REPORT

Mangawhai EcoCare Project Assessment of Environmental Effects

to accompany applications for resource consent and a notice of requirement to designate a site for waste water treatment purposes

Prepared for

Earth Tech Engineering Pty Ltd

71 Queens Road
Melbourne VIC 3004
Australia

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42133002

URS

Project Manager:	…………………………………..	URS New Zealand Limited
	Richard Jenkins	6th Floor, URS Centre
	Principal Planner	13-15 College Hill, Auckland
		PO Box 821, Auckland New Zealand
		Tel: 64 9 355 1300
Project Director:	…………………………………..	Fax: 64 9 355 1333
	Martin Evans	
	Principal	

Author:	…………………………………..	Date:	23 August 2006
(Optional)	Bernice Meyle	Reference:	42133002
	Senior Planner	Status:	Draft 1

Consent applications

Notice of Requirement to Designate Waste Water Treatment Plant

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This report has been prepared for Earth Tech Engineering Pty Limited (Earth Tech) to assist it in its contract with Kaipara District Council to design, build and operate for 15 years the Mangawhai EcoCare area sewage reticulation, waste water treatment plant (WWTP) and to dispose of treated effluent to land. The EcoCare project area is the presently all subdivided portion of Mangawhai Village and Mangawhai Heads settlements.

A multiplicity of resource consents is required from the Northland Regional Council in respect of the coastal marine area, earthworks, discharges to air, works in a water course, and the discharge of treated effluent to land. Compliance certificates will also be obtained for permitted activities, especially where compliance with standards associated with the permitted activity status needs to be demonstrated. In addition, the waste water treatment plant is the subject of a separate notice of requirement to designate by the Kaipara District Council under s168 of the Resource Management Act 1991. The activity of the provision of public utilities and earthworks within the Ecocare district is permitted by the district plan.

All of the applications for resource consents, compliance certificates, and the notice of requirement to designate the WWTP are supported by this assessment of environmental effects. All of the resource consent applications and any compliance certificate applications are in the name of Earth Tech, the designer, constructor and operator of the entire scheme. Kaipara District Council, the owner of the assets once construction is complete, is the requiring authority in relation to the designation of the waste water treatment plant.

1.1 Background

The Mangawhai EcoCare Wastewater Treatment Scheme project (Mangawhai Ecocare) has been under development in some form since the early 1990s when the water quality in the Mangawhai Estuary became noticeably degraded due to a number of contributing factors including the:

- Cumulative impact of sewage disposal;
- Geographic features of the land at Mangawhai;
- Number of occupants at Mangawhai particularly during the peak seasonal periods; and
- Continued use of septic tanks and long drops.

Kaipara District Council completed a risk management assessment of the available project delivery approaches and decided to use a 'Design, Build, Operate and Finance' approach for the execution of this project. This led to a publicly advertised tender process which resulted in three companies being short-listed to bid the project. The outcome of this tender process is that Earth Tech has been contracted for up to 15 years to provide wastewater services to Mangawhai including the provision of a wastewater collection, treatment and disposal system, subject to obtaining the necessary consents and meeting Local Government Act 2002 (LGA) requirements. The financing component of the contract will be provided by a company owned and operated by ABN Amro New Zealand.

A Statement of Proposal was released in August 2003 that outlined the project and the proposed charging regime including a Development Contributions Policy.

Earth Tech (the contractor) is required to obtain the necessary resource consents. The wastewater treatment plant is to be located in ‘Mangawhai Park’, a Rural zoned area of land owned by the council, but not subject to the Reserves Act 1977. Land disposal has been decided upon for the discharge of treated effluent, and negotiations are presently underway for the purchase by the council of a site for this purpose. The site that is the subject of this assessment of environmental effects is Lincoln Downs, on Brown Road, some 10km from Mangawhai.

The goals of the Kaipara District Council in relation to this project are[1]:

> *2. Goals*
> *Kaipara District Council’s objectives for this project are to:*
> - *Deliver cost-effective, high quality, and innovative waste water infrastructure to Mangawhai*
> - *Achieve or exceed predetermined service outcomes with optimum risk transfer to the Proponent (contractor);*
> - *Deliver significantly improved services to the community;*
> - *Deliver ongoing value for money throughout the Project including maximising social and economic returns;*
> - *Maintain and enhance the water quality of the Mangawhai Estuary whilst meeting environmental standards now and into the future; and*
> - *Satisfy regulatory requirements.*
>
> *Throughout this process, Council has been focussed on delivering high quality services at an affordable price. This has resulted in Council developing a framework of charges, rates and contributions designed to*
> - *fully fund the scheme,*
> - *fairly allocate costs to those who will benefit from the system and those who have triggered the need for the expenditure, and*
> - *is fair and equitable in its treatment of intergenerational issues.*

These objectives were also framed by reference to the community outcomes included in the Long Term Council Community Plan (LTCCP) 2004/2014.

1.2 Need for Scheme

Mangawhai is a small coastal community that is extremely popular with full-time residents and bach owners who, together with tourists, flock to the beaches and estuary during summer period and weekends.

[1] Page x, Volume 2 of the Draft LTCCP 2006/16. The statement should be read in conjunction with Proposed Development Contributions Policy 2006-16

It has a small base population of approximately 1400 that increases to around 4500 during summer with a peak of around 6500, including daily visitors.

The harbour and groundwater is degraded and has been since at least 1976 when the first surveys indicated unacceptable levels of human waste and other pollution sources.

The prime contributors to this situation are:

- Cumulative impact of sewage disposal;
- Ground conditions in large areas of Mangawhai have been proven to be unsuitable for septic tanks.
- Sewage is currently treated or disposed of via septic tanks/ long drops many of which are in poor condition;
- Stormwater, during major storm activity; and
- Rural run off which occurs in the upper reaches of the estuary.

This has been demonstrated through survey results and a series of reports commissioned by Northland Regional Council (formerly the Northland Catchment Commission) or Kaipara District Council (formerly the Otawatea County Council) dating back to 1976. Surveys have consistently demonstrated faecal coliform and enterococci results significantly above accepted guidelines. Water and shellfish quality reports together with analysis by Council's Development Engineer in 1990 further confirmed this and identified the causes listed above.

With the current and projected future growth this situation will further deteriorate without coordinated action across the community.

The above factors contribute to the degradation of the environmental condition of the estuary at Mangawhai which subsequently impacts on:

- Public health and safety issues from swimming/ playing within the estuary environs as well as those associated with the quality of the shellfish;
- Attractiveness of Mangawhai as a residential village and/or tourist destination;
- Sustainability of the environment; and
- Long-term economic health of Mangawhai.

In 1998 the Mangawhai Infrastructural Assets Study investigated and analysed options for infrastructure to meet the broad range of infrastructure requirements but with a specific emphasis on wastewater requirements including community preferences. A list of the investigations and reports is included in the Statement of Proposal – Mangawhai EcoCare[2] are contained in "Appendix A" to that document as follows:

[2] www.kaipara.govt.nz/pdf/statement_of_proposal.pdf Appendix A is shown below.

Appendix A: List of Investigations/ Reports - Mangawhai Sewage Issues

- *Monitoring of the estuary commenced in 1976 and has continued since then. This has demonstrated frequent instances of the estuary recording pollution readings well in excess of accepted guidelines;*
- *Sewerage Schemes were proposed in 1981 and 1988, however the community rejected them each time concerned about cost, need and the impact on the community;*
- *Northland Regional Council Water Quality Study in 1990 found pollution in the groundwater and recommended disposal of sewerage away from the Mangawhai Heads settlement;*
- *In 1990/91 Kaipara District Council conducted a survey of on site wastewater disposal units and found that the majority were faulty. At that time a third of the community wanted a reticulation system;*
- *In 1990/91 the District Council Development Engineer completed a report that examined all options including on site systems, centralised systems and localised mini treatment systems. The report recommended further analysis and the implementation of a septic tank bylaw. Council decided not to proceed with a centralised system given the 1988 rejection of any scheme;*
- *Department of Conservation raised significant concerns regarding the 1996 District Plan's failure to address the human impact on the Mangawhai estuary. The issue was settled with agreement to undertake the Mangawhai Planning Study;*
- *1996/97 Northland Regional Council commissioned the Mangawhai Water and Shellfish Quality study that concluded that pollution levels in the estuary were impacting on shellfish and water quality with 50% of the sites monitored reporting pollution levels more than 10 times accepted guidelines. Pollution in drains and seepage from septic tanks were identified as the most likely cause;*
- *ESR Water Quality report also confirmed unacceptable pollution levels in the harbour;*
- *Mangawhai Planning Study, completed in 1997, confirmed pollution in harbour and groundwater and identified a potential public health risk with sewerage in open drains in urban areas;*
- *In 1998 District Plan Change No 9 established planning controls within residential areas, and identified areas where septic tanks were no longer acceptable in new housing construction; and*
- *Mangawhai Infrastructural Asset Study was commissioned in 1998 to review amongst other infrastructural needs, the options for sewerage treatment and disposal within Mangawhai.*

The Mangawhai Infrastructural Asset Study was commissioned in 1998 to review amongst other infrastructure needs, the options for sewerage treatment and disposal within Mangawhai.

1.3 Drainage District

The declaration of the Drainage District was decided upon as part of the original Statement of Proposal process and no changes are proposed to the drainage district boundaries, as previously declared, which includes all the urban zoned areas, 'Mangawhai Park', Golf Course and the Rural-residential zoning under the Kaipara District Plan. The Drainage District is shown on the attached map titled *"Mangawhai Subdivision Approvals Post 1 July 2003"*as the Ecocare Scheme Boundary.

Within the drainage district (the EcoCare area) there will be an initial reticulation area that will largely include the existing established residential areas (pre-2003) at Mangawhai Village and the Heads. This initial reticulation area will be progressively expanded as required within the Drainage District to service those remaining properties as development occurs. During the detailed design phase the inclusion of recently developed areas will be considered and it is likely that they will be included within the initial reticulation area. This includes developments in and around the Mangawhai Beach Primary School, Jack Boyd Drive, Molesworth Drive and the new developments between Mangawhai Village and Mangawhai Heads.

Although the initial scheme was for a total of 1216 sites in 2002, the impetus given to subdivision by the prospect of a sewerage scheme has been such that now there are 3200 sites within the scheme. Since 2003, the Kaipara District Council has imposed conditions on developers to install sewerage reticulation suitable for connection to the Ecocare sewerage scheme.

1.4 The Applicants

1.4.1 Kaipara District Council

The requiring authority for the designation of the waste water treatment plant is the Kaipara District Council. The council owns the site that is called Mangawhai Park, on which the WWTP will be located, and will own the entire asset on completion of the construction project.

1.4.2 Earth Tech Engineering Pty Limited

In respect of all consents related to construction, Earth Tech is the applicant.

In respect of all consents related to the long-term operation of the system, the council and Earth Tech are joint applicants, as the council will own the assets, and Earth Tech will operate and maintain the entire system for a period of up to15 years.

Earth Tech is a leading global provider of consulting, engineering, and construction services for the transportation, water/wastewater, facilities and environmental markets. Its 8,500 employees, in over 130 offices in 17 countries, service commercial and government clients.

Earth Tech operates more than 200 water and wastewater treatment facilities serving more than 40 million people in the United States, Canada, United Kingdom, Ireland, Hungary, China, Australia, Thailand, Venezuela and Brazil. From Australia, from whence the team involved in the Mangawhai EcoCare project come, the firm is a leader in water recycling and water cycle management.

In Asia Earth Tech is building the world's largest DAF water treatment plant at Tianjin in China and designing a US$1 billion airport passenger terminal in Bangkok. Earth Tech designs and manages major infrastructure projects throughout Asia Pacific. Earth Tech also assists clients with the management of commercial risks by providing options to finance, build and operate.

Table 1-1: Application Details in relation to Notice of Requirement to Designate Waste Water Treatment Plant Site

Applicant:	Kaipara District Council and Earth Tech Pty Limited
Land Owner:	Kaipara District Council
Address for Service:	Earth Tech Pty Limited 71 Queens Road Melbourne VIC 3004 Australia Attention: George Schwab Phone: +61 3 8517 9285 Facsimile: +61 3 8517 9422 Email: george.schwab@earthtech.com.au
Legal description	Pt Lot 3 DP 108638, CT NA93D/777
Physical Address:	'Mangawhai Park', Thelma Road, Mangawhai
Site Area:	32.8623ha
Zoning:	Rural

Table 1-2: ***Application Details in relation to resource consents from Northland Regional Council***

Applicants:	Earth Tech Engineering Pty Limited (in relation to consents associated with construction, and all long-term operational consents) and Kaipara District Council (in relation to all long-term operational consents)
Land Owners:	Kaipara District Council in relation to all road reserve and bridges, and Mangawhai Park. The Crown (administered by Department of Conservation) in relation to coastal marine area crossings. Thomas Logan and Ann Elizabeth Lees in relation to the Lincoln Downs site (the disposal site); Various in relation to the transfer pipeline route. See Table 1-3 below.
Address for Service:	Earth Tech Pty Limited 71 Queens Road Melbourne VIC 3004 Australia Attention: George Schwab Phone: +61 3 8517 9285 Facsimile: +61 3 8517 9422 Email: george.schwab@earthtech.com.au
Legal description	Various as detailed in Table 1-3 below
Physical Address:	As shown in the attached plans
Site Area:	As shown in the attached plans (cross reference to plan Mangawhai Ecocare Scheme – key elements
Zoning:	As shown in the attached plans (extracts from district plan)

Table 1-3: Subject Properties Details

Legal Description	CT	Area (ha)	Owner
Lot 6 DP 314200	56155	47.8270	The Estuary Land Company
Lot 1 DP 205425	133C/635	24.0947	B & D Wintle
Pt Allot 122 Parish of Mangawhai (SO 723)	769/90	74.0575	Brunt
Lot 2 DP 62034	19C/1200	100.0585	Tovolea Farm Ltd (W & C Bygrave)
Lot 1 DP 204704	131195	21.0341	Anne Elizabeth Lees, Thomas Logan Lees
Lot 2 DP 331960	131195	27.983	Anne Elizabeth Lees, Thomas Logan Lees
Allot 284 Parish of Kaiwaka	907/238	25.0526	Anne Elizabeth Lees, Thomas Logan Lees
Lot 3 DP 331961	131198	22.9123	Anne Elizabeth Lees, Thomas Logan Lees
Allot 282 Parish of Kaiwaka	SO 3201/B	21.0437	Anne Elizabeth Lees, Thomas Logan Lees

2.1 Introduction

Mangawhai is located in the south eastern corner of Kaipara District. The Mangawhai area consists of two townships, Mangawhai Heads and Mangawhai Village, which are linked by a causeway that crosses the Mangawhai Estuary.

