00	1.00	Claystone Sandy Geologist	Claystone	
86.00	87.00	1.00	Sand Light Grey Fine-coarse Geologist	Sand	
87.00	91.00	4.00	Sandstone Light Grey Fine-coarse Geologist	Sandstone	
91.00	92.00	1.00	Claystone Sandy Geologist	Claystone	
91.00	92.00	1.00	Sand Light Grey Fine-coarse Geologist	Sand	
92.00	97.00	5.00	Sandstone Light Grey Fine-coarse Geologist	Sandstone	
97.00	98.00	1.00	Claystone Sandy Geologist	Claystone	
97.00	98.00	1.00	Sand Light Grey Fine-coarse Geologist	Sand	
98.00	111.00	13.00	Claystone Sandy Geologist	Claystone	
111.00	116.00	5.00	Sandstone Geologist	Sandstone	
116.00	117.00	1.00	Claystone Sandy Geologist	Claystone	
117.00	123.00	6.00	Sandstone Geologist	Sandstone	
123.00	127.00	4.00	Claystone Grey Carbonaceous Silty Water Supply Geologist	Claystone	
127.00	135.00	8.00	Sand Grey Fine-coarse Some Gravel Water Supply Geologist	Sand	
127.00	135.00	8.00	Sandstone Silty Clayey Water Supply Geologist	Sandstone	
135.00	145.00	10.00	Sandstone Water Supply Geologist	Sandstone	
145.00	150.00	5.00	Claystone Grey Silty Geologist	Claystone	
145.00	150.00	5.00	Some Fine-coarse Sand Water Supply Geologist		
150.00	151.00	1.00	Sandstone Grey Black Fine-coarse Silty Water Supply Geologist	Sandstone	
151.00	170.00	19.00	Coal Geologist	Coal	
170.00	175.00	5.00	Claystone Grey Silty Carbonaceous Geologist	Claystone	

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055804 *Converted From HYDSYS*

Remarks

LOT 8 SECTION 16 OAKLANDS CAS NO 4&5 ARE CLAY SEALS

***** End of GW055804 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055806

Converted From HYDSYS

Licence :50BL121091
Licence Status Lapsed
Authorised Purpose(s) TEST BORE
Intended Purpose(s) G/WATER XPLORE

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date :01-Nov-1981
Final Depth : 82.00 m
Drilled Depth : 83.50 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : 7001-10000 ppm
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	44
Licensed :	URANA	CLEAR HILL	Rd 44

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :8126-N OAKLANDS
Grid Zone :55/2 **Scale :**1:50,000

Elevation : 127.50 m (A.H.D.)
Elevation Source :R.L. at Surface

Northing :6064225
Easting :427620

Latitude (S) :35° 33' 46"
Longitude (E) :146° 12' 5"

GS Map :0080A3 **AMG Zone :**55

Coordinate Source :GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	82.00	83.50	130			
1		Casing	Casing Protector	0.00	0.00	0			(Unknown)
1	1	Casing	Pressure Cemented Casing	0.00	63.00	50			(Unknown)
1	1	Casing	P.V.C.	0.00	80.00	50			Seated
1	1	Casing	Other	63.00	64.00	50			(Unknown)
1	1	Casing	Other	81.00	82.00	50			(Unknown)
1	1	Opening	Slots	66.00	80.00	50		1	SL: 0mm; A: 0mm
1	1	Annulus	(Unknown)	64.00	81.00	130			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
63.00	82.00	19.00	Fractured			1.25			7001-10000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	6.00	6.00	Clay Sandy Very Plastic Geologist	Clay	
6.00	8.00	2.00	Sand Clayey Gravel Fine-coarse Geologist	Sand	
6.00	8.00	2.00	Very Plastic Geologist		
6.00	8.00	2.00	Gravel Red Light Grey Small Geologist	Gravel	
6.00	8.00	2.00	Clay Micaceous Sandy Geologist	Clay	
6.00	8.00	2.00	Fine-coarse Very Plastic Geologist		
8.00	13.50	5.50	Claystone Light Grey Some Fine-coarse Sand Geologist	Claystone	
13.50	17.00	3.50	Sandstone Light Grey Fine-coarse Traces Medium Geologist	Sandstone	
13.50	17.00	3.50	Clayey Gravel Geologist		
17.00	25.00	8.00	Claystone Some Sandy Geologist	Claystone	
25.00	34.00	9.00	Sandstone Sandy Claystone Interlayere Geologist	Sandstone	
34.00	36.50	2.50	Claystone Black Grey Carbonaceous Geologist	Claystone	
34.00	36.50	2.50	Very Plastic Some Silt Geologist		
36.50	48.00	11.50	Sandstone Gravel Geologist	Sandstone	
36.50	48.00	11.50	Sand Grey Fine-coarse Medium Gravel Geologist	Sand	
48.00	49.00	1.00	Claystone Sandy Very Plastic Geologist	Claystone	
48.00	49.00	1.00	Sand Grey Fine-coarse Medium-coarse Geologist	Sand	
49.00	55.50	6.50	Sandstone Fine-coarse Some Gravel Interlayere Geologist	Sandstone	
55.50	60.00	4.50	Sandstone Clayey Geologist	Sandstone	
55.50	60.00	4.50	Sand Fine-coarse Some Medium Gravel Geologist	Sand	
60.00	62.50	2.50	Claystone Sandy Some Silty Geologist	Claystone	
60.00	62.50	2.50	Very Plastic Geologist		
60.00	62.50	2.50	Sand Black Fine-coarse Geologist	Sand	
62.50	74.50	12.00	Coal Dull Geologist	Coal	
74.50	76.00	1.50	Siltstone Dark Grey Carbonaceous Geologist	Siltstone	
76.00	81.00	5.00	Coal Geologist	Coal	
81.00	83.50	2.50	Siltstone Geologist	Siltstone	

Remarks

CAS NO 4&5 ARE CLAY SEALS

***** End of GW055806 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055807

Converted From HYDSYS

Licence :50BL121092

Licence Status Lapsed

Authorised Purpose(s)
TEST BORE

Intended Purpose(s)
G/WATER XPLORE

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date :01-Nov-1981

Final Depth : 56.00 m
Drilled Depth : 0.00

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : 10001-14000 ppm
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	44
Licensed :	URANA	CLEAR HILL	Rd 44

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :8126-N OAKLANDS
Grid Zone :55/2 **Scale :**1:50,000

Elevation :
Elevation Source :(Unknown)

Northing :6064225
Easting :427620

Latitude (S) :35° 33' 46"
Longitude (E) :146° 12' 5"

GS Map :0080A3 **AMG Zone :**55

Coordinate Source :GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Casing	Casing Protector	0.00	0.00	0			(Unknown)
1	1	Casing	Pressure Cemented Casing	0.00	40.00	50			(Unknown)
1	1	Casing	P.V.C.	0.00	55.00	50			Seated
1	1	Casing	Other	40.00	41.00	50			(Unknown)
1	1	Opening	Slots	43.00	55.00	50		1	SL: 0mm; A: 0mm
1	1	Annulus	(Unknown)	41.00	66.00	130			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
36.00	55.00	19.00	Fractured			0.10			10001-14000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Remarks

FOR LOG SEE B/N 55806 ADJACENT CAS NO 3 IS A CLAY SEAL

***** End of GW055807 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055808

Converted From HYDSYS

Licence : 50BL121085
Licence Status Lapsed
Authorised Purpose(s) TEST BORE
Intended Purpose(s) G/WATER XPLORE

Work Type : Bore
Work Status : (Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date : 01-Nov-1981
Final Depth : 93.00 m
Drilled Depth : 120.00 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : 10001-14000 ppm
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	74
Licensed :	URANA	CLEAR HILL	Rd 74

Region : 50 - MURRAY
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map : 8126-N OAKLANDS
Grid Zone : 55/2
Scale : 1:50,000

Elevation : 125.50 m (A.H.D.)
Elevation Source : R.L. at Surface

Northing : 6067220
Easting : 427190

Latitude (S) : 35° 32' 9"
Longitude (E) : 146° 11' 49"

GS Map : 0080A3
AMG Zone : 55

Coordinate Source : GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	93.00	120.00	130			
1		Casing	Casing Protector	0.00	0.00	0			(Unknown)
1	1	Casing	Pressure Cemented Casing	0.00	79.00	50			(Unknown)
1	1	Casing	P.V.C.	0.00	91.50	50			Seated
1	1	Casing	Other	79.00	80.00	50			(Unknown)
1	1	Casing	Other	92.00	93.00	50			(Unknown)
1	1	Opening	Slots	81.00	91.50	50		1	SL: 0mm; A: 0mm
1	1	Annulus	(Unknown)	80.00	92.00	130			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
81.00	91.50	10.50	Consolidated	38.90		0.60			10001-14000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	2.50	2.50	Clay Grey Very Plastic Geologist	Clay	
0.00	2.50	2.50	Traces Fine-coarse Sand Small Gravel Geologist		
2.50	9.50	7.00	Clay Sandy Very Plastic Geologist	Clay	
2.50	9.50	7.00	Sand Orange Fine-coarse Fine-medium Geologist	Sand	
9.50	19.00	9.50	Sand Pink White Clayey Very Plastic Geologist	Sand	
9.50	19.00	9.50	Fine-coarse Geologist		
19.00	24.00	5.00	Clay Sandy Very Plastic Geologist	Clay	
24.00	37.50	13.50	Sandstone Fine-coarse Geologist	Sandstone	
24.00	37.50	13.50	Claystone White Some Kaolin Geologist	Claystone	
37.50	40.00	2.50	Claystone White Kaolin Geologist	Claystone	
40.00	49.00	9.00	Claystone White Kaolin Geologist	Claystone	
40.00	49.00	9.00	Some Fine-medium Sand Geologist		
49.00	51.00	2.00	Sandstone Light Brown Fine-coarse Geologist	Sandstone	
51.00	56.50	5.50	Claystone White Kaolin Geologist	Claystone	
51.00	56.50	5.50	Sand Fine-coarse Geologist	Sand	
56.50	57.50	1.00	Sandstone Clayey Band Geologist	Sandstone	
57.50	64.50	7.00	Claystone White Kaolin Geologist	Claystone	
57.50	64.50	7.00	Sand Fine-coarse Geologist	Sand	
64.50	79.00	14.50	Claystone Grey Sandy Bands Geologist	Claystone	
64.50	79.00	14.50	Sand Fine-coarse Bands Geologist	Sand	
79.00	80.00	1.00	Claystone Grey Geologist	Claystone	
80.00	92.00	12.00	Sandstone Grey Fine-coarse Water Supply Geologist	Sandstone	
92.00	109.00	17.00	Coal Geologist	Coal	
109.00	111.00	2.00	Siltstone Dark Grey Geologist	Siltstone	
111.00	114.00	3.00	Sandstone Dark Grey Fine-coarse Geologist	Sandstone	
114.00	120.00	6.00	Siltstone Dark Grey Geologist	Siltstone	

Remarks

CAS NO 4&5 ARE CLAY SEALS

***** End of GW055808 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055809

Converted From HYDSYS

Licence :50BL121086

Licence Status Lapsed

Authorised Purpose(s): TEST BORE

Intended Purpose(s): G/WATER XPLORE

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date :01-Dec-1981
Final Depth : 79.00 m
Drilled Depth : 0.00

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : (Unknown)
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	74
Licensed :	URANA	CLEAR HILL	Rd 74

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :8126-N OAKLANDS
Grid Zone :55/2 **Scale :**1:50,000

Elevation :
Elevation Source :(Unknown)

Northing :6067220 **Latitude (S) :**35° 32' 9"
Easting :427190 **Longitude (E) :**146° 11' 49"

GS Map :0080A3 **AMG Zone :**55 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	79.00	112.50	300			
1		Casing	Casing Protector	0.00	0.00	0			(Unknown)
1	1	Casing	Threaded Steel	0.00	72.00	150			Seated
1	1	Casing	Other	69.00	70.00	150			(Unknown)
1	1	Casing	Other	78.00	79.00	150			(Unknown)
1	1	Opening	Screen	72.00	78.00	0		1	Stainless Steel; SL: 0mm; A: 1mm
1	1	Annulus	(Unknown)	70.00	78.00	300			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
72.00	78.00	6.00	(Unknown)			14.40			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Remarks

