NATIONAL WASTE DATA REPORT

This report is a summary of the data available on waste in New Zealand. It is the first report of this kind to have been published, and is written for organisations and individuals who have an interest in waste management in New Zealand.

May 1997

MINISTRY FOR THE ENVIRONMENT
MANATŪ MŌ TE TAIAO

Acknowledgments

We would like to express our appreciation for the assistance and support provided by Margaret Bailey, Chris Patterson and Patricia Blutner for reviewing the draft report.

We would also like to acknowledge the many people we contacted directly to provide waste data and to assist in our understanding of their data. In particular, we would like to thank Chris Patterson and Jenny Holdt for aggregating landfilled waste data on the basis of the Landfill Census and the WAP surveys.

Finally, we wish to acknowledge all those who have contributed to the monitoring and analysis of waste in New Zealand and hope that their work will encourage others to do the same.

FOREWORD

This report represents a major step forward in our understanding of waste generation and disposal in New Zealand. Historically policy makers have been severely constrained by the lack of good information.

The purpose of the first National Waste Data Report is to gather and summarise all reliable data available on waste in New Zealand. The report is written for organisations and individuals who have an interest in waste management in New Zealand, including the Ministry for the Environment, regional councils, district/city councils, industry, waste contractors, the public and environmental groups. This is the first attempt to present comprehensive and quantitative waste data, in particular regarding solid waste.

The report provides an overview of available data and highlights those areas where robust data is available or lacking. The report will be used for a number of purposes, such as:

- to review the effectiveness and focus of current policies;
- to provide a basis for the development of environmental indicators as part of the *National Environmental Indicators Programme*;
- to identify information gaps and accuracy problems; and
- to provide a benchmark upon which to measure progress nationally and regionally.

This report represents a first snapshot. It should be acknowledged that this picture is still blurred in places (e.g. hazardous waste). Nevertheless, we are committed to repeating the national report every five years so that trends can emerge.

In the meantime, we have requested the Ministry for the Environment to provide advice over the next few months on the implication this new information has for the Government's current waste policies.

There is much more information to be derived from this report. We look forward to using this report and subsequent reports to ensure that our policy decisions and those of waste managers are soundly based.

Hon Simon Upton
Minister for the Environment

Hon Deborah Morris
Associate Minister for the Environment

Executive Summary

The first *National Waste Data Report* is written for organisations and individuals who have an interest in waste management. It presents data on the generation and management of waste in New Zealand. The data is presented in relation to the form or media in which waste is generated; that is, solid, liquid, gaseous and hazardous waste.

Solid waste includes all waste that is generated in a solid form or converted to a solid form for disposal. The solid waste chapter provides data on landfilled waste, and limited data on cleanfilled waste, litter, waste disposed at sea, recycling, and reduction. The data highlights that:

- in 1995, approximately 3,180,000 tonnes of waste was landfilled in New Zealand of which approximately 1,420,000 tonnes is residential waste and approximately 1,760,000 tonnes is industrial waste;
- organic waste is the largest proportion of waste going to landfills and the largest proportion in residential rubbish bags and bins;
- paper and construction and demolition waste represent the next largest categories, although the construction and demolition waste disposed of into cleanfills is probably much greater than that disposed to landfills;
- potentially hazardous waste represents 8% of landfilled waste;
- packaging is estimated to be between 10-14% of the waste going to landfills;
- an estimated average of 401 kg of residential waste is generated per capita in 1995, which is 20% less than the average of OECD countries;
- the total quantity of litter has declined from 1986 to 1994;
- it is estimated that more than 80% of the New Zealand population has access to one or more recycling schemes for paper, aluminium or glass.

Liquid waste includes all waste that is generated or converted to a liquid form for disposal. The liquid waste chapter provides data on wastewater and public water treatment plants drawn from the National Wastewater Treatment Plant Database, and limited data on point source and non-point source liquid waste. The main data include:

- the estimated average daily flow of New Zealand influent at wastewater treatment plants lies between 1.1 and 1.5 million cubic metres/day. In per capita terms this flow (0.41 cubic metres/capita/day) is about average internationally;
- sewage and waste water requiring treatment is generally much stronger (in terms of biochemical oxygen demand, BOD) compared to other developed countries;
- the main source of nitrogen discharges into surface water is agriculture;
- the major point sources of organic pollution (BOD) discharges into surface water in New Zealand are meat processing factories and farm dairies (cow sheds).

Gaseous waste includes small particles that can be carried by air, and gases in its associated forms, including dust, smoke, fumes, mist, and vapour. The gaseous waste chapter reports data on greenhouse gases, incineration facilities, and the Auckland Air Emissions Inventory. The main data include:

- emissions of all greenhouse gases have increased between 1990 and 1995, with the exceptions of methane and nitrous dioxide;
- agriculture was the main source of methane and nitrous dioxide emissions in 1995;
- transport was the main source of carbon dioxide, nitrogen oxides, carbon monoxide and non-methane volatile organic compounds in New Zealand in 1995.

Hazardous waste includes information on the acceptance of hazardous waste at New Zealand landfills, regional hazardous waste surveys in the Auckland region and the Otago region, regional hazardous waste collections, exported hazardous waste, the Used Oil Recovery Programme, and contaminated sites and soil clean-up. Main data include:

- 92% of New Zealand landfills do not accept hazardous waste;
- liquid waste (mainly trade waste) represented about 98% of hazardous waste generated by 609 businesses in the Auckland Region in 1995;
- the vast majority of hazardous waste in the Auckland region in 1995 was generated by businesses in the manufacturing sector;
- approximately 142,000 tonnes of hazardous waste (solid waste component) was handled by final disposal facilities in the Auckland Region in 1995, of which the majority was landfilled;
- New Zealand approved the import of 15,000 tonnes of hazardous waste and the export of 14,701 tonnes of hazardous waste in 1995;
- over 8,000 sites were identified as potentially contaminated in 1992.

The key issues identified in this report are:

Waste definitions
- a wide variety of waste definitions exist in New Zealand;
- waste definitions are inconsistently used in the absence of a set of legal or nationally agreed waste definitions;

Waste monitoring methods
- a number of methods are used to monitor waste;
- waste monitoring is mostly undertaken on an ad hoc basis around New Zealand;
- the *Waste Analysis Protocol* an important attempt to provide a uniform method to monitor waste, is not used consistently;

Waste data
- comprehensive data are scarce and reliability can often not be determined;
- national waste data are scarce, especially for hazardous waste, recycling, and gaseous waste;
- aggregation is often impossible because different definitions are used;
- the gathering of data is complicated by the fact that nobody is required to provide information about quantities of waste generated, treated and disposed;
- the gathering of data at a national level is difficult as most monitoring and data gathering is undertaken by local authorities;
- in the past few years there has been an increase in waste monitoring, in particular at a regional and local level.

The Ministry for the Environment has been asked to report on the policy implications of the *National Waste Data Report*. In May and June 1997 the Ministry will review whether the data indicate that any changes in priorities, different approaches or additional effort are required to achieve the Government's policy goals. This means analysing what the information is telling us about environmental problems and their causes, considering who is best placed to make any changes, and what role the Government has. This is likely to result in better policy advice and improved targeting of the Government's initiatives.

The data presented and the framework adopted in this report will also be used as the basis for developing environmental indicators for waste, hazardous substances and contaminated sites, as part of the *National Environmental Indicators Programme.*

Further work will also be required to ensure that information on waste is improved over the next few years. Only through monitoring can the effectiveness of the Government Waste Management Policy be gauged. This analysis will occur through:

- a review and extension of the *Waste Analysis Protocol*;
- development and implementation of the national environmental indicators.

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1. INTRODUCTION

1.1. Purpose of this report

This *First National Waste Data Report* gathers together and summarises all reliable data available to the Ministry for the Environment regarding waste in New Zealand. This is the first report to present quantitative waste data, particularly for solid waste. It should therefore be of real interest to New Zealand's waste stakeholders. This is a major step forward in New Zealand waste management.

Although comprehensive waste data are lacking in New Zealand, the report provides an initial overview of available data and highlights those areas where robust data can be found. While the Ministry for the Environment has included all the data available to it for this report, there will still be other material which it has not been able to access. The Ministry therefore would be grateful to receive any material readers may feel would contribute to the next Waste Data Report.

The report will be used by the Ministry for the Environment to review policy effectiveness and identify policy implications regarding waste management in New Zealand. The data presented and the framework adopted in this report will also be used as the basis for developing environmental indicators for monitoring waste, as part of the *National Environmental Indicators Programme* [Ministry for the Environment, 1995(a)].

Knowing how much, which types, why, and by whom waste is generated and disposed of in New Zealand is an essential step towards the goals stated in the *Environment 2010 Strategy* [Ministry for the Environment, 1995(b)] and in implementing the actions specified in the *Government's Waste Management Policy* [Ministry for the Environment 1992(a)].

1.2. Policy framework

In the *Environment 2010 Strategy* and the *Government's Waste Management Policy*, the New Zealand Government has committed to a number of goals and actions regarding the management of waste, contaminated sites and hazardous waste. In addition, the *Coalition Agreement* key commitments relevant to the waste data report are summarised below.