Mangawhai and the surrounding hinterland comprise a pattern of coastal and rural settlement formed around the wider Mangawhai Harbour.

The Mangawhai landscape is characterised by:

- An open coastal beach and harbour system
- An indented coastline offering a mixture of sandy beaches and dune systems
- Freshwater wetlands
- Estuarine and salt marsh ecosystems
- Steep cliffs and headlands

Within the upper Mangawhai catchment, the principal features of the landscape are:

- Ridges and valleys with re-generating and remnant patches of indigenous vegetation
- Interspersed areas of open pasture,
- Exotic forestry and horticulture, and
- Small clusters of farm and residential buildings.

The wider Mangawhai area comprises the largest settlement area in the south-eastern Kaipara District. Existing settlement patterns are characterised by coastal village settlements and allied activities comprising a mixture of land uses separated by areas of rural land.

The 2001 census reported that the population of the Mangawhai area was 1,260 people. Being within a reasonable distance of Auckland it has a large number of baches and attracts a large holiday population during the summer and holiday periods. In recent years significant new development has occurred in the areas surrounding both the Heads and the Village, in part spurred by the prospect of a sewerage scheme for the area.

In March 2002 the existing Heads and Village areas consisted of some 1,216 lots. Apart from small commercial areas both at the Village and the Heads, the area is residential in nature.

Since 2003, subdivision consents have been granted for the development of 875 lots and proposals are pending which would add a further 1100 lots. If all the proposed developments proceed, the size of the Mangawhai area will grow from the original 1,216 lots to nearly 3,200 lots (August 2006).

3.1 Introduction

The Ecocare project is in three parts:

- Reticulation within the drainage district,
- A waste water treatment plant, and
- A disposal system 10km to the west of Mangawhai.

3.2 Reticulation

3.2.1 The Reticulation District

In July 2003, Kaipara District Council adopted the Ecocare Drainage District. This area encompasses:

- Mangawhai Heads,
- Mangawhai Village, and
- The surrounding hinterland that is zoned residential and rural-residential.

The scheme for providing sewerage services to land within the Ecocare Drainage District is known as "Mangawhai EcoCare" or "EcoCare".

New subdivisions approved since July 2003 and within the Ecocare District, have in general been required to install sewerage infrastructure to enable connection to the Ecocare scheme once it has been constructed.

Areas developed prior to 2003 (referred to as "existing" areas) will be serviced with infrastructure designed, installed and operated for 15 years by Earth Tech under contract with Kaipara District Council.

Infrastructure installed by Earth Tech as part of the Ecocare project will be sized to accommodate sewage flows arising from the new subdivisions as well the existing areas. The attached plans show the proposed works ("*Mangawhai Sewerage Scheme Reticulation Alignments, Sheets 1 – 8).*

3.2.2 Summary of Reticulation System

The reticulation system within the townships is in two parts; a gravity system, and a low pressure system. In the gravity system waste drains without pumping to pump stations and on to the waste water treatment plant. In contrast, the low pressure system will service sites not able to be served by the gravity system. These are in areas where the terrain is flat, or which lie below the general level of the gravity system. The low pressure system will have associated with it grinder pumps and a small storage tank on each site. The appended plans ("*Mangawhai Sewerage Scheme Reticulation Alignments, Sheets 1 – 8)* show the extent of the reticulation system, and the split between gravity and low pressure systems.

A summary of the infrastructure required to be constructed is presented below:

Gravity System

- 21 km of sewer with diameters ranging from 150mm to 375mm
- 18 km of property drains (drains dedicated to an individual property which transfer waste from the house fixture to the communal sewer)
- 15 pumping stations
- 6 km of rising (or pressure) main with diameters ranging from 100mm to 375mm

Grinder System

- 330 grinder pump stations, each servicing a single property
- 7 km of low pressure pipeline

3.3 Geotechnical Description of Reticulation Site

Detailed geotechnical investigations have been undertaken to determine the nature of the sub-surface conditions across the site. Tonkin and Taylor Limited was engaged to prepare a geotechnical investigation report. The field work consisted of:

- Excavating 45 test holes to depths of between 1.2 and 3.1 metres, and
- Drilling 14 boreholes to depths in the order of 5 metres

Assessment of the published geology of the area and an interpretative assessment of the field work was incorporated into the investigation report.[3]

3.3.1 General Description

The geotechnical investigations undertaken at the site encountered a variety of materials generally consistent with published geology. Much of the area is underlain by sand deposits with the northern portion of the Mangawhai Heads underlain by firm to stiff dacite silts.

[3] Tonkin and Taylor Limited, Mangawhai Sewer Scheme Geotechnical Investigation Report, May 2006. See Appendix 1

Much of the central area of the Heads is underlain by sand overlying the dacite silts. Thicker sand deposits were encountered in the southern portion of the Heads and in the Village. Some estuarine silts were also encountered in low lying areas or at locations close to the estuary. A very dense cemented sand layer was encountered close to the ground surface in Mangawhai Village.

The materials encountered across the site are generally described as follows:

Fill

Fill was encountered over much of the site primarily due to investigations being undertaken adjacent to existing roads, while in other areas sand fill associated with old trench excavations for service lines was encountered.

Quaternary Sand

This type of material is sand that has been deposited in dunes or as beach deposits. Generally it is loosely packed, light orange-brown to grey and fine-to-medium or fine-to-coarse grained, typically becoming denser with depth.

Cemented Sand

An area of cemented sand was encountered in the Mangawhai Village area. This was very difficult to excavate in places and was encountered between approximately 0.5 and 1.45 metres below the existing ground level. Less cemented sands typically underlie this area.

Estuarine Material

This type of material was encountered on Thelma Road. The area is low lying and surrounded by swampy forest. Significant amounts of wood and silt material was encountered in the test pit dug in this location and the material was generally soft to firm. Estuarine material was also encountered near the Mangawhai Heads Camping Ground.

Dacite Silt

This was encountered across much of the northern portion of Mangawhai Heads and comprised light coloured (cream to light-grey) stiff to hard silts generally of low plasticity. The dacite silt is typically dense in its weathered state but loses strength in its weathered state and is prone to land slippage.

Waitemata Group

The Waitemata Group consists of interbedded siltstones and sandstones underlying the above units, but these were not encountered in these investigations.

Interpretation of findings

The geotechnical report identified that the trenched method of construction is suitable for the majority of the site, provided that the excavations remain above the water table but highlighted the risks of trench collapse in sandy soil. Trench safety regulations which construction contractors are obliged to meet, recognise the risk of trench collapse even in soils that appear safe. Accordingly, extensive use will be made of trench shields.

In most areas above the water table, directional drilling may be useful. This method of construction is suitable for areas where trenching is impractical and reinstatement costs are prohibitive.

Pump stations require the deepest excavation. The problems that are expected to be encountered such as managing ground water and securing excavations are well understood in backlog sewer construction and competent construction contractors are well equipped to successfully deal with them.

3.4 Proposed Sewage System Works

3.4.1 Existing conditions

Apart from some isolated dwellings that have long-drop toilets (that is, where sewage is discharged into a pit without any form of treatment), all dwellings presently rely on some form of on-site treatment system for the treatment of sewage. For dwellings more than five years old, each property would have a septic tank with an associated disposal field that allows the septic waste to be soaked into the ground.

Septic tanks provide a basic form of sewage treatment and when operating in conjunction with an effective soils absorption field, it can provide an effective solution to managing an individual dwelling's sewage disposal needs. Septic tanks that are regularly desludged (every 3-5 years depending on the number of occupants in the house) and that have water-tight concrete walls will perform as intended. However the effluent from the tank is not biologically safe and requires carefully managed disposal into the soil to ensure acceptable containment of sewage waste.

Most septic tanks are “all waste” tanks and receive both the black water stream (toilet waste) and the grey water stream (laundry, kitchen, bathroom wastes). Some properties in the order of 30 or more years old may be served with septic tanks which only receive the black water stream. In such instances the grey water stream is discharged in an uncontrolled manner to the environment. As the grey water stream has a significant pollutant load, such systems are generally unsuitable in built-up areas such as Mangawhai.

The objective of the absorption field is allow septic effluent to percolate sufficiently slowly through the soils so that effluent receives further purification from bacteria living in the soil, and slowly enough that effluent does not drain outside the site boundaries.

The successful use of a septic system relies on a number of different factors, including:

- Soils having suitable (medium) permeability
- Avoiding areas of high rainfall
- Lot sizes greater than 4,000 m^2
- Individual properties having sufficient unpaved area for a sufficient length of absorption drains to be installed
- Terrain not being excessively steep
- Avoiding areas where high water table or rock exists

Generally, if a septic tank is well maintained, system failure is the result of inadequacies of the soils absorption field. The most significant factor leading to failure is lot size. The majority of lots in the Heads and the Village are in the order of 1,000 m2. At this size successful performance would always be doubtful because there is insufficient room on each site for an adequately sized absorption field. This is exacerbated by the density of existing development, where the cumulative effect of minor inadequacies in multiple neighbouring properties results in the discharge of contaminated effluent to water courses and groundwater.

The Village area has high water table and the presence of a shallow cemented sand layers. In tandem these compromise the capability of the soils to absorb and contain septic effluent.

In the Heads a variety of additional problems arise:

- Some properties have steeply sloping terrain, resulting in effluent draining through the soils into neighbouring properties
- Some properties are in areas of high water table, which leads to septic waste entering the groundwater system directly
- Sandy soils throughout much of the town enables effluent to leach directly into the groundwater system without die-off of bacteria
- Many properties do not have sufficient unpaved area to allow sufficient length of drain to be installed to enable septic waste to percolate into the soil without water-logging.

As a consequence on site disposal systems are not an effective and reliable effluent disposal technique for Mangawhai.

3.4.2 Sewerage System Design

The Ecocare system will collect all wastewater from each property and transfer it to a common point for treatment. Once it has been rendered biologically safe effluent will be disposed of in a controlled manner. This section of the report introduces the proposed reticulation system.

- The reticulation system comprises of two types of technologies:
- Modified conventional sewerage for the majority of the Heads area
- Grinder pump systems for the Village area and for isolated areas within the Heads
- These technologies are described in detail below.

The system will service 1,216 existing lots in the existing areas. In addition, the scheme will accommodate an additional 875 lots in the surrounding areas which have been approved for subdivision since 2002; and the council is processing another 1,100 lots, making a total of 3200 lots overall. The waste water treatment plant is designed to accommodate expansion, so that additional sites will be able to be connected later on, as demand arises. Similarly, the reticulation system has considerable redundancy in it. For example, the reticulation system to the disposal field is designed for flows of 5000m^3 per day, whereas present calculated flows would be 400m^3 per day and 1400m^3 in summer.

In all cases each septic tank (or package treatment system) and disposal field will become redundant. Landowners will be required to decommission the septic tanks and disposal fields.

Grinder Pumps

Grinder pumps will be used to transfer wastewater from certain allotments into a small diameter pressure main which will be located in the road reserve. This pressure main will then convey the wastewater to a central collection point from where it will be pumped on to the wastewater treatment plant.

These grinder pumps are so called because they incorporate a grinding mechanism which reduces the size of solids in the wastewater before the wastewater passes through a pump and into the pressure main.

The grinder pump comes in a pre-fabricated 600L plastic tank which collects wastewater from the house and stores it until it reaches a pre-set high level. The grinder pump is then activated and the wastewater is pumped off the property. Once the level in the tank reaches a pre-set low level, the pump stops automatically.

The individual package pump stations have been designed to run almost silently and to be low maintenance. The installation of these units will be carried out by Earth Tech, and maintenance will be undertaken by them as part of the 15 year contract to operate the sewerage system.

Why are they used?

Grinder Pumps are used on properties which are not suited to being serviced by gravity sewers. This is typically due to the topography of the area or the arrangement of buildings in the area in relation to each other.

Grinder pumps and a low pressure reticulation system have been chosen because:

- The village area is flat, which would result in gravity lines being very deep in places in order to achieve sufficient fall in the lines.
- The deep stormwater drains in some areas of the Village make construction of deep gravity lines difficult and potentially dangerous.
- A shallow layer of rock in the Village would make deep excavations for gravity lines slow to dig and expensive.

Grinder Pump Images

The following images are intended as a guide only. The actual arrangement and detail of installation will vary from property to property. The grinder pump and boundary valve chamber will be installed as part of the project.