FOR LOG SEE B/N 55808 ADJACENT CAS NO 3 IS CLAY SEAL,CAS NO 4 IS CEMENT PLUG FOR SCN

***** End of GW055809 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055810

Converted From HYDSYS

Licence :50BL121087 **Licence Status** Lapsed

	Authorised Purpose(s)	Intended Purpose(s)
	TEST BORE	G/WATER XPLORE

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date : **Final Depth :** 79.00 m
Completion Date :01-Dec-1981 **Drilled Depth :** 0.00

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A **Standing Water Level :**
GWMA : - **Salinity :** 7001-10000 ppm
GW Zone : - **Yield :**

Site Details

Site Chosen By	County	Parish	Portion/Lot DP
	Form A :URANA	CLEAR HILL	74
	Licensed :URANA	CLEAR HILL	Rd 74

Region :50 - MURRAY **CMA Map :**8126-N OAKLANDS
River Basin :410 - MURRUMBIDGEE RIVER **Grid Zone :**55/2 **Scale :**1:50,000
Area / District :

Elevation : **Northing :**6067220 **Latitude (S) :**35° 32' 9"
Elevation Source :(Unknown) **Easting :**427190 **Longitude (E) :**146° 11' 49"

GS Map :0080A3 **AMG Zone :**55 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Casing	Casing Protector	0.00	0.00	0			(Unknown)
1	1	Casing	Pressure Cemented Casing	0.00	68.00	50			(Unknown)
1	1	Casing	P.V.C.	0.00	79.00	50			Seated on Bottom
1	1	Casing	Other	68.00	69.00	50			(Unknown)
1	1	Opening	Slots	71.00	79.00	50		1	SL: 0mm; A: 0mm
1	1	Annulus	(Unknown)	69.00	79.00	130			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
63.00	79.00	16.00	(Unknown)			1.25			7001-10000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Remarks

FOR LOG SEE B/N 55808 ADJACENT CAS NO 3 IS A CLAY SEAL

***** End of GW055810 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055814

Converted From HYDSYS

Licence :50BL124045
Licence Status Lapsed
Authorised Purpose(s) TEST BORE
Intended Purpose(s) G/WATER XPLORE

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date :01-Nov-1981
Final Depth : 80.00 m
Drilled Depth : 0.00

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : 10001-14000 ppm
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	72
Licensed :	URANA	CLEAR HILL	Rd 72

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :
Grid Zone :
Scale :

Elevation :
Elevation Source :(Unknown)
Northing :6067570
Easting :425380
Latitude (S) :35° 31' 57"
Longitude (E) :146° 10' 37"

GS Map :0080A3 **AMG Zone :**55 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Casing	Casing Protector	0.00	0.00	0			(Unknown)
1	1	Casing	Pressure Cemented Casing	0.00	65.00	50			(Unknown)
1	1	Casing	P.V.C.	0.00	80.00	50			Seated on Bottom
1	1	Casing	Other	65.00	66.00	50			(Unknown)
1	1	Opening	Slots	68.00	80.00	50		1	SL: 0mm; A: 0mm
1	1	Annulus	(Unknown)	66.00	80.00	130			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
80.00	80.00	0.00	(Unknown)			0.20			10001-14000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Remarks

CAS NO 3 IS A CLAY SEAL

***** End of GW055814 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055815

Converted From HYDSYS

Licence :50BL124044
Licence Status Lapsed
Authorised Purpose(s) TEST BORE
Intended Purpose(s) G/WATER XPLORE

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date :01-Nov-1981
Final Depth : 142.00 m
Drilled Depth : 0.00

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -

Standing Water Level :
Salinity : 7001-10000 ppm
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	72
Licensed :	URANA	CLEAR HILL	Rd 13

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :
Grid Zone :
Scale :

Elevation :
Elevation Source :(Unknown)
Northing :6067570
Easting :425380
Latitude (S) :35° 31' 57"
Longitude (E) :146° 10' 37"

GS Map :0080A3 **AMG Zone :**55 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Pressure Cemented Casing	0.00	127.00	50			(Unknown)
1	1	Casing	P.V.C.	0.00	142.00	50			Seated on Bottom
1	1	Casing	Other	127.00	128.00	50			(Unknown)
1	1	Opening	Slots	130.00	142.00	50		1	SL: 0mm; A: 0mm
1	1	Annulus	(Unknown)	128.00	142.00	130			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
120.00	142.00	22.00	(Unknown)			0.25			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Remarks

FOR LOG SEE B/N 55816 ADJACENT CAS NO 3 IS A CLAY SEAL

***** End of GW055815 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055816

Converted From HYDSYS

Licence : 50BL124043
Licence Status Lapsed
Authorised Purpose(s) TEST BORE
Intended Purpose(s) G/WATER XPLORE
Work Type : Bore
Work Status : (Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date : 01-Nov-1981
Final Depth : 161.50 m
Drilled Depth : 168.00 m

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -
Standing Water Level :
Salinity : 7001-10000 ppm
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	72
Licensed :	URANA	CLEAR HILL	Rd 72

Region : 50 - MURRAY
River Basin : 410 - MURRUMBIDGEE RIVER
Area / District :
CMA Map :
Grid Zone :
Scale :

Elevation : 126.70 m (A.H.D.)
Elevation Source : R.L. at Surface
Northing : 6067570
Easting : 425380
Latitude (S) : 35° 31' 57"
Longitude (E) : 146° 10' 37"

GS Map : 0080A3 **AMG Zone :** 55
Coordinate Source : GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	161.50	168.00	130			
1		Casing	Casing Protector	0.00	0.00	0			(Unknown)
1	1	Casing	Pressure Cemented Casing	0.00	144.00	50			(Unknown)
1	1	Casing	P.V.C.	0.00	160.00	50			Seated
1	1	Casing	Other	144.00	145.00	50			(Unknown)
1	1	Casing	Other	160.50	161.50	50			(Unknown)
1	1	Opening	Slots	148.00	160.00	50		1	SL: 0mm; A: 0mm
1	1	Annulus	(Unknown)	145.00	160.50	130			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
143.00	164.00	21.00	(Unknown)	40.10		1.25			7001-10000 ppm

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	2.00	2.00	Clay Sandy Very Plastic Geologist	Clay	
0.00	2.00	2.00	Sand Red Fine-coarse Geologist	Sand	
2.00	4.00	2.00	Sand Clayey Gravel Fine-coarse Geologist	Sand	
2.00	4.00	2.00	Some Medium Gravel Geologist		
4.00	15.00	11.00	Gravel Clayey Sandy Geologist	Gravel	
4.00	15.00	11.00	Very Plastic Geologist		
4.00	15.00	11.00	Sand Red Fine-coarse Some Medium Gravel Geologist	Sand	
15.00	18.00	3.00	Sandstone Clayey Very Plastic Geologist	Sandstone	
15.00	18.00	3.00	Sand Pink Light Brown Fine-coarse Fine-medium Micaceous Geologist	Sand	
18.00	30.00	12.00	Claystone Sandy Very Plastic Geologist	Claystone	
18.00	30.00	12.00	Clayey Sandstone Geologist		
18.00	30.00	12.00	Sand White Fine-coarse Micaceous Geologist	Sand	
30.00	31.00	1.00	Clay White Very Plastic Geologist	Clay	
31.00	40.00	9.00	Claystone Sandy Geologist	Claystone	
31.00	40.00	9.00	Sandstone Clayey Geologist	Sandstone	
40.00	47.00	7.00	Sandstone Sandy Claystone Geologist	Sandstone	
40.00	47.00	7.00	Sand White Fine-medium Geologist	Sand	
40.00	47.00	7.00	Sandy Gravel Bands Geologist		
47.00	80.00	33.00	Sandstone Sandy Claystone Geologist	Sandstone	
47.00	80.00	33.00	Sand Gravel Bands Geologist	Sand	
80.00	82.00	2.00	Claystone Pink Traces Fine-coarse Sand Geologist	Claystone	
80.00	82.00	2.00	Very Plastic Geologist		
82.00	87.00	5.00	Sandstone Pink Clayey Very Plastic Geologist	Sandstone	
82.00	87.00	5.00	Sand Fine-coarse Geologist	Sand	
87.00	90.00	3.00	Claystone Sandy Very Plastic Geologist	Claystone	
87.00	90.00	3.00	Sand Pink Grey Fine-coarse Geologist	Sand	
90.00	91.00	1.00	Sandstone Clayey Very Plastic Geologist	Sandstone	
90.00	91.00	1.00	Sand Pink Grey Fine-coarse Geologist	Sand	
91.00	92.00	1.00	Sandstone Pink Very Plastic Geologist	Sandstone	
92.00	97.00	5.00	Sandstone Clayey Geologist	Sandstone	
97.00	98.00	1.00	Claystone Grey Geologist	Claystone	
98.00	101.00	3.00	Sandstone Clayey Very Plastic Geologist	Sandstone	
98.00	101.00	3.00	Sand Pink Red Fine-coarse Geologist	Sand	
101.00	113.00	12.00	Claystone Red Grey Silty Very Plastic Geologist	Claystone	
101.00	113.00	12.00	Some Fine-medium Sand Geologist		
113.00	117.00	4.00	Sandstone Light Grey Coarse Some Large Gravel Geologist	Sandstone	
117.00	120.00	3.00	Siltstone Dark Grey Carbonaceous Geologist	Siltstone	
120.00	127.00	7.00	Sandstone Grey Siltstone Geologist	Sandstone	
120.00	127.00	7.00	Carbonaceous Interlayere Geologist		
127.00	130.00	3.00	Siltstone Grey Carbonaceous Geologist	Siltstone	
130.00	137.00	7.00	Sandstone Grey Fine-medium Carbonaceous Geologist	Sandstone	

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055816 *Converted From HYDSYS*

137.00	144.00	7.00	Sandstone Dark Grey Silty Fine-medium Carbonaceous Water Suppl y Geologist	Sandstone
144.00	149.00	5.00	Coal Water Supply Geologist	Coal
149.00	150.00	1.00	Gravel Grey Sandy Fine-coarse Water Supply Geologist	Gravel
150.00	168.00	18.00	Coal Water Supply Geologist	Coal

Remarks

CAS NO 4&5 ARE CLAY SEALS

***** End of GW055816 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055817

Converted From HYDSYS

Licence :50BL123534
Licence Status Lapsed
Authorised Purpose(s) TEST BORE
Intended Purpose(s) G/WATER XPLORE

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date :01-Nov-1981
Final Depth : 79.00 m
Drilled Depth : 0.00

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -
Standing Water Level :
Salinity : (Unknown)
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	72
Licensed :	URANA	CLEAR HILL	Rd 72

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :
CMA Map :
Grid Zone :
Scale :

Elevation :
Elevation Source :(Unknown)
Northing :6067570
Easting :425380
Latitude (S) :35° 31' 57"
Longitude (E) :146° 10' 37"

GS Map :0080A3 **AMG Zone :**55 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Threaded Steel	0.00	73.00	150			Seated
1	1	Casing	Other	70.00	71.00	50			(Unknown)
1	1	Opening	Screen	73.00	79.00	0		1	Stainless Steel; SL: 0mm; A: 1mm
1	1	Annulus	(Unknown)	71.00	79.00	300			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
73.00	79.00	6.00	Consolidated			5.10			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Remarks

FOR LOG SEE B/N 55816 ADJACENT CAS NO 2 IS A CLAY SEAL

***** End of GW055817 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW055818

Converted From HYDSYS

Licence :50BL123535
Licence Status Lapsed
Authorised Purpose(s) TEST BORE
Intended Purpose(s) G/WATER XPLORE

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Completion Date :01-Dec-1981
Final Depth : 144.00 m
Drilled Depth : 0.00

Contractor Name :
Driller :
Assistant Driller's Name :

Property : - N/A
GWMA : -
GW Zone : -
Standing Water Level :
Salinity : (Unknown)
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	URANA	CLEAR HILL	72
Licensed :	URANA	CLEAR HILL	Rd 72

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :
CMA Map :
Grid Zone :
Scale :

Elevation :
Elevation Source :(Unknown)
Northing :6067570
Easting :425380
Latitude (S) :35° 31' 57"
Longitude (E) :146° 10' 37"

GS Map :0080A3 **AMG Zone :**55 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Backfill	Backfill	144.00	162.00	150			
1	1	Casing	Threaded Steel	0.00	133.00	150			Seated
1	1	Casing	Other	129.00	130.00	150			(Unknown)
1	1	Casing	Other	143.00	144.00	150			Seated on Bottom
1	1	Opening	Screen	133.00	142.00	0		1	Stainless Steel; SL: 0mm; A: .5mm
1	1	Annulus	(Unknown)	130.00	143.00	300			Graded

