4.1 Introduction

A range of regional resource consents are required for the parts of the project, as well as a designation for the waste water treatment plant by the Kaipara District Council. Table 4-1 summarises the consents that it is considered are required for the construction and operation of the proposed sewerage scheme, including s139 certificates of compliance where it is deemed useful to obtain these.

Table 4-1: Summary of consents or s139 RMA Certificates of Compliance to be obtained for Project

	Aspect of project	Section of plan	Status of application	Assessment criteria
Regional Water and Soil Plan for Northland				
1.	Discharge of treated effluent at Lincoln Downs site	15.3.1	Discretionary	36.1
2.	Discharge of treated effluent to a water course	15.3.2	Discretionary	36.1
3. or see below	Unintended discharges from pump stations; or see below	15.2	Controlled	36.1
3a.	Unintended discharges from pump stations that do not meet controlled activity consents	15.3.4	Discretionary	36.1
4. or	Use of water in a dam that is not in a stream or riverbed or lake	24.01.05	Permitted	Permitted provided *'no more than minor adverse effects on the environment'*
4a. or	Use of water in a dam that is not in a stream or riverbed or lake; or see below	24.3.3	Discretionary	36.2
4b.	Use of water in a dam that is not in a stream or riverbed or lake; also (must consider both operative plan and proposed plan change)	Proposed Plan Change 1 24.01.05b	Permitted subject to standards of 23.01.04	N/A as permitted, but refer to standards in 23.01.04
5.	Diversion and discharge associated with land disturbance activities	22.03.01	Discretionary	36.4
6.	Structures (other than dam structures or weirs) in, on, under or over beds of rivers and lakes	29.03.01	Discretionary	36.3
7. and	Land disturbance and trenching in road reserves	33.02.01	Controlled	33.2
7a	Land disturbance activities associated with the construction of a dam	33.02.01	Controlled	33.2
8.	Land disturbance and trenching in road reserves and other locations in Riparian Management Zone	34.03.01	Discretionary	36.4

	Aspect of project	Section of plan	Status of application	Assessment criteria
9. or see below	Diversion and discharge of stormwater by way of an open constructed diversion system or piped system into water or into land where it might enter water	21.01.02	Permitted subject to standards	Refer standards in 21.01.02
9a.	Diversion and discharge of stormwater by way of an open constructed diversion system or piped system into water or into land where it might enter water which does not meet the permitted activity standard	21.02.01	Controlled	Subject to compliance with standards in 21.02.01
10. or	Diversion and discharge of stormwater from WWTP; or if permitted activity standards not met, see below	21.01.01	Permitted subject to standards	Refer Standards in 21.01.01
10a.	Diversion and discharge of stormwater from WWTP;	21.03.01	Discretionary	36.4
Regional Air Quality Plan for Northland				
11. or	Dust from earthworks	9.1.4	Permitted subject to conditions. Apply for a certificate of compliance for methodology, if possible	
11a.	Dust from earthworks	9.3.2	Discretionary where conditions to permitted activity not met.	12.2 – General assessment criteria 12.4 - Dust
12.	Operation of the sewerage scheme in its entirety (reticulation, pump stations, WWTP, and disposal area)	9.3.2	Discretionary	12.2 – General assessment criteria 12.7 - Odour
Regional Coastal Plan for Northland				
13.	Pipelines crossing coastal marine area	31.3.4 m	Non-complying	32.1 General criteria 32.2.1 – Specific criteria relating to structures
Kaipara District Plan				
14.	Waste water treatment plant	Designation	Notice of requirement under 168 RMA	

	Aspect of project	Section of plan	Status of application	Assessment criteria
15.	Pipes for conveying sewage and pump stations; or see below	10.6.1	Permitted in Rural, Coastal, Maori Purposes, Residential, Commercial and Industrial zones subject to standards	Permitted activity Standards: reinstatement, height of structures, size, location, landscaping, floodlighting, noise emissions, radiofrequency radiation, parking
15a.	Pipes for conveying sewage and pump stations where permitted activity standards not met;		Discretionary (Rural, Residential, Commercial, Coastal, Industrial, Maori Purposes,	
16.	Structures (e.g. the disposal dam structure)	2.5.2, 10.6.1	Permitted	
Other Regulatory Considerations				
17.	S338 Local Government Act 1974		S338 Council may grant right to lay … pipes along or under road	Council resolution to grant right to lay pipes for any purpose in the district under or along any road
18.	Reserves Act 1977		Construction on land with reserve appellation	Area at northwest edge of Heads – designated for recreation reserve, owned by KDC; underlying zoning Coastal. Sewer likely to be located in area of unformed road.

4.2 Notification

Consideration of the provisions of s93 to 94D of RMA is not considered necessary in the case of the proposal as the Northland Regional Council has indicated that the applications for proposed reticulation, treatment, and disposal system will be notified; although this would not apply to applications for certificates of compliance.

In addition, the Notice of Requirement to designate the waste water treatment plant would be either publicly notified by the Kaipara District Council at the same time as the regional council applications for consent, or notified by Northland Regional Council on behalf of Kaipara District Council.

4.3 Operative Regional Water and Soil Plan for Northland

4.3.1 Consents required

The entire sewerage system falls within the definition of industrial or trade process in the Plan (Section 41),

> *Industrial or trade premises – means*
>
> *a. Any premises that is used for any industrial or trade purposes; or*
>
> *b. Any premises used for the storage, transfer, treatment, or disposal of waste materials or for other waste-management purposes, or used for composting organic materials; or*
>
> *c. Any other premises from which a contaminant is discharge in connection with any industrial or trade process –*
>
> *but does not include any production land.*

Thus it would appear that the rules in Chapter 20 would apply. In that case under 20.3 the activity would be a discretionary activity. However, a note to Rule 20.1 2 that relates to small quantities of waste states that,

> *Any discharge that only contains human effluent or sullage water, or animal effluent from an industrial or trade premise (sic) shall be dealt with under section 15 and section 16 respectively of this Plan.*

Note that sewage, treated effluent, secondary treatment, tertiary treatment are separately defined in Ch 41 of the plan,

> *Sewage – the liquid wastes of a community, including toilet wastes, sullage, trade wastes.*
>
> *Treated effluent – Effluent which has undergone some physico-chemical and/or biological change.*

Secondary treatment – the further treatment of primary treated effluent which involves either anaerobic or aerobic biological or chemical or physical treatment which removes the bulk of organic contaminants.

Tertiary treatment – further treatment of biological or chemically treated secondary treated effluent to further remove contaminants such as nutrients, organic matter, and micro-organisms. It involves physical processes such as adsorption, absorption and filtering.

However, in order to comprehend the Regional Plan it seems that the following must be assumed: although there are separate definitions of raw sewage, primary, secondary and tertiary treated sewage in Section 41 Definitions, the references in Section 15 to sewage effluent mean all forms of treated sewage. Otherwise there would seem to be no provisions in the plan for the discharge to land of sewage effluent that has been treated to varying degrees of intervention. A reading of the household-scale provisions of Section 15.1.1 – 4 supports this interpretation. Thus the discharge of treated effluent to the Lincoln Downs site would be a discretionary activity under Section 15.3.1,

The discharge of:

a. sewage effluent; or

b. sewage sludge;

into or onto land in a manner outside the scope of or unable to meet the conditions pertaining to the permitted activity Rules 15.10.01, 15.01.02, 15.01.03, 15.01.04, is a discretionary activity.

The volume under consideration at this stage would be only that in relation to discharges up to 2014, or 184,000m^3 per annum on the 50ha of suitable pasture at the Lincoln Downs property.

Although the proposal is couched in terms of no flows direct to a water course, through the maintenance of 20m margins to drains, streams or watercourses, and the immediate cessation of irrigation before and for 24 hours after a rainfall event during the summer months, and adherence to the soil deficit model, resulting in its storage for the rest of the year, there is still provision in the dam structure for a 5000m^3 discharge during high rainfall events[17]. Thus, should there be any prospect whatsoever of the discharge of treated effluent to a water course, a discretionary activity consent would be required under section 15.03. 02,

*the discharge of **treated sewage effluent** into a water course from a sewage treatment and disposal system provided that the water course does not flow into any dune lake listed in Schedule E.*

The explanation to Section 15.3.1 notes that any discharge to land which results in run-off to water via discrete flow paths, such as channels, drains or tracks, is considered to be a direct discharge to water.

[17] Earth Tech Engineering Pty Limited, Disposal Options Report, June 2006

In the alternative, the provisions of the s330 and 330A might apply. However, it would seem appropriate that the consent should be sought and any adverse effects of such discharges monitored during the first years of operation. The quality of the treated effluent will be high, in most cases higher than catchment-collected fresh water. Faecal coliforms will be <23 organisms/100mL after chlorination or UV treatment at the WWTP, and the mean time of storage in dam of five months which would see a further drop-off in human generated faecal coliforms. E. coli might go up over the period, however, as uncontrolled additions occur, for example, through ducks migrating to the site.

Holding a resource consent for an activity that is not likely to be exercised would thus be a prudent undertaking. A likely condition of consent would be the notification of the NRC whenever the consent was exercised or a periodic confirmation that no such discharges had been made. In addition, the consent should note the intention not to exercise the consent in order to avoid its lapsing.

4.3.2 Unintended discharges of sewage

The following discharge of sewage is a controlled activity under Section 15.2.1:

> *The unplanned discharge of raw sewage from a sewage pump station or contributing pipe network onto or into land or into water is a controlled activity provided that:*
>
> *a. Each sewage pump station in the sewerage system has an automatic control and alarm system that provides:*
>
> *i. Immediate notification of pump failure;*
>
> *ii. Automatic switching to a standby pump*
>
> *iii. Immediate notification of station failure to pump sewage;*
>
> *iv. Notification when a system overflow is imminent, where imminent is not less than five minutes;*
>
> *v. Power supply backup for the alarm system.*
>
> *b. Each sewage pumping station has at least one dedicated standby pump that will activate in the event of failure of the duty pump(s). The capacity of the standby pump(s) shall be at least equal to that of the largest pump in that station.*
>
> *c. The sewage pump station has a storage capacity of not less than 12 hours (based on the average dry weather flow) to reduce the frequency of overflows of sewage.*
>
> *For the purpose of determining compliance with condition c. the storage volume provided shall be that calculated from the pump high level alarm to the lowest point at which an overflow will occur, including any storage in the upstream reticulation.*

As a controlled activity it would be open to public or council to seek relocation if they were concerned about potential effects on receiving environment.

If the project is unable to comply with the above terms, it becomes a discretionary activity under Section 15.03.04,

> *The discharge of sewage from a pump station and pipe network onto or into land or into water that is unable to comply with the requirements of Rule 15.02.01 is a discretionary activity.*

4.3.3 Dam

In relation to the proposed 4ha 'turkey nest' dam (that is to be located on the top of a hill and thus will have no contributing catchment), damming and storage of the treated effluent will be undertaken, along with storage of rainfall falling directly into the dam. The rules for taking, damming and use are as follows:

> *24.01.05 The taking and use of stored water associated with*
>
> *a. The damming and diverting of runoff (but not stream flow) into a reservoir which is not in the bed of a permanently or intermittently flowing river or stream, and the taking and use of that stored water; or*
>
> *b. The storing of surface water in a reservoir and the unlimited taking of that stored water;*
>
> *is a permitted activity, provided that there are no more than minor adverse effects on the environment as a result of the activity.*

However, the explanation to the rule, while acknowledging that diversion may occur from outside the immediate catchment, notes that if the activity is small, it can be permitted without adverse effects. *Surface water* is, however, defined as,

> *All water, flowing or not, above the ground. It includes water in continually or intermittently flowing rivers, artificial watercourses, lakes and wetlands, and water impounded by structures such as weirs but does not include water while in pipes, tanks, cisterns, nor water within the Coastal Marine Area.*

Thus, notwithstanding that it is likely to be of higher quality than most dam water for agricultural purposes, it would seem that the permitted activity rule does not apply. If this were the case, the damming, diverting and use would be a discretionary activity under Rule 24.03.03,

> *All other takes*
>
> *Any other taking, use, damming or diverting of surface water which does not meet the requirements of the permitted activity rules, or is not covered by the non-complying activity rules, and is not otherwise covered by a rule in any other section of this plan, is a discretionary activity.*

Note that 24.01.05 is the subject of Proposed Plan Change 1 notified 18 March 2006. Submissions and cross-submissions have closed on the plan change, but hearings have yet to be held. In terms of the provisions of the RMA the council would take limited note of the new provisions and give more weight to the operative plan. However, the balance will change as the Plan Change progresses through its stages, as set out in s19 RMA.

Rule 24.01.05 is proposed to read,

24.01.04 Stored water

The

a. Damming and diversion of rainfall runoff (but not water from a river, lake or indigenous wetland) into a reservoir which is not in the bed of a river, lake or indigenous wetland, and the unlimited taking and use of that stored water; or

b. The diversion and storing of water lawfully taken under the permitted rules in Sections 24 or 25 of the Plan or by way of a resource consent, into a reservoir not on the bed of a river or lake, and the unlimited taking and use of that stored water;

is a permitted activity provided that:

a. the take, damming or diversion does not limit or prevent the ability of an existing lawful user to take water

b. the take, damming or diversion does not change the seasonal or annual range in water level of any indigenous wetland to an extent and manner that may adversely affect the wetland's natural ecosystem;

c. the take, damming or diversion does not affect the flow of water to any associated water body, or the water level of any indigenous wetland, to an extent and manner that adversely affects the water body's natural ecosystem;

d. Any discharge from the reservoir meets the requirements of Rule 23.01.04.

In addition, the explanation removes the reference to '… *Provided the scale of the activity is small, it can be permitted without adverse effects.*

The requirements of Section 23.01.01 referred to in Plan Change 1 are as follows:

a. The discharge does not contain concentrations of any contaminants that could have an adverse effect on aquatic life.

b. The discharge does not contain any exotic organisms.

c. The discharge does not increase the natural temperature of the receiving water by more than 3^{o} Celsius at or beyond a 10 metre radius from the discharge point.

d. The discharge rate is controlled so that it does not cause erosion of the land or stream channel, or flooding of properties below the discharge point.

e. The discharge does not cause the pH of the receiving water to fall outside of the range if 6.5 to 9.0 at or beyond a 10 metre radius from the discharge point.

f. The discharge does not cause the production of any conspicuous oil or grease films, scums or foams or floatable or suspended materials in the receiving water, at or beyond a 10 metre radius from the discharge point.

g. The discharge does not cause any conspicuous change in the visual clarity of the receiving water, at or beyond a 10 metre radius from the discharge point.

h. The discharge does not cause any emission of objectionable odour in the receiving water at or beyond a 10 metre radius from the discharge point.

The discretionary activity rule is also amended as follows to redefine slightly the title of the section but is not relevant here.

There is one only submission in opposition to this section of Plan Change 1, and NRC officers are of the view that the submitter will withdraw it when they realise that the submission seeks a further restriction (in circumstances where all of their other submissions sought loosening of the controls). The hearing is scheduled for late August, so that part of the Plan Change will likely be the effective document soon after.

4.3.4 Structures in, on, under or over the beds of lakes and rivers

Eight stream crossings are required for the proposed pipeline alignment. The rules for crossings are set out in Section 29 of the plan. At 29.01.06 the plan provides as a permitted activity for,

The use, placement, repair, maintenance, upgrading or alteration of …any water pipelines, in, on, under or over the bed of a river or lack, and any associated drilling, tunnelling or other disturbance … provided that:

a. Any new … water pipeline is not in, under or over the bed of a dune lake in any dune lake listed in Schedule E; or an indigenous wetland; or a river or section of river or lake deemed to have outstanding values in Appendix 18.

b. Is not regulated by Rule 27.03.02.

c. The activity complies with the environmental standards in 29.01.11.

The environmental standards of 29.01.11 are,

1. The structure does not prevent fish passage under any flow conditions.

2. *Any placement of a new structure from 27 October 2001 shall not take place within any indigenous wetland; and*

3. *The repair, alteration, use or removal of an existing structure shall not cause change to the seasonal or annual range in water level of any indigenous wetland to an extent that may adversely affect the wetland's natural ecosystem.*

4. *No activity or structure shall adversely affect any area of significant indigenous vegetation or significant habitats of indigenous fauna as defined in Appendix 13B of this plan.*

5. *The structure does not cause the diversion, damming or blockage of any river or stream.*

6. *The short-term visual clarity of any permanently flowing river or wetland shall not be reduced by more than 40 per cent, after reasonable mixing, due to sediment or sediment laden discharge originating from the site of the land disturbance activity.*

7. *There is no damage to, or restriction of the use of, any existing river or lake protection works, or any other lawfully established structure as a result of the activity.*

8. *There is not significant erosion of the bed of the river or lake as a result of the activity.*

9. *Any associated embankments are maintained to prevent sediment entering the river or lake.*

10. *No contaminants (including but not limited to oil, petrol, diesel, paint, pr solvent) are released into the water or to the bed of the river or lake from equipment being used for the activity, and no refuelling of equipment takes place on any area of the river or lake bed.*

11. *All demolition debris from the river or lake bed structure is removed from the site.*

12. *Existing lawful public access rights to an along rivers and lakes are not restricted.*

13. *The activity shall not interfere with or destroy any waahi tapu, as defined in the definitions, urupa or any other sites known to the local iwi that are of spiritual or cultural significance to Maori which have been identified to the council. Should archaeological remains or features be uncovered the activity shall cease and the regional council notified as soon as practicable. Also as soon as practicable the regional council will then notify the appropriate tangata whenua entity. The activity shall not be recommenced without the authority of the New Zealand Historic Places Trust.*

Notes to the rules are set out, including,

> *The structure must also meet the navigational and safety requirements of the Minister of Transport (Maritime Safety Authority) if the structure is on, or over the bed of a navigable river).*

Appendix 15 sets out the principles of fish pass design, although in this case where crossing should be perpendicular to, and generally below the bed of, the streams, this should not be an issue.

The various stream crossings do not comply with the permitted activity conditions, and the activity becomes a discretionary activity under 29.03.01;

> *Any activity otherwise restricted by s13(1) of the Act, which cannot meet the requirements for permitted, controlled or prohibited activity rules in Section 29 and falls outside of the scope of any other rule in this plan, is a discretionary activity.*

The notes to the rule indicate that discretionary activity consent would be required for any pipelines carrying liquids, other than water, over river or lake beds. This would seem to include treated effluent, no matter what the standard of treatment.

4.3.5 Land disturbance

The rules for land disturbance activities are set out in Section 33. These apply to the roadside earthworks of trenching (54km) and the construction of the dam. The WWTP site is not affected, as the site size and volume falls below the thresholds in 33.01.02. The volume of material and the construction timetable for the other aspects of the project makes the activity of trenching a controlled activity, as is the dam notwithstanding the volume (~70,000m^3) of material involved.

The matters over which the council will exercise control are:

1. *The adequacy of sediment and run-off control measures.*
2. *The location and extent of any earthworks.*
3. *The adequacy of the site rehabilitation and revegetation measures to control sediment discharge and adverse effects on soil conservation.*
4. *Information and monitoring requirements.*

4.3.6 Stormwater discharges and diversions from roads and from land disturbance activities

Section 22 sets out the stormwater controls related to roads and land disturbance. Since the land disturbance will not be a permitted activity, neither is the stormwater discharge consent to be obtained under the plan.

Under these provisions, diversion and discharge associated with land disturbance activities and stormwater from roads is a discretionary activity:

22.03.01 *the diversion and discharge of stormwater from any land disturbance activity or stormwater diverted by a discharge from roads that in any way fails to comply with*

Rules 22.01.01, 22.01.02, 22.01.03, and 22.02.01 of this plan are a discretionary activity.

Subsequent to completion, stormwater discharges from the WWTP site would be a permitted activity under 22.01.03,

The diversion and discharge of stormwater, not otherwise permitted by Rule 22.01.02 from any road or track into water or onto land where it may enter water is a permitted activity, provided that:

a. The road does not form part of a stormwater collection system that is designed to divert or discharge stormwater from any of the sources otherwise regulated by rules contained in Section 21 of this plan.

b. Water and sediment control measures (e.g. rock rip-rap, cut-off drains, sediment traps) are installed and maintained to avoid or minimise erosion and to avoid or minimise sediment discharges to any adjacent water bodies or to any coastal water.

c. The diversion and discharge does not cause adverse effects on neighbouring properties.

d. The stormwater collection system is designed to cater for stormwater flows resulting from not less that a 1 in 5 year return period storm event, and a stabilised overland flow path including the use of a road is provided for to allow flows up to and including the 1 in 50 year storm event in excess of the capacity of the primary collection system.

e. Environmental standards in 32.02.02 and 32.02.03 are complied with.

f. For discharges to a water body, the discharge does not:

i. Increase the natural temperature of the receiving water by more than 3^{o} Celsius at or beyond a 20 metre radius of the discharge point.
ii. Cause the pH of the receiving water to fall outside of the range 6.5 to 9 at or beyond a 20 metre radius of the discharge point.
iii. Cause the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials in the receiving water at or beyond a 20 metre radius of the discharge point.
iv. Cause any emission of objectionable odour in the receiving water or beyond a 20 metre radius of the discharge point.
v. Cause at or beyond a 20 metre radius the following concentrations or contaminants to be exceeded:
- *5g/m^3 of total copper*
- *5g/m^3 total lead*
- *50g/m^3 total zinc*
- *50g/m^3 suspended solids*

vi. Contain more than 20g/m^3 of total petroleum hydrocarbons

In the alternative stormwater discharges from the road and the WWTP might be considered as one application.