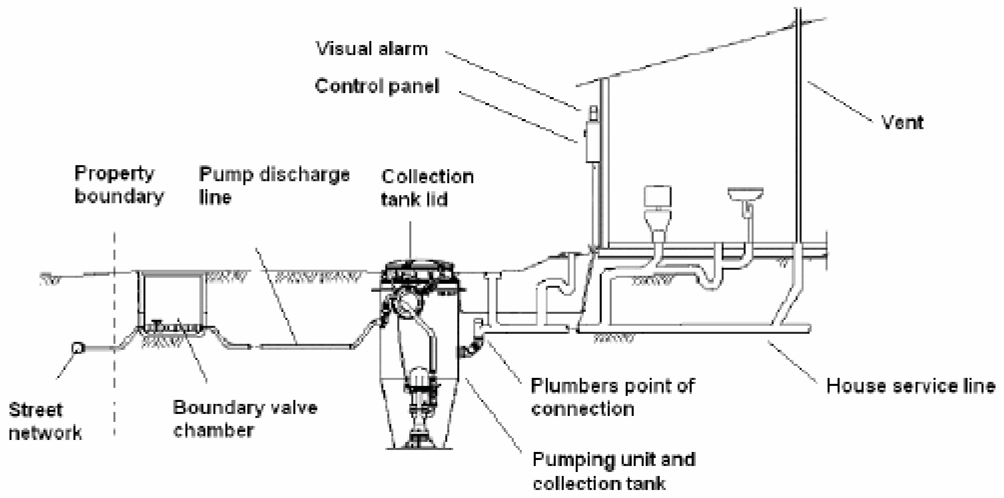


Figure 3-1: Typical On-Site Pump Installation

Location of pipelines

Each grinder pump will have a discharge line which leads from the pump collection tank through the landowner's property to the reticulated sewer line. Typically this will be in the road reserve, but in some cases the lines will run through the rear of properties. These will be council owned lines, and provision to locate the lines on private property, and maintain them, is governed by the Local Government Act 2002.

The network located in the road reserve services the community in general. These pipelines operate under low pressure and pump the sewage to a central pump station for transfer to the treatment plant.

Figure 3-2: Installation of Grinder Pump and Pit

Figure 3-3: Completed Installation

Figure 3-4: Installation of a Low Pressure Sewer Main

Gravity sewers

The most cost effective method of collecting wastewater for the majority of Mangawhai is through the use of gravity sewers. Wastewater will instead be drained by gravity into a sewer which is either laid in the road reserve or adjacent to the property boundary. However, because there are several distinct catchments within the areas, it is not possible to service the whole of Mangawhai using gravity sewers alone. Instead, several pump stations are used to collect the sewage from each separate catchment and transfer it either to the treatment plant or to the next catchment in the system.

Location of sewers

Normal sewerage design principles have been used for the selection of pipeline locations.

For gravity sewers these principles include:

- Location is determined by the topography of the site. The objective is to position the sewer so that sewage from the house can drain by gravity to the sewer
- When located on private property the sewer is positioned as close as practical to property boundaries in order to limit the intrusion on private property
- Where topography allows, sewers are located along the rear boundaries so that properties on either side of the boundary can be serviced by the one sewer
- If the sewer is in the road reserve, the location is chosen with regard to existing services, protection of structures and where possible preservation of vegetation

Gravity sewer systems also incorporate pressure mains so that sewage from one catchment can be pumped to a neighbouring catchment. The pressure mains (or rising mains) are located within road reserves in preference to private property.

Sewer Design Parameters

Sewer Diameter

Sewer diameters are based on the number of lots draining to the sewer in question and in accordance with the Water Services Association sewerage code (WSA code)[4]. The WSA code recommends sewer sizes are based on Equivalent Population (EP) and allows for typical rates of groundwater and stormwater infiltration. Given the number of properties in Mangawhai which are not permanently occupied, the adoption of WSA guidelines is considered to be conservative, even for peak holiday population events.

[4] Water Services Association Sewerage Code 2002 (Version 2.3, April 2004)

Minimum Sewer Grades

Minimum sewer grades are in line with WSA Code recommendations. Some minor adjustments have been made to accommodate the particular circumstances that affect beachside townships.

In beachside townships where there are high ground water levels and sandy ground conditions, there is significant advantage to be gained from keeping sewers as shallow as is practicable. Often, therefore, beachside townships adopt flatter sewers than other towns in order to minimise the difficulties associated with the ground conditions.

Also, Earth Tech has previously made provision for flushing of minimum grade sewers in order to manage the potential for siltation during periods of low flow. This approach has primarily been adopted for sewers larger than 300 mm diameter. For smaller reticulation sewers the grades adopted have not led to the need for flushing.

Based on the experience outlined above, the minimum grades for 150mm diameter sewers adopted for the Mangawhai reticulation design are given in Table 3-1, below:

Table 3-1: Minimum Grades for DN150 Gravity Sewers

Scenario	Adopted Minimum Grade
1 to 4 lots	1 in 100
5 to 15 lots	1 in 150
16 lots to 40 lots	1 in 180
More than 40 lots	1 in 200

Location of Access Structures

The WSA Code provides precise information on where and under what conditions the different types of access structures can be used. The information given in Table 3-2 below is therefore based on the information provided in the WSA Code. However, it is considered that each individual maintenance structure in Mangawhai will be subject to a unique set of local factors.

For this reason, the table is intended as a guide only, and the provision of maintenance structures and the choice of which type to use will be made on a case by case basis, considering the maintenance, construction and environmental issues.

Typically three types of access structure are used in reticulation sewers:

- Manholes (MH): these consist of a pit which is large enough for a worker to enter for maintenance purposes. Normally the pit is 1000mm in diameter. Fig. 3-11 shows a manhole during construction.
- Maintenance shaft (MS): rather than use a manhole, a smaller diameter inlet structure can be used to permit remote controlled CCTV or flushing hoses to be inserted into the sewer. The inlet may be only 150mm in diameter.
- Inspection shaft (IS): this is the simplest access structure. A vertical pipe extends from the sewer to the surface. This allows a maintenance operator to look down into the sewer while staying on the surface.

Table 3-2: Guidelines for Use of Maintenance Structures

Scenario	WSA Sewerage Code Recommendation	Adopted Values
Maximum distance between MH's (including intermediate MSs / ISs).	400m (see Fig 3-5)	300m
Maximum distance between terminal access structure and downstream MH	240m (See Fig 3-6)	240m
Maximum distance between any two consecutive structures	120m	120m
Discharge of rising main	Manhole Required (MS / IS not to be used)	Manhole Required (MS / IS not to be used)
End of sewer	MH / MS / IS	IS to be used under normal circumstances
Change of sewer diameter	MH only	MH or MS
Change of grade at same level	MH or (for DN150) MS	MH or MS or IS
Change of invert level (drop)	MH or (for DN150) MS / IS	MH
Intersection of 3 Sewers at any level	MH	MH or MS (where depth less than 2.5m)
Intersection of 2 Sewers at any level	MH / MS / IS	MH / MS / IS
Change of Horizontal Direction	MH / MS (max 30^{o}) / IS (DN150)	MH / MS / IS
Sewers Deeper than 3m	N/A	MH's only

Figure 3-5: Multiple Maintenance Shafts Between Consecutive Manholes

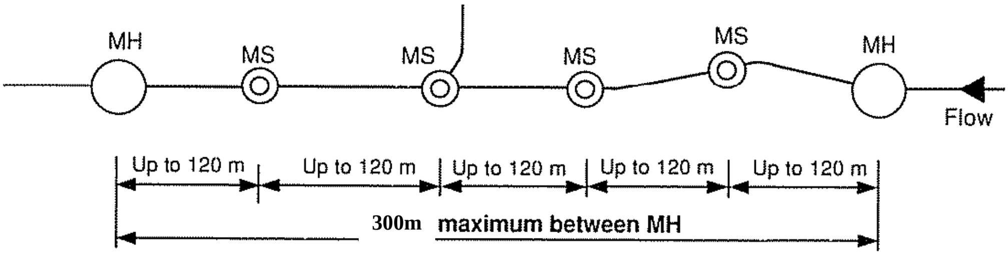
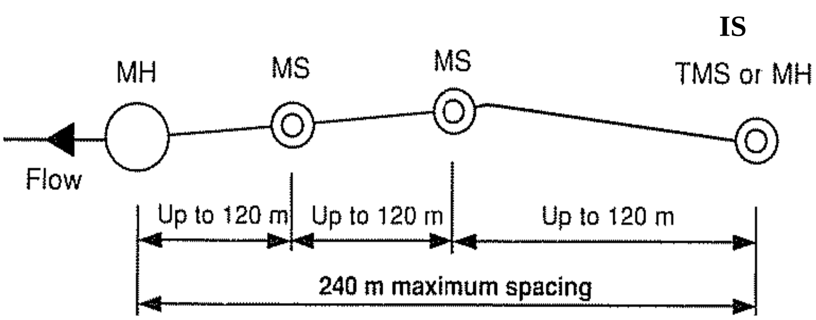


Figure 3-6: Multiple Maintenance Shafts Between Manhole and Terminal Access Structure



Gravity Sewer Images

Figure 3-7: *Installation of Conventional Gravity Sewer*

Figure 3-8: Installation of Conventional Gravity Sewer through private land.

(Courtesy of Grampians Wimmera Mallee Water).

3.4.3 Pump Stations

Pump Station Design

The wet well of each pump station will contain two submersible pumps which transfer the wastewater through a rising main either to the downstream catchment or the treatment site.

The pump stations will vary in size according to the number of contributing properties. However, all will be similar in layout and will be designed to eliminate as far as practicable the risk of spills. Each pump station will be fitted with telemetry equipment which constantly monitors the operation of the pump station and raises an alarm in the event of station failure.

Each station will also be provided with adequate emergency storage (see Table 3-5 and Table 3-6) to allow enough time for emergency pumping measures to be put in place in the event of station failure, without the station spilling wastewater to the surrounding environment.

Pump stations of the type to be used in Mangawhai are designed to be virtually inaudible from surrounding properties.

The location chosen for pump stations tends to be dictated by the topography of the catchment. However the following principles have been applied in choosing locations:

- Within road reserves as opposed to private land
- easily accessible by maintenance personnel
- accessible without inconveniencing neighbouring landowners

General Layout

As mentioned above, the pump stations will vary in size in depth and diameter. The pump stations will comprise a circular 'wet well' and a separate valve chamber, both of which will be installed below ground.

From ground level, for the majority of pump stations, the only visible items will be a concrete slab at ground level, aluminium panels set into the concrete and a small electrical kiosk or switchboard. These switchboards will be sited in such a way as to minimise inconvenience to the public.

For the remaining, larger, pump stations, a permanent structure may be constructed adjacent to the pump station. This structure would be designed with consideration given to the characteristics of the surrounding environment.

Photographs provided below illustrate typical arrangements of small and large pump stations.

Pump Station Photographs

Figure 3-9*: *Typical Small Pump Station

Shows cover slab and switchboard cubicle. Also shown is transmitter for telemetry equipment.

Figure 3-10**: **Typical Small Pump Station

Shows cover slab with aluminium access hatches and switchboard cubicle.

(Courtesy of Grampians Wimmera Mallee Water).

Figure 3-11**: **Construction of Typical Small Pump Station

Shows wet well, cover slab and inlet manhole.

(Courtesy of Grampians Wimmera Mallee Water).

3.4.4 Predicted Wastewater Flows

Analysis has been undertaken to predict wastewater flows which are expected over both the course of a year as a whole and during the peak summer periods.

The analysis has been based on a number of key parameters:

- Current population
- Expected growth rates
- Generation of wastewater per capita

Current Population

The current Mangawhai population has been derived from 2001 census data and to enable an estimate of the growth to be determined, a comparison was made of house counts derived from aerial photographs of the town undertaken in both 2001 and 2006.

In particular, the census data was used to determine the occupancy rates per house and the proportion of houses being permanent residencies. Coupled with the assessment of additional houses since 2001, the census data enabled an estimate of the increase in population since 2001 to be derived.

Comparison was also made with previous research undertaken for Kaipara District Council in its preparation of its District Plan.

The 2001 census data reveals that Mangawhai had:

- A population of 1,260
- 53% of houses were permanently occupied
- 560 permanently occupied houses
- Each permanently occupied household consisted of 2.25 people

The comparison of house counts in 2001 and 2006 showed that 172 new houses had been constructed.

Assuming the occupancy rates and proportion of permanent houses had not changed since 2001, a population of 1,465 people was derived. This was considered to be the lower bound solution. The upper bound solution assumes that all new houses since 2001 are permanent residencies. On this basis the population would be 1,760 people.

It was considered that 1,650 represented a reasonable estimate of the current population.

Expected Growth Rates

Using the actual census data and the estimate of the 2006 population, growth rates have been determined. These are tabulated below in Table 3-3:

Table 3-3: Population Growth

Date	Average Annual Growth over preceding 5 year period
1991	6.3%
1996	6.0%
2001	1.6%
2006	6.1%

Since 2001 resource consents applications have been granted for the subdivision of 875 new lots. Of these:

- Construction works have been completed on 590 lots
- Works have not started on the remaining 270 lots
- Houses have been constructed on 172 of the completed lots

House construction has averaged 34 houses per year over the last 5 years. This is equivalent to a growth rate of 3% per annum.

Generation of wastewater per capita

Normal practice for the design of wastewater treatment plants has been to adopt a wastewater flow of 180 -200 L/day/capita. This figure has been adopted after correlation with actual wastewater flows and populations for many townships. The actual flow rates vary from site to site according to particular site conditions.

