NVZ & Nutrient Budgeting Workshop

Andrew Baird & Jonathan Black

21st March 2017

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	Agenda
10.00am	Welcome and Introduction
10.15am	NVZ Plan – Key Requirements
11:00m	NVZ Records
11.30am	Common Inspection Issues
11:45am	Quiz
11:55am	Nutrient Budgeting

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NVZ Inspections

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- Breaches are still commonly being found at NVZ inspections

Requirement	Number of breaches (non-compliances)	Warning letter (0%)	1%	2%	3%	4%	5%	> 5% <=15%	>15%
SMR 1	16	2	0	0	3	0	11	0	0

Scottish Government: 2015 Inspection Statistics

SEPA Priority Catchment

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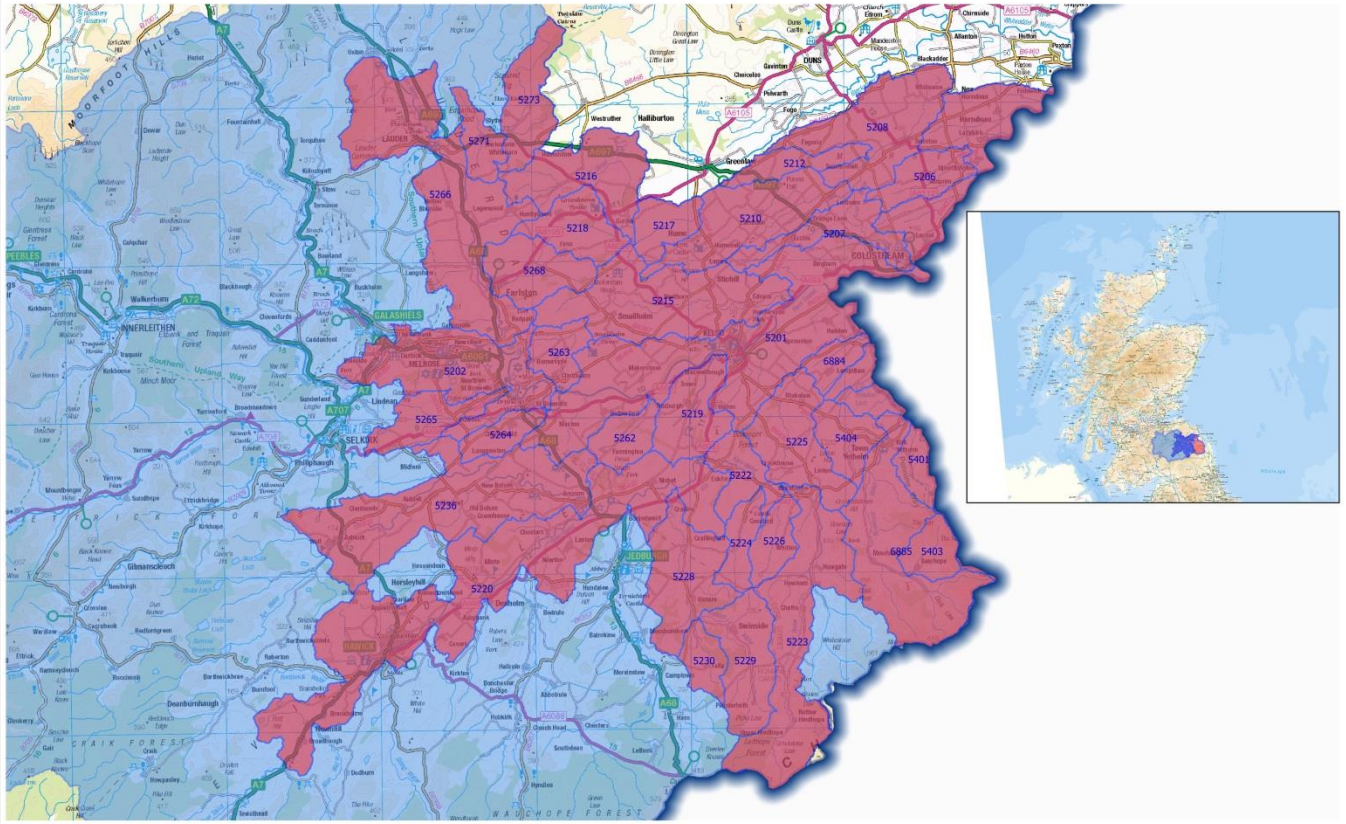
The River Tweed Priority Catchment and its associated operational area



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Lothian & Borders NVZ

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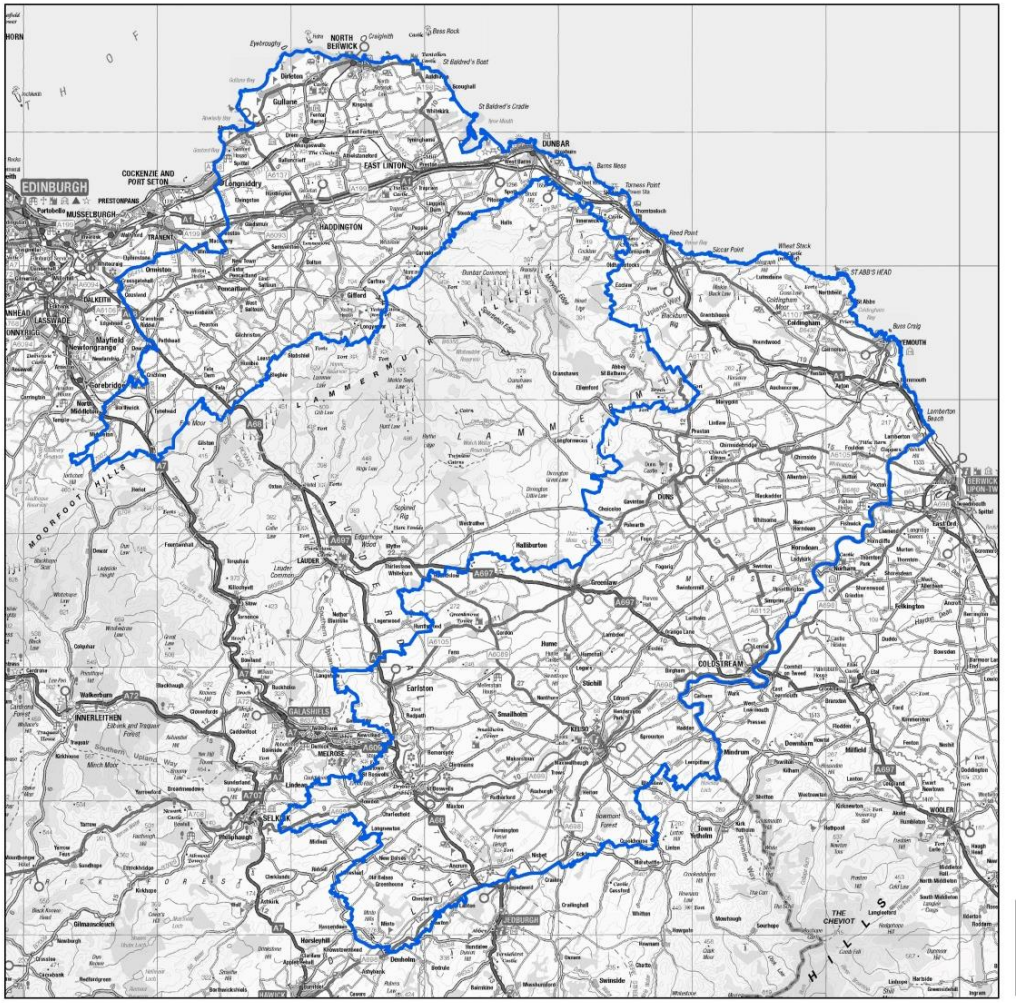

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Are you within the NVZ?

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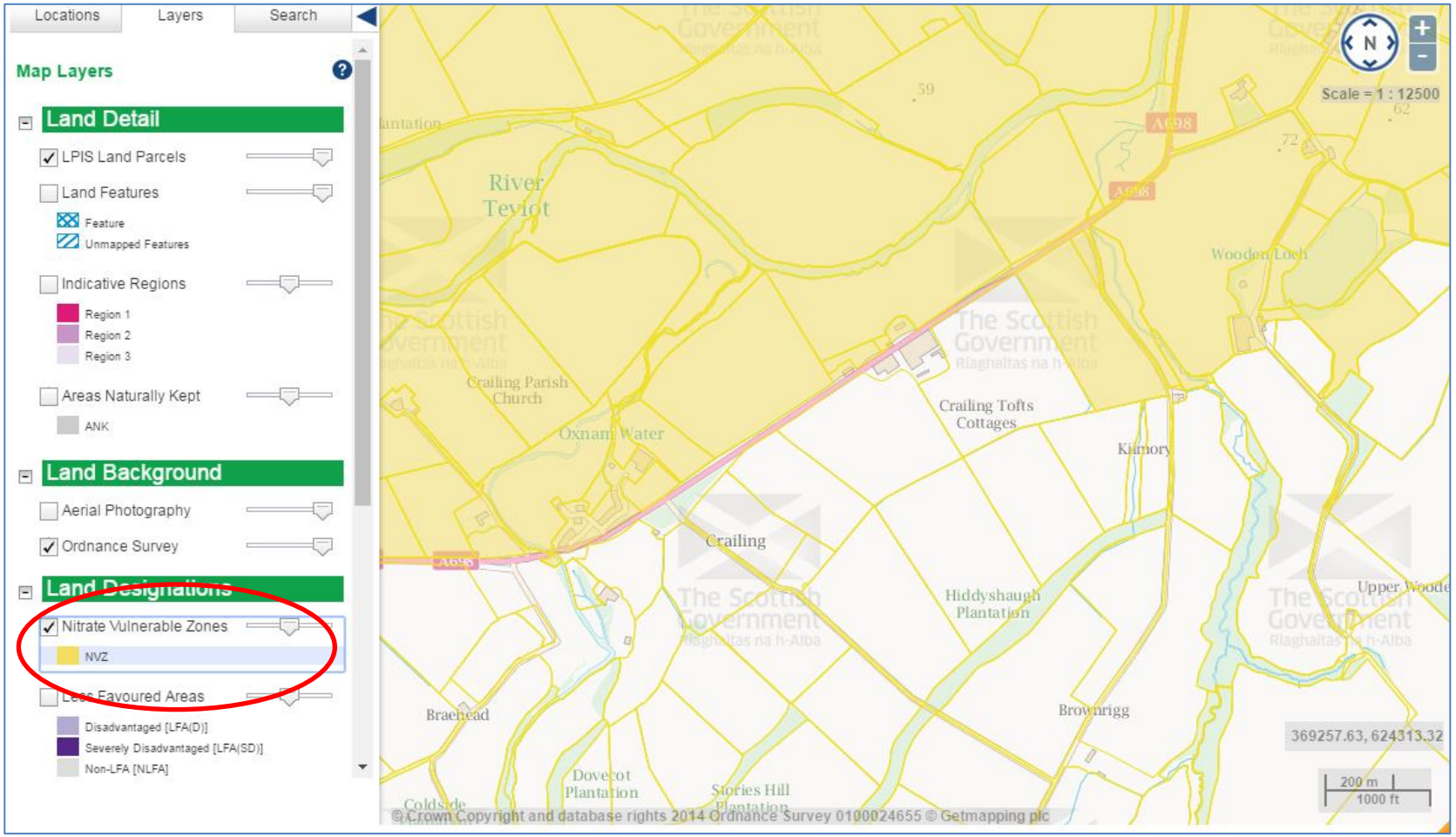

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NVZ Plan: Key Requirements

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You must prepare annually a Fertiliser and Manure Management Plan:

1. RAMS map
2. Calculation and record of storage capacity of livestock manures (if applicable)
3. Calculation and record of 170kg N/ha loading limit for livestock manure (livestock numbers)
4. An Nmax calculation for each crop type (field records)

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NVZ Plan

- To be completed annually
- To be in place by 1st March
- Kept for at least 3 years

Who Keeps the Records?

