greater WELLINGTON
REGIONAL COUNCIL

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Committee **Environment**
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Soil Quality Monitoring 2005-2006

1. Purpose

To inform the Committee of the results of the ongoing soil quality monitoring programme undertaken during 2005/2006.

2. Significance of the decision

The matters for decision in this report do not trigger the significance policy of the Council or otherwise trigger section 76(3)(b) of the Local Government Act 2002.

3. Background

The Regional Policy Statement for the Wellington Region outlines a vision for the future. In relation to soil this vision is:

"The soils are able to maintain their desirable physical, chemical and biological characteristics."

In "*Measuring Up*", the State of the Environment Report for the Wellington Region 1999, we found that we did not have sufficient information in relation to the quality of soils around the region to assess our progress towards this vision.

To remedy this situation a baseline soil quality monitoring programme was established. It was initially part of the national "500 Soils" programme run by Landcare Research. Greater Wellington has continued this programme in the region for the past six years and a total of 118 sites have been monitored.

This report is for the information of the Committee and provides a summary of work that has been done within the State of Environment monitoring programme over the past year. The programme includes monitoring general soil quality indicators on production land along with a more widespread survey

to establish background levels for a range of substances. While some possible trends are noted, no conclusions are drawn because of the long term nature of soil quality changes. A detailed analysis of data will be undertaken within the 2011 State of Environment reporting process.

4. Soil Quality monitoring programme

The Soil Quality monitoring programme follows a Landcare Research approach, which looks at soils in areas thought to be under stress from agriculture practices. The sampling programme began with the most common soil types for each of the predominant land uses on both the Wairarapa and Otaki plains. Intensive uses included dairying, market gardening, cropping, grazing, orchards, and indigenous bush.

The programme included the less widespread soils such as the Bideford, Martinborough and Tauherenikau soils types in the Wairarapa, and the Manawatu and Rahui soils types on the Otaki plains and finally the dominant hill country and steepland soils. See Figure 1 - Sample locations for the Soil Quality Monitoring Programme.

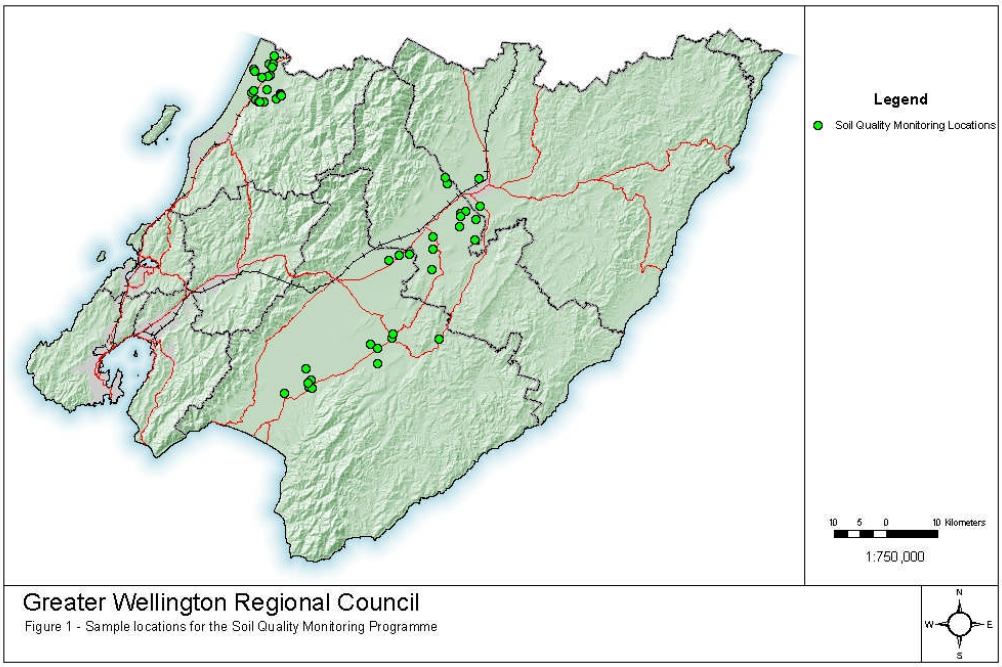

Figure 1: Sample locations for the Soil Quality Monitoring Programme.

