# APPENDICES

*This part contains the Appendices, where maps are referred to these are contained in the separate folder Water and Soil Plan for Northland Maps under the specific Appendix number.*

# APPENDIX 1: DERIVATION AND RATIONALE FOR WATER QUALITY GUIDELINES FOR AQUATIC ECOSYSTEMS, CONTACT RECREATION, WATER SUPPLY, AESTHETIC OR CULTURAL PURPOSES

## 1. DERIVATION

The water quality guidelines have been derived from a number of sources as follows:

1. Australia and New Zealand Environment and Conservation Council, November 1992: *Australian Water Quality Guidelines for Fresh and Marine Waters*.

   This source has been used for the following guidelines: pH, Toxic metals (except Chromium), Faecal Coliforms, Nutrients.

2. Ministry for the Environment, June 1994: *Water Quality Guidelines No. 2 - Guidelines for the Management of Water Colour and Clarity*.

   This source has been used for the water clarity guideline.

3. *Resource Management Act* 1991: Sections 70 and 107; Third Schedule.

   Sections 70 and 107 provide narrative guidelines for aesthetic values. The third schedule provides the temperature guideline.

4. Northland Regional Council Consultancy Report NRC 101/6, September 1994: *Low Flow Options for Northland*.

   This source has been used for the Dissolved Oxygen Guidelines.

5. United States Environmental Protection Agency, 1985: *Ambient Water Quality Criteria for Ammonia*.

   This source has been used for the Ammonia Guidelines.

6. Canadian Council of Resource and Environmental Ministers, 1991: *Canadian Water Quality Guidelines*.

   This source has been used for the water quality guideline for Chromium.

The 1992 ANZECC Water Quality Guidelines are a further "distillation" of the USEPA and Canadian guidelines, particularly the more stringent Canadian guidelines which have been refined to be more relevant to Australasia. With the exception of the standard for protection of freshwater aquatic life from chromium, the ANZECC standards are virtually identical to the Canadian standards, and are supported here because of their local and up-to-date refinement.

# 2. RATIONALE

## 2.1 Temperature

Changes in water temperature can adversely affect the habitats and functioning of aquatic ecosystems and the physiology of river life. Changes in ambient water temperature may adversely affect the growth, metabolism, timing and success of reproduction, mobility and migration patterns of river life. The effects of the changes in water temperature depend on the sensitivity of the different river life.

Temperature changes also affect the ability of water to hold oxygen, with subsequent effects on aquatic life.

## 2.2 pH

pH is a measure of the acidity or alkalinity of a solution. The pH index has a scale of 0 to 14. pH of 0 to 6.99 describe acidic solutions, a pH of 7 describes a neutral solution, and pH of 7.01 - 14 describes an alkaline solution. Most natural fresh waters have a pH close to 7. In natural conditions, the pH of water bodies is influenced by the soil type and vegetation cover of the land through which the respective water body passes, as well as the aquatic vegetation. Human induced point source or diffuse discharges, and land use and land use practices, can make a water body unnaturally acidic or alkaline.

It is generally accepted that a pH range of 6.5 - 9.0 will not adversely affect trout, invertebrates or other aquatic life.

## 2.3 Dissolved Oxygen

Dissolved Oxygen (DO) in water is a physical parameter used to measure water quality. The concentration of oxygen in water is a primary factor which determines the life supporting capacity of a water body. Dissolved Oxygen levels vary from water body to water body, depending on temperature, the Biochemical Oxygen Demand (BOD) and the re-aeration rate. The upper reaches of rivers commonly exhibit a high dissolved oxygen content of about 10 $g/m^3$ or more than 80% saturation. The concentration can be reduced in the lower reaches of rivers, due to greater BOD, a lower re-aeration rate and increased water temperature. Oxygen concentrations rise during the day as a result of photosynthetic activity of aquatic plants and fall at night as a result of plant (including algal) respiration. This is termed diurnal fluctuation.

Northland rivers commonly achieve DO levels of 7 - 9 $g/m^3$, and can get as low as 2 - 4 $g/m^3$ as a result of increased temperature. A minimum level of 6 $g/m^3$ is considered to protect aquatic ecosystems.

## 2.4 Visual Clarity

Clarity is one of the main aspects of water appearance, and relates directly to the visual and aesthetic values of water. The other main aspect, colour, is related to the effect on the human eye of reflected light energy. Visual clarity relates to the maximum distance at which objects can be viewed through water. Variations in clarity can be caused by dissolved, colloidal and suspended material in the water.

Visual clarity can be measured using a black disk or a secchi disk. The black disk is viewed horizontally under water through an inverted periscope. The black disk

distance is the distance, in metres, at which the disk just disappears from sight. There have been few black disk measurements taken of Northland streams and lakes. The secchi disk is used to measure clarity vertically based on similar principles.

There are two guidelines for clarity for the stated purposes. The 20% reduction guideline will protect aquatic ecosystems and would apply to water bodies where visual clarity is an important characteristic, but it is a guideline to strive for. It is the degree of clarity reduction which is found to be detectable by most people. It is therefore the lower bound of "conspicuous". For other water bodies, the visual clarity should not be changed by more than 33 - 50% depending on site conditions.

The guideline of a minimum distance of 1.6 metres as measured by a 200 millimetres black disc protects the water for contact recreation purposes. Research shows that this guideline satisfies the safety requirements as well as the aesthetic preferences of bathers.

## 2.5 Conspicuous Oil or Grease Films, Scums or Foams, or Floatable Material

Foam is a mass of small bubbles of gas formed on the surface of a liquid. Foam can occur naturally due to natural carbohydrates washed from forested areas. Many substances in water will cause foaming when the water is agitated or air is entrained. It can also occur as the result of a discharge and mixing of contaminants. Scums are layers of matter that form on the surface of a liquid, such as the greenish film of algae and similar vegetation on the surface of a stagnant pond. Like foams, scums can and do occur naturally. They also arise from point source discharges. Floatable materials are materials which have not dissolved in the water body after allowing for reasonable mixing, and float on the surface.

## 2.6 Toxic Metals

The ranges for toxic trace metals are subject to water hardness. The exception is for total Chromium (Cr), which is the Canadian (CCREM 1988) guideline based on protection of all fresh water life, including species of Cladocerans (water fleas) known to exist in New Zealand. The use of the guideline for total Cr assumes that all of the metal is in the toxic hexavalent form.

## 2.7 Faecal Coliforms

The faecal coliform standard is aimed at contact recreation. It offers limited protection for aquatic life and other uses but is considered to be more achievable than a higher standard.

## 2.8 Nutrients

Nutrients are substances which provide nourishment for plants and animals. Nutrient levels strongly influence the growth of organisms, and in large quantities, can be undesirable. Nitrogen and phosphorus levels in water bodies are dependant on a number of factors including direct discharges to the water and the rate of removal of nutrients from the water by adsorption onto sediments or uptake by aquatic biota.

The addition of plant nutrients, such as nitrogen and phosphorus, from sewage and agricultural runoff can create an imbalance by stimulating excessive growth of aquatic plants. These plants are normally a natural and important component of a stream. They provide habitat areas, food for other aquatic life, and contribute to re-

aeration through photosynthetic production of oxygen. However, excessive summer growth due to nutrient enrichment can choke water bodies which have low flow rates. During autumn and winter, when the plants die off, oxygen depletion occurs as they are decomposed by bacteria.

Specific nutrient levels for prevention of slime and algal enrichment should be derived from site investigations.