- Occupier who uses the land for more than 2 years
- Person letting out land if grazing let or short term let
- Only for land in NVZ, this can be part of the farm if on the boundary

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RAMS Map

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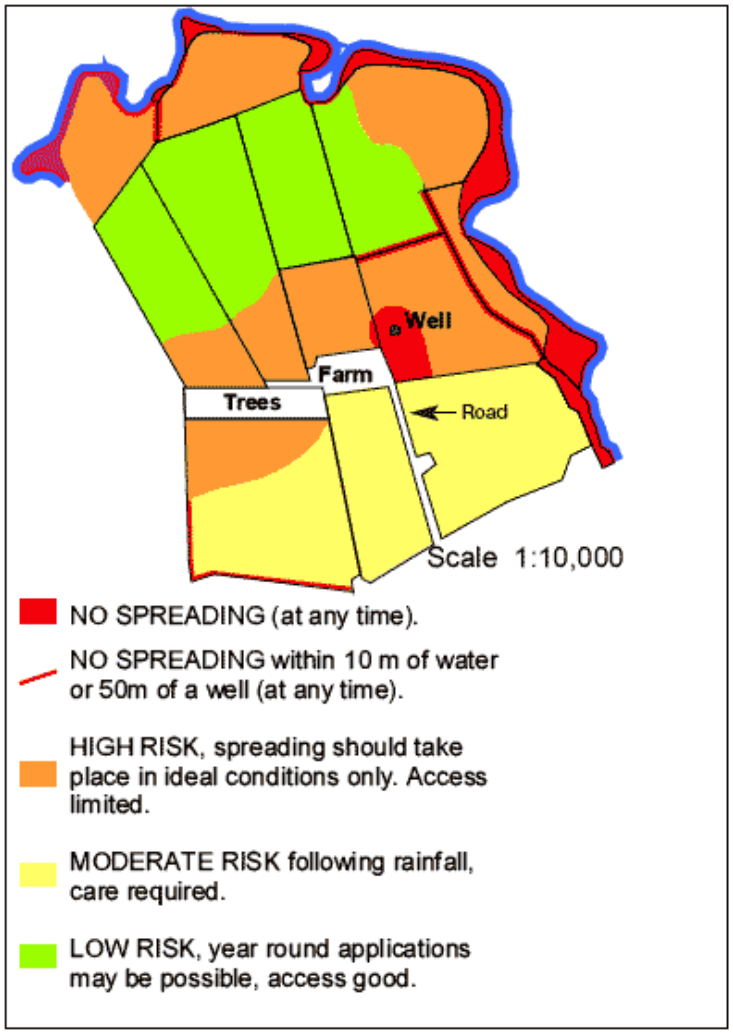
1. RAMS Map



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Risk Assessment for Manures & Slurry

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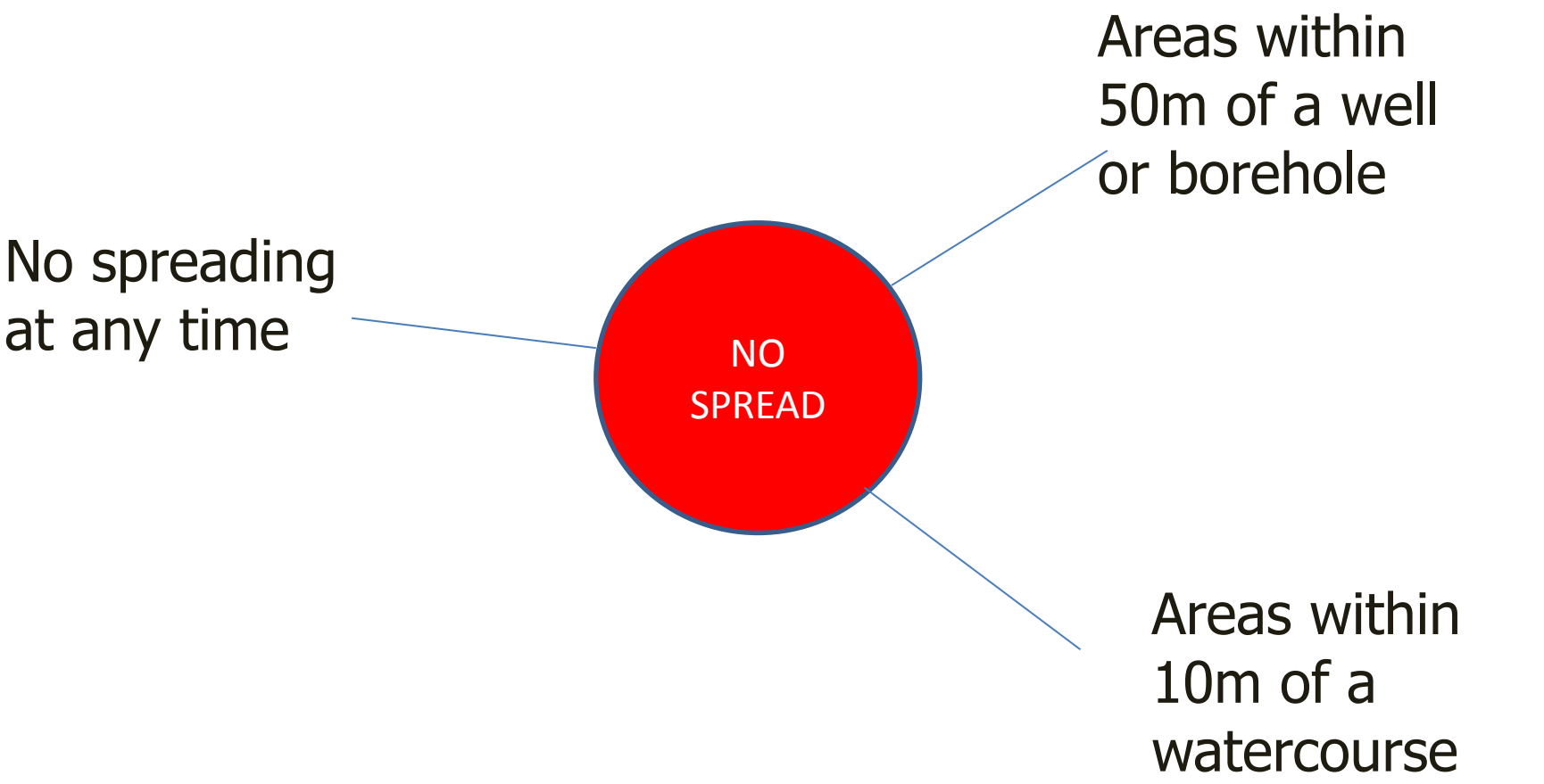

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Risk Assessment for Manures & Slurry

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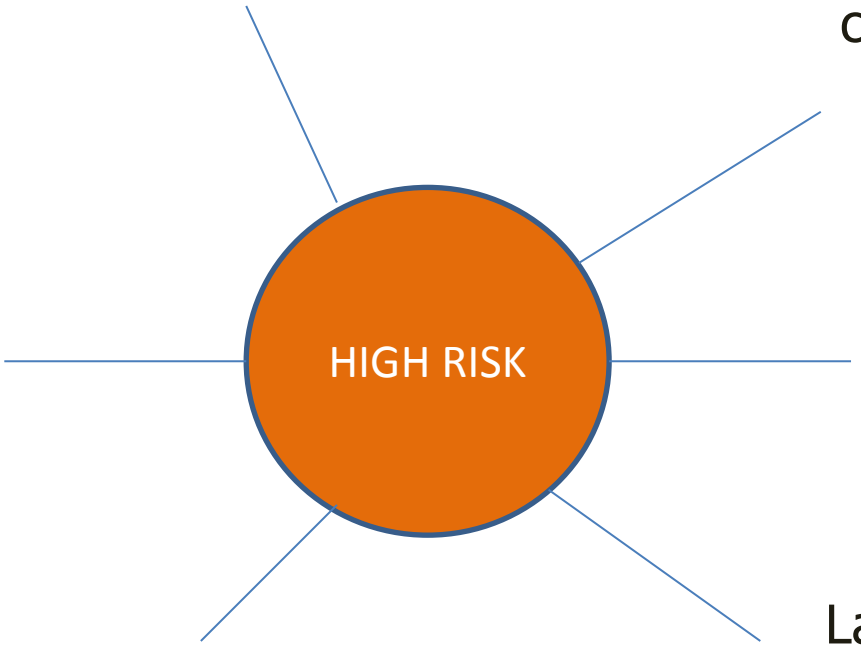

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Risk Assessment for Manures & Slurry

