# Soil Compliance Monitoring Annual Report 2013 and 2014

## Part I: Agricultural sites

# 0 Summary

This report presents results from soil sampling in agricultural fields carried out by SEPA as part of the 2013 and 2014 soil compliance monitoring campaigns, which investigated the impact of spreading a range of different organic materials to land on soil quality and whether or not relevant regulations had been complied with.

Over the course of these two years, samples were taken from 177 fields at 45 farms across Scotland. As well as fields that had been spread with organic materials, some fields sampled were reference locations that had not been spread with organic materials. Sampling reference locations allows comparison with spread locations so that possible influences of spreading on soil quality can be identified.

As in previous years, the main organic materials spread to land that were investigated as part of the soil compliance monitoring campaign were sewage sludge and distillery by-products, as these are the main organic materials spread to land that are regulated by SEPA. However, in 2013 and 2014, sampling of locations where manure or slurry from intensive agricultural units and novel wastes such as biomass ash had been spread to land were included.

Occasional instances of potentially toxic element concentrations in soils at locations spread with organic materials exceeding limits set out in the Sludge (Use in Agriculture) Regulations 1989 were found. These were reported to SEPA Operations staff for further follow-up and potential enforcement action. In circumstances where agricultural land was spread with sewage sludge, such instances may represent a breach of the Sludge (Use in Agriculture) Regulations.

The results from sampling in 2013 and 14 showed that there is evidence that organic material spreading to land may have some influences on soil quality, e.g. both distillery by-product and sewage sludge spreading appear to have led to increased extractable phosphorus concentrations in some soils. Whether or not the impact of organic material spreading to land is beneficial for agriculture varies, depending on the location spread and the initial condition of the soil. The impact of spreading on soil quality is also masked by other factors that control soil quality parameters, particularly land use and management.

# 1 Introduction and background

Spreading organic material to land offers a number of benefits for soil quality, agricultural production and the wider environment. These benefits include increasing nutrient levels and/or pH in soils where these are below optimum for crop growth, recovery of resources (plant nutrients) from waste materials, reduction in use of environmentally unsustainable disposal routes such as landfilling and reduction in the use of virgin resources by substitution for commercial fertiliser.

However, failure to apply the right amount of the right organic material to land in the right place and at the right time can have negative impacts on soil quality and/or the wider environment, for example by adding excessive amounts of major nutrients, such as nitrogen and phosphorus, that can be transferred to watercourses or groundwater through leaching or erosion leading to downgrades in water quality. Other problems associated with poorly-executed organic material spreading to land include soil contamination through accumulation of potentially toxic elements, local air quality problems resulting from ammonia emissions and odours.

Ensuring that good soil quality is maintained at locations where these materials are spread is very important to the environment and economy of Scotland.

Between 2007 and 2014, SEPA carried out strategic soil compliance monitoring, taking samples at locations where organic materials had been spread to land, in order to determine impacts of this activity on soil quality. This monitoring has allowed SEPA to audit compliance with the Sludge (Use in Agriculture) Regulations 1989 (henceforth referred to as the 'Sludge Regs'), and also to check soil quality at sites receiving organic materials under Paragraph 7 exemptions from the Waste Management Licensing Regulations 2011 (henceforth referred to as the 'WML Regs'), using criteria set out in the Sludge Regs as guidelines. In addition, although agricultural manure and slurry spreading to land does not fall under either the Sludge Regs or the WML Regs, concerns have been raised by SEPA regulatory staff about instances of manures and slurries from intensive agriculture operations being spread to land at very high rates and the environmental impact of this. Therefore, it was decided that some sampling of soils receiving applications of manures and slurries from high risk intensive agricultural operations would be carried out in 2013 and 2014.

This report summarises results from soil monitoring carried out in 2013 and 2014.

# 2 Methods

SEPA staff sampled soils from 94 fields at 23 farms in 2013 and from 83 fields at 22 farms in 2014. Sampling focused on sites receiving

- sewage sludge under the Sludge Regs (18 farms, 52 fields) and distillery by-products under paragraph 7 exemption from the WML Regs (14 farms, 35 fields): These are the organic waste materials that are most frequently spread on land in Scotland. Previous sampling suggested their application resulted in soil quality improvements at a number of sites; however, there was also evidence of potential soil quality problems that may have been related to spreading activities at a small number of sites sampled in the past.
- waste types that had not previously been looked at in detail (distillery bio-plant cake, plasterboard, biomass ash and off-specification anaerobic digestate) (7 farms, 17 fields): The impact on soil quality of materials that have not previously been spread to land in Scotland in large amounts is not well known.