## 2.9 Ammonia

The total ammonia concentration changes with pH and temperature. The guidelines protect trout habitats, however recent research on Toxicity of Ammonia to Nine Native New Zealand Freshwater Invertebrate Species (Hickey, Quinn 1994) indicates that native invertebrates may be more sensitive to ammonia toxicity and that this criteria may not provide adequate protection. Further research is required to determine their sensitivity to long-term exposure.

The diurnal fluctuations in ammonia and temperature complicate the application of the values. To simplify this and to err on the side of environmental protection, the pH and temperature shall be taken in the midday-early afternoon period (noon to 2 p.m. New Zealand Standard Time) when they are at their maximum, to derive the appropriate ammonia guideline from the table.

# APPENDIX 2: DERIVATION AND RATIONALE FOR WATER QUALITY GUIDELINES FOR STOCK WATER AND IRRIGATION WATER SUPPLIES

## 1. DERIVATION

The derivation for the guidelines are the same as those given in Appendix 1.

## 2. RATIONALE

The rationale for the following guidelines is also the same as given in Appendix 1: temperature, pH, dissolved oxygen, conspicuous oil, grease films, scums or foams, or floatable materials, and ammonia.

The rationale for the remaining guidelines are set out below.

### 2.1 Toxic Metals

Various toxic metals are poisonous to stock or can accumulate in crops. As the maximum concentration for each toxic metal varied for stock water and irrigation water in the ANZECC guidelines, whichever is the lower concentration (that is, the most stringent standard) has been selected for these guidelines.

### 2.2 Faecal Coliforms

Faecal coliform bacteria are an indicator of faecal contamination from humans and warm blooded animals and, therefore, indicate the potential presence of pathogenic organisms in the water. Serious infections in stock can result if the water supply is contaminated with pathogenic organisms. The water quality guideline represents a four-fold increase on that used to protect aquatic ecosystems and contact recreation and so on. However, it is less than half that recommended in the ANZECC guidelines. The ANZECC guidelines appeared too high, given Northland's existing water quality, and could allow, in some instances, a deterioration in water quality. This would be contrary to the objectives and policies for water quality management. The guidelines in this Plan represent a realistic and achievable level of water quality to meet and provides a reasonable baseline on which to improve the water quality.

### 2.3 Nitrate

Given that nitrate is a nutrient and beneficial to plant growth, there is no nitrate guideline for irrigation water in the ANZECC guidelines.

The recommended maximum concentration for nitrate in stock drinking water in the ANZECC manual is 30,000 milligrams per cubic metre. This guideline is based on protection of animal health. However, if this guideline was adopted it could allow nuisance growths in waters. Therefore, a significantly lower guideline of 500 milligrams per cubic metre has been adopted to reduce the potential for adverse effects.

# APPENDIX 3: SECTION 88 AND THE FOURTH SCHEDULE OF THE RESOURCE MANAGEMENT ACT 1991

## 1. MAKING AN APPLICATION (SECTION 88)

*(1) A person may apply to the relevant local authority for a resource consent.*

*(2) An application must –*

*(a) be made in the prescribed form and manner; and*

*(b) include, in accordance with Schedule 4, an assessment of environmental effects in such detail as corresponds with the scale and significance of the effects that the activity may have on the environment.*

*(3) If an application dos not include an adequate assessment of environmental effects or the information required by regulations, a local authority may, within 5 working days after the application was first lodged, determine that the application is incomplete and return the application with written reasons for the determination, to the applicant.*

*(4) If, after an application has been returned as incomplete, that is lodged again with the relevant local authority, that application is to be treated as a new application.*

*(5) Sections 357 to 358 apply to a determination that an application is incomplete.*

## 2. FOURTH SCHEDULE

*1. Matters that should be included in an assessment of effects on the environment*

*Subject to the provisions of any policy statement or plan, an assessment of effects on the environment for the purposes of Section 88 should include –*

(a) A description of the proposal:

*(b) Where it is likely that an activity will result in any significant adverse effect on the environment, a description of any possible alternative locations or methods for undertaking the activity:*

*(c) Repealed*

(d) An assessment of the actual or potential effect on the environment of the proposed activity:

*(e) Where the activity includes the use of hazardous substances and installations, an assessment of any risks to the environment which are likely to arise from such use:*

*(f) Where the activity includes the discharge of any contaminant, a description of –*

*(i) the nature of the discharge and the sensitivity of the proposed receiving environment to adverse effects; and*

*(ii) any possible alternative methods of discharge, including discharge into any other receiving environment:*

*(g) A description of the mitigation measures (safeguards and contingency plans where relevant) to be undertaken to help prevent or reduce the actual or potential effects:*

*(h) Identification of the persons affected by the proposal, the consultation undertaken, if any, and any response to the views of any person consulted.*

(i) Where the scale or significance of the activity's effect are such that monitoring is required, a description of how, once the proposal is approved, effects will be monitored and by whom.

1A Matters that must be included in an assessment of effects on the environment

*An assessment of effects on the environment for the purposes of section 88 must include, in the case where a recognised customary activity is, or is likely to be, adversely affected, a description of possible alternative locations or methods for the proposed activity (unless written approval for that activity is given by the holder of the customary rights order).*

**3. MATTERS THAT SHOULD BE CONSIDERED WHEN PREPARING AN ASSESSMENT OF EFFECTS ON THE ENVIRONMENT**

Subject to the provisions of any policy statement or plan, any person preparing an assessment of the effects on the environment should consider the following matters:

(a) Any effect on those in the neighbourhood and, where relevant, the wider community including any socio-economic and cultural effects:

(b) Any physical effect on the locality, including any landscape and visual effects:

(c) Any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity:

(d) Any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural, or other special value for present or future generations:

(e) Any discharge of contaminants into the environment, including any unreasonable emission of noise and options for the treatment and disposal of contaminants:

(f) Any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use of hazardous substances or hazardous installations.

# APPENDIX 4: LANDFILL MANAGEMENT PLAN

Matters to be addressed in a management plan shall include, but not be restricted to, the following:

1. Description of the waste collection, treatment, storage, and disposal system.

2. Identification of discharges and environmental effects and the safeguards in place to avoid or reduce the environmental effects.

3. Identification of wastes which are prohibited.

4. Identification of wastes which can only be accepted under special (specified) conditions.

5. Identification of accepted cleaner production technologies for classes of activity (identified by New Zealand Standard Industrial Classification) which together contribute at least 80% of the waste stream contaminants (measured by mass) and commentary on:

    - The extent to which the cleaner technologies are in place in each activity, including commentary on the source and accuracy of that information;
    - The measures that the consent holder is putting in place to achieve greater conformance with accepted cleaner production technologies;
    - The timetable prepared by the consent holder for each industrial activity for achieving at least 95% compliance with accepted cleaner production technology.

6. Monitoring requirements and procedures including random checking of incoming wastes.

7. Emergency response procedures and contingency plans including:

    - Detection of leakage of contaminants and/or discharge of contaminants in contravention of resource consent conditions
    - Power failure
    - Fire
    - Staff training
    - Public access

8. Identification of management responsibilities for compliance with resource consents and environmental regulatory requirements.

9. Maintenance requirements.

10. Identification of corporate environmental performance standards, national or industry group codes of practice, or other recognised environmental safety, or health standards with which the operation of the facility will comply, and a description of the means for auditing compliance.

11. Description of recycling and reusing strategy.

12. Description of storage of interim toxic waste.

# APPENDIX 4A: MATTERS TO BE ADDRESSED IN A LANDFILL CLOSURE PLAN

1. Description of the past landfilling operation and types of waste included in the landfill.

2. Identification of discharges and environmental effects.

3. The provision of a low permeability capping layer.

4. The final capping layer consists of a soil material that can be planted using vegetation that will maintain groundcover as far as practicable and whose roots will not intrude through the capping layer into the refuse in the landfill.