Mangawhai is a beachside township which experiences a substantial influx of people during holiday periods. In order to assess whether wastewater flows are likely to be significantly different to normal expectations an assessment of wastewater flow characteristics was undertaken for a number of similar beachside communities.

As Mangawhai does not possess a reticulated water supply it was considered that wastewater flows would tend towards the lower bound of the range of possible flows. However it was decided that a conservative approach was warranted and for the purposes of designing the reticulation system a wastewater flow of 210 L/day/capita was adopted.

This flow consists of:

- a dry weather component of 180 L/day/capita (sewage from toilet, laundry, kitchen, bathroom)
- a wet weather component of 30 L/day/capita (rainwater or groundwater finding its way into the system)

Peak Flow Rates

Reticulation sewers and pump stations are designed to allow for the daily variation in flows and the increase in flows due to the entry into the system of stormwater or groundwater.

Normal design practice is for the Peak Wet Weather Flow to be estimated at four times the Average Dry Weather Flow. To provide a factor of safety against underestimation of peak flows pumps and pressure mains are designed for a minimum flow of six times the Average Dry Weather Flow.

3.4.5 Mitigation measures

Gravity Sewers

Reticulation sewers are designed in accordance with WSA Code which is the current accepted design standard. Property Service drains (which convey waste from the household fixtures to the property boundary) are designed in accordance with AS/NZS 3500:2003 - National Plumbing Code. These codes have developed numerous design features to manage the potential impacts of operational problems.

The most significant problem which could occur in a gravity system is that the sewer becomes blocked, leading to overflows. Blockages are most frequently the result of tree roots entering into the sewer via cracks or poorly constructed joints. This problem will be dealt with by:

- Use of uPVC or HDPE pipe, which is unlikely to crack (cracks allow entry of tree roots). uPVC also enables a more reliable joint pressure to be maintained between the pipe wall and the rubber ring joint (joint pressure is an integral component in the strategy to prevent root penetration)

- Pipe joints constructed to prevent entry of tree roots. T his is achieved by either using rubber jointing rings that have been impregnated with root inhibitors, or by making the joint with solvent cement

Access to the sewers is provided by manholes and access shafts which have are designed to allow for:

- a remotely controlled CCTV camera to be inserted into the sewer to enable routine inspections to be carried out

- jetting tools to be inserted into the sewer to clear blockages

- maintenance operators to be able to observe flow in sewer without need for entry

The plumbing code requires that each landowner install an overflow relief gully. This ensures that if a blockage occurs in the property drains sewage will overflow outside the house rather than inside. Construction of this device, if not already installed, is the landowner's responsibility.

3.4.6 Pumping Stations – Gravity Collection Areas

General

A number of pump stations will be incorporated into the Mangawhai Ecocare sewage collection system. Earth Tech will be constructing a total of 10 pump stations within the pre 2001 developed area of which 8 will be located in the Heads area and 2 in the Village.

In addition, further pump stations will be constructed to service new estate developments as follows:

- 2 within the Anchorage Estate, and
- 1 within the KSR Farms Estate
- 2 others for new developments between the village and the heads

Other pump stations will be constructed in the Jack Boyd Drive area by developers when development occurs in this area, for which developers will seek any necessary consents.

The following sections describe the design principles built into the pump station designs and the operational principles that will apply to ensure successful operation.

Design Principles

The pump stations consist of conventional submersible sewage pumpsets set into a wet well.

Each pump station will be fitted with 2 pumps. One pump will operate as the "duty pump" and the other will be on "standby" in readiness to activate in the event of the failure of the duty pump. Both the duty and the standby pumps will have the same capacity.

The pumps will be operated such that after each pump cycle, the pump acting as the duty (or standby) pump will swap to standby (or duty) for the next pumping cycle. Hence neither pump is inactive for long periods of time. This approach ensures that in the event a failure of the duty pump, mechanical failure of the standby pump as well would be unlikely.

Security of Power Supply

For effective operation of pump stations consideration needs to be given to the potential for loss of power in the locality. Earth Tech staff have consulted with officers of Northpower to establish the nature of the power supply to Mangawhai.

Northpower provided historical data that showed that nearly 60% of power supply interruptions over the past 3.5 years were classified as “transient”. Under these conditions, the fault resolves itself and the period of interruption is minimal.

The remaining 40% of power supply interruptions are classified as “sustained”.

A detailed breakdown of the faults is presented below:

Table 3-4: Power Fault Types

Fault Type	Number over 3.5 years	Period of Interruption
Transient	31	momentary
Sustained	7	Less than 1 hour
	7	1 to 3 hours
	9	3 to 4 hours
Total	**54**	

The longest period of interruption was 4 hours and this particular interruption was confined to an area consisting of 9 houses. In only 2 instances did a power outage affect more than 50 houses simultaneously.

For most customers the period of interruption is less than the periods indicated above. This is because the fault can be identified quickly and isolated from surrounding areas. This allows most customers to have power supply restored with little delay.

Northpower has a depot in Maungaturoto which is 40 minutes from Mangawhai. As a result response times are relatively quick.

Contingency for loss of Power

Each pump station has the capacity to store sewage for 12 hours in an emergency. (The design of emergency storage facilities is detailed in a subsequent section.) Based on the details of faults provided by Northpower, the emergency storage capacity is expected to be adequate.

To provide contingency for extreme events, each pump station switchboard is capable of being powered by a mobile generator. The generator will be housed permanently in Mangawhai. In the event that an alarm signal is received indicating loss of power to a pump station, the generator will be towed to the relevant pump station to activate the pumping.

Given that 12 hours storage is available at each pump station, ample time is available to move the generator between various pump station sites in the event that multiple (or even all) pump stations lose power.

Mechanical Failure

Pump failure can also be as a result of mechanical failure.

The availability of 12 hours emergency storage allows Earth Tech's operators ample time to investigate the cause of any fault and restore service.

In many instances, various pump stations will have similar pump duties. This allows pumps to be temporarily moved from one pump station to another in order to allow repair work to be undertaken. Nevertheless, it is extremely unlikely that both the duty and standby pumps in the one pump well would fail together.

Also each pump station will have a temporary bypass pumping connection point. This will allow a suction pump to be brought to site and connected to the rising main without need for operators to enter the wet well.

Emergency Storage

The provision of emergency storage shall be achieved (under normal conditions) within the pump stations and adjacent sewers and manholes. The storage provided within the pump station wet well and adjoining sewers/manholes is referred to as "On Line Storage"

Should the additional storage be required to ensure that the desired volume of storage is provided, a separate storage tank will be provided adjacent to the pump station. This additional storage is referred to as "Off Line Storage".

Calculation of storage volume has been based on the following parameters:

- Storage volume equal to Average Dry Weather Flow over 12 hours.
- Storage volume being the volume of sewage required to raise the level in the pump station from the "Duty Start" level to the "Spill Level".
- Spill Level has been determined as the lowest of the following:
    - 200mm below the underside of the pump station cover slab, or:
    - The level of the lowest property connection sideline in the catchment.

The requirement for the spill level to be lower than the lowest property connection sideline prevents spillage of sewage into private property in the event of failure of the pumps or temporary loss of power supply.

The Spill level is the level at which sewage flows from the pump well into the “Off Line Storage” tank.

Detailed calculations have been carried out to determine the size of each storage tank. The details of emergency storage provided at each of the pump stations are presented in Tables 3-5 and 3-6 below:

Table 3-5: Mangawhai Heads Pump Stations

	Pump Station Reference	A	B	C	E	F	G	H	J	Outfall
	Location	Lincoln Street	Cheviot Court	Sea Breeze Estate	Heather Street	North End of Retirement Village Site	Alamar Crescent	Claude St & Wintle St	Wintle St east of Pearl St	Thelma Road & Molesworth Drive
	Volume Calculations									
	Storage in Pump Well (litres) =	8,469	4,776	12,420	10,467	15,271	14,150	11,661	8,875	25,769
	Storage in Sewers adjacent to Pump Well (litres) =	5,390	1,094	10,585	958	15,039	22,278	2,738	4,398	6,949
	Storage in Manholes adjacent to Pump Well (litres) =	1,814	0	9,407	523	4,674	12,530	11,775	1,948	3,562
	Total On line Storage Available (litres) =	**15,673**	**5,870**	**32,411**	**11,948**	**34,985**	**48,958**	**26,174**	**15,221**	**36,279**
	On Line Storage capacity required for 12 hours detention (litres) =	28,980	13,860	42,840	28,980	44,100	214,200	27,720	30,660	71,820
	Offline Storage Required for 12hour detention (litres) =	13,307	7,990	10,429	17,033	9,115	165,242	1,546	15,439	35,541
	Offline Storage Tank Sizing									
	Maximum Level in Pump Well to avoid overflow (m) =	2.15	17.42	24.72	31.72	16.4	3.54	3.5	10.91	13.9
	Pump Start Level (m) =	0.02	16.22	21.6	29.09	14.24	0.77	0.57	8.68	11.85
	Storage Operating Range (m) =	2.13	1.2	3.12	2.63	2.16	2.77	2.93	2.23	2.05
	Offline Storage Tank – (Piped Storage Option)									
	Top of Pump Station Level =	2.68	19.53	24.72	31.72	17.44	3.54	3.94	10.91	13.96
	Depth to top of pipe =	0.53	2.11	0	0	1.04	0	0.44	0	0.06
	Piped Storage Operating Range (m) =	2.13	1.2	3.12	2.63	2.16	2.77	2.93	2.23	2.05
Adopted Dimensions	Diameter =	2.05	1.2	1.8	2.25	1.8	2.55	0.9	1.5	2.05
Adopted Dimensions	Length of Pipe Required (m) =	4.03	7.06	4.10	4.28	3.58	32.36	2.43	8.74	10.77
	Actual Depth to top of pipe =	0.61	2.11	1.32	0.38	1.40	0.22	2.47	0.73	0.61
	Offline Storage Tank – (Tank Storage Option)									
Adopted Dimensions	Depth =	2.13	1.2	3.12	2.63	2.16	2.77	2.93	2.23	2.05
Adopted Dimensions	Plan Dimensions (m^2) =	6.25	6.66	3.34	6.48	4.22	59.65	0.53	6.92	17.34
Adopted Dimensions	Square Tank - inside wall =	2.50	2.58	1.83	2.54	2.05	7.72	0.73	2.63	4.16
Adopted Dimensions	Circular Tank - diameter =	2.82	2.91	2.06	2.87	2.32	8.72	0.82	2.97	4.70

Table 3-6: Mangawhai Village Pump Stations

Pump Station Reference		VA	VB	VC1	VC2
Location		Molesworth Drive	Moir Street	Insley Street (Anchorage Estate)	Anchorage Estate Internal
Volume Calculations					
	Storage in Pump Well (litres) =	24 hours storage provided at each Grinder Pump Well. No additional storage required at the Major Pump Station.	To be designed as part of developer works for KSR Farms Estate	To be designed as part of developer works for Anchorage Estate	To be designed as part of developer works for Anchorage Estate
	Storage in Sewers adjacent to Pump Well (litres) =				
	Storage in Manholes adjacent to Pump Well (litres) =				
	Total On line Storage Available (litres) =				
	On Line Storage capacity required for 12 hours detention (litres) =				
	Offline Storage Required for 12hour detention (litres) =				
Offline Storage Tank Sizing					
	Maximum Level in Pump Well to avoid overflow (m) =	N/A	To be designed as part of developer works for KSR Farms Estate	To be designed as part of developer works for Anchorage Estate	To be designed as part of developer works for Anchorage Estate
	Pump Start Level (m) =				
	Storage Operating Range (m) =				
Offline Storage Tank – (Piped Storage Option)					
	Top of Pump Station Level =	N/A	To be designed as part of developer works for KSR Farms Estate	To be designed as part of developer works for Anchorage Estate	To be designed as part of developer works for Anchorage Estate
	Depth to top of pipe =				
	Piped Storage Operating Range (m) =				
Adopted Dimensions	Diameter =				
	Length of Pipe Required (m) =				
	Actual Depth to top of pipe =				
Offline Storage Tank – (Tank Storage Option)					
Adopted Dimensions	Depth =	N/A	To be designed as part of developer works for KSR Farms Estate	To be designed as part of developer works for Anchorage Estate	To be designed as part of developer works for Anchorage Estate
	Plan Dimensions (m^2) =				
	Square Tank - inside wall =				
	Circular Tank - diameter =				

3.4.7 Alarms

Each pump station is equipped with a comprehensive set of non-audible alarms which notify Earth Tech's Operations Team of conditions such as:

- duty pump has failed to started
- standby pump has failed to start
- five minutes of system storage remains before overflow could occur
- duty pump failed to stop at low level (viz: risk of burn out)

Earth Tech's Operations Team will reside in Mangawhai, hence they can respond to the alarm immediately and remedy the problem.

All alarm signals as well as pump station status data will be relayed through a telemetry interface which will be located at the Mangawhai Water Reclamation Plant. An auto alarm dialler system will send a telephone message to the operators via a pager. An 'on call' roster will be established so that one person will be available 24 hours a day to respond to alarm call outs as and when they occur. In the event that the operator who has been rostered "on call" fails to respond or resolve the problem, the auto alarm dialling system will automatically notify a second operator that the alarm has not been adequately resolved. In the event of continued lack of operator response, the auto alarm dialling system will progressively work through a hierarchy of staff until an operator is on site dealing with the issue.

