Mercury Inventory for New Zealand: 2012

Report to the Ministry for the Environment

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Executive Summary

This report provides an inventory of the annual distribution of mercury and mercury-containing goods and materials in New Zealand, from anthropogenic (man-made) sources. It has been produced under a contract to the New Zealand Ministry for the Environment.

The inventory has been prepared generally in accordance with the guidance provided in the UNEP *Toolkit for identification and quantification of mercury releases* (the Toolkit), which aims to assist countries to build a knowledge base that identifies the sources of mercury releases in their country and estimates or quantifies the releases. This information is expected to assist in decision-making with regard to possible control measures on mercury releases; in communicating with stakeholders; and in monitoring changes over time.

The latest version of the Toolkit was published in April 2013 and has been used to provide the basic framework for this work. The methodology involves the collection of activity data for a wide range of possible mercury sources, coupled with calculations to determine the quantities of mercury brought into, or mobilised, within the country (the **Inputs**), and the quantities of mercury released into the different environmental compartments of air, water, land, and releases in wastes or in products (the **Outputs**).

The required activity data was obtained through published information sources and direct contact with government agencies, importers, manufacturers, industry associations, and regional and local councils, as appropriate. The reference year for this inventory is the 2012 calendar year, and the activity data for that year has been used wherever possible. The activity data was converted into mercury inputs and outputs using either locally available factors (such as the mercury content of a material, or a measured mercury emission rate) or the Toolkit default factors when local information was unavailable.

Estimated mercury inputs and outputs

The primary results of this assessment are summarised in Table ES1 on the next page (the numbers in brackets are the averages of the indicated ranges).

By far the greatest quantities in the inputs column are for category 9, waste disposal. However, describing these as inputs is not really correct – they would be better considered as secondary or down-stream inputs, in that they are the result of many of the past and current outputs from all other categories, plus contributions from indirect sources, such as mercury in foods and in airborne dust. A similar distinction applies to the inputs from waste incineration, metal recycling and cremations and burials. To assist with this distinction, the totals have been separated out into 3 different groupings in Table ES2.

Apart from the waste category, the next highest input is from primary metal production and, in particular gold mining. In this case, the bulk of the inputs and outputs are associated with the extraction of very large volumes of mercury-containing ore, which is processed to remove the gold and silver, and then 90% of it is returned to the land. It is debateable whether this should be regarded as a true mobilisation of mercury.

Table ES1: High-level summary of mercury inputs and outputs for 2012*

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
1. Extraction and use of fuels/energy sources	291 – 2,295 (1,293)	234.9 – 1,913.1 (1,074)	46.8 – 121 (83.9)	3.8 – 25.4 (14.6)	<0.01 – 3.7 (1.9)	5.3 – 231.2 (118.3)
2. Primary (virgin) metal production	1,310.5 – 2,681.9 (1,996)	74.3 – 184.9 (129.6)	33 – 58 (45.5)	1,133 – 2,258 (1,696)	50 – 100 (75)	20.3 – 80.9 (50.6)
3. Production of other minerals and materials	45.7 – 251 (148)	5.0 – 6.8 (5.9)	-	39 – 241.5 (140)	2.16 -2.9 (2.5)	-
4. Intentional use of mercury in industrial processes	-	-	-	-	-	-
5. Consumer products with intentional use of mercury	133.1 – 354.9 (244)	3.5 – 15.7 (9.6)	0.98 – 9.8 (5.4)	0.9 – 8.8 (4.8)	40.2	87.4 – 280.4 (183.9)
6. Other intentional product/process uses	205	5.8	26.5	-	90	82.8
7. Production of recycled metals	317	0.7	-	-	315	1.3
8. Waste incineration	20.8 – 190 (105.4)	20 – 189.2 (104.6)	-	-	-	0.8
9. Waste deposit/landfill and wastewater treatment	2,829 – 31,570 (17,199)	25 – 250 (137.5)	164.3 – 3,287.5 (1,726)	65.7 – 1,314 (689.9)	-	98.5 – 1,971 (1,034.8)
10. Crematoria and cemeteries	30.1 – 120.4 (75.2)	19.1 – 76.2 (47.7)	-	11 – 44 (27.6)	-	-
Totals, all groups	**5,182 – 37,986 (21,584)**	**388 – 2,642 (1,515)**	**272 – 3,503 (1,887)**	**1,253 – 3,892 (2,572)**	**498 – 552 (525)**	**296 – 2,649 (1,473)**