4.3.7 Land disturbance in the Riparian Management Zone

In addition, for construction in the Riparian Management Zone a discretionary activity consent would be required under 34.3,

> *The following land disturbance activities within the Riparian Management Zone are discretionary activities:*
>
> *1. Any activity which cannot comply with, or is outside the scope of, the permitted rules, or is not a non-complying activity, is a discretionary activity.*

The Section 34 Riparian Management Zone is variously defined in relation to water bodies, and the coast marine area, including in relation to foredunes. In relation to rivers and the CMA riparian management areas, the distance inland from the bank full edge of the water body or the top of the bank adjacent to the CMA varies between

- 5m where the dominant slope is less than 8 degrees
- 10m where the dominant slope is between 8 – 15 degrees
- 20m where the dominant slope is greater than 15 degrees

The foredune provision does not apply in this case where the CMA is in relation to bridge structure in all three cases where the CMA is crossed.

The permitted activity rule is framed in such a way that it cannot be met by earthworks associated with any activity other than a permitted activity. Land disturbance in the Riparian Management Zone is therefore a discretionary activity:

> *34.01.01 Any activity which cannot comply with, or is outside the scope of, the permitted rules, or is not a non-complying activity, is a discretionary activity.*

The land disturbance proposed, namely trenching in the margins of the causeways that cross three sections of the CMA are *not* non-complying activities.

4.3.8 Stormwater Waste water treatment plant

For the WWTP stormwater is a permitted activity under 21.1.2,

> *The diversion and discharge of stormwater, not otherwise permitted by Rule 21.01.01, by way of an open constructed stormwater collection system or piped stormwater collection system into water or onto or into land where it may enter water is a permitted activity, provided the following conditions are complied with:*
>
> *a. For new subdivision and development, the best practicable option for on-site stormwater disposal shall be identified and incorporated into the stormwater management design to avoid or*

minimise changes to stormwater flows after development for the 1 in 5 year return period storm event.

b. Where the diversion and/or discharge drains a hazardous substance storage area:

i. for hazardous substances stored in fluid form or likely to liquefy in fire, the area is bunded or otherwise designed with sufficient capacity to provide secondary containment that meets the following criteria:

- *where containers are stored that have capacities of less than or equal to 450 litres, the secondary containment is able to contain the total capacity of substances stored; and*
- *Where a single container with a capacity of greater than 450 litres is stored, the secondary containment is able to contain 110% of the volume of the container, or where two or more containers with capacities of greater than 450 litres are stored, the secondary containment is able to contain 1005 of the volume of the larges container plus 10% of the aggregate capacity of all other containers.*

ii. The stormwater collection system is designed to avoid any hazardous substances (including unintentional releases) entering the system, or a stormwater interceptor system shall be install; or

iii. The specific area complies with the following:

- *Hazardous substances are contained within vehicles, boasts, aircraft or small engines;*
- *It is for domestic storage of hazardous consumer products;*
- *It is a retail outlet for the sale of hazardous substances for domestic use (e.g. supermarkets, hardware shops, pharmacies);*
- *Agrichemicals are stored in accordance with the New Zealand Standard 'The Code of Practice for the Management of Agrichemicals', (NZS 8409:1999).*

c. Where the diversion and/or discharge drains an industrial or trade premise (sic):

i. The stormwater collection system shall be designed to avoid any contaminants stored or used on the site from being entrained in any stormwater discharge unless that stormwater is discharged through a stormwater interceptor system; and

ii. Any process water or waste stream on the site shall be bunded or otherwise contained, within an area of sufficient capacity to provide secondary containment equivalent to 100% of the quantity of any process water or waste that has the potential to spill into a stormwater collection system; and

iii. The site is managed such that the concentration of contaminants in stormwater leaving the site do not pose an immediate or long-term hazard to human health or the environment beyond a 10 metre radius of the discharge point.

d. The stormwater collection system is designed to cater for stormwater flows resulting from not less than a 1 in 5 year return period storm event and a stabilised overland flow path is provided for to allow flows up to and including a 1 in 50 year storm event in excess of the capacity of the primary collection system.

e. For discharges to water, the discharge does not:

vii. Increase the natural temperature of the receiving water by more than 3^{o} Celsius at or beyond a 20 metre radius of the discharge point.

viii. Cause the pH of the receiving water to fall outside of the range 6.5 to 9 at or beyond a 20 metre radius of the discharge point.

ix. Cause the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials in the receiving water at or beyond a 20 metre radius of the discharge point.

x. Cause any emission of objectionable odour in the receiving water or beyond a 20 metre radius of the discharge point.

xi. Contain more than:

- *20g/m^3 of total petroleum hydrocarbons*
- *10g/m^3 of total copper*
- *10g/m^3 total lead*
- *100g/m^3 total zinc*
- *100g/m^3 suspended solids*

f. The discharge does not cause scour or erosion of the beds or banks of the receiving body.

g. For diversion and/or discharges onto or into land, stormwater quality control measures or treatment systems such as silt, oil and grease traps are incorporated to minimise the level of contaminants prior to final disposal.

h. The stormwater management or treatment systems, and any associated works or equipment shall be operated and maintained in an effective operating condition.

i. The diversion and/or discharge does not cause flooding of adjacent properties.

Other provisions provide for controlled and discretionary activities, but compliance with the permitted activity can be demonstrated in relation to the WWTP stormwater discharges. A certificate of compliance can be sought.

4.4 Regional Air Quality Plan

4.4.1 Dust

The rules in the plan set out provisions for dust:

*9.1.4 The discharge of **dust** to air arising from:*

*(1) Quarrying operations, **earthworks**, …; or*

*(2) Road construction and maintenance, or **the use of unsealed roads …or***

is a permitted activity provided that:

(a) The discharge shall not result in any offensive or objectionable dust deposition, or any noxious or dangerous levels of airborne particulate matter, beyond the boundary of the subject property.

The explanatory text to the provision notes that this permits the creation of dust on roads within a property, and is not a general provision. Note however that the test for dust from earthworks in the road reserve may be difficult to satisfy given the proximity of site boundaries unless water spraying is maintained. On the other hand sand tends not to blow about as much as dry soil, and trenching may be able to be undertaken on sand through the winter months. In these circumstances application for a

certificate of compliance under s139 of RMA may be useful in order to achieve sign-off of the proposed mitigation measures for the trenching works.

4.4.2 Sewerage scheme and WWTP - an industrial or trade premises

The definition of **industrial or trade premises** under Chapter 17: Definitions means

> *a) Any premises used for any industrial or trade purposes; or*
> *b) Any premises used for the storage, transfer, treatment or disposal of waste materials or for other waste management purposes, or used for the composting of organic materials; or*
> *c) Any other premises from which a contaminant is discharged in connection with any industrial or trade process –*
>
> *but does not include any production land.*

Therefore the operation of a sewerage system (and the operation of air valves on the rising mains and at pump stations), waste water treatment plant and disposal area would constitute an industrial or trade premises; however, the reference to production land might render the spray irrigation part of the operation to be outside of the definition and therefore not subject to control in terms of the air quality plan. If this were the case, discharges for the spray irrigation of the treated effluent would then fall under the discretionary activity rules in Chapter 10, 10.3 1., namely,

> *The discharge of contaminants to air which fail to comply with the conditions in Rules 10.1(1) to 10.1 (7) is a discretionary activity.*

All other discharges to air would be discretionary activities under 9.3.2,

> *Any discharge of contaminants to air which is not permitted, controlled or prohibited or fails to comply with Rules 9.1(1), (2), (3), (4), (6), (7), (8), (9), (10), and Rule 9.2 (1) is a discretionary activity.*

These would include venting from pressure lines and pump stations; and discharges to air from the waste water treatment plant (plus the spray irrigation of the treated effluent). Overall it seems practicable to treat the entire project (reticulation, pump stations, waste water treatment plant, and disposal area) as a discretionary activity under Rule 9.3.2.

In terms of the notification of potentially affected parties in terms of the venting mechanisms related to the pump stations and lines, a radius of 50m of each vent is recommended.

4.5 Regional Coastal Plan

4.5.1 Restricted coastal activities

The coastal marine area (CMA) boundary is at the river mouth on Molesworth Drive causeway (R08 522 636). The bridge, also on Molesworth Drive, is in the CMA. Both of these will carry the treated effluent pipeline and the untreated effluent pipeline. No other areas of the coastal marine area would be impinged upon by this project.

The length of pipeline, including contiguous pipeline is <300m, and is therefore not a restricted coastal activity See S1.3 (a) or (b) National Coastal Policy Statement.

4.5.2 Zoning

The zoning of the entire coastal marine area identified within the Mangawhai Harbour including an area extending outside the harbour entrance, but excluding the specific are of MM4 is zoned as Marine Management 1. Its values are listed as:

> *Protected areas, coastal wetlands, marine mammals, birds, ecosystems, and habitat values. Intertidal areas, shellbanks and estuary provide important significant habitat for international migratory and NZ endemic wading and wetland birds, including some threatened species and an endangered sub-species.*

The zoning of the areas where the pipes will cross are thus all in the Marine 1 (Protection) Management Area. The construction of pipelines, even where they are attached to other structures such as bridges, are a non-complying activity (31.3.4(m)), namely,

> *The erection of any new structure and the occupation of space for and use of any new structure (other than those structures provided for as permitted, controlled, discretionary or prohibited activities) whether or not this is a restricted coastal activity.*

There is a cross reference to 17.5.9 of the plan (methods of implementation) which states,

> *Include appropriate rules within this Plan generally making new structures within the Marine 1 and Marine 2 Management Areas a discretionary activity and including appropriate criteria against which applications will be assessed.*

This does not seem to have been carried through into the plan rules, so that the tests are more stringent than would otherwise be the case. In particular, the test of s104D Particular restrictions for non-complying activities must be satisfied,

1. *Despite any decision made for the purpose of section 93 in relation to minor effects, a consent authority may grant a resource consent for a non-complying activity only if it is satisfied that either –*

    a. *The adverse effects of the activity on the environment (other than any effect to which section 104(3)(b) applies) will be minor; or*
    b. *The application is for an activity that will not be contrary to the objectives and policies of –*

i. *The relevant plan, if there is a plan but no proposed plan in respect of the activity; or*
ii. *The relevant proposed plan, if there is a proposed plan but no relevant plan in respect of the activity; or*
iii. *Both the relevant plan and the relevant proposed plan, if there is both a plan and a proposed plan in respect of the activity.*

2. *To avoid doubt, section 104(2) applies to the determination of an application for a non-complying activity.*

Although not stated in Rule 31.3.4(m), Rule 31.3.13 General performance standards apply to all non-complying activities listed in the Marine 1 (Protection) Management Area

31.3.13 General performance standards

The following standards shall apply to all specified….non-complying activities, listed in the Marine 1 (Protection) Management Area:

(a) Noise generated as a result of activity within the coastal marine area shall comply with the following standards:
  i. the activity shall not cause excessive noise as defined in section 326 of the Resource Management Act; and
  ii. any construction or maintenance activity near coastal subdivisions or other urban areas shall comply with the noise standards of the district council which is responsible for the use of the adjoining land.
(b) All lighting ….
(c) Discharges to water shall, after reasonable mixing, comply with the relevant receiving water quality standards and shall not contain any contaminants which could cause:
  i. The production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials.
  ii. Any conspicuous change in the colour or visual clarity of the receiving waters.
  iii. Any emission of objectionable odour.
  iv. Any significant adverse effects on aquatic life or public health.
(d) Any modification of the contour of the foreshore caused during any authorised construction or maintenance activity other than dredging shall be restored as soon as practicable after the completion of the construction or maintenance activity.
(e) Unless expressly authorised to do so by a coastal permit, structures within the coastal marine area shall not unduly impede safe navigation within natural drainage channels or unduly restrict the flow of flood waters within such channels.
(f) Discharges of contaminants into air….

All of the required structures are thus non-complying activities.

In addition to the general structures provisions, the objective and policies in Chapter 24 Network Utilities and Services will assist in demonstrating the necessity and acceptability of the proposed reticulation system when considering the provisions of s104D.

The cross-river Coastal Marine Area boundaries are defined in Appendix 1 of the Plan.

Appendix 5 to the Regional Coastal Plan sets out the information requirements for coastal permit applications that is drawn directly from section 88 RMA.

4.6 Kaipara District Plan

4.6.1 Designation of Waste Water Treatment Plant

Section 168A of the RMA provides for the Kaipara District Council to issue a notice of requirement for a designation in respect of any public work for which it has financial responsibility. The district council proposes to issue a notice of requirement to provide for the construction, operation and maintenance of the waste water treatment plant of a portion of the council owned Mangawhai Park. The WWTP is an essential element of the Mangawhai Ecocare sewerage scheme.

Notices of requirement must be in the prescribed form and address a number of matters specific in the RMA. Applications to the Northland Regional Council and the district council for the necessary resource consents and the requirement notice will be lodged simultaneously to enable concurrent processing.

4.6.2 Section 171 tests

Section 171 sets out the criteria that the council must apply in its consideration of a notice of requirement to designate.

S171 Recommendation by territorial authority

(a) When considering a requirement and any submissions received, a territorial authority must, subject to Part 2, consider the effects on the environment or allowing the requirement, having particular regard to –

(i) Any relevant provisions of –

(ii) A national policy statement:

(iii) A New Zealand coastal policy statement:

(iv) A regional policy statement or proposed regional policy statement:

(v) A plan or a proposed plan; and

b) whether adequate consideration has been given to alternative sites, routes, or methods of undertaking the work if –

(i) the requiring authority does not have an interest in the land sufficient for undertaking the work; or

(ii) it is likely that the work will have a significant adverse effect on the environment; and

(c) whether the work and the designation are reasonably necessary for achieving the objectives of the requiring authority for which the designation is sought; and

(d) any other matter the territorial authority considers reasonably necessary in order to make a recommendation on the requirement.

(2) the territorial authority may recommend to the requiring authority that it –

(a) Confirm the requirement:

(b) Modify the requirement

(c) Impose conditions:

(d) Withdraw the requirement.

(3) The territorial authority must give reasons for its recommendation under subsection 2.

The relevant provisions of policy statements and plans include any national policy statement, a New Zealand Coastal Policy Statement, a regional or proposed policy statement, and any plan or proposed plan

There are no relevant national policy statements in relation to this project, nor is the New Zealand Coastal Policy Statement relevant except to the extent that it has guided the development of the regional coastal plan. All works proposed fall under the ambit of regional plans. However, at the district level, the proposal for a sewerage treatment plant has been under consideration for a considerable period, finding reference in the district plan and LTCCP.

The District Plan deals with the need for a sewerage system at Mangawhai in some detail, and in the public works and services section sets out policy relevant to the sewerage scheme. In particular Policy 10.4.2.5 states,

To ensure that effective and environmentally acceptable sewerage, stormwater and water supply services are provided in settlement areas.
Methods of implementation
…
2. Investigate the establishment of community sewerage services for the settlements of Mangawhai and Ruawai

Section 10.4.2 sets out the policies and methods of implementation for works of requiring authorities,

Policy 1: To provide for the effective operation of public works and related facilities and limit any associated environmental impacts.

Methods of Implementation:
1 Designate on the planning maps land used or proposed to be used for public works or other similar purposes as sought by requiring authorities.

The District Plan also makes reference to the 1999 Mangawhai Infrastructural Assets Study which also highlighted the need for a sewerage scheme for Mangawhai. In addition, the Statement of Proposal for the Mangawhai Ecocare Scheme stated,

> *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. [18]

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

The following subsections will address in turn:

Whether the designation is reasonably necessary, within the context of the objectives for the public work and the consideration of alternative sites, routes or methods of achieving the public work.

4.6.3 District plan provisions related to particular works

Section 10.4.2.3 sets out the policies and methods of implementation for utility services.

[18] Statement of Proposal Mangawhai Ecocare, February 2006. See also Page x, Volume 2 of the Draft LTCCP 2006/16.

Policy 1: to enable utility services to be developed and maintained whilst controlling the environmental impacts of major structures.

….

Methods of implementation

1. *Rules which list public utilities (i.e. pipes, lines and similar minor services) as permitted activities in all zones.*

…

Network utility means according to 13-25,

pipes for the conveyance of sewage, stormwater, water and other liquids and necessary incidental equipment including pumping stations, and

buildings and other structures associated with the above.

The rules in 10.6.1 enable the placement of network utilities, including sewerage reticulation into the road reserve and into residential sites in the Rural, Coastal, Maori Purposes, Residential, Commercial and Industrial zones as permitted activities subject to standards. The standards relate to reinstatement, height of structures, gross floor area, location of structures in relation to yards, landscape planting, floodlighting, noise emissions, radiofrequency radiation, and parking.

The provisions for network utilities, particularly buildings and *other structures*, above, would appear to provide for the storage dam structure. In the alternative, the activity of the dam does not appear to require a resource consent in the Kaipara District Plan, being apparently covered by the presumption of s9 RMA that any activity is allowed unless a rule in a plan forbids it. (Most district plans specifically reverse the intent of this part of s9 RMA by the use of a catch-all provision that makes activities not already provided for discretionary activities.) Instead the KDC seems to rely on the disturbance provisions of the Water and Soil Plan for Northland. A building consent from the council would be required.

The area in the vicinity of pump station J related to the surf club is designated as a Recreation Reserve, with an underlying zoning of Coastal, and an overlay of Coastal Environment Area, which cross-references to the provisions of 6.3.2, 13.2.6, and 13.3.6, none of which are relevant to this project. The reticulation here would support the surf club and the public toilets, and is consistent with the purpose of the designation of reserve on land owned by the council.

The area immediately north-west of the surf club is zoned Rural-residential (landscape and ecological enhancement zone), and is not encompassed by the permitted activity rule at 10.6.1. However, the earthworks consents for this area are the subdivision developer's responsibility, not Earth Tech's.

Rule 3.6.2 for the rural-residential zone itself specifies that public utilities are permitted. However, a restricted discretionary activity consent is required for the associated earthworks, which would likely be non-notified (see Rule 3.6.5.2 Earthworks and clearance of indigenous vegetation) and Rules 13.2.3C (Special information requirements – applications for land-use consent involving sites in the Rural-Residential (Landscape and ecological enhancement) zone) and 13.2.7 (Activities made discretionary by

their failure to comply would apply with zone environmental standards – limited exercise of discretion) would apply. However, in respect of the individual sites where work might be undertaken, the disturbance is likely to be less than the area (200m^2) specified.

With the possible exception noted above, the rules in 10.6.1 mean that no separate earthworks consents are needed from the district council. Thus the majority of the 40km of pipe work and 15 pump stations in the Ecocare district and the 13km of pipe work and pump stations to the disposal site on public road and private land is a permitted activity subject to standards. The regional consents for disturbance still apply.

A certificate of compliance application along the lines above should be drafted, including demonstration of compliance with the standards set out in 10.6.1. This can occur independently of this consent process at any time.

In addition a Notice of Requirement for the council to designate the waste water treatment plant (WWTP) component of the project is needed. As a plan and elevations will be supplied, a subsequent outline plan should not be required.

Pukekaroro, an outstanding landscape feature (OLF1) is nearby the disposal site. The plan rules apply only to the particular feature, and have no relevance to the project at hand.

The District Plan contains no specific rules about archaeological sites except requiring compliance with the Historic Places Act to promote protection. Sites are identified in the planning maps where known. None are identified in the areas subject to the sewerage scheme.

Mangawhai Estuary is classed in Appendix 8E to the district plan as being a feature of international ecological significance (bearing in mind in this case that the causeway on Molesworth Drive is (by omission from the schedules) classed in the regional coastal plan as a reclamation). The habitat description is described as,

> *Estuarine harbour with mangroves at head and extensive sandspit. Nesting site of endangered fairy tern, NZ dotterel, variable oystercatcher and Caspian tern. Fernbird and banded rail may be present in shrubland areas.*

Rule 8.7.1 of the plan provides that,

> *No building shall be erected, earthworks or land drainage works carried out, indigenous vegetation cleared, or exotic vegetation planted within the boundaries of an protected natural feature (i.e. a feature rated of international, national, regional or district significance, shown on the planning maps, except with the land use consent approval of the council, …*

Certain exceptions apply that are not relevant to this project. The type of application, and thus the tests, depends on the significance of the protected natural feature. Rule 8.7.2 provides that applications related to features of outstanding (international) or high (national) shall be considered as *non-complying activities* with certain exceptions related to roads, as set out in Rule 8.7.3. None of these aspects assist the project, except that the WWTP site will be covered by a designation.

4.7 Other consents

4.7.1 S338 Local Government Act 1974

S338 Council may grant right to lay petroleum conduit pipes along or under road –

(1) Subject to section 357 of this Act the council may grant to any person an easement or other right for such period not exceeding 50 years and on such terms and conditions as the council thinks fit, authorising that person to lay conduit pipe for petroleum or for any other purpose in the district under or along any road or. ….

(2) The grant of any such right or easement shall be subject to the payment of such rent, and to the observance of such conditions as to size, construction, repair, and maintenance of the conduit pipes, and as to repair of any road … under which they are laid, as the council thinks fit.

A council resolution is required for the granting of a right to lay pipes for any purpose in the district under or along any road.

This should be done at the same time as the council decision on serving the notice of requirement to designate the waste water treatment plant.

4.7.2 Access to private sites

For access to private land for construction purposes s181 LGA 2002 is available, as Earth Tech is the direct contractor to KDC. The Act sets notification requirements and the mechanisms for financial compensation.

4.7.3 Avoidance of electric line supports

The district plan sets out an extract from the NZ Electrical Code of Practice for Electrical Safety Distances (NZEPC 34: 1993). The code has been superseded by the NZEPC34:2001. It specifies the restrictions on excavations or construction near electric line supports. These restrictions would apply in respect of the crossing of private land by the treated effluent pipeline underneath the electricity easement.