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
130.00	139.00	9.00	Consolidated			6.80			(Unknown)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Remarks

FOR LOG SEE B/N 55816 ADJACENT CAS NO 3&4 ARE CLAY SEALS

***** End of GW055818 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW059908

Converted From HYDSYS

Licence :
Licence Status Lapsed
Authorised Purpose(s)
Intended Purpose(s)
G/WATER XPLORE

Work Type : Bore
Work Status : Test Hole
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date :
Final Depth : 64.00 m
Completion Date :01-Nov-1985
Drilled Depth : 64.00 m

Contractor Name :
Driller :1451 MARTIN, Lance
Assistant Driller's Name :

Property :
Standing Water Level :
GWMA :
Salinity : (Unknown)
GW Zone :
Yield :

Site Details

Site Chosen By
County
Form A :URANA
Licensed :
Parish
CLEAR HILL
Portion/Lot DP
71

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :
CMA Map :8126-N OAKLANDS
Grid Zone :55/2
Scale :1:50,000

Elevation :
Elevation Source :(Unknown)
Northing :6064500
Easting :423910
Latitude (S) :35° 33' 36"
Longitude (E) :146° 9' 37"

GS Map :0080A3
AMG Zone :55
Coordinate Source :GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	P.V.C.	0.00	42.00	100			(Unknown)
1	1	Opening	Screen	42.00	54.00	100		1	Johnson; Stainless Steel; SL: 0mm; A: 1.5mm
1	1	Annulus	(Unknown)	0.00	64.00	160			(Unknown); GS: 9.5mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	14.00	14.00	Sand Medium	Sand	
14.00	16.00	2.00	Sand Clayey	Sand	
16.00	24.00	8.00	Sand	Sand	
24.00	26.00	2.00	Clay Sandy	Clay	
26.00	34.00	8.00	Sand Clayey	Sand	
34.00	44.00	10.00	Sand	Sand	
44.00	46.00	2.00	Clay	Clay	
46.00	52.00	6.00	Sand Clayey	Sand	
52.00	54.00	2.00	Clay	Clay	
54.00	64.00	10.00	Sand	Sand	

Remarks

***** End of GW059908 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW059909

Converted From HYDSYS

Licence :

Licence Status Lapsed
Authorised Purpose(s) | **Intended Purpose(s)**
G/WATER XPLORE

Work Type : Bore
Work Status : Test Hole
Construct. Method : Rotary Mud
Owner Type : Private

Commenced Date : **Final Depth :** 100.00 m
Completion Date :01-Nov-1985 **Drilled Depth :** 100.00 m

Contractor Name :
Driller :1451 MARTIN, Lance
Assistant Driller's Name :

Property : **Standing Water Level :**
GWMA : **Salinity :** (Unknown)
GW Zone : **Yield :**

Site Details

Site Chosen By | **County** | **Parish** | **Portion/Lot DP**
Form A :URANA CLEAR HILL 71
Licensed :

Region :50 - MURRAY **CMA Map :**8126-N OAKLANDS
River Basin :410 - MURRUMBIDGEE RIVER **Grid Zone :**55/2 **Scale :**1:50,000
Area / District :

Elevation : **Northing :**6064500 **Latitude (S) :**35° 33' 36"
Elevation Source :(Unknown) **Easting :**423910 **Longitude (E) :**146° 9' 37"

GS Map :0080A3 **AMG Zone :**55 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	P.V.C.	0.00	87.00	114			(Unknown)
1	2	Casing	P.V.C.	93.00	100.00	114			Seated on Bottom
1	1	Opening	Screen	87.00	93.00	100		1	Johnson; Stainless Steel; SL: 0mm; A: 1.5mm
1	1	Annulus	Waterworn/Rounded	79.00	100.00	160			(Unknown); GS: 9.5mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	6.00	6.00	Sand	Sand	
6.00	20.00	14.00	Sand Gravel	Sand	
20.00	24.00	4.00	Sand	Sand	
24.00	36.00	12.00	Sand Clayey	Sand	
36.00	46.00	10.00	Sand	Sand	
46.00	48.00	2.00	Sand Clayey	Sand	
48.00	74.00	26.00	Sand	Sand	
74.00	78.00	4.00	Clay	Clay	
78.00	82.00	4.00	Sand	Sand	
82.00	88.00	6.00	Clay	Clay	
88.00	94.00	6.00	Sand	Sand	
94.00	96.00	2.00	Clay	Clay	
96.00	98.00	2.00	Sand	Sand	
98.00	100.00	2.00	Driller	(Unknown)	

Remarks

***** End of GW059909 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW068921 *Converted From HYDSYS*

Licence :
Licence Status Lapsed
Authorised Purpose(s) **Intended Purpose(s)**
Work Type : Bore DOMESTIC
Work Status :(Unknown) STOCK
Construct. Method :
Owner Type : Private

Commenced Date : **Final Depth :** 70.00 m
Completion Date :01-Jan-1950 **Drilled Depth :** 0.00

Contractor Name :
Driller :
Assistant Driller's Name :

Property : **Standing Water Level :**
GWMA : **Salinity :** Brackish
GW Zone : **Yield :**

Site Details

Site Chosen By **County** **Parish** **Portion/Lot DP**
Form A :URANA CLEAR HILL L2 DP126238
Licensed :

Region :50 - MURRAY **CMA Map :**
River Basin :410 - MURRUMBIDGEE RIVER **Grid Zone :** **Scale :**
Area / District :

Elevation : 0.00 **Northing :**6064743.8 **Latitude (S) :**35° 33' 29"
Elevation Source : **Easting :**424062.6 **Longitude (E) :**146° 9' 44"

GS Map : **AMG Zone :**55 **Coordinate Source :**GD.,ACC.GIS

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Steel	0.00	0.00	102			

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Remarks

Data copied from "metering inspector" form.

***** End of GW068921 *****

DEPARTMENT OF NATURAL RESOURCES
Work Summary

GW068923

Converted From HYDSYS

Licence :

Licence Status Lapsed
Authorised Purpose(s)
Intended Purpose(s)
STOCK

Work Type : Bore
Work Status :(Unknown)
Construct. Method :
Owner Type : Private

Commenced Date :
Completion Date :01-Jan-1950
Final Depth : 65.00 m
Drilled Depth : 0.00

Contractor Name :
Driller :
Assistant Driller's Name :

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : Brackish
Yield :

Site Details

Site Chosen By

County
Form A :URANA
Licensed :

Parish
CLEAR HILL

Portion/Lot DP
L21 DP553959

Region :50 - MURRAY
River Basin :410 - MURRUMBIDGEE RIVER
Area / District :

CMA Map :
Grid Zone :
Scale :

Elevation : 0.00
Elevation Source :

Northing :6064451.6
Easting :423830.2

Latitude (S) :35° 33' 38"
Longitude (E) :146° 9' 34"

GS Map :
AMG Zone :55
Coordinate Source :GD.,ACC.GIS

Construction

Negative depths indicate Above Ground Level;

H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity;PL-Placement of Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	Steel	0.00	0.00	102			

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

Remarks

Data copied from the old "metering inspector" form.

***** End of GW068923 *****

***** End of Report *****

Annex C

Water Supply - West Corurgan

West Corurgan

Oaklands Rd, PO Box 156, Berrigan NSW 2712
www.corurgan.com.au email ; info@corurgan.com.au
Ph 03 5885 2392 Fax 03 58852660 Mobile 0419 156 429
ABN 92 793 193 219

ATTENTION : Mr. Stewart Rendell

I refer to previous discussions in relation to potential development by Australian Ethanol within the West Corurgan Private Irrigation District .

It is my understanding that the development would be seeking water supply from West Corurgan's O'Dwyer Main Canal in the Oaklands area.

West Corurgan foresees no problems in being able to supply a minimum of 8 Megalitres (your estimated requirement) per day during the normal irrigation season. Historically West Corurgan's average irrigation season has been for a duration of 243 days. Season commencement being dependent upon demand from the irrigation sector and in most years is in mid August. Season closure is normally towards the end of April each year. It is presumed that the development would further secure its water requirements by the construction of on farm storage to cater for its out of season needs etc.

It is further understood that at this time, Australian Ethanol is not securing a West Corurgan Water Entitlement in conjunction with its proposed land purchase. It is strongly recommended that Australian Ethanol source a Water Entitlement either from within West Corurgan or from the Murray River system. West Corurgan Board of Management must be involved in a consultative process in relation to the sourcing of that water.

Please contact this office at any time to discuss the matter further.

Yours faithfully,

Peter M Wallis
Manager.

Annex D

Irrigation Water Quality Data

Parameter Effluent Dam	Unit	Raw Water Filter	Process	Boiler	Cooling Tower	Floor Washings	Laboratory	Secondary Water Treatment Plant	Secondary Water Treatment Plant (N)	Total
Volumetric Rate	m3/day	665	0	1.4	126	24	10	285	285	**1111.4**
pH		7.21						3.73	7.5 – 9.0	**7 - 9**
Electrical Conductivity	mS / cm	120						0.1	0.1	**150-200**
Total Dissolved Solids	ppm	66		2000	2000	1300	1300	1300	1300	**641.8841101**
Total Suspended Solids	ppm	233.4451128				100	100	100	100	**168.3831204**
Calcium as Ca2+	ppm	4.2		5.4545455	5.7142857	20	20	20	20	**8.908256581**
Magnesium as Mg2+	ppm	3.6		3.4090909	3.5714286	3	3	3	3	**3.424305135**
Chlorides as Cl-	ppm	22		300	314.28571	0	0	0	0	**49.17221522**
Active Chlorine as Cl2	ppm	0		0	0	0	0	0	0	**0**
Total Iron	ppm	2.9		13.636364	14.285714	0	0	0	0	**3.37195511**
Total Manganese	ppm	0.08		1.0909091	1.1428571	0	0	0	0	**0.178808055**
Silica as SiO2 (reactive)	ppm	2.6		35.454545	37.142857	0	0	0	0	**5.811261799**
Silica as SiO2 (filter sand)	ppm	0		0	0	0	0	0	0	**0**
Sodium as Na+	ppm	15		204.54545	214.28571			109.2150211	109.2150211	**61.53288162**
Potassium as K+	ppm	2		27.272727	28.571429	0.012	0.012	0.012	0.012	**4.473645688**
Sulphates as SO42-	ppm	2		27.272727	28.571429	0	0	0	0	**4.470201384**
Nitrates/Nitrites (NO3 - NO2)	ppm	0.0585		0.7977273	0.8357143	10	10	10	40	**10.69400694**
Fluorides as F-	ppm	0.06		0.8181818	0.8571429	0	0	0	0	**0.134106042**
E Coli	no/ml	80				0 at 95%ile	0 at 95%ile	0 at 95%ile	0 at 95%ile	**0 at 95%ile**
Total Coliform Bacteria	no/ml	1047				0 at 95%ile	0 at 95%ile	0 at 95%ile	0 at 95%ile	**0 at 95%ile**
Phosphate as PO43-	ppm	no data		red*0.075	no data	no data	no data	no data	no data	**no data**
Total Phosphorus as P	ppm	0.078		red*0.075	0.078	0.078	0.078	0.078	0.078	**0.078**
Boron as B	ppm	0		0	0	0	0	0	0	**0**
BOD 5	ppm	0		0	0	1200	30	30	30	**33.87619219**
COD	ppm	33		0	0	200	200	200	200	**77.15044089**
Total Nitrogen (Kjeldahl)	ppm	0.013209677		0	0.1887097	55	55	55	5	**2.994027222**
H2S	ppm	0		0	0	0	0	0	0	**0**
Volatile Solids	ppm	0		0	0	30	30	30	30	**8.610761202**
Fats/Oils	ppm	0		0	0	5	5	5	5	**1.435126867**
Odour		0						Earthy smell	Earthy smell	**Earthy smell**
Ammonia as NH4+	ppm	0		0	0			55	5	**1.282166637**

Annex E

Irrigation Water Balance

Wet Weather Storage Requirements for a 75th%ile Rainfall Year

Water balance approach has been adapted from the nominated area method outlined in *Environment & Health Protection Guidelines* (1998) and is based on the following equation:

Precipitation + Wastewater applied = Evapotranspiration + Percolation + Runoff

Surface Area of storage	A	m2	60000				
Wastewater Flow to Effluent Dam	Q	L/day	1,150,000		rain days	73	
Design Percolation Rate	R	mm/hr	0.05				
Land Area	L	m2	**550,000**				

method 2 [larger]