(* The totals in the table may not exactly equal the sum of displayed data, due to rounding)

Table ES2: High-level summary grouped by primary and secondary sources*

Category	Mercury Inputs, kg/year	Mercury Outputs, kg/yr				
		Air	Water	Land	Product	Waste
Total for groups 1 to 6	1,985.4 – 5,788.1 (3,886.8)	323.4 – 2,126.3 (1,224.8)	107.3 – 215.2 (161.2)	1,176.2 – 2,533.7 (1,854.9)	182.7 – 237.1 (209.9)	195.8 - 675.4 (435.6)
Totals for groups 7, 8 and 10	367.9 - 627.4 (497.7)	39.7 – 266 (152.9)	-	11 – 44.2 (27.6)	315	2.2
Total for group 9	2,828.5 – 31,570 (17,199)	25 – 250 (137.5)	164.6 – 3,287.5 (1,726)	65.7 – 1,314 (689.9)	-	98.5 – 1,971 (1,034.8)
Totals, all groups	**5,182 – 37,986 (21,584)**	**388 – 2,642 (1,515)**	**272 – 3,503 (1,887)**	**1,253 – 3,892 (2,572)**	**498 – 552 (525)**	**296 – 2,649 (1,473)**

(* The totals in the table may not exactly equal the sum of displayed data, due to rounding)

Several reservoirs and stocks were also noted at various points through the report, but have not been included in the table because they should not be classified as inputs or outputs. Instead, they are summarised below:

Existing stocks

Thermometers:	26.7 – 267 kg, with a mean of 147 kg
Switches and relays:	170 kg
Manometers/gauges:	270 kg
Laboratory chemicals:	260 kg (including elemental mercury)
Total identified stocks:	727 – 967 kg, with a mean of 847 kg

Addition to reservoirs

Landfills	2,475 – 24,748 kg per year, with a mean of 13,612 kg

It should be noted that the figure shown for landfills is simply the annual addition to the existing landfill reservoirs that will have been accumulated over many years.

The following mercury exports were also noted. These have been included in the high-level table, so should be subtracted from the relevant totals.

Mineral oil	5 kg
Gold mining wastes	55 kg
Lamps	3 kg
Pharmaceuticals (vaccines)	24 kg
Recycled mercury	240 kg
Total exports:	327 kg

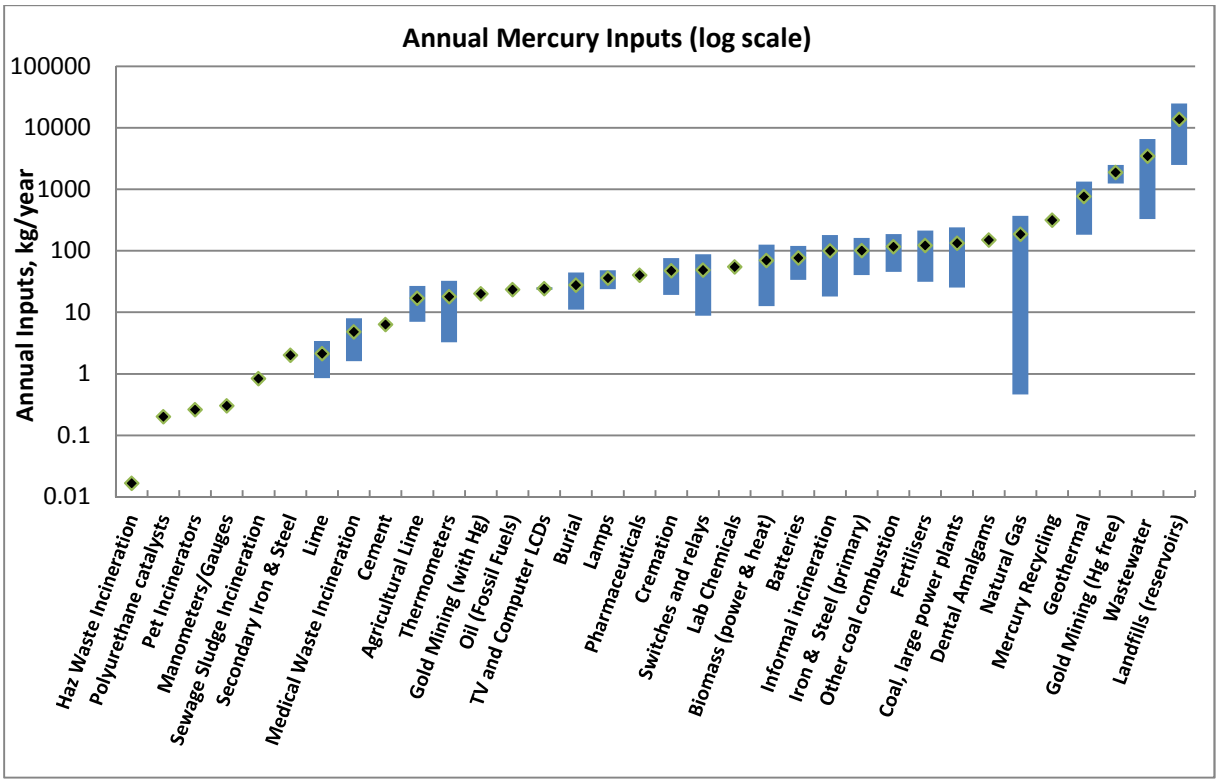
The relative inputs from each of the individual sources identified in the inventory are illustrated in Figure ES1, with the size of each bar giving an indication of the level of uncertainty associated with each estimate.