5.1 Do Nothing Option

The Do Nothing Option means that septic tank treatment and "on site" disposal of effluent would remain the strategy for sewage management. The term "on site" means that each individual landowner would be responsible for managing their own sewage on their own property.

The ability of an on-site system to perform adequately under the conditions prevailing at Mangawhai is highly compromised. At present effluent from disposal systems is leaching into the ground before an adequate standard of treatment can be achieved.

The effects of doing nothing include:

- The limited capacity within some areas to retain effluent on site will result in increased quantities of sullage and effluent on private properties, public reserves and discharge off the properties
- Increased probability that diseases may be spread from untreated or partially treated wastes surfacing in private property or being carried into open drains, water supplies or recreation areas. This problem is more likely to affect transient populations or visitors to the area.
- Once the self purification capacity of a water body has been exceeded, environmental degradation rapidly occurs. This would include visual impact with dark coloured waters, foaming, slimes, odours, weed and algae growth all of which contribute to the destruction of natural aquatic life and ecosystems by oxygen depletion and additional nutrient loads.

With the continuing increase in development within the township area, the resultant density of occupation and intensity of population during summer, these impacts are only going to increase in the future. Accordingly, the Do Nothing option is not considered viable.

5.2 Reticulation Options

5.2.1 Types of scheme

A brief description of common types of wastewater collection systems is given below. These collection systems have been divided into two groups, natural gravity and artificial gravity systems.

Natural Gravity Systems

Five gravity systems are tabulated below:

Table 5-1: Type of Gravity Systems

Type of Scheme	Comments	
Conventional Sewerage	All wastewater	Septic tank not required
Modified Conventional Sewerage	All wastewater	Septic tank not required
Common Effluent Disposal	Liquid Waste only	Needs septic tank
Variable Grade Sewer	Liquid Waste only	Needs septic tank
Modified Drainage	All wastewater	Needs existing stormwater

In general where there is sufficient natural slope, natural gravity systems have advantages in installation and operating costs. These conditions exist throughout most of the Mangawhai Heads area. The five options provide opportunity to optimise the scheme costs with regard to the prevailing conditions.

5.2.2 Conventional Sewerage (CS)

The key components of a CS system are:

- All wastewater from each individual property is discharged into the sewerage system
- Existing septic tanks are therefore not used and would be abandoned
- Each individual property drains its wastewater to a gravity sewer
- A network of gravity sewers transports sewage from multiple properties to a common collection point (generally a pump station) for conveyance to the Treatment Plant
- Depending on the topography of the township, one or more pump stations may be required

5.2.3 Modified Conventional Sewerage (MCS)

An MCS scheme has the same key features as a CS system. The key difference between an MCS scheme and a CS scheme lies in the detailed design standards.

CS design standards were developed in the early 20th century and had built-in redundancies to manage the limitations of pipe materials and maintenance techniques required at the time. With modern mechanised maintenance equipment and improved pipe jointing techniques design standards have been modified over the past 10 years: - leading to the term MCS.

5.2.4 Common Effluent Disposal (CED)

Unlike CS and MCS schemes in which all wastewater is discharged into the sewer, a CED scheme is designed to:

- Accept only the liquid waste from each property's septic tank
- Retain septic tanks for each property
- Require that new houses have a septic tank installed

Apart from these differences a CED scheme incorporates all other key components associated with a CS scheme.

The advantage of a CED scheme is that the retention of the septic tank and the elimination of solid material in the sewers allow for:

- smaller diameter sewer laid at flatter grades leading to shallower construction depths and cost savings
- reduced need for manholes and access shafts leading to further cost savings

The needs for land owners to continue to maintain and de-sludge their septic tanks as well as the corrosive nature of the anaerobic liquid waste stream are major disadvantages of this type of scheme.

In terms of cost, a CED scheme can offer savings over CS and MCS schemes provided the population remains static in the long term. For a community that is growing at even modest growth rates, the cost of each new house installing a septic tank outweighs the cost savings achieved in other areas of the reticulation design.

5.2.5 Variable Grade Sewer (VGS)

This option is a variation of the CED scheme in which a small diameter gravity sewer which conveys septic tank effluent and can be laid at constant depth following terrain. Intermediate grades can be negative and positive with an overall fall to the outlet.

The use of both negative and positive grades allows construction costs to be lower than a CED scheme.

5.2.6 Modified Drainage (MD)

Where an established stormwater network exists, the existing stormwater drains can be modified so that they can collect sewage as well as stormwater. As Mangawhai does not have an extensive stormwater drainage system, the opportunity to apply this type of scheme does not exist in this instance.

5.2.7 Artificial gravity systems

Three artificial gravity systems are set out below:

Table 5-2*: *Artificial Gravity Systems

Type of Scheme	Comments		
Grinder Pump	Pumped	All wastewater	Septic tank not required
Septic Tank Effluent Pumping	Pumped	Liquid Waste only	Need Septic tank
Vacuum Sewers	Vacuum	All wastewater	Septic tank not required

In situations of undulating or flat terrain, high water table, rock at shallow depths or surface obstructions, artificial gravity systems could provide a lower cost alternative. In general favourable conditions exist within the Mangawhai Village area for pumped or vacuum systems.

The three options provide opportunity to optimise the scheme costs with regard to the prevailing conditions.

5.2.8 Grinder Pump (GP)

The key components of a GP system are:

- Each property has a pump-well fitted with a macerating pump
- all domestic sewage is discharged into the sewerage system
- A small (40 mm diameter) pipeline conveys sewage to pressure main which receives waste from multiple properties
- The pressure system conveys wastewater to a single outfall pump station for transfer to the waste water treatment plant

The advantages of this type of scheme are that small diameter pressure systems can be laid at shallow depths, with less impact on properties. Significant savings in construction and reinstatement costs can be achieved as well.

The cost of each new house installing and operating a pump station reduces these cost savings.

5.2.9 Septic Tank Effluent Pumping (STEP)

STEP systems are very similar to GP systems except that they:

- Accept only the liquid waste from each property's septic tank

- Retain septic tanks for each property
- Require that new houses have a septic tank installed

The needs for land owners to continue to maintain and de-sludge their septic tanks as well as the corrosive nature of the anaerobic liquid waste stream are major disadvantages of this type of scheme.

In terms of cost, a STEP scheme can offer savings over a CED scheme provided the population remains static in the long term. For a community that is growing at even modest rates, the cost of each new house installing a septic tank outweighs the cost savings achieved in other areas of the reticulation design.

5.2.10 Vacuum Sewer (VS)

The key features of this type of scheme are:

- Sewage from each individual property drains by gravity to small collection pits
- Each collection pit serves 3 or 4 houses
- A network of small diameter pipelines links each of the collection pits.
- A centralised vacuum station maintains the pipeline in vacuum conditions
- Specialised valves allow sewage in the collection pits to discharge into the vacuum line and be sucked to the vacuum station
- A conventional pump transfers sewage collected at the vacuum well to the treatment plant

This option has similar advantages and costs to a GP system.

5.2.11 Preliminary option assessment

Mangawhai has experienced a rapid growth in recent years that is expected to continue for a number of years to come. These conditions render options reliant on a septic tank as environmentally unsound and cost prohibitive.

Modified Drainage has also been eliminated as detailed in preceding sections.

Furthermore the water industry has widely adopted modern maintenance techniques (jetting, remote controlled cameras, remotely operated mechanised cutting tools) and the resultant reduced need for manholes. Accordingly Conventional Sewerage has been superseded by Modified Conventional Sewerage as the industry standard gravity system.

As a result the options considered feasible for reticulation were:

- Modified Conventional Sewerage (MCS)
- Grinder Pump (GP)
- Vacuum Sewers (VS)

5.2.12 Detailed Option Assessment

Heads Area

The bulk of the Heads area is suitable for gravity based systems and accordingly MCS has been adopted.

Isolated portions of the Heads area, however, are difficult the service by gravity for reasons including:

- Topography – individual houses or small groups of houses are at lower elevation than adjoining properties. Adoption of a Grinder System in such instances may allow nearby gravity sewers to be kept at minimum depths
- Size of Catchment – if approximately 10 or less properties draining by gravity to a pump station, it may be more cost effective to service each property with its own grinder pump than to install the more sophisticated style of community pump station which are employed in gravity systems
- Environmental – servicing some houses by gravity would require removal of significant amounts of vegetation
- Construction Practicalities – some properties have restricted access for the larger construction equipment required for deeper gravity trenches
- Ground Water – in areas near the harbour where ground water is likely to be close to the surface deep excavations may be problematic

Detailed site inspections have been undertaken of each property in the Heads area to identify properties where Grinder Pump Systems would be more favourable than a gravity system.

In total some properties have been assessed as being more suitable for serving by Grinder Pump Systems than gravity. The remaining properties in the Heads area are to be serviced by MCS.

Village Area

Both Vacuum and Grinder Pump Systems are considered to be appropriate technologies for the provision of a sewerage scheme for Mangawhai Village. More detailed analysis of the two options was undertaken to determine which technologies would be the more appropriate.

Preliminary estimates indicate that both the Capital Cost of scheme implementation and the 25 year NPV are significantly lower for a Grinder Pump scheme compared to a Vacuum Sewer scheme.

In relation to capital cost preliminary estimates indicate that the overall capital cost saving of a Grinder Pump scheme in comparison to a vacuum system is approximately $590,000.

Implementation of a Grinder Pump scheme would cause less disruption to the public and commercial interests due to the fact that excavations are shallower and the possible use of boring techniques in particularly sensitive areas.

Adoption of a Grinder Pump scheme to service Mangawhai Village would result in the whole scheme containing only two basic technologies i.e. Modified Conventional Sewers and Grinder Pumps.

Adoption of a Vacuum Sewer System would result in there being three separate technologies being implemented throughout the EcoCare district.

Limiting the number of technologies to two will provide some economies in relation to equipment suppliers, staff training, service agreements, etc.

As a result Grinder Pump has been adopted for the Village area.

Treatment plant sites

Earth Tech's original proposal to KDC was based on providing a medium level treatment plant in Mangawhai Park. This location was appropriate for disposal options within the golf course and Mangawhai Park.

However, with disposal of effluent onto farmland being introduced to the suite of potential disposal options, consideration was given to siting the treatment facility at the disposal site. The approach raised a number of disadvantages which are listed below:

- Required raw sewage to be transferred long distances from town to the disposal site which in turn:
    - Introduced a higher degree of environmental and social impact in the event of the pipeline bursting.
    - Greater potential for, and impact of, odour nuisance.
- Transferring raw sewage eliminated opportunities for KDC to take advantage of additional disposal opportunities where potential customers were found in close proximity to the transfer pipeline. These would include the golf club, an irrigator east of Brown Road, a tree lot on Cove Road, and other interested parties along Tara Road.

As a result it was agreed to retain the treatment plant at the Mangawhai Park site.

5.3 Treatment plant processes

Several other treatment processes were considered for treating the raw sewage at Mangawhai.

5.3.1 Lagoons

The processes considered were lagoons, oxidation ditches and various configurations of the aerated, microbiological type.

Lagoons were not regarded favourably by the council. Lagoons were not considered as suitable for locations of reasonable proximity to the township. Thus, if lagoons were to be used, a site some distance from Mangawhai would be required. In turn this raised issues related to the sizing of delivery lines, which would be sized for peak holiday flows, but which for much of the year would carry low flows. In these circumstances sewage may turn anaerobic, with the consequent release of hydrogen sulphide. This would lead to serious odour problems at air valves along the pipeline, and in the large pump well that would be required within the Mangawhai township.

- Leaks or breakages in the delivery pipeline would result in spills of raw sewage in a public environment.
- Lagoons can also have odour problems, and thus usually require large buffer areas.

For the above reasons lagoons were not a preferred option.

5.3.2 Oxidation ditches

Oxidation ditches were not regarded as suitable for the township environment. Construction of these ditches at an out of town location would likely lead to the same problems as set out above.

Oxidation ditches are therefore not a favoured option.

5.3.3 IDEA/CASS treatment

Once land disposal began to be discussed as an option, the disposal regime determined the treatment standard required for the treatment plant. The preferred disposal option of spray irrigation of treated effluent on dairy pasture requires a faecal coliform level of 23 organisms per 100ml of effluent. The disposal method also requires sustainable concentrations of nitrogen, phosphorus, BOD and TDS.

The IDEA [intermittent decant, extended aeration] process was originally proposed as an option for the Mangawhai treatment plant. The IDEA process is suitable for the delivery of effluent to the quality required for dairy irrigation. However, a closely related process was considered even better.

The CASS process is one of a number of sequence batching processes that are in operation world-wide. The advantages of the CASS process are that it has much smaller process tanks than the IDEA process and that it is more economic in terms of power use than the IDEA process. The smaller tank size allows the use of a much smaller footprint in Mangawhai Park. The CASS process is equivalent to the IDEA process.

5.3.4 Disposal options

A staged process for the identification of the method for and locations for disposal were undertaken. These included the following:

- Mangawhai Park drip irrigation
- Mangawhai Park bore injection
- Mangawhai Golf Course irrigation
- Department of Conservation land on the foreshore
- Te Uri o Hau forestry land immediately south of the Department of Conservation dunes
- Mangawhai Estuary

A wide range of disposal options was considered for each of the options (apart from the estuary, which would have been a direct discharge):

- Surface irrigation
- Sub-surface irrigation
- Various rates of irrigation, i.e. low 'greening' rates, mid-rate, high rate and infiltration rate
- Deep bore injection
- Trench disposal; and infiltration galleries

A total of 32 options (locations and disposal methods) were considered. The relative merits of these schemes are set out in the following reports:

- URS (NZ) Limited, Mangawhai Effluent Disposal Initial Desktop Issues and Options Assessment, (draft report) November 2005, and
- URS (NZ) Limited, Mangawhai Treated Wastewater Disposal Assessment of Land Disposal Options, March 2006

Subsequently another report was prepared, being

Earth Tech Engineering Pty Limited, Assessment of Treatment and Disposal Options, March 2006

This distinguished between the various options, and introduced increased quantities and restrictions (that had been placed on the use of council land by the council) and promoted the option of beneficial re-use on pasture by spray irrigation.

In turn, a further report was commissioned to investigate in greater detail the re-use by spray irrigation option for the Lincoln Downs site at Hakaru, being

RMCG, Mangawhai Treated Wastewater Disposal /re-use Lincoln Down, April/May 2006

This was followed by Earth Tech Engineering Pty Limited, Disposal Options Report, June 2006 in which assessed three disposal options:

Disposal to Mangawhai Golf Course

Disposal to sand spit

Disposal to farm land

The background to this report is as follows: the proposal submitted by Earth Tech to Kaipara District Council in 2002 strongly recommended the complete re-use of the reclaimed effluent from the Ecocare scheme on land applications and the contract between Earth Tech and KDC was initially based on a drip feed irrigation network within Mangawhai Park. KDC withdrew this option on signing of the contract because of community expectations for the utilization of Mangawhai Park.

Various disposal options were then considered and two of these were investigated in detail.

The first option, total disposal to the Mangawhai Golf Course, was discarded because the golf course was too small an area for total effluent disposal. The Golf Club was also not in favour of accepting reclaimed water for periods when the golf course fairways did not require moisture.

The second option, disposal to the dune area south-east, and adjacent to, the big sand dune on the Department of Conservation land, was also found to be unsuitable. This area is used by the public for access to the big dune. Effluent would, in all probability, discharge across the beach area adjacent to the big dune. This imposition on physical public access to a recreation area and the mental public perception of the disposal of effluent in a conservation area created doubts over the timing of resource consents.

The decision was then made to investigate the more costly option of land re-use of the reclaimed water with an irrigation application.

5.4 Parameters of the re-use scheme

The treatment process produces high-class reclaimed water which conforms to the following parameters: BOD <10mg/l, SS <10mg/l, Total N <10mg/l, P <5mg/l, TDS 600mg/l, e-coli <100organisms/100ml.

Flows produced by the scheme are projected to be 140ML/annum in year 2008, 184ML/annum in year 2014 and 284ML/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.

5.4.1 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.
- Area of irrigable land to be of the order of 50 hectares minimum. Half of the gross area will be used in boundary and stream easements adjoining the irrigation area. Therefore minimum property area required is 100 hectares.
- Suitable topography for irrigation. Slopes of 1 in 8 are the limit in steepness for irrigation and erosion can be a factor with steeper country
- Soil type and hydrogeology must be such that contamination of underlying aquifers are not adversely affected
- Suitable location and soil type to locate and construct a large storage reservoir

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

It is anticipated that demand for the reclaimed water will increase as community perception of the value of this commodity elevates. 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.

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 also 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 principal of RMCG which company is used by Earth Tech for irrigation viability studies, and Donn Armstrong, a recommended local agricultural advisor, were engaged by Earth Tech to report on the suitability of the Lees property for irrigation re-use. They 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. Their reports are appended elsewhere.

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

Reclaimed water contains small amounts of nitrogen and phosphorus and can contain viruses. Nitrates and phosphates can lead to pollution of waterways with a continuing discharge.

All irrigated water is processed through the surface soil layer and through the vegetation. The nutrients in the water supply approximately 25% of the nutrient requirements of the pasture. Viruses 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 sample.

Raw sewage into the treatment plant contains of the order of 10,000,000 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 for the period to 2014.

The initial sizing of the storage facility will be large enough to hold the projected flows up until year 2014. To cater for flows beyond 2014 and up to 2023 an additional storage facility may need to be constructed prior to the storage reaching its capacity.

A suitable site for a storage reservoir of 130,000m^3 capacity has been selected. This site is currently undergoing geotechnical examination. The geotechnical investigation is necessary to confirm assumptions made in the structural design of the storage and also to confirm construction and permeability parameters.

The stated purpose was to present the investigations into alternative methods of disposal to the Kaipara District Council, and to make a final recommendation based on these findings.

The above provides the current Earth Tech position with the disposal of effluent, which has selected the spray irrigation to pasture option as the preferred option, with the prospect of other users joining in with the spray irrigation venture.

5.4.2 Transfer pipeline alignment options

Introduction

A major component of the Mangawhai Ecocare project is a reclaimed water irrigation enterprise. Once this option had been decided upon, the next task was to select a route for the pipeline to the selected discharge site at Lincoln Downs.

Objectives

In developing options for the transfer pipeline alignment the key objectives were:

- Maximizing options for delivering reclaimed water to interested parties (present and future) in as cost effective manner as possible
- Minimizing impact on private landowners
- Ensuring accessibility to pipeline for future maintenance purposes

- Ease of obtaining resource consents
- Ease of construction
- Minimizing cost

Options Identified

Potential alignments have been considered along every public road between Mangawhai Park and Lincoln Downs. In addition alignments within a selection of private landholdings have been considered.

The various road alignments between Mangawhai Park and Lincoln Downs lead to many combinations and permutations. Hence, rather than listing each individual combination, the major groupings of options are set out below:

- public road (southern) alignments
- public road (northern) alignments
- private property alignment

The plan entitled *"Options for Reclaimed Water Transfer Pipeline"* (Refer attached plan) sets out details of the various alignments. With reference to that plan:

- Private property alignments included the potential to follow the route of a power supply line between Browns Road and Tara Road as well as pass through a large new development adjoining Molesworth Drive. In addition opportunities exist for aligning the pipeline east of the power supply line.
- Public road (northern) alignments included the Cove Road Option and the Tara Road upper option.
- Public road (southern) alignments involved taking the transfer pipeline through Mangawhai Village and along the Kaiwaka Road. The southern end of Tara Road was also considered.

From examination of the accompanying plan, it is evident that the private property alignments are significantly shorter than the Public Road alignments.

Investigations

The initial considerations into the transfer pipeline alignment were coupled with the examination of potential site for the reuse enterprise.

Public road (southern) alignments

Kaiwaka Road option

At that initial stage, assessment was made of the potential to construct a pipeline along Kaiwaka Road.

This alignment had the advantage of avoiding construction on private property. Preliminary inspections of this option identified that:

- The crossing of Hakaru River was a significant issue.
- This road has a high traffic volume.
- The road had a winding horizontal alignment resulting in poor sight distances. This posed a safety problem for construction purposes.
- Many sections of the road had a narrow road shoulder. Accordingly, entry into private property was considered highly likely in certain sections.
- A 120-metre highpoint between Garbolino Road and Hill Road was hydraulically undesirable.

In addition this route involved construction through the Village. Again, cost considerations made this option unattractive.

This alignment would have had an advantage if potential reuse customers were readily evident south of Kaiwaka Road. However, with the decision to site the reuse enterprise at the Lincoln Downs property, the Kaiwaka Road option became a circuitous and inefficient choice of alignment, the length of pipeline required being 14.6 km. In addition, as most of the reuse prospects lay north of Kaiwaka Road, little advantage was seen in pursuing this option further.

The long length of pipeline would also have exacerbated the hydraulic disadvantages associated with pumping over the 120-metre highpoint.

Tara Road (lower) option

In order to avoid the construction and safety difficulties associated with construction along Kaiwaka Road, consideration was given to relocating the works to Tara Road (between Cove Road and Moir Street) and through private property between Tara and Brown Roads.

This approach would avoid the highpoint between Garbolino Road and Hill Road, thereby providing a hydraulically preferable option.

This option also reduced the total length of pipeline by 1.4 km in comparison to the Kaiwaka Road option. Nevertheless, being routed through the Village makes it an indirect route from the Water Reclamation Plant to Lincoln Downs. Given that a strong demand had not been identified for reclaimed water from properties south of the Kaiwaka Road and south of the Village, little advantage was seen in pursuing this option.

Consideration of the portion of the route through private property between Tara and Brown Roads is given in section 4.3.

Public road (northern) alignments

Cove Road option

The options presented above all require crossing of the Mangawhai Estuary at Molesworth Drive.