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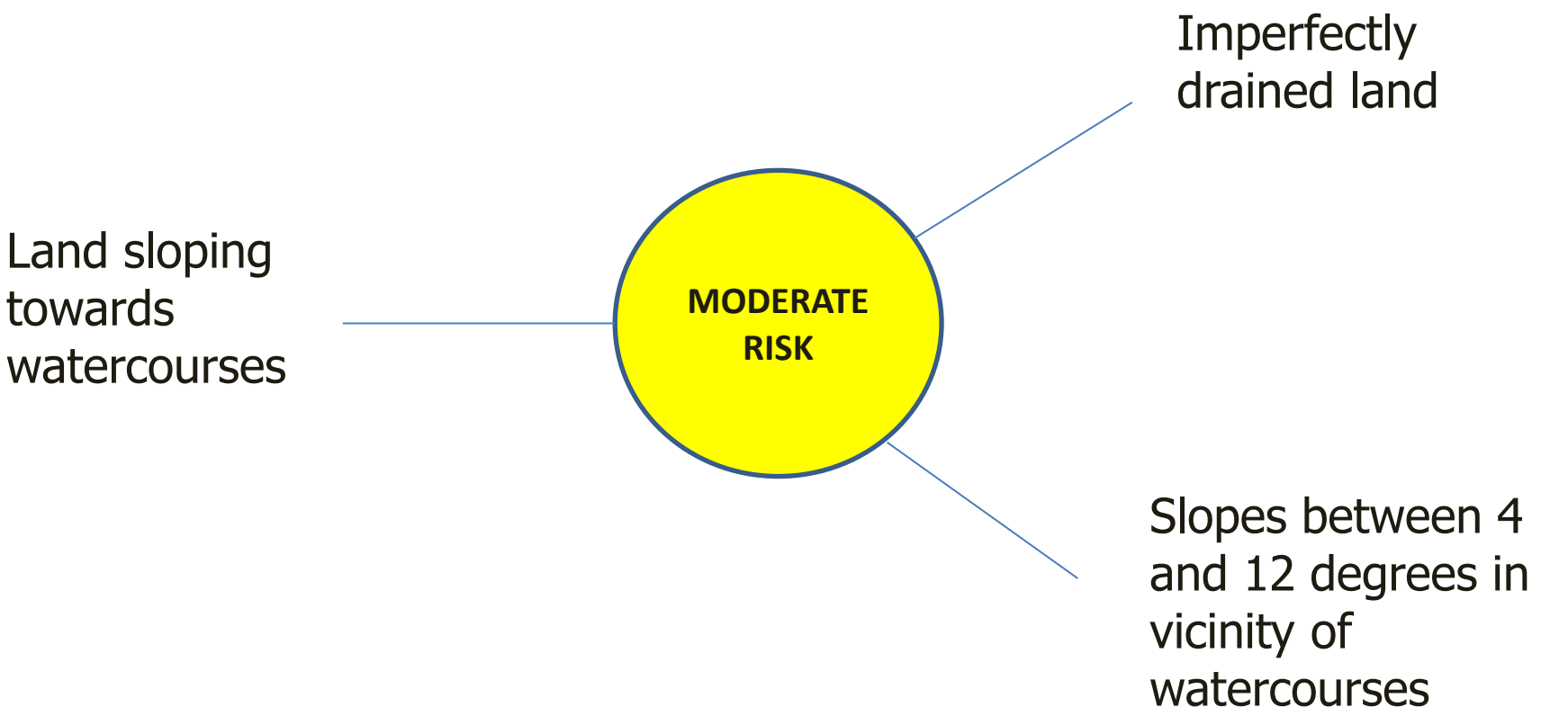

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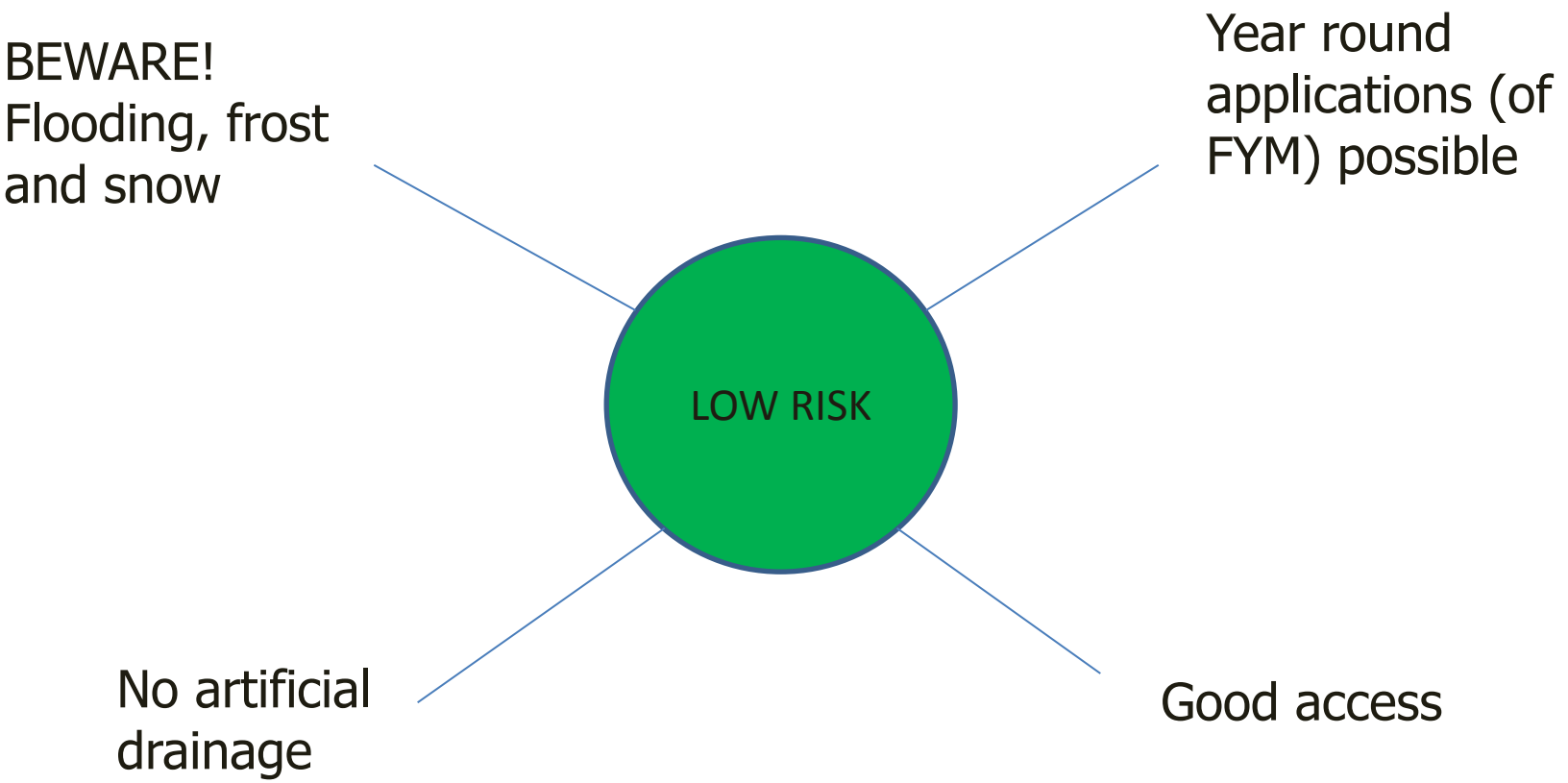
Risk Assessment for Manures & Slurry



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Other Features on RAMS Map

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- Identify surface waters e.g ditches, burns, rivers, lochs, ponds and any wet areas especially areas that are prone to flooding
- Identify unavailable areas where spreading cannot be carried out e.g woodlands, steading areas, roads, yards. Deduct from spreadable area
- Mark the location of field middens – NOT located on no spread or high risk areas

Storage of Solid Manures

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Temporary Field Middens

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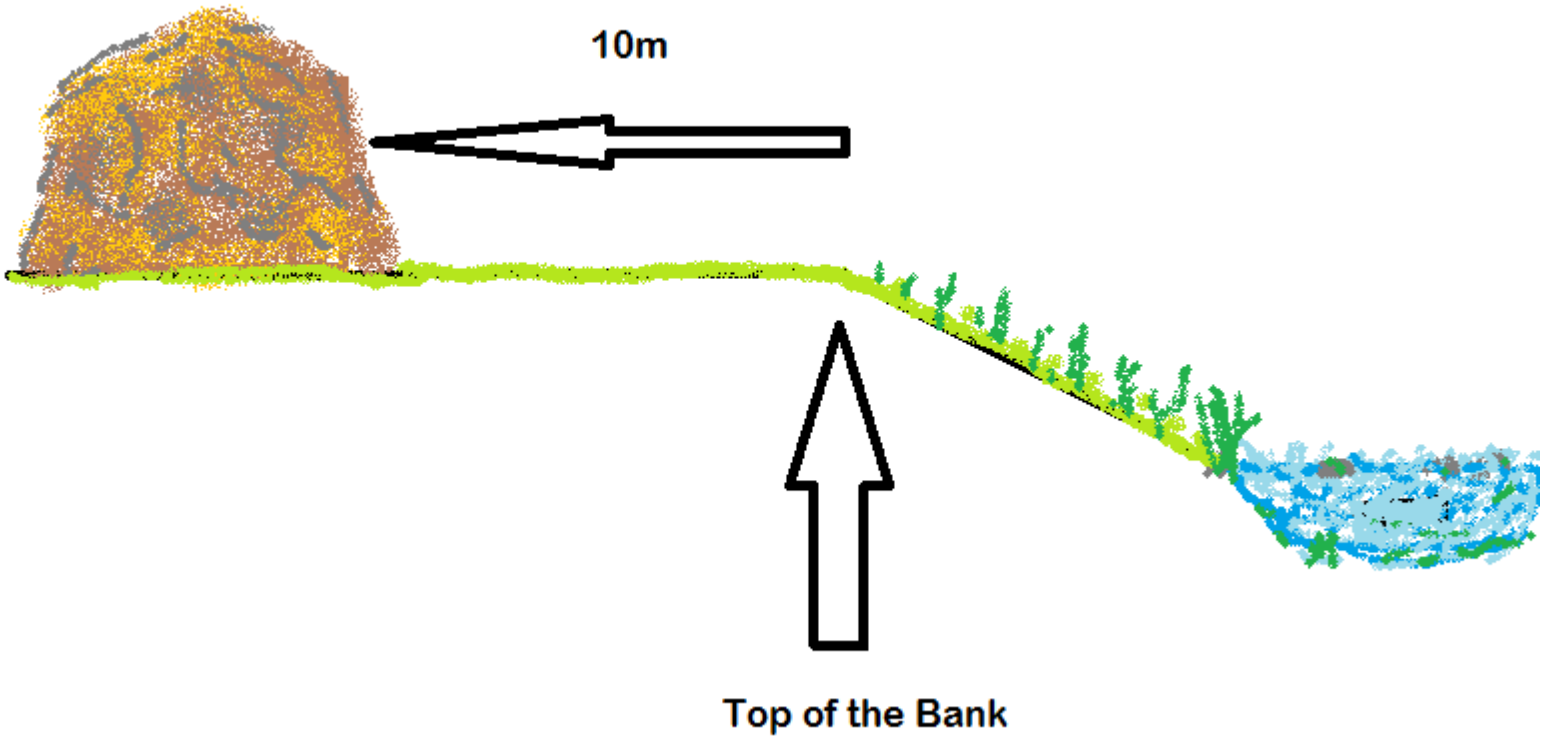

