REPORT

Taranaki Regional Council

Dairy Effluent Pond Guidelines

Report prepared for:

TARANAKI REGIONAL COUNCIL

Report prepared by:

Tonkin & Taylor Ltd

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1 Purpose and objective

There are a number of considerations when putting in a dairy effluent storage pond. Choosing a suitable pond for your property is important to minimise leakage from the pond, protect water quality and meet resource consent conditions.

This short guide provides information to assist with choosing a suitable pond. It includes information on the key steps and considerations for putting in a pond, including:

- Choosing pond location.
- Leakage and permeability.
- Taranaki soils.
- Dairy effluent pond types and features.
- Construction.

This guide has been specifically developed for Taranaki and addresses storage ponds only. This reflects changes in effluent management from traditional treatment ponds (with discharge to water) to effluent holding ponds (with irrigation to land).

For information on treatment ponds and leak rates from existing ponds see *Managing Dairy Farm Effluent* (Dairying and Environment Committee Manual), Chapter 3, prepared by Taranaki Regional Council.

Links to more detailed guidance on design and construction of dairy effluent ponds are provided in Section 8.

Please note: advice on Resource Management Act (RMA) requirements is not provided in this guide, and should be sought from Taranaki Regional Council prior to construction.

Tonkin & Taylor has prepared this guideline in accordance with our engagement dated 6 June 2012 and letter dated 24 May 2013.

2 Choosing the pond location

Pond location should be chosen to minimise the risk and impact of leakage, and the impact of smell from the pond. Choosing a pond location that meets the following criteria will help to minimise these impacts. If these criteria cannot be met then special design may be needed.

Pond location criteria:

- The pond base must be at least 1 m above the groundwater table. If this is not possible special design must be used (refer IPENZ Practice Note 21 (2012) Part 1, Section 5.10.1).
- Choose a location that allows you to minimise stormwater catchment. Use stormwater diversion methods if necessary.
- Pond must be more than:
    - 150 m from a dwelling.
    - 45 m from the farm dairy.
    - 20 m from the boundary.
    - 20 m from trees, or two-thirds the expected height of the mature tree.
    - 50 m from water courses (streams, rivers, ponds, lakes).
    - 90 m from a drinking water well, if on the ring plain. Elsewhere, site specific assessment if well is within 200 m of pond.

- Avoid:
    - Areas prone to flooding or freezing.
    - Steep slopes running toward a waterway.
    - Springs and boreholes.
    - Areas that are pipe-drained, mole ploughed, or have been recently disturbed.
    - Free draining soils such as sands and gravels.
    - Areas of instability and areas prone to settlement.

3 Leakage and permeability

Leakage from a pond depends on the permeability of the material that lines the pond. The permeability of soil present at the pond site (in-situ soil) is important in determining the type of pond liner that is required, particularly as it might be able to be used to line the pond.

Permeability of soil varies depending on what the soil is made up of, for example sandy soils are more permeable than clay soils. The permeability is measured by how quickly water is able to pass through the soil: the faster water passes through soil, the more permeable the soil is. For example, a soil with a permeability of one-millionth of a metre per second ($1x10^{-6}$ m/s) is more permeable than a soil with a permeability of one-billionth of a metre per second ($1x10^{-9}$ m/s) so water (or effluent) will pass through the soil more quickly.

Indicative permeability information for Taranaki soils is included in Section 7.

4 Dairy effluent pond types and features

Described below are the six broad types of dairy effluent ponds. The description of each pond type lists the design features required to meet a common performance standard (so the leakage is restricted to a specified value). Because detecting leaks is difficult after installation, the performance standard relies on good construction methods to ensure pond performance. For example, a poorly installed geomembrane liner will leak more effluent into the ground than a well-constructed unlined pond.

If the pond location does not meet all the criteria listed in Section 2, a site specific assessment of environmental impact to determine the standard of pond lining is required.

4.1 Soil lined ponds

Compacted soil

450 mm soil with permeability ≤1x10^{-9} m/s.

Soil can be either in-situ soil dug up and reworked, or imported from elsewhere on the farm or region.

Cover layer of soil required to prevent surface drying out when pond is empty.

In-situ soil

Either 1 m thick soil below base of pond if permeability ≤1x10^{-9} m/s; or 2 m thick soil below base if permeability ≤5x10^{-9}m/s.

Scarify (make cuts) and compact top 150 mm.

Scour protection may be required.

Bentonite-enhanced soil liners

Same as for compacted soil liner (450 mm thick with permeability of ≤1x10^{-9}m/s).

Bentonite is mixed with soil to achieve desired permeability at a rate of 10% of the dry weight of soil.

Should work well with sandy soils.