- Other locations where a variety of waste materials (e.g. paper crumble, off-specification compost, abattoir by-products, malt effluent) were being spread to land (7 farms, 21 fields): These locations were selected for sampling due to concerns about poor operator practice or operator results that indicated that soil conditions were not optimal for spreading waste to land.
- manure and slurry from intensive agriculture activities (6 farms, 16 fields): Manures and slurries make up 95% of all organic material applied to land in Scotland and there is limited information on their impact on soil quality. Pig and poultry manure often contain high concentrations of available phosphorus and nitrogen, so spreading these materials to land carries a high risk of causing nutrient contamination of groundwater and/or surface water, particularly if high spread rates are used. Pig manure may also contain high concentrations of potentially toxic elements, e.g. zinc, which may lead to harmful accumulation in soils if the same fields are spread repeatedly with this material.

Care was taken to select sites from across Scotland that received a range of organic materials (Figure 1).

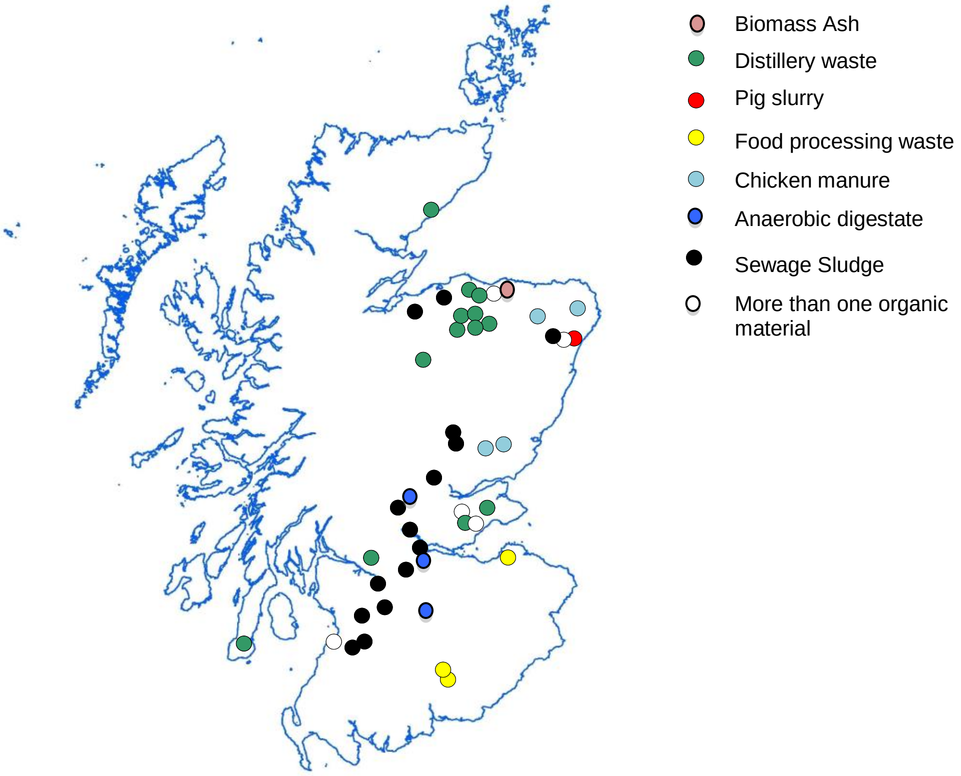


**Figure 1:** Locations of farms sampled in 2013 and 2014 and organic material types spread to land.

A representative soil sample was collected in each field by taking 25 subsamples in a W-shaped pattern across the whole area to be sampled, then reducing to a suitable volume for bagging by mixing and coning and quartering. Samples were analysed by external laboratories for:

- pH;
- organic carbon and total nitrogen;

- extractable[a] phosphorous, potassium and magnesium;
- total cadmium, chromium, copper, lead, nickel, zinc and mercury;
- microbial biomass carbon.

At a sub-set of sites earthworms were collected separately and analysed by SEPA ecology staff.

# 3 Results

Mean, median, maximum and minimum values for soil quality indicators are shown in Tables 1 - 4.

