

5.0 Comparison with International Guidelines

5.1 Introduction

A variety of international soil criteria exist for dioxin against which the results of this study may be compared. Several soil criteria and their basis are set out in Appendix C.

Most of the soil criteria do not have statutory force, but are issued as guidelines in recognition that:

- ∴ The science is not definitive.
- ∴ The assumed exposure scenarios are conservative assumptions of what might occur in reality.
- ∴ Exposure on a site will vary on a case by case basis depending on the land use and the receptors present on the site.
- ∴ The measurement of contaminant concentrations in soil is not an absolute process, with, for some situations, concentrations potentially varying over short distances.

While a result in excess of a guideline criteria may indicate a potential for a health risk to occur, it should not be immediately assumed that a health risk will eventuate. Any risk will be relative to the exposure assumed in the derivation of the guideline and the exposure likely in the actual situation. The guidelines set out in Appendix C are for a residential (and in some cases parkland) scenario in which long-term frequent exposure through soil ingestion, and in some cases ingestion of produce grown on site, inhalation of dust and dermal contact with soil, is assumed. Exposure as a child is factored in. Residential exposure scenarios will result in lower guideline values than an industrial exposure scenario, where only adults are considered, the exposure duration and frequency is restricted to working hours and the opportunity for and degree of exposure to soil is less.

Some guidelines assume a tolerable daily intake (TDI), based on animal studies in which a “no observable adverse effects level” (NOAEL) in the animals concerned is factored down, generally by several orders of magnitude, to take account of experimental and interspecies uncertainty.

For human carcinogens, some guidelines assume there is no threshold TDI below which no effects will occur, but adopt the approach that there is some low frequency of cancer end points that is “acceptable”. The USEPA uses this approach for carcinogens, adopting an incremental cancer risk in a lifetime of 10^{-6} (1 in 1,000,000) on the basis that this will result in a cancer risk of 10^{-4} to 10^{-6} for exposure to the mixtures of chemicals typically found on Superfund sites (USEPA, 1996a). Superfund sites are major, federally listed contaminated sites in the US.

In New Zealand, for setting soil guidelines the Ministry for the Environment and the Ministry of Health have adopted a similar approach to the USEPA with respect to carcinogens (MfE/MoH, 1997, MfE, 1997, 1999), but have assumed a cancer risk of 10^{-5} (1 in 100,000). The MoH have also used a cancer risk of 10^{-5} in setting drinking-water

standards. This cancer risk is in the middle of the range that the USEPA considers acceptable.

Many soil criteria documents use terms such as “screening level” and “action level”, which may or may not be tied into local regulatory practices. Typically a screening level is a trigger to carry out further investigation at a hazardous waste site (ATSDR, 1998, USEPA R9, 2000), but it is not considered a remediation level. An action level would typically trigger some sort of intervention, but not necessarily remediation. Other intervention could include site-specific exposure assessments, behaviour modification for occupants or institutional controls to prevent sensitive site uses. This is consistent with the concept of the soil criteria being guidelines, rather than regulatory numbers.

5.2 Guidelines Used for this Study

Five different guidelines have been chosen for comparison with the results of this study, as set out in Table 9 below.

Table 9: Residential soil guidelines (ng/kg)		
Country	Guideline	Comment
New Zealand guideline (MfE/MoH, 1997)	1,500	I-TEQ – Interim guideline currently under review
Germany (BMU, 1999)	1,000	I-TEQ - Action level
USEPA (Fields, 1998)	1,000	TEQ
EPA Region 6 (2001) & Region 9 (2000)	39 ¹	2,3,7,8-TCDD
US ATSDR (ATSDR, 1998)	50 1000	TEQ – Screening Level TEQ – Action Level
1. Set at 3.9 ng/kg for a one in a million cancer risk. Figure of 39 ng/kg is adjusted value for 1 in 100,000 cancer risk, consistent with other NZ guideline values.		