The use of bentonite slurry from drilling would require:

- specific trials to confirm the required permeability can be achieved, and
- contamination testing to assess effects on the environment or liner (if used under a geomembrane).

4.2 Geomembranes

Geomembrane (synthetic) liners

HDPE or butyl rubber liner.

Needs a layer of soil beneath it with a permeability ≤5x10^{-6} m/s.

The soil layer can be 300 mm thick if compacted soil, or 1 m thick if in-situ, with top 150 mm scarified and compacted.

Avoid a 'cushion' or sand blinding layer, use silt if blinding layer necessary to protect geomembrane.

If a soil gas or groundwater drainage layer is needed, it must be placed below the soil layer.

4.3 Concrete liners

Concrete liners

Site specific design required.

Minimum 100 mm concrete liner with a layer of soil beneath it.

If a soil gas or groundwater drainage layer is needed, this should be placed below the soil layer.

Not recommended if ground settlement is expected.

Concrete tanks (in photo)

Commonly have pre-cast walls and poured in place floor. Underlying soils must be strong enough to take the weight. Soft clay or peaty soils are unlikely to be suitable without special design

5 Choosing a pond type

Below is a decision path to determine which type of pond is right in a given location. Note that concrete lined ponds and pre-cast concrete ponds are not recommended if ground settlement is expected. Permeability testing is only required if soil layers are used in the pond design, either as the main lining or as a secondary layer below a concrete or geomembrane liner.

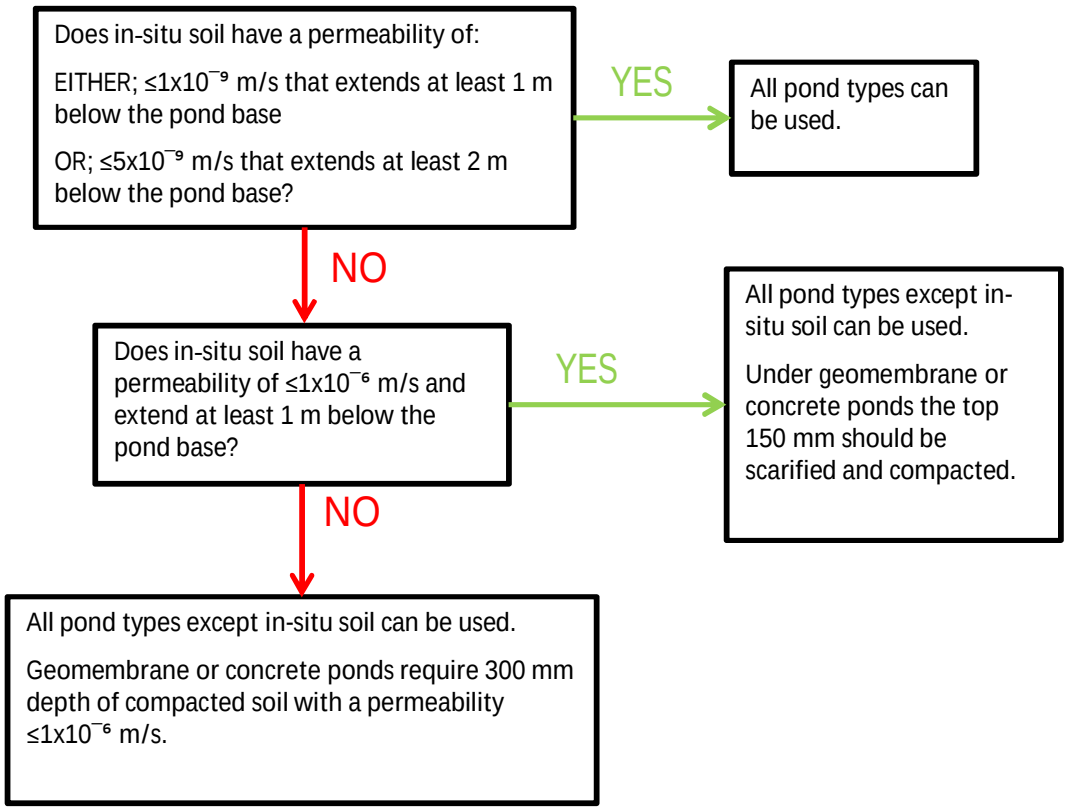

Figure 2: Flow chart for selection of suitable pond liner (normal environmental sensitivity).

6 Construction

Good construction practices and quality control are essential to ensure a new pond performs well. This section outlines the fundamental aspects of construction for all ponds, and some of the considerations for constructing different types of dairy effluent ponds. Construction requirements also differ from site to site, and this should be accounted for during site-specific design.