**Table 1:** Mean, median and ranges for each parameter measured in 2013 (except earthworms).

| Parameter | Unit | Mean | Median | Minimum | Maximum | N |
|---|---|---|---|---|---|---|
| pH | | 5.9 | 5.8 | 4.6 | 7.4 | 94 |
| P* | mg/l | 12.6 | 8.7 | 1.2 | 80.8 | 94 |
| K* | mg/l | 175 | 154 | 18 | 429 | 94 |
| Mg* | mg/l | 167 | 159 | 49 | 333 | 94 |
| $C_{org}^{\$}$ | % | 4.9 | 4.2 | 1.7 | 24.3 | 94 |
| $N^{\dagger}$ | % | 0.39 | 0.35 | 0.09 | 1.29 | 94 |
| C:N | | 13.6 | 13.2 | 9.7 | 19.6 | 94 |
| $Cd^{\dagger}$ | mg/kg | 0.24 | 0.23 | 0.06 | 0.55 | 94 |
| $Cr^{\dagger}$ | mg/kg | 37.1 | 36.0 | 4.2 | 132.9 | 94 |
| $Cu^{\dagger}$ | mg/kg | 26.3 | 18.8 | 3.5 | 114.9 | 94 |
| $Hg^{\dagger}$ | mg/kg | 0.08^ | 0.08 | <0.05 | 0.36 | 94 |
| $Ni^{\dagger}$ | mg/kg | 22.7 | 20.0 | 2.0 | 105.4 | 94 |
| $Pb^{\dagger}$ | mg/kg | 33.2 | 25.3 | 6.0 | 146.9 | 94 |
| $Zn^{\dagger}$ | mg/kg | 75.9 | 64.2 | 15.7 | 320.3 | 94 |
| $C_{mic}^{\sim}$ | µg/g | 750 | 643 | 278 | 2296 | 94 |
| $C_{mic}:C_{org}$ | % | 1.6 | 1.6 | 0.8 | 3.0 | 94 |

* extractable, $ organic carbon, † total, ~ microbial biomass carbon, ^ The mean concentration was calculated by assigning a value of half the detection limit to all results where measured concentration was below detection limit.

[a] Extractable nutrients were measured in modified Morgan's extract (SAC method).

**Table 2:** Mean, median and ranges for each parameter measured in 2014 (except earthworms).

| Parameter | Unit | Mean | Median | Minimum | Maximum | N |
|---|---|---|---|---|---|---|
| pH | | 5.9 | 5.9 | 4.7 | 7.3 | 83 |
| P* | mg/l | 6.9 | 5.2 | 0.8 | 29.3 | 83 |
| K* | mg/l | 136 | 124 | 52 | 317 | 83 |
| Mg* | mg/l | 144 | 109 | 40 | 533 | 83 |
| $C_{org}^{\$}$ | % | 4.4 | 4.0 | 2.1 | 9.5 | 83 |
| $N^{\dagger}$ | % | 0.35 | 0.30 | 0.16 | 0.83 | 83 |
| C:N | | 12.9 | 12.6 | 9.8 | 19.7 | 83 |
| $Cd^{\dagger}$ | mg/kg | 0.22 | 0.20 | 0.09 | 0.58 | 83 |
| $Cr^{\dagger}$ | mg/kg | 32.8 | 33.4 | 5.5 | 75.0 | 83 |
| $Cu^{\dagger}$ | mg/kg | 23.8 | 16.9 | 3.7 | 311.8 | 83 |
| $Hg^{\dagger}$ | mg/kg | 0.09^ | 0.09 | <0.05 | 0.31 | 83 |
| $Ni^{\dagger}$ | mg/kg | 19.0 | 18.9 | 2.9 | 46.9 | 83 |
| $Pb^{\dagger}$ | mg/kg | 35.5 | 23.0 | 6.4 | 627.7 | 83 |
| $Zn^{\dagger}$ | mg/kg | 58.9 | 55.9 | 13.4 | 136.3 | 83 |
| $C_{mic}^{\sim}$ | µg/g | 848 | 698 | 227 | 1936 | 80 |
| $C_{mic}$:$C_{org}$ | % | 2.0 | 1.8 | 0.8 | 3.8 | 80 |

$^{*}$ extractable, $^{\$}$ organic carbon, $^{\dagger}$ total, $^{\sim}$ microbial biomass carbon, ^ The mean concentration was calculated by assigning a value of half the detection limit to all results where measured concentration was below detection limit.

**Table 3:** Mean, median and ranges for earthworm parameters measured in 2013.

| Parameter | Unit | Mean | Median | Minimum | Maximum | N |
|---|---|---|---|---|---|---|
| Species number | | 5 | 5 | 1 | 9 | 26 |
| Total abundance | Ind/$m^2$ | 188 | 158 | 4 | 440 | 26 |
| Total biomass | g/$m^2$ | 48.4 | 47.9 | 1.6 | 139.5 | 26 |

**Table 4:** Mean, median and ranges for earthworm parameters measured in 2014.

| Parameter | Unit | Mean | Median | Minimum | Maximum | N |
|---|---|---|---|---|---|---|
| Species number | | 6 | 6 | 4 | 10 | 25 |
| Total abundance | Ind/$m^2$ | 290 | 242 | 48 | 675 | 25 |
| Total biomass | g/$m^2$ | 88.0 | 74.5 | 14.4 | 208.0 | 25 |

## 3.1 Compliance with regulations

### 3.1.1 Sewage sludge spread to agricultural land under the Sludge Regs

No breaches of the Sludge Regs limits were found in fields where sewage sludge was spread in 2012; two breaches were found in fields spread in 2013 (Table 5). Information on these apparent breaches of the Sludge Regs was sent to the relevant SEPA regulatory teams for further investigation and possible follow-up enforcement action.