Parameter		Day	Precipitation	Evaporation	Evap from Storage	Crop Factor	**Inputs**	Precipitation	Effluent Irrigation	Total Inputs	**Outputs**	Evapotranspiration	Percolation	Runoff	Total Outputs	**Storage**	Days of non irrigation	Cumulative days of non	Maximum Number of	**Storage Volume Required**
Symbol		D	P	E	Es	C		P	W	IN		ET	B	Run	OUT	S	IF (S during any of	irrigation	non irrigation	
Formula		-	-	-	E x A			-	(Q-Es)/L	(P + W)		E x C	R x 24	if P>E, (P-ET-B), 0	ET + B + Run	IN - OUT	past 3 days >0,1, 0)		days	(Max Days x Q) /1000
Units			mm/day	mm/day	L/day			mm/day	mm/day	mm/day		mm/day	mm/day		mm/day	mm/day	days	days	days	m3
	1	01/01/31	0	9.6	576000	0.95		0.0	1.04	1.0		9.12	1.2	0.0	10.3	-9.28			**32**	**36,800**
	2	02/01/31	8.9	9.6	576000	0.95		8.9	1.04	9.9		9.12	1.2	0.0	10.3	-0.38				
	3	03/01/31	0	9.6	576000	0.95		0.0	1.04	1.04		9.12	1.2	0.0	10.3	-9.28	0	0		
	4	04/01/31	0	9.6	576000	0.95		0.0	1.04	1.0		9.12	1.2	0.0	10.3	-9.28	0	0		
	5	05/01/31	0	9.6	576000	0.95		0.0	1.04	1.0		9.12	1.2	0.0	10.3	-9.28	0	0		
	6	06/01/31	0	7.6	456000	0.95		0.0	1.26	1.3		7.22	1.2	0.0	8.4	-7.16	0	0		
	7	07/01/31	0	8.8	528000	0.95		0.0	1.13	1.1		8.36	1.2	0.0	9.6	-8.43	0	0		
	8	08/01/31	0	8	480000	0.95		0.0	1.22	1.2		7.6	1.2	0.0	8.8	-7.58	0	0		
	9	09/01/31	0	8	480000	0.95		0.0	1.22	1.2		7.6	1.2	0.0	8.8	-7.58	0	0		
	10	10/01/31	0	8	480000	0.95		0.0	1.22	1.2		7.6	1.2	0.0	8.8	-7.58	0	0		
	11	11/01/31	0	8	480000	0.95		0.0	1.22	1.2		7.6	1.2	0.0	8.8	-7.58	0	0		
	12	12/01/31	0	8	480000	0.95		0.0	1.22	1.2		7.6	1.2	0.0	8.8	-7.58	0	0		
	13	13/01/31	0	12	720000	0.95		0.0	0.78	0.8		11.4	1.2	0.0	12.6	-11.82	0	0		
	14	14/01/31	0	10.2	612000	0.95		0.0	0.98	1.0		9.69	1.2	0.0	10.9	-9.91	0	0		
	15	15/01/31	0	8.5	510000	0.95		0.0	1.16	1.2		8.075	1.2	0.0	9.3	-8.11	0	0		
	16	16/01/31	0	8.5	510000	0.95		0.0	1.16	1.2		8.075	1.2	0.0	9.3	-8.11	0	0		
	17	17/01/31	0	8.5	510000	0.95		0.0	1.16	1.2		8.075	1.2	0.0	9.3	-8.11	0	0		
	18	18/01/31	0	10.2	612000	0.95		0.0	0.98	1.0		9.69	1.2	0.0	10.9	-9.91	0	0		
	19	19/01/31	0	6.6	396000	0.95		0.0	1.37	1.4		6.27	1.2	0.0	7.5	-6.10	0	0		
	20	20/01/31	0	13.8	828000	0.95		0.0	0.59	0.6		13.11	1.2	0.0	14.3	-13.72	0	0		
	21	21/01/31	0	4.4	264000	0.95		0.0	1.61	1.6		4.18	1.2	0.0	5.4	-3.77	0	0		
	22	22/01/31	0	9.8	588000	0.95		0.0	1.02	1.0		9.31	1.2	0.0	10.5	-9.49	0	0		
	23	23/01/31	0	9.8	588000	0.95		0.0	1.02	1.0		9.31	1.2	0.0	10.5	-9.49	0	0		
	24	24/01/31	0	9.8	588000	0.95		0.0	1.02	1.0		9.31	1.2	0.0	10.5	-9.49	0	0		
	25	25/01/31	0	10.2	612000	0.95		0.0	0.98	1.0		9.69	1.2	0.0	10.9	-9.91	0	0		
	26	26/01/31	0	8	480000	0.95		0.0	1.22	1.2		7.6	1.2	0.0	8.8	-7.58	0	0		
	27	27/01/31	0	8	480000	0.95		0.0	1.22	1.2		7.6	1.2	0.0	8.8	-7.58	0	0		
	28	28/01/31	0	10.1	606000	0.95		0.0	0.99	1.0		9.595	1.2	0.0	10.8	-9.81	0	0		
	29	29/01/31	0	6.7	402000	0.95		0.0	1.36	1.4		6.365	1.2	0.0	7.6	-6.21	0	0		
	30	30/01/31	0	6.7	402000	0.95		0.0	1.36	1.4		6.365	1.2	0.0	7.6	-6.21	0	0		
	31	31/01/31	0	6.7	402000	0.95		0.0	1.36	1.4		6.365	1.2	0.0	7.6	-6.21	0	0		
	32	01/02/31	0	9.2	552000	0.9		0.0	1.09	1.1		8.28	1.2	0.0	9.5	-8.39	0	0		
	33	02/02/31	0	16	960000	0.9		0.0	0.35	0.3		14.4	1.2	0.0	15.6	-15.25	0	0		
	34	03/02/31	0	3.5	210000	0.9		0.0	1.71	1.7		3.15	1.2	0.0	4.4	-2.64	0	0		
	35	04/02/31	0	3.1	186000	0.9		0.0	1.75	1.8		2.79	1.2	0.0	4.0	-2.24	0	0		
	36	05/02/31	2.5	3.1	186000	0.9		2.5	1.75	4.3		2.79	1.2	0.0	4.0	0.26	1	1		
	37	06/02/31	0	3.1	186000	0.9		0.0	1.75	1.8		2.79	1.2	0.0	4.0	-2.24	1	2		
	38	07/02/31	0	3.1	186000	0.9		0.0	1.75	1.8		2.79	1.2	0.0	4.0	-2.24	1	3		
	39	08/02/31	0	6.6	396000	0.9		0.0	1.37	1.4		5.94	1.2	0.0	7.1	-5.77	0	0		
	40	09/02/31	11.7	6.1	366000	0.9		11.7	1.43	13.1		5.49	1.2	5.0	11.7	1.43	1	1		
	41	10/02/31	0	6.5	390000	0.9		0.0	1.38	1.4		5.85	1.2	0.0	7.1	-5.67	1	2		
	42	11/02/31	0	7.7	462000	0.9		0.0	1.25	1.3		6.93	1.2	0.0	8.1	-6.88	1	3		
	43	12/02/31	0	7.5	450000	0.9		0.0	1.27	1.3		6.75	1.2	0.0	8.0	-6.68	0	0		
	44	13/02/31	0	7.5	450000	0.9		0.0	1.27	1.3		6.75	1.2	0.0	8.0	-6.68	0	0		
	45	14/02/31	3.8	7.5	450000	0.9		3.8	1.27	5.1		6.75	1.2	0.0	8.0	-2.88	0	0		
	46	15/02/31	0	7.6	456000	0.9		0.0	1.26	1.3		6.84	1.2	0.0	8.0	-6.78	0	0		
	47	16/02/31	0	7.9	474000	0.9		0.0	1.23	1.2		7.11	1.2	0.0	8.3	-7.08	0	0		
	48	17/02/31	0	5.3	318000	0.9		0.0	1.51	1.5		4.77	1.2	0.0	6.0	-4.46	0	0		
	49	18/02/31	0	5.3	318000	0.9		0.0	1.51	1.5		4.77	1.2	0.0	6.0	-4.46	0	0		
	50	19/02/31	0	5.2	312000	0.9		0.0	1.52	1.5		4.68	1.2	0.0	5.9	-4.36	0	0		
	51	20/02/31	0	5.2	312000	0.9		0.0	1.52	1.5		4.68	1.2	0.0	5.9	-4.36	0	0		
	52	21/02/31	1.3	5.2	312000	0.9		1.3	1.52	2.8		4.68	1.2	0.0	5.9	-3.06	0	0		
	53	22/02/31	0	5	300000	0.9		0.0	1.55	1.5		4.5	1.2	0.0	5.7	-4.15	0	0		
	54	23/02/31	0	5	300000	0.9		0.0	1.55	1.5		4.5	1.2	0.0	5.7	-4.15	0	0		
	55	24/02/31	0	5	300000	0.9		0.0	1.55	1.5		4.5	1.2	0.0	5.7	-4.15	0	0		
	56	25/02/31	0	5	300000	0.9		0.0	1.55	1.5		4.5	1.2	0.0	5.7	-4.15	0	0		
	57	26/02/31	0	5	300000	0.9		0.0	1.55	1.5		4.5	1.2	0.0	5.7	-4.15	0	0		
	58	27/02/31	0	5	300000	0.9		0.0	1.55	1.5		4.5	1.2	0.0	5.7	-4.15	0	0		
	59	28/02/31	0	5	300000	0.9		0.0	1.55	1.5		4.5	1.2	0.0	5.7	-4.15	0	0		
	60	01/03/31	0	7.6	456000	0.85		0.0	1.26	1.3		6.46	1.2	0.0	7.7	-6.40	0	0		
	61	02/03/31	19.6	12.6	756000	0.85		19.6	0.72	20.3		10.71	1.2	7.7	19.6	0.72	1	1		
	62	03/03/31	4.3	10.4	624000	0.85		4.3	0.96	5.3		8.84	1.2	0.0	10.0	-4.78	1	2		
	63	04/03/31	15.2	7	420000	0.85		15.2	1.33	16.5		5.95	1.2	8.1	15.2	1.33	1	3		
	64	05/03/31	0	6.2	372000	0.85		0.0	1.41	1.4		5.27	1.2	0.0	6.5	-5.06	1	4		
	65	06/03/31	0	6.2	372000	0.85		0.0	1.41	1.4		5.27	1.2	0.0	6.5	-5.06	1	5		
	66	07/03/31	0	6.2	372000	0.85		0.0	1.41	1.4		5.27	1.2	0.0	6.5	-5.06	0	0		
	67	08/03/31	0	6.1	366000	0.85		0.0	1.43	1.4		5.185	1.2	0.0	6.4	-4.96	0	0		
	68	09/03/31	0	6.7	402000	0.85		0.0	1.36	1.4		5.695	1.2	0.0	6.9	-5.54	0	0		
	69	10/03/31	0	6.3	378000	0.85		0.0	1.40	1.4		5.355	1.2	0.0	6.6	-5.15	0	0		
	70	11/03/31	0	6.5	390000	0.85		0.0	1.38	1.4		5.525	1.2	0.0	6.7	-5.34	0	0		
	71	12/03/31	0	7.7	462000	0.85		0.0	1.25	1.3		6.545	1.2	0.0	7.7	-6.49	0	0		
	72	13/03/31	0	7.7	462000	0.85		0.0	1.25	1.3		6.545	1.2	0.0	7.7	-6.49	0	0		
	73	14/03/31	3.8	7.7	462000	0.85		3.8	1.25	5.1		6.545	1.2	0.0	7.7	-2.69	0	0		
	74	15/03/31	0	10.5	630000	0.85		0.0	0.95	0.9		8.925	1.2	0.0	10.1	-9.18	0	0		
	75	16/03/31	0	10.7	642000	0.85		0.0	0.92	0.9		9.095	1.2	0.0	10.3	-9.37	0	0		