Objectives of the *Government's Waste Management Policy* include:

1. *"to ensure that, as far as practicable, waste generators meet the costs of managing the waste they produce";*
2. *"to encourage implementation of the internationally recognised hierarchy of reduction, reuse, recycling, recovery and residual management (the "5 Rs") by waste producers."*

A priority action which has been agreed for implementation of the *Government's Waste Management Policy* is to create a national waste data set using the Waste Analysis Protocol.

The *Environment 2010 Strategy* takes a longer-term view of New Zealand's environmental priorities and Government's approach to management. The vision for the New Zealand environment to 2010 is: "a clean, healthy and unique environment, sustaining nature and people's needs and aspirations". This vision is supported by 11

goals. One of these goals is *"managing waste, contaminated sites and hazardous substances by:*

- *managing waste to reduce risks to environmental quality and public health to levels that are widely agreed as being socially acceptable;*
- *cleaning up contaminated sites to reduce risk to the environment, people and the economy;*
- *managing or preventing the harmful effects of hazardous substances in order to protect the environment and well-being of people and communities so as to enable the maximum net national benefit to be achieved."*

Specific actions required to achieve the above goals on waste include:

- implementing the Government's "generator pays" policy for producers of waste to provide clear incentives for resource users to apply the waste hierarchy: **reduce, reuse, recycle, recover, manage the residual**;
- promoting minimisation of residential waste (e.g. through "green" labelling);
- establishing waste reduction targets with major industry groups and bringing about a progressive reduction in the quantity of waste requiring treatment or disposal;
- designing and establishing systems that will hold resource users accountable for effective waste reduction and management;
- achieving high standards of waste disposal (e.g. by encouraging all regional and territorial authorities to adopt the Landfill Guidelines);
- achieving high standards for the land disposal of sewage sludge (e.g. by encouraging all local authorities to adopt the Ministry of Health Guidelines.

Actions required to achieve the hazardous substances and hazardous waste goals include:

- promoting an assessment of contaminated sites on the basis of risk, and removing barriers to clean-up;
- identifying hazardous waste, and appropriate management strategies for them, starting with those wastes that pose the highest risk.

Key policy initiatives in the *Government's Coalition Agreement* in the environment area include:

- developing national standards and guidelines for landfills, solid waste disposal, and hazardous waste disposal, including a timetable for the phasing out of hazardous, toxic and bioaccumulative substances;
- working with waste producers to reduce waste at source (seek to reduce solid waste production to half the 1990 level by the year 2000) and to encourage reuse and recycling;
- phasing out persistent chemicals such as organochlorines by the year 2000 and working with the agricultural sector to develop alternatives;
- establishing a national register to record uses of pollutants and chemicals in agriculture, horticulture and industry.

As a complementary document to *Environment 2010*, the Ministry for the Environment will produce a *First New Zealand State of the Environment Report* (1997(a)) which describes the state of New Zealand's natural environment, impacts and modifications to it and actions to address this. The purpose of the *First New Zealand State of the Environment Report* is to establish a baseline record of the state of the New Zealand environment, and to provide an information base for environmental education, debate, and decision-making on issues of environmental monitoring, management and reporting.

A national *Environmental Indicators and Monitoring Programme* to improve understanding of the environment, and how activities affect it, is currently being developed for New Zealand by the Ministry for the Environment. Core sets of indicators

are being identified, the first being for land, water and air. Indicators for other issues will subsequently be developed, including for:

- waste, hazardous waste and contaminated land
- indigenous habitat and biodiversity
- pests, weeds and diseases
- fisheries resources
- energy
- climate change
- transport.

The intention is to have a core set of indicators in place by the turn of the century, so the environment can stand alongside economic and social considerations in the development of sound environmental policy and equitable laws in the new millennium.

To further assist in achieving the Government's environmental goals outlined in *Environment 2010*, the Ministry for the Environment established the Sustainable Management Fund (SMF) in 1994. A number of waste management projects have been funded through the SMF. A list of funded waste-related projects is provided in Appendix I.

The legislative framework is provided by the Resource Management Act 1991, the Hazardous Substances and New Organisms Act 1996 and the Local Government Act. Specific reference to waste is made in the Local Government Amendment Act (Number 4) 1996, which requires local authorities to consider the waste hierarchy and develop a waste management plan for the district based on the hierarchy. It also gives specific powers to make by-laws, for example, to license collectors.

1.3. Stakeholders

A large number of organisations and individuals have an interest in waste management in New Zealand. Stakeholders include the Ministry for the Environment, regional councils, district/city councils, industry, waste contractors, the public and environmental groups. Figure 1.3.1 summarises the major stakeholders, their main interests and concerns regarding waste management and waste information. The arrows to indicate the influences between these stakeholders

1.4. Report structure

Chapter 1 provides the background to this report, while Chapter 2 summarises key waste definitions which are fundamental to the consistent interpretation and gathering of waste data in New Zealand.

The structure adopted for Chapters 3-5 is based on the form or media in which waste is generated. The data is therefore presented in relation to solid waste (Chapter 3), liquid waste (Chapter 4) and gaseous waste (Chapter 5). As hazardous waste is generated in the form of solid, liquid and gaseous waste it is discussed separately in Chapter 6, and includes waste generated from the clean-up of contaminated sites. This format minimises repetition as far as possible and should prove easy to follow for readers.

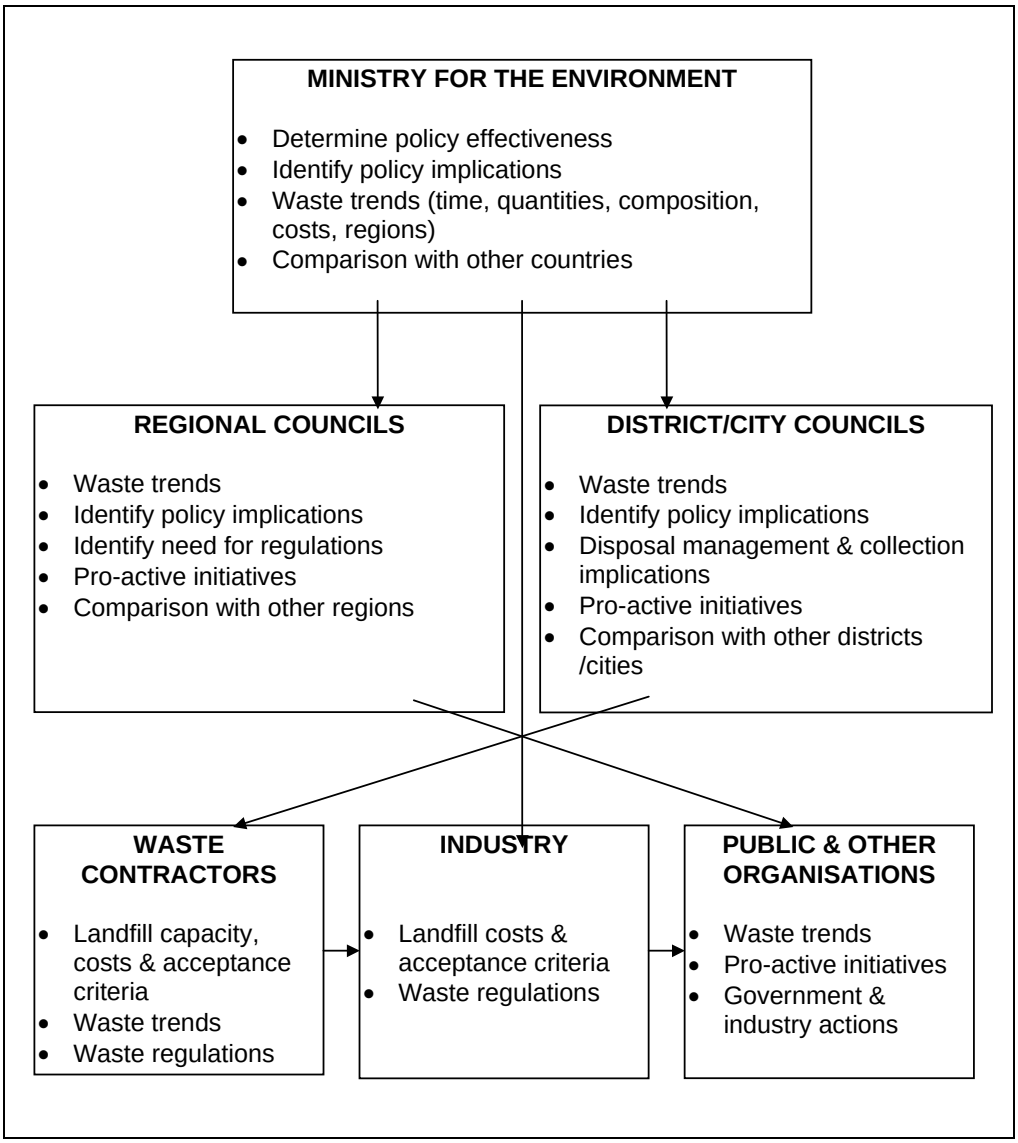


Figure 1.3.1 Stakeholders of the First National Waste Data Report.

Where possible, figures and tables have been included in the body of the report to provide easier interpretation of the available data. More detailed tables, figures and background information are provided in the appendices.

Definitions are given as they occur throughout the text. Most of these are contained in Chapter 2. A Glossary of Acronyms and Abbreviations appears on page 83.

