

## Climate and Soils

### Guideline No 6.



*It is important to know the climate and soils of your property, as it will influence the type of dairy effluent management system that can be implemented.*

*Times of the year when rainfall exceeds evaporation, or soil temperatures are low will identify when spreading of effluent is not advisable and storage of effluent is required.*

*Soil types will influence the type of lining required in effluent ponds.*

*Soil type will influence the amount of effluent that can be spread at one time, and the spreading rate.*

This Guideline provides a general outline of the regional climate and soils, and how they influence the choice of an effluent management system and the spreading of effluent on crops or pastures.

### **The Northern and Yorke Agricultural region**

The Northern and Yorke Agricultural region is a large and diverse region encompassing the central area of the state. It covers over three million hectares and comprises Yorke Peninsula, the Lower, Mid and Upper North, southern Flinders Ranges and parts of the Adelaide Plains and Barossa Valley.

### **The Climate of the Region**

The region has a Mediterranean climate with mild wet winters and hot dry summers. Conditions vary over the region because of differences in latitude and altitude. Average annual maximum temperatures are around 22°C for the region. Average daily minimum temperatures range around nine to 13 °C. Temperatures often exceed 30°C and on extreme days can reach the mid 40°C.

Rainfall varies from less than 200mm annually in the section north east of Peterborough, to above 600mm in the Clare region and in parts of the southern Flinders Ranges. Over most of the region monthly effective<sup>1</sup> rainfall is less than the average evaporation.

Chart 6.1 shows possible times of the year when effective rainfall exceeds evaporation. It is during this time that in normal years pasture growth is not limited by soil moisture, soils are generally wet, and the spreading of dairy effluent is not advised in those districts.

Storage of effluent during this period may be required, and a pond for winter storage of effluent should be factored into the effluent management system.

Chart 6.1 depicts these months for different rainfall recording stations. You will need to determine the location which is most relevant to your property.

<sup>1</sup> Effective rainfall can be estimated from average rainfall. Average rainfall in months with less than 75 mm multiply by 0.6, months over 75 mm multiply by 0.8.

**Chart 6.1 Months Effective Rainfall Exceeds Evaporation**

LOCALITY	MONTHS EFFECTIVE RAINFALL EXCEEDS EVAPORATION	May	Jun	Jul	Aug
Auburn	0				
Balaklava	0				
Blyth	0				
Booborowie	0				
Clare	2				
Farrell Flat	0				
Hoyleton	0				
Kapunda	0				
Laura	0				
Mallala	0				
Marrabel	0				
Riverton	0				
Tarlee	0				

Chart 6.1 shows the months for which wet weather storage of dairy shed effluent is likely to be required in the Northern and Yorke region. The chart shows that winter storage is only likely to be required in the higher rainfall districts such as Clare.

Actual storage time may need to be extended for two weeks before and two weeks after the months shown to allow soil moisture conditions to become suitable for irrigation. For Clare the actual storage required could extend from mid-May to mid-August – a period of three months, or 90 days.

Developing an irrigation schedule based on crop water use and soil moisture deficit principles will give better accuracy to the calculation of minimum storage time.

### **Spreading Effluent During Times of High Rainfall**

Spreading of effluent during the period when rainfall exceeds evaporation may be possible depending on the ability of pastures or crops to utilise the nutrients applied.

To utilise the nutrients applied in effluent the pastures or crops must be actively growing. Temperatures can affect growth rates and the rate of uptake of nutrients.

### **Effects of Temperature on Pasture Growth**

Temperature has a significant effect on pasture growth. High and low temperatures can inhibit the growth of pastures and crops. High temperatures are possible each summer in the Northern and Yorke region, normally at the time when dryland pasture growth has stopped. Unless pastures are growing under irrigation the high temperatures have little effect on nutrient uptake and pasture growth. The region, however, does experience low temperatures during winter, which may reduce the growth of pastures. Low temperatures slow down the mineralisation of the nitrogen in dairy shed effluent and restrict the uptake of nutrients by plants. This means that the nutrients in effluent applied during this period will not be taken up by plants and therefore increase the risk of them entering surface or groundwater systems.

Months when average minimum temperatures are less than 6°C and average maximum temperatures are less than 15°C are likely to have soil temperatures of less than 10°C, which will cause mineralisation of nitrogen and pasture growth to both slow down dramatically.

There are limited temperature records for region. Charts 6.2 and 6.3 show the months during which average daily temperatures could be expected to limit mineralisation and pasture growth for the two sites for which records are available.