	76	17/03/31	0	5.1	306000	0.85		0.0	1.53	1.5		4.335	1.2	0.0	5.5	-4.00	0	0		
	77	18/03/31	0	7.2	432000	0.85		0.0	1.31	1.3		6.12	1.2	0.0	7.3	-6.01	0	0		
	78	19/03/31	13.5	5.3	318000	0.85		13.5	1.51	15.0		4.505	1.2	7.8	13.5	1.51	1	1		
	79	20/03/31	23.6	5.3	318000	0.85		23.6	1.51	25.1		4.505	1.2	17.9	23.6	1.51	1	2		
	80	21/03/31	42.9	5.3	318000	0.85		42.9	1.51	44.4		4.505	1.2	37.2	42.9	1.51	1	3		
	81	22/03/31	0	5.7	342000	0.85		0.0	1.47	1.5		4.845	1.2	0.0	6.0	-4.58	1	4		
	82	23/03/31	0.8	6.6	396000	0.85		0.8	1.37	2.2		5.61	1.2	0.0	6.8	-4.64	1	5		
	83	24/03/31	0	5.2	312000	0.85		0.0	1.52	1.5		4.42	1.2	0.0	5.6	-4.10	0	0		
	84	25/03/31	0	6.4	384000	0.85		0.0	1.39	1.4		5.44	1.2	0.0	6.6	-5.25	0	0		
	85	26/03/31	0	6.4	384000	0.85		0.0	1.39	1.4		5.44	1.2	0.0	6.6	-5.25	0	0		
	86	27/03/31	0	6.4	384000	0.85		0.0	1.39	1.4		5.44	1.2	0.0	6.6	-5.25	0	0		
	87	28/03/31	0	6.4	384000	0.85		0.0	1.39	1.4		5.44	1.2	0.0	6.6	-5.25	0	0		
	88	29/03/31	0	6.4	384000	0.85		0.0	1.39	1.4		5.44	1.2	0.0	6.6	-5.25	0	0		
	89	30/03/31	0	3.9	234000	0.85		0.0	1.67	1.7		3.315	1.2	0.0	4.5	-2.85	0	0		
	90	31/03/31	0	4	240000	0.85		0.0	1.65	1.7		3.4	1.2	0.0	4.6	-2.95	0	0		
	91	01/04/31	19.6	4.3	258000	0.8		19.6	1.62	21.2		3.44	1.2	15.0	19.6	1.62	1	1		
	92	02/04/31	0.5	6.7	402000	0.8		0.5	1.36	1.9		5.36	1.2	0.0	6.6	-4.70	1	2		
	93	03/04/31	0	6.7	402000	0.8		0.0	1.36	1.4		5.36	1.2	0.0	6.6	-5.20	1	3		
	94	04/04/31	0	6.7	402000	0.8		0.0	1.36	1.4		5.36	1.2	0.0	6.6	-5.20	0	0		
	95	05/04/31	0	4.9	294000	0.8		0.0	1.56	1.6		3.92	1.2	0.0	5.1	-3.56	0	0		
	96	06/04/31	0	4	240000	0.8		0.0	1.65	1.7		3.2	1.2	0.0	4.4	-2.75	0	0		
	97	07/04/31	0	3.7	222000	0.8		0.0	1.69	1.7		2.96	1.2	0.0	4.2	-2.47	0	0		
	98	08/04/31	0	3.8	228000	0.8		0.0	1.68	1.7		3.04	1.2	0.0	4.2	-2.56	0	0		
	99	09/04/31	0	7.3	438000	0.8		0.0	1.29	1.3		5.84	1.2	0.0	7.0	-5.75	0	0		
	100	10/04/31	0	7.3	438000	0.8		0.0	1.29	1.3		5.84	1.2	0.0	7.0	-5.75	0	0		
	101	11/04/31	0	7.3	438000	0.8		0.0	1.29	1.3		5.84	1.2	0.0	7.0	-5.75	0	0		
	102	12/04/31	0	3.9	234000	0.8		0.0	1.67	1.7		3.12	1.2	0.0	4.3	-2.65	0	0		
	103	13/04/31	0	3.8	228000	0.8		0.0	1.68	1.7		3.04	1.2	0.0	4.2	-2.56	0	0		
	104	14/04/31	0	3.7	222000	0.8		0.0	1.69	1.7		2.96	1.2	0.0	4.2	-2.47	0	0		
	105	15/04/31	13.7	3	180000	0.8		13.7	1.76	15.5		2.4	1.2	10.1	13.7	1.76	1	1		
	106	16/04/31	0	3.1	186000	0.8		0.0	1.75	1.8		2.48	1.2	0.0	3.7	-1.93	1	2		
	107	17/04/31	0	3.1	186000	0.8		0.0	1.75	1.8		2.48	1.2	0.0	3.7	-1.93	1	3		
	108	18/04/31	0	3.1	186000	0.8		0.0	1.75	1.8		2.48	1.2	0.0	3.7	-1.93	0	0		
	109	19/04/31	0	3.7	222000	0.8		0.0	1.69	1.7		2.96	1.2	0.0	4.2	-2.47	0	0		
	110	20/04/31	0	5.2	312000	0.8		0.0	1.52	1.5		4.16	1.2	0.0	5.4	-3.84	0	0		
	111	21/04/31	0	4	240000	0.8		0.0	1.65	1.7		3.2	1.2	0.0	4.4	-2.75	0	0		
	112	22/04/31	0	3.6	216000	0.8		0.0	1.70	1.7		2.88	1.2	0.0	4.1	-2.38	0	0		
	113	23/04/31	0	4.2	252000	0.8		0.0	1.63	1.6		3.36	1.2	0.0	4.6	-2.93	0	0		
	114	24/04/31	0	4.2	252000	0.8		0.0	1.63	1.6		3.36	1.2	0.0	4.6	-2.93	0	0		
	115	25/04/31	0.8	4.2	252000	0.8		0.8	1.63	2.4		3.36	1.2	0.0	4.6	-2.13	0	0		
	116	26/04/31	0	4.2	252000	0.8		0.0	1.63	1.6		3.36	1.2	0.0	4.6	-2.93	0	0		
	117	27/04/31	0	3.7	222000	0.8		0.0	1.69	1.7		2.96	1.2	0.0	4.2	-2.47	0	0		
	118	28/04/31	0	3.8	228000	0.8		0.0	1.68	1.7		3.04	1.2	0.0	4.2	-2.56	0	0		
	119	29/04/31	11.7	5.5	330000	0.8		11.7	1.49	13.2		4.4	1.2	6.1	11.7	1.49	1	1		
	120	30/04/31	9.4	1.3	78000	0.8		9.4	1.95	11.3		1.04	1.2	7.2	9.4	1.95	1	2		
	121	01/05/31	5.1	1.3	78000	0.7		5.1	1.95	7.0		0.91	1.2	3.0	5.1	1.95	1	3		
	122	02/05/31	0	1.3	78000	0.7		0.0	1.95	1.9		0.91	1.2	0.0	2.1	-0.16	1	4		
	123	03/05/31	0	3.1	186000	0.7		0.0	1.75	1.8		2.17	1.2	0.0	3.4	-1.62	1	5		
	124	04/05/31	0	2.4	144000	0.7		0.0	1.83	1.8		1.68	1.2	0.0	2.9	-1.05	0	0		
	125	05/05/31	0	2.8	168000	0.7		0.0	1.79	1.8		1.96	1.2	0.0	3.2	-1.37	0	0		
	126	06/05/31	0	2.8	168000	0.7		0.0	1.79	1.8		1.96	1.2	0.0	3.2	-1.37	0	0		
	127	07/05/31	2	3.2	192000	0.7		2.0	1.74	3.7		2.24	1.2	0.0	3.4	0.30	1	1		
	128	08/05/31	11.4	3.2	192000	0.7		11.4	1.74	13.1		2.24	1.2	8.0	11.4	1.74	1	2		
	129	09/05/31	13.7	3.2	192000	0.7		13.7	1.74	15.4		2.24	1.2	10.3	13.7	1.74	1	3		
	130	10/05/31	0	2.5	150000	0.7		0.0	1.82	1.8		1.75	1.2	0.0	3.0	-1.13	1	4		
	131	11/05/31	0	3.6	216000	0.7		0.0	1.70	1.7		2.52	1.2	0.0	3.7	-2.02	1	5		
	132	12/05/31	4.3	3.7	222000	0.7		4.3	1.69	6.0		2.59	1.2	0.5	4.3	1.69	1	6		
	133	13/05/31	0	3.1	186000	0.7		0.0	1.75	1.8		2.17	1.2	0.0	3.4	-1.62	1	7		
	134	14/05/31	8.4	3.2	192000	0.7		8.4	1.74	10.1		2.24	1.2	5.0	8.4	1.74	1	8		
	135	15/05/31	1.5	3.2	192000	0.7		1.5	1.74	3.2		2.24	1.2	0.0	3.4	-0.20	1	9		
	136	16/05/31	0	3.2	192000	0.7		0.0	1.74	1.7		2.24	1.2	0.0	3.4	-1.70	1	10		
	137	17/05/31	0	1.5	90000	0.7		0.0	1.93	1.9		1.05	1.2	0.0	2.3	-0.32	0	0		
	138	18/05/31	0	1.5	90000	0.7		0.0	1.93	1.9		1.05	1.2	0.0	2.3	-0.32	0	0		
	139	19/05/31	0	3	180000	0.7		0.0	1.76	1.8		2.1	1.2	0.0	3.3	-1.54	0	0		
	140	20/05/31	0	3.2	192000	0.7		0.0	1.74	1.7		2.24	1.2	0.0	3.4	-1.70	0	0		
	141	21/05/31	0	2	120000	0.7		0.0	1.87	1.9		1.4	1.2	0.0	2.6	-0.73	0	0		
	142	22/05/31	1.8	2	120000	0.7		1.8	1.87	3.7		1.4	1.2	0.0	2.6	1.07	1	1		
	143	23/05/31	19.1	2	120000	0.7		19.1	1.87	21.0		1.4	1.2	16.5	19.1	1.87	1	2		
	144	24/05/31	0	1.5	90000	0.7		0.0	1.93	1.9		1.05	1.2	0.0	2.3	-0.32	1	3		
	145	25/05/31	2.8	1.9	114000	0.7		2.8	1.88	4.7		1.33	1.2	0.3	2.8	1.88	1	4		
	146	26/05/31	0	3.3	198000	0.7		0.0	1.73	1.7		2.31	1.2	0.0	3.5	-1.78	1	5		
	147	27/05/31	0	3.3	198000	0.7		0.0	1.73	1.7		2.31	1.2	0.0	3.5	-1.78	1	6		
	148	28/05/31	21.8	1.4	84000	0.7		21.8	1.94	23.7		0.98	1.2	19.6	21.8	1.94	1	7		
	149	29/05/31	5.3	1.4	84000	0.7		5.3	1.94	7.2		0.98	1.2	3.1	5.3	1.94	1	8		
	150	30/05/31	2	1.4	84000	0.7		2.0	1.94	3.9		0.98	1.2	-0.2	2.0	1.94	1	9		
	151	31/05/31	0	1.6	96000	0.7		0.0	1.92	1.9		1.12	1.2	0.0	2.3	-0.40	1	10		
	152	01/06/31	0	1.4	84000	0.55		0.0	1.94	1.9		0.77	1.2	0.0	2.0	-0.03	1	11		
	153	02/06/31	0	1.6	96000	0.55		0.0	1.92	1.9		0.88	1.2	0.0	2.1	-0.16	0	0		
	154	03/06/31	0	1.6	96000	0.55		0.0	1.92	1.9		0.88	1.2	0.0	2.1	-0.16	0	0		
	155	04/06/31	0	1.6	96000	0.55		0.0	1.92	1.9		0.88	1.2	0.0	2.1	-0.16	0	0		
	156	05/06/31	0	1.6	96000	0.55		0.0	1.92	1.9		0.88	1.2	0.0	2.1	-0.16	0	0		
	157	06/06/31	12.4	1.6	96000	0.55		12.4	1.92	14.3		0.88	1.2	10.3	12.4	1.92	1	1		