5. The facilitation of surface water runoff from the landfill surface and prevention of ponding.

6. The prevention of catchment runoff from entering the landfill.

7. The mitigation measures necessary to meet the required receiving water quality standards.

8. Monitoring requirements and procedures.

# APPENDIX 5: STORMWATER MANAGEMENT PLANS

Matters to be addressed in a stormwater management plan shall include but not necessarily be restricted to the following:

- A description of the catchment and the drainage areas.
- The identification of existing drainage problems and potential flood hazards and other sensitive areas such as unstable land.
- The location of major drainage works and flood protection systems.
- Calculation of peak flows from each drainage area and the specifications for system design to avoid erosion and flooding.
- Identification of stormwater quality controls required for each drainage area.
- Upgrade requirements and a programme for upgrade.
- Monitoring requirements for inlet and outlet structures, flow channels and stormwater quality.
- A maintenance programme for the catchment drainage system.
- Identification of management responsibilities for compliance with resource consents.

# APPENDIX 6: LAND USE CAPABILITY CLASSIFICATION

## 1. INTRODUCTION

This section explains the basis for the Land Use Capability Classification.

## 2. ASSUMPTIONS OF THE LAND USE CAPABILITY CLASSIFICATION

The Land Use Capability Classification (LUC), used throughout New Zealand, assesses land in terms of its suitability for long-term sustained productive use, taking into account physical limitations, management requirements and soil conservation needs. It considers the suitability of land to support broad agricultural uses, including cultivated crops, pasture, forestry and agro forestry.

The following assumptions are made when assessing Land Use Capability:

(a) LUC is an interpretative assessment based on the permanent physical characteristics of the land.

(b) Where it is feasible for an individual landowner to remove or significantly reduce physical limitations, for example, lower a high watertable, apply additional water, improve soil fertility, remove surface gravel, stones or boulders, or minimise erosion, the land is assessed according to the degree of limitations remaining after the changes have been made.

(c) An above-average level of land management is or will be practised.

(d) Appropriate soil conservation measures have been or will be applied and maintained.

(e) The LUC classification is not a productivity rating for specific crops. Economics does not enter into LUC mapping.

(f) LUC assessments of an area can be changed by major schemes that permanently change the nature and extent of the limitations, for example, large drainage, irrigation, or flood control schemes.

(g) LUC is not influenced by such factors as location, distance from markets, or processing facilities, land ownership, or the skill of individual farmers.

## 3. STRUCTURE OF THE LAND USE CAPABILITY CLASSIFICATION

The LUC classification has three levels:

(a) The LUC Class - which expresses the degree of limitation to productive use from nil or negligible in Class I to extreme in Class VIII.

(b) The LUC Subclass - which identifies the main kind of limitation. These comprise (e) erosion, (w) wetness, (s) soil characteristics, and (c) climate.

(c) The LUC Unit - which groups together mapped areas of land which respond similarly to the same management, are adapted to the same kinds of crops, pasture or forest species, have about the same potential yield, and require the application of the same soil conservation measures.

A physical inventory referred to as the Land Resource Inventory is recorded for each area on the map:

Rock Type - Soil - Slope Group

Erosion Severity and Type - Vegetation Cover

Erosion type, erosion severity and vegetation cover are those present at the date of mapping. Maps containing the LUC Classification and the Land Resource Inventory are available at a scale of 1:50,000. Maps for the Northland region (1973-75) have recently being updated as a result of field surveys carried out during 1985-90[7]. These maps identify land which, on the information currently available, is prone to soil erosion. Due to the scale of mapping, there will be areas within the identified land not susceptible to erosion, just as outside the identified land, there will be areas which are susceptible.

The key point is that within areas of land identified as erosion-prone at this scale, most of the surface is susceptible to erosion. There is no need to enlarge or use these maps to a more detailed scale than that used in the mapping of this data, that is, a scale of 1:50,000, because doing so does not provide any additional information.

### 3.1 LUC Class

The broadest level in the LUC classification is the 'Class'. The LUC Class expresses the degree of limitation to sustainable use. There are eight classes, from Class I to Class VIII, arranged in order of increasing limitations or hazards to use, and decreasing land use versatility.

- Classes I-IV land are determined on their physical limitations for cultivation. They may also be suitable for pastoral, or forestry use (36.5% of Northland).
- Class V land has too many limitations to be cultivated for cropping, although in some instances it can be cultivated for the purposes of development or pasture renewal. Class V has only slight limitations for pastoral use or forestry use.
- Class VI land is not suitable for cultivation for cropping. It has moderate limitations for pastoral use. It may be suited to forestry.
- Class VII land is not suitable for cultivation for cropping. It has severe limitations for pastoral use and may also be suitable for forestry.

  (Classes V, VI and VII describe 61% of Northland).
- Class VIII land has physical limitations so severe that it is unsuitable for any form of cropping, pastoral or production forestry use. It is suitable only for catchment protection (2.5% of Northland).

### 3.2 LUC Subclass

The second level in the classification expresses the major kind of limitation contributing to the LUC assessment.

Four kinds of subclass limitations are used:

[7] Harmsworth, G.R. 1996: Land Use Capability Classification of the Northland Region: a report to accompany the second edition New Zealand Land Research Inventory. Landcare Research Science Series No. 9, 269p

- **Erosion (e)** Erosion hazard including surface erosion of topsoil, rilling and gullying and a mass movement erosion of subsoil (79% of Northland).
- **Wetness (w)** Wetness which limits plant growth through lack of aeration in the soil, high watertable levels, flooding or ponding (12% of Northland).
- **Soils (s)** Limitations in the plant rooting zone (apart from wetness) arising from, shallow soils, stoniness throughout the profile, low moisture holding capacity, low fertility or element deficiency, poor soil texture and structure (8% of Northland).
- **Climate (c)** Limitations imposed by unfavourable climate: prolonged high or low temperatures, frequent high-intensity rainfall, prolonged drought, wind exposure, salt spray (1% of Northland).

Generally more than one kind of physical limitation must be considered when assessing LUC. However, the person undertaking mapping is required to select a single dominant limitation. If two limitations are considered dominant, the decision is made using the progression e, w, s, c. The "e" limitation is not used for LUC Class I and Class V.

### 3.3 LUC Unit

The third level of the classification is the LUC unit. The LUC unit groups together those mapped areas which respond similarly to the same management, are adapted to the same kinds of crops, pastures or forest species, which have about the same potential yield, and require the application of the same soil conservation measures. This is the "management" level in the classification. The 1:50,000 NZLRI maps of Northland group 11,718 individually mapped areas into nine LUC units, which are defined in a Land Use Capability Classification specifically for the Northland Region.

More detailed information on the Land Use Capability Classification for Northland is available in the "Land Use Capability Classification of the Northland Region, New Zealand Parts 1 and 2". These are available at all Regional Council offices.

## 4. IDENTIFICATION OF LAND OF HIGH EROSION RISK

Land in Northland identified as being at most risk from erosion and requiring very careful management and soil conservation measures includes all Class VIIe and VIIIe units. The class VII and VIII lands selected as erosion-prone have severe or greater potential for erosion over most of their area, wherever mapped.

Class VIII land, by definition, has such severe, permanent physical limitations that it has no inherent productive value, that is, it is only suitable for ecological, conservation and protective uses.

Land classified as Class VIII because of extreme erosion risk must be carefully managed to maintain its protective vegetation. For example, a dense and healthy cover of dune-binding plants must be maintained on the foredune on both the coasts and the coastal cliffs from Glinks Gully to Maunganui Bluff. Similarly, the dense scrub and bush cover on the steep sides of river gorges is essential to maintain the stability of the gorge and to protect downstream land and river systems from sedimentation.