**Table 5:** Numbers of fields sampled to which sewage sludge was applied and number of non-compliances with the Sludge (Use in Agriculture) Regulations detected.

| Year covered by sludge register | Number of fields sampled | Number of fields with non-compliant results |
|---|---|---|
| 2006 | 16 | 2 |
| 2007 | 21 | 0 |
| 2008 | 22 | 1 |
| 2009 | 26 | 1 |
| 2010 | 37 | 2 |
| 2011 | 31 | 3 |
| 2012 | 22 | 0 |
| 2013 | 26 | 2 |

Note: sludge registers are issued to SEPA in March each year for the previous year, and hence SEPA soil compliance monitoring involves sampling being carried out at locations that were indicated as having been spread in the previous year's sludge register.

### 3.1.2 Organic waste spread to agricultural land under Waste Management Licensing exemption

Exceedance of the PTE limits from the Sludge Regs cannot be treated as a breach of legislation where materials are spread to land under paragraph 7 exemptions from the WML Regs. No legal limits exist for soil PTE concentrations under the WML Regs, however SEPA would consider withdrawing or refusing to renew an exemption in order to prevent further PTE accumulation, if it was suspected that a spreading activity has or is likely to lead to exceedance of the Sludge Regs limits.

In 2013, of 33 fields sampled that were spread with organic materials there were nine results in excess of the maximum recommended concentrations, three each for copper, nickel and zinc. These occurred in seven fields (21% of spread fields sampled) at four farms that had been spread with a range of organic materials. This represents a high number and proportion of the fields sampled in comparison with soil compliance monitoring in previous years.

In 2014, of 40 fields sampled that were spread with organic materials, there was one result in excess of maximum recommended copper concentration, two results in excess of maximum recommended zinc concentration and one result in excess of maximum recommended lead concentration. These occurred in three fields at two spreading locations. This was a similar number of exceedances of limits as found in years prior to 2013.

More details on these occasions can be found in the annex. At each location where Sludge Regs limits for PTEs were exceeded, the occupants were advised to practice caution in spreading any further materials containing high concentrations of the relevant PTEs to land.

## 3.2 Effects of organic material application on agricultural soil quality

Organic waste materials are used in agriculture to replace inorganic fertiliser and/or lime. They have the additional benefit to agricultural soils of adding organic matter. However, they can also contain Potentially Toxic Elements (PTE) which may accumulate in soils over time, potentially leading to negative impacts on crop or animal health. Also, if organic waste materials are applied at unsuitably high rates, this may lead to excessive addition of nitrogen and phosphorus, resulting in wider environmental problems, such as contribution to nutrient enrichment of surface water and/or groundwater.

Where sample numbers for fields receiving a particular waste type from the 2013 and 2014 soil compliance monitoring campaigns were large enough (≥ 30 from at least 10 different farms) the effect of their application on the soil was analysed both nationally and locally:

- National analysis: The results of all samples from fields spread with the same waste type were averaged and compared with average concentrations in reference fields that had not been spread with waste. Separate national analyses were carried out for the years 2013 and 2014.
- Local analysis: Results from treated fields were compared with those from a reference field with similar land use on the same farm. Local analysis was carried out for all farms sampled in 2013 and 2014 and where results from this analysis is presented in the following sections, they cover farms that were sampled in both years.

### 3.2.1 Effects on soil organic carbon concentrations

One advantage of using organic materials instead of inorganic fertiliser is the addition of organic matter. So a positive effect resulting in increase of soil organic carbon concentrations could be expected where organic materials were applied. However no such overall effect was detected in results from the 2013 and 2014 soil compliance monitoring campaigns, probably because of the small number of samples and the overriding influence of land use on organic matter concentrations in agricultural soils.