**Chart 6.2 Months with Average Minimum Temperatures Less Than 6°C**

LOCALITY	MONTHS AVERAGE MINIMUM TEMPERATURE IS LESS THAN 6°C	Apr	May	Jun	Jul	Aug	Sep	Oct
Clare	5							
Kapunda	2							

**Chart 6.3 Months with Average Maximum Temperatures Less Than 15°C**

LOCALITY	MONTHS AVERAGE MAXIMUM TEMPERATURE IS LESS THAN 15°C	Apr	May	Jun	Jul	Aug	Sep	Oct
Clare	0							
Kapunda	0							

The charts show the months during which pasture growth is likely to be inhibited by low temperatures. There are no months on record where average maximum temperatures are less than 15°C. Pasture growth, however, is likely to be inhibited by low average minimum temperatures.

Low pasture growth means that the uptake of nutrients by the pasture is also low.

During the months in which pasture uptake of nutrients is low, the spreading of dairy shed effluent is not advisable. Storage is recommended over this period until pasture growth and the uptake of nutrients by the pasture increases.

### **Advantages of Storing Effluent Over Slow Pasture Growing Periods**

There are distinct advantages in storing the effluent over the period when pasture growth is low. Superior utilisation of the nutrients it contains will be achieved when spread during the spring and summer months. This will help offset some of the cost of installing an effluent storage. Another significant advantage is the saving in the additional infrastructure, which would be required to spread the effluent over a larger area. For example, based on pasture growth rates, if the effluent is not stored, the area required for spreading the effluent could be from 4–8 times the area required for spreading in spring and summer. This would require a much larger investment in the distribution system.

## Determining Effluent Storage Period

The period of the year during which spreading of effluent is not advisable can be determined by combining the data from charts 6.1, 6.2 and 6.3. This can be done by combining the relevant data into a simple table.

An example for the Clare district is shown in Chart 6.4 below.

**Chart 6.4 Example of combined climate data for Clare**

LOCALITY	Limitation to Spreading Effluent	Apr	May	Jun	Jul	Aug	Sep	Oct
Clare	Effective Rainfall exceeds evaporation							
Clare	Minimum Temperature less than 6°C							
Clare	Maximum Temperature less than 15°C							

Chart 6.4 shows a period from June to July when effective rainfall exceeds evaporation, and a period from May to September when minimum temperature is less than 6°C. There is no period when the average maximum temperature is less than 15°C.

The recommended storage period is from the earliest marked month up to and including the latest marked month. The climate data indicates that dairies in the Clare district should have an effluent storage period from May through to the end of September.

To find the recommended storage period for your district enter the relevant data from charts 6.1, 6.2 and 6.3 in the chart below. If data is not available for your exact location use the nearest or most relevant data in the charts.

The recommended storage period is from the earliest marked month up to and including the latest marked month.

**Chart 6.5 Combined climate data for your district**

LOCALITY (enter the name of the recording station for the climate data)	Limitation to Spreading Effluent	Apr	May	Jun	Jul	Aug	Sep	Oct
	Effective Rainfall exceeds evaporation							
	Minimum Temperature less than 6°C							
	Maximum Temperature less than 15°C							

## Calculating Effluent Storage Capacity

Once the storage period is determined, the minimum storage volume can be calculated. The storage capacity will be the sum of the:

- 1) dairy shed and yard wash-water;
- 2) rainfall and runoff which lands on the dairy yards and roof that drains to the effluent system
- 3) rainfall on the storage pond itself.

In order to calculate the volume of water that is captured by the yards, roof and storage pond local rainfall data needs to be used. The 90 percentile rainfall figures of the contributing storage months is then multiplied by the area of the dairy catchment, (rainfall and runoff which lands on the dairy yards

and roof that drains to the effluent system). The 90th percentile rainfall is approximately 1.5 times the average rainfall for the specific period.

Other areas feeding effluent into the ponds must also be accounted for, such as laneways, adjacent yards, and feeding sheds or feed pads. Again, the 90 percentile rainfall should be used.

### **Soils in the Northern and Yorke Agricultural region**

The soils contribute enormously to the region's environmental, economic and social prosperity. They underpin the primary industries. Soil type and soil properties often are reflected by the type and form of native vegetation that grows in the area.

On the plains and gentle rises west of the Northern Mount Lofty and southern Flinders Ranges are generally calcareous soils formed on calcrete or soft rubbly calcareous sediments. These are usually loams or sands and on Yorke Peninsula often overlie calcrete or limestone.

Deep sands are found on the south west end of Yorke Peninsula, and in dunes of dune-swale systems near Moonta, Avon, east of Grace Plains, north of Balaklava and from Bute to Wandearah. Sand deposits of the coastal and marine zone are a limited and dynamic resource.