Output distribution by source category

The distributions of outputs to air, water, land, waste, and in products, are summarised in a series of charts given in Section 14 of this report. (It should be noted that the waste disposal category was excluded from all these charts to avoid having the presentations dominated by this secondary category). The key points noted from these charts are as follows:

- The outputs to air are dominated by fuel/energy use, especially geothermal, and to a lesser extent, primary metal production and waste incineration.
- The outputs to water are dominated by fuel/energy use and, to a lesser extent, primary metal production.
- The outputs to land are dominated by gold mining but this has been excluded from the chart.
- The outputs via products are dominated by the production of recycled metals, but with other significant contributions coming from other intentional products/processes, primary metal production and consumer products.
- The outputs to wastes are distributed across 4 categories, in the following order of decreasing significance: consumer products, fuel/energy use, other intentional products/processes, and primary metal production.

Figure ES1: Annual mercury inputs by individual sources



Relevance to the proposed convention requirements

Some of the findings from this inventory are relevant to a few of the specific requirements under the proposed text for the Minamata Convention, and these are noted briefly in section 14.3 of the report.

The 2008 Mercury Inventory

A previous Mercury Inventory for New Zealand was published by the Ministry for a base year of 2008 (the 2008 Inventory Report). The work was based around the use of an earlier version of the UNEP Toolkit, and there are some significant changes between the 2008 estimates and those presented here. The differences between the two estimates and the reasons for these are discussed at the end of each source sub-section in this report.

Overview of mercury inputs, outputs, reservoirs and stocks

An overview chart of the flows of mercury into and within the New Zealand environment is shown in Figure ES2. The key points to note from this are as follows:

Mercury inputs

- Approximately 600 kg of mercury is brought into New Zealand each year though imported fuels, manufactured articles and chemicals, as shown in the top left box.
- A further 3,270 kg of mercury is mobilised within New Zealand each year, through the extraction, processing and use of fuels, energy, metal ores and minerals (see middle-left box).
- Some mercury is also mobilised from the existing reservoirs of mercury. These are indicated in the top right box in the figure and include mercury-containing articles currently in use; the mercury stored in our bodies and in the general environment; and mercury taken up into food. The total amounts of mercury stored in these reservoirs is unknown, apart from the estimated 847 kg stored in some articles

in storage and in use (eg. thermometers, switches and relays, sphygmomanometers, lamps) and laboratory chemicals.

- One of the mobilisation routes for these reservoirs is the recycling of scrap metal and liquid mercury, which together contribute 335 kg to the total annual inputs (see the centre top box).
- The total annual mercury inputs to New Zealand via all of the above pathways are about 4,205 kg, as shown in the centre box.