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Temporary Field Middens

- No more than 12 months in the same place
- Site cannot be re-used within 24 months
- 10m from surface water and 50m from a borehole
- Not sited on land sloping toward surface water
- Location identified on RAMS map
  - Not located on high risk or no spread areas
- Poultry manure not mixed with litter must be covered

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Slurry Storage Facilities

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2. Record Capacity of Storage Facilities for Livestock Manure

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Slurry Storage

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Slurry	Storage Capacity
Pig	26 Weeks
All other livestock	22 Weeks

- Maintained free from structural defect
- Sufficient standard to prevent run off or seepage entering groundwater
- Must have a 75 cm free board
- Account for rainfall if outside

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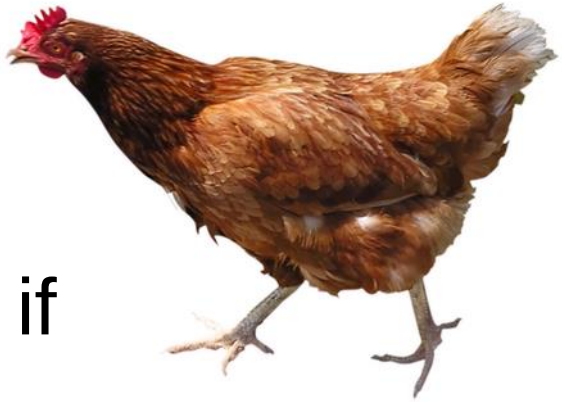
Permanent Storage (Poultry Manure)

- Manure that cannot be stacked without slumping
- Manure that produces free drainage of liquid

Storage:

- Impermeable base and run off collected
- Covered to prevent rainfall ingress or
- have facilities to collect and store run off (constructed farm wetlands for FYM run off)

Poultry Manure



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- 26 weeks storage if cannot be stored in a temporary field heap or exported off the farm

Storage:

- In the livestock house or on a concrete base
- Covered by a roof or provisions for safe storage of run off

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Livestock Loading Limit

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3. Calculate Loading Limit for Livestock Manure

- 170kg N/ha/year – loading limit for livestock manure
- Nitrogen excreted by animals on the farm – spread on land or deposited during grazing
- Nitrogen content of any imported livestock manure
- Standard production figures
- Assessed across **utilisable** agricultural area of the land within the NVZ

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170 kg/ha/yr – Loading Limit for Livestock Manure

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Total N excreted by livestock on the farm plus the N content of imported manure

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the **utilisable** agricultural area of the farm within the NVZ

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SRUC Technical Note (TN650)

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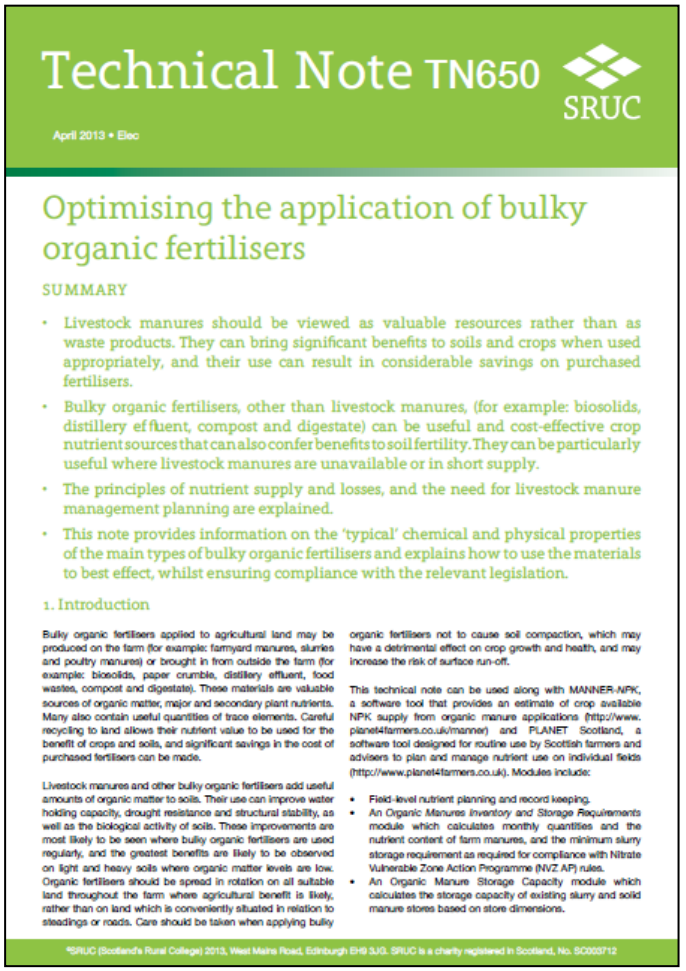


Technical Note TN650

SRUC

April 2013 • Elec

Optimising the application of bulky organic fertilisers

SUMMARY

- Livestock manures should be viewed as valuable resources rather than as waste products. They can bring significant benefits to soils and crops when used appropriately, and their use can result in considerable savings on purchased fertilisers.
- Bulky organic fertilisers, other than livestock manures, (for example: biosolids, distillery effluent, compost and digestate) can be useful and cost-effective crop nutrient sources that can also confer benefits to soil fertility. They can be particularly useful where livestock manures are unavailable or in short supply.
- The principles of nutrient supply and losses, and the need for livestock manure management planning are explained.
- This note provides information on the 'typical' chemical and physical properties of the main types of bulky organic fertilisers and explains how to use the materials to best effect, whilst ensuring compliance with the relevant legislation.

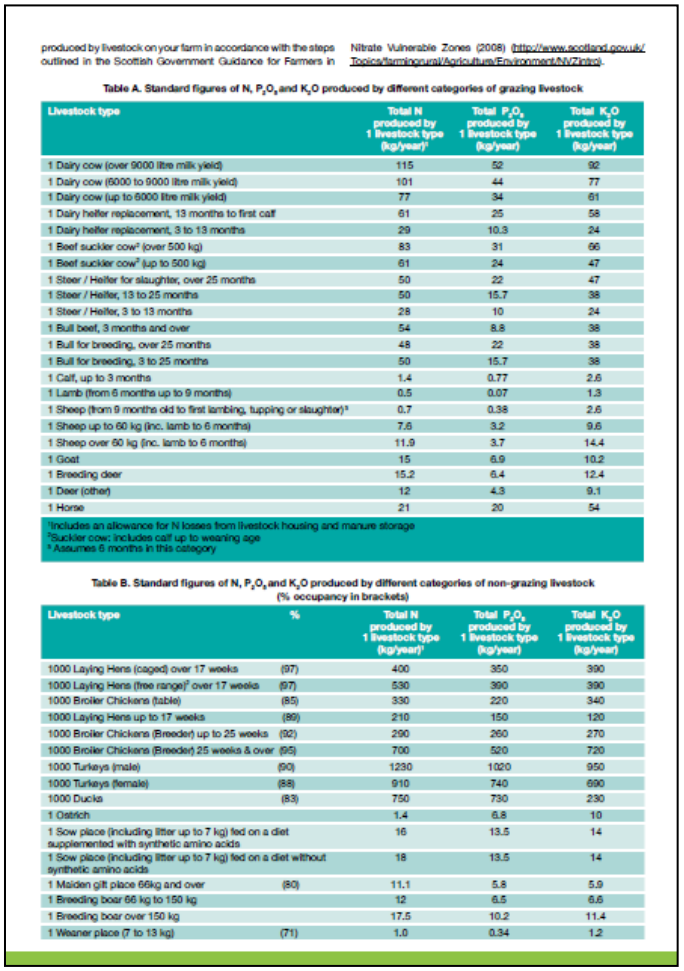
1. Introduction

Bulky organic fertilisers applied to agricultural land may be produced on the farm (for example: farmyard manures, slurries and poultry manures) or brought in from outside the farm (for example: biosolids, paper crumble, distillery effluent, food wastes, compost and digestate). These materials are valuable sources of organic matter, major and secondary plant nutrients. Many also contain useful quantities of trace elements. Careful recycling to land allows their nutrient value to be used for the benefit of crops and soils, and significant savings in the cost of purchased fertilisers can be made.

Livestock manures and other bulky organic fertilisers add useful amounts of organic matter to soils. Their use can improve water holding capacity, drought resistance and structural stability, as well as the biological activity of soils. These improvements are most likely to be seen where bulky organic fertilisers are used regularly, and the greatest benefits are likely to be observed on light and heavy soils where organic matter levels are low. Organic fertilisers should be spread in rotation on all suitable land throughout the farm where agricultural benefit is likely, rather than on land which is conveniently situated in relation to steadings or roads. Care should be taken when applying bulky organic fertilisers not to cause soil compaction, which may have a detrimental effect on crop growth and health, and may increase the risk of surface run-off.

This technical note can be used along with MANNER-NPK, a software tool that provides an estimate of crop available NPK supply from organic manure applications (http://www.planet4farmers.co.uk/manner) and PLANET Scotland, a software tool designed for routine use by Scottish farmers and advisers to plan and manage nutrient use on individual fields (http://www.planet4farmers.co.uk). Modules include:

- Field-level nutrient planning and record keeping.
- An *Organic Manures Inventory and Storage Requirements* module which calculates monthly quantities and the nutrient content of farm manures, and the minimum slurry storage requirement as required for compliance with Nitrate Vulnerable Zone Action Programme (NVZ AP) rules.
- An Organic Manure Storage Capacity module which calculates the storage capacity of existing slurry and solid manure stores based on store dimensions.



produced by livestock on your farm in accordance with the steps outlined in the Scottish Government Guidance for Farmers in Nitrate Vulnerable Zones (2008) (http://www.scotland.gov.uk/Topics/farmingrural/Agriculture/Environment/NVZintro).