The recent sands inland of the west coast foredunes from Pouto to west of Te Kopuru and from Ahipara to the Te Paki Stream are particularly susceptible to wind erosion, forming large mobile sand drifts. During periods of abuse, for example, excessive burning and overgrazing, the dunes have migrated inland, engulfing forests, productive alluvial soils and lakes. Now largely stabilised by marram grass and lupins, all except the foredune and a narrow inland buffer strip is capable of production forestry, given careful management during harvest and replanting. This area, mapped as Unit VIIIe1 in the 1970's because it was bare sand at the time, was mostly remapped as Unit VIIe10 because it can be, and has been, successfully stabilised.

Class VII land comprises moderately steep to very steep sedimentary and volcanic rocks and flat to moderately steep coastal sands. The Class VII coastal sands are predominantly found inland of the Class VIII sands and are vulnerable to wind sheet and gully erosion if there is a loss of cover in these areas. Regular inputs of nitrogen and other fertilisers are required to maintain cover, as the raw sand has no structure or available nutrients.

Maintenance of a good vegetative cover on Class VII land farmed from sedimentary and volcanic rocks is essential as bare ground is often very difficult to revegetate. Under grazing regimes regular fertiliser inputs are required to maintain pasture cover. The steeper land should be retired into forestry. Soil conservation and runoff control measures must be an integral part of the management of this land.

Section 41 contains the definition of Erosion Prone Land for the purposes of this Plan, including descriptions of constituent LUC units.

Maps showing Erosion Prone Land at a Scale of 1:100,000 are contained in the Regional Water and Soil Plan for Northland Maps folder.

# APPENDIX 7: PIT PRIVY SPECIFICATIONS

## NON-FLUSHING SANITARY FIXTURES

Soil fixtures which are not water flushed, such as those using chemicals or biological treatment, shall be located where they will not cause a nuisance.

Privies are acceptable if located at least three metres from any building having a classified use, other than outbuildings or ancillary buildings. Receptacles for excreta are to be constructed to exclude flies and be fitted with a hinged lid.

# APPENDIX 8: PROCEDURE FOR PERCOLATION TESTING

NEW ZEALAND STANDARD NZS 4610: 1982
HOUSEHOLD SEPTIC TANK SYSTEMS Pr 00
AMENDMENT No. 1

June 1991

**EXPLANATORY NOTE - The amendment clarifies the requirements of the percolation test so as to provide more reliable test results.**

## APPROVAL

Amendment No. 1 was approved on 28 May 1991 by the Standards Council to be an amendment to NZS4610:1982 pursuant to the provisions of Section 10 of the Standards Act 1988.

## SUGGESTED PROCEDURE FOR PERCOLATION TESTING

Delete Appendix A and substitute:

**A1** A minimum of three tests should be carried out in separate test holes spaced uniformly over the proposed disposal field site.

**A2** Test holes of 100 millimetres diameter should be bored to the base level of the proposed disposal trench or soakhole (depth D of Figure A1). The soil profile should be recorded as excavation proceeds.

**A3** The hole should be prepared by carefully scratching the sides with a sharp-pointed tool to remove any smeared soil surfaces and to provide a natural soil interface through which water may infiltrate.

**A4** The test should be performed in the following manner:

(a) The hole should be filled with clean water and maintained full for at least 4 hours but preferably overnight.

(b) The percolation rate should preferably be determined 24 hours after the water is first introduced into the hole. This procedure is to ensure that the soil is given ample opportunity to swell and approach close to normal operation condition for the season of the year in which the test is carried out. In sandy soils containing little or no clay, the swelling procedure is not appropriate and the test may be made after water from one filling of the hole has completely seeped away.

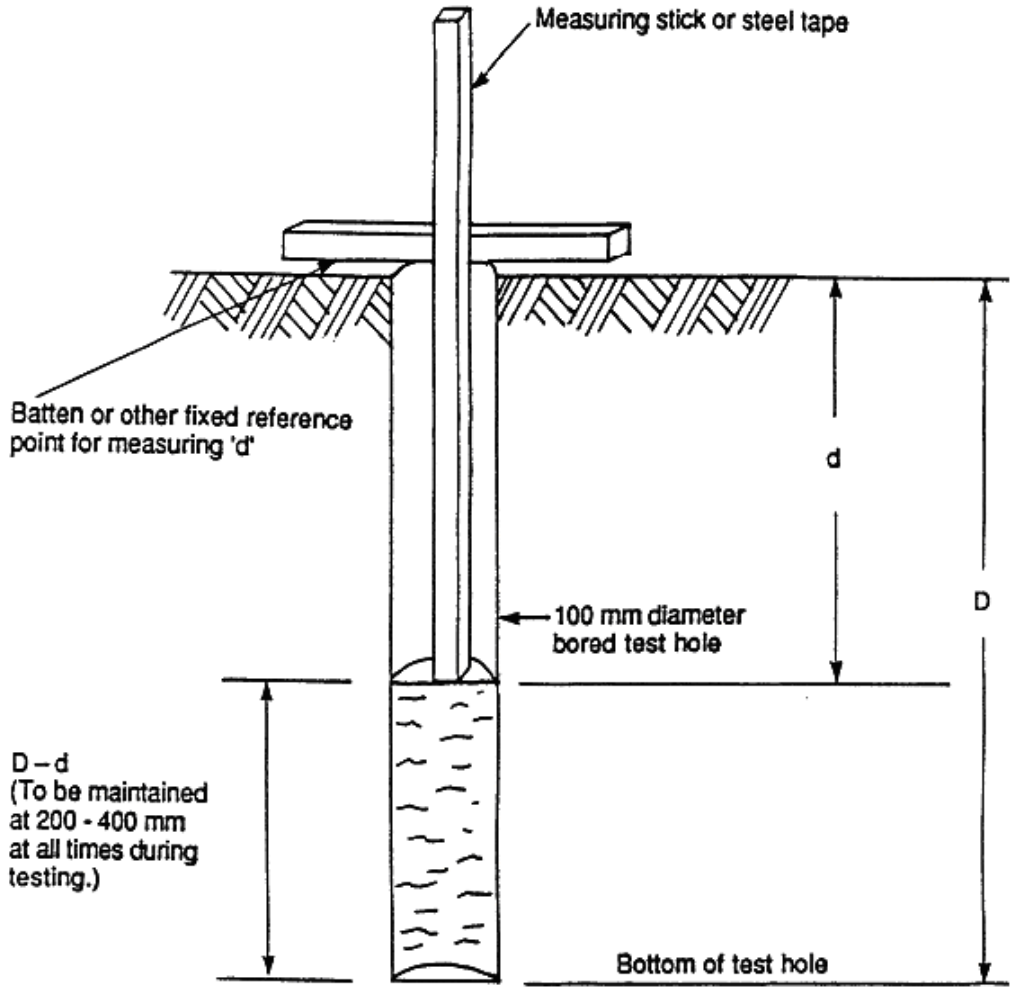
(c) The percolation test should be carried out by adding to the test hole a maximum depth of 400 millimetres of clean water, and recording the drop in water level at timed intervals down to a minimum depth of 200 millimetres, adding water as necessary to maintain the level within a depth range of 200 millimetres to 400 millimetres at all times. This procedure should be continued for a minimum period of 4 hours.

(d) The test results should be plotted on a graph of cumulative water level drop versus time from the commencement of the test. The percolation rate to be reported should then be determined from the tangent to the curve at the point of minimum slope.