2. WHAT IS WASTE?

2.1. General definition of waste

The Organisation for Economic Cooperation and Development (OECD) defines waste in general terms as:

> *"unavoidable materials for which there is currently or no near future economic demand and for which treatment and/or disposal may be required".*

The United Nations Environment Programme (UNEP) defines waste as [United Nations et al, 1995]:

> *"objects which the owner does not want, need or use any longer, which require treatment and/or disposal".*

There is no legal definition of waste in New Zealand. Although the purpose of this report is not to establish a standard set of waste definitions for New Zealand, it is important that data presented in this report are interpreted accurately and consistently.

Various organisations have used different terms and definitions to classify waste. This report aims to present the data using the same waste terms and definitions. Where data presented in this report are based on different definitions, this will be indicated.

Figure 2.1.1 shows an integrated model of waste generation, disposal and dispersion in the environment. The model addresses waste in the following sequence:

- the **form** in which waste is generated: solid, liquid or gaseous. Hazardous waste is treated as a separate category as it is generated in solid, liquid and gaseous form;
- the **source** of waste: residential or industrial;
- **transport** of waste or **direct release** into the environment;
- the **waste management method**, including
  - disposal to land: public, private landfilling, or littering;
  - disposal to air: controlled incineration, open burning or direct disposal to air (e.g. vehicle exhaust gases);
  - disposal to water: treatment at wastewater treatment plants, or direct disposal to surface waters and coastal waters;
  - other: recycling, storage or export of waste;
- the **dispersion** or **transfer** of waste between land, air and water.

This model is a useful way to capture and consider the forms and flow of waste and is consistent with the Resource Management Act 1991 (RM Act) with regard to disposal to land, water and air, and with the Waste Analysis Protocol (WAP). The RM Act is concerned with the effects of activities and controls discharges to air, land and water. The WAP classifies waste according to its source rather than its disposal method.

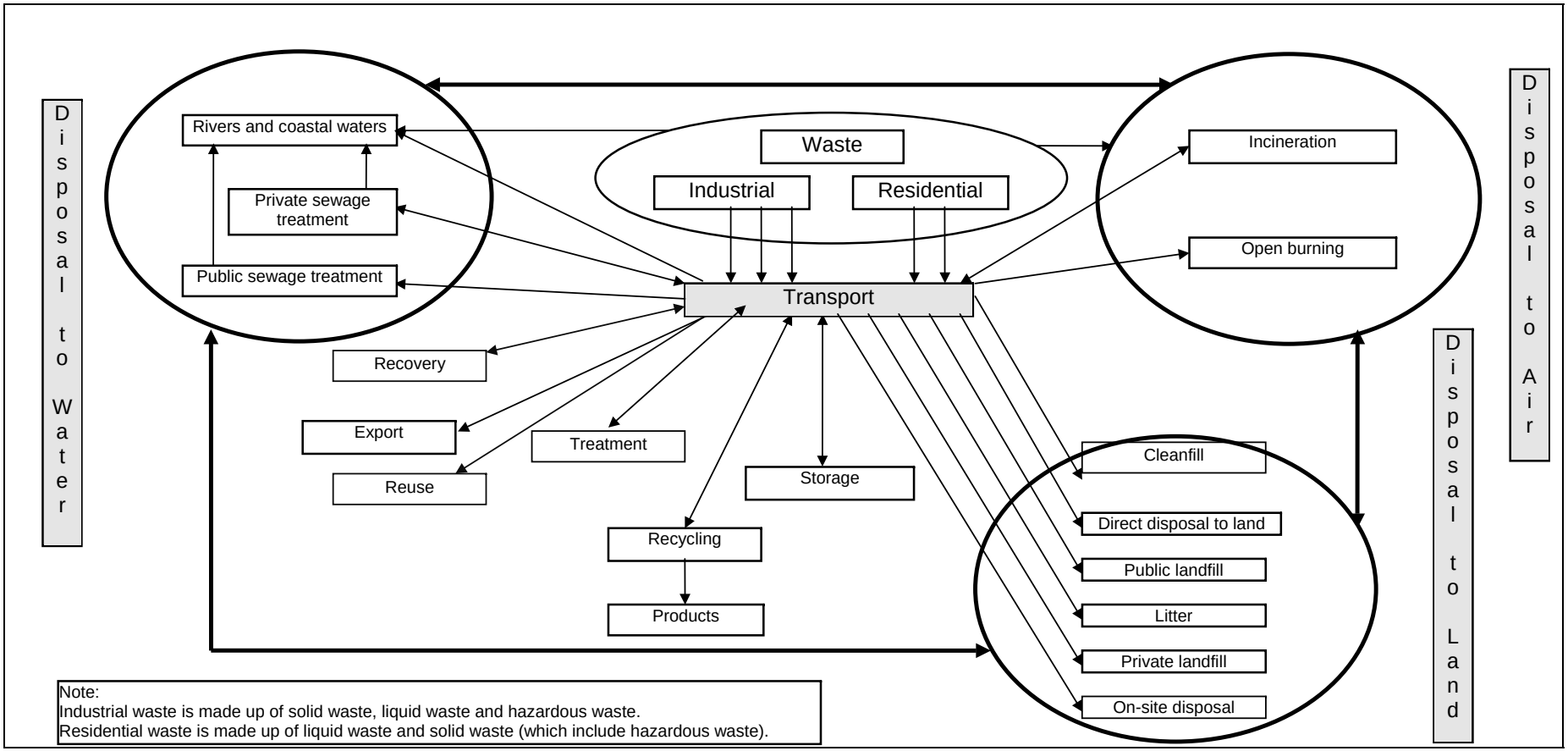


Figure 2.1.1 Integrated model of waste generation, disposal and dispersion in the environment.

2.2. Forms of waste

Waste is generated in either a solid, liquid or gaseous form. A number of complicating factors are involved in classifying waste in these three categories, including:

- waste can be transferred from one medium to another (land, air, water) and can change from solid to liquid to gaseous and vice versa depending on variables such as temperature and pressure;
- many types of waste consist of a mixture of the three phases. For example, sludge is considered by some to be a liquid waste and by others a solid waste. Also, gases can be dissolved in liquid solvents;
- hazardous waste can be in solid, liquid or gaseous form.

Figure 2.2.1 shows how solid, liquid and gaseous waste overlap.

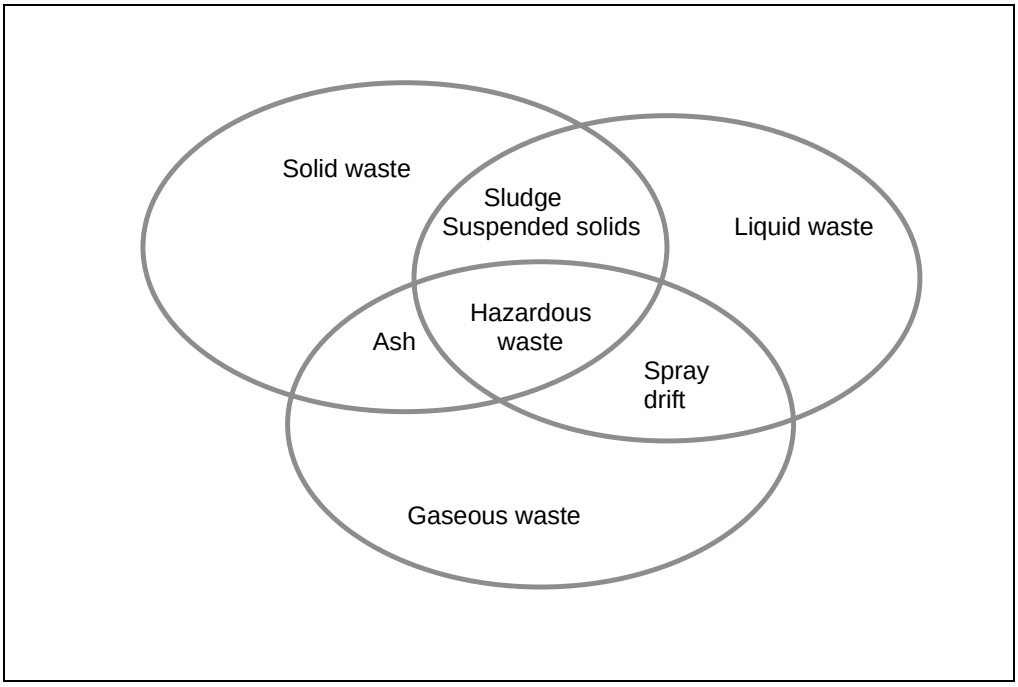


Figure 2.2.1 Relation between solid, liquid and gaseous waste.

The following sections specify for the purpose of this report which types of waste have been included under solid, liquid and gaseous waste. As hazardous waste is generated in the form of solid, liquid and gaseous waste, it is discussed separately.

2.2.1. Solid waste

Solid waste can be defined as all waste that is generated in a solid form or converted to a solid form for disposal. The New Zealand *Waste Analysis Protocol* (WAP) uses eight solid waste categories [Ministry for the Environment, 1992(c)]. These are:

1. **paper**, including newsprint, cartons, sheets paper, boxes, food wrappers, advertising materials, packaging etc.;
2. **plastic**, including bottles, bags, food containers, styrene foam, consumer durables, etc.;
3. **glass**, including container glass (bottles and jars), sheet glass, window glass etc.;
4. **metal**, including fabricated metals, aluminium and steel cans, car bodies, metal appliances etc.