### 3.2.2 Effects on soil extractable phosphorus concentration

In total, out of the 116 studied fields which had been spread with organic materials under either a paragraph 7 exemption from the WML Regs or under the Sludge Regs and sampled as part of the 2013-2014 soil compliance monitoring campaign, 22 fields with ‘high’ phosphorus index (19% of the total number) and 5 fields with ‘very high’ phosphorus index (4% of the total number) were found. By contrast, out of 37 reference fields, which had not been spread, only 1 field (3% of the total number) was found where extractable phosphorus concentration was in the ‘high’ index range, with 1 further field where extractable phosphorus concentration was in the ‘very high’ index range. This is potentially an effect of regular application of phosphorous rich materials; however other factors (e.g. differences in land use) are also likely to account for the higher extractable phosphorus concentrations in the spread fields.

On a national scale, extractable phosphorus concentration was higher in soil in fields spread with sewage sludge (in 2014 only) and distillery by-products (both years) compared to reference fields. At the farm using pig slurry, extractable phosphorus concentration was also higher in fields where slurry had been spread than in an adjacent reference field.

Extractable phosphorus concentrations in soil were found to be significantly higher under arable land use than both rotational and permanent grassland (Figure 2), probably as a result of differences in fertiliser usage.

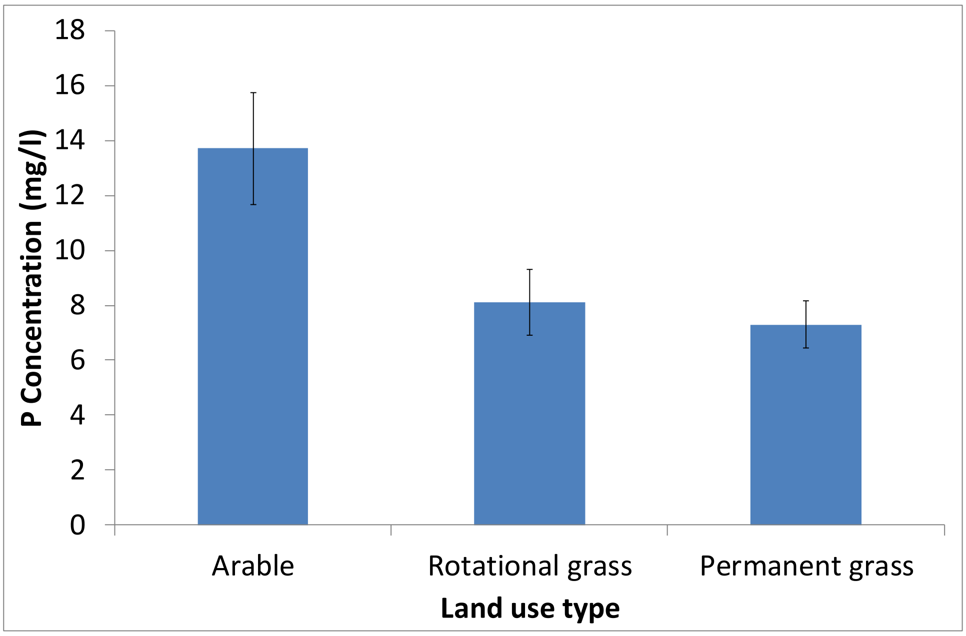


**Figure 2:** Extractable phosphorus concentrations in soils under different land use at agricultural sites, sampled as part of the 2013 and 2014 SEPA soil compliance monitoring campaigns. Bars show mean concentration, whiskers standard error. Extractable phosphorus concentrations in arable fields were significantly higher than those in both rotational grass fields and permanent grass fields ($p<0.05$). Differences in concentrations between rotational grass and permanent grass fields were not statistically significant.

Phosphorus was sometimes added in excess of crop requirements as a result of organic material spreading to land because the calculated application rate was based on nitrogen crop requirement only and the phosphorous addition rate and soil phosphorus index were not taken into account. Nitrogen addition rate is restricted to 250kg/ha/yr for waste spread under paragraph 7 exemptions, however there is no equivalent maximum addition rate for phosphorous.

Phosphorus addition from sewage sludge and slurry/manure spreading to land cannot be directly controlled as these activities do not require prior notification from SEPA. However, most paragraph 7 Waste Management Licensing Exemption applications now check crop phosphorous requirements and soil phosphorus status when determining suitable application rates after refusals/restrictions placed by SEPA on their registration due to previous failures to consider the implication of the proposed spread rate for phosphorus addition.

Where excess soil phosphorous concentrations were identified during the 2013 and 2014 soil compliance monitoring campaigns, farmers/land managers were notified that soil phosphorus levels in certain fields were higher than crop requirements, and informed that it may not be advisable to spread further materials containing high levels of phosphorus at these locations.