**A5** Information gathered on the soil profile should be reported together with the determined percolation rate, the test hole depth D, and other site conditions at the time of the test, e.g. season of the year, depth to watertable, general soil moisture conditions, antecedent weather conditions.

**A6** The percolation rate should NOT be used as the sole criterion upon which site selection and disposal field sizing is made - it should be but one component of the evaluation processes as set out in 6.1 and 7.1 of the Standard.

## FIGURE A1: PERCOLATION TESTING




**Note:** Sides of bored hole to be carefully scratched with a sharp instrument prior to testing - Bottom of test hole to be at the base level of the proposed soakage trench or soakhole

(amendment No. 1, June 1991)

# APPENDIX 9: CONTROLLED PESTICIDES

**Note: At the date of this Plan becoming Operative the functions of the *Pesticides Act* 1979 has been transferred to other legislation such as the *Hazardous Substances and New Organisms Act* 1996. It is advisable that you contact the Northland Regional Council with regards to controlled pesticides.**

Controlled Pesticides as listed in the First Schedule of the Pesticides Act 1979.

## PART I

1. Sodium fluoroacetate (also known as 1080).
2. Methyl naphthyl fluoroacetamide.

## PART II

1. Arsenic trioxide.
2. Phosphorus.
3. Strychnine.
4. Sodium cyanide.
5. Potassium cyanide.
6. Calcium cyanide.

## PART III

1. 3-chloro-p-toluidine hydrochloride (also known as DRC 1339)
2. Alphachloralose (as an avicide), except when used as a bait immediately available for use, where the concentration of active ingredient does not exceed 25 g/kg (2.5%) of bait.
3. 4-aminopyridine (also known as Avitrol).

# APPENDIX 10: REVOKED SECTIONS OF THE TRANSITIONAL REGIONAL PLAN

Upon this plan becoming operative, the Transitional Regional Plan is hereby revoked in its entirety and the following sections are no longer operative:

**Part I:** Explanatory notes for information purposes only, not being an instrument forming part of the plan.

**Part II:** The final classification of the Bay of Islands, under the *Water and Soil Conservation Act* 1967.

**Part III:**

1. General Authorisation for the use of natural water, under the *Water and Soil Conservation Act* 1967.

2 Bylaw for the protection of watercourses and defences against water, under the *Soil Conservation and Rivers Control Act* 1941.

3. Notice relating to clearance of vegetation and disturbance of land surfaces, under Section 34(2) of the *Soil Conservation and Rivers Control Amendment Act* 1959.

# APPENDIX 11: ESTIMATION OF DESIGN MINIMUM FLOWS USING FLOW CORRELATION METHODS

The following methodology should be used when estimating the Design Minimum Flows (MALF or the 1 in 5 year 7 day low flow) in catchments with no long-term record. It is recommended that resource users contact the Northland Regional Council for advice prior to undertaking estimations of design minimum flows for rivers.

## 1. GAUGING DATA

A minimum of 5, and ideally at least 10 gaugings should be done at the site within the catchment for which the design minimum flow is being estimated. The gaugings should cover a range of flow conditions from mean flow and below.

In the event that there are less than 10 flow gaugings available from the "unknown" site, the resource user should contact the Northland Regional Council for advice regarding the adequacy of the smaller number of gaugings, and whether further flow gaugings will need to be obtained.

The flow data used should take into account any abstractions that may have been occurring at the time and the flow adjusted accordingly. The effects of any dams upstream of the gauging site and the continuation flow at the time of gauging should also be taken into account.

## 2. SELECTION OF LONG-TERM CATCHMENT

Where possible, an appropriate long-term site (of at least 20 years record) should be selected from the list included in Method 10.07.11. The catchment of the site selected should display similar hydrogeological characteristics to the catchment for which the design minimum flow is being estimated.

## 3. CORRELATION

Plot the $\log_{10}$ flow from the "unknown" catchment (y-axis) with the $\log_{10}$ average daily flow from the long-term recorder site (x-axis) for the same day (i.e. $\log_{10}$ transformed flow data to be plotted). Draw a line through the points on the graph that represents the best fit. Ideally, computer software that enables regression analysis of the data should be used to determine the line of best fit.

Using the MALF and 1 in 5 year, 7 day low flow figures for the long-term recorder site, read off the design minimum flow for the site in the "unknown" catchment.

## 4. CORRELATION COEFFICIENT AND MARGIN OF ERROR

Correlation coefficients and the margin of error can be determined from statistical analysis. Council staff will check the correlation and the estimates put forward by applicants by putting it through a statistical analysis package on the computer.

The correlation coefficient should ideally be at least 0.9. However, lower correlation coefficients are not uncommon, and are considered to be an artefact of the methodology as it applies to flow gauging data.

The margin of error can vary depending on the number of points and the spread of them on the log-log plot, and the appropriateness of the long-term catchment. A

large margin of error could occur where there is a small number of points on the log-log plot[1].

Gauging-flow pair censoring is a common practice used to eliminate data points that may be erroneous, thus reducing scatter and improving the correlation coefficient and margin of error. For example, censoring may be applied to gaugings with higher than normal flows resulting from rainfall at one or both sites. Many factors need to be considered when determining the validity of a gauged flow, and assessing the recession in a river or stream from high flow to baseline levels. These factors may include climate, season, ground cover (vegetation), geology, topology, soil type, and previous rainfall in the catchment. Arbitrary elimination of data points should not be conducted to artificially improve the correlation coefficient. Evidence should be provided to justify any data that are eliminated from the regression using this method.

It is recommended that the applicant contact the Northland Regional Council hydrologist for advice regarding gauging flow-pair censoring and also where regression analysis results in a correlation coefficient that is below 0.9.

If, after flow censoring, the correlation coefficient is less than 0.9, further gaugings or a reassessment of the selected long-term recorder site should be considered. Land uses within the "unknown" catchment may also influence the correlation.

The most conservative estimate of the design minimum flow should be used within the margin of error where:

(i) there are less than 10 valid gaugings from the "unknown" catchment over the desired range of flows, or

(ii) there is more than 20% of afforestation within the "unknown" catchment between 4 and 13 years old, or

(iii) the gaugings took place during El Nino weather pattern, or

(iv) the correlation coefficient is less than 0.9.

The resource user should contact the Regional Council regarding the most conservative estimate that should be used, which will be determined on a case by case basis.

# APPENDIX 12: GUIDELINES FOR FLOW SENSITIVE RIVERS AND SECTIONS OF RIVERS

The objective of these guidelines is to assist water permit applicants to identify flow sensitive rivers in accordance with Policy 9.05.03 and 9.05.04.

## 1. GUIDELINES ON THE DETERMINATION OF THE MEAN ANNUAL LOW FLOW (MALF)

Guidelines are contained in Appendix 11.

## 2. GUIDELINES ON DETERMINATION OF RIVER BED SUBSTRATE TYPE

1. The presence of coarse substrates below the take point within that part of the river potentially by the water take needs to be established by the applicant.

2. Coarse substrates are generally defined as those having a grain size of 2mm diameter and above. This includes gravels, cobbles, boulders or bedrock.

3. The presence of such river beds should be readily discernible and need only be documented by the applicant by:

   - A map showing the approximate location of such river bed in the potentially affected zones below the take point;
   - Photographs of the representative sections.

4. Where there is uncertainty or dispute as to the description of the river sections (i.e. whether they are coarse substrates or fine substrates) the Council may require a more formal sampling method.

