

# ENVIRONMENTAL CONCENTRATIONS OF CADMIUM IN THE TARANAKI ENVIRONMENT AND IMPLICATIONS FOR POLICY

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## **Summary**

Management of soil quality includes consideration of the potential risk that various contaminants may alter the physical, chemical or biological condition of the soil, or enter the human or animal food chain via ingestion. Taranaki Regional Council has an ongoing soil monitoring programme that has been running since 1998 (originally part of the national 500 Soils project). For land in agricultural use, the underlying concern is that the widespread application of fertilisers, animal remedies, and/or agrichemicals may lead to diffuse source soil contamination with the passage of time.

Repetitive sampling across a variety of sites within this programme indicates that concentrations of cadmium in the region's productive soils appear to have plateaued at levels that are well below those that might pose a risk to human, animal, or soil health. This is at variance with earlier modelling projections, which may be explained by re-consideration of modelling assumptions and inputs. Other investigations undertaken by the Council across groundwater, river water quality, and river sediments, find no evidence that cadmium is at or near levels of concern in any environmental domain.

In the light of these findings, the Taranaki Regional Council finds no justification to pursue regulatory intervention in the management of land use (ie fertiliser application and its consequences) in the region. There is no evidence of an actual or potential risk to human, soil, or ecological health that is not being adequately addressed already through on-going soil monitoring, voluntary controls by industry and users, advocacy, participation in research, and guidance and education. The Council's policy is therefore one of maintaining active monitoring programmes and encouraging farmers and the fertiliser industry to adhere to the national cadmium management strategy.

## **Discussion**

### ***Soil levels of cadmium***

Through participation in the '500 Soils' programme of **1998-2000**, it was found that cadmium levels in the Taranaki region (total Cd) ranged from 0.03 to 1.05 mg/kg, with a mean of 0.47 mg/kg across all topsoils and a mean of 0.52 mg/kg cadmium in dairy soils. Total bio-available cadmium concentrations were orders of magnitude lower (<0.001 to 0.036 mg/kg).

When the potential issue of cadmium accumulation in soil was first raised more broadly elsewhere in New Zealand around 2005, the Taranaki Regional Council conducted an assessment of the historical, current, and potential future scenarios. The key points to emerge from this assessment were that:

- An assessment of historical applications of superphosphate (and the cadmium contained therein) against current soil levels of cadmium indicated that historical rates of accumulation appeared to be only about one quarter, give or take, of those being modelled by Dr Nick Kim at EW;
- On a regional basis, Taranaki along with Waikato had the highest levels of cadmium in pasture [a mean of around 0.5-0.7 mg/kg (depending on dataset)] in New Zealand;
- These levels were well below reference levels for pasture
- Farmers in Taranaki would most likely continue to be significant users of superphosphate, but application rates were much lower than in the past, and levels of cadmium in superphosphate were likewise falling
- Therefore the concentrations of cadmium in soils in Taranaki were not considered to constitute a major immediate or looming environmental risk, nor were they at a level that might affect the health of consumers, now or in the foreseeable future.
- Therefore there was no justification for a regulatory intervention at the time
- But on behalf of its regional community, the Council would support and as appropriate participate in research, working parties, and other initiatives that would identify, quantify, and address any implications arising from the on-going use of superphosphate in New Zealand.

The Council conducted a second soils survey in **2007-2008**, re-sampling sites used in the 1998-2000 survey. It was found that there was no evidence of an increase in cadmium across the region as a whole or within individual land uses, other than at two plantation forestry sites (increase).

The Council repeated the soils survey again in **2012-2013**. Again it was notable that there was no evidence of any trend in cadmium concentrations across the region or within any land use. No site was found to be above 1.4 mg kg<sup>-1</sup>, and only one site was found to be above 1.0 mg Cd kg<sup>-1</sup>, the same result as in the 2007 survey. Generally cadmium levels were highest on grazed pastures (but there was little distinction between dairy pastoral soils and drystock, market gardening, and cropping soils) and lowest within plantation forestry and indigenous forestry soils.

