Pocket guide to determine soil risk for farm dairy effluent application

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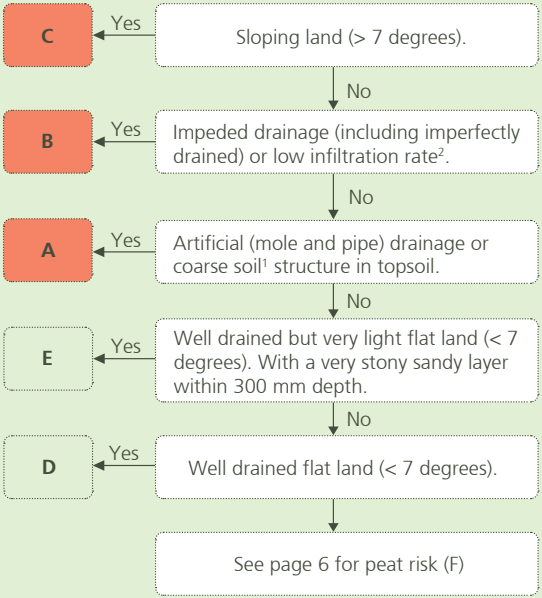
DNZ40-130

Soils across New Zealand have been classified into high and low soil risk categories for farm dairy effluent application.

Management practices need to be matched to soil and landscape risk in order to prevent loss of effluent into the surrounding environment.

This field guide will take you step by step through the process of working out the soil risk for a farm.



The soil risk decision tree shows the 6 risk categories with those in red **High Risk (A,B,C)** and those in green **Low Risk (D,E,F).**

[1] Soils with 80% or more soil aggregates captured on a 10 mm sieve within the top 300 mm soil layer are considered to have coarse soil structure.

[2] Low soil infiltration rate is defined as 10 mm/hr or less.

Soil risk categories overview

Step 1. Check out soil information for the specific area on-line

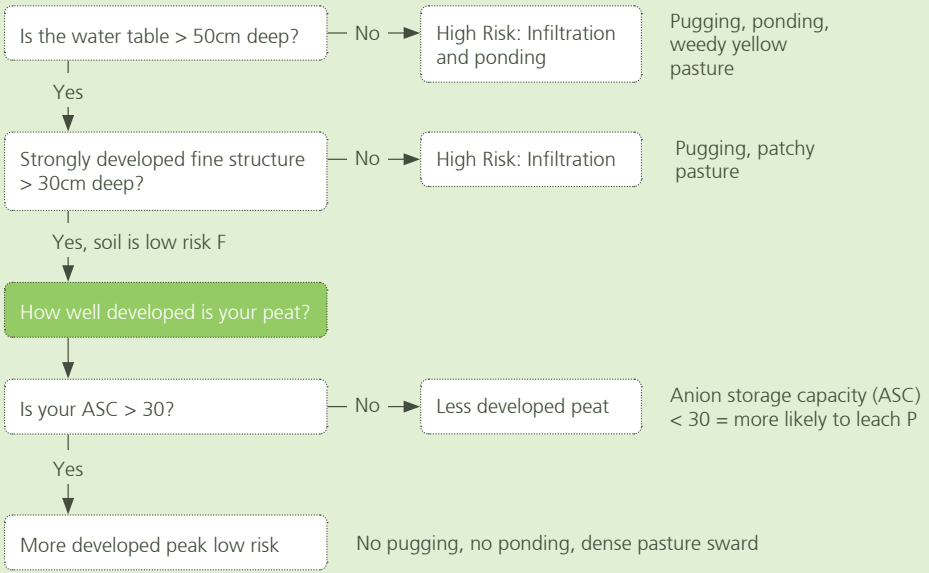
Step 2. Understand the A,B,C,D,E,F risk profiles and what they mean