5. The natural morphology of coarse river beds is characterised by sequences of shallow coarse sections interspersed with deeper pools. The latter tend to have fine substrate (silt and sand). Information will need to be supplied by the applicant as to the total amount of such habitat and the relative proportions of these different shallow and deeper zones in order that a conclusion can be drawn as to the significance of the area of coarse substrate. This information could include:

   - The number of pools versus shallow sections downstream of the take;
   - The relative lengths and widths of the pools and shallow sections downstream;
   - The area of coarse substrates downstream relative to the amount of such sites upstream of the take.

## 3. GUIDELINES ON DETERMINATION OF AVERAGE DEPTH OF THE RIVER

1. Select one or several fast flowing river stretches as is necessary to describe the morphological range.

2. In each stretch, select 3 cross-sectional transects which divide the stretch into approximately equal segments and which appear to be visually representative of the range in depths.

3. Across each transect, measure the depth from the bed to the water surface at 0.5 metre intervals or less if necessary to obtain at least 3 measurements per transect. Start the measurements about 0.2 - 0.5 metres in from the waters edge.

4. Calculate the average of all measurements.

Measurements can be taken at any time of the year provided conditions are at normal base flows. To this extent the applicant should provide the following record:

- Date and time of measurement;
- The climatic conditions on the day and some indication of the approximate rainfall over the preceding 5 days;
- A plan showing the locations of the river sections and the transect sites.

## 4. GUIDELINES ON DETERMINATION OF THE PROPORTION OF NATIVE BUSH IN A CATCHMENT, AND THE AREAS OF STREAM BANK VEGETATION OFFERING COVER AND SHADE

### 4.1 Percentage of Native Bush in a Catchment

The applicant need only provide an estimate of the proportion of the catchment above and below the take point that is in native bush. It would be expected that this estimate would be supported by any of the following:

- An up-to-date aerial photograph;
- A delineation of the catchment on a NZ Topographical Map (NZMS 260 series 1:50000 scale). These are available from any Department of Survey and Land Information office;
- A copy of relevant information obtained in the District Plan for the area;
- Information obtained from the Department of Conservation.

### 4.2 Percentage of River containing Riparian Vegetation

Riparian Vegetation' in this context is intended to mean vegetation within the riparian management zone and provides any or all of the following:

- Shade from sunlight (limiting heating effects);
- Instream cover from overhanging fronds, roots and the like;
- Buffer strips of vegetation which effectively intercept sediment and nutrients.

An indication of riparian features can be obtained from the same information sources cited above. However, the best information will be photographs of representative riparian zones.

## 5. ADDITIONAL INDICATORS OF POTENTIAL ECOLOGICAL SENSITIVITY TO FLOW REDUCTION

1. Specific indicators of flow sensitivity are:

   An average depth in riffles of:

   - 0.1 metres or less where the river provides habitat for invertebrates only;
   - 0.25 metres or less where the river provides habitat for native fish;
   - 0.5 metres or less where the river provides habitat for trout.

# APPENDIX 13A: INDIGENOUS WETLANDS

*The following plates are provided to assist in determining a "wetland" from a "wet" area which is not considered to be a wetland.*

**Note:** If you are unsure if an area is an indigenous wetland and is subject to rules in this Plan contact the Council for advice.

For the purposes of this Plan, the following photographs show several types of indigenous wetlands and emphasise the range in such wetlands.

Natural old dune lake with aquatic vegetation. For example native Flax, *Baumea* and *Schoenus* Sedges. Habitat for Water Birds, Crakes and Fernbirds.

Acid peat bog dominated by acid loving aquatic plants and shrubs, for example *Baumea* and *Schoenus* Sedges, Gleichenia Fern and Manuka. Habitat for Bittern Fernbird, Black Mudfish and Native Orchids.

Mixed Kahikatea mineralised swamp dominated by Kahikatea and Raupo. Habitat for Bittern and Spotless Crake.

Mineralised Raupo Swamp dominated by Raupo with occasional Flax, Coprosma Shrubs, Carex Sedges and Juncas Rushes. Habitat for Spotless Crake, Banded Rail and Bittern.

For the purposes of this Plan, the following photographs are indicative of “wet areas” that are not considered to be indigenous wetlands.

A drainage channel containing emergent mangroves *(Avicenna marina* var. *resinifera)*, is not regarded as an indigenous wetland.

# APPENDIX 13B: CRITERIA FOR AREAS OF SIGNIFICANT INDIGENOUS VEGETATION, AND SIGNIFICANT HABITATS OF INDIGENOUS FAUNA AND SIGNIFICANT INDIGENOUS WETLANDS

Natural areas which meet any of the following criteria are significant:

1. Contain critical, endangered, vulnerable, or rare taxa, taxa of indeterminate threatened status (sensu International Union for Conservation of Nature definitions).

2. Contain indigenous or endemic taxa that are threatened or rare in Northland.

3. Contain the best representative examples in an ecological district of a particular habitat type.

4. Have high density of taxa or habitat types for the ecological district.

5. Form ecological buffers, linkages or corridors to other areas of significant vegetation or significant habitats of indigenous fauna.

6. Contain habitat types that are rare in the ecological district.

7. Support good populations of taxa which are endemic to the Northland or Northland-Auckland regions.

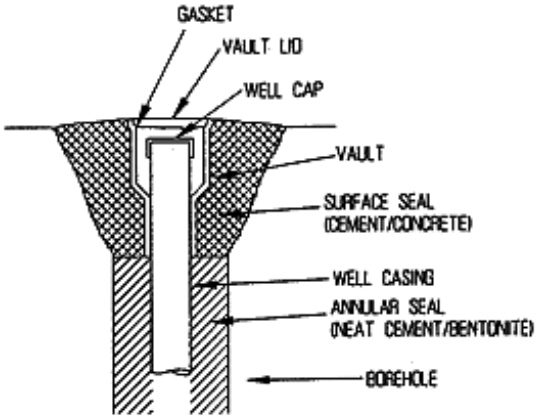
8. Are important for indigenous or endemic migratory taxa.

9. Support viable populations of species, which are typical of that habitat type within an ecological district and retain a high degree of naturalness.

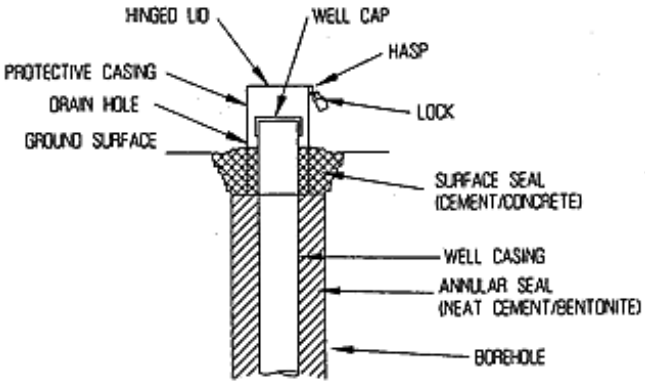
**Note:** Significant indigenous wetlands are a subset of indigenous wetlands.

# APPENDIX 14: MONITORING BORE SURFACE COMPLETION SPECIFICATIONS

TYPICAL FLUSH-TO-GROUND-SURFACE MOINTORING WELL COMPLETION




TYPICAL ABOVE-GROUND MONITORING WELL COMPLETION



# APPENDIX 15: PRINCIPLES OF FISH PASS DESIGN

## 1. INTRODUCTION

Many native freshwater fish species found in Northland must move between the sea and their freshwater habitats. Activities such as dams, crossings, culverts, floodgates and water intakes can deny or impinge upon fish access both up and downstream. Fish populations may therefore be adversely affected.

As a result of the varying habitat preferences and abilities of fish to move inland, fish communities will vary depending on distance inland and elevation. In order to design an effective fish pass, knowledge of the aquatic life present, or migrating past, a particular location is therefore required.