Importantly, in the latest survey, the number of sites in the lowest tier of the Tiered Fertiliser Management System increased by 4 between 2007 and 2012, from 11 (55%) to 15 (75%); the number of dairy farms in the lowest tier increased from zero to 4 (out of 7); the number of dairy farms showing a reduction in cadmium (4) out-numbered the number of dairy farms showing an increase in cadmium (3); and the number of sites showing a reduction of more than 0.01 mg Cd kg<sup>-1</sup> out-numbered the number of sites showing an increase, by 11: 5. The overall average change found in this survey was a **reduction** of 0.06 mg Cd kg<sup>-1</sup> in 5 years, but very wide variations in the extent of change over 5 years were found at each individual site (from an apparent increase of 0.23 mg Cd kg<sup>-1</sup> to an apparent decrease of 0.39 mg Cd kg<sup>-1</sup>). This suggests in turn wide variability in soil concentrations across paddocks and/or significantly varying outcomes for soil cadmium levels depending on individual on-farm soil and fertiliser management.

### ***Groundwater levels of cadmium***

An initial investigation into cadmium concentrations in shallow Taranaki groundwater was conducted by the Taranaki Regional Council (the Council) in 2009. Samples of groundwater were obtained from 12 sites across Taranaki and analysed for cadmium concentrations. All samples analysed returned cadmium concentrations less than the laboratory detection limit of

0.005 mg/L. It was recommended that further cadmium sampling be conducted as part of a planned region-wide groundwater nitrates monitoring survey five years later.

In line with the recommendations made following that initial cadmium in shallow groundwater survey, a follow-up survey was undertaken over the period from late June to mid July 2015. Samples were collected from 30 shallow wells (<15 m total depth) in conjunction with the Council's established nitrates in shallow groundwater monitoring programme. The 30 groundwater sites sampled are geographically distributed across the region, with the majority of sites located in intensively farmed areas (being those with heaviest and longest fertiliser use). Cadmium analysis was carried out with a detection limit of 0.0001 mg/L (0.1 parts per billion). Figure 1 illustrates the location of monitoring sites sampled as part of the 2015 survey.

Of the 30 samples collected as part of the 2015 survey, 27 samples returned cadmium concentrations of less than the laboratory detection limit of 0.0001 mg/L, or more than 40 times below the New Zealand Drinking Water Standard. The highest cadmium concentration detected was 0.0006 mg/L, which is still an order of magnitude lower than the MAV for cadmium in drinking water of 0.004 mg/L.

#### ***River sediment levels of cadmium***

Sediment samples were collected at or in close proximity to eleven river sites routinely used the purpose of regional state of the environment monitoring (SEM) of surface water quality by the Council. No cadmium was detected (at a detection limit of 0.1 mg/kg) in any sample. The Australia and New Zealand Environment and Conservation Council investigation trigger guidelines for sediment are 1.5 mg/kg (ISQC- low level- 10% probability of effects) and 10 mg/kg (ISQC- high level ie 50% likelihood of effects )<sup>1</sup>. Taking into account the concentrations of cadmium in soil that have been found (see above), it was noted that this indicated there was no evidence of accumulation of cadmium in stream sediments within the region, and that levels that were present, were highly unlikely to cause adverse ecological effects .

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<sup>1</sup> Australian and New Zealand Guidelines for Fresh and Marine water Quality 2000, Table 3.5.1