The only other alternative to this crossing point is to locate the pipeline along the unmade portion of Thelma Road (west of the golf course) to a crossing of a watercourse near the estuary. From this point the pipeline south of Cove Road could be within private property. The estuary crossing would then be incorporated into the Cove Road bridge crossing. From the Cove Road bridge to Tara Road the desired alignment would be within the road reserve.

The section of the pipeline in private property south of Cove Road was problematic. Closer site inspections revealed that only a small portion of the land was actually in private ownership. The majority formed part of the estuary and associated land subject to environmental controls.

The land in the vicinity of Cove Road is being developed as lifestyle blocks. Few prospects for prospective reuse of reclaimed water were readily apparent.

This alignment option was not developed further.

Tara Road (upper)

Consideration was given also to construction of the transfer pipeline along the northern section of Tara Road. Reference to the accompanying plan shows that this route is circuitous.

A site inspection determined that finding a suitable alignment within the road reserve would be problematic, particularly in the northern reaches of Tara Road and near the Hakaru River crossing. In these areas the road verges were extensively vegetated.

Pursuing this indirect route did not increase the prospect of efficiently delivering water to potential consumers of reclaimed water. Hence the option was developed no further.

Private property alignment

The sections of the pipeline that traverse private property fall into two broad areas:

- Land adjoining the Mangawhai Estuary, and
- Land between Tara Road and Brown Road

Land adjoining the Mangawhai Estuary

In May 2006, a private developer advised the council of a concept proposal to develop some 130 hectares of land adjoining Mangawhai Estuary. In June 2006 council officers and representatives of Earth Tech met with the developer for a briefing. The estate is to be known as “Estuary Estates”.

The reclaimed water transfer pipeline is to traverse this site. The precise location of the pipeline will be chosen to fall within the developer's intended road alignment and allotment configuration. Landowners in the estate could receive reclaimed water from the pipeline, much as there is a proposal for the golf course to receive water.

West of the estate, the pipeline would be located in Old Waipu Road. This road is partly formed and partly unformed, as described below.

Old Waipu Road is formed for about a kilometre north of Molesworth Drive, and for about 500 metres south of Cove Road. Between these two sections is a further kilometre of unformed. It is proposed that the pipeline would be constructed northward along the unformed section of Old Waipu Road and then along the formed section to Cove Road.

Land between Tara Road and Brown Road

Existing Irrigators

A dairy farm sited between Tara and Brown Roads currently uses irrigation. The farm is owned by W and C Bygrave. Fruitful discussions have been held with the owners to consider the options for both supplying reclaimed water to their farm and siting the transfer pipeline within their land. To best suit the owners' needs, it is proposed to align the pipeline through open paddocks that are presently used for grazing.

In terms of other opportunities for supplying reclaimed water, an avocado farm is situated in Tara Road. Reclaimed water may be of interest to the owner (although no approach has yet been made). Hence finding an alignment that allowed for a future extension to this farm was considered.

Power supply alignment

The prospect of locating the pipeline parallel to an existing power supply pipeline from Tara Road to Brown Road was considered.

The objective of aligning the pipeline parallel to the power supply easement was to minimize encumbrance on private property. Research into the pattern of ownership revealed that the pipeline would pass through ten separate landowners' land. Some of the parcels of land were small and a proposal for a pipeline in addition to the existing power line was considered to have unreasonable impact on the landowners. Hence this option was not pursued further.

South of power supply alignment

About 700 metres to the south of the power supply line, an alignment was identified that would affect only two landowners. Earth Tech discussed the potential pipeline alignment options with the relevant landowners and undertook detailed site inspections of the properties.

The eastern property, owned by Mr D. Wintle, fronts Tara Road. This property has a race formed along its south-eastern boundary. Site inspections confirm that construction could occur within the race without

undue difficulty. Mr Wintle has acknowledged that in the future the availability of reclaimed water may be an asset.

West of the Wintle property is land owned by R. and S. Brunt. The owners grow maize on the paddocks in question. Cattle grazing also occurs on the property. A site inspection undertaken by Earth Tech revealed that a pipeline could be aligned to follow the edge of the cropped area and avoid all trees.

Initial discussions with Mr Brunt were productive. Further consultation with Mr Brunt is necessary to ensure that his cropping operation is not compromised by construction and that any particular issues are identified and resolved satisfactorily. At this stage, Mr Brunt was not interested in utilizing any reclaimed water.

5.5 Adopted Alignment

As a result of Earth Tech's investigations the following alignment was adopted:

1. Thelma Road: - from the Water Reclamation Plant in Mangawhai Park to Molesworth Drive
2. Molesworth Drive:- from Thelma Road to Estuary Estate
3. Within Estuary Estate
4. Old Waipu Road – along unmade section and the trafficable section near Cove Road
5. Cove Road – from Old Waipu Road to Tara Road
6. Tara Road – from Cove Road to the southern boundary of land owned by D.Wintle
7. D. Wintle property – along southern boundary within existing race and along western boundary
8. R. Brunt property – along northern edge of paddocks used for maize cropping
9. W. & C. Bygrave property
10. Brown Rd – from Bygrave property to Lincoln Downs

The total length of pipeline is approximately 10.8 km.

5.5.1 Crossings of Watercourses

The proposed alignment involves the crossing of a number of watercourses. These are detailed in the table below and are shown on the attached plan titled *"Mangawhai Ecocare Scheme- Locations of Watercourse Crossings'*:

Table 5-3: Watercourse Crossings for Delivery Pipeline

Segment of Pipeline	Crossing location		Comments
Thelma Road: -	No water course crossings		
Molesworth Drive:-	Crossing 1	Crossing of Estuary	Pipeline attached to bridge
Estuary Estate	Crossing 2	Crossing of minor water course	This portion of the pipeline is within land subject to a new development proposal The alignment of the pipeline and the location of the crossing of watercourse will be developed in conjunction with the developers as they prepare their proposal and application for resource consent.
Old Waipu Road	No water course crossings		Pipeline follows the Old Waipu Road alignment
Cove Road	No water course crossings		
Tara Road	No water course crossings		
Private Property between Tara and Brown Roads	Crossing 3	crossing of minor water course, Wintel Property	Pipeline above ground and adjoining existing bridge on farm access track
	Crossing 4	Crossing of Hakaru River Tributary, Brunt Property	Pipeline to cross under watercourse
	Crossing 5	Crossing of Hakaru River, boundary between Brunt and Bygrave Properties	Pipeline to cross under river
	Crossing 6	Crossing of Cook Creek Tributary	Pipeline to cross under creek
	Crossing 7	Crossing of Cook Creek	Pipeline to cross under creek
Brown Rd	Crossing 8	Crossing of Cook Creek	Pipeline attached to bridge
Lincoln Downs site	no water course crossings		

5.5.2 Selected alignment

The key issues associated with the adopted alignment are:

- It is a direct alignment, about 4 km shorter than the Kaiwaka Road alignment.
- It is largely located within sections of road reserve where construction can proceed:
  - without undue safety concerns
  - in a manner that allows excavation of trenches without undue environmental issues arising
  - without impact on native vegetation
- Locations in road reserve are readily accessible for future maintenance purposes.
- Affects least number of private landowners and has least impact on those landowners.
- It maximizes prospects for future delivery of reclaimed water to interested parties
  - Allows for future supply of reclaimed water to parks and gardens in the Estuary estate.
  - Allows Mr Wintle and Mr Bygrave access to reclaimed water.
  - Can be located in an existing race on the Wintle property.
  - Landowners along Tara Road could obtain access to the reclaimed water.
- The critical crossings of watercourses can be constructed in an environmentally sound manner:
  - The estuary crossing can be constructed by attaching the pipeline to the bridge
  - The Hakaru River can be crossed in an environmentally sensitive manner by directional drilling

6.1 Introduction

The Mangawhai Ecocare project is comprised of four components: the reticulation network in the Mangawhai Heads and Village, the waste water treatment plant, the line to the disposal site, and the disposal dam and irrigation network. Due to the sub-surface location of the bulk of the proposed scheme, ongoing effects on the surrounding environment will be confined to discrete locations where facilities, such as pump stations, vents, and valves are located. The WWTP will be largely unseen, and the disposal site is some 10km from Mangawhai. The irrigation network will look like any other spray irrigation system found in the farming environment.

Most of the environmental effects of the reticulation network will be generated during construction, where disturbance of local road and reserve areas, and private property will require open trenching to provide a waste water connection to all properties. The proposed restrictions on the length of piping under construction will, however, ensure that construction effects are minimised.

The reticulation pipeline route has been chosen, as has the discharge pipeline, to avoid as much as possible the coastal marine area. Where crossings are undertaken they are slung under bridges or over already culverted sections of the CMA.

Following reinstatement within the Heads and Village areas environmental effects will be limited to the location of pumps station telemetry, vents and valves. Specific odour control, provision for emergency containment and ongoing monitoring and maintenance of the waste water system will ensure that impacts on surrounding residents are either avoided altogether or controlled to an acceptable level.

In respect of the WWTP, its elevated location and bund wall, along with acoustic housings and mulch filter beds, will control the potentially adverse effects of noise and odour.

The assessment of environmental effects is governed by the requirements of Schedule 4 to the RMA 1991. In addition, the applicant must report on the various requirements specified in the regional and district plans as requiring to be discussed in order to afford the consent authority that the proposed activity has been properly described and its effects satisfactorily dealt with. These requirements are set out in Section 4 Consents to this application. Section 6 will undertake the statutory assessment that is required, including consideration of Part 2 of the Act and the various documents relevant to the proposal.

Instead of repeating the body of the text, this section will deal only with aspects of the proposal that require consent, or the remedying or mitigating of effects.

6.2 Existing environment

6.2.1 Geology

Mangawhai Heads and Village Area

Tonkin and Taylor Ltd undertook a geological investigation of the Mangawhai Heads and Village area to identify ground conditions and issues that may arise in the construction of the proposed reticulation system. It reported that:

"The investigation identified that the area is underlain by isolated areas of fill, estuarine deposits, alluvial sands and dacite tuff from the Parahaki Volcanics. A very dense cemented sand layer was identified in the village at less than 1m depth."

Further, that:

"The published geology for the area, New Zealand Geological Survey – Whangarei (Scale 1:250,000(ref 1), indicates that the site is mostly underlain with Quaternary dune and beach sand deposits. At the northern end of Mangawhai Heads, residual Parahaki Volcanics are present and mostly comprise dacite tuffs. Further north along Lang's Beach Jurassic age argillite greywacke is present with interbedded siltstones and sandstones of the Waitemata Formation located generally south of the village.

The majority of the area is expected to comprise dune and beach sands, and the proposed sewerage scheme is expected to be constructed on and within these sand deposits throughout much of the site. Localised areas of swamp/peaty material exist in low lying areas, particularly adjacent to the estuary, while residual silts (dacite tuff) are encountered in the northern portion of the Mangawhai Heads area.

Waitemata Group interbedded sandstones and siltstones and or older basement Greywacke rocks are expected to underlie the near surface materials."[19]

A copy of this report is attached as Appendix 1.

Waste Water Treatment Plant Site

With regards to the proposed Waste Water Treatment Plant site, the report prepared by Tonkin and Taylor Ltd indicates that the site is underlain by Quaternary aged fixed dune sands. [20] A copy of this report is attached as Appendix 2.

[19] Tonkin and Taylor Ltd, May 2006

[20] Tonkin and Taylor Ltd, June 2006

Dam Site

With regards to the proposed Dam site, the geotechnical report prepared by Tonkin and Taylor Ltd states that:

> *"The published geology for the area, New Zealand Geological Survey – Whangarei (Scale 1:250 000, ref 1) indicates that the site is underlain by Paleocene aged greensands, argillaceous limestone, and green and chocolate shale with fine flints of the Opahi Formation."*

It is further stated that:

> *"Our site investigations indicate the geology of the low rolling hill country was shown to comprise Northland Allochthon sheared mudstone and shattered limestone. The soils developed on the Northland Allochthon rock mass are generally clay rich and have low permeability with a very defined contact with the unweathered parent rock mass at a shallow depth. Soils developed on the mudstone lithology are prone to shallow creep and are likely to have undergone lateral movement previously."*

A copy of this report is attached as Appendix 7.

Disposal Site

A geological investigation of the proposed disposal site at Lincoln Downs was undertaken by Tonkin and Taylor Ltd, and the report states that:

> *"The geology of the irrigated area of the Lincoln Downs site consists of low rolling hill country underlain by Northland Allochthon sheared mudstone and shattered limestone to the east and steeper hill country underlain by massive dacite volcanic lava to the west. The soils developed on the Northland Allochthon rock mass are generally clay rich and have low permeability with a sharp contact to the unweathered parent rock mass at a shallow depth. Soils developed on the mudstone lithology are prone to shallow creep. The dacite soils are mostly low permeability silts of variable thickness."*[21]

A copy of this report is attached as Appendix 4.

6.2.2 Soils

Mangawhai Heads and Village Area

Section 6 of the Geotechnical Investigation Report prepared by Tonkin and Taylor (refer Appendix 1) sets out the types of soils encountered during the geotechnical investigation. The types of materials encountered included fill (gravel and sand), quarternary sand, cemented sand (Mangawhai Village area),

[21] Tonkin and Taylor Ltd, August 2006

estuarine sand (Thelma Road), dacite silt (northern portion of Mangawhai Heads), and Waitemata group siltstones and sandstones.

Waste Water Treatment Plant Site

The topsoil encountered at the Waste Water Treatment Plant site included organic and humic debris and sandy silt. Quarternary sands were encountered over much of the site, and to considerable depth. The sands were often silty, orange brown, with occasional sandy silt lenses. Sands were typically loose near the surface becoming denser with depth.

Estuarine deposits encountered included loose fine to medium grained sands and firm high plasticity silts and clays. These materials are likely to have been deposited from a water body behind the dunes. The materials consist of clays and silts, and are soft to very still and generally highly plastic. The estuarine deposits were encountered mostly to the eastern part of the proposed treatment site.

Dam Site

Geotechnical investigations carried out at the Dam site by Tonkin and Taylor Ltd encountered variable materials and generally confirmed the conditions described in the Geological Map (Ref 1). The site is generally underlain by Northland Allochthon weathered soils and sheared siltstone and mudstone.

The topsoil included organic and humic debris and sandy silt. It was generally dark brown, wet to saturated and varied in thickness from 0.1m to a maximum thickness of 0.5m.

Organic rich, moist to wet, clayey Silt was encountered in the geotechnical investigations at two boreholes in the centre north of the site. This has been interpreted as some reworked/slope wash colluvium. It is typically of lower undrained shear strength than the soils encountered elsewhere in the investigation. The material was encountered to approximately 2.4m depth and was variable with organic inclusions and boulders of up to 400mm diameter.

Silts and clays were encountered in all of the trial pits derived from weathering of the parent rock mass. The completely weathered Northland Allochthon rock mass typically comprises stiff to very stiff, highly plastic silts and clays. Fissures exist within the upper two or three metres of this material and are thought to have formed from seasonal shrink/swell processes. Below these fissures the soil fabric is commonly highly disturbed with many internal shear surfaces due to down slope movement on the underlying unweathered rock mass.

Below the soil mantle, softened pervasively sheared siltstone/mudstone overlies the unweathered in situ rock mass. Colours within the rock mass vary, and the strength is also highly variable, typically being extremely weak to weak, but some soil strength silt is also present within the rock mass.

The depth of the softened zone is variable across the site ranging from 3 to 4.5m. Slope-parallel shear surfaces are developed on the interface between the softened zone and the upper 0.5m or so of the underlying intact Allochthon rock mass.

Also encountered within this rock mass are moderately strong to strong inclusions of calcareous siltstone and Limestone (encountered at approximately 2.8m depth in one of the test pits amongst the sheared siltstone). Within these rocks, recrystallised calcareous veins are present.

Disposal Site

Eight boreholes were sunk at the disposal site, as shown in the attached Tonkin and Taylor report (Appendix 4). Topsoil was encountered in each of the boreholes with a general thickness of 0.4m. Seven of the eight boreholes encountered geology representative of the Northland Allocthon group. These soils generally comprised completely weathered, light brown, occasionally orange/brown, very stiff silt to a maximum depth of 3.8 m below ground level. Beyond the weathered zone, the soils generally comprised greenish grey siltstone.

In borehole BHI the soils of the Parahaki Volcanics were encountered. The shallow soils were light grey/white with occasional brown layers, which between 2.0m and 3.0m below ground level were predominantly orange silt. To the base of the borehole the geology was represented by orange and pink silt (Dacite Tuff).

6.2.3 Hydrogeology

Mangawhai Heads and Village Area

The geotechnical investigation undertaken by Tonkin and Taylor states that groundwater was encountered in a number of boreholes and several test pits, predominantly those in close proximity to Mangawhai Harbour.

In the Mangawhai village area, water inflows were encountered at three borehole locations, and generally occurred at the upper contact of the cemented sand layer, which indicated that the cemented sand was acting as an impermeable barrier at those locations. The depth of the groundwater encountered in the village area was between 0.8 and 1.0m below existing ground level.

Waste Water Treatment Plant Site

The Tonkin and Taylor report detailing the geotechnical investigation carried out for the proposed disposal site states that saturated materials were encountered at between 5.4 and 6.8m at three of the boreholes. Piezometers were installed in two of these boreholes, and they recorded groundwater levels or between 4.1m and 6.6m. It was noted that the levels were recorded during a prolonged wet period in early winter when groundwater levels would be expected to be high, and it was not anticipated that the levels would vary significantly from those recorded for this reason.

Dam Site

Minor groundwater inflows were encountered at a depth of between 1.5m and 2.2m in 7 of the 9 test pits. Minor inflows were encountered during the drilling of two of the boreholes. The permanent ground water table was not encountered during drilling in the boreholes.

Disposal Site

In a geotechnical investigation of the disposal site by Tonkin and Taylor Ltd, groundwater was sampled and tested from eight monitoring wells. Full laboratory transcripts are provided in the geotechnical report included at Appendix 4 to this report. Deep groundwater samples tended to be sodium and bicarbonate dominated alkali carbonate water. Shallow groundwater samples tended to show a greater spread of water type than the deeper groundwater, although most tended towards calcium and bicarbonate dominated temporary hardness waters.

Bacteriological results show that E coli and faecal coliforms are present in all samples. The results show that all samples exceed the relevant standard. The report recommends that further samples should be collected for analysis to confirm these baseline values.

The investigation revealed an unconfined shallow groundwater system at the site formed in the silts and siltstones, with the potential for upwards vertical flow from depth. All boreholes had water levels measured within 4m of ground surface. Inferred groundwater flow beneath the site is from topographically higher areas to lower areas, and is shown in the attached geotechnical report (Appendix 4).

The groundwater system beneath the site is interpreted as unconfined, with steep hydraulic gradients. These steep groundwater gradients and permeability testing confirm that the aquifer (i.e. the silts and sandstone) permeability is low. Groundwater recharge is likely to be from rainfall in topographically higher areas. Streams and low lying areas are likely to act as discharge areas from the groundwater system, although flow directions may reverse depending on relative levels between surface water and groundwater.

6.2.4 Surface water

The water quality and ecology of the small streams in the area are adversely affected by pastoral development. Increases in organic enrichment, a decrease in dissolved oxygen concentrations and an increase in stream temperatures can be observed, consistent with reduced shading and run-off interception resulting from the loss of riparian vegetation in the stream catchments. Many of the minor creeks and streams have been heavily modified, with most lower streams formed into channels, at least in part, and generally devoid of riparian vegetation. These in turn detrimentally affect the Mangawhai Estuary, effects which are magnified by discharges of human sewage to groundwater and thence the estuary.

6.2.5 Foreshore

The foreshore is largely developed in the Mangawhai area, with dwellings running down to the foreshore or esplanade reserves.

6.2.6 Mangawhai Estuary

Monitoring of the estuary has been undertaken since 1976 and has shown frequent instances of sewage contamination in excess of accepted guidelines. This was confirmed again in 1990 when a Northland Regional Council study found pollution in the groundwater and recommended the disposal of sewerage away from the Mangawhai Heads settlement. A survey by the Kaipara District Council shortly after found that the majority of on-site disposal systems were faulty, either through poor maintenance, limited drainage fields or inappropriate soil conditions. If further evidence were needed to confirm that a sewerage plant was essential, a 1996-97 Northland Regional Council commissioned water and shellfish quality study showed that 50 per cent of shellfish sampled in the estuary had contamination levels more than ten times accepted guidelines. A further study, the Mangawhai Planning Study, completed in 1997 confirmed contamination of the harbour and groundwater, and identified a public health risk with sewerage in open drains in the settlements.

6.2.7 Health and safety issues

The dominant health and safety issue associate with wastewater is the exposure of people to potentially pathogenic organisms sometimes found in waste water. These organisms can be broadly classified into one of four types:

- Viruses, for example, enteric viruses that can cause stomach upsets
- Bacteria, for example, salmonella and typhoid
- Protozoa, for example, giardia and cryptosporidium
- Helminths, for example beef and pork tapeworms

The Northland Regional Council's Recreational Bathing Survey 2004-05 concluded that the overall water quality within the lower Mangawhai Estuary complied with the bacteriological guidelines for recreational bathing on most occasions. There was only one occasion when the Faecal coliform and Enterococci levels exceeded the threshold limit, which was not strongly correlated with rainfall.[22]

Water quality monitoring for the purpose of assessing the suitability of microbial water quality for recreational shellfish gathering was undertaken at a number of popular recreational shellfish gathering sites during summer 2004-05. This monitoring was done concurrently with the marine recreational bathing water quality programme.[23]

[22] Northland Regional Council, *Annual Environmental Monitoring Report: Recreational Bathing Water Quality 2004-2005*

[23] Ibid, *Annual Environmental Monitoring Report: Recreational Shellfish Gathering Water Quality 2004-2005*

This programme involved testing concentrations of faecal coliform bacteria in coastal waters at popular shellfish gathering sites. Seventeen individual sites were monitored at weekly intervals on 10 separate occasions from December 2004 to mid-February 2005. The guideline for recreational shellfish gathering water quality is a median faecal coliform count not exceeding 14 per 100 ml over a shellfish-gathering season and not more than 10% of samples exceeding 43 per 100 ml. Non-compliance with either of these parameters indicates that the waters are not suitable for the purpose of recreational shellfish gathering.