5. **organic**, including garden, fruit and vegetable waste;
6. **construction and demolition** (C&D), which is classified into five subclasses, including:
    - wood (sawn timber);
    - wood fibre products (softboard, hardboard, particle wood);
    - rubble (concrete, bricks, fired clay, gib board);
    - clean fill (clay, sand, rock, that is contaminated with less than 5% by materials that will leach into the environment such as metals, organic matter or timber);
    - other C&D waste not elsewhere;
7. **potentially hazardous**, including chemicals, household hazardous items, pesticides etc. It also includes waste requiring controlled disposal or co-disposal at landfills (mainly treated or untreated hazardous waste), which is sometimes referred to as "special waste";
8. **other** waste, a wide range of materials present in relatively small quantities, including textiles, rubber, tyres, electrical cable, wood waste.

2.2.2. Liquid waste

Liquid waste can be defined as waste that is generated or converted to a liquid form for disposal. It includes:

- **wastewater or sewage**, which is collected through the sewerage system and transported to water treatment plants and then discharged into rivers and coastal waters;
- **point source discharges**, which include untreated or treated waste from farms, factories and mines discharged into rivers and coastal waters;
- **stormwater**, which is rainwater channelled from roads and urban properties into rivers and coastal waters (picking up street litter and contaminants on the way);
- **non-point source discharges**, such as livestock excrement and sprayed agrichemicals which are washed from paddocks into streams by rainwater.

2.2.3. Gaseous waste

Gaseous waste can be defined as small particles that can be carried by air, and gas in its associated forms, including dust, smoke, fumes, mist, and vapour. Gaseous waste can contaminate the ambient air we breathe. Gaseous waste can be divided into two categories depending on their source:

- **stationary gaseous waste**, coming from a stationary source such as incinerators, emission pipes, and including solvent emissions, emissions from incinerators, etc.;
- **mobile gaseous waste**, generated by mobile sources such as land-based vehicles, airplanes and ships, and including vehicle exhaust, spraydrift, etc.

2.2.4. Hazardous waste

Currently, there is no definition of hazardous waste that is nationally accepted. The Basel Convention developed by UNEP, and the OECD define hazardous waste as "waste that contains substances that are toxic to humans, plants or animals, are flammable, corrosive or explosive, or have high chemical reactivity". This definition excludes radioactive substances.

A range of national and international systems relevant to the classification of hazardous waste are currently in use in New Zealand. These include:

- **OECD classification system for hazardous waste**, which is largely qualitative and does not take into account the actual strength or degree of hazard of waste [Yasowitz, 1989];

- **Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal** [UNEP, 1989], which was based on the OECD classification system;
- **New Zealand Waste Identification Code** (NZWIC), which is a slightly modified and truncated version of the system used in the Basel Convention, and has been adopted in WAP. The NZWIC is provided in Appendix II;
- **United States Environmental Protection Agency (USEPA) Regulations** for hazardous waste, which are embedded in the Code of Federal Regulations (parts 260 to 290) [USEPA, 1991]. The Regulations cover solid hazardous waste only and prohibit the dilution of any hazardous waste to a degree where they are no longer solid;
- **Hazardous Substances and New Organisms Act 1996**, which defines "hazardous substance", which potentially includes a substance that is hazardous waste, as any substance:

  "(a) With one or more of the following intrinsic properties:

  (i) Explosiveness:
  (ii)Flammability:
  (iii)A capacity to oxidise:
  (iv)Toxicity (including chronic toxicity):
  (v) Corrosiveness:
  (vi)Ecotoxicity with or without bio-accumulation:

  (b) Which on contact with air or water (other than air or water where the temperature or pressure has been artificially decreased) generates a substance with any one or more of the properties specified in paragraph (a) of this definition".

The Auckland Region Hazardous Waste Survey [Auckland Regional Council, 1996], uses a definition of hazardous waste which covers and extends beyond the definitions provided by the above. Within the survey a hazardous waste is defined as *"any substance which:*

- *is listed in the New Zealand Waste Identification Code (NZWIC) (see Appendix II);*
- *exceeds USEPA TCLP (Toxicity Characteristics Leaching Procedure) criteria which are part of the USEPA Regulations for hazardous waste[1];*
- *conforms with the specifications of the Hazardous Substances and New Organisms Act 1996;*
- *has the potential to cause significant adverse environmental effects as defined under the Resource Management Act 1991, for example trade waste discharges and industrial organic waste;*
- *is a 'special' waste, that is a hazardous waste which was treated before being disposed of at a landfill;*
- *is a mixed hazardous waste such as access pit and grease trap waste, contaminated soil or treated timber;*
- *is radioactive;*
- *organic waste because they have a very high biochemical oxygen demand (BOD) and need to be treated before they can be disposed of."*

Definitions of hazardous waste used at landfills as identified as part of the *1995 Landfill Census* [Ministry for the Environment, 1997(b)] are given in Table 2.2.1.

Table 2.2.1 Definition of hazardous waste used at landfills as in 1995 [Ministry for the Environment, 1997(b)].

[1] The United States Environmental Protection Agency (USEPA) has established specific values for a range of materials to describe the degree of leaching that is permissible after the waste has been treated and immobilised. The test applied to measure the leaching is termed "Toxicity Characteristic Leaching Procedure" (TCLP).

Key word/concept	% of landfills using definition
Toxic substances/chemicals/pesticides	24
A present or future threat to the environment	22
Harmful to people/dangerous to health	12
Our Waste: Our Responsibility [Centre for Advanced Engineering, 1992]	11
Infectious/medical waste	9
Explosive	8
Flammable/ignitable	8
Radioactive/reactive/irradiating	8
Corrosive	8
Landfill Guidelines [Ministry for the Environment, 1992(b)]	5
Offal/animal carcasses	4
Fuel/soil/diesel/automobile wastes	4
OECD classification system for hazardous waste [Yasowitz, 1989]	4
Hot ashes	3
Asbestos	3
USEPA Regulations [USEPA, 1991]	2
Guidelines for Waste Management Practice in New Zealand [NZCIC, 1991]	2
Other	8
No hazardous waste accepted at landfill	6
No definition used	4
Not known	2
No reply	28

Hazardous waste also includes waste requiring controlled disposal or co-disposal at landfills (mainly treated or untreated hazardous waste), which is sometimes referred to as "special waste". A review of consent files found that waste requiring special treatment at landfills includes agricultural chemicals, arsenate of lead, carbon tetrachloride, chromic acid sludge, electroplating sludge, formaldehyde, fungicides, galvanising liquids, waste, ink residue, lead paint, medical waste incinerator ash, mercury, oil, paint sludge, paint sumps, pesticides, poisons, soluble pure chemical reagents (laboratory chemicals like cadmium, mercury), solvents, still bottoms, tannery waste, timber treatment sludge, unknown military waste, and unspecified waste chemicals [Ministry for the Environment, unpublished]. However, there may be many more types of waste that are disposed of as special waste. Definitions of special waste used at landfills as identified as part of the *1995 Landfill Census* are given in Table 2.2.2.

Waste resulting from the remediation of contaminated sites is in this report considered as hazardous waste, because the clean-up of locally contaminated sites can create large amounts of waste which will require some form of management, ranging from disposal to treatment. Contaminated sites are generally treated in two ways [Ministry of Housing, Spatial planning and the Environment, 1991]:

- the removal of pollutants from the soil by cleaning up on site, or by excavation of the polluted soil, possibly followed by decontamination;
- prevention of the spreading of the soil pollution and its damaging consequences by insulating the polluted soil through the application of the so-called "ICM criteria" (Insulate, Control, Monitor). Insulation can be done on the spot or elsewhere at a dump site.

Table 2.2.2 Definition of special waste used at landfills [Ministry for the Environment, 1997(b)].

Key words/concepts	% of landfills using definition
Require special disposal	14

Require special consideration	11
Our Waste: Our Responsibility [Centre for Advanced Engineering, 1992]	6
Require pre-treatment	4
Landfill Guidelines [Ministry for the Environment, 1992(b)	4
Toxic substances/chemicals/pesticides	3
OECD classification system for hazardous waste [Yasowitz, 1989]	2
Fuels/oils/automotive wastes	2
Asbestos	1
Infectious/medical wastes	1
Offal/animal carcasses	1
Others	8
No special waste disposed/not applicable	8
No definition used	10
No reply	49

Radioactive substances are not included in the Hazardous Substances and New Organisms Act 1996 nor in the UNEP definitions of hazardous waste. Radioactive waste is classified according to the level of radiation at the surface. Low and medium radioactive waste has a radiation level less than 10 mSv (milliSievert) per hour. High level radioactive waste has a higher radiation level [Ministry of Housing, Spatial planning and the Environment, The Netherlands, 1991].

2.3. Sources of waste

A large number of definitions are used by different agencies and authorities to describe the source of waste generated in New Zealand. These include household, domestic, residential, industrial, commercial, municipal and business waste. The problem with using this number of definitions is that it becomes unclear what source waste is included, which makes a reliable comparison and interpretation of different data sets impossible.