Table A. Standard figures of N, P_2O_5 and K_2O produced by different categories of grazing livestock

Livestock type	Total N produced by 1 livestock type (kg/year)[1]	Total P_2O_5 produced by 1 livestock type (kg/year)	Total K_2O produced by 1 livestock type (kg/year)
1 Dairy cow (over 9000 litre milk yield)	115	52	92
1 Dairy cow (6000 to 9000 litre milk yield)	101	44	77
1 Dairy cow (up to 6000 litre milk yield)	77	34	61
1 Dairy heifer replacement, 13 months to first calf	61	25	58
1 Dairy heifer replacement, 3 to 13 months	29	10.3	24
1 Beef suckler cow[2] (over 500 kg)	83	31	66
1 Beef suckler cow[2] (up to 500 kg)	61	24	47
1 Steer / Heifer for slaughter, over 25 months	50	22	47
1 Steer / Heifer, 13 to 25 months	50	15.7	38
1 Steer / Heifer, 3 to 13 months	28	10	24
1 Bull beef, 3 months and over	54	8.8	38
1 Bull for breeding, over 25 months	48	22	38
1 Bull for breeding, 3 to 25 months	50	15.7	38
1 Calf, up to 3 months	1.4	0.77	2.6
1 Lamb (from 6 months up to 9 months)	0.5	0.07	1.3
1 Sheep (from 9 months old to first lambing, tupping or slaughter)[3]	0.7	0.38	2.6
1 Sheep up to 60 kg (inc. lamb to 6 months)	7.6	3.2	9.6
1 Sheep over 60 kg (inc. lamb to 6 months)	11.9	3.7	14.4
1 Goat	15	6.9	10.2
1 Breeding deer	15.2	6.4	12.4
1 Deer (other)	12	4.3	9.1
1 Horse	21	20	54

[1]Includes an allowance for N losses from livestock housing and manure storage
[2]Suckler cow: includes calf up to weaning age
[3] Assumes 6 months in this category

Table B. Standard figures of N, P_2O_5 and K_2O produced by different categories of non-grazing livestock (% occupancy in brackets)

Livestock type	%	Total N produced by 1 livestock type (kg/year)[1]	Total P_2O_5 produced by 1 livestock type (kg/year)	Total K_2O produced by 1 livestock type (kg/year)
1000 Laying Hens (caged) over 17 weeks	(97)	400	350	390
1000 Laying Hens (free range)[2] over 17 weeks	(97)	530	390	390
1000 Broiler Chickens (table)	(85)	330	220	340
1000 Laying Hens up to 17 weeks	(89)	210	150	120
1000 Broiler Chickens (Breeder) up to 25 weeks	(92)	290	260	270
1000 Broiler Chickens (Breeder) 25 weeks & over	(95)	700	520	720
1000 Turkeys (male)	(90)	1230	1020	950
1000 Turkeys (female)	(88)	910	740	690
1000 Ducks	(83)	750	730	230
1 Ostrich		1.4	6.8	10
1 Sow place (including litter up to 7 kg) fed on a diet supplemented with synthetic amino acids		16	13.5	14
1 Sow place (including litter up to 7 kg) fed on a diet without synthetic amino acids		18	13.5	14
1 Maiden gilt place 66kg and over	(80)	11.1	5.8	5.9
1 Breeding boar 66 kg to 150 kg		12	6.5	6.6
1 Breeding boar over 150 kg		17.5	10.2	11.4
1 Weaner place (7 to 13 kg)	(71)	1.0	0.34	1.2

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Livestock Loading Limit Exercise

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Mixed Farm in Borders NVZ

Total Farm area = 100ha

BPS Eligible Area = 95ha

50 suckler cows (over 500kg)

100 ewes (over 60kg)

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Calculating your Livestock Loading: TN650 Table A

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Livestock loading for **95 ha utilisable area** with **50 suckler cows** & **100 ewes:**

1. Cows - 50*83 =

4,150 Kg N/Year

2. Sheep - 100*11.9 =

1,190 Kg N/Year

3. Livestock deposit on farm =

5,340 Kg N/Year

4. Livestock loading = N deposited on farm (**5,340**) / farm area (**95**)

56 Kg/Ha = well below 170 kg/ha limit

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250 kg N/ha – Field Application Limit for Organic Nitrogen

- All organic manures
- Applied in any 12 month period
- Excludes grazing deposition and manufactured nitrogen fertiliser
- Assessed across the **spreadable** area of the field

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250 kg/ha – Field Limit for Organic Nitrogen

Total Nitrogen content of all organic manures to be applied to the field

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The available **spreading** area of the field

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Nmax for Crops & Grassland

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4. Calculate Nitrogen Requirement for Each Crop Including Grassland

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What is the Nmax?

- Total Nitrogen applied as manufactured fertilisers plus the crop **available** Nitrogen from organic manure applications

- Assessed across a crop type- not on a field level

- Gives flexibility at a field level

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Calculating Nmax for Crops

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Stage 1

- Gather field information: Previous Crop, Planned crop, Soil type (see Soils for Scotland website)

Stage 2

- Use simple look- up tables to work out standard Nitrogen requirement
- Can adjust for different markets or higher than standard yields – CAUTION! Need records to justify this!

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Nmax: Market Adjustment

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- For market adjustment factors, acceptable records would include a forward contract document or previous year's sales to the market specified

- Farmers could also demonstrate that the variety grown is approved for the intended market

Nmax: Yield Adjustment

- Yield adjustment supporting records should cover three consecutive harvest years based on:
  - weighed (not estimated) yields
  - moisture content readings (as standard yields are based on a dry matter of 85%)
- Records could consist of:
  - farm yield records
  - sales invoices
  - weights of home grown cereals when fed on farm
- Common issues are incomplete records / information for a harvest year being submitted or poor harvest years being ignored / discounted

Calculating Nmax for Crops

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Technical Note TN651

SRUC

March 2013 • Elec

Nitrogen recommendations for cereals, oilseed rape and potatoes.

SUMMARY

- Nitrogen recommendations for cereals and winter oilseed rape include an adjustment for expected yield.
- Effects of economic changes on nitrogen rates for cereals and oilseed rape are tabulated.
- Nitrogen recommendations for potatoes take account of length of growing season, variety group and soil N residues.
- Nitrogen recommendations take account of new NVZ Action Programme rules and Nmax.

Introduction

Nitrogen (N) recommendations for cereals, oilseed rape and potatoes have been updated in the light of recent trials results and advisory experience. Tables that take account of N released from previous crop residues, grass leys and N available from reserves in different soil types have been updated. The recommendations are consistent with the NVZ Action Programme rules and Nmax. Volatility in prices of fertiliser and grain has accentuated the need for guidelines on adjusting for the break-even ratio (BER). BER is the ratio between the purchase price of the N fertiliser per kg of N and the sale price per kg of the grain and defines the point at which further expense on fertiliser is not worthwhile. These adjustments depend on the rate of change of slope of the grain yield response curves, leaving aside the commercial issues concerning the time-lag between paying for the fertiliser and receiving payment for the grain, and judgement of which N rate should form the basis for adjustment. Cereal research has shown that the adjustment per point change in BER was relatively stable over the range of BER that has been experienced, averaging 11 and 8 kg/ha N per point increase for winter wheat and spring barley respectively (HGCA Project Report No.438, 2008). As there is insufficient research with modern oilseed rape varieties, the winter wheat adjustment is used for winter OSR and the spring barley adjustment for spring OSR.

Calculating the breakeven ratio (BER)

The breakeven ratio is the kg grain needed to pay for 1 kg of N. It is calculated as follows

$$\frac{\text{Price (£) per tonne of fertiliser} \times 100}{\text{Percent N in the fertiliser} \times 10} = \text{pence/kg of N}$$

$$\frac{\text{Price (£) per tonne of grain/seed}}{10} = \text{pence/kg of grain or seed}$$

$$\text{Breakeven ratio, BER} = \frac{\text{pence/kg of N}}{\text{pence/kg of grain or seed}}$$

Cereal recommendations are based on a standard breakeven ratio of 3:1 (i.e. 3kg grain needed to pay for each 1 kg of N), and a ratio of 2.5:1 for oilseed rape. The look-up table below shows the actual range of breakeven ratios for cereals and oilseed rape at different crop and ammonium nitrate prices.

*SRUC (Scotland's Rural College) 2013, West Mains Road, Edinburgh EH9 3JG. SRUC is a charity registered in Scotland, No. SC035712

Winter rainfall

The drier the winter and the greater the soil capacity to hold water, the smaller the proportion of N from crop residues that will be washed out of the soil before crop growth starts in the spring. If winter rainfall between 1 October and 1 March is more than 450mm (18 inches) then standard N recommendations should be adjusted according to the information in the crop Tables 4 to 10.

Winter cereals (Tables 4 and 5)

Autumn nitrogen is NOT generally recommended, as profitable responses are not normally attained and the practice will increase N losses to watercourses. There is a possible N requirement in some winter barley that has been direct drilled, established following minimum cultivation, or established after ploughing down large quantities of straw e.g. after carrots.

Spring N is best applied as a split dressing. In general a 33%/67% (one-two thirds) split between the start of spring growth and growth stage 30-31 is recommended. A 20/80 split will improve bread-making quality and help to prevent lodging, a 50/50 split will help to reduce grain N% for malting or distilling. For wheat grown for breadmaking/milling the additional 40 kg/ha, as shown in Table 4, should be applied either as a solid fertiliser as soon as the flag leaf is fully emerged, or as a foliar spray at the milky ripe stage in order to increase grain protein. These adjustments in timing should be used in conjunction with adjustments in the amount of N applied.

Spring cereals (Tables 6 and 7)

Nitrogen recommendations should be reduced for crops which are sown ten days or more after the optimum sowing period. Pressure of spring work and adverse weather can often account for delays in excess of ten days. In these circumstances the N recommendation should be reduced for crops which are sown ten days or more after the optimum sowing period by approximately 1.5 kg/ha/day for each day of delay for feed or high N malting and 2.25 kg/ha/day for low N malting.

For crops sown up to the beginning of April apply half fertiliser N to seedbed and half at 2-3 leaf stage for low N malting and start of tillering for feed. For high N malting crops use feed recommendations. From beginning of April onwards, all may be applied to seedbed.

Combine drilling is recommended for early sown crops and crops grown in high soil pH (>6.4). Combine drilling of urea is NOT recommended as close contact with germinating seed can be damaging. Combine-drilled fertiliser should be limited to 150 kg/ha N + K_2O on sands and sandy loams.

Winter oilseed rape (Table 8)

It is important to sow oilseed rape early in order to achieve sufficient plant size to withstand winter conditions. Sowing date is particularly important in Scotland and the end of August is recognised as the latest advisable sowing date for most areas. Winter barley is generally the most suitable crop for entry of winter oilseed rape in Scotland, although in some areas and in earlier seasons spring barley may be harvested early enough to provide a suitable entry. Autumn sown rape can produce about 20-25 t/ha fresh material by December, and seedbed/autumn application of N is recommended following crops/grass in N residue groups 1, 2 and 3. N top dressing in spring is best split, applying half at the start of spring growth and half prior to stem elongation.

Spring oilseed rape (Table 9)

Spring sown crops generally utilise soil N more efficiently than winter crops. Their requirement for N coincides with the normal period of soil N release in May and June whereas winter crops require N when the soil is still too cold for soil N release in March.