Table 6-1: Faecal Coliform Levels at Mangawhai

Area	Median Faecal Coliform (# per 100ml (MPN))	Number of Samples Exceeding 43 Faecal Coliform per 100ml	Number of Samples Collected
Mangawhai	*17*	*2*	9

Mangawhai exceeded the median faecal coliform limit of 14 per 100 ml and had two samples that exceeded a faecal coliform count of 43 per 100ml. It is acknowledged that these results are indicative only, as they were not collected over an entire shellfish-gathering season (which would be year round in Northland) and more samples are required to have reasonable certainty in testing for compliance with the standard. Nevertheless, these data provide a reasonable snapshot of the suitability of water-quality for recreational shellfish gathering purposes in the areas assessed.

6.3 Construction and operational effects of the proposed Mangawhai Ecocare sewerage scheme

6.3.1 Crossing of Coastal Marine Area

Presently there are three crossings of the coastal marine area (CMA) proposed. These relate to:

- 2 crossings of the CMA on the bridge on Molesworth Drive by two pipelines, one carrying raw sewage (250mm), and the other carrying treated effluent (250mm) destined for the disposal site (NZMS 260 1980 Mangawhai R08 527 646). These crossings are identified as point 1 on the attached plan titled *"Mangawhai Ecocare Scheme – Locations of Watercourse Crossings"*

- Crossing of the CMA by one pipeline carrying raw sewage (250mm) on Molesworth Drive where it crosses Mangawhai River. This crossing is identified as the southernmost crossing of point 2 on the attached plan titled *"Mangawhai Ecocare Scheme – Locations of Watercourse Crossings"*

The route of the pipelines to and from the WWTP in Thelma Road crosses the coastal marine area on the causeway and bridge linking the Village and the Heads. The works will take place in the road margins.

One watercourse, Bob Creek, which is within the CMA, drains through the western extremity of Mangawhai Village and through land included within the Ecocare Drainage District. Despite the land being within the drainage district, the reticulation network will not extend as far as Bob Creek.

Crossings of Piped Water courses

The Ecocare scheme involves a number of crossings of piped watercourses. These are shown below in Table 6-2.

Reticulation

Reticulation sewers in the Heads and Village areas are located in either residential property or public road reserves. A number of crossings of the local street drainage will be required. As these watercourses are not identified on the 1:25,000 topographical plans we understand that consents are not required under Rule 29.1.9 of the Regional Water and Soil Plan for Northland.

Nevertheless, Earth Tech intends to manage all its construction activities in a manner that prevents run off of water and soil particles into the drainage network. This is dealt with elsewhere in the document.

Rising Mains and Reclaimed Water Transfer Pipeline

The decision to locate the rising main from the Village to Mangawhai Heads in the road shoulder of Molesworth Drive has been made because:

- It allows for the easiest means of construction with ready access to the work site
- Avoids the need for intrusion into private property
- Facilitates access to the pipelines should future maintenance works be required

The consequential benefit is that this location simplifies the crossings of the work within the Coastal Marine Area along Molesworth Drive.

Excavation works near, above or under a piped watercourse will have no impact in itself on the ecology, amenity, recreational, cultural or other matters as the work will be contained within areas already disturbed. Indeed co-location is the superior in such circumstances, as additional disturbance will be minimised.

Table 6-2: Crossings of Piped Watercourses within the CMA

Scheme Component	Location	Name of Watercourse	Description	Within CMA
Rising Mains	Molesworth Drive – near Estuary Estate Crossing 2 (south)	Unnamed (1)	• Rising main will be in road shoulder. • Water course will be piped under road • Rising main will cross over piped water course.	Yes

However of particular importance will be to ensure that construction works are confined to the intended area (viz close to the road shoulder) and comply with the standard Soil management techniques.

The objective will be to ensure that excavated material is not stockpiled in areas adjoining the watercourse crossing if potential exists for the material to be washed into any open drain that leads into the watercourse.

Backfilling of excavations is also important to eliminate the potential for soil to be washed into the watercourse. Trenches backfilled with loosely compacted clay or silt can lead to soil being washed into the watercourse during rainfall. In this instance, as the pipeline will be located in or near the road shoulder a crushed rock material will be used to ensure that adequate trench compaction can be achieved without undue delay. Whilst this technique is adopted mainly to ensure that vehicular road traffic do not get bogged if they park on the road shoulder, it also protects the watercourse from loose material being eroded away.

Other standard soil management techniques which serve to protect the watercourse are addressed elsewhere in the AEE.

Bridge Crossing of Estuary

The crossing of the estuary will involve construction of 2 separate pipelines suspended from the existing bridge. The two pipelines are:

- Rising main which transfers wastewater from the Village to the Mangawhai WWTP, and
- Effluent transfer pipeline which transfers the treated effluent to the reclaimed water enterprise at the Lincoln Downs property

Both of these pipelines are 250 mm diameter.

In developing the design for the bridge crossing consideration has been given to Sections 35.3.1, 36.3, 36.03.01, and 41 of the Water and Soil Plan for Northland.

The installation of the pipeline across the Mangawhai Estuary is an important component of Kaipara District Council's strategy to improve the health of the estuary through implementation of the sewerage scheme. In particular the bridge crossing will allow sewage from both the Heads and the Village to be conveyed to the one location to enable a single WWTP to be established. The bridge crossing also allows the treated effluent to be efficiently conveyed to the site of the reclaimed water reuse enterprise.

A significant potential that needs to be considered is the potential for the pipeline to be damaged resulting in wastewater discharging into the estuary. For bridge crossings, the fact that the pipeline is visible raises the prospect that people may attempt to climb onto the pipe. Without having sufficient strength the pipeline could potentially have its joints dislodged or have its fixings to the bridge broken. In either case the result would be release of wastewater into the estuary.

To ensure that this circumstance does not arise, the pipeline across the bridge will be designed with the:

- pipe enclosed within a sleeve pipe
- sleeve pipe would be constructed in steel with flanged joints
- fixings to the bridge spaced at six metre intervals (to coincide with the pipe joints)
- sleeve pipe and fixings designed to withstand the weight of the:
    - pipe conveying the wastewater (carrier pipe),
    - steel pipe itself
    - rain water which could drain into the void between the steel sleeve pipe and the carrier pipe (unlikely circumstance)
    - an adult hanging from a pipe

As a consequence of attaching the pipeline to the bridge in lieu of passing it under the estuary, potential impacts on the environment (such as erosion of the bed or shore of the estuary, sediment control, impact on aquatic life) will be reduced to the area where the pipe exits the ground to join the bridge. In particular:

- The works will have no impact on the aquatic habitat or fish migration patterns.
- The works on the bridge can be undertaken at any time of year without causing any adverse effect on water quality.
- Having the works isolated from the environment will eliminate environmental concerns with regard the length of time required to complete construction. (However, construction will need to be planned to minimise impact on vehicular traffic.)
- Bypass flows are not required and aquatic life will, therefore, be unaffected.
- Drainage patterns or flooding potential will remain unaltered by the proposed works.

- It is understood that the bridge has no heritage value.

As the pipeline will be constructed at the deck level of the bridge structure it will not interfere with the recreational uses in the estuary. Also having the pipeline adjoining the bridge preserves the amenity of the area.

The alternative to a bridge crossing over the estuary is to directionally drill a pipeline under the estuary bed. This approach would involve significant risks which make it an unacceptable option in the circumstances where the pipelines can be accommodated on an existing structure.

Directional drilling is a technique that is commonly used for construction of pipelines under water bodies. A drilling head creates a borehole. Initially the borehole is relatively small. The drilling process is repeated with a larger drilling head to achieve the desired borehole diameter.

For this method to be successful, self supporting soils are required. In other words, after drilling has been completed, the borehole needs to remain stable long enough for the pipeline to be inserted into it. Soft clays, sands, or wet material will lead to the borehole collapsing and prevent the insertion of the pipeline.

Geotechnical investigations undertaken along Molesworth Drive on the approaches to the bridge reveal that the soils are of a sandy nature and unsuitable for drilling. Further geotechnical investigations would intrude into the estuarine environment and have therefore not been undertaken. Attempting to drill under the estuary would be a risky exercise without a guarantee of success. Hence drilling is considered an inappropriate method of construction in this case.

Consultation meetings were held with TUOH and Department of Conservation in which plans of the scheme were presented and a briefing of the key aspects was delivered (July 2006). Consultation meetings with the public at large have been held in January 2006 and July 2006 in which plans were displayed and made available to interested individuals. No comments have been received in respect to the bridge crossing.

6.3.2 Crossing of Watercourses Outside CMA

Crossings of Piped Water courses

The Ecocare scheme involves a number of crossings of piped watercourses. These are shown below in Table 6-3.

Reticulation

Reticulation sewers in the Heads and Village areas are located in either residential property or public road reserves. A number of crossings of the local street drainage will be required. As these watercourses are not identified on the 1:25,000 topographical plans we understand that consents are not required under Rule 29.1.9 of the Regional Water and Soil Plan for Northland.

Nevertheless, Earth Tech intends to manage all its construction activities in a manner that prevents run off of water and soil particles into the drainage network. This is dealt with elsewhere in the document.

Rising Mains and Reclaimed Water Transfer Pipeline

In developing the design for the crossings of watercourses that are piped (viz: along Molesworth Drive) consideration has been given to Sections 35.3.1, 36.3, 36.03.01, and 41 of the plan.

The decision to locate the rising main from the Village to Mangawhai Heads has been made because:

- It allows for the easiest means of construction with ready access to the work site
- Avoids the need for intrusion into private property
- Facilitates access to the pipelines should future maintenance works be required

The consequential benefit is that this location simplifies the crossings of the two watercourses along Molesworth Drive.

Excavation works near, above or under a piped watercourse will have no impact in itself on the ecology, amenity, recreational, cultural or other matters as the work will be contained within areas already disturbed. Indeed co-location is the superior in such circumstances, as additional disturbance will be minimised.

Table 6-3: Crossings of Piped Watercourses outside CMA

Scheme Component	Location	Name of Watercourse	Description	Within CMA
Reticulation	N/A – Refer to body of report	N/A	N/A - refer to body of report	No
	Molesworth Drive – near Old Waipu Road Crossing 9	Unnamed (2)	• Rising main will be in road shoulder. • Water course will be piped under road • Rising main will cross over piped water course.	No
Reclaimed Water Transfer Pipeline	Within Estuary Estate Crossing 2 (north)	Unnamed (1)	• This portion of the pipeline is within land subject to a new development proposal • The alignment of the pipeline and the location of the crossing of watercourse will be developed in conjunction with the developer as he prepares his proposal and his application for resource consents	No

However of particular importance will be to ensure that construction works are confined to the intended area (viz close to the road shoulder) and comply with the standard Soil management techniques.

The objective will be to ensure that excavated material is not stockpiled in areas adjoining the watercourse crossing if potential exists for the material to be washed into any open drain that leads into the watercourse.

Backfilling of excavations is also important to eliminate the potential for soil to be washed into the watercourse. Trenches backfilled with loosely compacted clay or silt can lead to soil being washed into the watercourse during rainfall. In this instance, as the pipeline will be located in or near the road shoulder a crushed rock material will be used to ensure that adequate trench compaction can be achieved without undue delay. Whilst this technique is adopted mainly to ensure that vehicular road traffic do not get bogged if they park on the road shoulder, it also protects the watercourse from loose material being eroded away.

Other standard soil management techniques which serve to protect the watercourse are addressed elsewhere in the AEE.

Pipeline crossing of watercourse in Estuary Estate

The reclaimed water transfer pipeline will cross a watercourse within the proposed Estuary Estate.

At this stage detailed design work has not commenced because it is intended to coordinate the alignment with the allotment and road configuration proposed by the developer. Whilst precise alignment details cannot be provided yet, the potential for the Estate Developer's plans to be delayed has been considered. In such circumstances the Ecocare scheme would need to proceed regardless and a suitable alignment chosen with the estate.

The location of the crossing will be towards the northern edge of the estate. In this region, the site is already transversed by a driveway the leads to the existing homestead. This existing crossing provides an opportunity for the pipeline to cross the waterway without adverse impact on the waterways.

The techniques proposed will be the same as for the piped watercourse crossings described above.

This location is at the head of the watercourse's catchment. Accordingly the volume of water within the watercourse is low. Construction can be programmed for drier months to provide additional protection against the potential for excavated soil to be inadvertently discharged into the watercourse.

6.3.3 Stream crossings

A minimum of eight consents are required in terms of the Section 29.01.03 of the Regional Water and Soil Plan for Northland. These relate to the discharge pipeline that is proposed to run from Thelma Road via Molesworth Drive, through the Estuary Estate, up Old Waipu Road, to Cove Road, thence to Tara Road, and across private property between Tara and Brown Roads. In the latter section five stream crossings are to be undertaken. On Brown Road en route to the disposal site, a further crossing will be undertaken. In general, work is to be undertaken during the construction season. With streams where low environmental values pertain, for example, cattle have access to the streams, or there is little riparian vegetation, trenching across the stream beds during low flow periods is proposed.

Watercourses in Farmland

The Ecocare scheme involves a number of crossings of watercourses within farmland. Each of these crossings relates to the 250 mm diameter reclaimed water pipeline.

These can be categorised into three types:

- Crossings adjoining existing culvert crossings
- Crossings through bed of watercourses
- Boring under watercourses

The details of each crossing are set out in the accompanying table.

Crossings adjoining existing culvert crossings

In two locations (within the Wintle property and along Brown Road) a watercourse is already crossed by a suitable bridge and culvert structure. In these instances the reclaimed water pipeline will cross over the watercourse at the same height and alignment as the bridge in a position immediately adjacent to the bridge.

The pipe will be encased in a steel sleeve which will span the entire length of the crossing. The sleeve will be designed in a similar fashion to the sleeve adopted for the estuary crossing. However, because the pipe will span the entire length of the crossing, there is no need for fixings to the bridge.

As a consequence, passing over the watercourse will reduce potential impacts on the environment such as erosion of the watercourse bed, sedimentation, and impact on aquatic life. In particular:

- the works will have limited impact on the aquatic habitat
- the watercourse will be protected against erosion.
- the works can be undertaken at any time of year without causing adverse effects on water quality
- bypass flows will not be required and aquatic life would be unaffected.
- drainage patterns or flooding potential will remain unaltered by the pipeline

On the edges of the watercourse where the pipeline will transition from being within a trench to within a sleeve pipe, the ground will be stabilized with concrete and rock spalls. This will prevent erosion from occurring around the junction.

The sleeve pipe will be extended into the firm ground abutting the watercourse and founded on concrete supports. The alignment of the pipeline will be approximately 1-2 metres separated from the culverts to ensure that any movement in the existing structure does not cause any stress on the pipeline structure.

During concreting, sedimentation protection will be put in place. Depending on the stream slope, either hay bales or sediment fences will be used.

Table 6-3: Watercourse crossings and proposed method of crossing

Type of Crossing	Location	Name of Watercourse	Description
Adjoining Culvert Crossings	Private Property between Tara and Brown Roads:- Crossing of minor water course, Wintel Property	Hakaru River Tributary (crossing 3)	Minor watercourse crossed by existing formed farm race and concrete culverts
	Brown Rd	Cook Creek (crossing 8)	Creek passes under Brown Road through concrete culverts
Crossings through bed of watercourses	Private Property between Tara and Brown Roads:- Crossing of minor water course, Brunt Property	Hakaru River Tributary (crossing 4)	Minor watercourse crossed by existing concrete culverts and cattle path
	Private Property between Tara and Brown Roads:- Crossing of minor water course, Bygrave Property	Cook Creek Tributary (crossing 6)	No formed crossing at present
		Cook Creek Tributary (crossing 7)	
Crossing under bed of watercourse	Private Property between Tara and Brown Roads:- Crossing of watercourse, Brunt Property	Hakaru River (Crossing 5)	Pipeline to cross under watercourse

Crossings through bed of watercourse

Three of the crossings (one in the Brunt property and two in the Bygrave property) involve crossings of that can be constructed by open excavation through the creek bed. A photograph of the crossing in the Brunt property is shown below.

In these instances the watercourses are ephemeral or have very low water flows.

Construction will occur in summer, when the flows are lowest and at a time when rain is not forecast. The actual construction method would be tailored to suit the flow conditions prevailing at the time. These methods include:

- temporarily installing a formed flume to allow flow to continue without interruption while excavation proceeds under the flume
- constructing a temporary diversion to the watercourse to allow water to flow without interruption while excavation occurs through the bed of the watercourse
- temporarily stopping flow and constructing through the watercourse bed, reinstating and then allowing flow to resume

The base of the pipeline trench would be approximately one metre below the bed of the watercourse. If the bed was very soft the depth might be deepened in order to avoid the risk of erosion during floods.

The pipe itself would be bedded and fully surrounded on course single sized aggregate (20mm nominal size). The thickness of the aggregate material over the pipe would be 100mm. Above this would be a 300 mm layer of selected natural material. Overlying this would be a 150 mm thick reinforced concrete slab which would be approximately one metre wide and founded on firm material. Overlying the concrete slab would be rock spalls.

The concrete slab will provide both protection to the pipeline and prevent erosion. Having the concrete slab separate from the pipeline ensures that the pipeline can move independently of the slab. The rock spalls would be approximately 150 mm in size and would also prevent erosion.

The reinstatement measures proposed will ensure that there is no adverse impact on the environment in the medium- or long- term.

Given that this type of watercourse crossing is proposed only in land subject to dairy production, the aquatic life within in the watercourse is very limited. Coupled with the low flows and the ability to time construction to suit the most quiescent periods, the impact on the environment during construction is very limited.

Boring under watercourses

The most significant watercourse crossing within farmland is the crossing of the Hakaru River.

Earth Tech has consulted with the adjoining landowner, Mr Bygrave, concerning the location of the pipeline on his property. However the precise location of the pipeline's crossing of the Hakaru River has not been finalized. The objective will be to site the crossing so it:

- causes least inconvenience to the landowner and
- allows the requirements of Sections 35 and 36 of the Regional Water and Soil Plan to be achieved

The Hakaru River has a large catchment upstream of the Bygrave property and therefore the higher and more constant water flows are expected. Therefore prospects of trenching through the river bed satisfactorily are limited.

In this instance it is proposed to directionally drill underneath the river bed.

Directional drilling is a technique that is commonly used for construction of pipelines under water bodies. A drilling head creates a borehole. Initially the borehole is relatively small. The drilling process is repeated with a larger drilling head to achieve the desired borehole diameter.

The first step in the drilling process is for a 50 mm diameter pilot hole to be drilled. If in drilling the pilot hole obstructions or problem soils are encountered, the pilot hole can be abandoned and drilling repeated on a modified alignment or depth. Once a pilot hole has been successfully completed across the full length of the bore, the hole is reamed with a larger drilling head. This process increases the diameter of the borehole. It is not unusual for two or three reaming operations to be undertaken to progressively increase the diameter of the pilot hole to the final diameter. In conjunction with the final reaming operation the sleeve pipe is introduced into the borehole.

One of the main construction issues faced by the directional driller is the potential variation in ground conditions. As with any form of drilling or boring sub surfaces conditions can alter significantly throughout the length of the drill (or bore).

Hard rock can be managed successfully by using heavier drilling heads and cutters. Of more concern is an abrupt change in hardness. For instance, if drilling through soft clay, encountering a boulder will cause a problem. Running or wet sand also pose problems. Typically variations in soil conditions are managed

by the driller without much concern. As a result the technique is widely adopted for service crossings under major highways or rivers.

For this method to be successful, self supporting soils are required, that is, after drilling has been completed, the borehole needs to remain stable long enough for the pipeline to be inserted into it. Soft clays, sands, or wet material will lead to the borehole collapsing and prevent the insertion of the pipeline.

Geotechnical investigations will be undertaken to confirm that the technique will be satisfactory at this location.

Boring will be at a sufficient depth that the riverbed will not be affected. The pipeline will be installed in a polyethylene sleeve to minimise damage in the unlikely event of a failure in the disposal line. All material sourced from excavations will be stockpiled away from drainage paths, or will be located uphill from sediment fences or hay bales, depending on the quantity of material.

As a consequence potential impacts on the environment such as erosion of the watercourse bed, sedimentation, and impact on aquatic life will be mitigated, and the likely impacts on the Hakaru River will be negligible.

6.3.4 Visual and landscape effects

The proposed layout of the reticulation system is shown on the plans for the area. With the exception of the switchboards, similar in size to Montrose boxes, at the pump stations, and the ground level evidence of access hatches, there will be no visual evidence of the system once it is constructed. This is particularly so since the bulk of the work will located in the road reserve. Positioning of the pump stations is, however, determined by the characteristics of the networks, and the manner in which they intersect.

Furthermore, the proposed system will largely avoid areas of established vegetation. Final detailed design will be undertaken taking careful consideration of major trees and where possible these will be avoided.

In respect of the WWTP, the plant's location within Mangawhai Park and its elevation a critical 6 metres above nearby residences is sufficient to render it largely unseen except from elevated land some distance away. Even as the park is developed, the location of the WWTP in the western corner of the site should mean that it remains tucked away out of sight. Nor is its utilitarian aspect necessarily inharmonious with the rural-residential character of nearby properties.