Step 3. Review the topography of the farm

Step 4. Verify soil risk on-farm by digging some test pits

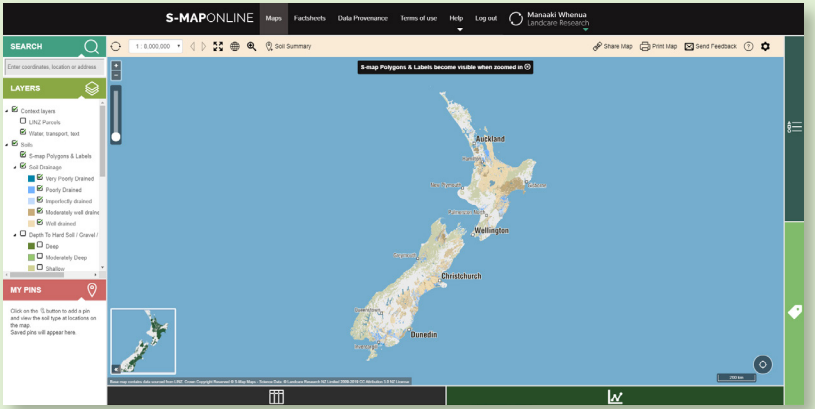
Step 5. If unsure consult a soils expert

Understanding risk of peat soils

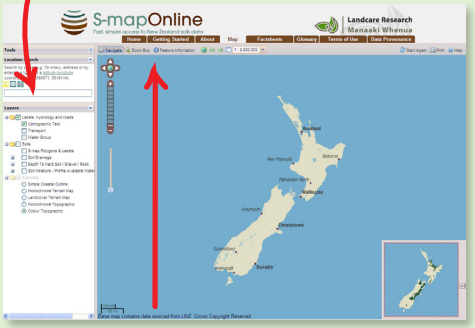


Go to S-map online website **http://smap.landcareresearch.co.nz**

Click locate me and register or logon



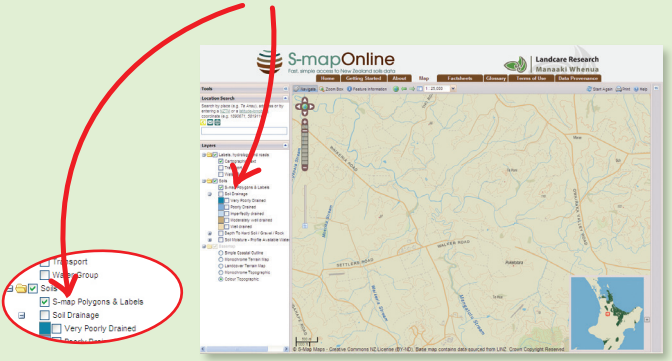
Find the property by entering the address in the location search box, and then select the envelope to search for the address.



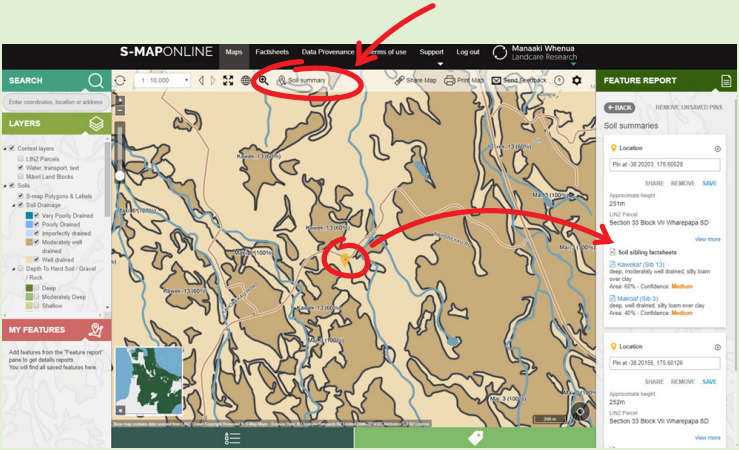
Alternatively, use the navigate and zoom buttons to find the area of interest.

The map will automatically zoom to your location, and highlight as a red dot.

Turn on the soil map by selecting **S-map Polygons and Labels**

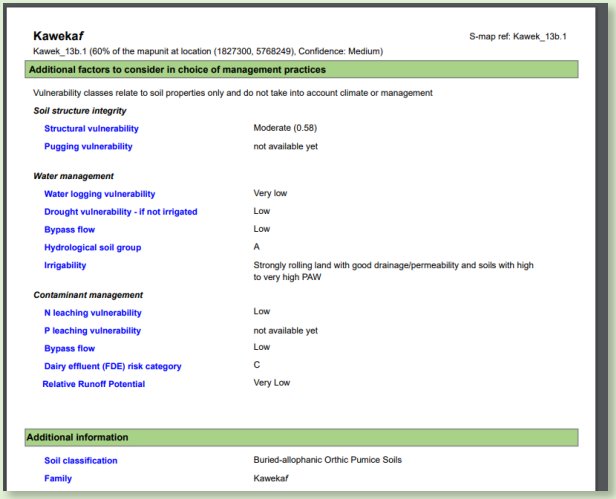


To identify the soil type(s) select the **soil summary** button at the top of the page, and click on the map where you want information.