Table 4: Winter wheat: N recommendations in kg/ha

Previous crop or grass N group (Table 2 or 3)	1	2	3	4	5	6
Sands and shallow soils	220	210	200	180	150	110
Sandy loams and other mineral soils	200	190	180	160	130	90
Humose soils	140	130	120	100	70	30
Peaty soils	80	70	60	40	10	0
Adjustments:						
Milling varieties	+40	+40	+40	+40	+40	+40
Grain distilling	0	0	0	0	0	0
Whole crop	0	0	0	0	0	0
Yield adjustment*						
Winter rainfall (1 Oct – 1 Mar)						
More than 450mm (18 inches)						
Sands, sandy loams, shallow soils	0	+10	+20	+20	+20	+20
All other soils	0	+10	+10	+10	+10	+10

Triticale: *use winter wheat recommendation -20 kg/ha N. There is no yield adjustment for triticale.*

* *An additional 20kg/ha may be justified for every tonne that the expected yield exceeds 8t/ha, and is permitted in NVZs where farm average yield is supported by evidence of yields previously achieved by that crop.*

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Calculating Nmax for Crops

FARM ADVISORY SERVICE

Stage 3

- Account for livestock and other organic manures

- Deduct the crop available Nitrogen from the crop requirement to give the balance that can be applied as bagged fertiliser

Manure type	Typical N (kg/t)	NVZ Minimum% Available to crop	Available N (kg/t)
Cattle Slurry	2.6	40	1.04
Pig Slurry	3.6	50	1.8
Layer Manure	19	30	5.7
Cattle FYM	6	10	0.6

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Calculating Nmax for Crops

FARM ADVISORY SERVICE

Stage 4

- Adjust for rainfall (if records available!). An upward adjustment can be made if the actual localised rainfall 1st Oct – 1st March exceeds 450mm (Not on residue group 1)

Stage 5

- Calculate the Nmax for the crop type by adding up the nitrogen requirement for each field growing that crop type

Nmax Exercise -TN651

FARM ADVISORY SERVICE

Nmax for of Winter Wheat (no yield or market adjustments);

1. Table1 – Soil type of the field – Sandy Loam

2. Table 2 - Previous Crop residue – Spring barley

3. Table 4 – What is the Nmax ?

Answer = 200 Kg/Ha

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Nmax Exercise -TN651

Nmax for Spring Barley (Feed);

1. Table1 – Soil type of the field – Sandy Loam
2. Table 2 – Previous Crop – Forage Rape
3. Table 6 – What is the Nmax?

Answer = 120kg/ha

Nmax Exercise -TN651 & TN650

FARM ADVISORY SERVICE

Nmax for Milling Winter Wheat, with 20 t/ha of FYM :

1. Table 1 – Soil type – Other Mineral Soil
2. Table 2 – Previous Crop – Winter Barley
3. Table 4 – What is the N recommendation/ha?
   240Kg/ha
4. Table C (TN650)–What is the total N / available N?
   N = 120Kg/ha total, of which <u>12Kg/ha available</u>

What is the Nmax?

<u>Answer = 228Kg/ha</u>

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Calculating Nmax for Grassland

FARM ADVISORY SERVICE

Stage 1

- Determine site class

Stage 2

- Use look-up tables to determine Nitrogen requirement for intended management
  - i.e grazing/ cutting

Stage 3

- Deduct crop available Nitrogen from manure applications

= Nmax for whole grassland area

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Nmax for Grassland

FARM ADVISORY SERVICE

Technical Note TN652

SRUC

April 2013 • Elec

Fertiliser recommendations for grassland

SUMMARY

- The main limitations to grass production are temperature, moisture, soil pH, soil drainage and structure, and nitrogen (N).
- Recommendations take account of nutrient management planning in the PLANET Scotland software tool and NVZ Action Programme rules.
- Good soil management is required to optimise nutrient use and maximise grassland productivity.
- Regular soil analysis is essential to manage soil pH and optimise phosphate (P_2O_5) and potash (K_2O) inputs for maximum yields and profitability.
- Considered application of nitrogen to meet grass needs can reduce the loss of harmful greenhouse gases.
- Appropriate use of livestock manures can result in considerable savings on purchased fertilisers.

1. Introduction

The main limitations to grass production are temperature, moisture, soil pH, soil drainage and structure, and nitrogen (N). This technical note shows how to calculate the optimal amount of N that should be applied based on:

- Assessment of *"site class"* (grass growing conditions). This is a measure of the production potential of the farm and determines the area of grass and quantity of fertiliser N needed to produce the grass required for your intended grassland management.
- Prediction from tabulated data of the *annual N use* to support a particular grassland management at a given site class.

Phosphate, potash, and sulphur recommendations have been updated in the light of current advances in understanding of soil nutrient management. Regular soil analysis is essential to optimise phosphate (P_2O_5) and potash (K_2O) inputs for maximum yields and profitability. Soil should be sampled and tested every 4-5 years and prior to establishment. P and K inputs from organic manures reduce annual P and K requirements. Over-use of P is wasteful and can lead to the loss of phosphorus from agricultural land to fresh water and impair water quality.

This technical note can be used along with PLANET Scotland, a software tool designed for routine use by Scottish farmers and consultants to plan and manage nutrient use on individual fields (http://www.planet4farmers.co.uk).

In addition, considered nutrient application will help to reduce the loss of nutrients to the environment; an important factor in terms of protecting water quality and reducing emissions of greenhouse gases such as nitrous oxide (N_2O). Injecting slurry, avoiding application on windy days and not applying fertilisers to wet, saturated or compacted soils will all help to minimise the loss of greenhouse gases. Further information on climate change and farming is available at http://www.sac.ac.uk/climatechange/farmingforabetterclimate/

matter levels are most prone to deficiency. Swards that receive high levels of nitrogen fertiliser and are cut regularly for silage are also more at risk whereas fields that receive regular applications of bulky organic fertilises, or have organic soils, are less likely to show deficiency. Soil analysis can help identify severely deficient soils but in other situations it is not as reliable a guide as herbage analysis.

3. Assessment of site class and nitrogen recommendations

Grassland production is limited by growing conditions, in particular the quantity of rainfall between April and September and soil type. The combined effect of these factors defines the *"Site Class"* as shown in Table A.

An area of land classified as:

- *Site Class 1* is limited by N not by water supply since N is utilised very efficiently and rainfall is above 500 mm between April and September.
- *Site Class 5* is severely limited by water supply since rainfall is below 350 mm between April and September. The potential yield of grass growing within a Site Class 5 is about half of that growing in a Class 1 site.

Standard or maximum N recommendations for each grass field based upon site class and intended grassland management are given in Table B. In practice, levels of N use may be less than the figures shown in Table B to reflect the level of intensity and production that is required on that particular farm unit. Clearly it makes little sense to produce more grass than can be utilised by the farm. Drought can impair growth and reduce N usage where moisture and not nitrogen limits growth. In NVZs the maximum nitrogen that can be applied to the whole grassland area (Nmax) is calculated by adding up the N requirement for each grass field as given in Table B. If you apply organic manures, you must use N efficiency values to determine the percentage of the total N content that will become available to the grass. This available N content contributes to Nmax and must be deducted from Nmax to calculate the balance that can be applied as manufactured N fertiliser. In some situations, lower application rates than those in Table B may be appropriate e.g. where grass management relies on high clover. Further guidance on NVZ regulations is provided in Scottish Government guidance on NVZs (http://www.scotland.gov.uk/Topics/farmingrural/Agriculture/Environment/NVZintro).

Seasonal distribution of nitrogen for existing swards

1) For Grazing:-
Nitrogen should be applied at *regular intervals over the grazing season at a declining rate to match the falling response to N by the grass.*

- Under optimal conditions grass can utilise approximately 2.5 kg N/ha/day of growth
- The first dressing should be about 6 weeks before turnout (maximum rate 100 kg N/ha) or at the time of "T-sum 200"
- Should "T-sum 200" occur much earlier than normal, delaying application until the first period of mild weather will reduce the risk of N loss
- No N should be applied after mid-August. This reduces the risk of winter losses of nitrogen from the soil and winter damage to the grass. The response to N will also be lower after this time
- Fertilisers and manures should never be spread on to frozen, waterlogged, or snow covered soils.

2) For Conservation:-
Based on a daily uptake of 2.5 kg N/ha the optimum rate of N application for the first cut of silage is 120 kg N/ha applied

Table A. Site Classes

Soil texture	Average April-September rainfall (mm)*			
	More than 500	425-500	350-425	Less than 350
	Site class **			
Sands and shallow soils	2	3	4	5
All other soils	1	2	2	3

* Approx. 50% annual rainfall. PLANET Scotland provides annual rainfall estimates for all of Scotland
** Add 1 for farms above 300 m

Table B. Standard or maximum total annual N recommendations in kg/ha for each grass field based upon site class and grass management

Grass management	Site Class 1	Site Class 2	Site Class 3	Site Class 4	Site Class 5
2 or 3 cut silage + grazing	310	300	290	280	270
1 cut silage + grazing	280	270	260	250	240
Grazing with low clover	270	260	250	240	230
Hay + grazing	220	210	200	190	180
Grass with high clover*	100	90	80	70	60

* High clover = 20-30% clover content mid-season

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Nmax for Grassland

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Grass Management	Site Class 3 kgN/ha
2 or 3 cut silage + grazing	290
1 cut silage + grazing	260
Grazing with low clover	250
Hay + grazing	200
Grazing with high clover	80

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NVZ Plan – Key Requirements

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You must prepare annually a Fertiliser and Manure Management Plan:

1. RAMS map
2. Calculation and record of storage capacity of livestock manures (if applicable)
3. Calculation and record of 170kg N/ha loading limit for livestock manure (livestock numbers)
4. An Nmax calculation for each crop type (field records)

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FARM ADVISORY SERVICE

NVZ Records

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NVZ Records

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- Record the area of a farm within an NVZ
- Field records
- Livestock numbers
- Movement of livestock manure on and off farm
- Inorganic fertiliser inventory

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Field Records

- Area
- Soil type
- Crop and date of sowing
- Quantity and type of inorganic fertilisers and organic manures

- Are you already doing this?