The series of ranges that comprise the southern Flinders and Northern Mount Lofty Ranges usually have skeletal soils on tops of hills and hard red-brown texture contrast soils (typically loam over clay) with highly calcareous lower subsoils on slopes. Some of these soils are also found around Petersville and Sandilands on Yorke Peninsula. These soils are formed on basement rock. The soils on the valley floors and plains between the ranges are formed on outwash sediments from the basement rock. They tend to be deep texture contrast soils with calcareous subsoils, deep calcareous soils or gradational/clayey soils with calcareous subsoil.

### **Effect of Soil Type on Pond Sealing**

It is important to know the type of soil you are dealing with in order to determine what effluent management system to implement. If your area has little or no clay, you will have to look at lining your pond with imported clay or an artificial liner. If you do have a clay soil or plan to use imported clay, it must be tested to ensure that it will hold water. All ponds must be sealed watertight.

### **Effect of Soil Type on Effluent Spreading**

The spreading and utilization of dairy effluent by crops or pastures is influenced by soil type. Sandy soils have a higher infiltration rate than clay soils and have a higher risk of passing nutrients below the root zone of the crop. Clay soils on the other hand will cause surface runoff of applied effluent at lower application rates than sandy soils, because the applied effluent is more easily able to soak into the sandy soils.

Soil type therefore can influence the amount (maximum millimetres per application) and the rate (maximum millimetres per hour) at which effluent can be applied.

It is important to recognize the soil types on your property and apply effluent according to soil water holding and infiltration characteristics.

Slope will also affect infiltration rate. Steeper slopes generally cause greater surface runoff and need lower application rates (millimetres per hour) to prevent this happening.

Chart 6.6 shows general data for different basic soil types.

**Chart 6.6 Typical Water Holding Capacity, Infiltration and Application Rates**

Soil Type	Available Water Holding Capacity (mm/m)	Infiltration Rate (mm/hr)	Irrigation Application rate (mm/hr)#		
			0 – 5% slope	5 – 10% slope	Over 10% slope
Coarse and fine textured sands, and loamy sands	20 – 60	12 – 25	10 - 20	8 - 16	5 – 10
Moderately coarse textured sandy loams, loam, sandy clay loams and silt loams	80 – 130	9 – 20	8 – 16	6 – 11	4 - 8
Medium textured very fine sandy loams, loam, sandy clay loams and silt loams	130 – 160	5 – 8	4 - 6	3 – 5	3 – 4
Fine textured sandy clays, silty clay, and clay	Silty clay 130 - 160 Clay 160 – 250	1 - 4	Less than 4	Less than 3	Less than 3

# Application rates are for bare ground. Rates may be increased with good plant cover.

### Map of Soil Types in the Northern and Yorke Agricultural region

The soil map below provides an overview of the many soil groups across the Northern and Yorke Agricultural region.

Before installing an effluent management system, it is important to obtain more detailed information on the soil types in your region. Soil tests should also be conducted on the suitability of the soil for pond construction. Soils are probably the most variable aspect of your farm.

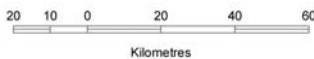
Maps can provide a general overview of the soil type and its properties but only a detailed investigation of the soil properties will provide all the right details for the installation of a system that will hold water.





## Northern and Yorke NRM Region SOIL GROUPS

The map depicts the distribution of up to 15 generalised soil groups. The map is based on an interpretation of soil landscape units. Soil landscapes invariably comprise several soils. The most commonly occurring soil group in each landscape is delineated on this map.

-  Calcareous soils
-  Shallow soils on calcrete or limestone
-  Gradational soils with highly calcareous lower subsoil
-  Hard red-brown texture contrast soils with alkaline subsoil
-  Cracking clay soils
-  Deep loamy texture contrast soils with brown or dark subsoil
-  Sand over clay soils
-  Deep sands
-  Highly leached sands
-  Ironstone soils
-  Shallow to moderately deep acidic soils on rock
-  Shallow soils on rock
-  Deep uniform to gradational soils
-  Wet soils
-  Rock
-  Water
-  Not applicable or no data



-  Northern and Yorke NRM Region Boundary
-  Main Roads

### NOTES ON USE OF THE MAP:

1. This information is derived from limited field inspection, and is subject to change without notice.
2. Boundaries between mapping units should be treated as transition zones.
3. The map is intended to provide a regional overview and should not be used to draw conclusions about conditions at specific locations.
4. Under no circumstances must the scale of the map be enlarged beyond its scale of mapping.
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**MAP PRODUCTION:** Resource Information, DMLBC.

**MAP PROJECTION:** MGA Zone 54    **MAP DATUM:** GDA94