The terms used in this report to consider the sources of waste are “residential” and “industrial” waste. Definitions are given below and are consistent with the Waste Analysis Protocol, and the OECD, and UNEP definitions and classifications. Data presented in this report are presented using these two definitions, unless otherwise stated. It may be helpful to refer to Figure 2.1.1 when considering these definitions.

2.3.1. Residential waste

Residential waste includes all waste generated by households. Residential solid waste is collected through the kerbside refuse collection system, kerbside or on-street recycling collection system, or taken to landfills and transfer stations by private vehicles. Residential liquid waste is collected through the sewage system or in pits when households are not connected to the public sewage system. Residential gaseous waste is directly emitted into the air.

2.3.2. Industrial waste

Industrial waste includes all waste from the 17 industrial categories identified by the Australian and New Zealand Standard Industrial Classification (ANZSIC) [Australian Bureau of Statistics and New Zealand Department of Statistics, 1993] including:

1. agriculture, forestry and fishing;
2. mining;
3. manufacturing;
4. electricity, gas and water supply;
5. construction;
6. wholesale trade;
7. retail trade;
8. accommodation, cafes and restaurants;
9. transport and storage;
10. communication services;
11. finance and insurance;
12. property and business services;
13. government administration and defence;
14. education;
15. health and community services;
16. cultural and recreational services;
17. personal and other services.

Industrial waste encompasses a wide range of materials of varying environmental toxicity, but typically includes general rubbish, packaging, food waste, acids and alkalis, oils, solvents, resins, paints and sludge [UNEP, 1993].

Most waste monitoring takes place when waste is disposed of rather than when it is generated. Therefore it is possible that in some cases residential waste may be included in industrial waste and vice versa. For example, a skipbin hired by a household will be included in industrial waste as it is disposed of by a waste contractor. On the other hand, empty agrichemical containers that are taken to the landfill by a pipfruit grower in his private vehicle together with some household waste can be included in residential waste rather than industrial. To be able to draw a clear line between residential and industrial waste, monitoring needs to take place when waste is generated rather than simply at disposal. However, this is very costly to undertake.

2.4. Waste management methods

Waste can be disposed of to land, water or air, or managed in another way including treatment, storage, export or recycling. A brief description of each of these methods is provided in the following.

2.4.1. Disposal to land

Disposal to land includes private and public landfilling, cleanfilling, direct disposal to land, and littering. As there is no legal definition for any of these disposal methods, it is difficult to determine what is included under each disposal method. The creation of contaminated sites can result from any of these disposal methods if poorly managed. Key disposal methods are briefly described below.

a) Landfilling

Landfilling is the most common method of solid waste disposal in New Zealand. Although availability of landfill space is not quite the same problem in New Zealand as it is in more densely populated countries, existing landfills in larger urban areas are approaching full capacity and the availability of new space is limited by opposition from local residents (the "not in my backyard" syndrome) and by higher environmental standards (such as avoiding sites that could contaminate groundwater or streams).

Information about landfills has been gathered mainly through the 1995 Landfill Census. In 1995 there were 327 legal landfills operating in New Zealand. More information on the *1995 Landfill Census* and the information it obtained, such as landfill sizes and populations served, is given in Appendix III. Landfills include public landfills (owned by territorial local authorities or the Crown) and private landfills (owned by a private organisation).

As there is no national legal definition of landfills in New Zealand, the number of tips containing waste (e.g. drilling mud dumps) is likely to be much higher than the number of landfills covered by the Landfill Census.

b) Cleanfilling

Cleanfill waste is the most common destination for construction and demolition waste. Cleanfill sites are similar to landfills but accept only uncontaminated waste. As with landfills, there is no national legal definition of cleanfills in New Zealand.

c) Direct disposal to land

Some types of waste are stockpiled or left on-site rather than disposed of in a landfill. This typically includes mining and quarrying waste. Waste can also be directly disposed to land, for example by businesses into an unconsented tip on their property, storage of waste in a pile, or disposal of liquid waste through drilling mud dumps. Waste can also be disposed to land gradually (through leakage or leaching of waste materials, through fuel tanks).

d) Litter

Waste can be disposed of by littering, which is the accidental or purposeful disposal of waste onto land or into water, but is discussed under disposal to land. Examples of littering include throwing rubbish on the street, leaving waste behind at a picnic area, waste blowing off car trailers, and tipping paint and chemicals. Generally speaking, litter is considered residential waste. Large quantities of waste disposed of purposely by businesses is considered unconsented disposal. *Keep New Zealand Beautiful* is the agency responsible for promoting anti-litter campaigns and monitoring litter.

e) Contaminated sites

Contaminated sites are not a disposal to land method as such. However, the creation of contaminated sites can result from any of the disposal methods mentioned above. Although no legal definition of contaminated sites exists in New Zealand, the Australian and New Zealand Environment and Conservation Council (ANZECC) and the National Health and Medical Research Council (NHMRC) definition of a contaminated site is generally used (1992). This is:

> *"A site at which hazardous substances occur at concentrations above background levels[2] and where assessment indicates it poses, or is likely to*

[2] Background levels are the ambient levels of a contaminant in the local area under consideration.

pose, an immediate or long-term hazard to human health or the environment"

2.4.2. Disposal to water

A large component of the waste generated in New Zealand is disposed of to water (sewage ponds, freshwater bodies including surface and groundwater, and coastal water). Waste can be disposed directly into water or indirectly into water via the sewerage system and public and private wastewater treatment plants, or via the stormwater system.

a) Wastewater treatment plants (sewage system)

Sewered wastewater in New Zealand comes from a number of sources, including industrial, residential, stormflow, and infiltration of groundwater into the sewer due to poorly functioning joints and through the pipe materials.

Wastewater or sewerage is treated at public or private wastewater treatment plants prior to disposal to rivers or coastal waters. Information regarding public wastewater treatment plants is can be found on the *National Database of Wastewater Treatment Plants in New Zealand* [Woodward-Clyde, 1996].

There are many different ways to treat sewage until the effluent may be regarded as suitable for discharge. What the methods have in common is that:

- solids are mechanically settled out;
- dissolved and suspended carbohydrates, proteins, fats, urea, etc. present in the wastewater form a substrate and food for organisms. These organisms trap, metabolise, and store these materials to prevent them reaching the receiving waterbody.

Sewage is referred to as being treated to primary, secondary, or tertiary levels. Degrees or types of treatment include:

- preliminary: screening to remove rags, plastics, etc, settling out of grit and communition of solids.
- primary: settling out of solids by physical and mechanical means, which results in a decanted effluent and a separate sludge. Aims to remove 30 - 40% of influent BOD (biochemical oxygen demand) and 60 - 75% of suspended solids;
- secondary: aerobic or anaerobic reduction of BOD by biological treatment. Secondary treatment involves nitrification of ammonia to nitrates and removal of 90% of the BOD and generates a separate sludge;
- tertiary: The use of treatment technologies to reduce specific constants of the secondary effluent (e.g. nutrient removal, sterilisation of bacteria and viruses) and/or further treatment of the effluent through filter-beds, land treatment, etc.

One treatment method widely used by New Zealand wastewater treatment plants is oxidation ponds. Oxidation ponds generally are secondary or tertiary treatment methods depending on the efficiency of the pond, which is a function of temperature and detention time. Different types of oxidation ponds include:

- anaerobic: which usually treat concentrated waste at temperatures above 15°C (usually found for industrial applications);
- facultative: involving sludge digestion in the lower layers and algae production in the aerobic upper layers;
- aerated ponds: which are akin to a mixture of waste stabilisation ponds and activated sludge plants;

- maturation ponds: tertiary treatment ponds used to 'polish' effluent to a high quality. Algae in these ponds may cause high levels of suspended solids (SS) in the effluent, but nutrient and coliform (bacteria) levels are expected to be low.

b) Other disposal to water

Other methods of waste disposal into water include:

- disposal to water of non-point discharges and untreated point source discharges;
- disposal to water by dumping at sea of, for example, dredging waste;
- disposal to water of stormwater via the stormwater system.

2.4.3. Disposal to air

Waste disposal methods to air include controlled incineration, open burning, point source air emissions and vehicle exhausts. These are briefly described below.

a) Controlled incineration

Incineration reduces the volume of waste that requires landfilling, often by about two-thirds. Controlled incineration is not widely used in New Zealand but is used for specific waste streams, including clinical and pharmaceutical waste, quarantine waste, and sometimes confidential waste. Incineration always leaves some waste residue requiring further management. In New Zealand, waste is legally incinerated in:

- **conventional furnaces**: small industrial furnaces are still operated throughout New Zealand, mainly at businesses, ports and hospitals. No data on the number or capacities of these incinerators are available;
- **high temperature incinerators**: multi-chamber incinerators involve restricting the air supply to the primary chamber, which controls the rate of combustion independent of the amount of waste in the chamber and minimises particulate emissions. A properly designed secondary chamber then completes the combustion process ensuring that gaseous emissions are rendered harmless. There are four licensed commercial high-temperature incinerators in New Zealand at Auckland, Wellington, Christchurch, and Dunedin.

b) Open burning

Although most regional and territorial councils have banned the open burning of waste, which means burning of waste in open air, either in a drum or directly on the ground, this waste disposal method is still often applied. Open burning is a method used by a wide range of industrial sectors, households and landfills.

c) Direct release into the air

Many forms of gaseous waste are directly released into the air, from both stationary and mobile sources, including vehicle exhausts, solvent emissions, emissions from factories, spraydrift, and greenhouse gases from sprays (e.g. carbon dioxide and nitrous dioxide). Emissions from vehicles and airplanes are one of the largest sources of gaseous waste in New Zealand.