Once you have clicked on the location for your soil type, the soil summary will be available in a sidebar.

There may be one or more soil sibling fact sheets available. Open the relevant factsheet.



Kawekaf S-map ref: Kawek_13b.1

Kawek_13b.1 (60% of the mapunit at location (1827300, 5768249), Confidence: Medium)

Additional factors to consider in choice of management practices

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability	Moderate (0.58)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Very low
Drought vulnerability - if not irrigated	Low
Bypass flow	Low
Hydrological soil group	A
Irrigability	Strongly rolling land with good drainage/permeability and soils with high to very high PAW

Contaminant management

N leaching vulnerability	Low
P leaching vulnerability	not available yet
Bypass flow	Low
Dairy effluent (FDE) risk category	C
Relative Runoff Potential	Very Low

Additional information

Soil classification	Buried-allophanic Orthic Pumice Soils
Family	Kawekaf

For some areas the soil risk classification may be unknown. If this is the case for your farm, contact your local regional council.

This table describes effluent considerations related to the risk class.

Category	A	B	C	D	E	F
Soil and landscape feature	Artificial drainage or coarse soil structure	Impeded drainage or low infiltration rate	Sloping land (>7°) or land with hump & hollow drainage	Well drained flat land (<7°)	Other well drained but very light flat land (<7°)	Low water table peat with good structure
Risk	High	High	High	Low	Low	Low
Application depth (mm)	< SWD[1]	< SWD	< SWD	< 50% of PAW[2]	≤ 10 mm & < 50% of PAW[2]	< 50% PAW
Storage requirement	Apply only when SWD exists	Apply only when SWD exists	Apply only when SWD exists	24 hours drainage post saturation	24 hours drainage post saturation	24 hours drainage post saturation
Max depth: High rate tool	10 mm	10 mm	10 mm[3]	25 mm[4] (10 mm at field capacity)	10 mm	25 mm[4] (10 mm at field capacity)
Max depth: Low rate tool	25 mm	25 mm	10 mm	25 mm	10 mm	25 mm[4] (10 mm at field capacity)

[1] SWD is the soil water deficit

[2] PAW is the plant available water in the top 300 mm of soil

[3] Only applicable when instantaneous application rate from the irrigator is less than the infiltration rate

[4] Suggested maximum application depth when a suitable SWD exists (≥ 15 mm)

For all the risk categories the application rate should always be less than the soil infiltration rate otherwise you will get ponding (on sloping land the instantaneous application rate needs to be less than the soil infiltration rate or you will get run-off).

Sloping land greater than 7˚?

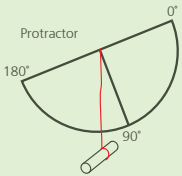
If, yes → Category **C High Risk**

If, no → Go to Step 4

Clinometers (inclinometers) are tools for measuring slope angle. They can be sourced from suppliers of technical instruments or can be downloaded as an app on smartphones.

Common clinometer

Compass clinometer
(Geological or Brunton compass)



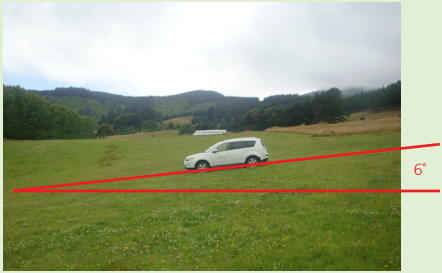
Home made clinometer

Download a clinometer app
on your Smartphone

Alternatively these photos of a car on a slope gives some idea of slope, 7˚ is not actually that steep!

Slope less than 7 degrees (actual slope of 6 degrees)

Slope less than 7 degrees (actual slope of 6 degrees)



Slope greater than 7 degrees (actual slope of 14 degrees)

Slope greater than 7 degrees (actual slope of 14 degrees)

All hump and hollow drained land is Category **C High Risk**

First, check to ensure no underground services are near proposed pit site.