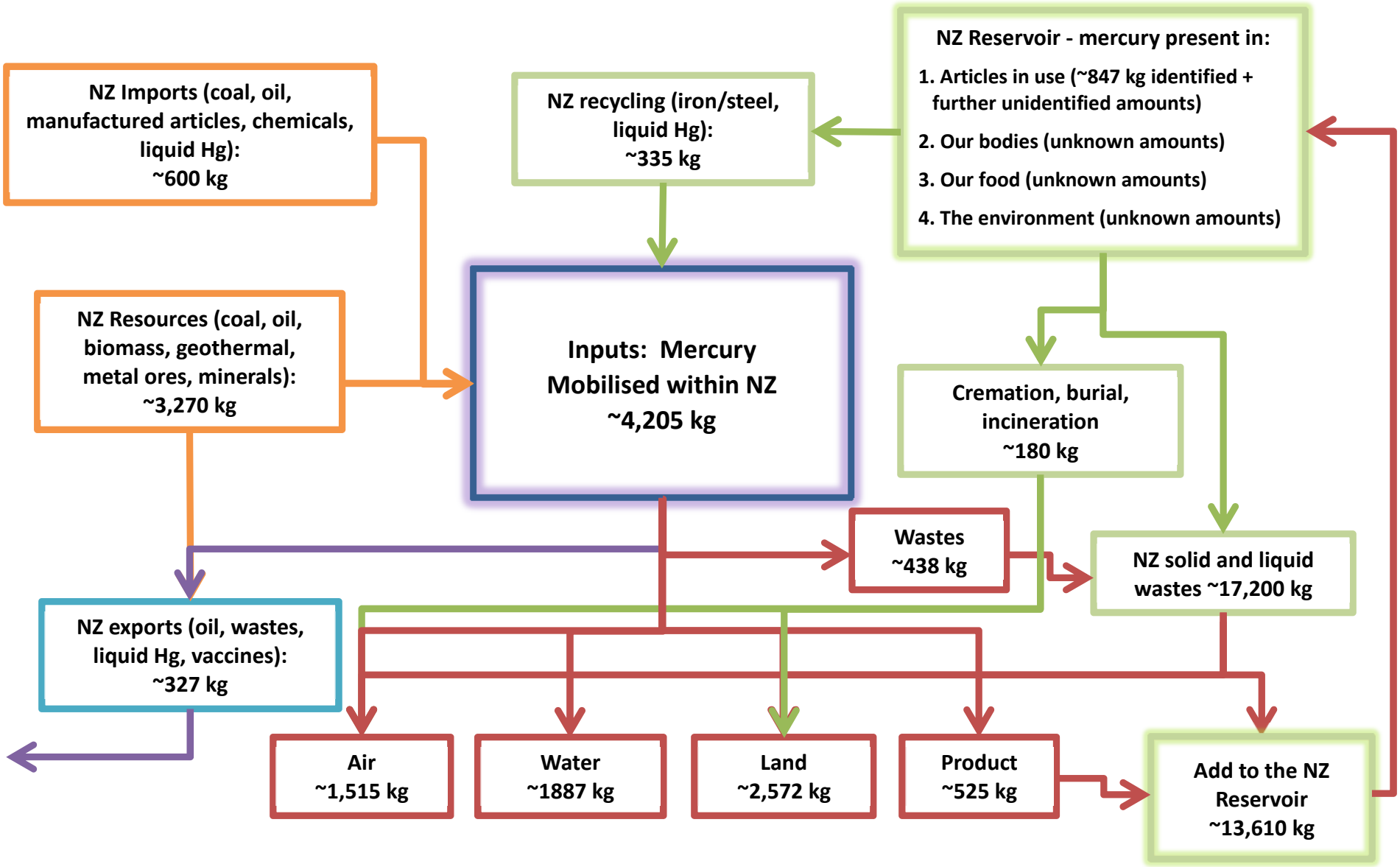
Mercury outputs

- The processing, use and disposal of the fuels, minerals, manufactured articles, and chemicals that contribute to the total mercury inputs, leads to the various outputs to air, water, land, and in products and in wastes, that are shown at the bottom of the chart.
- The burial and cremation of human bodies also contributes to these outputs (middle right box).
- In addition, there are significant mercury outputs, especially to water, land and wastes, through municipal solid and liquid waste streams, with the mercury coming primarily from the existing reservoirs (lower middle right box).

Stocks, reservoirs and exports

- Most of the outputs in products and in wastes remain in the New Zealand environment and therefore contribute further to the existing stocks and reservoirs shown in the top right box in the figure. However, there is also some exporting of products and wastes (bottom left box), which leads to a reduction in the overall mercury stocks.

Figure ES2: Overview of mercury flows into and within New Zealand



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