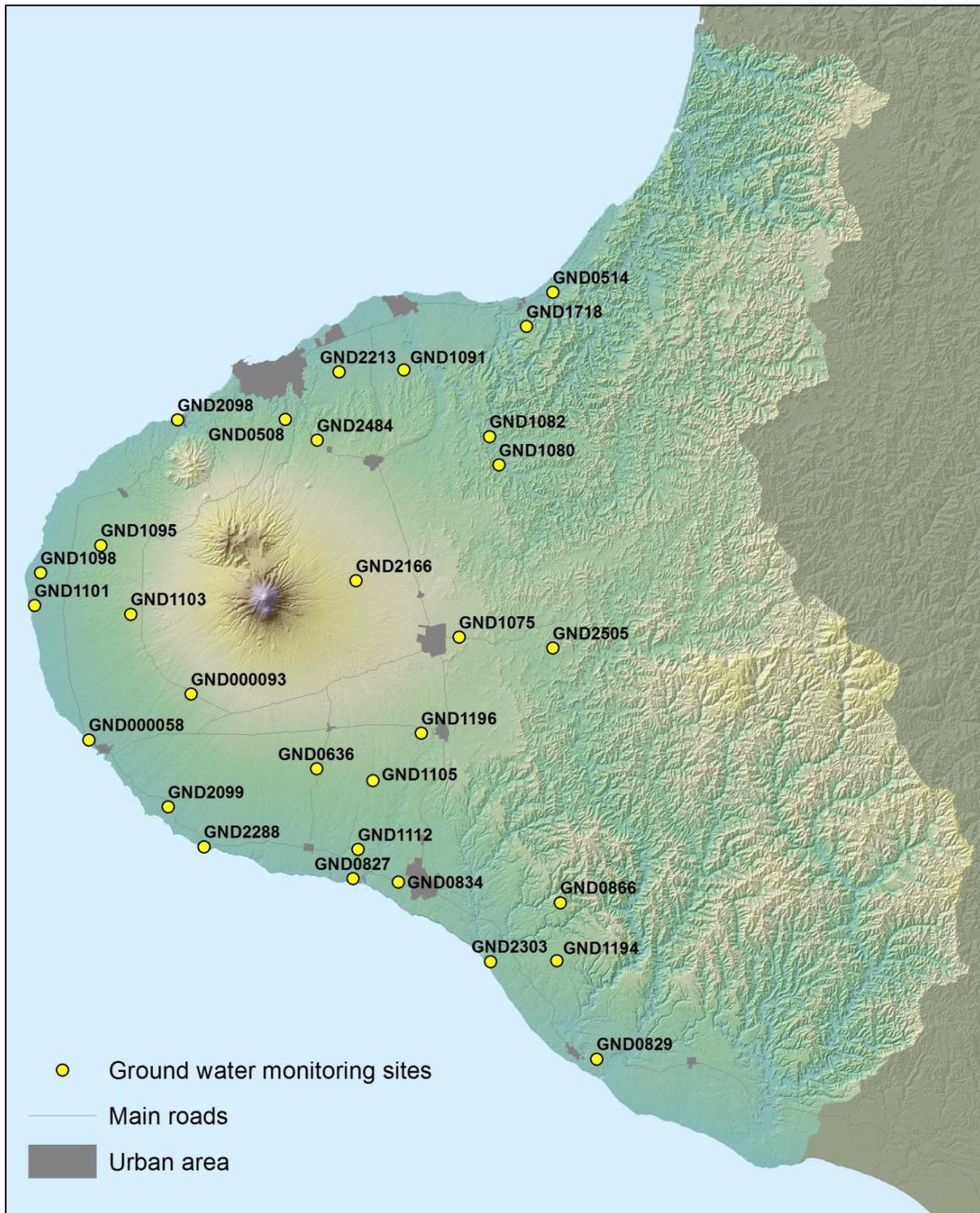


Figure 1: Location of groundwater sites monitored for cadmium during the 2015 survey

## **Policy implications**

The Taranaki Regional Council finds no justification to pursue regulatory intervention in the management of land use (ie fertiliser application and its consequences) in the region. There is no evidence of an actual or potential risk to human, soil, or ecological health that is not being adequately addressed already through on-going soil monitoring, voluntary controls by industry and users, advocacy, participation in new research into soil ecological health, pasture uptake, and accumulation in animals via soil and pasture ingestion, and guidance and education. The Council's policy is therefore one of maintaining active monitoring programmes and encouraging farmers and the fertiliser industry to adhere to the national cadmium management strategy.

In its Regional Soil Plan for Taranaki (2001), the Council had noted:

With respect to fertiliser use, a national survey of pastoral soils analysed for five metallic elements (arsenic, cadmium, copper, lead and zinc), found that only cadmium showed any significant accumulation in soils in New Zealand. Cadmium levels are currently 14% and 17% of the Australia New Zealand Environmental Conservation Council's investigation level (the level for carrying out further investigations) for sheep/beef and dairying soils respectively. Cadmium concentration levels in Taranaki soils are therefore not at levels to warrant concern. However, the Taranaki Regional Council intends to continue to promote appropriate land management practices and monitor soil contaminants of particular concern (for example, cadmium and DDE) through the testing programmes currently being undertaken.

This approach was reviewed and updated at the time of preparation of the Regional Policy Statement (2010). The objectives, and policies, and their methods of implementation, are set out below.