Wet Weather Storage Requirements for a 75th%ile Rainfall Year

Water balance approach has been adapted from the nominated area method outlined in *Environment & Health Protection Guidelines* (1998) and is based on the following equation:

Precipitation + Wastewater applied = Evapotranspiration + Percolation + Runoff

Surface Area of storage	A	m2	60000			
Wastewater Flow to Effluent Dam	Q	L/day	1,150,000	rain days	73	
Design Percolation Rate	R	mm/hr	0.05			
Land Area	L	m2	**550,000**			

method 2 [larger]

Parameter		Day	Precipitation	Evaporation	Evap from Storage	Crop Factor	**Inputs**	Precipitation	Effluent Irrigation	Total Inputs	**Outputs**	Evapotranspiration	Percolation	Runoff	Total Outputs	**Storage**	Days of non irrigation	Cumulative days of non	Maximum Number of	**Storage Volume Required**
Symbol		D	P	E	Es	C		P	W	IN		ET	B	Run	OUT	S	IF (S during any of	irrigation	non irrigation	
Formula		-	-	-	E x A			-	(Q-Es)/L	(P + W)		E x C	R x 24	if P>E, (P-ET-B), 0	ET + B + Run	IN - OUT	past 3 days >0,1, 0)		days	(Max Days x Q) /1000
Units			mm/day	mm/day	L/day			mm/day	mm/day	mm/day		mm/day	mm/day		mm/day	mm/day	days	days		m3
	158	07/06/31	0	2.2	132000	0.55		0.0	1.85	1.9		1.21	1.2	0.0	2.4	-0.56	1	2		
	159	08/06/31	17.3	2.8	168000	0.55		17.3	1.79	19.1		1.54	1.2	14.6	17.3	1.79	1	3		
	160	09/06/31	0	2.4	144000	0.55		0.0	1.83	1.8		1.32	1.2	0.0	2.5	-0.69	1	4		
	161	10/06/31	27.2	2.1	126000	0.55		27.2	1.86	29.1		1.155	1.2	24.8	27.2	1.86	1	5		
	162	11/06/31	12.7	2.9	174000	0.55		12.7	1.77	14.5		1.595	1.2	9.9	12.7	1.77	1	6		
	163	12/06/31	0	2.9	174000	0.55		0.0	1.77	1.8		1.595	1.2	0.0	2.8	-1.02	1	7		
	164	13/06/31	0	2.9	174000	0.55		0.0	1.77	1.8		1.595	1.2	0.0	2.8	-1.02	1	8		
	165	14/06/31	0	2.9	174000	0.55		0.0	1.77	1.8		1.595	1.2	0.0	2.8	-1.02	0	0		
	166	15/06/31	4.1	0.9	54000	0.55		4.1	1.99	6.1		0.495	1.2	2.4	4.1	1.99	1	1		
	167	16/06/31	0	4.1	246000	0.55		0.0	1.64	1.6		2.255	1.2	0.0	3.5	-1.81	1	2		
	168	17/06/31	0	1.5	90000	0.55		0.0	1.93	1.9		0.825	1.2	0.0	2.0	-0.10	1	3		
	169	18/06/31	0	1.5	90000	0.55		0.0	1.93	1.9		0.825	1.2	0.0	2.0	-0.10	0	0		
	170	19/06/31	11.2	1.5	90000	0.55		11.2	1.93	13.1		0.825	1.2	9.2	11.2	1.93	1	1		
	171	20/06/31	3.3	1.5	90000	0.55		3.3	1.93	5.2		0.825	1.2	1.3	3.3	1.93	1	2		
	172	21/06/31	0	1	60000	0.55		0.0	1.98	2.0		0.55	1.2	0.0	1.8	0.23	1	3		
	173	22/06/31	0	2.3	138000	0.55		0.0	1.84	1.8		1.265	1.2	0.0	2.5	-0.63	1	4		
	174	23/06/31	0	3.3	198000	0.55		0.0	1.73	1.7		1.815	1.2	0.0	3.0	-1.28	1	5		
	175	24/06/31	43.9	1	60000	0.55		43.9	1.98	45.9		0.55	1.2	42.2	43.9	1.98	1	6		
	176	25/06/31	11.9	1	60000	0.55		11.9	1.98	13.9		0.55	1.2	10.2	11.9	1.98	1	7		
	177	26/06/31	0	1	60000	0.55		0.0	1.98	2.0		0.55	1.2	0.0	1.8	0.23	1	8		
	178	27/06/31	0	1	60000	0.55		0.0	1.98	2.0		0.55	1.2	0.0	1.8	0.23	1	9		
	179	28/06/31	0	1	60000	0.55		0.0	1.98	2.0		0.55	1.2	0.0	1.8	0.23	1	10		
	180	29/06/31	10.9	1	60000	0.55		10.9	1.98	12.9		0.55	1.2	9.2	10.9	1.98	1	11		
	181	30/06/31	5.8	1.8	108000	0.55		5.8	1.89	7.7		0.99	1.2	3.6	5.8	1.89	1	12		
	182	01/07/31	1	1.1	66000	0.55		1.0	1.97	3.0		0.605	1.2	0.0	1.8	1.17	1	13		
	183	02/07/31	0	0.4	24000	0.55		0.0	2.05	2.0		0.22	1.2	0.0	1.4	0.63	1	14		
	184	03/07/31	0	0.4	24000	0.55		0.0	2.05	2.0		0.22	1.2	0.0	1.4	0.63	1	15		
	185	04/07/31	1	0.4	24000	0.55		1.0	2.05	3.0		0.22	1.2	-0.4	1.0	2.05	1	16		
	186	05/07/31	0	0.4	24000	0.55		0.0	2.05	2.0		0.22	1.2	0.0	1.4	0.63	1	17		
	187	06/07/31	0	1	60000	0.55		0.0	1.98	2.0		0.55	1.2	0.0	1.8	0.23	1	18		
	188	07/07/31	0	0.9	54000	0.55		0.0	1.99	2.0		0.495	1.2	0.0	1.7	0.30	1	19		
	189	08/07/31	0	1.8	108000	0.55		0.0	1.89	1.9		0.99	1.2	0.0	2.2	-0.30	1	20		
	190	09/07/31	0	1.3	78000	0.55		0.0	1.95	1.9		0.715	1.2	0.0	1.9	0.03	1	21		
	191	10/07/31	6.1	1.3	78000	0.55		6.1	1.95	8.0		0.715	1.2	4.2	6.1	1.95	1	22		
	192	11/07/31	4.3	1.3	78000	0.55		4.3	1.95	6.2		0.715	1.2	2.4	4.3	1.95	1	23		
	193	12/07/31	0	2.5	150000	0.55		0.0	1.82	1.8		1.375	1.2	0.0	2.6	-0.76	1	24		
	194	13/07/31	19.1	0.9	54000	0.55		19.1	1.99	21.1		0.495	1.2	17.4	19.1	1.99	1	25		
	195	14/07/31	0	0.9	54000	0.55		0.0	1.99	2.0		0.495	1.2	0.0	1.7	0.30	1	26		
	196	15/07/31	0	0.9	54000	0.55		0.0	1.99	2.0		0.495	1.2	0.0	1.7	0.30	1	27		
	197	16/07/31	0	0.9	54000	0.55		0.0	1.99	2.0		0.495	1.2	0.0	1.7	0.30	1	28		
	198	17/07/31	0	0.9	54000	0.55		0.0	1.99	2.0		0.495	1.2	0.0	1.7	0.30	1	29		
	199	18/07/31	0	0.9	54000	0.55		0.0	1.99	2.0		0.495	1.2	0.0	1.7	0.30	1	30		
	200	19/07/31	0	1.4	84000	0.55		0.0	1.94	1.9		0.77	1.2	0.0	2.0	-0.03	1	31		
	201	20/07/31	0	1.5	90000	0.55		0.0	1.93	1.9		0.825	1.2	0.0	2.0	-0.10	1	32		
	202	21/07/31	0	1.6	96000	0.55		0.0	1.92	1.9		0.88	1.2	0.0	2.1	-0.16	0	0		
	203	22/07/31	3	1.5	90000	0.55		3.0	1.93	4.9		0.825	1.2	1.0	3.0	1.93	1	1		
	204	23/07/31	1	1.3	78000	0.55		1.0	1.95	2.9		0.715	1.2	0.0	1.9	1.03	1	2		
	205	24/07/31	0	1.3	78000	0.55		0.0	1.95	1.9		0.715	1.2	0.0	1.9	0.03	1	3		
	206	25/07/31	0	1.3	78000	0.55		0.0	1.95	1.9		0.715	1.2	0.0	1.9	0.03	1	4		
	207	26/07/31	0	1.3	78000	0.55		0.0	1.95	1.9		0.715	1.2	0.0	1.9	0.03	1	5		
	208	27/07/31	0	1.4	84000	0.55		0.0	1.94	1.9		0.77	1.2	0.0	2.0	-0.03	1	6		
	209	28/07/31	0	1.5	90000	0.55		0.0	1.93	1.9		0.825	1.2	0.0	2.0	-0.10	1	7		
	210	29/07/31	2.8	1.2	72000	0.55		2.8	1.96	4.8		0.66	1.2	0.9	2.8	1.96	1	8		
	211	30/07/31	0	1.9	114000	0.55		0.0	1.88	1.9		1.045	1.2	0.0	2.2	-0.36	1	9		
	212	31/07/31	0	1.9	114000	0.55		0.0	1.88	1.9		1.045	1.2	0.0	2.2	-0.36	1	10		
	213	01/08/31	0	3.7	222000	0.65		0.0	1.69	1.7		2.405	1.2	0.0	3.6	-1.92	0	0		
	214	02/08/31	0	1.4	84000	0.65		0.0	1.94	1.9		0.91	1.2	0.0	2.1	-0.17	0	0		
	215	03/08/31	0	1.2	72000	0.65		0.0	1.96	2.0		0.78	1.2	0.0	2.0	-0.02	0	0		
	216	04/08/31	0	2	120000	0.65		0.0	1.87	1.9		1.3	1.2	0.0	2.5	-0.63	0	0		
	217	05/08/31	0	1.3	78000	0.65		0.0	1.95	1.9		0.845	1.2	0.0	2.0	-0.10	0	0		
	218	06/08/31	2.8	2	120000	0.65		2.8	1.87	4.7		1.3	1.2	0.3	2.8	1.87	1	1		
	219	07/08/31	3.6	2	120000	0.65		3.6	1.87	5.5		1.3	1.2	1.1	3.6	1.87	1	2		
	220	08/08/31	0	2	120000	0.65		0.0	1.87	1.9		1.3	1.2	0.0	2.5	-0.63	1	3		
	221	09/08/31	0	1.9	114000	0.65		0.0	1.88	1.9		1.235	1.2	0.0	2.4	-0.55	1	4		
	222	10/08/31	0	3.2	192000	0.65		0.0	1.74	1.7		2.08	1.2	0.0	3.3	-1.54	0	0		
	223	11/08/31	0	1.8	108000	0.65		0.0	1.89	1.9		1.17	1.2	0.0	2.4	-0.48	0	0		
	224	12/08/31	0	1.9	114000	0.65		0.0	1.88	1.9		1.235	1.2	0.0	2.4	-0.55	0	0		
	225	13/08/31	0	2.1	126000	0.65		0.0	1.86	1.9		1.365	1.2	0.0	2.6	-0.70	0	0		
	226	14/08/31	0	2.1	126000	0.65		0.0	1.86	1.9		1.365	1.2	0.0	2.6	-0.70	0	0		
	227	15/08/31	0	2.1	126000	0.65		0.0	1.86	1.9		1.365	1.2	0.0	2.6	-0.70	0	0		
	228	16/08/31	0	2.7	162000	0.65		0.0	1.80	1.8		1.755	1.2	0.0	3.0	-1.16	0	0		