Earth Tech's Asia Pacific Operations Manager will have direct access to telemetry data from its Melbourne office. This allows management the ability to ensure that operation staff are adequately responding to call outs. In particular:

- should a particular operator fail to adequately respond to a call out in a timely manner, management are alerted and steps can be taken to improve staff responsiveness or investigate any underlying issues
- If local operators deactivate alarms, the Melbourne office will be alerted immediately. The alarm will then be reactivated remotely by Earth Tech's Melbourne staff

3.4.8 Overflow Control

The overflow connection between the pump well and the emergency storage tank is designed to control the passage of floatable solids.

The overflow pipe which connects the pump well to the emergency storage will draw sewage from below the overflow level. Initially a small quantity of floatable material will be drawn into the overflow pipe when the sewage rises to the level of the pipe inlet. As sewage continues to rise in the pump well all other floatable material will be contained in the pump well. Once the overflow level is reached, the sewage which enters the emergency storage will be largely free of floatable matter.

A similar philosophy will apply for the emergency storage outlet so that sewage additional separation of floatable material from sewage occurs. Thus any sewage that cannot be contained in the emergency storage will be free of floatable material.

3.4.9 Maintenance

In order to maximize the performance of the pumps, a regime of routine inspections will be implemented for each pump station.

This would include:

- Fortnightly visual inspections of each pump well
- Six monthly removal of pumps from well for routine servicing
- Major servicing at times as recommended by the pump manufacturer

The fortnightly visual inspections would allow operators to ensure that accumulation of fats or rags (which may lead to blockages in pumps) is not occurring.

The six monthly routine serving of the pumps will ensure that mechanical performance is maintained.

In addition to the above, records of the pump operating hours will be kept for each pump station. Monitoring of trends will be undertaken to provide early warning of anomalies within the system.

3.4.10 Pumping Stations – Grinder Collection Areas

As described in the reticulation section of this document, some 330 houses are serviced by a “Low Pressure Sewer System” also known as a “Grinder System”.

Each property serviced by the Grinder System will have its own Grinder Pump Station on the property. Each Grinder Pump Station is fitted with its own warning light which will operate when a system fault occurs. These faults include:

- Failure of pump to start
- Failure of pump to stop
- Sewage level rising in wet well above predetermined level
- Loss of power to pump station

In the event of failure, each grinder pump well has 24 hours emergency storage capacity. In addition given that the wells only service a single property, landowners would be able to manage their own sewage generation habits to ensure that sewage overflows do not occur. Landowners would be able to call Earth Tech’s local operations team to site to remedy the problem.

Each grinder pump will have the same duty. This allows Earth Tech to keep a stock of spare pumps in store which can be installed at any property as a replacement for the original pump.

Earth Tech will undertake periodic maintenance of the pumps in accordance with the manufacturer's guidelines.

3.4.11 Rising Mains

Rising mains operate under pressure. Detailed analysis of pressure conditions, including the effect off waterhammer will be undertaken to ensure that a suitable class of pipe is chosen to prevent bursting of the pipe wall.

The rising mains will be tested after completion of construction to pressure well in excess of the maximum operating pressures to ensure that construction has occurred to the required standards.

Pipes are designed to have a life of excess of 100 years and fatigue calculations are undertaken to verify the long term ability of the pipe material to withstand the fatigue inducing impacts of continual changes in pressure as pumps turn on and off.

Whilst bursting of sewage rising mains should not occur, alignment selection takes into account the consequence of a burst. As a general rule, rising mains are located on the higher side of a road reserve so that any leakage does not drain into private property.

3.5 Waste water treatment plant

3.5.1 The site

The waste water treatment plant (WWTP) will be located in the west corner of “Mangawhai Park”.

The west corner has been nominated as the area where the treatment plant will be least conspicuous in regard to future park activities and public aesthetics.

The plant has been sited with a 70m wide buffer strip of dense re-growth vegetation. The buffer strip is on the south side between Thelma Avenue and the treatment plant site. To the west of the site lies 100 m of low scrub which is prone to flooding and a steep sand ridge which forms the boundary of Mangawhai Park and the Golf Club. The footprint of the WWTP will be 65m x 75m. (See location plan Section 3.2.2).

The site is on a gently sloping area which is vegetated by re-growth of native and exotic species. The dominant feature is the large pine trees which grow on the south and west perimeters of the treatment plant site.

The elevation of the site is approximately 14m above sea level.

Access will be via the access track into this area from Thelma Avenue.

3.5.2 Geotechnical description of the site

Tonkin and Taylor were commissioned to undertake a geotechnical survey of the sub-strata at the site[5]. They were instructed to report on the suitability of the site with regard to bearing pressures, differential settlements and effects on, and of, the water table. Four boreholes to 12m were drilled and two piezometers installed. Results indicated that the sub-strata consisted of fairly uniform silty and clayey sand overlain with approximately 200mm of top-soil. The water table was detected some 5m below ground level.

The piezometers will be used to monitor both the water table and the groundwater quality.

No large excavations will be undertaken at the site and it is not anticipated that material will be required to be removed from site. The topsoil and excavated surplus material will be used in the site landscaping works.

[5] Tonkin and Taylor Limited, Mangawhai Waste Water Treatment Plant Geotechnical Investigation Report, June 2006. (Refer Appendix 2)

Natural drainage of the site is generally south towards Thelma Avenue and west to the swamp area beside the golf course. Non-work areas of the treatment plant will continue to drain naturally. Work areas will have stormwater captured and pumped to the inlet works for treatment.

3.5.3 Proposed works

The proposed treatment plant comprises:

(1) Pre-treatment works

(2) A biological treatment process known as the Cyclic Activated Sludge System (CASS) process

(3) Granular filtration

(4) Disinfection

(5) Sludge storage and digestion.

(6) Sludge dewatering.

These elements of the treatment plant are described below:

Pre-treatment works

Pre-treatment works comprise 3 mm aperture screening, with washing of the screenings. The purpose of this process is to remove non-biodegradable material which may cause blockages of equipment (mainly pumps) or loss of reactor volume if it accumulates.

The recovered screenings will be washed thoroughly in a ‘Washpactor’, which is a washing machine for screenings. This will ensure maximum recovery of organics from the screenings, thereby reducing the putrescibility and volume of the material for disposal. The recovered organics are returned to the process for treatment.

CASS Process

CASS™ is an adaptation of the well-established activated sludge process developed by Fowler, Ardern, Lockett and Mumford at Manchester, England in 1914. The activated sludge process provides an aerobic environment using aeration which is controlled in such a way as to encourage naturally occurring floc forming micro-organisms to proliferate. These micro-organisms are capable of relatively rapid and extensive treatment of wastewater, including by absorption, and form a floc with excellent settling properties under quiescent conditions, thereby allowing separation of the micro-organisms from the treated effluent by settlement.

The activated sludge process removes particulate and dissolved organic matter, and can be readily adapted to grow organisms which will oxidise ammonia to nitrate (nitrification). The activated sludge can further be modified to reduce the nitrate to nitrogen gas (de-nitrification). In conventional activated sludge processes, settlement takes place in a separate tank from the aeration stage of treatment. The settled micro-organisms are returned from the settlement stage to the aeration stage of the process in a controlled fashion to maintain the population of micro-organisms available to undertake treatment.

Sequencing batch reactors (SBRs) arrange the steps of aeration and separation of floc and effluent into one basin by separating the processes in time. Fowler, Ardern, Lockett and Mumford's original work was based on sequencing batch reactor principles but during the early part of the 20th century, the SBR concept proved too labour intensive and the conventional activated sludge process, with separate aeration and settlement tanks, found favour. However, thanks to the development of simple PLC control systems, the concept of operating a single reactor basin using repetitive cycles of aeration, settlement and discharge of treated effluent was well established by the late 1970s. Further refinements of SBR processes took place mainly in Australia and the United States, including the incorporation of a "pre-react zone" or selector within the SBR to control filamentous sludge bulking in 1978.

CASS™ is a further development of the basic SBR process and incorporates an internal selector with a controlled rate of return sludge to promote good sludge settleability and a robust and highly developed design of decanter. In the CASS™ process, a simple repeated sequence of aeration and non-aeration is used to provide aerobic, anoxic and anaerobic process conditions, which in combination with the aeration intensity, favour nitrification, de-nitrification and biological phosphorus removal.

The essential features of the CASS™ process are the plug-flow initial reaction conditions and a complete-mix reactor basin. Each CASS™ reactor basin is divided by baffle walls into three sections (Zone 1: selector, Zone 2: secondary aeration, Zone 3: main aeration). For typical domestic wastewater treatment applications, these sections are in the approximate proportions of 5%, 10%, and 85%. Sludge biomass is continuously recycled from Zone 3 to the Zone 1 selector during cycle fill phases to remove the readily degradable soluble substrate and to encourage the growth of floc-forming micro-organisms. System design is such that the sludge return rate causes an approximate daily cycling of biomass in the main aeration zone through the selector zone.

The mechanisms of Zone 1 and the internal sludge recycle eliminate the requirement for separate fill-ratio selectivity, anoxic, and anaerobic mixing periods. The selector is self-regulating for any load condition and operates under anoxic and anaerobic reaction conditions during non-aerated periods. Denitrification and enzymatic transfer of available substrate during enhanced biological phosphorus removal is also achieved in the selector zone.

The complete-mix nature of the main reactor provides flow and load balancing and a tolerance to shock or toxic loadings, and the process prevents solids washout during peak or wet weather hydraulic surges.

CASS™ utilizes a simple repeated time-based sequence which incorporates:

- Fill-aeration (for biological reactions)
- Fill-settle (for solids-liquid separation)
- Decant (to remove treated effluent)

Completion of these three operations constitutes a process cycle which is then repeated. Typically, the cycle above would last a total of four hours for treating normal domestic wastewater.

During the period of a cycle, the liquid level inside the CASS™ SBR reactor basin rises from a set bottom water level in response to a varying influent wastewater flow rate. Aeration ceases at a predetermined period of the cycle to allow the biomass to flocculate and settle under quiescent conditions. After a specific settling period, the treated effluent supernatant is removed (decanted), using a moving weir decanter. This operation returns the liquid level in the reactor basin to the bottom water level and the process cycle begins again.

Surplus solids are removed as required to maintain the biomass mixed liquor suspended solids (MLSS) at the required level. Solids removal after settling enables waste sludge concentrations in excess of 10,000 mg/L to be removed.

Fill - Aeration

The fill-aeration (react) operation refers to the air-on time of the process cycle. During this period, influent wastewater is received into the CASS™ basin through the selector zone where it contacts with the biomass recycled from the main aeration zone. Complete-mix reaction conditions occur during this time.

Dissolved oxygen is a necessary requirement for the biological oxidation reactions which take place with the CASS™ process. Residual dissolved oxygen occurs when the micro-organisms in the biomass do not take up all of the available oxygen. Too much dissolved oxygen in the CASS™ process is wasteful of energy and may inhibit biological nutrient removal.

A simple control method has been developed to ensure optimum biological reaction conditions take place and energy is not wasted.

A dissolved oxygen probe is used to measure changes in biomass oxygen demand. For example, a reduction in the oxygen load demand to a CASS™ basin will automatically cause a lowering of the aeration intensity (air supply) so that excessive dissolved oxygen concentrations are prevented. Conversely, an increase in load demand will cause an increase in aeration intensity so that the metabolic activity of the biomass, as registered by its propensity to use oxygen, is matched with the corresponding aeration intensity rate of air feed into the reaction basin.

The process control system interacts with the dissolved oxygen probe in each basin for to control the flow of air into the process. Low oxygen demand caused by low loadings during diurnal period or other variations can be directly matched to energy use. The biomass senses the oxygen requirements which are needed for the process and causes interaction with the rate of introduction of air into the reaction basin.

Fill – settle

This refers to the first part of the air-off period when quiescent settling conditions are created in Zones 2 and 3 to allow solids-liquid separation. The activated sludge solids progressively fall to the floor of the basin. The flocs adhere together and the mass settles as a blanket, leaving a clear supernatant.

During the initial settling period, the sludge undergoes internal flocculation and a sludge interface forms and settles as a blanket. Initial slow settling velocity increases and then gradually falls off due to the compressive accumulation of solids on the basin floor. Settling velocity is a function of the initial solids concentration, basin depth, total area of the basin and nature of the biological solids. A top water level solids concentration of around 3,500 mg/L will typically settle to form a layer of sludge having a mean concentration of around 10,000 mg/L.

CASS™ facilities are sized and configured to operate with inflow into the basin during the settle phase of the cycle. Biomass is returned from the main aeration zone to the selector zone to promote selectivity and create anoxic/anaerobic conditions.

Decant (effluent removal)

Inflow to the basin undergoing decanting (effluent withdrawal) is interrupted and directed to an alternate basin in a multi-basin facility or stored in a pump-well in a single basin facility. Treated effluent is removed from the basin using a driven overflow weir decanter. The decanter is fabricated almost entirely from stainless steel with no parts below water level requiring routine inspection or maintenance. All components that may require inspection or maintenance are easily accessible from the access gantry at walkway level.

The weir trough of the decanter is situated above top water level for both aeration and settling phases to prevent mixed liquor suspended solids contaminating the inside of the decanter during aeration. When operated during the decant phase of the cycle, the decanter travels at an initial fast speed. Interaction with the liquid level is detected by a simple conductivity probe, which causes the decanter to proceed at a slower rate of travel, producing a constant rate of discharge of treated effluent from the basin. On reaching a pre-determined bottom water level, the decanter is reversed to its rest position.

The decant speed of the decanter is calculated based on the actual volume of water to be decanted from the basin. In this way, virtually all of the decant phase can be used for effluent discharge. This maximises the total settle time (i.e., fill settle plus decant) and also minimises the interval between decant events.