2.4.4. Other

Waste is not always disposed of directly after it is generated. Other waste management methods include:

- waste minimisation methods (prevention, reduce/reuse, recycling, recovery);

- treatment methods (pretreatment of waste, compaction of residuals);
- export and storage of waste.

Waste minimisation and other management methods are presented in Figure 2.4.1 and are briefly described below. Definitions have been taken from the OECD [1997].

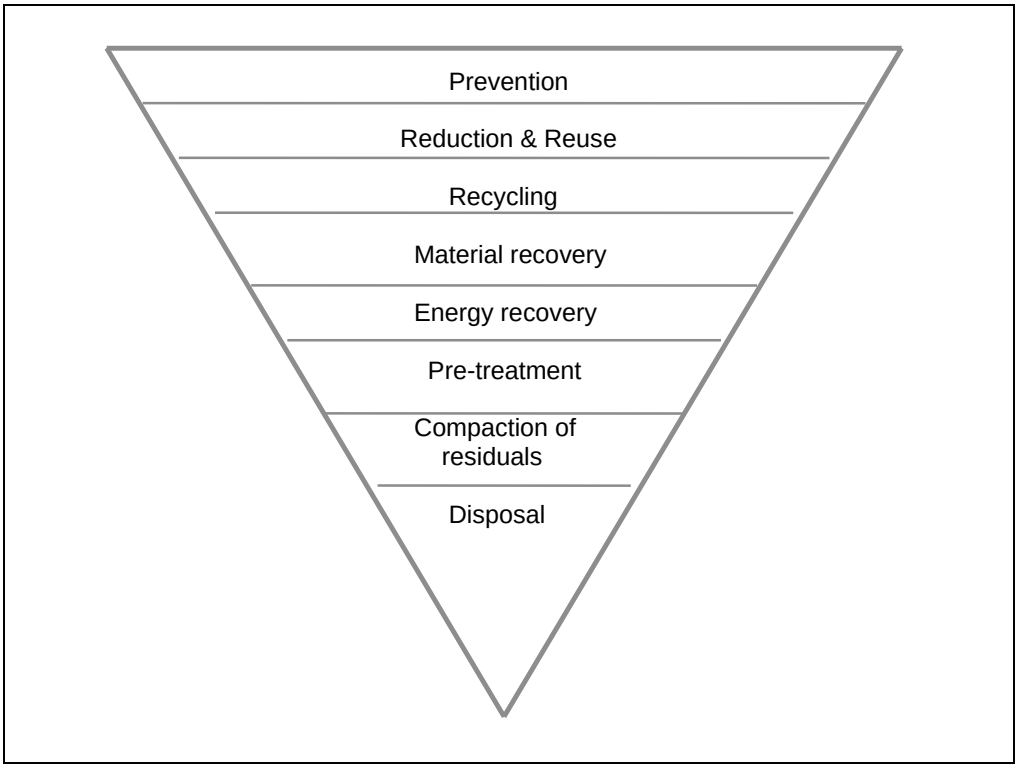


Figure 2.4.1 Hierarchy of waste management methods [OECD, 1997].

a) Prevention

Prevention is defined by the OECD [1997] as "to strictly avoid the generation of waste, especially toxic and harmful substances (which is qualitative prevention), material or energy consumption, including transport and the consumption of commodities (which is quantitative prevention)." Examples of prevention include the avoidance of interim packaging for office products and avoiding CFC in sprays by using pumping systems. Prevention is not strictly a waste management method as it prevents waste from being generated.

b) Reduction

Reduction from a waste minimisation perspective means to reduce the amount of materials or energy consumed. Examples include selecting product designs and materials which facilitate reuse or repair of a product, and the near elimination of harmful substances for waste recovery processes (e.g. de-inking in waste paper recycling).

c) Reuse

Reuse is a method of waste reduction which involves the multiple use of a product in its existing form, with or without re-processing or re-conditioning, for the same use or different use. Examples of reuse include shopping bags used again as shopping bags or as waste bags, waste tyres used for swings in playgrounds or in marinas, and refilling of bottles after a washing process. Waste exchange programmes established by New Zealand councils, such as Christchurch City Council and Auckland Regional Council, are based on reuse of waste materials by other businesses.

d) Recycling

Recycling is the reuse of waste materials, in such a way that the original products lose their identities. Examples of recycling include the industrial melting of post-consumer glass bottles to form new bottles, and the collection of post-consumer newspapers for the production of sanitary products made of waste paper. In New Zealand, recycling of residential waste is generally organised or coordinated by local authorities. Other agencies or clubs also organise recycling bins at schools etc. Collection facilities for recycling of residential waste range from sophisticated kerbside programmes to drop-off centres or transfer stations in rural towns. Collection of industrial waste for recycling is generally undertaken by waste contractors. Businesses can also bring recyclable industrial waste to transfer stations. Many businesses recycle materials within the business itself (e.g. recycling of chemicals or cooling water).

e) Recovery

Recovery of waste refers to the recovery of materials or recovery of energy. Material recovery is the reuse of waste materials in a different form. Examples of material recovery include composting of separately collected organic residential waste (bio-waste) or of sludge from wastewater treatment plants, and the sterilisation of organic kitchen waste for use as animal food.

Energy recovery involves the recovery of the energy content of waste materials with or without pre-processing or pre-treatment. Examples include the recovery of methane from landfills to supply electricity, and the incineration of residential waste, using the energy for district heating.

f) Pre-treatment

Pre-treatment involves the reduction of volume, mass or toxicity of waste by mechanical, physical, chemical or biochemical processes before landfilling or final storage. Examples include the biochemical treatment of oil-contaminated soils, and the sterilisation of some forms of hospital waste.

In New Zealand some hazardous waste is treated for safe disposal, to reduce the toxicity, weight or volume of the waste. Treatment methods include chemical treatment (including neutralisation), settling and sedimentation, filtration, dewatering, biological, solidification and other methods. These methods differ in effectiveness in reducing or eliminating the hazardous characteristics of the waste.

g) Compaction of residuals

Compaction of waste residuals means the reduction of volume and mass of materials on sanitary landfill sites by mechanical, physical, chemical or biochemical processes. Examples include compaction of waste for transfer to landfills, and using water for initiating biochemical processes on sanitary landfill sites in order to decompose the organic components.

h) Export

In New Zealand a number of hazardous waste are exported for treatment and/or disposal using facilities not available in New Zealand. The majority of waste is exported for recycling. Waste is also moved to other regions in New Zealand if appropriate disposal environments or treatment methods are not available.

i) Storage

Some hazardous waste is currently being stored in New Zealand, because there is currently no suitable disposal method available, or because the waste is in transit in New Zealand awaiting onward transportation for disposal. Stored waste in New Zealand mainly includes unused agrichemicals, radioactive waste, and PCBs.

2.5. Environmental effects

2.5.1. All waste

Although waste can be disposed of to land, air or water, the contaminants contained within the waste can be dispersed to all media in the environment as illustrated in Figure 2.1.1.

Pollution of land, air and water through dispersion of contaminants presents a risk to the environment and public health, now and in the future. It also creates increased economic costs associated with wasteful production and the need for clean-up. Examples of specific risks created by inappropriate waste disposal include [Ministry for the Environment, 1995(b)]:

- a reduction in urban air quality caused by particulate emissions and carbon monoxide emissions from vehicles;
- run-off from roads and domestic activity contaminating stormwater thereby affecting water quality in rivers and coastal areas near urban centres;
- leachate from landfills and industrial sites contaminating water bodies (e.g. aquifers and estuaries);
- land-use practices - such as excessive or inappropriate use of chemical pesticides and fertiliser, agricultural run-off, and point source pollution from cow sheds, piggeries, feed lots and silage pits - causing damage to ecosystems, contamination of drinking water and reduced recreational opportunities;
- potential risks to humans and native flora and fauna from bio-accumulative compounds (e.g. PCBs);
- loss of land-use options because of site contamination (e.g. former timber treatment sites) and land degradation;
- injuries to people and property resulting from the misuse of hazardous substances (leading to higher insurance costs);

- lead in petrol, paint and waste oil, resulting in high lead levels in the environment and associated risk to health;
- damage to taonga Maori (e.g. to traditional shellfish collection areas or to freshwater quality);
- rubbish in the marine environment, on beaches and from boats;
- damage to our "clean, green" image, affecting tourism and a wide range of exports.

2.5.2. Hazardous waste

The potential environmental consequences of hazardous substances vary greatly depending on the nature and volume of the substance and the sensitivity of the receiving environment. Substances which are persistent or enter the environment in large quantities can be dispersed over large distances in water or air currents, but also via organisms after absorption. Certain substances can accumulate considerably in certain parts of the environment (e.g. heavy metals in sediments and PCBs in living organisms). Furthermore, the toxicity can vary greatly from substance to substance. The possible effects of pollution with toxic and hazardous substances on humans, animals and plants include:

- mortality;
- adverse effects on reproduction;
- causing cancer;
- causing deformities and genetic mutations;
- causing other diseases;
- accumulation in the environment and in living tissue (this may have consequences in the food chain);
- indirect effects on ecosystems (alterations in competitive relationships between species) [Ministry of Housing, Spatial Planning and the Environment, The Netherlands, 1991].