As with the Mangawhai Heads and Village reticulation, the line to the disposal site will have limited visual or landscape impacts once construction is complete. Construction will take place entirely in the road reserve, except for the bridge crossings and the segment through the Bygrave-Wintle-Brunt properties. In these cases discussion has been commenced with the landowners as to the best route that suits their purposes, and in all cases is through farmland.

At the disposal site, the significant element in the landscape will be the 'turkey's nest' dam that will be constructed on a ridge line. The proposal is to undertake a cut and fill construction, so that all of the material for the dam's construction will come from the material cut from the ridge top. The effect will be

to cut down to a degree the top of the hill, and to build it up again, so that there is an internal depth of about 5m. The comparative flatness of the top of the ridge is such that the dam will not have an unduly dominating aspect in the general landscape (although the activity of dam construction is a permitted activity and thus not susceptible to assessment with a view to relocation for landscape reasons). Spare material from the trenching operations will be used to batter the external slopes of the dam, in order to reduce the angle of the slope, which will generally be 1:3, that is, not overly steep. Prospects for moving the dam for other than engineering reasons are also limited by the location of two high pressure lines that cross the ridge in a north-south direction. These are the Westfield to Whangarei high pressure gas line administered by Vector, and the oil pipeline that runs from Marsden Point to the Wiri oil terminal in Auckland. The easement for these is 20m. Although likely to be a landscape element that attracts the eye because of the redefinition of the ridge top, no landscape assessment is required, as the construction of the dam is a permitted activity in terms of the district plan.

Finally, the reclaimed effluent disposal system will look like any other farm irrigation system, consistent with the type of equipment seen in the rural environment.

6.3.5 Ecological effects

The installation of the reticulation network in the Mangawhai Village and Heads will be largely confined to modified road reserve areas and accordingly will be isolated from any existing terrestrial or marine features of ecological significance. A number of crossings of the local street drainage system will be required. In these areas construction techniques will be used that minimise discharges to the drainage system, as set out in the section on erosion and sediment control. Accordingly, no damage or disturbance of any notable ecological or natural habitats areas of significance or value will arise. In the coastal marine area, the pipelines will be placed in steel sleeves and slung alongside the bridge, or will be buried in the road shoulder above the culverts where the coastal marine area has been piped.

The replacement of the existing soakage method of waste water treatment and disposal throughout the area will alleviate existing sewage discharge into the groundwater system and subsequent discharges into the estuary in particular. Accordingly the proposed reticulation systems will provide significant environmental benefits to the Mangawhai area.

In relation to the disposal site, the effects of discharging reclaimed effluent to soil is likely to be of limited impact on account of the soil conditions, the disposal method, and the quality of effluent. In particular:

- Pathogen numbers are likely to be low because the effluent quality will be high, residence times in the storage dam will average five months, and organic matter will have been removed previously at the WWTP
- Salt and sodium loadings are likely to be low because of the high winter rainfall onto the surface of the storage dam
- Heavy metals will be low because the effluent will be almost entirely domestic in origin

- Hydraulic loadings will be low because the soil deficit model will be used, and the area of land sufficient for the purpose
- Spray irrigation systems will be designed according to the soil type and will be operated accordingly [24]

Natural hazards

The reticulation system within the Mangawhai Village and Heads area is widely underlain by sand and silt deposits. Silty dacite tuff is present in the northern part of the area. A cemented sand layer exists at relatively shallow depths in the Village area. Significant parts of the road reserves have fill material. Generally there are no natural hazards identified, although certain geotechnical issues will need to be addressed, for example, to ensure the temporary stability of trenches, particularly where the water table is high.

Otherwise there are no natural hazards identified that would lead to land stability issues.

6.3.6 Noise effects

Construction noise

The nature of the work is such that construction of the reticulation system and pump stations within the Mangawhai Heads and Village will be such that it will not be undertaken during the peak holiday periods. Rather the concentration at this stage will be on elements of the project more distant from the built-up area. During construction of the plant, compliance with NZS 6803: 1999 Acoustics: Construction Noise will be achieved.

Pump stations

Within topographical constraints, the pump stations have been located to minimise nuisance to residents. The pump stations proposed for the Mangawhai scheme will consist of below ground, reinforced concrete structures with reinforced concrete roofs and tight-fitting solid aluminium covers of normal design standards. This type of structure is typical of sewage reticulation pump stations. The pump stations throughout the area will generate limited noise from mechanical action of the pumps and from blowers, where used.

Noise from pumping cannot be completely avoided but will be reduced by immersion of the pump in the effluent. The pump stations will be concrete structures, which in turn will assist in reducing noise. In

[24] RMCG, op cit Appendix 8 Option 1

addition, the lids will be either concrete or thick steel, a further acoustic barrier. Finally, the pumps will operate intermittently in response to the levels of waste water flows from the catchment

Although noise cannot be completely avoided, pump station noise is unlikely to be an issue with this type of structure because:

- the in-ground concrete structure will provide an effective barrier to noise transfer
- pumps will be partially or totally submerged, which will allow for absorption of noise within the pump well
- influent drops will be designed for minimum turbulence, which will avoid noise from influent wastewater dropping into the wet well

In respect of switchboards, most will not have variable speed drives, although provision of some insulation around fans where they are provided would be prudent.

Treatment Plant

Noise from construction of the plant will be controlled by the provisions of NZS 6803: 1999 Acoustics: Construction Noise.

The main risk of noise detectable outside the WWTP will be associated with operation of mechanical equipment. Some noise will occur from the passage of wastewater into tanks, for example, from the CASS/IDEA process into decant weirs, and effluent passing into holding tanks, but the low flows and use of normal design practise to minimise excessive turbulence will result in this being a local noise not detectable at the rural residential site boundary.

Certain mechanical units, such as the inlet works, will be sealed for odour control reasons, which will further mitigate noise.

The pumps, inlet screens and other mechanical items will be relatively small. However, the aeration system blowers will be typically high speed units, and will produce noise potentially detectable outside the plant. To manage this, the blowers will be provided with acoustic enclosures capable of reducing the noise emitted to 75 dBA, and silencers. This level permits short term exposure in the relevant equipment room without significant OHS issues (although wearing of ear protection will still be required).

Further attenuation will be incorporated into the building design, by selection of appropriate materials during detail design. This includes consideration of:

- use of a sound absorbing material, such as concrete masonry, for the walls of the blower building, and
- use of acoustic cladding on the walls of the blower room.

Other buildings will not require consideration of sound attenuation.

The design of aeration pipe work also requires some care to ensure that noise is not transmitted from the blowers through the pipe work. Pipe work is typically thin walled, and may require use of anchors with sound absorption mats on pipe work between the blower building and CASS/IDEA tanks. Control of pressure change rates is also likely to be an issue, and the design will include consideration of pressure release valves on the aeration pipe work to manage this issue.

The location of the WWTP approximately 6m higher than the nearby residences, the distance from residences, and the construction of the 1.5m earthen bund will provide sufficient attenuation of noise from the plant. However, should the council have concerns on this matter, a review clause, either for production of an acoustic report to confirm satisfaction of the requirements once detailed design is completed, or for a review of the recommended noise condition to the designation would be acceptable.

Disposal line and disposal site

The location of the lines in the road reserve will mean that, once construction is complete, noise emanating from the system will be minimal. At the disposal site, operation of the system would be consistent with normal farming practice.

Conclusion

Overall, provided the above actions are undertaken, noise from the various elements of the project, pump stations, WWTP and reticulation is unlikely to cause disturbance to neighbours and the effects on residents would therefore be likely to be no more than minor.

6.3.7 Air quality effects

General

With regard to the design process, the pump stations and wastewater treatment plant design has been undertaken utilizing direct experience of odours emanating from pump stations in similar beach side holiday townships, the assessment of odour complaints and the installation of equipment to control such odours.

The first objective of the design has been to adopt a preventative approach to odour by eliminating the conditions that give rise to odour. Reference has been made to the *"Hydrogen Sulphide Control Manual"* (which was produced by the Technological Standing Committee on Hydrogen Sulphide Corrosion in Sewage Works – a committee appointed by the Major Urban Water Authorities of Australia).

The second objective has been to provide a curative approach to manage odour where preventative efforts are insufficient to prevent odour problems.

In terms of monitoring, an odour management plan would be developed to ensure that resource consent conditions are being complied with. Earth Tech will have full time operators living in Mangawhai and as part of their routine maintenance activities, they will action the odour management plan. This would include:

- documenting the potential sources of odour
- identifying the most critical elements in the scheme/asset that lead to the odour generation risk
- establishing the operating techniques required to successfully manage odour risk
- providing appropriate training and on going supervision to ensure that they are able to effectively monitor performance
- periodic checks on the:
    - operation of fans at pump stations
    - filters (in line with manufacturers requirements) at pump stations
    - integrity of equipment seals
- ensuring that sewage discharges from industry are appropriately monitored and conditions in any Trade Waste agreements are being complied with
- documenting odour complaints and observations

Reticulation system

As the Mangawhai scheme is a new scheme actual odour data does not exist in order undertake dispersion modelling. As such Earth Tech has undertaken its assessment on the basis of experience of:

- investigating odour problems in existing beachside resort townships (similar to Mangawhai)
- understanding of the factors required to allow formation of H_2S(hydrogen sulphide)
- predictive analysis
- products on the market for odour control

For wastewater of domestic origin, the generation of H_2S is the most significant cause of odour concerns. Other potential sources of odour emanate from industrial and trade waste enterprises, which represent an insignificant component of the total wastewater flows.

The generation of hydrogen sulphide requires all three of the following elements to be present:

- Anaerobic conditions (related to the time sewage is detained in system)

- Available sulphur (related to the wastewater characteristics)
- Suitable micro-organisms (related to the wastewater temperature and velocity)

Control (in the sense of prevention) of odours associated with hydrogen sulphide requires control of one or more of the above elements.

Once the H_2S has been formed, for it to create an odour problem it must reach the gaseous phase in detectable concentrations. Release to gaseous phase can happen through two mechanisms:

- release of soluble H_2S when turbulence is experienced, and
- through transfers to maintain an equilibrium at the air-wastewater surface

Analysis

The prediction of probable rates of formation H_2S of in wastewater has taken into account each of the factors described above.

As temperature, and the time sewage is retained within the system will vary on both a seasonal and daily basis, the predictive analysis has been carried out for both peak- and off-peak conditions.

Table 6-4 (below) details the results of the analysis for each pump station. It shows that of the 10 reticulation pump stations designed by Earth Tech to service the pre 2001 developed area:

- 3 would not release detectable quantities of H_2S
- 1 requires minor preventative action
- 6 require more sophisticated preventative action

With regard to the other 5 pump stations which are required to service new estate developments, details of odour control facilities will be determined once the respective developers have completed detailed design of their own sewer networks within their own estate.

In addition to the proposals outlined below, the applicant accepts that a review condition should be attached to the discharge to air consent that requires monitoring, and, if the need is identified either through monitoring or through feedback, that retrofitting with odour control devices be undertaken.

Required Actions

Analysis for Mangawhai are typical of that expected for beachside township experiencing a large influx of people during the summer holiday season. Odour management techniques adopted for this scheme have proven themselves to be simple and trouble free in many similar situations.

For each pump station in which the quantity of H_2S is below detectable limits normal good design practise is proposed. Such practise is applied for the associated gravity catchment and rising main, and includes:

- Reducing turbulence in system to minimise release of H_2S from solution
- Keeping pipeline velocities high enough to strip slimes that harbour micro-organisms from pipe walls.

For the 3 pump stations that require minor preventative action, a ventilation fan is required. The fan would be located in the switchboard and blow air **into** the pump station at a minimum of 3 changes of air per hour. Preliminary estimates of required capacity included in Table 6-4. The pump station **must** also have a vent pipe discharging at least approximately. 2 - 3m above the top of the pump station.

The ventilation fans, where provided, would run continuously and would have a small motor size (30 m^3/h equates to around 0.2 kW or, with a filter, around 0.4 kW).

For the 6 pump stations that require more sophisticated preventative action a ventilation fan is required as above. In addition the fan would be supplemented with a discharge vent pipe (still discharging at least approximately. 2 - 3m above the top of the pump station) fitted with an activated carbon filter capable of coping with the mass H_2S load nominated in Table 6-4.

Management issues

There are a number of critical aspects to successful operation of activated carbon and similar chemical filters for odour control:

- realistic determination of odour load
- adequate design detailing
- proper maintenance

When activated carbon filters came onto the market, certain types failed to deliver the desired outcomes. This has been attributed to the unit being sensitive to humidity. Newer filters do not have the same sensitivity to humidity, but they do have the same sensitivity to proper design and operation.

The importance of these items is discussed below.

(1) Odour load

Equations for estimating H_2S load have improved in recent years, based on an improved understanding of the chemical processes which occur in sewers. One of the key aspects discussed is contact between microorganisms and sulphur. There is a view that this can only happen while sewage is flowing along the sewer. However Earth Tech considers this view to be somewhat optimistic, as it does not allow for microturbulence after pumps stop. Accordingly, Earth Tech has taken such effects into account and present a conservative estimate of H_2S generation.

Having generated the H2S, an odour will only occur if the gas transfers to the atmosphere. Earth Tech has allowed for this in two ways:

- phase transfer across the surface in response to partial pressures
- release generated through turbulence, which increases contact between wastewater and air (particularly if any droplets occur)

Appropriate design detailing will help to minimise release through turbulence.

The releases adopted as a result of turbulence are based on guidelines developed by the US Water Environment Federation.

(2) Design detailing

It is of fairly obvious importance to ensure that the air flow is directed as intended - i.e., through the filter. Hence, a certain amount of airtight construction is required to ensure that no leaks occur which release odours elsewhere. A small leak is potentially detectable.

A further key factor is that ventilation should be achieved by positive pressure ventilation - i.e., by blowing air into the wet well. Where ventilation is installed which draws air out of the wet well, the pressure is lowered, and increased transfer of odorous gases across surfaces (particularly droplet surfaces) will result. The effect of this can be significant.

In addition, minimising turbulence will minimise release of odorous gases.

(3) Proper maintenance

Activated carbon and other chemical filters are not capable of indefinite life. At some point the filter will become exhausted, and the media will need replacement. On small filters as are proposed for this project, it is fairly common to take a precautionary approach and replace the media every year or two, as it is a relatively inexpensive exercise.

In addition, it is important that maintenance recommended by suppliers (e.g., emptying water traps) be performed as required.

Table 6-4: Pump Station Odour Control Measures

Pump Station	Season	Hydraulic Retention Time (hours)	Mass release H_2S > 0.5 kg/d?	Equilibrium concentration > 70 ppm (v/v)?	Recommended Actions
Mangawhai Heads Pump Stations					
A: - Lincoln Street	Peak Off Peak	1.1 2.4	No No	No Yes	Option No. 1 (ventilation fan 16 m3/hour capacity)
B: - Cheviot Street	Peak Off Peak	2.2 5.0	Yes No	Yes Yes	Option No. 2 (6 m^3/hour fan with filter to cope with up to 0.1 kg/d H_2S)
C: - Sea Breeze Estate	Peak Off Peak	4.6 11.3	No No	No No	Normal good design practice
D: - Sea Breeze Estate: - deleted and replaced with gravity sewer					
E: - Heather Street	Peak Off Peak	3.5 8.3	No No	No No	Normal good design practice
F: - North End of Retirement Village site	Peak Off Peak	2.9 6.6	Yes Yes	Yes Yes	Option No. 2 (30 m^3/hour fan with filter to cope with up to 0.8 kg/d H_2S)
G: - Alamar Crescent	Peak Off Peak	2.0 4.4	Yes Yes	Yes Yes	Option No. 2 (30 m^3/hour fan with filter to cope with up to 0.5 kg/d H_2S)
H: - Wintle Street and Pearl Street	Peak Off Peak	1.9 4.0	No No	Yes Yes	Option No. 2 (30 m^3/hour fan with filter to cope with up to 0.05 kg/d H_2S)
I: - not used					
J: - Wintle Street (near new estate at Surf Club end of road)	Peak Off Peak	4.3 11.0	No No	No No	Normal good design practice
Outfall – corner of Thelma Road and Molesworth Drive	Peak Off Peak	2.9 7.0	Yes Yes	Yes Yes	Option No. 2 (30 m^3/hour fan with filter to cope with up to 0.5 kg/d H_2S)
Mangawhai Village Pump Stations					
VA - Village Outfall	Peak Off Peak	27.4 72.8	Yes No	Yes Yes	Option No. 2 (30 m^3/hour fan with filter to cope with up to 0.1 kg/d H_2S)
VB – Moir Street	These three pump stations service new developments. Pump Stations will be designed as part of the developers' works to service the respective pump stations.				
VC1- Insley Street, (Anchorage Estate)					
VC2 – Anchorage Estate					

Rising Mains

Rising mains will be designed with a minimum velocity of 0.9 m/s. This velocity is sufficient to strip slimes containing micro-organisms capable of generating odours from pipe walls.

Gravity Sewers

Gravity sewers will be designed to industry accepted minimum grades. The industry standards have been developed to ensure that minimum sewage flows are achieved and that growth of sulphide generating slimes is minimised.

Trade Waste Enterprises

For enterprises seeking to discharge trade waste (or non-domestic waste) into the sewerage system, the usual practice is for industries to enter into an agreement with the council. The agreements impose limitations on the volume, temperature, and concentrations of key pollutants which would impact on the performance of the sewerage infrastructure. This approach will be adopted by council for the Mangawhai sewerage scheme.

Treatment works

Odour at a WWTP can arise from:

- release of odour from influent wastewater
- generation of odours from processes at the WWTP, including the bio-solids dewatering.

The potential for generation of odour has an impact on design issues beyond management of any odour itself. In particular, odour potential is also associated with potential corrosion issues, and thus may require consideration of matters such as epoxy coating of concrete.

Release of odour from influent wastewater

In brief, the formation of offensive odours such as hydrogen sulphide (H_2S) is generally related to the presence of anaerobic conditions and anaerobic biological activity.

In a sewerage system, the presence of anaerobic conditions is generally related to detention periods. Generation of odour in the proposed sewerage scheme at Mangawhai has been examined separately, and has confirmed that odorous substances will be present in the WWTP's influent. Hence, consideration of a preventative design approach to odour issues at the WWTP is warranted.

Once H_2S has been formed, for it to create an odour problem it must

(a) reach the gaseous phase in detectable concentrations, and
(b) the odorous gases must then reach people whilst still at detectable concentrations.

The second of these issues raises the matter of buffer distances. Treatment plants are typically surrounded by zones without residences or frequent human activity, to allow for dispersion of odorous gases before they create a public nuisance. This practise means that a certain amount of local odour at a wastewater treatment plant can be acceptable despite being detectable (provided it does not create occupational safety and health issues), as the odour will be dispersed to less than detectable limits when it reaches public areas. (The concept of buffer distances does not apply to wastewater pump stations within a sewerage scheme, as they are, of necessity, typically located within residential areas.)

The proposed Mangawhai WWTP is located a reasonable distance away from housing, which, subject to consideration of prevailing wind directions, reduces the criticality of odour control somewhat.

Release to gaseous phase can happen through two mechanisms:

- release of soluble H_2S when turbulence is experienced, and
- transfers to maintain a chemical equilibrium at the air-wastewater surface.

From the sewerage odour study, the following has been predicted with respect to influent characteristics at the WWTP:

Table 6-5: Probable Odour Release from Influent Waste Water

Season	Mass load of H_2S	Probable release (based on 15% release through turbulence at inlet works)	Equilibrium interstitial concentration
Peak	18.8 kg/d	2.8 kg/d	280 ppm (v/v)
Off-peak	8.5 kg/d	1.3 kg/d	250 ppm (v/v))

The control of odours will be examined below under the section headed ‘Control of Odours’.

The associated potential for corrosion will require concrete at the inlet works to be epoxy coated.

Odour sources within the WWTP

As mentioned, typically offensive odours result from the occurrence of anaerobic conditions. The treatment processes selected at the proposed Mangawhai WWTP are aerobic processes, so the intrinsic nature of the microbial reactions is such that formation of offensive odours such as H_2S is not likely. The aerobic processes are the CASS or IDEA process for the main biological treatment, and aerobic digestion in the sludge holding/digestion tank.

The CASS/IDEA processes also use a selector at the inlet where influent wastewater is mixed with the recycled contents of the process. This provides some preconditioning of the influent wastewater, and helps to control the types of micro-organisms present in the process. Typically, odours from this process are only localised, and may not be offensive. However, for the sake of certainty of management of the risk of odours, measures for managing this part of the WWTP will be discussed in ‘Control of Odours’

One other area where odours can occur is mechanical dewatering of biosolids. The odours associated with this process tend to be musty odours, akin to the odours of a good compost process, but can be strong enough to be offensive. It is also more difficult to ensure aerobic conditions throughout the dewatering and storage process. Hence, measure for managing this part of the WWTP will be discussed below in 'Control of Odours'.

There are further safeguards on the presence of aerobic conditions in the main CASS/IDEA process and sludge digester/holding tank:

- provision of standby blowers (with automatic changeover if needed) guard against mechanical problems, and
- use of dissolved oxygen monitoring and control on aeration systems, allows real-time monitoring conditions in both the CASS/IDEA basins and the aerobic digester.

The use of on-line dissolved oxygen monitoring and control:

- ensures that adequate oxygen is normally provided to the system, and
- if low oxygenation levels (typically <0.5 mg/L) present in the system, alarms are raised to ensure that the operator attends to the problem promptly.

Other than the inlet works, selectors and biosolids dewatering and subsequent management, there are no intrinsic sources of potential odour within the WWTP.

Control of odours

Control measures are generally classified into two categories:

- preventative
- curative

Preventative measures include:

- Selection of appropriate processes (as outlined in Section 3.5.3), and
- Minimising turbulence, where practicable, in order to minimise the release of odorous gases if they are present.