Our knowledge of freshwater fish means that it is largely possible to predict the species which might occur at a particular site. Such predictions can be based on an assessment of the key features of the catchment and the particular river. If the approach is to be conservative there may not be the need for costly field surveys of the fish community. However, if there is doubt as to the fish which use the river at a particular location, then surveys may be needed in order to determine the design requirements of a fish pass. Potential solutions will vary according to this information. Identification of the need or otherwise for a fish pass and their design and construction, requires the input of appropriately experienced fisheries specialists in addition to any local knowledge.

The Council holds information on the provision of fish passage, including the design of culverts and fish passes for different rivers and stream types.

In the context of fish pass construction, design and operation, native fish can be divided into three groups:

- Swimmers,
- Climbers, and
- Insinuators

## 2. SWIMMERS

A fish pass for swimmers essentially reproduces a segment of stream, inclined at a gradient that will still maintain acceptably low water velocities. It will generally be achieved by a design that baffles the stream flow and although creating a wide range of water velocities and eddies, maintains pathways of unbroken water and resting areas.

If the velocity of water flowing downstream is too high then these fish simply cannot swim against the current.

The two factors controlling water velocity are slope and surface roughness. If the slope can be made long enough, then the water velocities can be reduced down to about 0.3 metres per second. This velocity is about the maximum small native fish can swim against. Roughness can be increased by baffles (rocks) and deflectors designed to slow the water and create turbulence and eddies.

## 3. CLIMBERS

Species capable of climbing can scale impressive natural obstacles. The presence of species such as banded kokopu and long-finned eels above large waterfalls is evidence of this ability.

The basic requirement of any fish pass for climber fish species is a sloping surface covered by a gentle trickle of water.

Basic problems for climbing fishes are:

(a) Continuity: Many dams and weirs have places where climbing behaviour occurs but where water flow is discontinuous and prevents fish from scaling the obstacle. Relatively minor modifications can often solve these problems.

(b) Heating and Exposure: Exposed dam faces can heat up during the day and result in temperatures exceeding acceptable levels. Shading and other forms of insulation of fish passes for climbing species may be required. Exposure to predators is also potentially important. Rats, cats, and some birds will all opportunistically feed on native fish climbing over natural or artificial structures within a stream.

## 4. INSINUATORS

Eels are adept at wriggling through the smallest crack. A pass for elvers can be very cheap and only use small amounts of water. A simple design for example could be a pipe filled with brushing, down which a small amount of water is trickled. Elvers move along the pass by worming through the damp brushing. By using this method they will even climb up a vertical pipe.

## 5. PUMPS

Insinuator and climbing type fish passes face a potential problem. Fluctuating water levels upstream mean that it is often difficult to get fish back to the upstream water surface having passed over the structure. In practice this may require pumping water usually to a header tank where float switch controls pump operation. Water is then fed into the fish pass. There are a wide range of 240v single phase submersible pumps which will supply sufficient water for insinuator and climbing type fish passes. A further complication is that fish are very sensitive to water quality. For example it is likely that fish would be repelled if a treated bore water supply was used. Using water from the upstream impoundment or river will give fish the necessary cues that following the flow will lead them over the pass.

## 6. INTAKE SCREENS

Piped intakes can potentially capture passing fish. Numbers of fish can be potentially large if pumping coincides with periods of peak fish migration. Properly designed screens and carefully located intakes can adequately mitigate the potential for adverse effects.

Slotted screens of 5 millimetres maximum mesh size are preferable. Smaller mesh sizes may be desirable in some circumstances. Examples are wedge wire screens and Johnson-T-screens. Screens should be sized to achieve screen surface intake velocities of no greater than 0.3 metres per second and preferably 0.15 metres per second. The latter is desirable to allow for up to 50% clogging of screen area with debris at times.

Velocities across the screen surface at least twice the through screen velocity will enhance self cleaning properties and minimise the potential for impingement of biota. This effectively means targeting high flow areas for siting of intakes, preferably away from the bank and one metre out into flowing water above the stream bed. This also is preferable because fish movement tends to be close to the bed or the bank of a river where velocities are lower and where there is more natural cover and refuge.

# APPENDIX 16: CONTENTS OF A REGIONAL PLAN FOR SPECIFIC CATCHMENT

Section 67 of the Act outlines what a regional plan must state, and what matters a regional plan may make provision for. While following the provisions of these sections, a regional plan for a specific catchment should address the following matters:

## 1. WATER QUALITY

(a) Existing baseline water quality;

(b) Existing point source discharges and effects on water quality;

(c) Existing non point source discharge and effects on water quality;

(d) Water quality required for desired uses of water;

(e) Methods to achieve desired water quality.

## 2. WATER QUANTITY

(a) Existing water users;

(b) Potential water users;

(c) Catchment hydrology - surface and groundwater;

(d) Effects of land user on catchment hydrology;

(e) Alternative sources.

## 3. SOIL CONSERVATION

(a) Current land uses;

(b) Potential land uses;

(c) Actual and potential areas of soil erosion;

(d) Catchment protection works.

## 4. RIPARIAN MANAGEMENT

(a) Purpose;

(b) Management requirements.

## 5. VALUES OF WATER BODIES

(a) Aquatic and wetland habitats;

(b) Cultural;

(c) Natural character;

(d) Amenity/recreational.

## 6. NATURAL HAZARDS

(a) Flooding.

*This list is not comprehensive and further matters may be identified in relation to a particular resource.*

# APPENDIX 17: POSSIBLE CONTENTS OF DRAINAGE DISTRICT MANAGEMENT PLAN

Matters to be addressed in a management plan shall include, but not be restricted to, the following:

1. The objectives of the drainage scheme.

2. A summary of the statutory and legal mandate under which the drainage district was created, including reference to any Gazette Notices, Local Acts of Parliament, etc., and any resource consents or authorisations.

3. Definition of Drainage District and catchment area.

4. The planned/design level of protection.

5. Description of the works involved in the scheme. This would include drains, canals, stopbanks, floodgates, pumping stations or similar works which are owned by the Drainage District. Appendices would include schedules of drains, etc., their dimensions, and plans showing their location.

6. Programme for construction of planned and "approved" works. This section would apply to new schemes, to existing schemes which have not been completed to the design standard, and to those which are being brought back up to the design standard from a deteriorated state.

7. A description of work programmes to maintain the drainage scheme at the approved design levels. This section would involve a schedule which specifies the maintenance standard for each drain or other piece of the infrastructure, the method of maintenance (whether it will be by machine cleaning or herbicides), the timing and frequency of maintenance, resource consent conditions or performance standards on authorisations for maintenance, methods of disposing or revegetating drain cleanings, etc.

8. An outline of the rules or bylaws controlling things such as stock access to drains, culverts or crossings over drains, connecting private drains to the community drains, planting hedges or erecting fences near drains, machine access along drains, etc.

9. A description of the rating/funding classification, including a plan showing the rating classification for each property.

10. Provisions for the protection of any significant indigenous wetlands.

11. Details of resource consents and monitoring programmes.

12. Review date for the management plan.

# APPENDIX 18: OUTSTANDING VALUE RIVERS AND LAKES

The following Rivers or Sections of Rivers and lakes have been identified in accordance with Polices 9.05.01 and 9.05.02:

- Waipoua
- Whirinaki
- Waipapa
- Mangamuka
- Punaruku
- Lake Ora
- Waikohatu
- Wairau

Maps showing the extent of these Rivers or Sections of Rivers and Lakes classed as outstanding are contained within the “Regional Water and Soil Plan for Northland, Maps”.