The United States has a number of different guidelines promulgated by both state and federal agencies. The Federal EPA, the primary agency for developing regulations for soil in the US, has a preliminary remediation goal (PRG) of 1,000 ng TEQ/kg for residential soil. In response to a number of EPA regions setting their own criteria, the Office of Solid Waste and Emergency Response has issued a directive stating that this level (i.e. 1000 ng TEQ/kg) is to be generally used as a PRG for dioxin in surface soil at residential sites (Fields, 1998).

Two USEPA regional offices have issued their own, very much lower, risk-based guidelines for 2,3,7,8-TCDD - Region 6 and Region 9. Both these guidelines have similar derivations, being consistent with the Soil Screening Guidance: User's Guide and Technical Background Document (USEPA 1996a,b), and combine exposure from ingestion, dermal contact and inhalation of dust. To make the values consistent with the

New Zealand approach of using a cancer risk of 1 in 100,000 the USEPA Region 6 and 9 guideline values have been multiplied by 10 in Table 9 (see Appendix C). The Region 6 and 9 values are considered to be screening values which, if exceeded, indicate further investigation, rather than remediation, is required.

Canada has recently issued a revised residential/parkland soil guideline to replace the interim soil quality criterion set in 1991. The new value of 4 ng TEQ/kg (CCME, 2001) is not an effects-based value, but is based on a policy decision to classify dioxin as “toxic” under the Canadian Environmental Protection Act. As such, dioxin is slated for virtual elimination and the guideline has been set at a value considered to be representative of the mean background concentration of dioxins in Canadian soils. The same value also applies to agricultural, commercial and industrial land. The supporting documentation notes that the soil quality guidelines for dioxins are considered to be management levels, rather than levels that are protective of human or environmental health, because the guideline is not effects based. Accordingly, it is not considered appropriate to compare the results of the current study with the Canadian guideline, as the guideline does not provide a measure of the health risk posed by a value exceeding the guideline.

5.3 Guideline Comparison and Risk Assessment

The results reported in Section 4 are compared with the five guideline values in Table 6. A comparison is also made in histogram form in Figure 12.

The histogram shows all but one of the results fall below both the USEPA Region 6 and Region 9 guidelines and the ATSDR guideline. All values fall below the New Zealand, German and Federal USEPA criteria by large margins.

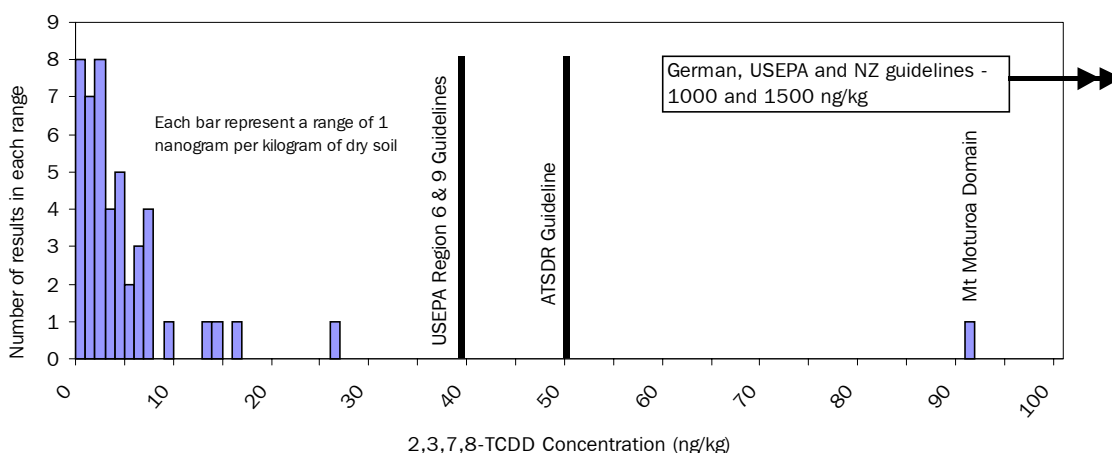


Figure 12: Histogram of 2,3,7,8-TCDD results showing guideline values

The single result (92 ng/kg) that falls outside the USEPA Region 6 and 9, and ATSDR guidelines is the sample from the west-facing slope of Mount Moturoa Domain, a recreational reserve. The MfE result (Buckland *et al.*, 1998) from elsewhere on the Domain (31.2 ng/kg TCDD,) complies with these guidelines. The dioxin concentration collected for the community action group (as reported in the Daily News, Appendix B), and all the TRC samples collected on residential and reserve land, are also below the Region 6 and 9 and ATSDR screening guidelines.