6.1 Fundamental aspects of pond construction

Use a contractor with the right equipment and expertise to install the type of pond you have decided on.

Soil used in construction should be tested for permeability.

Any soil layers required during the construction of the pond should be laid down and compacted in 150 mm layers to ensure they are adequately compacted and achieve the necessary permeability, including on the sides of the pond.

Keep good documentation, including:

- A specification and drawings.
- An agreed method for construction, to:
  - Comply with the requirements of the specification.
  - Achieve the required quality of materials and construction
- Quality control procedures, including records of construction and testing results, to:
  - Ensure the agreed method is followed.
  - Ensure the requirements of the specification are achieved.

NOTE: This documentation forms the basis for execution and control of construction, and if required, can be provided to Taranaki Regional Council to demonstrate compliance with the performance standard. Without this documentation the pond may not meet the pond performance criteria, and even if it does, it may not be possible for you to verify compliance.

6.2 Pond type specific construction requirements

Some additional points for construction of different pond types are:

- Geomembrane and concrete lined ponds
  - To avoid damaging the lining, prepare a smooth surface for the liner to rest on.
  - To minimise leaks, a high standard of workmanship is required on the joints. Joints should be tested for leaks.
- Concrete lined ponds
  - To minimise leaks, a high standard of workmanship is required on the joints.
- Bentonite-enhanced soil liners
  - Trials and testing to check suitability of mixing soil and required bentonite content.
  - Essential to control bentonite application rate and thorough mixing.
- Concrete tanks
  - Tanks to be designed to appropriate standards, with site investigation and design of foundations by a geotechnical specialist.

Further detail on design and construction of dairy effluent ponds, including testing requirements is available in IPENZ Practice Note 21.

7 Taranaki soils

The following map (Figure 1) shows the geological terrain zones for the Taranaki Region. Table 1 provides a description of each zone and indicative permeabilities of soils within that zone. Each zone has a number of different soil types and each soil type can have a range of permeabilities. The values in Table 1 are a general guide. Permeability testing may be required for site specific design. See IPENZ Practice Note 21 for testing information.

