BEFORE THE ENVIRONMENT COURT **ENV-2006-CHC-000455**

BETWEEN **OTAGO REGIONAL COUNCIL**

Applicant

AND **F URQUHART FARMLANDS LIMITED**

First Respondent

AND **ALLAN GRAY** and **EVELYN MAY GRAY**

Second Respondents

AND **CENTRAL TIMBER TREATMENT LIMITED**

Third Respondent

AND **RAYMOND JOHN JOHNSTON**

Fourth Respondent

AND **MARTIN JAMES CORNISH** and **KERRI LYNN CORNISH**

Fifth Respondents

AFFIDAVIT OF NADARAJA SELVARAJAH
Sworn **2007**

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AFFIDAVIT OF NADARAJA SELVARAJAH

I, **NADARAJA SELVARAJAH** of Dunedin, Director Resource Management, swear that:

Qualifications and Experience

1 I hold a Bachelor of Agricultural Science with honours majoring in Soil Science from the University of Peradeniya, Sri Lanka and a Doctor of Philosophy in Soil Science obtained from Lincoln University, New Zealand.

2 For nearly 11 years from 1981 I gained experience in teaching and conducting tutorials and laboratory demonstrations for undergraduates in Chemistry, Physics and Soil Science. During this period I undertook research into various aspects of Soil Science. From December 1992 to December 2000 I worked for the Waikato Regional Council as a Soil and Water Scientist, Manager for Agriculture and Forestry Programme and Manager for Water, Air and Resource Utilisation Programme. Since 2001 I have worked for the Otago Regional Council as Director Resource Management. Since 1981 I have also been a practising scientist with more than 35 scientific research papers in the field of soil, effluent and water chemistry. I am a member of the New Zealand Soil Science Society, New Zealand Hydrological Society, New Zealand Institute of Agricultural Science, Royal Society of New Zealand and Senior Executive Forum of the New Zealand Water & Waste Association. In 1997 I was awarded "Leading Professional" status by the New Zealand Institute of Agricultural Science and Australian Institute of Agricultural Science and Technology, and NZIAS Science Award in 2000 by New Zealand Institute of Agricultural Science.

3 I have read the code of conduct for expert witnesses in the Environment Court practice note (31 March 2005). I agree to comply with this code of conduct. This evidence is within my area of expertise except where I state that I am relying on information from another person. I have not omitted to consider facts known to me that alter or detract from the opinion I express.

Scope of Evidence

4 In this evidence I will provide technical opinion on the affidavit filed by the first respondent's consultant Clive Rivers.

Clive N Rivers' Affidavit

5 I refer to paragraph 28 of the affidavit of Clive Rivers which states that a thorough assessment of the potential risks to either human health or the environment posed by the material should be in place before deciding the removal of the material. He further stated that had such a detailed study been undertaken, the likely actual risks posed by the remaining material would be demonstrated to be relatively low. I disagree with his statements for the following reasons:

6 I will address the health or environmental risks associated with leaving the hazardous waste on the 481 Camp Hill Road site. The dumped hazardous waste contains a timber treatment chemical called CCA which contains copper (Cu), chromium (Cr) and arsenic (As).

7 A large proportion of remaining hazardous waste is sawdust and bark. I estimate the area where the contaminated sawdust and bark are present is at least 7 m x 10 to 15 m. The depth of contaminated material could be at least 30 cm. Therefore my rough estimate of the contaminated sawdust and bark is anywhere between 20 and 30 m^3. The soil sample field sheets submitted with Martin King's affidavit indicate that sites 1 and 2 were sampled mainly from the contaminated sawdust and bark material at depths of 300 and 200 mm respectively. The above samples also contained stones and hence the contaminant levels analysed may be lower than those from a sample without stones.

8 Table 1 indicates the results of laboratory analysis of samples from site 1 and 2.

9 **Table 1. CCA levels in sawdust and bark**

Sites	Total As	Total Cr	Cr VI	CrIII	Total Cu
1	153	99	<2	99	62
2	121	95	<2	95	52

Levels are in mg/kg dry weight.

10 The relative environmental and health risk associated with As, particularly ground water contamination, is more than that posed by Cr and Cu and hence I focus on the risks of As contamination.

11 Arsenic in the environment exists in two main forms, i.e. arsenate (AsO_4^{3-} or $HAsO_4^{2-}$) and arsenite ($HAsO_4^{2-}$); the latter is more toxic and mobile than the former, although both forms will leach. Decaying sawdust has a potential to provide a reducing environment and hence a proportion of the As may be in the form of arsenite.

12 There are several factors that can contribute to As leaching. The predominant factors are forms of As, soil iron oxide content, organic matter, pH, clay or silt content, anoxic soil conditions, and rainfall.

13 Michelle Baker identifies in her affidavit that the site soil is gravelly and very permeable. The ground water table is at or around 8 m depth. The bore water in the area is used for potable purposes.

14 Typically gravelly soils with high permeability lack iron oxides, clay and silt. High presence of clay, silt and iron oxides will slow down the leaching of As. I believe that there is a substantial mass of As present in the dumped hazardous waste. I will now use the As level of 153 mg/kg sawdust, the dry matter 50 g/ 100 g (derived from the laboratory sheet "B" attached to Martin King's affidavit), an estimate of bulk density as 0.45 for moist saw dust to estimate the amount of As present at the site.