Examining the spatial distribution of the results from the current study (Figure 12), it is reasonable to conclude that, for the residential area of Paritutu, apart from part of the west-facing slopes of Mount Moturoa Domain, the surface soil can be expected to have 2,3,7,8-TCDD (and TEQ) values less than the USEPA Region 6 and 9 screening values.

The land immediately to the west, and below Mount Moturoa, towards the Dow plant is in industrial use (see Figure 2), for which the residential criteria does not apply. The USEPA Region 6 screening values for indoor and outdoor industrial workers are 200 and 540 ng TCDD/kg, respectively (adjusted for the New Zealand cancer risk of 1 in 100,000). All the earlier sampling (Appendix B) of industrial land, whether within or outside the Dow property, gave 2,3,7,8-TCDD concentrations that were below the upper value and all but one result were below the lower value.

Within Mount Moturoa Domain there is likely to be an area with 2,3,7,8-TCDD concentrations in excess of the USEPA Region 6 and 9 and ATSDR guidelines. The extent of this area is not known. It is considered that the concentration at Site O5 (Sample SS#05; 92 ng TCDD/kg) will be close to the maximum expected, given that the sample was taken from the highest and most westerly point of Mount Moturoa. The "leading edge" of Mount Moturoa is expected to intercept an air-borne plume travelling from the Dow Plant to a greater degree than any other point to the east of the plant. Previous sampling on Mount Moturoa measured a 2,3,7,8-TCDD concentration markedly lower than that recorded in the current study (Buckland, *et al.*, 1998).

It is appropriate to consider the likely exposure to soil of users of the Domain, in considering whether concentrations in the order of 100 ng TEQ/kg present a risk to recreational users (noting that only part of the Domain will have concentrations of that magnitude, as demonstrated by the markedly lower MfE sample (Buckland *et al.*, 1998)). The Domain has little if any exposed soil, being well covered by grass. Thus the opportunity for exposure to soil will be less than a residential situation with exposed soil in gardens. Further, the residential exposure scenario used in the derivation of the USEPA Region 6 and 9 guideline assumes exposure for a large part of each day for 350 days over a 30 year duration, in a 70 year lifetime.

While it is conceivable that an individual might visit the Domain every day for many years, the duration of daily exposure is likely to be at least an order of magnitude less than the residential situation. The lower opportunity for soil exposure afforded by the grass cover reduces the probability of exposure further. It is therefore considered that a reasonable screening level for a recreational user of Mount Moturoa Domain would be at least an

order of magnitude higher than the residential scenario, that is, 390 ng 2,3,7,8-TCDD/kg, and possible higher. On this basis, the likelihood of an area on Mount Moturoa Domain having 2,3,7,8-TCDD concentrations (or TEQ) in excess of this level is considered to be extremely remote, and consequently there is no need to investigate the Domain further.

The concentrations measured around the western edge of the Domain suggest the possibility of 2,3,7,8-TCDD concentrations being somewhere in the range between 90 ng/kg and about 20 ng/kg (i.e. falling within the concentrations measured in samples SS#05 and SS#09) in the three or four residential properties on the north-west side of Mount Moturoa, in Port View Road. Concentrations are likely to be lowest at the base of the hill, and increase with elevation and more westerly aspect.

Considering the site-specific characteristics of the Port View Road properties, there appears to be little opportunity for exposure to soil, as these properties have multi-unit flats surrounded by mostly paved surfaces. A high-density residential exposure scenario would therefore be more appropriate than the standard residential scenario, with an appropriate guideline being at least a factor of two higher (the Australian soil guidelines suggests a factor of four, NEPC 1999) than for the standard residential guideline. On that basis, there is no need to investigate these properties further.