Curative measures include:

- Containment
- Chemical dosing to address one or more of the three main factors associated with odour (i.e., anaerobic conditions, available sulphur or microbial activity)

- Scrubbing or filtering air to remove odours
- Dilution to reduce concentrations below detectable limits.

In the context of the WWTP, the following measures have been adopted for control of odours, which are a significant issue only at the inlet works:

- Containment
- Scrubbing or filtering air to remove odours
- Dilution to reduce concentrations below detectable limits.
- This will be provided by:
- Sealing of the inlet works
- Covering the selectors
- Having the biosolids dewatering process in a contained area, with a ventilation system providing at least 3 changes of air per hour to all covered areas (this may require separate ventilation fans), and discharging to a filter bed designed to cope with a baseline H_2S concentration of 280 ppm (v/v), and a mass load of 2.8 kg/d H_2S, in the cumulative air flow from the ventilation system.

(If flow equalisation basins were still to be provided, they also would be covered and ventilated.)

6.3.8 Recreational effects

The bulk of the scheme will be located below ground and accordingly, after construction, this will not affect public use of road reserves and reserves in which those services will be located. Surface components of the pump stations, for example, manhole covers and switchboards, would potentially have an effect. The exception to this will be the WWTP, but its location in a relatively inaccessible scrub area in the west corner of Mangawhai Park means that its impact on recreation will be limited. Even if the park is developed, its location will likely remain inaccessible because of the topography and the location nearby of a permanently swampy area. At the disposal site, the public will be excluded, at least for the summer peak irrigation period. Should the golf course take the treated effluent, similar restrictions would apply, whereby public access would be restricted during irrigation and for four hours after completion of the spraying cycle. In most circumstances this would be undertaken at night. Access to the hill areas of the Lincoln Rise site (that the council has an option to purchase) will not be affected. Overall, the occupation of publicly accessible space by the entire sewerage scheme will be minimal overall. On land recreational effects will therefore be limited.

In terms of estuarine water quality, the improvements are expected to result in compliance with the guidelines for recreational bathing, which will constitute a significant positive effect of the proposal.

6.3.9 Historic and archaeological effects

All excavation works will be undertaken in accordance with archaeological protocols whereby work will cease and the appropriate authorities (including the New Zealand Historic Places Trust and Te Uri o Hau) will be informed if archaeological remains are found during excavation works. Where appropriate, services will be relocated to protect archaeological features.

Consultation has been undertaken with Te Uri o Hau, and it is to be expected that they will be represented at certain stages of the work.

6.3.10 Cultural effects

Te Uri o Hau have been involved in discussions about and are supportive of the proposed sewerage scheme since its inception. Support was expressed at the last meeting in July 2006 between the council, Te Uri o Hau and Earth Tech for the proposal to discharge treated effluent to land. As noted above, Te Uri o Hau will continue to be involved in the construction process. As the treated effluent is to land, it is understood that this is consistent with Tikanga Maori practice.

6.3.11 Water Quality Effects

Mangawhai

Overall the proposed wastewater reticulation system will have a beneficial impact on local stormwater and groundwater water quality through the provision of a comprehensive wastewater collection and treatment system.

The removal of the potential for faecally sourced enteric viruses from septic tank discharges in the Mangawhai stormwater system will avoid their accumulation in shellfish in the harbour.

Disposal site

The basis of the soil deficit model is set out the RMCG report.[25] The model is described thus:

The effective rainfall for an area is calculated from daily rainfall data. Not all rain is useful to a crop, so the calculation accommodates this.

Daily crop evapotranspiration is calculated.

The daily deficit is calculated by subtracting effective rainfall from the daily crop evapotranspiration.

[25] RMCG, op cit, Appendix 3 Hydraulic calculations, Section 2

The cumulative soil deficit is calculated

The cumulative soil deficit equals the sum of the previous cumulative deficit, the current day deficit and the previous day's irrigation.

If the sum of the accumulated deficit and effective rainfall exceed a certain surface storage, the excess is deemed to be run-off and the cumulative soil deficit for that day is equal to surface storage. In this case 10mm was adopted to represent the surface storage.

Two variables were used to determine when and how much to irrigate:

An irrigation buffer to represent the practice of scheduling irrigation so that a soil deficit remains following irrigation. This prevents irrigation run-off and provides a buffer to take up the first flush of rainfall run-off.

The irrigation depth. A figure of 30cm was adopted, and sensitivity tested down to 25cm and up to 40cm.

Using these variables, the irrigation was calculated for each day as follows:

If the cumulative soil deficit was greater than the sum of the irrigation buffer depth: irrigate.

If not: do not irrigate

Using this data, the irrigation requirement for the disposal area was calculated, giving an average requirement of 4,100m^3 per ha, ranging from 3,300m^3 /ha in 10-percentile wet years, up to 4,800m^3 /ha in 90-percentile dry years.

The modelling concluded that standard soil deficit irrigation is feasible in the Mangawhai area with a combination of storage dam and sufficient pasture irrigation area. The requirements are summarised below:

Table 6-6: Summary of irrigation area and winter storage requirements

Wastewater (m^3/year)	Pasture irrigation area (ha)	Winter storage volume (m^3)
148,000	48	110,000
183,000	60	110,000
280,000	91	152,000

The average application rate is around 80 per cent of the plant requirement. The model is quite sensitive to the effectiveness of rainfall. The model assumes a monthly pattern of wastewater generation that is typical of a holiday area, with flows higher in summer than winter. The storage requirement is quite sensitive to additional waste water flows.

Groundwater

The conclusion thus drawn is that the effect of spray irrigation on groundwater is likely to be limited. In particular:

- Pathogens will be low as the sub-soil is relatively poorly drained and thus accessions to groundwater would be small; additionally there is no immediate groundwater system.
- Nitrate levels would be low for the reasons set out above, but also because the nitrogen levels would be less than for normal pasture requirements.

Discussion on the sub surface hydrology is given in section 6.3.13 which shows that accessions to the groundwater would not adversely impact on landowners neighbouring the site to beneficially use the groundwater. In particular:

- The groundwater underlying the irrigation site is not expected to be in hydraulic connection to the Tara aquifer
- There are no known groundwater supplies within 500 metres of the site
- The groundwater underlying the irrigation site has levels of e.coli and faecal coliforms in excess of the New Zealand Drinking Water Standards

Surface waters

In terms of surface waters, the likelihood of run-off to watercourses is low. However consideration is given to the impacts arising if run off enters the watercourses.

General

Seepage of poorly treated effluent from septic tank systems compromise the life sustaining capacity of a watercourse. Once the self purification capacity of a water body has been exceeded, environmental degradation rapidly occurs. This would include visual impact with dark coloured waters, foaming, slimes, odours, weed and algae growth all of which contribute to the destruction of natural aquatic life and ecosystems by oxygen depletion and additional nutrient loads.

Critical factors to maintaining a water body's life sustaining capacity are:

- the control of nutrient inputs
- the elimination of organic discharges which deplete oxygen concentrations in the water

Nutrients

The irrigation system proposed for the Ecocare scheme, delivers nutrients (nitrogen and phosphorous) at a concentration of approximately 50% of the level that a dairy farm would typically require. These nutrients are delivered to the crop in a uniform and controlled manner by spray irrigation as opposed to hand

applications of fertiliser which are difficult to control. Therefore the efficiency of this method of application of nutrients is much greater than normal agricultural practice; and if run off occurs the volume of nitrogen and phosphorous entering a water course would be considerably less than at present.

Organics

The wastewater treatment plant produces a very high standard of effluent. Organics (as measured by BOD_5 will be reduced to less than 10 mg BOD/L. At this concentration any run off would not compromise the watercourse's capacity to maintain satisfactory oxygen concentrations.

Pathogens

The wastewater treatment plant is designed to produce effluent to accord with Fonterra's requirements.The median concentration of total coliform bacteria must not exceed a most probable number (MPN) of 23 per mL (based on a 7 day period).This level is close to the requirements for contact recreation for fresh and marine water as expressed in "Bacteriological Water Quality Guidelines for Marine and Fresh Water" (published by the Ministry for the Environment and the Ministry of Health (MfE 1998). Shellfish gathering standards are set at a median (taken over a season) of 14 MPN faecal coliforms / 100 mL with a 90 percentile limit of 43 MPN faecal coliforms / 100 mL.

With further die off of pathogens expected in the winter storage, during irrigation and after irrigation (within the soil or on the plant) only a small proportion of the original pathogens could run off the site. Hence any concentration of pathogens found in run –off would be well within the acceptable limits for full human contact.

Preventing Run off

The most important strategy for protecting any watercourse from adverse effects of run off is to prevent run off from leaving the site in the first instance. The irrigation system proposed for the Ecocare scheme addresses this by:

- adopting the soil deficit method of irrigation to ensure that:
    - irrigation water soaks into the soil and the soil has capacity to accept the moisture
    - a buffer exists in the soil's capacity to accept moisture such that the first flush of any rainfall (after cessation of irrigation) can also be soaked into the soil
- adoption of spray irrigation to deliver water to the soils in a controlled manner
- ceasing irrigation whenever rainfall occurred
- and not recommencing irrigation until a minimum of 24 hours after the rainfall event

The sizing of the irrigation field and winter storage has been undertaken on the basis of modelling undertaken by RMCG. The modelling exercise utilized 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.

Provision for extreme wet weather events

(i) Controlled Releases

As described elsewhere in the document, the winter storage holds effluent during the non irrigation season plus any rainfall that falls directly onto the storage during the year. The volume of effluent contained in the storage each year can be predicted with reasonable accuracy for a given population. The volume of rain falling onto the storage is totally dependant on the local weather conditions and, therefore, is far less predictable. In addition, water is lost due to the evaporative effects of wind and heat.

RMCG observed the net inflow of water (rain less evaporation) would be 5,000 m^3 per hectare of storage catchment. Therefore for an area inside the top of embankment of 4.2 Ha, the net inflow would be 21,000 m^3. During the non irrigation period the net inflow would be higher (say 25,000 m^3) with a net outflow occurring during summer (say 4,000 m^3)

The storage would be operated such that it would be empty at the end of an irrigation season and fill during the non irrigation season. For a 25,000 m^3 inflow occurring during the non irrigation season and at the commencement of the next irrigation season the 110,000 m^3 storage has reached capacity, the percentages of the total volume of water from the two sources would be:

- 25 % derived from net rainfall (the more variable component)
- 75 % derived from effluent (the more predictable component)

Whilst 34 years of rainfall records provides a strong basis for predicting whether the storage will have capacity to hold the effluent for the entire non irrigation season without the need for a release to the environment, the potential for an extremely wet rainfall period always exists. Under such circumstances controlled releases to the Hakaru River would be necessary.

As the need for such a release is highly weather dependant it is not possible to know:

- whether a release will be required in any year at all, or
- The volume to be released, if required

(ii) Monitoring the need for releases

The potential need for controlled releases can be successfully monitored throughout the nine month non irrigation season by:

- recording of the water levels within the storage and comparison against an expected level for the particular week of the year,
- comparing effluent flows against expected flows, and
- comparing rainfall with average rainfall records

This level of monitoring allows the potential need for controlled releases to be identified with many weeks notice.

Accordingly, a discharge could be arranged to coincide with a rainfall event so that the dilution of effluent would be maximised. Also the discharge could be undertaken as a series of small controlled releases.

(iii) Environmental Impacts

In order to assess the environmental impacts of this strategy, an analysis was undertaken of stream flows in the north Hakaru River catchment during the more significant rainfall events that could be expected during a typical year. The data obtained enabled an assessment to be made of the expected dilution achieved in the discharged effluent and an assessment of its impact on the environment.

Based on the last 34 years of rainfall records for the north Hakaru catchment, in an average year the Lincoln Downs site would be subject to 6 events of 30mm precipitation, or greater during a single 24 hour period.

From just downstream of the junction of the Hakaru River with Cook's Creek, the upstream catchment area is approx 36 square kilometres. 30mm of rainfall falling over the catchment in a 24 hour period therefore amounts to 1,080,000 cubic metres of water of which 750,000 cubic metres (say) would runoff down the Hakaru River and pass the release point from the proposed re-use scheme.

A 10,000 m^3 release from the storage during the rainfall event will mix with the 750ML when it meets the Hakaru River, resulting in effluent dilution of some 75 times at this point and dilution of much greater magnitude before discharge into the Kaipara Harbour.

The magnitude of this dilution will result in concentrations of nutrient and pathogens which will be much lower than those required to meet sustainability criteria. As described in a preceding paragraph entitled "Pathogens" the water within the winter storage is already within the limits for full human contact as described in "Bacteriological Water Quality Guidelines for Marine and Fresh Water" (published by the Ministry for the Environment and the Ministry of Health (MfE 1998). The dilution achieved through mixing with high stream flows within the Hakaru River will dilute the pathogen level to one percent of that limit.

In terms of volume the amount released would also represent one percent of the total river flow.

Hence, a release of 10,000 m^3 over a day during the high flows in the Hakaru River resulting from a 30 mm rainfall event will have insignificant environmental effects.

With a typical year having six rainfall events of 30mm or more during a single 24 hour period, 60,000 m^3 of water could be disposed of during these events which occur generally through the wetter period of the year.

(v) Probability/Consequence Assessment

An effective tool in assessing the acceptability of an activity is to examine the probability of an event occurring versus the severity of adverse consequences of the event. By combining the likelihood of an

event occurring with the severity of impact, a risk can be attributed to the particular activity. A typical matrix is presented below:

	Severity				
	Little Effect				Extreme Effect
Unlikely	1	2	3	4	5
Likelihood	2	4	6	8	10
	3	6	9	12	15
	4	8	12	16	20
Highly probable	5	10	15	20	25

Risk Level
Low
Medium
High

Referring to sub section (i), Controlled Releases, the need for 10,000 $m^3$of water to be released would most probably result from a corresponding increase in net rainfall. This volume would represent a 40% increase in the net rainfall over the most extreme event in the 34 years of available rainfall records.

The probability of such an event occurring is, therefore, extremely low.

In terms of the severity of the consequence, the paragraph concerning “Environmental Impacts” shows that the activity has an insignificant impact on the environment.

Referring to the matrix above, a release 10,000 m^3 of water to the environment during a 30 mm rainfall event, represents the lowest risk activity.

(vi) Method for Release

The timing and arrangements for release would be subject to the requirements of Northland Regional Council. In the event that storage volume monitoring suggested that the need for a release was imminent, Earth Tech would advise Northland Regional Council that it intended to use its consent to release water to the environment. Arrangements would be made with Northland Regional Council to ensure that the release occurs in accordance with the conditions that apply to the consent.

Two means of release are proposed:

- a pipe delivering water directly into the Hakaru River, and
- via the irrigation network

To deliver water directly into the Hakaru River, a 250 mm pipeline will branch of from the effluent transfer pipeline. The pipeline will be fitted with a valve and the river bed would be protected from any erosive actions of released water through the installation of energy dissipation structures and rock beaching.

Releases via the irrigation network, will simply effluent to run off into the natural drainage network. In comparison to the runoff from the rainfall, the additional input from the irrigation network will not be noticeable. Hence no specific erosion protection measures will be required.

6.3.12 Spray drift

The Ecocare Sewerage Scheme incorporates reclaimed water irrigation enterprise. The system proposed incorporates application of the reclaimed water to pasture using spray irrigation. Issues of particular relevance in this instance are the impacts on neighbouring landowners and public:

- Odour
- Effects of pathogens on public health
- Buffer distances; and
- Management of potential for aerosols (spray drift)

Odour

Spray irrigation techniques can allow for aerosols to drift from the site subject to irrigation into neighbouring properties. For reclaimed water treated to a low standard, the aerosols can transmit odour.

In this instance the Mangawhai WWTP will treat sewage to a nominal Category I (NZ Guidelines for Utilizing Sewage Effluent on Land, p176:- the highest standard). This standard eliminates the potential for the reclaimed water to be odorous. As a consequence there will be no odours associated with aerosols.

Furthermore, as described below, the irrigators will be designed and managed to largely eliminate adverse effects of aerosols.

Effects of pathogens on public health

Where spray irrigation occurs, a portion of the irrigated water will become spray drift. These small particles of water (aerosols) may contain micro-organisms. Potentially some of the micro-organisms may be pathogenic.

The potential risks to neighbouring land users has been the subject of a significant amount of research. Chapter 3 of 'NZ Guidelines for Utilizing Sewage Effluent on Land' discusses the research in some detail. The research could not identify adverse health impacts to people working and living near spray irrigation systems. One of the research papers quoted (Pahren and Kacubowski (1981) lists several explanations for the fact that people working and living near wastewater treatment facilities have not become infected:

The densities of specific pathogens in the aerosols were low, and were reduced rapidly with time and distance from the source.

With a respiration rate of approximately 1 m3/hr, a person would ordinarily inhale very few organisms unless constantly exposed for many hours.

The exposure levels were below the minimum infective dose.

Micro- organisms in wastewater are primarily enteric organisms whereas the route of exposure was respiratory. The proper surface receptor sites for the organisms may have been available.

Non-specific immunity, which responds quickly to foreign substances, was capable of handling the few micro-organisms inhaled.

Chapter 3 of the NZ Guidelines for Utilizing Sewage Effluent on Land concluded that:

application of best practice; and

maintaining buffer distances

would be a principal method of mitigation.

Overseas Best Practice

In Australia, the United States and other drier countries there has been a growing realisation that reclaimed water is a valuable and safe resource. As a result there has been increased interest in and use of reclaimed water for public irrigation purposes.

The use of spray irrigation for rurally based pasture crops has been accepted practice in Victoria for many years. The Victorian Environment Protection Authority (EPA (Vic)) has developed guidelines for the management of this technique. These guidelines have been developed to safeguard the environment (surface waters, groundwater, and air), ensure sustainability of operation and safeguard the health of people living in proximity to the irrigation enterprises. Earth Tech's irrigation enterprise is intended to be managed according to the practises set out in EPA (Vic) Publication 464.2 Guidelines for Environmental Management – Use of Reclaimed Water.

Typically for application in rural areas the effluent is treated to a standard equivalent to the lower range of the New Zealand Category II standard. This allows the water to have up to 1000 faecal coliforms / 100 mL. Spray irrigation is a common application technique for effluent treated to this standard. Treating the effluent to a higher standard than required is one strategy that can be adopted to mitigate against the potential adverse impacts of pathogens on surrounding landowners.

The Mangawhai WWTP is designed to produce an effluent far higher in standard. Nominally, Category I standard would be achieved. The median faecal coliform level will not exceed 23 faecal coliforms / 100 mL. However Earth Tech's irrigation enterprise will be managed with the same levels of control that would apply if the lower standard Category I effluent was being applied. In this regard, the adoption of conservative effluent management techniques is an appropriate strategy for dealing with any potential adverse impacts of pathogens on surrounding landowners.

Public Health authorities worldwide have undertaken extensive research over recent years into more extensive use of reclaimed water. Recently the EPA (Vic) in conjunction with the Victorian Department of Human Services produced guidelines to allow reclaimed water to be returned to domestic residences

for use for toilet flushing and garden watering purposes. The document is entitled Guidelines for Environmental Management – Dual Pipe Water Recycling Schemes – Health and Environmental Risk Management. While such domestic use is not proposed for in this scheme, it demonstrates that effluent treated to a standard as that produced by the Mangawhai WWTP can be used in applications where a high potential exists for humans to come in contact with the effluent.

In summary:

pathogens can be found in aerosols resulting from spray irrigation activities

research has failed to link spray irrigation of treated effluent (or, for that matter, aerosols emanating from wastewater treatment plants) to adverse health outcomes for people living nearby to these facilities

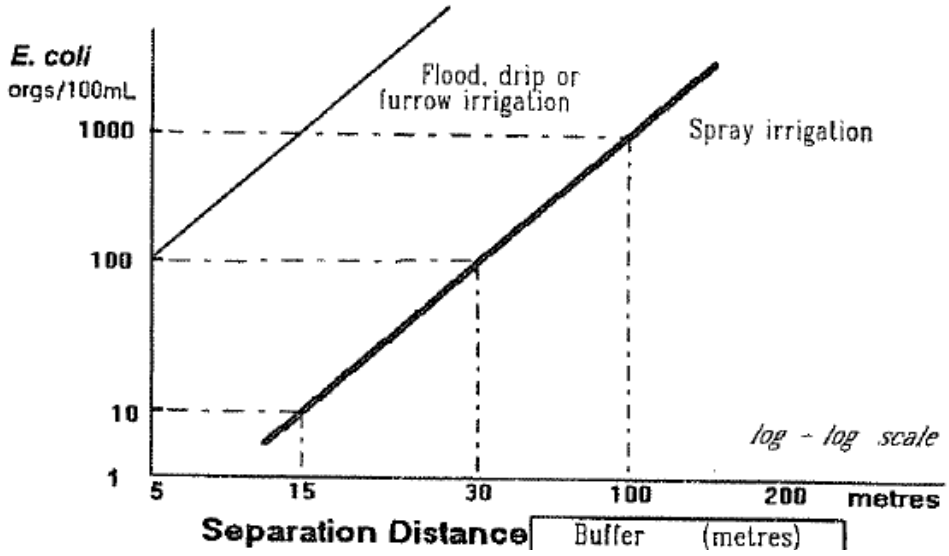
The potential impacts of aerosols can best be managed by adopting best practice:

- Best Practise guidelines have been developed (in Australia) for the use of treated effluent for spray irrigation purposes.
- These Best Practice Guidelines have been developed taking into account, amongst other factors, health related matters
- Earth Tech propose a significantly higher level of treatment (nominally Category I) than required for a rurally based irrigation scheme(Category II)
- Earth Tech propose to apply the higher level of irrigation management controls that would apply for a lower treatment standard (Category II)

Buffer distances

Chapter 3 of the New Zealand Guidelines for Utilization of Sewage Effluent on Land, states that: *"There is little scientific information relating to buffer distances, and most recommendations for buffers are based on rules of practice passed down over time. Past experience should not however be ignored"*.