# SCHEDULES

*This part contains the Schedules, where maps are referred to these are contained in the separate folder Water and Soil Plan for Northland Maps under the specific Schedule Number.*

# SCHEDULE A: AQUIFERS WITH HIGH ACTUAL OR POTENTIAL DEMAND

Maps showing the following extents of Aquifers with High Actual or Potential Demand are contained within the "Regional Water and Soil Plan for Northland, Maps":

- Kaikohe
- Matarau
- Three Mile Bush
- Glenbervie
- Maunu
- Maungakaramea
- Tara

# SCHEDULE B: AQUIFERS AT RISK (SHORT TO MEDIUM TERM) OF SEAWATER INTRUSION

Maps showing the following extents of the aquifers at risk (short to medium term) of seawater intrusion are contained within the "Regional Water and Soil Plan for Northland, Maps":

- Taipa Beach
- Cable Bay/Coopers Beach
- Taupo Bay
- Tauranga Bay
- Te Ngaire
- Matauri Bay/Putatua
- Otehei Bay
- Urupukapuka Bay
- Tapeka Point
- Russell
- Bland Bay Isthmus
- Ohawini Bay
- Parutahi Beach
- Oakura Bay
- Teal Bay
- Moureeses Bay
- Whananaki North
- Whananaki South
- Sandy Bay
- Woolleys Bay
- Matapouri
- Whangaumu Bay
- Church Bay
- Kowharewa Bay
- Ngunguru
- Pataua North
- Pataua South
- Taiharuru
- Mangawhai

# SCHEDULE C: GEOTHERMAL AQUIFERS

A map showing the following extent of the above geothermal aquifers is contained within the “Regional Water and Soil Plan for Northland, Maps”:

- Ngawha Geothermal Field

# SCHEDULE D: EXISTING DRAINAGE DISTRICTS AND FLOOD SCHEMES

| | |
|---|---|
| **FAR NORTH DISTRICT** | Herekino<br>Kaitaia<br>Motutangi<br>Waiharara<br>Waikino |
| **WHANGAREI DISTRICT** | Hikurangi Swamp Major Scheme<br>Hikurangi Swamp Drainage District |
| **KAIPARA DISTRICT** | Aoroa<br>Arapohue No. 1<br>Arapohue No. 2<br>Aratapu Swamp<br>Aratapu Village<br>Awakino Land<br>Awakino Point<br>Greenhill<br>Hoanga No. 1<br>Hoanga No. 2<br>Horehore<br>Kaihu Valley<br>Kaihu River Control<br>Kopuru<br>Koremoa<br>Manganui<br>Mangatara<br>Mititai<br>Notorious<br>Okaka<br>Okaro<br>Oruariki<br>Owairangi<br>Otiria<br>Raupo<br>Sunnynook<br>Tangowahine No. 1<br>Tangowahine No. 2<br>Tangaihi<br>Tatarariki No. 1<br>Tatarariki No. 2<br>Tatarariki No. 3<br>Te Hapi<br>Tikinui<br>Waikere<br>Waimamaku |

**Note:** Maps of these Drainage Districts and Flood Schemes are available at the relevant district council. However, most landowners would know whether they are within these areas because their land would be rated for drainage works. Where there is doubt as to whether an activity which affects the bed of a river is within a drainage district and therefore should be authorised as part of the Resource Consent, the surface water sub-catchment boundary will be taken as the boundary of the drainage district.

# SCHEDULE E: LIST OF DUNE LAKES IN NORTHLAND

Map co-ordinates are taken from the New Zealand Topographic Map Series 260.

**AUPOURI AND KARIKARI PENINSULAS**

| | |
|---|---|
| Lake Austria | N02:958-369 |
| Pretty Lake | N02:955-354 |
| Waipara and Dead Lakes | N02:976-350 |
| Ngatuwhete Lake | N02:004-359 |
| Lake Kihona | N02:020-303 |
| Lake Wahakari | N03:039-277 |
| Lake Te Kahika | N02:110-308 |
| Lake Morehurehu and smaller lake | N03:104-289 |
| Lake Taeoro | N03:129-250 |
| Lake Ngatumoroki | N02:091-229 |
| Bulrush Lake | N03:106-216 |
| Salt Lake | N03:132-217 |
| Lake Waihopo | N03:148-161 |
| Turks Lake | N04:244-995 |
| Bacica Road Lake | N04:257-994 |
| Lake Waiparera and associated lakes | N04:259-953<br>N04:273-952<br>N04:252-949 |
| Jones Lake | N04:269-918 |
| Gleeson's Lake | N04:279-907 |
| Lake Ngakapua Complex and unnamed lake by Forest HQ | N04:279-865<br>N04:286-869<br>N04:283-869 |
| Lake Rotokawau | N04:296-869 |
| West Coast Road Lake | N04:275-855 |
| Lake Ngatu | N04:289-855 |
| Lake Heather | N04:285-833 |
| Lake Rotoroa | N04:286-824 |
| Round Lake | N04:281-807 |
| Waimimiha Lakes | N04:263-729<br>N04:262-735 |
| Rotokawau Lakes | O03:392-033<br>O03:401-032 |
| Lake Waiporohita | O04:427-000 |

**EASTERN NORTHLAND REGION DUNE LAKES**

| | |
|---|---|
| Racecourse Lake | Q07:421-890 |

**KAI IWI DUNE LAKES**

| | |
|---|---|
| Shag Lake | O07:655-009 |
| Kai Iwi Lakes (Kai Iwi, Taharoa and Waikere Lakes) | O07:692-993<br>O07:697-983<br>O07:670-004<br>O07:676-001 |

**POUTO PENINSULA**

| | |
|---|---|
| Lake Parawanui | P08:871-707 |
| Lake Wainui | P08:899-663 |
| Clarkes Lake | P08:918-649 |
| Roundhill Lakes | P08:993-505<br>P08:994-501 |
| Lake Rototuna | P09:040-494 |
| Lake Unnamed (Roundhill South) | P09:017-470 |
| Lake Karaka | P09:038-426 |
| Lake cluster north of Lake Mokeno | P09:047-412<br>P09:045-417 |
| Lake Mokeno | P09:056-392 |
| Crescent Lake | P09:040-368 |
| Unnamed lake just south of Lake Mokeno | P09:058-374 |
| Lake Whakaneke | P09:058-365 |
| Stick Lake (Lake Mathews) | P09:070-350 |
| Pheobes Lake | P09:073-437 |
| Lake Rotopouua | Q09:100-419 |
| Lake Humuhumu | Q09:113-409 |
| Lake Rotootuauru (Swan Lake) | Q09:128-406 |
| Rotokawau Ponds | Q09:128-389<br>Q09:131-390 |
| Lake Rotokawau | Q09:135-388 |
| Lake Waingata | Q09:138-383 |
| Lake Kanono | Q09:130-370 |
| The Spectacles Lakes | Q09:142-373 |
| Finalysons Lake | Q09:140-367 |
| Lake Kahuparere | Q09:144-362 |

Northland contains numerous lakes. Most are small, shallow and located within consolidated sand dunes on the Aupouri, Karikari and Pouto peninsulas. The Council has produced two major reports pertaining to lakes in Northland, the Kai Iwi -

Pouto Dune Lakes Water Resources (1991) and, the Aupouri Peninsula Water Resources Assessment (1991).

For maps showing the locations of the dune lakes listed in Schedule E, contact the Northland Regional Council.

# SCHEDULE F: AQUIFERS SENSITIVE TO BORE CONSTRUCTION

Maps showing the following extents of the aquifers which are sensitive to bore construction are contained within the "Water and Soil Plan for Northland, Maps":

- Aupouri
- Ruawai