Idle

In practice, decanting will often be less than the allocated time available. This residual time is designated as IDLE and can be used as a period of inflow without aeration or reaction. The IDLE sequence begins 4 minutes after the decanter has travelled in to its resting position and finishes at the end of the designated decant period. Biomass is recycled from Zone 3 to the selector zone to promote selectivity and create anoxic/anaerobic conditions.

In-basin equipment

In addition to the dissolved oxygen probe and the decanter as previously described, each basin contains two small submersible pumps. One pumps return activated sludge (RAS) back to the inlet selector zone and the other pumps waste activated sludge (WAS) out of the basin at the end of the cycle, when the solids content of the settled sludge blanket is at its maximum.

Each basin also contains one ultrasonic level instrument to monitor the basin water level (see Wet Weather Flows below).

Wet weather flows

Wet weather flows are catered for by reducing the duration of the process cycle to enable more process cycles (and hence more batches of wastewater) to be treated per day.

For the Mangawhai CASS™ plant, the normal flow cycle will last for a total of four hours, as follows:

Fill aerate	120 minutes
Fill settle	60 minutes
Decant	60 minutes

When flow conditions require, the CASS™ control system will automatically reduce the cycle phase durations to 75% of their normal flow values to produce a three hour cycle, as follows:

Fill aerate	90 minutes
Fill settle	45 minutes
Decant	45 minutes

Each basin contains an ultrasonic level detector which continuously monitors the basin water level. If the basin water level against time indicates that there is a risk of the basin being over-filled, the control system will automatically initiate the three hour high flow cycle as detailed above. When flow conditions permit, the control system will automatically revert to the four hour normal flow cycle.

Peak and off-peak seasons

During the off peak season, one cell will be removed from service. The cell will be aerated during a transition period of around six weeks as solids in the cell are reduced until there is no significant risk of odour.

Prior to the peak season, the cell will be re-commissioned using aerobic micro-organisms from the sludge storage and digestion tank.

Granular filtration

Granular filtration will be provided after the CASS™ process to polish the effluent by removing around 90% of particulate matter. This will remove helminths and those pathogens which are attached to solids, thereby improving the efficiency of the disinfection process.

Removal of particulate matter will also provide some supplemental removal of nutrients (organic N and P forming part of the cellular mass in volatile solids carried over in the effluent).

Disinfection

The disinfection standards adopted are those of the probable end user of the milk produced by dairy cattle grazing the irrigated pasture. Fonterra has adopted the following in relation to human effluent to pasture[6]:

'We have been able to identify through Dr Jim Barnett a level of treatment after which it is acceptable to spread the treated waste to pasture for grazing by dairy animals that supply milk to Fonterra, or pasture that is to be harvested for feeding to these animals.

Treatment equivalent to the Title 22 of the California Health Law has been adopted.

The standard of acceptable treatment is summarised as:

- *Sewage or sewage derived material can only be applied to pasture destined for consumption by dairy cattle if it has been secondary treated and disinfected.*
- *Secondary treatment requires a process producing an oxidised effluent (i.e. the organic matter in the sewage has been stabilised and contains dissolved oxygen).*
- *The degree of disinfection required is based on the residual total coliform bacteria in the water. The median concentration of total coliform bacteria must not exceed a most probable number (MPN) of 23 per 100mL (based on a 7 day period) and the maximum number in any one sample over a 30-day period must not exceed an MPN of 240 per 100mL.*
- *A management plan must be developed for where sewage is applied to a dairy farm.*

We continue to accept:

1. *Sub-surface placement of effluent not treated to the above standard.*
2. *Incorporation of effluent not treated to the above level, into soil, the growing of crops for harvest then sowing pasture for grazing.*

Our suppliers have been updated on our position.'

[6] Pers. Comm, Shane Lodge, Field and Technical Services Manager to CEO, Northland Regional Council 4 July 2005:

These requirements will be complied with by using post-treatment granular filtration and disinfection designed for the above standard.

The required disinfection standard is Faecal coliforms <23/100ml. This will be achieved with sodium hypochlorite or ultra-violet dosing.

Sludge Storage and Digestion

Biological treatment processes can be thought of as conversion processes, whereby the pollutants targeted for removal are converted to energy to sustain micro-organisms, and additional micro-organisms. The solids generated are removed in a controlled fashion as part of the process of controlling the CASS™ process.

Removed solids are kept in an aerobic environment in the sludge storage and digestion tank, pending removal. Aeration will manage the risk of odours, and will promote further decomposition of the solids.

Some solids will be retained in the tank to facilitate re-commissioning of cells prior to the peak season.

Sludge Dewatering

Thickened sludge will be dewatered by means of a mechanical belt press.

3.5.4 Mitigation measures for WWTP

Odour

Control of odour is necessary at the WWTP only in relation to the inlet works, where effluent is transferred from the settlement's reticulation system into the plant. At this point hydrogen sulphide from the reticulation system will be released. Control of odour will be established by a housing around the structure, and through entrapped air being sucked through a mulch bed.

Plant controls

Plant controls and alarms will be grouped into categories according to their urgency. Category One alarms will be those requiring immediate attendance, and Category Two alarms will require attendance within a few hours, whereas Category Three alarms can be attended to during the next routine site attendance.

In general, all motors will have motor status monitored through the SCADA system. Motors or units that are critical will have duty-standby units provided. This will cover the influent screens, transfer pump sets and blowers (where one standby unit will be provided). Transfer of duty to a standby unit will generally raise a Category Two alarm or in some cases, a Category One alarm.

Noise

The plant has been designed to comply with the noise provisions of the underlying Rural zone, as set out in section 2.5.5.2 Noise Emissions of the district plan. However, since the plant will operate 24 hours per day, compliance with the night-time limit is the relevant limit: 40 dBA L_{10}, and a 70 dBA L_{max} from 10pm to 7am at or within the boundary of any site zoned Residential, or within the notional boundary of any dwelling on a site in the Rural, Coastal or Maori Purposes zones.

Compliance will be achieved by a mix of siting of the plant in a position some 6m higher than the nearby dwellings and by acoustic enclosures. The aeration blowers have the potential to cause adverse noise effects. Therefore the blower building enclosure will be acoustically dampened and acoustic enclosures will surround each blower, if necessary. A 1.5m bund will be constructed in the treatment plant area parallel to Thelma Road, although it is unlikely to be necessary given that nearby residences are located approximately 6m lower than the WWTP itself.

3.6 Disposal

3.6.1 Introduction

Disposal is necessary for the three elements of the treatment process: inlet screenings, sludge, and treated effluent.

The disposal system will be comprised of two elements, a dam for winter storage and an irrigation system for the spray irrigation of treated effluent during the period of soil moisture deficit over the summer months.

The winter storage will be located on the south side boundary of the property. This storage dam of 110,000 cubic metres will be located on top of a ridge, so that a ‘turkey’s nest’ dam will be created. The dam will have depth of approximately 5m and will cover an area of approximately 300m east-west and 140m north-south. The final dam configuration will be such that a balance of cut material to fill material will be achieved. The inner surface of the dam may be lined with a 1.6mm thick high density polyethylene lining to ensure that leakage does not occur and also to protect the batters from erosion. The dam wall will be keyed into the founding material.

Inlet screening

The inlet screens at the commencement of the treatment process remove material which is greater than 3mm in size. Objects such as plastics, wood, false teeth etc are removed at the commencement of the process, washed to remove organic material, and deposited in plastic bags for removal to land fill. These objects are called screenings and one or two rubbish bags per day would be expected for these arisings.

Sludge

Sludge produced at the plant will be thickened to approximately 12 -14% solids and loaded into a truck skip by conveyor. The plant will produce 400 kg of sludge per day during the summer peak and approximately one third of this quantity during the off peak season.

This sludge will be removed by a local contractor who is licensed for removal and disposal of sludge. Preliminary negotiations have been held with Mc Jimray Septic Tank Cleaning Services from Wellsford. This company has a licensed treatment facility on its farm.

Treated effluent

Various disposal options have been considered and are set out in Section 5. This section deals only with the selected option of disposal to land.

Effluent produced at the plant will be stored on site in a large transfer tank. The effluent will be pumped generally at off-peak times at night, from the tank through an estimated 250mm diameter pipeline to the disposal site north of Hakaru on the Lincoln Downs property.

The following section considers first the selection of the effluent disposal site, and then deals with the three components for treated effluent disposal:

- a delivery pipeline,
- a winter storage dam, and
- an irrigation network.

3.6.2 The Effluent Disposal Site

Spray irrigation of treated effluent is the proposed method of disposal. Spray irrigation will be controlled by the soil moisture deficit method.

Although models other than the soil moisture deficit method are available, the soil deficit model is the preferred option as it will ensure that no discharges are made to watercourses. In the New Zealand climate, the soil deficit model will require storage of the treated effluent in a dam at the disposal site for discharge during the summer months.

The effluent disposal site that has been selected will be located at Lincoln Downs, a 248 hectare property situated on the west side of Brown’s Road, north of Cook’s Creek, in the Hakaru area, 10 km west of Mangawhai. The council has an option to purchase the property, as the LGA 2002 requires that councils own the land and infrastructure associated with wastewater management.

By way of clarification, during the selection of potential properties an assessment was made with the assistance of a local real estate agent of all properties that were for sale or potentially for sale within a 25km radius of Mangawhai. The Lincoln Downs property was considered the most suitable available. It became the subject of the RMCG report[7]. Subsequently other landowners showed interest in the potential of land disposal (see below) and these are likely to provide the additional land disposal sites that will be required as the overall discharges from the sewerage scheme increase.

Lincoln Downs ranges from gently undulating hills on the cleared area to quite steep slopes for the bush areas (refer plan titled "Mangawhai Ecocare Water Storage and Reuse Area: Inferred Groundwater Flow Contours" prepared by Tonkin and Taylor at Appendix 4). The land is comprised in seven titles. Two titles consisting of a total area of 138 hectares are bush covered hill country in the northern portion of the property. The remaining five titles consist of a total area of 110 hectares of developed dairy pasture.

3.6.3 Geotechnical description of site

The soils are classified as Class IVe5 with a sliver of Class IVs3 adjacent to Brown Road. These soils[8] are weakly to moderately leached Northern yellow earths of the Omu, Omanaia and Puhoi suites and are reported as deriving from Dacites and Tangihua volcanics as well as sedimentary complexes, and expressly not from limestone lithologies.

The geology is also described in the Tonkin and Taylor report dated August 2006[9] notes the geology derives from the Northland Allochthon rock mass which is generally clay rich and which has low permeability in sharp contrast to the unweathered parent rock mass which is at a shallow depth. This report further notes that the mudstone lithologies are prone to shallow creep and the dacite derived soils have low permeability silts.

Tonkin & Taylor's on site investigations confirm the NWASCO findings on soils for the re-use irrigation area. Of the 10 boreholes, 9 were representative of the Northland Allochthon revealing completely weathered light brown and occasionally orange/brown very stiff soils to a maximum depth of 3.8 m, with the 10th hole containing Parahaki volcanics.

The site for the proposed dam is also situated on weak Northland Allochthon rock consisting of pervasively sheared inter-bedded mudstone and sandstone with isolated pods of sheared limestone and the residual soils derived from the parent rock mass. This geology means that the dam site will be comprehensively investigated and that the final dam configuration will be engineered around the results of this investigation by Tonkin and Taylor. Its report is attached at Appendix 4.

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[7] RMCG, Mangawhai Treated Wastewater Disposal/Reuse Lincoln Down (Lees and neighbours properties), April/May 2006. Appendix 3

[8] NWASCO Sheet N28

[9] Tonkin & Taylor, "*Mangawhai Ecocare Project Hydrogeological Investigation – Water Reuse Area*", September 2006

3.6.4 Hydrogeology

Tonkin & Taylor also conducted permeability testing August 2006 in shallow and deeper boreholes. The calculated permeabilities range between 3.9×10^{-3} m/day and 1.3 m/day for the shallow bores and the deeper bores were between 3.9×10^{-3} and 9.9×10^{-1} m/day. .

Deep groundwater at the re-use site has also been tested and is found to be typically sodium and bicarbonate dominated. Shallower groundwater tended to be sodium and chloride based. Nitrate-nitrogen concentrations were well below the standard. Two shallow and one deep borehole exceeded the NZ Drinking Water Standards for analytes, and E coli and faecal coliforms were present in all samples.

In terms of the groundwater system the Tonkin & Taylor report observed an unconfined shallow system at the sites located in the silts and siltstones, which has a potential for upwards vertical flow from depth. All boreholes had groundwater at a depth of 4 m below ground surface. Groundwater flows north and south from the ridge in the southern part of the site. The testing results also indicate that there is no evidence of artesian pressures in the monitoring wells. Groundwater recharge is expected to be from rainfall in the topographically higher ridges around the re-use site.

In addition, the agricultural consultant contracted by Earth Tech to advise on the project, Donn Armstrong, undertook a reconnaissance survey of the property and reported as follows:

> *The effluent disposal irrigation system will be located on the 110 hectares of the existing dairy enterprise. This country has easy rolling contours between 40 and 80m above sea level. The irrigation network, comprising about 50ha can be readily constructed within this area.*
>
> *The area has a temperate Northland climate with rainfall averaging 1,400mm per annum. The property is moderately sheltered on the pastoral land from the prevailing south-westerly or north-easterly winds.*
>
> *The dairy enterprise has a dwelling, associated shedding and a 20 a-side herringbone milking shed, all of which are in average condition. The property currently produces 75,000 kgm of milk solids from 250 cows. There are currently two large earth dams and an irrigation system which waters approximately 20 hectares of pasture. Internal access around the property is by a network of limestone roads. The limestone has been quarried on site with a limestone pit on the western boundary of the property[10].*

[10] RMCG op.cit.