We have now established a representative number of sites on each on the soil types and for each of the land uses. To determine trends in soil quality it is programmed to revisit these sites every three to ten years dependant on the landuse. This year the first round of revisits were undertaken. Twenty five sites - dairying and market gardening areas - were visited, sampled and analysed. Although indications of potential trends may be detected over the short time frame between tests, further soil sampling will be needed before any statistically robust trends can be determined.

5. Main findings

5.1 Soil quality

The results of this year's soil quality monitoring showed a similar pattern to those of previous years. Thirty-six percent of the sites sampled met all the soil quality parameters, whilst fifty-two percent had one indicator outside of the target ranges and twelve percent of the sites had more than one indicator outside of the target ranges for that soil and land use.

The most common indicator where results were outside the target range is soil compaction. Forty-eight per cent of the sites surveyed fell outside the target ranges for air capacity, an indicator of soil compaction. Soil compaction is a problem because as the air spaces (macroporosity) in soil are reduced, the infiltration of water and nutrients into the lower soil layers is inhibited. As a consequence, overland flow can increase and there is less recharge of shallow groundwater. Soil compaction resulting in lower macroporosity is normally the result of continuous tracking by heavy machinery or heavy hoofed stock (mostly dairy cattle) grazing in one place for long periods of time.

For the majority of the sites, the soil chemical characteristics were acceptable. However, twenty percent of sites had indicators that fell outside of the acceptable ranges. The soil on a third of the market garden sites had low organic matter content.

Twelve percent of the sample sites within the region had high fertility. Fertility is measured by levels of Olsen-P (plant available phosphate) and total nitrogen content of the soil. The fertility levels at these sites were in excess of the amounts needed for maximum agronomic benefit. By putting too much fertiliser on the soil, farmers can have an adverse effect on the water quality of shallow groundwater aquifers, and lead to excess nutrients in streams where they enhance weed growth.

When the results of this year's monitoring were compared to the result of the previous sampling undertaken, some potential trends were detected. On market garden sites there was a decrease in the total carbon, total nitrogen and mineralisable nitrogen indicating a loss in soil organic matter. Arable cropping sites showed a similar trend to market gardens with an indicated loss of soil organic matter. However there was a reduction in Olsen P, suggesting lower application of phosphate fertilisers to these soils.

On dairy sites there were indications of a small decrease in organic matter, along with increases in nutrient concentrations indicative of higher application rates of fertilisers to these soils. Whilst there was no apparent change in the bulk dry density and particle density, the air capacity had marked reduced indicating the on-going compaction of these soils.

Due to the concerns regarding heavy metal accumulation, an agricultural land heavy metal monitoring was incorporated into the soil quality monitoring programme in 2004-2005. The majority of the soil taken during the preceding years have now been analysed for heavy metal content. The comparison of the results from this year with the previous year's monitoring - where available - indicates a small increase in all metals although further rounds of monitoring will be required to determine any trends. However, there was a marked increase in zinc on most dairy farms. One possible explanation for the increase in zinc concentration is the use of facial eczema treatments for cattle. Possibly of more concern is a cadmium result on a dairy farm exceeding the guideline value[1] of 1mg/kg. Cadmium is toxic and is also a minor component in some phosphate rock based fertilisers. Elevated cadmium concentrations have the potential to impact on the life giving capacity of the soil and limit the potential land uses for this site.

5.2 Background concentration of common contaminants in Wairarapa soils

In the past four years we have sampled five soil groups across the region to determine the background concentrations of common pollutants in the environment. See Figure 2 – Sample locations of background soil survey. These pollutants are natural and sourced from the parent rock or are anthropogenic (man made), but now widely dispersed at low concentrations across the country. The aim of this investigation was to establish the background levels of soil contamination in and around areas where people live and work.