Hazardous waste also has the potential to contaminate other waste streams, most notably residential waste, through the disposal of, for example, pesticides, paints, oils, solvents and batteries with non-hazardous waste. These types of waste have traditionally been disposed of at landfills in small quantities. Businesses that produce these types of hazardous waste include photographic laboratories, paint and printing workshops, educational establishments, research laboratories, hospitals and the agricultural sector.

2.6. Waste information sources

Comprehensive waste data are lacking in New Zealand, in particular at a national level. However, a number of attempts have been made to gather waste data in New Zealand. The main information sources used are briefly described in the following sections which correspond with the chapters included in this report. Additional data presented in this report have been obtained from regional State of the Environment reports, other literature publications and personal communication about waste. These additional information sources are listed in the *References*, page 79.

2.6.1. Solid waste (Chapter 3)

a) Department of Health landfill surveys

In 1982 the Board of Health undertook a refuse survey and grading of landfills, with an emphasis on hazardous waste [Department of Health, 1983]. As the survey was undertaken in 1982, only estimates of landfilled waste quantities have been included in this report.

b) United Councils regional waste surveys

Between 1985 and 1989 a number of regional waste surveys were undertaken by all of the former United Councils funded through the Department of Health Grant Scheme. In order to provide some data on waste production, a national compilation was undertaken [Royds Garden Ltd, 1991, unpublished]. The compilation brought together all of the original survey data and reclassified them using the system developed for the New Zealand Chemical Industry Council [1991]. Waste was then classified according to type using the list of potentially hazardous waste from the OECD Classification System mentioned in section 2.2.4.

c) Centre for Advanced Engineering waste management project

To assist in developing appropriate solutions to waste management problems the Centre for Advanced Engineering of the University of Canterbury undertook a comprehensive waste management project from August 1990 until February 1992. The findings were published in the report *Our Waste: Our Responsibility* [Centre for Advanced Engineering, 1992], which contained four key chapters, including:

- waste minimisation practices;
- hazardous waste: appropriate technologies for New Zealand;
- landfill engineering guidelines;
- waste management in relation to water supplies.

This report drew on the data on waste production discussed in (b).

d) Waste Analysis Protocol

Although regional data had been collected through the United Councils' regional waste surveys, it was not done on a national basis or consistently. The *Waste Analysis Protocol* (WAP) was developed by Ministry for the Environment as a set of guidelines to consistently obtain statistically robust information on the amount, composition and source of solid and hazardous waste streams to enable comparison between districts and regions, and over time.

WAP surveys were undertaken from 1992 to 1995 throughout New Zealand for an area representing 65% of the New Zealand population. WAP surveys have provided a significant amount of data on waste quantities and composition. WAP results are reported in Chapter 3, Solid Waste and Chapter 6, Hazardous Waste. For more information on the WAP methodology see Appendix IV [Ministry for the Environment, 1992(c)].

e) Landfill Census 1995

The Ministry for the Environment commissioned a national Landfill Census in 1995 to obtain baseline data regarding landfills, landfill management and landfilled waste in New Zealand. Results are included in Chapter 3 (solid waste). For more information see Appendix III, Landfill Census [Ministry for the Environment, 1997(b)].

f) Keep New Zealand Beautiful surveys

Litter surveys have been undertaken for New Zealand by Keep New Zealand Beautiful.

g) Construction and demolition waste in the Auckland region

A report on construction and demolition waste has been written as part of "Project C&D" which is undertaken by Auckland Regional Council, Auckland City Council and is financially supported by theMinistry for the Environment's Sustainable Management Fund.

h) A Strategy to Minimise Packaging Waste

In June 1996 the Packaging Accord was signed between the Minister for the Environment and the Packaging Industry to reduce packaging waste in New Zealand. The Packaging Industry Advisory Council (PIAC, representing the packaged goods industry) published a report to review the available information about packaging waste, outline management options, provide recommendations for a strategy, and promote the minimisation of packaging waste [PIAC, 1996].

2.6.2. Liquid waste

a) New Zealand Water and Wastes Association annual meetings

New Zealand Water and Wastes Association (NZWWA) holds annual meetings of the Operations and Research Group for Drainage to discuss collection systems of wastewater treatment plants. A report containing information on a number of wastewater treatment plants is published for these meetings [NZWWA, 1994 and 1996]. A summary table of a number of wastewater treatment plants for 1995/96 in included in Appendix VI.

b) National Wastewater Treatment Plants Database

Ministry for the Environment funded through the Sustainable Management Fund (SMF) the development of a National Wastewater Treatment Database. Details of all sewage treatment plants operated by local authorities throughout New Zealand were obtained for 1994/95 and this information was placed on a database owned and operated by the NZWWA. The database has been updated with 1995/96 information [Woodward-Clyde, 1996]. For more information see Appendix VI.

2.6.3. Gaseous waste

a) Survey of New Zealand incineration facilities

A survey of New Zealand incineration facilities was undertaken in 1988 by the National Environmental Chemistry and Acoustics Laboratory for the Department of Health [NECAL, 1988]. The report, however, was never published because the information was obtained through the Clean Air Act and was considered confidential. No information from the survey has been included in this report as many of the facilities have shut, rendering the information gathered out of date. Regional Councils were recently

contacted to provide updated information regarding incineration facilities, but insufficient information has been returned to date for inclusion in this report.

b) Climate change, the New Zealand response

The Ministry for the Environment has gathered quantitative data on greenhouse gas emissions on a national basis [Ministry for the Environment, 1994(a), 1997(c)].

c) Auckland Air Emissions Inventory

The Auckland Air Emissions Inventory project was a SMF funded project that was carried out to provide an inventory of pollutant emissions to air, resulting from activities within the Auckland region, with the potential to be used as a planning tool for evaluating policy options to reduce air pollution in Auckland. Results are summarised in Chapter 6 and in Appendix VII.

2.6.4. Hazardous waste

a) Auckland Region Hazardous Waste Survey 1996

The Auckland Hazardous Waste Survey was a SMF funded project to provide baseline information on the generation and disposal of hazardous waste in the Auckland region. The survey is part of a Hazardous Waste Management Programme initiated by the Auckland Regional Council (ARC) in 1995. Survey results are reported in Chapter 6 (hazardous waste). For more information regarding the survey, see Appendix VIII [Environment and Business Group Ltd and Auckland Regional Council, 1996].

3. SOLID WASTE

Most data available on solid waste refer to landfilled waste. There are limited data available on solid waste collected for recycling and recovery, littered waste, incinerated waste, and waste dumped at sea. No data were obtained on several other types of waste, such as cleanfill, mining and quarrying waste, which may be significant waste streams in terms of quantity and hazard.

3.1. Landfilled waste

3.1.1. Total landfilled waste

a) Quantities

Module C of the Waste Analysis Protocol (WAP) can be used to determine the weights and composition of waste disposed of at the landfill, from both industrial and residential sources.

Figure 3.1.1 summarises the weights of residential, industrial and total waste landfilled in New Zealand. Figure 3.1.2 summarises the weights of residential, industrial and total waste landfilled in 14 regions. These figures have been derived from data obtained in WAP surveys for the period 1993-1995 and data from the 1995 Landfill Census. The total weight of all landfilled waste in 1995 was approximately 3,180,000 tonnes, of which approximately 1,420,000 tonnes (45%) is residential waste and approximately 1,760,000 tonnes (55%) is industrial waste. It has not been possible to determine the accuracy of the overall waste tonnage as no estimates of error were provided for the WAP survey results nor were they provided for the Landfill Census operators' estimates of landfilled waste. The errors may vary from plus or minus 1 to 10% depending on the level of accuracy assumed for these estimates and on which estimate is used. Most

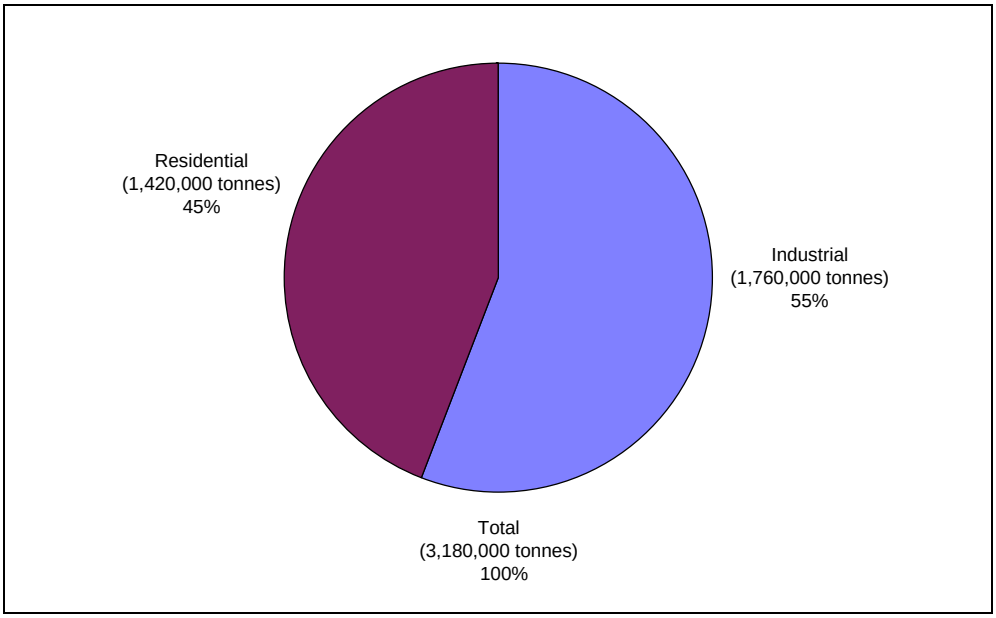


Figure 3.1.1 Annual weight of landfilled waste in New Zealand in 1995.

accurate figures are provided by the WAP surveys, which were undertaken for the 10 major landfills, accounting for 40% of the total waste. The methodology used to obtain

total landfilled waste figures along with additional background data are provided in Appendix V.