	229	17/08/31	3.6	1.4	84000	0.65		3.6	1.94	5.5		0.91	1.2	1.5	3.6	1.94	1	1		
	230	18/08/31	0	2.3	138000	0.65		0.0	1.84	1.8		1.495	1.2	0.0	2.7	-0.86	1	2		
	231	19/08/31	0	3.1	186000	0.65		0.0	1.75	1.8		2.015	1.2	0.0	3.2	-1.46	1	3		
	232	20/08/31	4.6	2.3	138000	0.65		4.6	1.84	6.4		1.495	1.2	1.9	4.6	1.84	1	4		
	233	21/08/31	0	2.3	138000	0.65		0.0	1.84	1.8		1.495	1.2	0.0	2.7	-0.86	1	5		
	234	22/08/31	4.8	2.3	138000	0.65		4.8	1.84	6.6		1.495	1.2	2.1	4.8	1.84	1	6		
	235	23/08/31	0	2.1	126000	0.65		0.0	1.86	1.9		1.365	1.2	0.0	2.6	-0.70	1	7		
	236	24/08/31	3.8	2.4	144000	0.65		3.8	1.83	5.6		1.56	1.2	1.0	3.8	1.83	1	8		
	237	25/08/31	0	2.1	126000	0.65		0.0	1.86	1.9		1.365	1.2	0.0	2.6	-0.70	1	9		
	238	26/08/31	0	2	120000	0.65		0.0	1.87	1.9		1.3	1.2	0.0	2.5	-0.63	1	10		
	239	27/08/31	0	3	180000	0.65		0.0	1.76	1.8		1.95	1.2	0.0	3.2	-1.39	0	0		
	240	28/08/31	1.8	3	180000	0.65		1.8	1.76	3.6		1.95	1.2	0.0	3.2	0.41	1	1		
	241	29/08/31	0	3	180000	0.65		0.0	1.76	1.8		1.95	1.2	0.0	3.2	-1.39	1	2		
	242	30/08/31	0	3	180000	0.65		0.0	1.76	1.8		1.95	1.2	0.0	3.2	-1.39	1	3		
	243	31/08/31	0	4.2	252000	0.65		0.0	1.63	1.6		2.73	1.2	0.0	3.9	-2.30	0	0		
	244	01/09/31	3.8	1.8	108000	0.75		3.8	1.89	5.7		1.35	1.2	1.3	3.8	1.89	1	1		
	245	02/09/31	0	1.9	114000	0.75		0.0	1.88	1.9		1.425	1.2	0.0	2.6	-0.74	1	2		
	246	03/09/31	0	1	60000	0.75		0.0	1.98	2.0		0.75	1.2	0.0	2.0	0.03	1	3		
	247	04/09/31	10.4	1	60000	0.75		10.4	1.98	12.4		0.75	1.2	8.5	10.4	1.98	1	4		
	248	05/09/31	0	1	60000	0.75		0.0	1.98	2.0		0.75	1.2	0.0	2.0	0.03	1	5		
	249	06/09/31	0	1	60000	0.75		0.0	1.98	2.0		0.75	1.2	0.0	2.0	0.03	1	6		
	250	07/09/31	0	1	60000	0.75		0.0	1.98	2.0		0.75	1.2	0.0	2.0	0.03	1	7		
	251	08/09/31	1.3	4.9	294000	0.75		1.3	1.56	2.9		3.675	1.2	0.0	4.9	-2.02	1	8		
	252	09/09/31	0	2.7	162000	0.75		0.0	1.80	1.8		2.025	1.2	0.0	3.2	-1.43	1	9		
	253	10/09/31	0	3.6	216000	0.75		0.0	1.70	1.7		2.7	1.2	0.0	3.9	-2.20	0	0		
	254	11/09/31	1	3.6	216000	0.75		1.0	1.70	2.7		2.7	1.2	0.0	3.9	-1.20	0	0		
	255	12/09/31	8.4	3.6	216000	0.75		8.4	1.70	10.1		2.7	1.2	4.5	8.4	1.70	1	1		
	256	13/09/31	0	2.7	162000	0.75		0.0	1.80	1.8		2.025	1.2	0.0	3.2	-1.43	1	2		
	257	14/09/31	4.6	3.1	186000	0.75		4.6	1.75	6.4		2.325	1.2	1.1	4.6	1.75	1	3		
	258	15/09/31	0	1.2	72000	0.75		0.0	1.96	2.0		0.9	1.2	0.0	2.1	-0.14	1	4		
	259	16/09/31	0	2.6	156000	0.75		0.0	1.81	1.8		1.95	1.2	0.0	3.2	-1.34	1	5		
	260	17/09/31	0	3.2	192000	0.75		0.0	1.74	1.7		2.4	1.2	0.0	3.6	-1.86	0	0		
	261	18/09/31	0	3.2	192000	0.75		0.0	1.74	1.7		2.4	1.2	0.0	3.6	-1.86	0	0		
	262	19/09/31	0	3.2	192000	0.75		0.0	1.74	1.7		2.4	1.2	0.0	3.6	-1.86	0	0		
	263	20/09/31	0	2.1	126000	0.75		0.0	1.86	1.9		1.575	1.2	0.0	2.8	-0.91	0	0		
	264	21/09/31	0	3.5	210000	0.75		0.0	1.71	1.7		2.625	1.2	0.0	3.8	-2.12	0	0		
	265	22/09/31	0	3.3	198000	0.75		0.0	1.73	1.7		2.475	1.2	0.0	3.7	-1.94	0	0		
	266	23/09/31	0	3.4	204000	0.75		0.0	1.72	1.7		2.55	1.2	0.0	3.8	-2.03	0	0		
	267	24/09/31	0	3	180000	0.75		0.0	1.76	1.8		2.25	1.2	0.0	3.5	-1.69	0	0		
	268	25/09/31	0	3	180000	0.75		0.0	1.76	1.8		2.25	1.2	0.0	3.5	-1.69	0	0		
	269	26/09/31	0	3	180000	0.75		0.0	1.76	1.8		2.25	1.2	0.0	3.5	-1.69	0	0		
	270	27/09/31	0	2.7	162000	0.75		0.0	1.80	1.8		2.025	1.2	0.0	3.2	-1.43	0	0		
	271	28/09/31	5.6	2.7	162000	0.75		5.6	1.80	7.4		2.025	1.2	2.4	5.6	1.80	1	1		
	272	29/09/31	0	1.7	102000	0.75		0.0	1.91	1.9		1.275	1.2	0.0	2.5	-0.57	1	2		
	273	30/09/31	0	3.5	210000	0.75		0.0	1.71	1.7		2.625	1.2	0.0	3.8	-2.12	1	3		
	274	01/10/31	0	3.5	210000	0.85		0.0	1.71	1.7		2.975	1.2	0.0	4.2	-2.47	0	0		
	275	02/10/31	0	5.7	342000	0.85		0.0	1.47	1.5		4.845	1.2	0.0	6.0	-4.58	0	0		
	276	03/10/31	0	5.7	342000	0.85		0.0	1.47	1.5		4.845	1.2	0.0	6.0	-4.58	0	0		
	277	04/10/31	0	5.7	342000	0.85		0.0	1.47	1.5		4.845	1.2	0.0	6.0	-4.58	0	0		
	278	05/10/31	3.6	4.9	294000	0.85		3.6	1.56	5.2		4.165	1.2	0.0	5.4	-0.21	0	0		
	279	06/10/31	0	1.8	108000	0.85		0.0	1.89	1.9		1.53	1.2	0.0	2.7	-0.84	0	0		
	280	07/10/31	0	7	420000	0.85		0.0	1.33	1.3		5.95	1.2	0.0	7.2	-5.82	0	0		
	281	08/10/31	0	2.6	156000	0.85		0.0	1.81	1.8		2.21	1.2	0.0	3.4	-1.60	0	0		
	282	09/10/31	4.8	2.6	156000	0.85		4.8	1.81	6.6		2.21	1.2	1.4	4.8	1.81	1	1		
	283	10/10/31	4.8	2.6	156000	0.85		4.8	1.81	6.6		2.21	1.2	1.4	4.8	1.81	1	2		
	284	11/10/31	0	2.6	156000	0.85		0.0	1.81	1.8		2.21	1.2	0.0	3.4	-1.60	1	3		
	285	12/10/31	0	5.2	312000	0.85		0.0	1.52	1.5		4.42	1.2	0.0	5.6	-4.10	1	4		
	286	13/10/31	0	5.1	306000	0.85		0.0	1.53	1.5		4.335	1.2	0.0	5.5	-4.00	0	0		
	287	14/10/31	0	4	240000	0.85		0.0	1.65	1.7		3.4	1.2	0.0	4.6	-2.95	0	0		
	288	15/10/31	0	4.5	270000	0.85		0.0	1.60	1.6		3.825	1.2	0.0	5.0	-3.43	0	0		
	289	16/10/31	0	4.5	270000	0.85		0.0	1.60	1.6		3.825	1.2	0.0	5.0	-3.43	0	0		
	290	17/10/31	0	4.5	270000	0.85		0.0	1.60	1.6		3.825	1.2	0.0	5.0	-3.43	0	0		
	291	18/10/31	0	6.7	402000	0.85		0.0	1.36	1.4		5.695	1.2	0.0	6.9	-5.54	0	0		
	292	19/10/31	21.1	7	420000	0.85		21.1	1.33	22.4		5.95	1.2	14.0	21.1	1.33	1	1		
	293	20/10/31	0	0.4	24000	0.85		0.0	2.05	2.0		0.34	1.2	0.0	1.5	0.51	1	2		
	294	21/10/31	0	2.9	174000	0.85		0.0	1.77	1.8		2.465	1.2	0.0	3.7	-1.89	1	3		
	295	22/10/31	0	4	240000	0.85		0.0	1.65	1.7		3.4	1.2	0.0	4.6	-2.95	1	4		
	296	23/10/31	0	4	240000	0.85		0.0	1.65	1.7		3.4	1.2	0.0	4.6	-2.95	0	0		
	297	24/10/31	0	4	240000	0.85		0.0	1.65	1.7		3.4	1.2	0.0	4.6	-2.95	0	0		
	298	25/10/31	0	6	360000	0.85		0.0	1.44	1.4		5.1	1.2	0.0	6.3	-4.86	0	0		
	299	26/10/31	0	3.8	228000	0.85		0.0	1.68	1.7		3.23	1.2	0.0	4.4	-2.75	0	0		
	300	27/10/31	0	5.5	330000	0.85		0.0	1.49	1.5		4.675	1.2	0.0	5.9	-4.38	0	0		
	301	28/10/31	0	6.4	384000	0.85		0.0	1.39	1.4		5.44	1.2	0.0	6.6	-5.25	0	0		
	302	29/10/31	0	3.2	192000	0.85		0.0	1.74	1.7		2.72	1.2	0.0	3.9	-2.18	0	0		
	303	30/10/31	0	3.2	192000	0.85		0.0	1.74	1.7		2.72	1.2	0.0	3.9	-2.18	0	0		
	304	31/10/31	0	3.2	192000	0.85		0.0	1.74	1.7		2.72	1.2	0.0	3.9	-2.18	0	0		
	305	01/11/31	0	6.1	366000	0.95		0.0	1.43	1.4		5.795	1.2	0.0	7.0	-5.57	0	0		
	306	02/11/31	0	5.5	330000	0.95		0.0	1.49	1.5		5.225	1.2	0.0	6.4	-4.93	0	0		
	307	03/11/31	0	5.6	336000	0.95		0.0	1.48	1.5		5.32	1.2	0.0	6.5	-5.04	0	0		
	308	04/11/31	0	3.5	210000	0.95		0.0	1.71	1.7		3.325	1.2	0.0	4.5	-2.82	0	0		
	309	05/11/31	0	4	240000	0.95		0.0	1.65	1.7		3.8	1.2	0.0	5.0	-3.35	0	0		
	310	06/11/31	0	4	240000	0.95		0.0	1.65	1.7		3.8	1.2	0.0	5.0	-3.35	0	0		
	311	07/11/31	0	4	240000	0.95		0.0	1.65	1.7		3.8	1.2	0.0	5.0	-3.35	0	0		
	312	08/11/31	0	4	240000	0.95		0.0	1.65	1.7		3.8	1.2	0.0	5.0	-3.35	0	0		
	313	09/11/31	2	4	240000	0.95		2.0	1.65	3.7		3.8	1.2	0.0	5.0	-1.35	0	0		
	314	10/11/31	0	7.9	474000	0.95		0.0	1.23	1.2		7.505	1.2	0.0	8.7	-7.48	0	0		