Example Field Record

FARM ADVISORY SERVICE

Field Number: Field 1	**Field Area: 10ha**	**Harvest year: 2016**
Calculated Nmax for crop type: 130kg/ha		**Soil Type: OMS**

	Field use details		Manufactured nitrogen applied			Organic manure applications			
Date fert or manure applied	**Crop type**	**Date sown**	**Fertiliser type**	**Amount applied kg/ha**	**Total nitrogen applied**	**Manure reference**	**Available N content kg/t**	**Quantity applied m³/t per ha**	**Total N applied kg/ha**
10/01/2016	SB	15/03/2016				Cattle FYM	0.6	25	15
15/03/2016			14:14:21	375	52.5				52.5
15/04/2016			34.50%	175	60				60
								Total	**127.5kgN/ha**

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Livestock Numbers

- Species
- Type
- Length of time on the farm

Example Stocking Records / Livestock Numbers

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Livestock Type	Number present on first day of calendar month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Average**
1 Dairy Cow, High Milk Yield (> 9000kg)													
1 Dairy Cow, Med Milk Yield (6000 to 9000kg)													
1 Dairy Cow, Low Milk Yield (less than 6000kg)													
1 Dairy Heifer Replacement, 13 mths to first calf													
1 Dairy Heifer Replacement, 3 to 13 mths													
1 Large Beef Suckler, 25 mths and over (over 500kg)	50	50	50	50	50	50	50	50	50	50	50	50	**50**
1 Small Beef Suckler, 25 mths and over (up to 500kg)													
1 Beef Grower, 25 mths and over													
1 Beef Grower, 13 to 25 mths													
1 Beef Grower, 3 to 13 mths	25	50	50	50	50	50	50	50	50	50	50	50	**48**
1 Bull Beef 3 mths and over													
1 Bull for breeding 25 mths and over													
1 Bull for Breeding, 3 to 25 mths	2	2	2	2	2	2	2	2	2	2	2	2	**2**
1 Calf up to 3 mths	25									25	50	50	**13**
1 Hill Ewe with suckled lamb(s) up to 6 mths													
1 Lowground Ewe with suckled lamb(s) up to 6 mths	100	100	100	100	100	100	100	100	100	100	100	100	**100**
1 Lamb from 6 mths up to 9 mths													
1 Lamb , 9 mths & over to 1st lambing/tupping or slaughter													
1 Goat													
1 Breeding Deer Hind													
1 Deer Calf Finisher													
1 Horse													

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Movement Of Livestock Manure On Or Off The Farm

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- Type of manure
- Nitrogen content of manure (standard figures or own analysis)
- Quantity moved
- Date of movement
- Name and address of person supplying or receiving the manure

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Example Manure Records

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Date of Import/Export	Tonnes Supplied (S) / Received (R)	Manure type	Nitrogen content kg/t/m³	Received from / Supplied to
30/03/2016	1,000t (S)	Cattle FYM	6	Mr Brown, Green Farm, Duns
15/07/2016	500t (R)	Layer manure	19	Mr Smith, Town Farm, Gordon

Manufactured Fertiliser Inventory

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- Purchases
- Used
- Retained

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Example Fertiliser Inventory

FARM ADVISORY SERVICE

Calendar Year 2016

Fertiliser type	Opening stock in tonnes	Purchased fertiliser in tonnes (01/01)	Closing stock in tonnes (31/12)
20:10:10	3	30	0
34.5%	0	20	5

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FARM ADVISORY SERVICE

Rules For Application & Storage of N Fertiliser & Manure

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Rules For Application & Storage of N Fertiliser & Manure

FARM ADVISORY SERVICE

- No applications to take place when land is;
  - Waterlogged
  - Flooded
  - Frozen for 12 hours or longer
  - Snow covered
  - sloped >12 degrees if risk of N entering water

- All applications of N fertiliser must be recorded

Rules For Application & Storage of N Fertiliser & Manure

FARM ADVISORY SERVICE

- No application of **manufactured** N fertiliser during the following periods:

	Grassland	Other Land
Lothian and Borders NVZ	15th September to 15th February	1st September to 15th February

- Applications to WOSR permitted

- A max of 100kg/ha can be applied to other brassica crops during closed period

Rules For Application & Storage of N Fertiliser & Manure

FARM ADVISORY SERVICE

Organic manure:

- 250kg N/ha/field application limit for organic N
- No spreading within 10m of a watercourse
- No spreading within 50m of a well, borehole or other water supply

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Rules For Application & Storage of N Fertiliser & Manure

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Organic manure with a **high available** N content

- No spreading within the NVZ during the following periods:

	Grassland	Other Land
Sandy or shallow soil	1st September to 31st December	1st August to 31st December *
All other soils	15th October to 31st January	1st October to 31st January

*applications permitted up to and including 15th September if a cereal crop is sown before that date, also permitted up to 30th September if the land is sown with OSR

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Rules For Application & Storage of Fertiliser & Manure

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- Quantitative restrictions:
  - 4 weeks prior to the start of the closed period
  - the last day of the closed period until 14th February
  - 5 t/ha for layer manure / 30 m3 for slurry

- If applied to bare ground during July, August or September, crop must be sown within 6 weeks of first application

- At least 3 weeks must elapse before a repeat application of organic manures

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Rules For Application & Storage of N Fertiliser & Manure

FARM ADVISORY SERVICE

Solid manure:

- Temporary field heaps in place for no longer than 12 months
- Site cannot be reused for 24 months

- Any permanent storage site must be on an impermeable surface which prevents drainage to the water environment

- Must have a waterproof covering or adequate facilities to collect run off

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FARM ADVISORY SERVICE

Common Issues Found at NVZ Inspections

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Common Issues Found at NVZ Inspections

- NVZ plan not available
- Applications of nitrogen within closed periods
- Nmax breach (plan not being followed or understood)
- No evidence to support yield or market adjustment
- Applications of organic manures with high available N
- Records not matching NVZ plan
- 250kg/ha N organic manure limit exceeded

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Closed Period Breach

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			January	Febuary	March	April	May	May	June	July	August	September	October	November	December
High Available N manures	Chemical fertilliser	Grassland Otherland										*			
	Sandy/Shallow soils	Grass Other Land										**			
	Other Soils	Grass Other Land													

Close period

Quantititive restrictions

** Application permitted if sowing a crop, 15/9 for cereal, 30/9 for WOSR

* Can apply 30 kg/ha for WOSR

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Nmax Breach

- Incorrect calculation of Nmax
- Not accounting for organic Nitrogen in calculations
- Incorrect previous crop
  - grassland, brassicas, N fixing, rape with high residue groups
- Autumn Nitrogen application on WOSR (>30kg / ha)
- Use of English figures when calculating N requirements (RB209 Fertiliser Manual)

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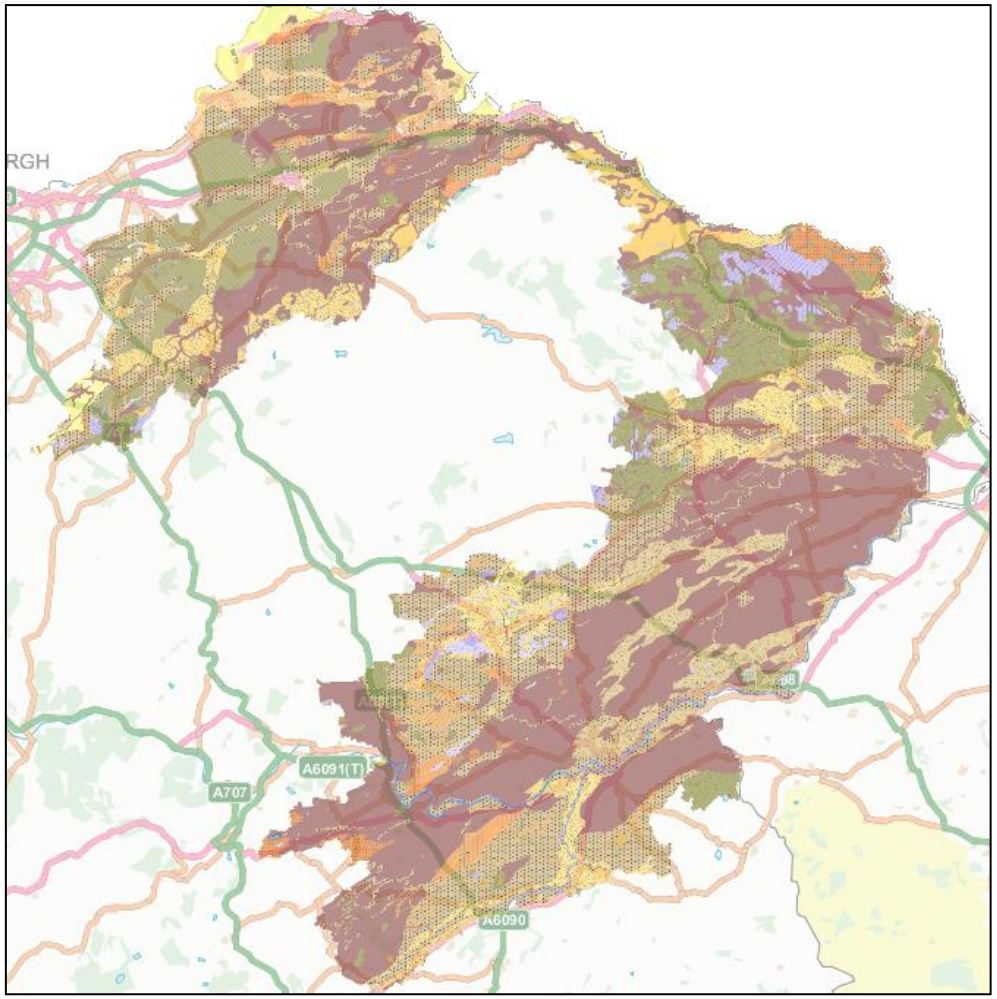
Nmax Breach Due to Incorrect Soil Texture



Soils for Scotland website

No Evidence to Support Yield or Market Adjustment

FARM ADVISORY SERVICE

- Three years of yield data to prove higher than average yields

- Contract from millers to prove that wheat is grown for milling market or for high N grain distilling

Records Not Matching NVZ Plan

- Incorrectly recorded fertiliser applications
- E.g. recording AN 34.5% when Urea (46%) has been applied
- Importing poultry manure with no account for it in Nmax or NVZ plan
- Incorrect livestock numbers
- Not recording where organic manures are applied