### 3.2.3 Effects on biological activity in soil

There is no significant statistical difference in microbial biomass between treated and non-treated fields where sewage sludge or distillery waste was applied. For all other organic materials the number of sampling locations was too small for meaningful analysis. Microbial carbon (Cmic) is highly dependent on land use, but this is driven mainly by the difference in soil organic carbon content under different land use types. By analysing differences between treated and non-treated fields on the basis of the ratio of microbial carbon to total carbon (Cmic:Ct), which takes the soil carbon content into account, the land use effect diminishes. There was also no difference in Cmic:Ct between treated and non-treated fields, both in locations where distillery waste and sewage sludge were spread to land.

For earthworms parameters (species number, abundance, biomass, and presence of ecological groups) no difference was found between fields receiving liquid, solid and no organic material. Analysis was carried out on the basis of whether organic material applied was liquid or solid, rather than looking at the impact of different organic materials, because there was not enough data available for analysis on the latter basis to provide meaningful results and the physical nature of the organic material, i.e. liquid or solid, has the greatest influence on the food supply for earthworms anyway.

Biological parameters provide a more integrated assessment on the effect of application of organic materials to agricultural land than chemical analyses. However they also integrate the effects of other influences (land use, land management, weather, soil properties as soil pH and texture etc.) on soil quality. The fact that no clearly negative impacts on biological parameters were found in fields receiving organic material applications at any of the farms visited during the 2013 and 2014 soil compliance monitoring campaign suggests that the application of organic material to agricultural land is no more harmful than any other intensive agricultural practice. The lack of positive effects indicates that either little or no benefits derive from organic waste spreading or, more likely, they are not seen because the waste spreading compensates for deterioration that would otherwise have occurred.

### 3.2.4 Effects on soil pH

Some organic materials have an effect on soil pH when spread to land due to their inherent acidity (e.g. distillery by-products) or liming properties (e.g. paper sludge or limed sewage sludge).

On a national scale, soil pH was on average higher for fields where sewage sludge was applied than for reference fields in both 2013 and 2014; however the effect wasn't statistically significant. Distillery by-product spreading had no apparent impact on soil pH on a national scale in either 2013 or 2014. There are two main factors that obscure the effect of organic material application on soil pH: the variability of the pH of the materials applied and additional application of lime to fields.

### 3.2.5 Effects on soil Potentially Toxic Elements (PTE) concentrations

All organic materials spread to land contain PTE; however levels vary enormously between materials and can also vary between batches of the same material due to inconsistencies in either production processes or feedstocks. PTE added to soil will tend to accumulate since they do not decompose and are usually only very gradually taken up by vegetation or lost via leaching and erosion.

Nationally, for farms where distillery by-products were spread to land, average copper concentrations were higher in spread fields than reference fields in both 2013 and 2014, although this difference was statistically significant in 2014 only. This effect may have been caused by high copper concentrations in some distillery by-products. However, local analysis of copper concentrations in soil in 2013 and 2014 (see figure 3) illustrates that the relationship between copper concentration in spread and reference fields is complex and variable and demonstrates that it is difficult to draw any firm conclusions from the small number of data points available.

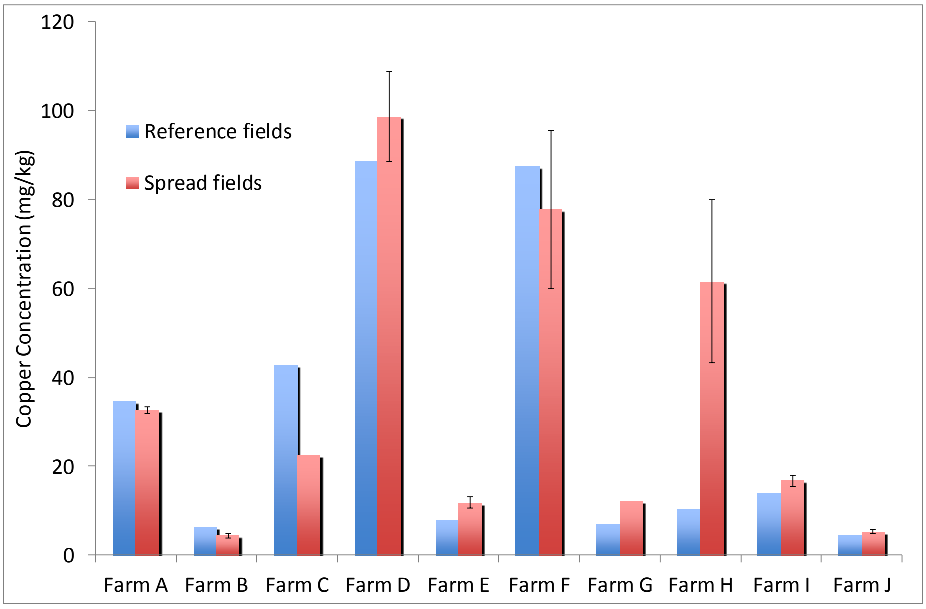


**Figure 3:** Copper concentrations in fields receiving distillery by-products in comparison with reference fields under the same land use. Whiskers represent the standard error of concentrations found in the spread fields. Farm names are omitted for data protection purposes.