3.6.5 Proposed Works for Effluent Disposal

Parameters of the re-use scheme

Flows produced by the scheme are projected to be 140,000m^3/annum in year 2008, 184,000m^3/annum in year 2014 and 284,000m^3/annum in year 2023.

Initial design of the storage and irrigation portions of the scheme will be for the year 2014 flows. The reason for this is that both irrigation area and storage volume can be readily up-graded to accommodate increased flows. Also Mangawhai is currently undergoing a dynamic transition and future flows are difficult to predict.

Secure base for re-use irrigation scheme

The property required as the base for a re-use scheme is required to have the following characteristics:

- Proximity to the treatment plant to minimize capital costs of the delivery pipeline. Pumping costs for the Ecocare scheme are approximately $1,000/annum/km of pipeline and therefore relatively insignificant.
- A net area of irrigable land to be of the order of 50 hectares minimum. Half of the gross area will be used as buffer areas where the irrigation area adjoins the site boundary and streams. Therefore minimum property area required is 100 hectares.
- Suitable topography for irrigation. Slopes of 1 in 8 are the limit in steepness for irrigation; erosion can be a factor with steeper country.
- Soil type and hydrogeology must be such that underlying aquifers are not adversely affected.
- Suitable location and soil type to locate and construct a large storage reservoir.

A secure disposal site is required because costly infrastructure in the form of a delivery pipeline and a large storage dam must be constructed.

It is anticipated that demand for the reclaimed water will increase as community perception of the value of this commodity increases. Experience elsewhere indicates that this is the likely scenario. However the secure base should provide the irrigation area required for the first 3 or 4 years of operation. After that additional willing recipients of the treated effluent will be sought, contingent upon obtaining the appropriate resource consents, and adhering to the disposal site environmental plan.

Locating the secure base

Fifteen properties were appraised within a 25 km radius of Mangawhai. The Lees property, Lincoln Rise and Lincoln Downs, was selected as the most suitable of these. The property, Lincoln Downs, consists of

110 hectares of dairy pasture of which at least 50 hectares is suitable for re-use irrigation. The elevated portion of the property, Lincoln Rise, consists of 138 hectares and has 20 hectares of irrigable pasture on the ridge lines and bush over the remainder of the property. Lincoln Rise would be suitable for a nature reserve and for provision of public space or for sub-division and selling as lifestyle blocks.

Verifying the secure base

Rob Rendell, an irrigation consultant, and Donn Armstrong, a local agricultural advisor, were engaged by Earth Tech to report on the suitability of the Lees property for irrigation re-use. It was recommended that the most suitable re-use irrigation crop would be pasture used for dairy farming and they determined that 50 hectares of irrigable land was available on Lincoln Downs for re-use irrigation. Its reports are appended at Appendix 3.

RMCG determined that the irrigation demand of dairy pasture in this area is 4.1 ML/hectare/annum. In an average year this volume is needed over the four summer months. Irrigation is not required at any other time of the year. This irrigation rate was arrived at after an analysis of daily climate data for North Hakaru for the years 1960 to 2004. This rate was confirmed by analysing the irrigation records and equipment of local farmer, Bill Bygrave, who irrigates a dairy property adjacent to the Lees property.

Soil deficit irrigation

Soil deficit irrigation is used by Earth Tech to ensure that run-off and excess seepage do not occur with the reclaimed water. This irrigation method allows irrigation only when the soil is dry. Irrigation does not proceed for the 24 hours immediately after, or immediately preceding, a rainfall event. Therefore not all of the irrigation requirement of the pasture is satisfied. Approximately 75% of the irrigation demand of 4.1 ML/hectare/annum will be provided by soil deficit irrigation on Lincoln Downs. The irrigable area required is calculated for a demand figure of 3.1 ML/hectare.

Soil moisture will be measured through potentiometers located at suitable positions on the property.

Therefore 45 hectares are needed for the start-up flows in the initial years of Ecocare. The Lees property has 50 irrigable hectares on Lincoln Downs and a further 20 hectares on Lincoln Rise and this will provide security of operation until year 2014.

Controls on reclaimed water irrigation

The treatment process at the WWTP will produce reclaimed water which will conform to the following parameters:

- BOD <10mg/L,
- SS <10mg/L,
- Total N <30mg/L,

- P <10mg/L,
-
- TDS 600mg/L,
- Faecal coliforms <23organisms/100mL.

All irrigated water will be processed through the surface soil layer and through the vegetation. The nutrients in the water supply approximately 50 per cent of the nutrient requirements of the pasture. Although reclaimed water can also contain viruses, they are eliminated quickly in soil that is not saturated.

Dairy export requirements

Fonterra requirements for irrigation of pasture with reclaimed water from sewerage effluent relate to the bacteria count in the reclaimed water. The requirement is that reclaimed water contains less than a median value of 23 faecal coliforms/100mL.

Raw sewage into the treatment plant contains of the order of 10 million e-coli organisms/100ml. At completion of the aerated microbiological process the treated effluent will contain less than 10,000 organisms/100ml sample. The treatment process will be supplemented with multi media filtration and ultra violet light dosing or hypochlorite dosing of the treated effluent. The reclaimed water pumped from the treatment plant will then contain approximately 5 E-coli organism/100ml sample.

The high quality of the reclaimed water will conform readily to the export requirements.

Size of storage facility

RMCG carried out a modelling exercise with monthly 2014 projected flows into the storage reservoir and with the 35 years of monthly rainfall records as the basis for rainfall requiring storage in the reservoir. The model indicated that a storage capacity of 110,000m^3 is required as the volume where no spills will occur due to under-capacity of the storage. In Australia, a spill is generally allowed once every 10 years due to the storage having insufficient capacity. Applying a similar release to the Ecocare scenario would result in the required storage being reduced to 100,000m^3.

The Ecocare scheme is designed on the basis of no spills occurring, although a resource consent is being sought for this remote possibility.

A suitable site for a storage reservoir of 130,000m^3 capacity has been selected. A geotechnical report has been prepared for the proposed dam and is attached as Appendix 7.

The sizing of the proposed storage facility will be large enough to take the projected flows up until year 2014. At this date provision of additional capacity may be necessary to accommodate flows up until 2023.

The initial 110,000m^3 storage dam that is the subject of this application will cope with all combinations of weather patterns, carry-over volumes and inflows such that there is no discharge to the environment until after year 2014. At this time the projected flows will have increased such that there is the possibility of a spill (a controlled discharge to lower the storage level). Therefore in 2014 another storage dam will be required in order to accommodate treated effluent flows up until 2023 without the likelihood of a spill. This calculation is based on current flow projections, while the design parameters for storage volume modelling are based on North Hakaru rainfall records going back 35 years (to 1967).

In anticipation of the 2014 requirement for another storage dam, a site which will accommodate a major storage has been identified in the central north area of Lincoln Downs.

3.6.6 Delivery Pipeline

Design basis

The design basis of the delivery pipeline is as follows. The delivery pipeline will be sized for projected flows for year 2023.

Pipeline route

- South from the treatment plant along Thelma Road, south-west along Molesworth Drive to the Estuary Estate;
- Within the Estuary Estate;
- Along Old Waipu Road on unmade section and thence the trafficable section near Cove Road;
- Cove Road from Old Waipu Road to Tara Road;
- Tara Road from Cove Road to the southern boundary of land owned by D. Wintle;
- D. Wintle property along south boundary within existing race and thence along western boundary;
- R. Brunt property along the northern edge of paddocks used for maize cropping;
- W and C Bygrave property; and
- Brown Road from Bygrave property to Lincoln Downs

The length of the pipeline is approximately 10.8km.

Negotiations with affected landowners are underway. Access to private property will be undertaken in terms of the provisions of the Local Government Act 2002, which sets out a consultation, access and compensation framework for infrastructure such as sewerage.

The route has been chosen because it lies within the road reserve as much as possible. It is also considered to be the most economical route for construction of a pipeline and will cause less interference with the public than alternative routes. Other routes considered were Mangawhai-Kaiwaka Road, Tara Road (lower), Cove Road, including a pipeline under the a watercourse near the estuary; Tara Road (upper). A discussion of the alternatives considered is contained in Section 5 of this report.

Pipeline specification

The effluent will generally be pumped during the off peak power period in the evening. Peak wet weather flows will require pumping for longer periods.

The pipeline will consist of 250mm diameter ductile iron or Class 16 PVC rubber ring joint pipe. The pipeline will be designed with air valves at local high spots and scour valves at appropriate low points.

Stop valves will be located at suitable intervals along the pipeline. The stop valves will allow isolation of sections of the pipeline should a break occur or should maintenance be required.

Effluent in the pipeline will be elevated 65m to a high point 80 metres above sea level. The high point is on Tara Road. The pipeline then will fall 35m to the Hakaru River flats before rising again by 35m for discharge into the winter storage.

The pipeline will be graded with minimum cover of 600mm in protected areas. Backfilling will be done with the excavated material except where crushed rock backfill is called for along road shoulders and under vehicle crossings. The pipeline in these areas will be covered with 1200mm fill.

An unspecified quantity of material will be surplus to backfilling in the trenching areas. This will be taken to the dam site for incorporation in the winter storage embankments. Material from off-site which is used in the storage dam will be added to the outside of the embankment batters. Surplus material will be placed on the outside of the dam batters such that the geometrical effect will be the reduction of the outer slope of part of the batters. The dam is designed on a cut to fill basis with a slight theoretical excess of cut to allow for variations in compacted volumes. Therefore unsuitable fill will mixed with surplus material from the dam site and sloped against the batters.

The pipeline will have mauve marking tape placed in the backfill to indicate that it contains effluent. Markers will be installed along the route in appropriate positions.

3.7 Winter Storage Dam

3.7.1 Background

It is proposed to construct a storage dam for the reclaimed water produced in the Ecocare scheme. The storage is to be located at Lincoln Downs which is a dairy property that KDC is purchasing for the purpose of securing an irrigation property and of obtaining a secure location for the storage asset.

The storage asset has been sized initially at 110,000m^3. This size will accommodate all projected flows, annual carry-over volumes and rainfall patterns up until year 2014 without discharge to the environment. This is based on annual flows to the dam site of 184,000m^3 in 2014. The water balance in the storage has been calculated on a monthly basis utilizing rainfall records for the local area and projected flows from the Mangawhai Reclaimed Water Plant. The rainfall records extend back 35 years from 2002.

It is anticipated that an additional storage will be needed from 2014 to cope with projected increased flows of reclaimed water. The projected increase in capacity will be sized to provide the system with no spills up until 2023.

The no spill scenario is based on all combinations of projected flows, rainfall ingress to the storage and allowable irrigation windows - all as modelled by consultants RMCG in their attached irrigation viability study of the property.

3.7.2 Design basis

Design flows that have been considered are those projected for year 2014 (184,000 m^3). It is considered unwise to project storage flows beyond this date. There is considerable flexibility for a variety of re-use proposals after commissioning of the scheme and the rate of growth in Mangawhai is unknown. The secure base at Lincoln Downs is able to accommodate an additional storage dam should it be required in 2015, although new irrigation sites would have to be located, the Lincoln Downs site being sufficient for the period until 2014.

Analysis of 30 years of rainfall records and modelling of the volumes of effluent within the storage dam on a daily basis has been carried out by irrigation consultants RMCG.

The details of their modelling work for various irrigation and ground condition regimes are contained in the appended RMCG report (Appendix 3). The recommendations from this research are:

- That a 100,000m^3 storage dam is required, with one spill occurring every ten years. This is generally accepted in Australia where the rainfall patterns are not conducive to flushing away of effluent.

- That a 110,000m^3 storage dam is required if no spills are to occur. This is considered restrictive and unnecessary for this part of New Zealand which has high rainfall and high run-off. The high run-off acts as a flushing agent which would mitigate the effects of any spill to the Hakaru River.

3.7.3 Location

The storage is located on top of the ridge which extends from behind the Lincoln Downs homestead across to the western extremity of the property. The axis of the storage runs approximately 300m along this ridgeline. The western end of the storage is approximately 100 metres from the western boundary of Lincoln Downs and approximately 100 metres south east of the limestone quarry which is located on the western boundary of the property.

The width of the storage plus embankments is approximately 140 metres running in a north-south direction across the ridgeline.

Access to the dam site is via Brown's Road to Cook's Creek and then west along Hope Road to the limestone quarry. The site is then accessed from the limestone base farm track which commences at the limestone quarry. There are two gates to open and shut.

3.7.4 Topography

The top of the ridge is relatively flat with the north and south facing ridges sloping away at grades of up to 10 degrees. The only vegetation that is present is pasture grasses.

The top of the ridge is at elevation 80m and the ridges fall away to lower levels of approximately 60m.

3.7.5 Dam specification

The dam would be constructed in a balanced cut-fill configuration. The northern wall would be cut into the southern down-slopes on the site to a depth of approximately 5m. The volume excavated will form the adjacent east and west walls and the opposing south wall. Its area will be about four hectares. The dam walls will be sloped at the geotechnically correct angle which will be approximately 1 vertical to 3 horizontal. The walls that consist of fill material will be keyed to the base with a drained shear key.

There will be an outward sloping 3m wide road on top of the walls. All external run-off will be channelled away from the dam.

The inside of the dam may be lined with 1.6mm thick high density polyethylene should permeability of the dam material be insufficient to prevent seepage and should the inner wall lining be unsuitable to prevent wave erosion.