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250kg/ha N 12 Month Period

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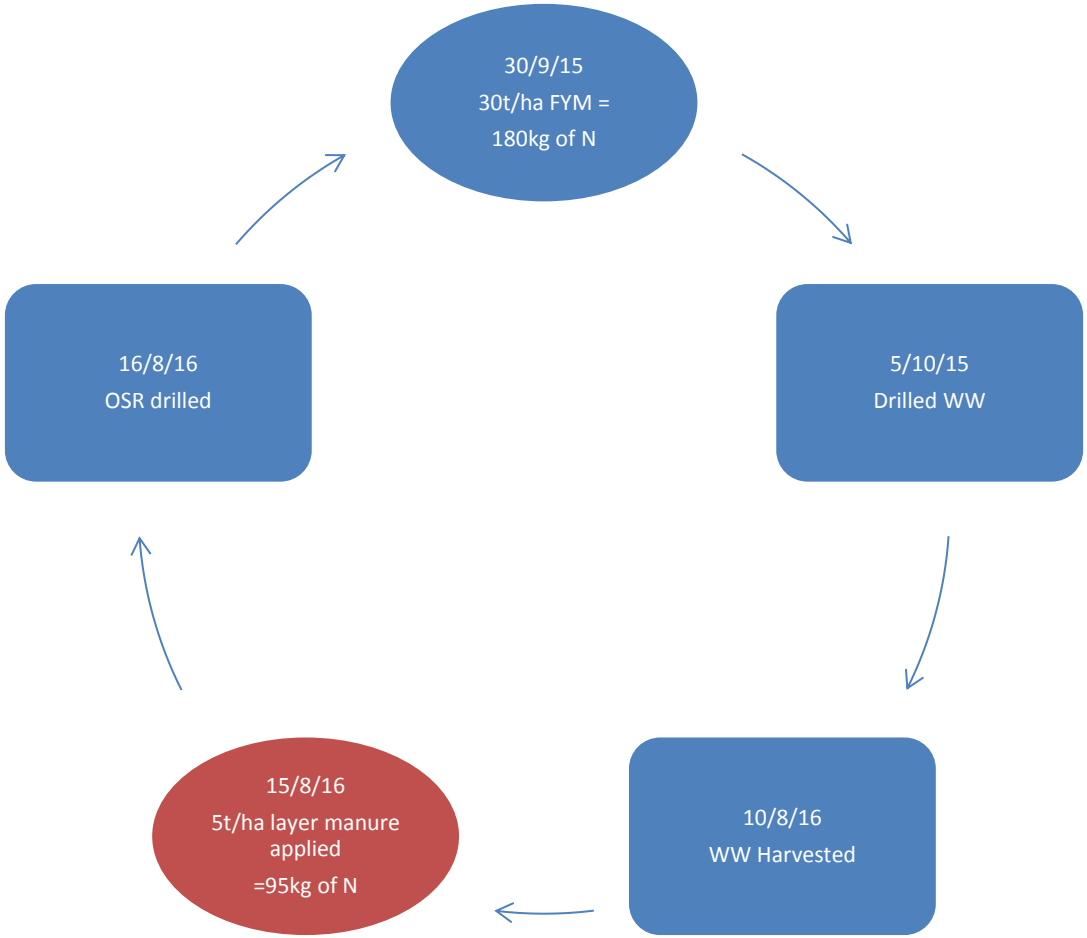

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NVZ Quiz

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1. When should your NVZ plan be completed by?
2. If you let grazing land annually, who keeps the records?
3. On the RAMS map, what does orange mean?
4. What areas should you colour red on your RAMS map?
5. How long can a temporary midden remain in one place?
6. How soon can you reuse that same site for storage?
7. Minimum distance from surface water that your middens must be?
8. If poultry manure cannot be stored in a field heap (i.e. laying hen manure), how many weeks storage do you need if it's not exported off the farm?

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NVZ Quiz

FARM ADVISORY SERVICE

9. What is the livestock loading limit on a holding?
10. What is the field application limit for organic Nitrogen?
11. What is the Nmax?
12. Apart from planned crop and soil type, what else do you need to know to work out your Nmax?
13. What factors can you use to increase the Nmax?
14. How many weeks must you leave between livestock manure applications?
15. Between what dates must you not apply inorganic fertilisers in Borders NVZ on arable land?
16. When do the quantitative restrictions apply?

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PLANET Scotland

FARM ADVISORY SERVICE

- Field-level nutrient and lime recommendations based on SAC Technical Notes
- Field-level records to meet NVZ compliance requirements
- Also an effective **nutrient management tool** for N, P & K, taking account of soil analysis and manure applications

PLANET
NUTRIENT MANAGEMENT

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Nutrient Budgeting

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Silage: High vs Low P & K

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		Crop Need	From Manures	From Fertiliser	
Silage (High P & K)	N	120	0	120	£60.00
	P	17	0	17	£10.20
	K	60	0	60	£24.00
				Fertiliser Cost / ha	**£94.20**

		Crop Need	From Manures	From Fertiliser	
Silage (Low P & K)	N	120	0	120	£60.00
	P	74	0	74	£44.40
	K	140	0	140	£56.00
Saving / ha £66.20				**Fertiliser Cost / ha**	**£160.40**

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Silage: with Slurry & Without

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		Crop Need	From Manures	From Fertiliser	
Silage & Slurry	N	120	24	96	£48.00
Slurry @ 30m3/ha	P	34	36	0	£0.00
	K	120	96	24	£9.60
				Fertiliser Cost / ha	**£57.60**

		Crop Need	From Manures	From Fertiliser	
Silage no Slurry	N	120	0	120	£60.00
	P	34	0	34	£20.40
	K	120	0	120	£48.00
Saving / ha £70.80				**Fertiliser Cost / ha**	**£128.40**

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Spring Barley: with FYM & Without

FARM ADVISORY SERVICE

		Crop Need	From Manures	From Fertiliser	
Spring Barley (FYM)	N	130	11	119	£59.50
FYM fresh @ 15t/ha	P	52	48	4	£2.40
	K	71	120	0	£0.00
				Fertiliser Cost / ha	**£61.90**
		Crop Need	**From Manures**	**From Fertiliser**	
Spring Barley (No FYM)	N	130	0	130	£65.00
	P	52	0	52	£31.20
	K	71	0	71	£28.40
Saving / ha £62.70				**Fertiliser Cost / ha**	**£124.60**

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Nutrient Network Farm

FARM ADVISORY SERVICE

- 1st meeting held at Girrick two weeks ago
- Take a ‘before and after’ look at how to protect and improve farm soils and make best use of both organic and inorganic fertilisers
- Aim is to save money, benefit yields and improve farm efficiency and resilience

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Soil and Nutrient Network

Farm Advisory Service

National Advice Hub
T: 0300 323 0161
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W: www.fas.scot

Helping farmers improve soil and nutrient management

Case study -
Wormiston Farm, Peeblesshire

Wormiston, farmed by Robbie Brockie is an upland mixed beef and sheep farm covering 283 ha. The farm lies around 770ft above sea level with the business focusing on grass production for cattle and sheep, with some spring barley grown for cattle feed.

The farm has 120 cows with all calves finished. The cattle are housed in the winter with half on bedded courts and half on cubicles. There are also around 1000 ewes on the farm. Wormiston has a vast range of soil types from alluvial soil running parallel to the Eddleston water, to Brown Forest soils to areas of gley. The soil series are Yarrow and Ettrick. Soil Capability ranges from 4.1 to 5.2.

Assess soil structure

SAC Consulting's Bill Crooks dug two separate soil pits to show how to identify soil structure using the Visual Evaluation of Soil Structure (VESS) guide.

Bill described the process of selecting various areas of the field for evaluation, digging down to 40cm and removing a block of soil. The depth of each horizontal layer can be measured. By looking at the soil block you can determine and score soil structure, based on 1 being friable with good soil structure to 5 being very compact suggesting additional action will be needed.

Good soil structure will be characterised by well formed porous blocks with rounded edges which can be easily broken between the fingers when moist. Vertical fissures will help to lead roots downwards. The soil will be more resistant to damage. A well structured soil will help soil nitrogen to be used more effectively and will also give good drainage and better uptake of minerals via the roots.

Poor soil structure will be much harder with sharper blocks which are more difficult to break apart. Horizontal fissures restrict root growth and development. Poor soil structure will be easier to damage. Options to rectify damage should be sought on soils scored 4 or 5.

The two soils evaluated at Wormiston were a spring barley and permanent grass field close to the steading.

The spring barley field scored a 1 - being friable with good root depth and aggregates that were easy to break up with one hand. The permanent grass field was rated 2 as being intact with much more root activity in the top two inches of soil which is typical of permanent pasture.

The quality of the soil structure in these fields was not as expected.

It is important to assess soil structure BEFORE taking any action to improve. Many problems can be easily worsened by subsoiling or taking action in unfavourable conditions.

For more information on the Soil and Nutrient Network see www.farmingandwaterscotland.org. For dates of SNN events, find us on Facebook or follow us on Twitter @FarmWaterScot

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Nutrient Budgeting—how can it benefit your farm?

SAC consulting sampled 12 fields for pH, P, K and Mg. Maps for pH, P, K and Mg were created to give a clear picture as to which fields required targeting. The pH for the fields sampled ranged from 5.3 to 6.2. (Figure 1). Other than two fields, all were within a suitable pH range for grassland production. The phosphate levels were mostly low to moderate which would require some additional application to rectify this. The potash levels were mostly moderate to high which is typical of a farm with a lot of FYM (Figure 2).

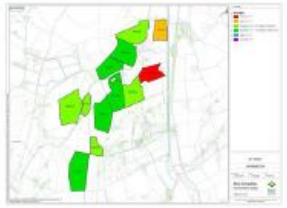

Figure 1 – pH status of fields

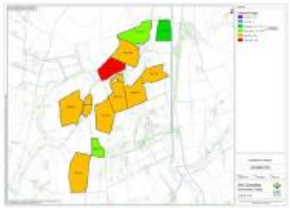

Figure 2 – Potassium status of fields

Using the soil testing information, a nutrient budget for the farm was created using PLANET Scotland. The recommendation was to alter fertiliser application to the spring barley. Currently 370kg/ha of 20:10:10 was applied over 28.57ha which resulted in a total cost of £2,625. An alternative to this was to make use of organic manure, applying FYM at 15t/ha to 25.02ha and 25t/ha to 3.55 ha.

To meet the spring barleys nitrogen requirements, the recommendation was to apply 180kg/ha of urea 46% to the 25.02ha and 105 kg/ha to the 3.55ha. On the 25.02ha no additional P & K was required and on the 3.55ha 96kg/ha was required. This gave a total inorganic fertiliser cost of £1,204 **resulting in an estimated saving of £1,421.**

For silage, currently 556kg/ha of 22:4:14 is applied on 51.83ha resulting in a total cost of £6,916. The recommendation was to apply slurry at 24m³/ha to 43.91ha and at 20m³ on 14.52ha. For the nitrogen requirement for growing silage, urea 46% should be applied between 200-260kg/ha of the whole area and 22kg/ha of TSP on 29.39ha. Total inorganic fertiliser cost would be £2,828 **with an estimated saving of £4,088.**

Key Findings

- Check soil structure for surface and sub soil compaction before taking any action to rectify problems.
- Sample your soils for pH, P, K & Mg routinely
- Prepare a nutrient budget to make the best use of organic manures to reduce your fertiliser bill
- Ensure sufficient storage to time organic manure applications to apply to growing crops.

Manure management at Wormiston

Dung from the straw bedded courts is typically mucked out every 2 months and middened in a field for spreading in the spring, either to stubble or to grassland.

Slurry is scraped from cubicles to a passage way then into an outside midden. Most of the farm is concreted, with dirty water also running into the midden.

It may be beneficial to explore ways of collecting dirty water to manage the dry matter content of the slurry, as a lot of rain water is collected in the slurry midden. The farm has sufficient storage to collect slurry and spread when conditions allow.

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Thank You

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