At the farm using pig slurry on land, total zinc concentrations were higher in fields where slurry had been spread than in an adjacent reference field, possibly due to high zinc concentrations in the slurry.

### 3.2.6 Agricultural benefit

Whether changes in soil pH and increases in phosphorous or PTE concentrations are beneficial or harmful depends on the soil properties before organic material application.

Agricultural soils with a low soil pH will benefit from addition of a material with a liming effect whereas if the soil is already above around 6.3, no benefit will occur. Application of phosphorous is beneficial where soil phosphorus concentration is below or at optimum for crop growth but not beneficial if this is already above optimum levels. Likewise, increase of certain PTE concentrations in soil (for example copper and zinc which are essential trace nutrients) is beneficial where the soil is deficient in these. Addition of major and/or trace plant nutrients up to the level required by the crop will improve crop yield and quality.

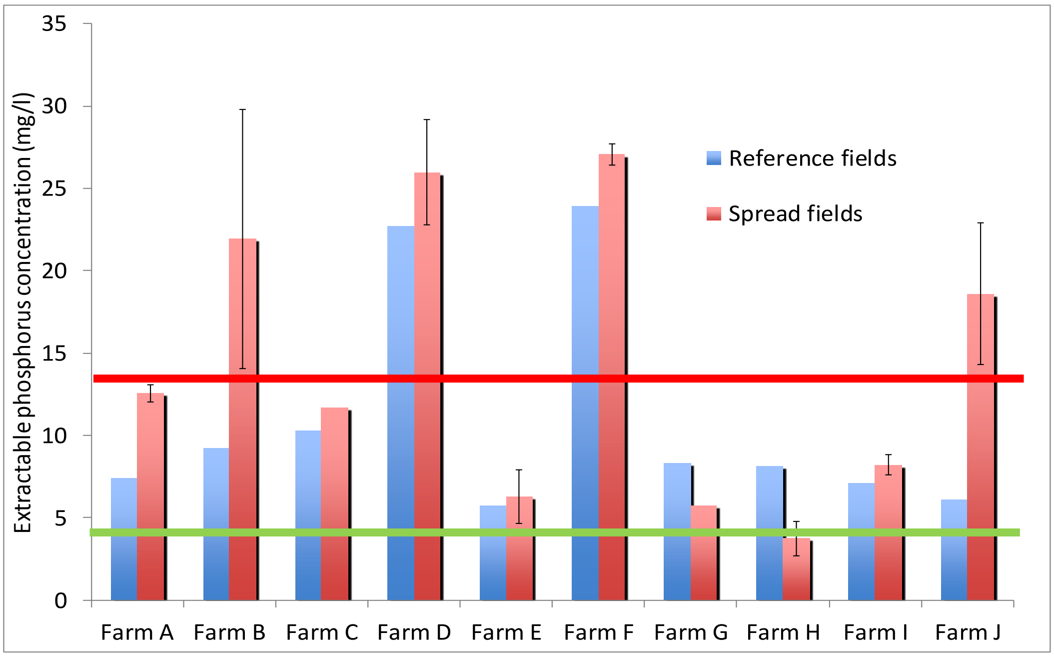


**Figure 4:** Extractable phosphorus concentrations in fields receiving distillery by-products in comparison with reference fields from the same farm under the same land use. The main bar shows the mean concentration and the whiskers show the standard error. The green line represents the lower limit for optimum soil phosphorus concentrations, below which crop growth is likely to be limited, whilst the red line represents the upper limit for optimum soil phosphorus concentrations, above which the growth of most crops will not be increased by further phosphorus additions.

For example, as can be seen in Figure 4, at farms A, C, E and I, additional supply of phosphorus is likely to have a positive impact on crop growth, as background soil phosphorus levels are low to moderate. However, at farms D and F it is questionable whether additional phosphorus provided by the distillery by-product spreading will result in benefit to agriculture, as high background soil phosphorus concentrations will already supply much of the crop requirement. Furthermore, there is a risk that any additional phosphorus could increase soil phosphorus levels further, increasing the risk of impacts on watercourses through leaching and soil erosion, which could transfer the extra phosphorus to surface water or groundwater, with a subsequent negative impact on water quality.

