

## Use of the Tellus geochemical dataset to map areas where sewage sludge can be disposed of in Northern Ireland

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### Introduction

Sewage sludge has a fertilising value when applied to agricultural land or forest. However, due to the presence of potentially toxic heavy metals in the sludge, disposal of sewage sludge on agricultural soils in Northern Ireland is subject to an EU directive to protect animal and human health. The Sludge (Use in Agriculture) Regulations (Northern Ireland) 1990 implement the European Communities Council Directive No. 86/278/EEC (OJ No. L181/6) on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture.

Over the period 2004–2006, the Tellus Project measured and assessed the environmental well-being of Northern Ireland using modern mapping techniques (see [www.bgs.ac.uk/gsni/tellus/index.html](http://www.bgs.ac.uk/gsni/tellus/index.html)). There were two aspects to the project, one a geochemical survey, the other geophysical. The geochemical data from the survey were used to map areas of the province where sewage sludge should not be spread.

### Materials and Methods

The Tellus geochemical survey began in the summer of 2004 and was completed in 2006. This survey was a multi-media survey of soil, stream sediment and stream water in rural and urban areas. Rural soils were sampled at an interval of approximately one site per 2 km<sup>2</sup>. Soil samples were taken from two depths (5–20 cm and 35–50 cm) at each site to provide an insight into vertical geochemical variations. Urban soils were sampled at a distribution of four sites per 1 km<sup>2</sup>. Stream waters and stream sediments were sampled at an interval of about one site per 2 km<sup>2</sup>.

Several different accredited laboratories were contracted to analyse the samples for total concentrations of more than 50 elements including Cd, Cr, Cu, Hg, Ni, Pb and Zn. Soil pH was measured on a CaCl<sub>2</sub> extract. The survey followed the British Geological Survey Geochemical Baseline Survey of the Environment (G-BASE) standard developed over many years (Johnson & Breward, 2004). Only data for the upper soil sample were used in this study.

Under the Sludge (Use in Agriculture) Regulations (Northern Ireland) 1990, and for soils with pH greater than or equal to 5.0 only, the specified limit values of concentration of metals (in mg/kg dry matter) for any representative sample, are set out in Table 1.

### Results and Discussion

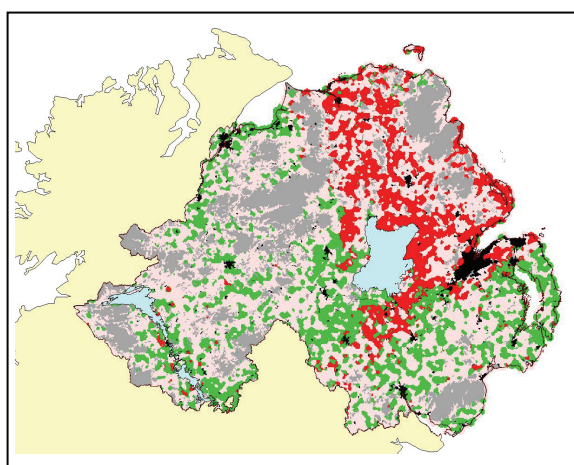
The areas exceeding the limits detailed in Table 1 were identified and an overall map produced (Figure 1) highlighting those areas in Northern Ireland where, under the regulations, sewage sludge should *not* be spread on agricultural soils. The areas excluded due to Cd, Cr, Cu, Ni, Pb or Zn concentrations in the soil being too high were 4, 196, 630, 1833, 8 and 41 km<sup>2</sup>,

respectively. The total area excluded due to metal concentrations in the soil being too high was 1,899 km<sup>2</sup> (coloured red in Figure 1) and most of this was due to excessively high Ni concentrations.

**Table 1.** Limits of heavy metal concentrations in soils

Element	Limit value (mg/kg dry matter) at pH			
	5.0<5.5	5.5<6.0	6.0-7.0	>7.0
Cadmium	3	3	3	3
Chromium <sup>1</sup>	400	400	400	400
Copper	80	100	135	200
Mercury	1	1	1	1
Nickel	50	60	75	110
Lead	300	300	300	300
Zinc	200	250	300	450

<sup>1</sup>DoE, 1996.



**Figure 1.** Northern Irish soils where sewage sludge cannot be disposed of due to (a) heavy metal concentrations (red areas) and (b) soil pH < 5.0 (pink areas). Only the green areas are suited to disposal of sewage sludge. The light grey and black areas represent non-agricultural and urban areas, respectively.

It should be noted that the ‘high’ Ni concentrations are geological in origin, not man-made, as the soils in the area excluded are derived largely from basalt parent material. Moreover, based on the Tellus soil pH data, a further 9,331 km<sup>2</sup> were excluded (soil pH < 5 or the land was non-agricultural).

### Conclusion

The Tellus data illustrate clearly that, under current legislation, only about 20% (2,250 km<sup>2</sup>) of the agricultural land area in Northern Ireland could potentially be used for the disposal of sewage sludge (the green areas in Figure 1). In particular, sewage sludge should not be spread on agricultural or forested land anywhere in County Antrim due, essentially, to the basalt geology of that area.

### References

- Johnson, C.C. & Breward, N. (2004). G-BASE: Geochemical Baseline Survey of the Environment, British Geological Survey, BGS Report CR/04/016N.
- DoE (1996). Code of Practice for Agricultural Use of Sewage Sludge, HMSO, London, May 1996.