Water storage of 110,000m^3 is based on requirement for 2014, after which another dam will be required.

3.7.6 Storage Dam Geometry

The internal dam dimensions are approximately 250 ms in length and 70 m in width at the base. The embankments have inner and outer slopes of 3 horizontal to 1 vertical. The top of the embankment is an access road of nominal 3 metre width.

The dam base is at level RL 74 m and the top of embankment is at RL 80 m. The shear key which is located at the toe of the embankments is approximately 4 metres deep and 13 metres wide at the base.

3.7.7 Construction Methodology

The first operation will be removal of topsoil from the dam area. The topsoil will later be reused on the outer dam batters. Topsoil will be pushed down to the lower extremity of the earthworks and left, until embankment construction is completed, in a continuous mound which rings the complete dam excavation area. The height of this mound will be of the order of 2 metres given an average 70 m push and 100mm thickness of topsoil. This continuous mound of topsoil will entrap runoff from the disturbed area of the site. A 20mm rainfall event over the 4 hectare site will result in a precipitation volume of 800m3 which, with 75% runoff and an equal split to the north and south, will result in 300 m3 of runoff east and west. Therefore 4 containment ponds within the topsoil mound will be located on each of the north and south sides. These ponds will be sculpted into the topsoil mound which encompasses the site. Sediment will be trapped in these ponds and the entrapped water will be pumped onto the natural pasture to drain away at the end of the rainfall event after sedimentation has occurred. In the event of overflows, silt curtains will be installed across the hillsides just below the topsoil mounds. These curtains will not be continuous but will be located in the lower areas. Silt entrapped against these curtains will be recovered and blended into the embankment fill material.

After removal of topsoil, the embankment shear key will be excavated and the excavated material will be conditioned and compacted into the embankment adjacent to the shear key.

The shear key slot will provide additional protection against runoff from the site as any runoff will be captured within the slot which is always close to the outer perimeter of the earthworks.

When the excavation and proving of the shear key slot is proceeding satisfactorily, then bulk excavation of the decomposed siltstone from the storage innards will proceed. This will be conditioned inside the storage area as necessary and compacted within the shear key slot and the storage embankments. This operation will continue at depth through the decomposed siltstone and into the sheared and fractured siltstone area until the storage founding depth is attained.

All of the earthworks will be carried out inside the outer ring of mounded topsoil and generally within the protective barrier of the shear key slot excavation. Any runoff and sediment movement outside of the storage area will be minimized with this method of construction.

On progressive completion of the storage embankments the adjacent topsoil mound will be pushed back over the outer batter, compacted lightly, seeded with grass and fertilized. The previously installed silt curtains will be removed just prior to this operation occurring. Silt trapped by the silt curtains will be recovered and blended into the embankment below the topsoil.

Construction work will be executed and completed to the quality nominated in the relevant NZ standards and carried out during the earthworks season between 1st October – 1st May unless directed otherwise by Northland Regional Council.

3.8 Irrigation Network

3.8.1 Existing network

The irrigation system at Lincoln Downs will be replaced as necessary.

3.8.2 Design basis

The 110 hectares of Lincoln Downs available for spray irrigation has been surveyed by RMCG and an underground fixed sprinkler has been nominated as suitable for effluent irrigation. Approximately 50 hectares of Lincoln Downs is suitable for effluent irrigation by the fixed sprinkler system. The fixed sprinkler system is relatively expensive but it provides the optimum coverage and has the best control of the commonly used systems.

RMCG has been engaged to carry out a full irrigation network design for the property.

The design allowed for a 15m buffer strip along boundaries and streams and is also set up to be in excess of 150m of any dwelling.

3.8.3 Other irrigation options

There is already interest in the re-use of effluent produced at by the waste water treatment plant.

The Mangawhai Golf Club has expressed interest in irrigating in summer with effluent produced from the plant. The golf course has been investigated and a requirement of 40,000 m^3 [approx] has been identified. This irrigation would take place in summer from a by-line from the main discharge line. The volume used on the golf course would have no effect on the size of the winter storage but would reduce the area of farmland required for disposal by approximately 13 hectares. This would be 25% of the total area initially required. In other words, locating further disposal sites would be delayed by the availability of the golf course site.

A farmer adjacent to the Lincoln Downs property, Bill Bygrave, has also expressed interest in using the treated effluent for irrigation. A brief investigation of his properties has indicated that there is sufficient area and suitable topography for the use of all of the effluent produced from the Mangawhai scheme for the foreseeable future.

Similarly, an examination of the irrigable land of another adjacent landholder has indicated that this property also has suitable topography for effluent irrigation.

The intention therefore is to negotiate with adjacent farmers for the use of land for the disposal of effluent for irrigation within their existing irrigation networks. This option could provide the Council with some flexibility for delaying expenditure on the fixed sprinkler disposal system on Lincoln Downs. Each landowner joining into the spray irrigation programme will be required to adhere to an environmental management plan, the prototype of which has been developed for the Lincoln downs site[11], see Appendix 5.

There is sufficient irrigable land at Lincoln Downs, 50 hectares, for the first three years of operation of the Mangawhai scheme. This area will require supplementation in the future.

3.8.4 Mitigation Measures

The disposal system is to be designed in accordance with the NZ Guidelines for Utilization of Sewage Effluent of land, a two-part manual to assist persons who design, consent, manage or monitor land treatment systems for municipal or domestic waste water in New Zealand [12]. This document provides guidance on the design, management, operating and monitoring of land treatment systems. Part 1 provides a guide to the overall process involved in designing, gaining resource consents, and setting up management systems. Part 2 provides supporting information, serving as a technical reference on key issues related to designing, operating, and monitoring land treatment systems.

Earth Tech engaged RMCG Pty Ltd to undertake an assessment of the options of disposing or reusing waste at the Lincoln Downs site and other neighbouring sites. It examined a limited range of possible land-uses, tenure arrangements, and land areas, including, for example, irrigated steeply contoured forest, bush areas with normal irrigation and bush areas with continuous irrigation, and privately held pasture with existing irrigation equipment. The RMCG report used in part the process set out in the Guidelines.

The design process set out in the NZ Guidelines has fourteen steps to be followed. These are as follows:

Feasibility Assessment

1. Establish decision-making and consultative framework
2. Characterise sewage
3. Identify potential land uses and candidate land areas
4. Estimate land area requirements

Site Selection

5. Identify and screen potential sites
6. Conduct initial field investigations

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[11] Earth Tech Engineering Limited, Ecocare Reclaimed Water Irrigation Scheme: Lincoln Downs Site Environmental Management Plan, Draft Version A, July 2006. See Appendix 5

[12] NZ Land Treatment Collective and Forest Research, NZ guidelines for utilisation of sewage effluent on land, 2000

System Design and Assessment of Environmental Effects

7. Design the land treatment system

8. Analyse potential environmental effects

9. Conduct field investigations and evaluate soils

10. Determine system management and monitoring

11. Prepare cost and return estimates

Final Design and Implementation

12. Finalise site, irrigation system, site management and crop

13. Obtain resource consents

14. Prepare final design specifications and costings

The RMCG report provided detailed information on steps 2 – 5 and sufficient information on one site (Lincoln Downs) for steps 7 – 11 in order to proceed to step 12, that is, to finalise the site, irrigation system and site management and crop. This may appear as a somewhat truncated process, but was realistic when the limitations for disposal and of land available for sale were considered.

3.8.5 Water Quantity

The RMCG report estimated inflows for the period 2006 – 2023 as follows:

2006 138,000m^3

2008 148,000m^3

2014 184,000m^3

2023 280,000m^3

The proposed design flow was based on inflows to 2014 and the project will be initially staged for 184,000 m^3 [13]. A monthly inflow distribution was also estimated.

Two models are available in the Guidelines for calculating hydraulic loading:

- Soil deficit model

[13] The staging element relates in particular to the CASS tanks at the waste water treatment plant, where initially two will be constructed, with provision for a third as demand increases. During off-peak periods, use of the CASS tanks will reduce to one of two tanks.

- Wet weather limited depth

Because of the limitations of landuse capability at the site, both of these models were considered in terms of two only land-use regimes, existing bush and pasture for livestock grazing. However, the limitations of the Lincoln Downs soils were such that the wet weather limited depth model is unacceptable at this site. The soil deficit model was therefore selected even though the storage requirements were calculated as being significantly greater.

3.8.6 Water Quality

The proposed water quality is as follows:

- Micro-organisms <23 Faecal coliforms/100mls
- Salinity 500-600mg/L
- Nitrogen 30mg/L
- Phosphorus 10ml/L

The receiving environment of dairy pasture requires nutrients N and P. The elevated levels of nutrient (above) will satisfy approximately 50% of the nutrient demand of the pasture.

3.8.7 Health requirements

The treated effluent is Category II (<200 faecal coliforms/100ml) in terms of the Department of Health Guidelines section 8.2 Table A, and is considered suitable for

> *Irrigation of public amenities for example, sports fields, public parks, golf courses, play grounds. Irrigation of crops for human consumption which will be peeled or cooked before being eaten, orchards where dropped fruit is not harvested, industrial or non-edible crops.*[14]

The typical requirements are no public access while land is being irrigated and treatment by conventional biological oxidation or equivalent with tertiary disinfection.

In practice the treated effluent will be Category 1, less than 10 faecal coliforms per 100ml and the sole restriction on its use is that crops cannot be harvested when wet with irrigation water.

[14] Department of Health, *Public Health Guidelines for the Safe Use of Sewage Effluent and Sewage Sludge on Land*, 1992.

3.8.8 Buffer distances

The Guidelines indicate that buffer distances can be determined on a site by site basis. However, it also advised that in areas of high wind exposure, design computations should be prepared to demonstrate the likely wind drift of spray from the irrigation area. Buffers would be based on these. Otherwise buffers to dwelling houses would be 150m, and 15m if the irrigation is in forest or shelter belts. Given the lack of public access, the RMCG report recommends a 15m buffer.

Buffer distances to watercourses

The requirements for buffer distances to water courses depend upon:

- Water micro-biological quality
- Nutrient loadings
- Likelihood of run-off

By using the soil deficit model, the suggested buffer distance to water courses is 20m. Under the soil deficit model irrigation is applied to meet plant demand; that is, managed to ensure no over-irrigation. In addition, the micro-biological quality of the treated effluent will be high, and nutrient loadings will be less than what would be required for normal dairy pasture. In addition, operational practices can be maintained to minimise run-off. These will include not irrigating before and 24 hours after rainfall.

3.8.9 Salinity

The salinity of the effluent is classified as Category 2 under Australian guidelines[15] and is suitable for most crops if a moderate amount of leaching occurs. These Australian guidelines assume twice the irrigation application rate and about 1/3 of the rainfall compared to New Zealand; thus the guidelines exaggerate the risk at the site.

Therefore, because of the lower application rate that is a consequence of the higher rainfall, the risks are as low as outlined in section 3.3.4 of the NZ Guidelines.

3.8.10 Nitrogen

The proposed N application rate (kg/ha) is approximately 60kg/ha, for an application rate of 3,000m^3/ha/year. The rates would be considerably less than plant uptake and are considered a very low application rate. Combined with the relatively impermeable subsoil as discussed in the Tonkin & Taylor

[15] See RMCG report App 4. Table A4 1 Salinity Classes of Irrigation Water is drawn from Guidelines for Wastewater Irrigation, (EPA Victoria, Publication No. 168, 1991)

Report August 2006, the risk of contamination to groundwater is very low. Note also that these rates are less than the ARC dairy discharge rates of 150kg/ha or more depending on soils[16].

The risk to surface waters would also be negligible in the case of deficit irrigation.

3.8.11 Phosphorus

The proposed application rate for P is 20kg/ha for an application rate of 3000m^3. This is considerably less than the requirements for dairy pasture. On dairy farms typically ~20 – 40kg/ha would be applied. The application of P in small amounts during each irrigation phase also means less likelihood of P entering waterways via run-off than in the case of farm fertiliser applications. Therefore the efficiency of this method of application of P is much greater than normal agricultural practice; and waterways and surface waters are protected from surface runoff.

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[16] Auckland Regional Council, *Auckland Regional Plan: Farm Dairy Discharges*, May 1999. Rule 6.2.1 provides as a permitted activity for the discharge of dairy sludge and/or farm dairy wash water onto or into land which complies with a range of conditions. These include, 6.2.1.1 *The application rate of nitrogen from any combination of dairy sludge, farm dairy wash water and nitrogenous fertiliser shall be:*

a. At a rate not exceeding the equivalent of 150kgN/ha/year and 30kgN/ha/day in the following areas:

i. those areas underlain by Aeolian sands (Awhitu, Kaipara, Tapora, Pakiri, Omaha Flats);…OR

b. At a rate not exceeding the equivalent of 200kgN/ha/year and 50kgN/ha/day, on low permeability clayey soils of low vulnerability due to poor groundwater quality/yield. …

Explanation: The daily application rate is based on maximum recommended nitrogen application rates for pasture growth which minimise leaching rates of nitrates to soil water. This also assumes that the total nitrogen content of wet sludge is 0.166% and that 50% of the applied nitrogen to pasture is the mineralised organic fraction immediately available for plant uptake.

Further, the associated condition 6.2.1.2 requires, *Farm dairy wash water and dairy sludge shall be spread in a manner and in places which ensure that run-off does not result at any time.*

3.8.12 Other toxicants

Almost without exception the risks posed by the above factors to the environment were deemed to be either low or very low. Mangawhai effluent consists of domestic sewage with a very small proportion of industrial or trade waste content. Heavy metals, boron and aluminium are generally not of concern in domestic sewage.