15 As I stated, there is an estimated 20 to 30 m^3 of contaminated sawdust at the 481 Camp Hill Road site. Using the bulk density I estimate the wet weight of the sawdust to be 9.0 to 13.5 tonnes. Using the dry matter of 50 g/100 g I estimate the dry weight of the sawdust at the site to be 4.5 to 6.75 tonnes.

16 Using the As level of 153 mg/kg dry matter I now estimate the total As present at the site as 0.69 to 1.03 kg. I estimate the area affected by As as 100 m^2. From this I estimate the loading of As being 69 to 103 kg As/ha. This loading of the As and the non-reactive and porous status of the soil profile at the site indicate there is a long-term risk of contaminating deeper soil and ground water at and beyond the site.

17 There is substantial information on leaching of As from much lower loading of As. For example Robinson *et al*, 2006 showed that at a loading rate of 17 kg As/ha from CCA treated vineyard posts, a substantial amount of As leached in a three year period in a shallow silt loam overlying gravel. They did not discount the possibility of CCA reaching ground water at the trial site.

18 In New Zealand, the Provisional Maximum Acceptable Value (PMAV), or standard, for arsenic in drinking water is 10 µg/L (parts-per-billion) (Ministry of Health, 2005). Referring to the As drinking water standard level the Environment Waikato Technical Report 2006/14 states "…*this level of exposure, where experienced over an extended period, is still associated with a reasonably high lifetime excess cancer risk of 1 in 300 for bladder and lung cancers (National Research Council, 2001), and 1 in 1700 for skin cancers (Ministry of Health, 2005). By comparison, the usual tolerable excess cancer risk for New Zealand is regarded as 1 in 100,000 (Ministry for the Environment and Ministry of Health, 1997). The standard therefore defines a tolerated upper limit for arsenic in drinking water, but it is apparent that most protection of the general population still relies on the fact that concentrations in drinking water are usually much lower than 10 µg/L, most of the time. In addition to regulatory limits, for contaminants with no known benefit such as arsenic the As Low As Reasonably Achievable (ALARA) principle is usually adopted as the desirable policy position*…".

19 Bearing in mind the above view, I am not surprised that the Waikato River water As (23 µg/L) is treated to 2.2 µg/L (drinking water supply level) by the Hamilton City Council (Environment Waikato Technical Report 2006/14).

20 It must be noted that since the required level of As in water is measured in parts per billion only a small quantity of As is required to pollute ground water. If a 'pollute up to level' of 2.2 µg As/L is used, in order to pollute a cubic metre of water only 2.2 mg of As is required. Even if half of the estimated As present at the site leaches into the ground water this will be 345 to 515 g for the site which will require a water volume of 156,000 to 234,000 m^3 to dilute As to 2.2 µg As/L. Whilst it is not possible for all leached As to reach the ground water at one time, the above estimate illustrates the serious long term risk to the ground water.

21 I believe that the unconfined shallow aquifer at the site would not offer a large amount of dilution required to sustain the potable quality of water. To provide this in the perspective of the local aquifer, assuming a saturated thickness of 5 m and a specific yield of 0.2 there will be 10,000 m^3 in a one hectare area. I must

note that it is misleading to use 2.2 µg As/L as 'pollute up to level' because in reality the community that uses ground water in the area have the right to expect zero As in ground water which is the current status of the ground water in the area (paragraph 11 of Michelle Baker's affidavit indicates that As in the neighbour's bore water is below detection limit). If such a cautious approach is adopted the risks from As leaching is much higher.

22 To illustrate the high potential for leaching at the site in question I have also used a risk screening system provided in the MfE Contaminated Land Management Guidelines (2004). According to these guidelines, when using such a screening system, factors such as toxicity, quantity, mobility, containment, flood potential, ground water pathway, depth to hazard, surface cover, soil permeability, water use and land use could be considered. Since there is high weighting accorded to the toxicity of As, shallow unconfined ground water, porous and chemically un-reactive soils, agricultural land use and the potable use of ground water, I conclude the long-term risks of leaving hazardous waste at the 481 Camp Hill Road site are high.

23 I conclude that the hazardous waste present at the 481 Camp Hill Road site will pose further contamination of deeper soils and a long term contamination of the ground water in the area. Therefore I strongly recommend that the hazardous waste be removed as soon as possible. The longer period the hazardous waste is left on site the larger the soil clean-up that will be required.

24 **References**

The references in this affidavit are:

(a) Contaminated Land Management Guidelines (2004). Risk Screening System. No.3, Ministry for the Environment.

(b) Environment Waikato Technical Report 2006/14.

(c) Ministry of Health. (2005). *Drinking-water Standards for New Zealand 2005*. Wellington: Ministry of Health.

(d) Robinson, B, Greven, M, Green, S, Sivakumaran, S, Davidson, P and Clothier B. 2006. Leaching of copper, chromium and arsenic from treated vineyard posts in Marlborough, New Zealand. *Science of the Total Environment*, 364, 113-123.

Sworn at Dunedin this)
day of 2006)
before me:-)

Nadaraja Selvarajah

A Solicitor of the High Court of New Zealand