## 4 Conclusion

Two instances of fields where pH and/or concentration of one or more PTE were non-compliant with the requirements of the Sludge Regs were found in 2014, with no instances in 2013. These numbers are similar to those found in previous years.

There were a number of fields spread with organic materials under the WML Regs in which PTE concentrations exceeded the limits in the Sludge Regs. Further spreading in these fields has the potential to cause further increases in levels of some PTEs in soils where these were already high.

The impact of spreading organic material to land on a Scotland-wide basis cannot be discerned from results from SEPA compliance monitoring sampling in 2013 and

2014, due to the variability of soil quality indicator parameters caused by both land management and natural factors. This is a similar result to that found in previous years of SEPA soil compliance monitoring. However, continuing to collect samples over a number of years will increase the number of points in the dataset and increase the likelihood that national analysis will be possible in future.

On an individual farm/ spreading site basis, it is possible to distinguish certain impacts from spreading organic materials, for example spread fields at locations receiving distillery by-products generally had higher soil extractable phosphorus concentration than reference fields.

Regarding new work areas in 2013 and 2014, no consistent impact on soil quality indicators could be determined at farms where chicken manure had been spread to land, however results from a farm where pig slurry had been spread showed that soils in spread fields were higher in extractable phosphorus, zinc and copper concentrations than a reference field.

Overall, results from 2013 and 2014 soil compliance monitoring indicated that soil quality at locations receiving applications of organic materials was generally good, and that organic material spreading had no generally identifiable negative impacts on soil quality.

Where concerns were noted with regard to the possible impact of organic material spreading on soil quality at a specific site, both the farmer/site manager and SEPA Operations teams responsible for the site were notified of the potential issues highlighted by soil sampling.

Alan Cundill on behalf of the SEPA Soil Science Working Group, September 2018

## Annex 1. Discussion of possible reasons for PTE limit exceedance in soils at locations sampled as part of the 2013 and 2014 Soil Compliance Monitoring Campaigns

There were four exceedances of copper, three of nickel, one of lead and five of zinc limits found across ten fields at six spreading locations that were receiving a variety of materials under paragraph 7 Waste Management Licensing Exemptions. Details of these exceedances are outlined below:

Farm 1. Off-specification compost has been spread at this farm for at least 7 years and paper crumble has also been spread previously. Nickel concentrations were above limits in one spread field and were well below limits in the reference field; however the reference field was under a different land use. Operator analysis of both off-specification compost and paper crumble suggest that neither waste contains excessive concentrations of nickel, which suggests that the high concentrations are not due to the waste spreading. In addition, the farm is located in an area of volcanic geology, so is likely to have higher background soil nickel levels than the Scottish average. However, SEPA sampling at this farm conducted in 2007, 2011 and 2013 suggests that nickel and zinc concentrations in fields other than the reference field are generally increasing. There is no obvious explanation for why this may be happening. It is possible that this could be due to farm management practices other than organic material spreading, although an interview with the farm manager did not establish any obvious cause for this.

Farm 2. Distillery by-products have been spread since at least 2009. Limits for copper were exceeded in two spread fields and limits for zinc exceeded in three spread fields that were sampled, however these limits were also exceeded in a nearby reference field under similar land use. It is possible that this may be a result of historic pig slurry spreading (now discontinued) at the farm. The extractable phosphorus concentrations in all soils at the farm were also high, which is often a further consequence of pig slurry spreading.

Farm 3. Distillery by-products and plasterboard had been spread for one year under exemption. Limits for copper were exceeded in one spread field, however copper concentration was in excess of Scottish soil averages in all sampled fields, including the reference field, and also had a high range (36 – 115 mg/kg). It is possible that the high copper concentration in the soil was due to historic spreading of distillery by-products at the farm, before the WML Regs and their predecessors came into force, which would have included spreading on the reference field.

Farm 4. Abattoir waste and sewage sludge had been spread for one year. Two fields where abattoir waste, but not sewage sludge, had been spread were discovered with nickel concentrations in excess of limits. Given the low nickel concentration of the abattoir waste (< 9 mg/kg) and the presence of volcanic rocks underlying these fields, it was concluded that a natural source was the most likely cause of the high nickel concentrations.

Farm 5. Distillery by-products had been spread to land at this farm for many years. Copper concentration in both fields sampled was above expected background levels, however in one field levels were extremely high (311 mg/kg), which is substantially in excess of limits in the Sludge Regs at any soil pH. This is highly likely to be due to historic spreading of distillery waste in the field. It was noted, however, that the field where these high copper levels were found is no longer used for agricultural purposes and has been earmarked for construction of new distillery buildings.