Regional Policy Statement (2010) objective re soil contaminants:-

Current soil contamination issues relate to the risk of certain contaminants altering the physical, chemical or biological condition of the soil and entering the food chain.<sup>2</sup> Diffuse source soil contamination is a side effect associated primarily with the widespread application of fertilisers and agrichemicals – whether through the primary active ingredient (agrichemical residues) or a by-product (eg, fluoride and cadmium). Investigations in Taranaki show that there are no significant levels of fertiliser or agrichemical residues in Taranaki soils that pose a risk to human or animal health. However, there is potential for adverse effects as a result of inappropriate land management practices applied over time.

### *Objective*

#### **HSO OBJECTIVE 1**

To maintain soil health in the Taranaki region by maintaining soil nutrients at appropriate levels and avoiding or minimising soil compaction and soil contamination caused by inappropriate land management practices.

### *Policy*

Sustainable land management practices

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<sup>2</sup> Soil contamination may occur in other ways such as when chemicals are spilt or disposed of incorrectly, from the use, transportation or storage of hazardous substances and contaminated sites (these sources are addressed separately in section 5.3 below).

## HSO POLICY 1

Encourage land management practices that:

- (a) avoid, remedy or mitigate soil compaction and residual soil contamination, and maintain soil nutrients at appropriate levels;
- (b) safeguard the life supporting capacity of soils;
- (c) maintain and optimise soil versatility and productivity; and
- (d) protect human and animal health.

### *Explanation of the policy*

Policy 1 recognises that, while soil structural degradation, nutrient depletion and residual soil contamination are not of immediate concern in Taranaki, there is a long term risk that irreversible degradation in soil health may occur if appropriate land management practices are not adopted or continued to address soil compaction and residual soil contamination, and to ensure that soil nutrients are maintained at appropriate levels (not too high, not too low).

### *Methods of implementation*

The Taranaki Regional Council will:

HSO            Maintain a **regional plan or plans** with objectives, policies and methods of  
METH 1       implementation that address soil health.

HSO            Provide **advice and information**, including guidelines to landowners and  
METH 2       resource users to:  
                  (a) promote recognition of soil health issues;  
                  (b) encourage the adoption of practices and techniques that maintain soil  
                  nutrients at appropriate levels and avoid, remedy or mitigate soil  
                  compaction and residual soil contamination; and  
                  (c) encourage the use of industry recognised guidelines, New Zealand  
                  Standards or codes of practice and other relevant industry guidelines  
                  that promote sustainable soil management, such as: *NZS8409: 2004  
                  Management of Agrichemicals* (developed by NZ Agrichemical  
                  Education Trust and published by Standards New Zealand), and the  
                  *Code of Practice for Nutrient Management 2007* developed by  
                  FertResearch.

HSO            **Advocate**, as appropriate:  
METH 3       (a) to industry that they reduce or avoid the use of those elements in  
                  agricultural compounds that have the potential to cause residual soil  
                  contamination;  
                  (b) to industry that they establish or continue to revise standards in relation  
                  to the use of agrichemicals, fertilisers, or other agricultural compounds;  
                  (c) to the farming community that they incorporate soil health and nutrient  
                  budgeting within their on-farm environmental management systems;  
                  (d) and to government departments or agencies that they introduce, or  
                  amend, regulations in relation to the importation of or manufacturing  
                  standards associated with the use of agrichemicals, fertilisers, or other  
                  agricultural compounds as they relate to soil health issues.

HSO            **Monitor and gather information** on the state of soil health, pressures on  
METH 4       soil health, and management responses to soil health issues.

Territorial authorities may wish to consider the following method:

HSO            **Control**, through appropriate provisions in district plans, or conditions on  
METH 5       resource consents, land use for the purpose of preventing or mitigating any  
adverse effects of the use of hazardous substances where such control is  
necessary and appropriate to achieve the purpose of the Act.

*Principal reasons for adopting the objective, policies and methods*

The objective, policies and methods of implementation establish a policy framework for soil health issues in the Taranaki region. Their aim is to increase awareness of soil health issues and promote sustainable land management practices that minimise the risk of any long-term degradation of soil health in Taranaki.

Given that there are no immediate soil health issues in the Taranaki region, the policies and methods focus on non-regulatory methods such as information and advocacy. Regular monitoring will provide information on any changes in soil health status or trends. The policies and methods build on current approaches to this issue and their efficiency and effectiveness and their benefits and costs have been appropriate to date.