Dig a small soil pit about 300 x 300 mm square x 400 mm deep with a spade.

- Keep the sides of the pit vertical and observe the depth to gravel (if present)
- Clean up one side of the pit so it is smooth (ideally either facing the sun or completely in the shade – so it is uniformly light for photographing)
- Identify any boundaries of soil layers, usually identified by a change in soil colour (in the photo (left) the subsoil layer is apparent in the base of the pit in contrast to the brown colour of the topsoil above)

How many test pits are needed?

- Sloping land greater than 7 degrees is automatically Class **C High risk**, so there is no need to locate pits here
- Recommend that an average of one test pit per 6 hectares are dug (this is a mapping scale of 1:25,000)
- Avoid fencelines, gateways, trees and around troughs
- Digging multiple test pits will indicate any major soil variations between paddocks and locate areas of low risk soils on the farm
- Take a picture of the soil profile of each pit and record on farm map the rough location of each pit.

Is the soil predominately peat?

If, yes → Go to page 28

If, no → Keep working through this step

Peat soil, like those in the photos above, is characterised by a high level of organic matter that has accumulated in areas with a high water table. They can be recognised by black to very dark brown colours and when rubbed between the fingers. Peat material often has a greasy feel. Plant material decomposes slowly in peat and is often observable in the soil pit.

Does the soil have impeded drainage?

Identifying impeded drainage, (imperfectly and poorly drained soils), is done primarily by soil colour and the presence, size and colour of soil mottles within 400 mm depth. Soil mottles are the 'spots' or 'blotches' of colour different from the predominant soil matrix colour (excluding pieces of topsoil), often specks of rusty orange or grey or bluish grey colours.

Can you see spots or blotches of colour in the side of the test pit?

If, yes ⟶ Category **B High Risk**

If, no ⟶ Keep working through this step

Does it have low infiltration rate?

If, yes → Category **B High Risk**

If, no → Keep working through this step

Dark coloured top soil indicating a well aerated well drained topsoil which is likely to have a good infiltration rate

Soil with medium structure with signs of moderate to low infiltration then soil risk **Category B High Risk**

Pale grey soil colours with distinct large orange and grey mottles of a poorly drained soil with a low infiltration rate then soil risk **Category B High Risk**

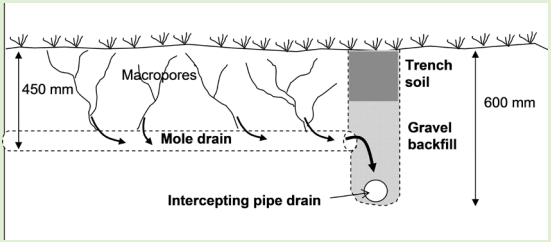
Does it have artificial (mole and pipe) drains?

Does it have artificial (mole and pipe) drains?

If, yes ⟶ Category **A High Risk**

If, no ⟶ Keep working through this step

Mole drains are very effective at draining wet areas of a farm. Unfortunately they can also be a good way for effluent to enter waterways through the drainage network.



If possible mole drain areas should be avoided for effluent application. If you cannot avoid them then Category **A High Risk.**

How to work out if soil has coarse soil structure in topsoil?

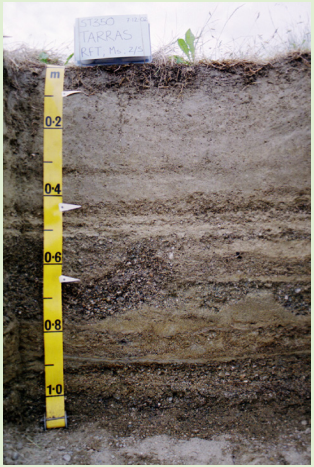
To check this category out, dig out a 200 mm x 200 mm x 300 mm deep sod from the wall of the pit. Tear it in half or cut with a spade.

Fine soil structure, not Category A

Medium soil structure, not Category A

Coarse soil structure, firm clods with few aggregate soil risk Category **A High Risk**

Examples of Category D Low Risk soils



Category **D Low Risk** from Southland, Canterbury, and Taranaki. These soils are well or moderately well drained soils, on slopes < 7 degrees, with very stony sand at depths greater than 300 mm

Examples of Category E Low Risk soils

An example of a soil classified as Category **E Low Risk** with very stony sand within 300 mm depth.