Wet Weather Storage Requirements for a 75th%ile Rainfall Year

Water balance approach has been adapted from the nominated area method outlined in *Environment & Health Protection Guidelines* (1998) and is based on the following equation:

Precipitation + Wastewater applied = Evapotranspiration + Percolation + Runoff

Surface Area of storage	A	m2	60000		
Wastewater Flow to Effluent Dam	Q	L/day	1,150,000	rain days	73
Design Percolation Rate	R	mm/hr	0.05		
Land Area	L	m2	**550,000**		

method 2 [larger]

Parameter		Day	Precipitation	Evaporation	Evap from Storage	Crop Factor	**Inputs**	Precipitation	Effluent Irrigation	Total Inputs	**Outputs**	Evapotranspiration	Percolation	Runoff	Total Outputs	**Storage**	Days of non irrigation	Cumulative days of non irrigation	Maximum Number of non irrigation days	**Storage Volume Required**
Symbol		D	P	E	Es	C		P	W	IN		ET	B	Run	OUT	S	IF (S during any of past 3 days >0,1, 0)			
Formula		-	-	-	E x A			-	(Q-Es)/L	(P + W)		E x C	R x 24	if P>E, (P-ET-B), 0	ET + B + Run	IN - OUT				(Max Days x Q) /1000
Units			mm/day	mm/day	L/day			mm/day	mm/day	mm/day		mm/day	mm/day		mm/day	mm/day	days	days	days	m3
	315	11/11/31	0	7	420000	0.95		0.0	1.33	1.3		6.65	1.2	0.0	7.9	-6.52	0	0		
	316	12/11/31	0	6.4	384000	0.95		0.0	1.39	1.4		6.08	1.2	0.0	7.3	-5.89	0	0		
	317	13/11/31	0	6.4	384000	0.95		0.0	1.39	1.4		6.08	1.2	0.0	7.3	-5.89	0	0		
	318	14/11/31	6.4	6.4	384000	0.95		6.4	1.39	7.8		6.08	1.2	0.0	7.3	0.51	1	1		
	319	15/11/31	0	7.6	456000	0.95		0.0	1.26	1.3		7.22	1.2	0.0	8.4	-7.16	1	2		
	320	16/11/31	33	8.6	516000	0.95		33.0	1.15	34.2		8.17	1.2	23.6	33.0	1.15	1	3		
	321	17/11/31	3.6	6.8	408000	0.95		3.6	1.35	4.9		6.46	1.2	0.0	7.7	-2.71	1	4		
	322	18/11/31	0	6.7	402000	0.95		0.0	1.36	1.4		6.365	1.2	0.0	7.6	-6.21	1	5		
	323	19/11/31	0	9.2	552000	0.95		0.0	1.09	1.1		8.74	1.2	0.0	9.9	-8.85	0	0		
	324	20/11/31	0	9.2	552000	0.95		0.0	1.09	1.1		8.74	1.2	0.0	9.9	-8.85	0	0		
	325	21/11/31	0	9.2	552000	0.95		0.0	1.09	1.1		8.74	1.2	0.0	9.9	-8.85	0	0		
	326	22/11/31	0	7.6	456000	0.95		0.0	1.26	1.3		7.22	1.2	0.0	8.4	-7.16	0	0		
	327	23/11/31	0	10.3	618000	0.95		0.0	0.97	1.0		9.785	1.2	0.0	11.0	-10.02	0	0		
	328	24/11/31	0	9.4	564000	0.95		0.0	1.07	1.1		8.93	1.2	0.0	10.1	-9.06	0	0		
	329	25/11/31	0	7.2	432000	0.95		0.0	1.31	1.3		6.84	1.2	0.0	8.0	-6.73	0	0		
	330	26/11/31	0	10.1	606000	0.95		0.0	0.99	1.0		9.595	1.2	0.0	10.8	-9.81	0	0		
	331	27/11/31	0	10.1	606000	0.95		0.0	0.99	1.0		9.595	1.2	0.0	10.8	-9.81	0	0		
	332	28/11/31	0	10.1	606000	0.95		0.0	0.99	1.0		9.595	1.2	0.0	10.8	-9.81	0	0		
	333	29/11/31	0	8.2	492000	0.95		0.0	1.20	1.2		7.79	1.2	0.0	9.0	-7.79	0	0		
	334	30/11/31	0	4.4	264000	0.95		0.0	1.61	1.6		4.18	1.2	0.0	5.4	-3.77	0	0		
	335	01/12/31	0	15.8	948000	1		0.0	0.37	0.4		15.8	1.2	0.0	17.0	-16.63	0	0		
	336	02/12/31	0	6.9	414000	1		0.0	1.34	1.3		6.9	1.2	0.0	8.1	-6.76	0	0		
	337	03/12/31	0	6.9	414000	1		0.0	1.34	1.3		6.9	1.2	0.0	8.1	-6.76	0	0		
	338	04/12/31	0	6.9	414000	1		0.0	1.34	1.3		6.9	1.2	0.0	8.1	-6.76	0	0		
	339	05/12/31	0	7.6	456000	1		0.0	1.26	1.3		7.6	1.2	0.0	8.8	-7.54	0	0		
	340	06/12/31	0	3.8	228000	1		0.0	1.68	1.7		3.8	1.2	0.0	5.0	-3.32	0	0		
	341	07/12/31	0	9.4	564000	1		0.0	1.07	1.1		9.4	1.2	0.0	10.6	-9.53	0	0		
	342	08/12/31	0	7.8	468000	1		0.0	1.24	1.2		7.8	1.2	0.0	9.0	-7.76	0	0		
	343	09/12/31	0	9	540000	1		0.0	1.11	1.1		9	1.2	0.0	10.2	-9.09	0	0		
	344	10/12/31	0	9	540000	1		0.0	1.11	1.1		9	1.2	0.0	10.2	-9.09	0	0		
	345	11/12/31	0	9	540000	1		0.0	1.11	1.1		9	1.2	0.0	10.2	-9.09	0	0		
	346	12/12/31	0	9.8	588000	1		0.0	1.02	1.0		9.8	1.2	0.0	11.0	-9.98	0	0		
	347	13/12/31	0	7.9	474000	1		0.0	1.23	1.2		7.9	1.2	0.0	9.1	-7.87	0	0		
	348	14/12/31	0	7.8	468000	1		0.0	1.24	1.2		7.8	1.2	0.0	9.0	-7.76	0	0		
	349	15/12/31	0	11	660000	1		0.0	0.89	0.9		11	1.2	0.0	12.2	-11.31	0	0		
	350	16/12/31	0	7.9	474000	1		0.0	1.23	1.2		7.9	1.2	0.0	9.1	-7.87	0	0		
	351	17/12/31	0	7.9	474000	1		0.0	1.23	1.2		7.9	1.2	0.0	9.1	-7.87	0	0		
	352	18/12/31	0	7.9	474000	1		0.0	1.23	1.2		7.9	1.2	0.0	9.1	-7.87	0	0		
	353	19/12/31	0	8	480000	1		0.0	1.22	1.2		8	1.2	0.0	9.2	-7.98	0	0		
	354	20/12/31	0	9.2	552000	1		0.0	1.09	1.1		9.2	1.2	0.0	10.4	-9.31	0	0		
	355	21/12/31	0	14.4	864000	1		0.0	0.52	0.5		14.4	1.2	0.0	15.6	-15.08	0	0		
	356	22/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
	357	23/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
	358	24/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
	359	25/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
	360	26/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
	361	27/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
	362	28/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
	363	29/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
	364	30/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
	365	31/12/31	0	7	420000	1		0.0	1.33	1.3		7	1.2	0.0	8.2	-6.87	0	0		
			645.2	1702.1																
				-1056.9																

Annex F

Nutrient And Salt Balances

EC

Percolation cals for EC leaching requirements

	EC @50% yield reduction
Phalaris	11
Perennial Ryegrass	12.2
Couch	14.7
Lucerne	**8.8**

EC (irrigation water) / EC (50% lucerne yield reduction)
= 0.2/8.8
= 0.022727

Annual effluent application (maximum)
= 0.023 x 1112m3/day x 365days / 550000m2
= 0.017 m

percolation required annually to leach salts out of root zone
= 17mm

annual rainfall mm	490
annual evaporation mm	1663

Due to deficit between evaporation and rainfall and to account for the possibility that seasonal rainfall may not provide the required 17mm to leach salts out of the root zone, additional irrigation depth can be required at least once per year to provide this leaching. Alternatively rainfall depth can provide required leaching.

BOD LOADING

A = CQ x (1000 x Lc)
Lc = CQ x (1000 x A)

Area ha 55
CQ 1168860

Lc (BOD5) = 21.252 kg/ha/mth
= 0.7084 kg/ha/day

	Data							Concentrations			Application Rates											
	Max plant uptake (N) (ref 1)	525	kg/ha/yr			Total N in Wastewater		15	mg/l		114	kg/ha/year										
	Irrigation Area	55	ha			Ammonia in Wastewat		1.28	mg/l		10	kg/ha/year										
	Total Irrigation Volume	419.75	ML/year	@1.15ML/d		Nitrates in Wastewater		5.69	mg/l		43	kg/ha/year										
	Application	7.63	ML/ha/year			Nitrites in Wastewater		5	mg/l		38	kg/ha/year										
						Organic Nitrogen		3.03	mg/l		23	kg/ha/year										

	Process	Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
1	Total Annual Application	(kg/ha/yr)	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114
2	Volatilisation Losses	(kg/ha/yr)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
3	Organic Fraction	(kg/ha)	23.1	32.4	48.6	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4
4	Available from Application	(kg/ha/yr)	81.6	95.5	102.4	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7	104.7
5	Carryover from previous year	(kg/ha/yr)	0	4	7	9	10	11	12	13	13	13	13	13	13	13	13	13	13	13	13	13
6	Uptake by plants	(kg/ha/yr)	82	99	109	114	115	116	117	117	117	118	118	118	118	118	118	118	118	118	118	118
7	Removed	(kg/ha/yr)	69	84	93	97	98	99	99	100	100	100	100	100	100	100	100	100	100	100	100	100
8	Held in Humus	(kg/ha)	12	22	30	35	38	40	42	43	43	44	44	44	44	44	44	44	44	44	44	44
9	Decay losses	(kg/ha/yr)	0	1	2	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
10	Cumulative sorption	(kg/ha)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Leaching	(kg/ha/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

References

1 Based on 15 tonnes/ha/yr lucerne, 3.5% N - Table 4.2 DEC 2004

Nitrogen budget for zero deficit									
		Effluent Characteristics			Area Characteristics			Application rate	
		Ammonium	1.28		Pasture	0		Area	55
		Nitrate	10.69		Lucerne	55		ML/day	1.15
		Organic N	3		Trees	0		day/yr	365
		Total N	14.97		Total	55			
Year	Effluent Application (ML/ha)	N applied	N available	N in Lucerne	Lucerne net N export	Lucerne net N balance (Kg/ha)	Lucerne net N balance (tonnes)		
1	7.632	114.248	77.673	300	270	-192.327	-10.578		
2	7.632	114.248	82.252	300	270	-187.748	-10.326		
3	7.632	114.248	84.541	300	270	-185.459	-10.200		
4	7.632	114.248	86.831	300	270	-183.169	-10.074		
5	7.632	114.248	86.831	300	270	-183.169	-10.074		
6	7.632	114.248	86.831	300	270	-183.169	-10.074		
7	7.632	114.248	86.831	300	270	-183.169	-10.074		
8	7.632	114.248	86.831	300	270	-183.169	-10.074		
9	7.632	114.248	86.831	300	270	-183.169	-10.074		
10	7.632	114.248	86.831	300	270	-183.169	-10.074		
10 yr Totals		1142.483	852.2833	3000	2700	-1847.717	-101.6244		
Average		114.2483	85.22833	300	270	-184.7717	-10.16244		
Grand Total (tonnes)									
Yearly	-10.16244								
10 yrs	-101.6244								

P balance DEC (2004) Method

Assume phosphorus saturation point

= 0.5 x average P sorption capacity from lab [EPA Effluent Guidelines 2005 p 44]

Lab data not available – use default DEC data p.47 Table 4.3 of 2000kg/ha to 1m depth:

Critical soil P sorption =2000kg/ha to 1 m

Soil depth = 1m

Soil density = 1.78 t/m3

Land area for irrigation = 55

Total P in applied effluent = 0.078 mg/L

Volume of effluent at 1.15 ML/d = 419.75 ML

Calculations:

Total P adsorbed before leaching;

= Crit P sorp capacity x soil density x soil depth x irrigation area

= 2000kg/10000m3x 1780 kg/m3 x 550,000m2

= 0.2kg/m3 x 55 ha x 10000m2/ha

= 110 000 kg

Total orthophosphate in applied effluent per year

= 0.078 mg/L x 419,750,000 L

= 32.74 kg

Total P removed by Lucerne /ha/yr = 60 kg

Therefore total P removed by lucerne per 55 ha per year = 3300 kg

Site irrigation period:

= (110000 kg) / (32.74 kg/yr – 3300 kg/yr)

Plant uptake greater than wastewater input requirements resulting in negative answer; therefore model allowable life of soil/project using P additions due to wastewater alone:

= 110,000 kg / 32.74 kg/yr

= 3360years.

Therefore Phosphorus addition via to soil irrigation is not a limiting factor in wastewater.

ERM consulting services worldwide **www.erm.com**

Environmental Resources Management Australia
Building C, 33 Saunders Street
Pyrmont NSW 2009
Telephone (02) 8584 8888
Facsimile (02) 8584 8800