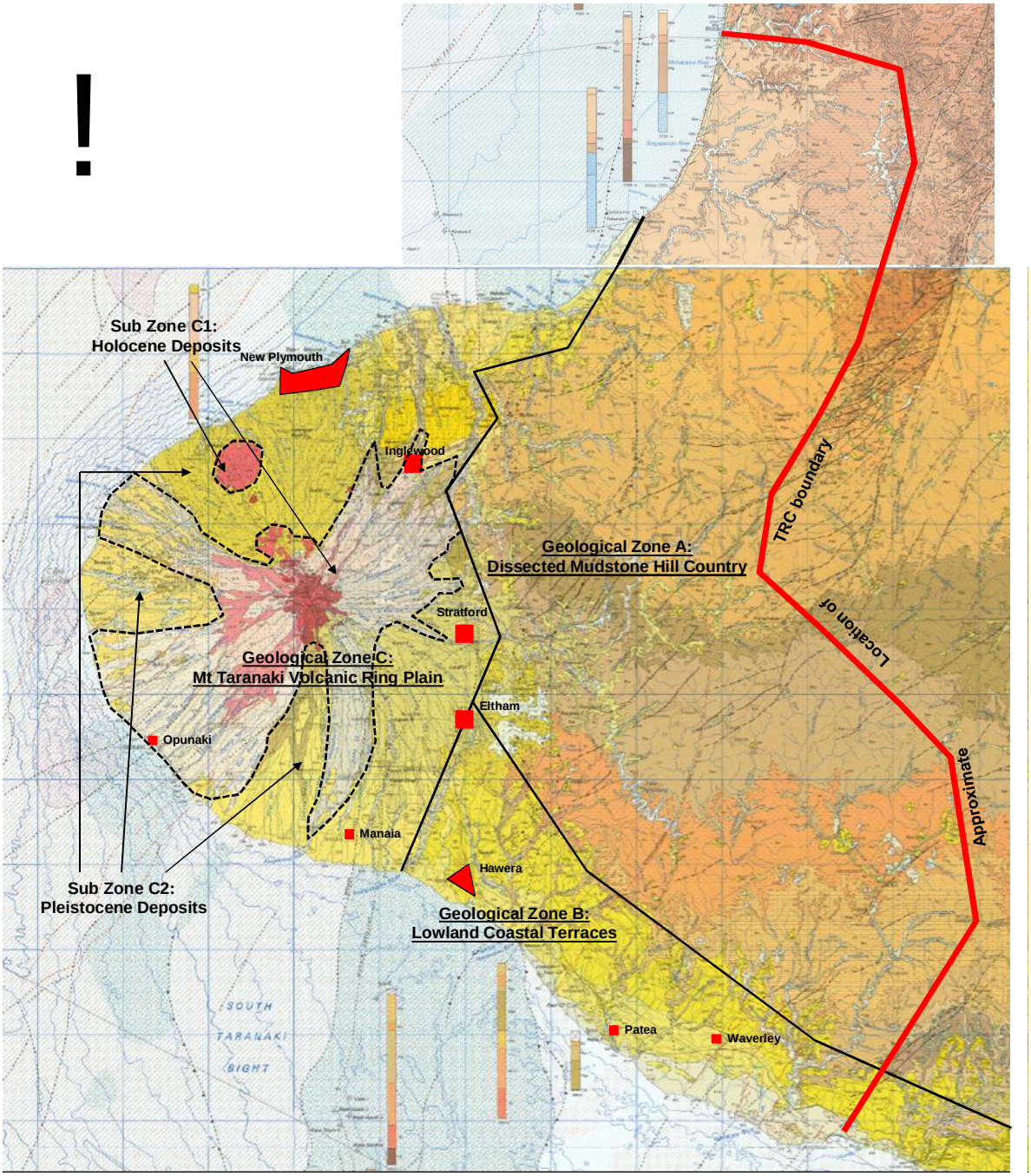

Figure 1: Taranaki geological terrain zones

Table 1: Description of Taranaki soil zones, associated soil types and permeabilities

Geological terrain zone	Soil types and general description	Range of permeability (m/s)
A: Dissected hill country Inland hill country. Relatively low hill topography and flat benches dissected by streams and rivers.	Mudstone/siltstone derived: very fine grained, with no grains visible to the naked eye. Brown or grey.	$1x10^{-6}$ to $1x10^{-9}$
	Sandstone derived. Fine grained with some grains visible. Brown or grey.	$1x10^{-4}$ to $1x10^{-6}$
	Volcanic Ash. Fine grained. Orange-brown to dark brown.	$1x10^{-5}$ to $1x10^{-9}$
B: Coastal lowlands Sets of uplifted marine terraces that stretch from south Taranaki Bight inland for approximately 20km.	Marine terrace deposits: - Fine grained with some grains visible to naked eye. Light brown to grey. - Coarse grained with sand and gravel. Light brown to grey.	$1x10^{-5}$ to $1x10^{-7}$ $1x10^{-2}$ to $1x10^{-5}$
	Dune sand. Fine grained, gritty, with uniform sized sand grains. Crumbles in fingers.	$1x10^{-2}$ to $1x10^{-4}$
	Loess. Fine grained with some grains visible to naked eye. Orange-brown to dark brown. Sticky when wet, but cannot be rolled into thin threads in fingers.	$1x10^{-6}$ to $1x10^{-8}$
	Volcanic Ash. See description above.	$1x10^{-5}$ to $1x10^{-9}$
C: Mt Taranaki ring plain Circular area of undulating terrain around Mt Taranaki, radius approx. 30km. C1: gravels and sand covered by thin or no silt and clay ash. C2: relatively thick layers of silt and clay ash deposits.	Laharic deposits. Ranges from clay to large gravels. Red-brown to light brown. Clay is sticky when wet and can be rolled into thin threads with fingers.	$1x10^{-1}$ to $1x10^{-8}$
	Volcaniclastic deposits. Fine grained with most grains visible to the naked eye. Grey. Crumbles when rolled in fingers.	$1x10^{-4}$ to $1x10^{-8}$
	Volcanic Ash. See description above.	$1x10^{-5}$ to $1x10^{-9}$

Note: permeabilities sourced from IPENZ Practice Note 21, Part 2 Clay Liners for Ponds.

8 Further information

This guide draws on the following sources, which contain further information on designing and constructing dairy effluent ponds:

- IPENZ Practice Note 21: IPENZ: Farm Dairy Effluent Pond Design and Construction, available at: http://www.dairynz.co.nz/page/pageid/2145869375?resourceId=686
- Managing Dairy Farm Effluent (Dairying and Environment Committee Manual), Chapter 3, prepared by Taranaki Regional Council can be found here: http://www.trc.govt.nz/assets/taranaki/environment/land/dairying-environment/effluent/3.pdf
- DairyNZ has a number of online resources about effluent systems, available at: http://www.dairynz.co.nz/page/pageid/2145866686/Effluent_Systems

9 Applicability

This report has been prepared for the benefit of the Taranaki Regional Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor LTD

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
.....	.....
Claire Marshall	Ed Breese
Environmental Scientist	Project Director
Technical review:	Hugh Cherrill, Senior Geotechnical Engineer
	Penny Kneebone, Senior Environmental Scientist

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