Categorising peat soils

When soil is squeezed it feels slightly moist to dry, and falls apart easily rather than forming a mouldable shape.

Low Risk - F

Is there ponding?

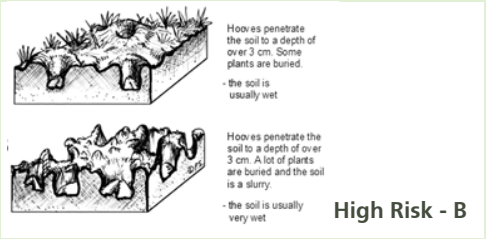
Paddocks with ponding and/or high water tables are often wet, easily pugged, have yellowing and weedy pasture.

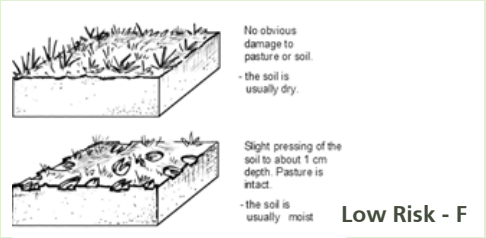
High Risk - B

No evidence of ponding. Paddock is dry and pasture is even.

Low Risk - F

Is there pugging?

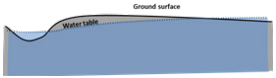




Well drained peat soil is difficult to pug, is moist and pasture is dense, green and has few weeds.

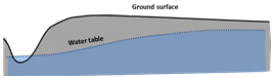
Depth to water table

Shallow water table; A high water table in drains will mean a high water table in the paddock



High Risk - B

Deep water table; A deep water table in drains indicates a deep water table in the paddock. Depth to water table generally reduces with distance from the drain. Closely spaced drains will likely result in lower water tables.



Low Risk - F

If the water table is less than 50cm deep, then it is high risk from infiltration and ponding.

Soil structure

Soil structure refers to how particles of soil are grouped together into aggregates/peds. Friability refers to how soil fails (crumbles) under increasing pressure. Friable soil easily crumbles into aggregates when crushed in the hand. Well-developed fine friable structure increases matrix flow through soil, while poor structure increases the risk of bypass flow or runoff and therefore increasing the risk of losses to water.

Soil structure can be assessed by digging small soil pits (40cm deep) across the effluent disposal area

For more information, go to:
https://soils.landcareresearch.co.nz/understanding-soils/get-dirty/

Examples of high risk soil structure in peat soils

Crust like formation at surface

Soil aggregates are medium to coarse size (20-60mm diameter) or can be difficult to recognise. Roots mainly go around the aggregates and can have a reddish lining.

Fibric material present

Plant material (fibric) present

Platy structure

Platey structure, crust like formation at the surface often associated with growth of moss.

Examples of high risk soil structure in peat soils

Water running through fingers

A squeeze test can be done 24-hours after significant rain (i.e. when soil moisture is at field capacity).

Mouldable shape

When soil is squeezed it feels wet, water runs through fingers, and the soil can easily be formed into a mouldable shape.

Step 4. Final checklist to verify soil risk

Does it have coarse soil structure?

If, yes → Category **A High Risk**. If, no → Go to final check.

Final check

- If sloping land greater than 7 degrees then **High Risk**
- Artificial (mole and pipe) drainage then **High Risk**
- Hump and hollow land then **High Risk**
- Impeded drainage then **High Risk**
- Low infiltration rate then **High Risk**
- Coarse soil structure then **High Risk**

For peat

- Soil pugged then **High Risk**
- water table less than 50cm deep then **High Risk**
- is soil to 30cm:
  - crust like at surface
  - fibric
  - platy
  - wet when squeezed 24hr post rain
  - mouldable

  High Risk

If the soil does not show any of these characteristics then likely to be **Low Risk**

Step 5. Consult a soils expert

If still unsure you might find it beneficial to contact a soils expert. This may be particularly important if the farm is located in a catchment of focused attention or soil risk is specified in your consent.

A list of available experts can be found on the New Zealand Society of Soil Science
http://nzsss.science.org.nz

Or contact:

Landcare Research Ltd
landcareresearch.co.nz

AgResearch Ltd
agresearch.co.nz

Or contact your regional council

dairynz.co.nz/effluent