The Victorian EPA developed a sliding scale of buffer distances that relate to the E.coli levels present in the effluent. This relationship is shown below.



For spray irrigation enterprises commonly in use in Australia Class C effluent is adopted. In this instance a buffer of 100 metres is recommended. The chart shows the significant difference in buffer distances that can be achieved by improving the treatment standard. (The Mangawhai WWTP will produce water with a median level not exceeding 23 faecal coliforms / 100 mL.)

The Mangawhai Ecocare scheme has adopted a much higher treatment standard than is required for the type of irrigation proposed at Lincoln Downs. The reason for the high standard is that it provides the opportunity for the reclaimed water to be used in public open space such as the golf club in the future without the need for the public's use of the golf course to be unduly interfered with.

With the considerably higher standard of treatment provided for the Mangawhai scheme the Victorian EPA Publication 464.2 would allow the buffer to be reduced to 15 metres.

Given that:

- the Victorian EPA has developed the guidelines for buffer distances in association with research organisations such as the CSIRO, overseas regulators such as the US EPA, and the WHO (amongst others)
- in Victoria irrigation with treated effluent is a common practice, and
- the Victorian EPA is influenced by a strong public interest in ensuring that public safety has a high priority

the buffer distances adopted by the Victorian EPA are considered appropriate for adoption in New Zealand and appropriate for the Mangawhai Ecocare scheme.

Management of potential for aerosols (spray drift)

Whilst preceding paragraphs do not show a link to living near a wastewater irrigation enterprise and increased incidence of viral infection in comparison with the general population, the Ecocare scheme will be designed to control spray drift.

For any drift that does occur the principal method of mitigation is the establishment of buffer zones between incompatible land uses and the irrigation area. This has been dealt with in the preceding paragraph.

The amount of spray drift that will occur cannot be accurately determined. However, there are a number of known techniques for minimising the amount of drift. These include:

The pressure of the irrigators. Higher pressure equates to higher risk of spray drift, so the system should be designed for medium or low pressure where possible;

The height and direction of the spray trajectory is also a factor in spray drift. Sprinklers should be set as close to the ground as practical and sprinkler types selected so that the angle and throw distance are minimal. For solid-set sprinklers it is also recommended that the sprinklers on the boundary of the irrigated area are half circle sprinklers;

Droplet size of the spray should be as large as possible so it is less likely to be picked up by wind (however, this needs to be balanced with the instantaneous application rate which needs to be less than the soil infiltration rate to prevent runoff occurring);

Automatic wind cut off mechanisms can be used on spray irrigation. These are set for a particular wind speed, which would be based on experience with wind conditions at the site.

Each of the existing irrigation systems will need to be assessed to determine if changes are required to sprinkler locations of types.

The control mechanisms listed in VEPA Publication 464.2 provide backup protection for neighbouring landowners. The suggested techniques to limit the potential for spray drift include:

Buffers between the irrigation area and the nearest sensitive development (public park, residential area, shops, schools)

Tree belts around the perimeter of the site

Using irrigators that do not produce fine mist – detailed above

Anemometer switching controls for the sprinklers

Restricted watering times, for example, at night for the golf course if it takes the reclaimed water.

Earth Tech proposes to adopt a combination of the above strategies. Where the buffer distance is < 30 m a mixture of trees and shrubs should be planted in the buffer zone to provide a screen. In locations where

spray drift is likely to be of concern, medium or low pressure irrigators will be adopted along with a low angle of spray and short throw distance. The pertinent conditions will change within the Lincoln Downs site depending on the topography and proximity to houses and watercourses. These considerations will be reflected in the detailed design. The need for anemometer switching controls will be considered in the detailed design.

Overview

As a result of:

- designing the irrigators to control aerosol production,
- complying with buffer distances which meet Victorian EPA guidelines,
- the fact that those guidelines have been developed for a region in which effluent irrigation is a common practice,
- providing shielding (tree belts) to isolate the irrigation site from surrounding neighbours and
- adopting management techniques to provide further back up

it is considered that the irrigation system will have no adverse impact on surrounding neighbours.

6.3.13 Earthworks

Reticulation Earthworks

The extent of reticulation covers some 180 hectares, although coverage will change as more subdivisions are included within the scheme. The total length of the pipeline required within the boundaries of the EcoCare area is 50km plus the first four kilometres of discharge line. In general the trenches required to lay the piping network within road reserve will be 0.5 m wide, with an average depth of 1.5 m. Depth of trench will vary depending on the type of sewer system (gravity or low pressure), and depth minimisation has been factored into the design of the system. The deepest trench will be 4.5m. Taking into account that additional earthworks will be required for the 15 pumping stations consent is sought for 45,000 m^3 for that aspect of the project. The likely material to waste would be 4000m3.

The management of earthworks is therefore a critical component of the works. The sections below discuss the potential impacts associated with earthworks as well as the measures which have been, and will be, taken to ensure that these impacts are minimised.

The trenching earthworks are subject to a disturbance consent from the Northland Regional Council, but not to a district council consent. The specification for trenching and pump station earthworks is attached at Appendix 6 to this report. The plans will be prepared separately after the detailed design is completed. A condition of consent requiring the furnishing of such a plan to the satisfaction of the Manager,

Consents, Northland Regional Council would be appropriate. Use of the Auckland Regional Council's TP 90 in the development of the parts of the specification related to erosion and sediment control is recommended as one of the conditions of consent to all disturbance consents[26].

The programme is to have twelve teams undertaking work in the area over the course of the project, in order to lay the pipelines and construct the pump stations and wastewater treatment plant within the fourteen month construction timetable. Whereas construction in other soils would usually be suspended over the winter, in the sandy sections of the Ecocare district work is intended to be undertaken throughout the winter. This will assist in avoiding the peak holiday periods. The sediment and erosion control plan for the trenching and pump station construction is necessarily generic, but is considered sufficiently detailed to enable all of the construction teams to construct and maintain the range of sediment control structures required for the project

There are three crossings of the coastal marine area that are dealt with in other sections. However, parts of the pipeline en route the coastal marine area crossing will be located within the riparian margins, and are subject to particular consents related to disturbance in the Riparian Management Zone. On the main crossing over the estuary disturbance of the riparian margins will occur in the road margin on the causeway on Molesworth Drive. In these cases, the pipelines will follow existing routes, and will be in the road margin, or slung under bridges. That stated, the riparian margin controls apply in these circumstances and those controls will be separately handled in the sediment control plan.

Trenching

Generally the catchments are small and have slopes of less than 20 per cent (particularly in the Ecocare district). This will assist in stormwater management by enabling the use of simple sediment control techniques. The minimum distance possible will be exposed during each team's trenching programme, typically 100m at a time. Simple silt fences, hay bales, and stormwater inlet protection (in the commercial area) are proposed for the trenching works in order to intercept runoff, reduce its velocity and impound sediment laden runoff. Construction and maintenance of the devices will in accordance with TP90. For the pump stations, where greater depths of excavation will be required, silt fences will be used in all circumstances. In addition, where the riparian margin is crossed, silt fences will be used in all cases.

For the route from the WWTP to the disposal site, the soil types are such that work within the construction season alone is envisaged. The more difficult terrain will require more detailed sediment control measures, although trenching will be limited to 100m open trench at any time.

Waste volumes will be minimised through shallow trenching and return of waste soil to its original positions. However, there will be an element of waste, typically 10 per cent and this will be used at the dam site (if appropriate) or, for clay, as a seal to stop water migration to low points of the system. All areas will be grassed as soon as feasible, typically autumn through spring.

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[26] Auckland Regional Council, Erosion and sediment control: Guidelines for land disturbing activities in the Auckland Region, Technical Publication 90, 1999

The geotechnical investigations identified high ground water levels and seepage flows in several areas of town, and made recommendations as to the depth of trenching (<2m) in low-lying areas close to the estuary[27]. Dewatering of some trenches and other excavations will be required. This will be achieved through either "spear" dewatering adjacent to the excavation or sump pumps in the excavation itself. The water is likely to be contaminated with fines of silt, clay or sandy material. These will be discharges onto land draining to the sediment treatment devices, as set out in the plan.

Generally, however, the geotechnical report recommends shallow open trenching techniques where the invert if the excavations remain above the water table[28]. The recommendations are such as to encourage the rapid backfilling of trenches.

Pump stations

Silt fences will be used in all cases for pump station excavations and sediment ponds may be needed for the larger pump stations where the water table is close to the surface. Reinstatement will be required immediately after construction is complete. For safety reasons the number and depth of the pump stations will require construction outside of peak holiday periods.

Excavation is required for the pump stations, and most of the material will be to waste. Where possible it will be re-used around the township area or at the dam site.

Waste water treatment plant

The vegetation on the WWTP is scrub with wilding pines coming through. It will be stripped, mulched and disposed of on the Mangawhai Park site. The limited footprint of the WWTP is such that disturbance will be limited to less than 0.5ha, although its contour requires the removal of approximately 800m^3 of topsoil.

Approximately 200 cubic metres of topsoil will be stockpiled for future landscaping works both in and around the plant. Waste soil will be removed to the dam site as appropriate, and otherwise to landfill.

A 4m wide track has already been made into the area, and this will be formed to 400mm in metal initially, before construction of a sealed surface at the conclusion of the construction period. The metalled road surface and the WWTP platform will be either fenced with a sediment fence on its downward side, or a sediment pond constructed. Detailed surveying of the site will determine which device is most appropriate, but ultimately the discharge will be to the low-lying wetland close by.

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27 Tonkin and Taylor Limited, Mangawhai Sewer Scheme Geotechnical Investigation Report, May 2006

28 Ibid, p.7

Excavation of in-situ material will consist of general contouring of the site and local excavations of up to a maximum of 2m in depth. Total volume of disturbed material will be of the order of 2,000 cubic metres. All of this material will remain on site.

Work areas of the site during construction will be covered with a 200mm thick layer of crushed rock or salamander.

On completion of construction, a permanent stormwater system will be constructed such that compliance with the permitted activity provisions of the Water and Soil Plan for Northland Rule 22.01.03 can be achieved or a resource consent under 22.03.01 obtained.

Disposal site

A 110,000m^3 storage dam will be constructed on site. This will consist of approximately 70,000m^3 of cut to fill to form a storage dam of 5 metres depth. The storage will cover an area of approximately four hectares.

Topsoil will be stripped from the total area for later re-use on the outer batters of the storage. Batters will be no steeper than 1 vertical to 3 horizontal. Finished batters will be top-soiled and grassed

Run-off from the site will be contained in sedimentation ponds before filtration through hay bale weirs and discharge to the natural waterways. Run-off will be monitored and a series of sedimentation traps may be employed if this is necessary. As mentioned above, the erosion and sediment control plan will be supplied after the completion of detailed design. An irrigation network will be installed across 50 hectares of the property. This network will consist of shallow pipe trenches which will be backfilled with the in-situ material. The backfill will be compacted and re-seeded to prevent erosion.

6.3.14 Sub-surface hydrology

Dam site

Recent site investigations by Tonkin and Taylor (July 2006) advanced two boreholes to a maximum depth of 10.8 metres (BH1). The boreholes encountered completely weathered Northland Allochton group comprising very stiff silt to a maximum depth of 2.7m bgl. Beyond the weathered zone, the unweathered northland Allochthon group comprised siltstone. Groundwater was observed in both boreholes at approximately 1.6m bgl. It is considered likely that groundwater flow direction below the site is to the east.

Effect of discharge at disposal site

Existing hydrogeological information indicates that the site is situated to the west of the Mangawhai Aquifer unit, which is described as an unconfined aquifer having a saturated thickness of 8 to 50m[29]. The Tara Acquifer is situated almost immediately adjacent to the eastern boundary of the site comprising basalt flow with underlying sedimentary rocks, and having a saturated thickness of 20m. The Northland Regional Council has confirmed that the site under consideration is outside the boundary of the Tara Groundwater Management Area.

The Tara Aquifer is the principal aquifer in the area, which is high yielding and the groundwater is of good quality. The surrounding aquifers of less importance include Waitemata and Greywacke units used for local abstractions.

Groundwater quality data specific to the site was not available, however data for the Tara Aquifer was obtained[30]. This shows that the groundwater in the Tara Aquifer is mildly acidic (pH 6.4), with a conductivity of 0.14mS/cm. Due to the differences in lithologies, the groundwater underlying the site is not expected to be in hydraulic connection with the Tara Aquifer. In general, the salinity of the applied Category 1 water is equal to that of the groundwater.

In terms of contaminants the fact that the scheme is designed to receive domestic wastewater means that the risk of heavy metals being in the wastewater is very low and no special practices need to be adopted. However, this will require the council to carefully monitor industrial discharges that may be permitted to discharge into the system.

The treatment processes will deliver a high quality effluent such that there will be a low risk of pathogens present. In addition, storage for a mean time of five months prior to irrigation means that pathogens will largely die off prior to irrigation. Should pathogens survive and enter the irrigation system, rapid die-off would occur. Management controls on the Lincoln Downs site are set out in the attached Lincoln Downs Site Environmental Management Plan (draft, Version A July 2006)). As set out in the plan, the WWTP has been designed so that the reclaimed effluent will meet the Category 1 treatment guidelines set out in the Ministry of Health guidelines, a category that would allow the irrigation of salad crops, fruit etc. However, the Health guideline is for <10 faecal coliforms/100mL, whereas the Earth Tech proposal is for <23 faecal coliforms/100mL. The water is defined as nominal Category 1 quality because of the expectation that the median value of faecal coliforms will be less than 10 orgnaisms/100mL sample even though the lesser level (<23 faecal coliforms/100mL) is the Fonterra requirement for application to pasture.

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29 New Zealand Hydrological Society, Groundwaters of New Zealand, 2001

30 Northland Regional Council, Groundwater quality characteristics for Northland sites, www.nrc.govt.nz/soe.2002

Table 6-7*: *Proposed Reclaimed Water Quality Parameters

Parameter	Nominal Category 1 quality
BOD	<10mg/L
SS	<10mg/L
pH	6 to 9
Faecal coliforms	<23 org/100mL
Total N	<30mg/L
P	<10mg/L

In terms of nutrients, the levels are elevated in order to satisfy in part pasture needs and to re-use as much of the influent wastewater as possible. At 30mg/L of nitrogen and 10mg/L of phosphorus, irrigation by the soil deficit model will supply about 50 per cent of the nutrients required by the pasture.

Nitrate and phosphorous levels in the treated effluent will be low and less than the requirements for pasture crops. The risk of transfer to sub-surface water is low, and no special precautions are proposed other than irrigation using the soil deficit model.

Careful scheduling and monitoring of irrigation would be adopted to manage potential discharges into the groundwater, run-off to streams or neighbouring properties. Again the risks of adverse impacts are assessed as being very low. The draft Lincoln Downs Environmental Management Plan sets out the soils sampling programme that is to be undertaken to determine each area's suitability to accept reclaimed water. The soils have been classified into soils groups based on soil profile characteristics with some local interpretation.

From the information drawn from the soils investigations, historical rainfall data and crop demand information, the soil deficit demand of pasture for irrigation water is determined. That demand has been assessed as 4,100m^3 per hectare; at 75 per cent, this figure would be 3,100m^3 in the average year.

Based on previous experience, median concentrations of nutrients are likely to be

- Total nitrogen 20mg/L
- Total phosphorus 6.5mg/L

Ideally the maximum possible levels of nutrients would be left in the treated effluent, so that fertiliser applications may be reduced accordingly. Overall application rates will be based on annual soil monitoring and nutrient balance results.

The loading of salt is expected to be about 550mg/L (TDS), typical for domestic wastewater from a non-water reticulated coastal settlement.

6.3.15 Discharges to watercourse

Although the land disposal system is based upon the soil deficit model, which is designed to provide 75 per cent of the actual needs of the vegetation, and the storage dam has been sized accordingly, the reality is that discharges to a surface watercourse could happen through operator error, or through the failure of plant. In addition, the topography of the disposal area is such that the provision of catch-drains and return pumps for reclaimed water that may be subject to overland flow is not feasible.

An application for consent to discharge treated effluent to a water course or to land such that it discharges to a watercourse has therefore been lodged with the Northland Regional Council. Consent in terms of Section 15.03.02 is required in terms of the Regional Water and Soil Plan for Northland. It would be the operator's intention that the consent need never be exercised. Thus, in order to maintain its effect, an annual return should be required, so that the consent can be considered to have been exercised, and thus remain in effect.

The guidelines for disposal by spray irrigation are such that buffers are required between any spray irrigation area and any water course or other sensitive land use, such as residences or public roads. The NZ Guidelines for the Utilisation of Sewage Effluent on Land require, for nominal Class 1 reclaimed water, buffers of 15 metres between spray irrigation and sensitive land-uses; and for surface waters 20m separation.

Some variation is permitted based on the type of surface waters, the land topography and the amount of vegetation. However, the Lincoln Downs site is relatively exposed, and it will take some time for buffer vegetation to reduce overall wind effects.

The method of application will be as follows: run-off before irrigation commences and run-off which might occur more than 24 hours after and irrigation event is allowed to drain from the property. Run-off during irrigation will be managed by the soil deficit irrigation method which will ensure that all irrigated water is absorbed.

In the soil deficit method, the moisture content of the soil will be measured through probes located at specific points within the property. Irrigation will commence when the soil deficit is below a predetermined level, and will cease after the calculated water volume related to the dryness of the soil has been applied. Irrigation would cease whenever rainfall occurred and would not recommence until a minimum of 24 hours after the rainfall event.

At the Lincoln Downs site, any discharge would be to one of two unnamed tributaries of Cook's Creek close to the junction of Cook's Creek and the Hakaru River.

In this regard an ecological assessment has been undertaken and is attached at Appendix 9. This assessment surveyed the water and ecological quality of Cook's Creek and the two unnamed tributaries to

Cook's Creek on the Lincoln Downs site. These watercourses were found to have poor ecological and water quality. The management of the disposal of effluent will ensure that there will be no direct discharge to these watercourses. Considering that there is limited likelihood of the effluent entering the surface water directly there should be no detrimental effect on these watercourses. However, if some of the effluent were to be discharged directly to the water, it can be assumed that there would be mixing with the stream water which would result in some degree of dilution and that the quality of water in the stream would not be significantly altered.

6.3.16 Effect of removal of on-site discharge to land at Mangawhai

In comparison to the total volume of rainwater entering into the ground over a year, sewage effluent is a small component. Therefore little impact on the subsurface hydrology would be noticed. However the most significant impact would be that disease bearing groundwater discharges and disease bearing sodden grass would be reduced significantly. This is addressed in the next section.

The most noticeable effect of ceasing the discharge of effluent to land for an individual landowner will be that if the disposal field is prone to waterlogging, it will be drier. Often diseases contained within waterlogged soils are transferred to humans via pet animals that unwittingly play in the contaminated water. Elimination of this potential pathway for disease to be transferred to humans conveys significant health benefits.

In many instances the impacts of onsite discharge only appear remote from the source. The cumulative effect of multiple properties discharges effluent on site within a dense community is that contaminated groundwater will flow underground until topographical conditions allow it to come to the surface and travel overland along natural contours to watercourse. Removal of onsite discharge will eliminate this problem and eliminate a potential pathway for disease to be passed onto humans.

6.3.17 Traffic

During construction

Construction traffic will comprise:

- trucks for earth moving, excavator transport, delivery of pipes and other construction materials
- excavators on short trips
- tractor mounted backhoes
- personnel vehicles (mainly utes and cars)

While the need for vehicular transport cannot be avoided, all available steps will be taken to ensure that this need is minimised, and that the use of vehicles is as efficient as possible. This will be done by the following means:

- minimising the quantities of earthmoving required (see Section 7.1)
- minimising the double handling of materials
- use of numerous stockpiles of materials at strategic locations around Mangawhai

A full assessment of the increased health and safety risks from construction traffic will be undertaken and control measures put in place to manage this risk. However, this will be undertaken at a later stage in the project as detailed planning for the many construction teams gets underway. Likely control measures would be include:

- full road closures
- partial road closures
- traffic management signage
- public education
- use of spotters for reversing of large vehicles
- demarcation of work sites
- appropriate use of warning lights on construction vehicles
- consultation with authority responsible for road management
- consultation with local police
- education of site staff (particularly drivers)

During operation

Operations traffic will be relatively minor and will comprise:

- Operator vehicles (utes/cars) for transporting maintenance tools etc to blockage sites, pump stations etc.
- Tonne tipper trucks (approximately 4 per week) transporting solid waste from the WWTP to Wellsford for disposal.
- Tonne tipper truck (approximately 1 per month) delivering chemicals to the treatment plant.

These vehicle movements will not have a significant impact on traffic volumes in Mangawhai.

6.3.18 Health and safety

The proposed construction works will incorporate standard health and safety measures for the protection of contracting staff and the public whether they be either living in close proximity to the works or passers-by. These measures will include:

- Minimising the length of open excavation during the evenings.
- Ensuring all equipment is safely located and made secure at night.
- Providing safe access around and across excavations including appropriate road signage.
- Advising and consulting potentially affected residents prior to, and during, works.
- Ensuring adequate support is installed during excavation work to prevent collapse of trenching works.
- Taking appropriate measures to control dust nuisance, vibration and the emission of noise.

The reticulation works will be constructed in a progressive manner by about twelve teams. This means that there will be a degree of disruption, particularly in Mangawhai Heads and Village, but the overall duration will be minimised. The Heads and Village areas will need to be avoided during the peak holiday season, and this methods would facilitate this approach.