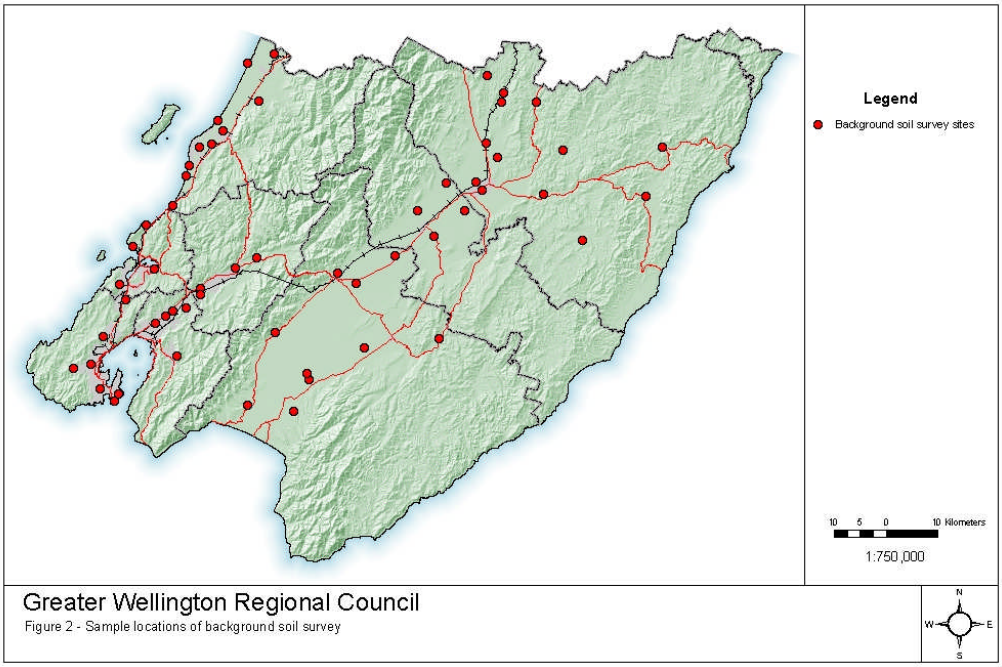

Figure 2: Sample locations of background soil survey.

[1] The result of 1.1 mg/kg exceeds the "Guidelines for Safe Application of Biosolids to Land in New Zealand – New Zealand Water & Waste Association 2003. This guideline value has been developed to prevent exceedance of Food Safety Standards

This year we undertook further sampling on the two soil groups in the Wairarapa. Fourteen sites were selected where anthropogenic affects would not be present or severely limited and these sites sampled and analysed for a range of heavy metals and organic pollutants. The results of the analyses show that the background concentrations of heavy metals are very low when compared to many other regions and all below health and environmental guideline values. See Table 1 - Background soil concentrations ranges of metals in the Wellington Region.

Polycyclic aromatic hydrocarbons (PAHs) were detected at low levels, but did not exceed any health and environmental guideline values. PAHs generally result from combustion processes either naturally, such as bush fires, or from manmade processes including car exhausts and home heating using wood or coal fires.

The sites were also sampled and analysed for a range of organochlorine chemicals. There are no natural sources of these chemicals. However, their widespread application and their persistence in the environment have resulted in their long term presence in soils. DDT and its breakdown products (DDD & DDE) were present at low concentrations in 10 of the fourteen samples and Dieldrin was found in one sample. No other organochlorines were detected in any of the samples.

6. Further work

The Soil Quality Monitoring programme is scheduled to revisit and sample twenty five sites this year. Further sampling for background concentrations of contaminants in the soils in the Hutt Valley and Wellington may be undertaken.

7. Communications

Copies of the results of these investigations will be made available to the land owners, Landcare and Ministry for Agriculture and Forestry.

Table 1: Background soil concentrations ranges of metals in the Wellington Region

		Soil type 1 (Sand)	Soil type 2 (Greywacke)	Soil type 3 (Hutt Alluvium)	Soil type 4 (Wairarapa Alluvium)	Soil type 5 (Mudstone/ Siltstone)
Elements	**Units**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soluble Boron		0.3 - 2.1	0.9 - 2.2	0.3 - 1.6	0.7 - 3.6	0.6 - 2.6
Arsenic		1 - 7	1 - 7	1 - 7	1.8 - 12.3	1 - 4.1
Cadmium		0.05 - 0.3	0.05 - 0.1	0.05 - 0.2	0.02 - 0.21	0.03 - 0.2
Chromium		6 - 15	6 - 16	6 - 18	8.2 - 21	8 - 15.4
Copper		3 - 10	3 - 25	5 - 19	4.1 - 32.7	3.1 - 19
Mercury		0.05 - 0.1	0.05 - 0.2	0.05 - 2.6	0.05 - 0.29	0.02 - 0.14
Nickel		4 - 10	4 - 13	4 - 14	4.1 - 35.3	5 - 13
Lead		3.6 - 13.5	5.9 - 31.2	14.8 - 73.3	6.24 - 65.6	4.7 - 38.1
Zinc		26 - 79	24 - 105	38 - 201	21.6 - 133	29.7 - 72

8. Recommendations

That the Committee:

1. ***Receive** the report; and*

2. ***Note** the contents.*

Report prepared by:	Report approved by:	Report approved by:
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