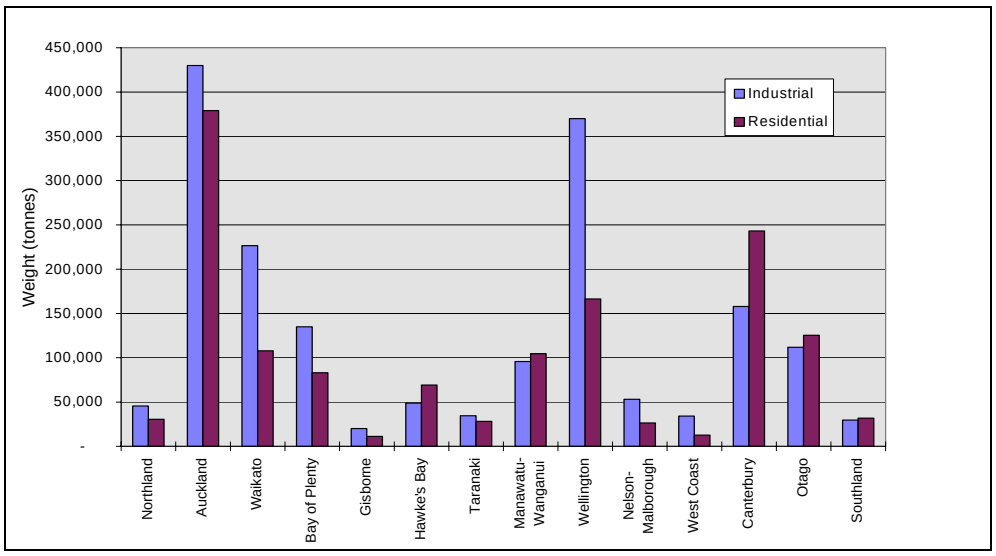


Figure 3.1.2 Estimated annual weight of landfilled waste for New Zealand regions in 1995.

Table 3.1.1 summarises quantities of landfilled waste as determined by different studies undertaken in New Zealand. Given that the methodologies used to monitor and extrapolate the waste quantities are different and that no standard error was given for any of the data, the data should be considered approximate. For the same reason it is difficult to identify definite trends in the quantities of waste landfilled in New Zealand over time or between regions. A comparison between 1982 and 1995 figures indicates that quantities of landfilled waste have increased over the past decade by approximately 30%.

The increase has been highest in Auckland region where landfill waste has almost doubled since 1983, with most of the increase occurring during the recent years of high economic growth (see Figure 3.1.3). This reflects the increased activity in the construction industry, the changing consumption patterns of homes and businesses, and population growth.

Table 3.1.1 Quantities of landfilled waste in New Zealand.

Description	Year	Landfilled waste per year (million tonnes)			Comments	Reference
		Total	Residential	Industrial		
Refuse Survey and Grading of Landfills	1982	2,030,000	880,000	1,350,000	Undertaken by Department of Health	Departmen t of Health, 1983
United Councils waste management surveys	1986-1991	3,330,000	1,140,000	2,200,000	Undertaken under Department of Health Grant Scheme (can include recycled waste and waste disposed to sewer)	Royds Garden Ltd, 1991
A strategy to minimise packaging waste	1994	2,700,000	Not given	Not given	Based on questionnaire and WAP results	PIAC, 1996
WAP Surveys & Landfills Census	1995	3,180,000	1,420,000	1,760,000	Base on WAP surveys and Landfill Census	

Note:
1. Different surveys have used different methodologies and have not been provided with standard errors. The data themselves and the comparison between data should therefore be considered approximate.
2. Other waste refers to "special waste", e.g. treated hazardous waste or waste requiring special disposal etc.

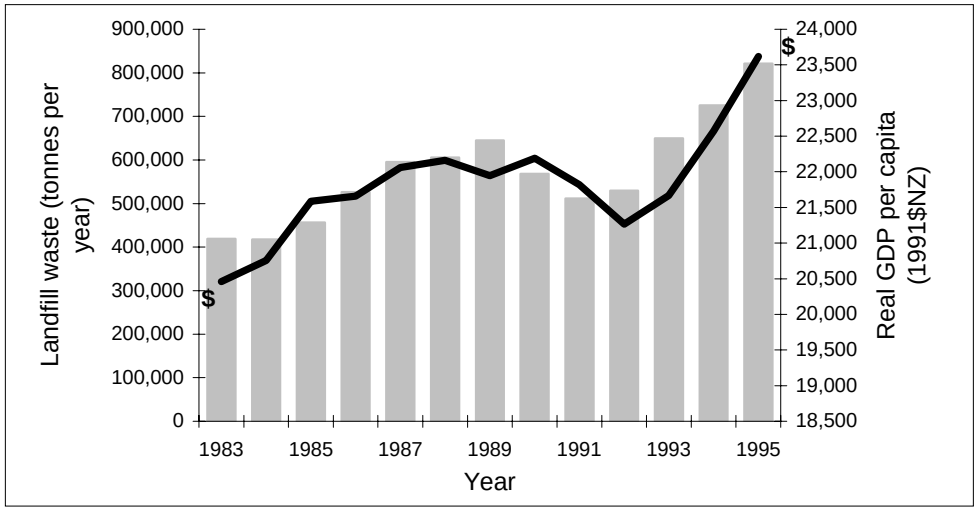


Figure 3.1.3 Economic growth and waste disposal at Auckland landfills [Auckland Regional Council, *unpublished*; Statistics New Zealand, 1996].

b) Composition

Figure 3.1.4 summarises the composition of total landfilled waste in New Zealand and in 14 regions in 1995. These figures have a standard error of less than 1%. The figure shows that organic waste is the largest component of landfilled waste (38%), followed by paper (20%) and construction and demolition waste (18%). The three waste types combined account for 76% of the total weight of landfilled waste.

This waste profile can be compared to waste profiles of developed and developing countries to identify trends which are shown in Figure 3.1.5. The New Zealand waste profile falls somewhere in the middle of the developing-developed country spectrum. This does not necessarily mean that New Zealand discards less metal, glass, plastic or paper than the developed countries, but only that these make up a relatively smaller proportion of the total waste because of the greater predominance of organic matter.

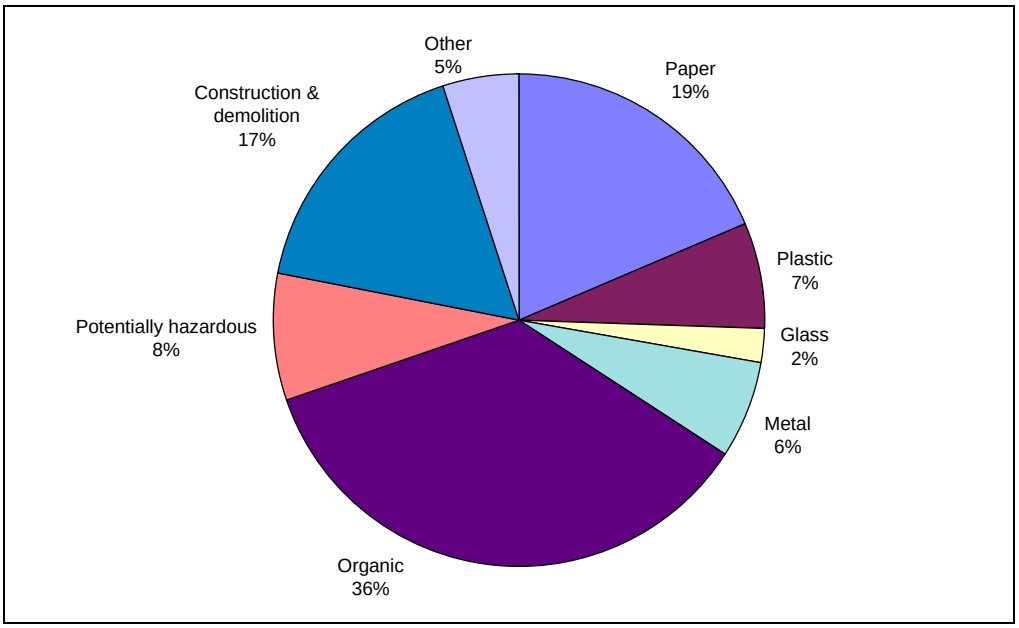


Figure 3.1.4 Composition of total landfilled waste in New Zealand in 1995.

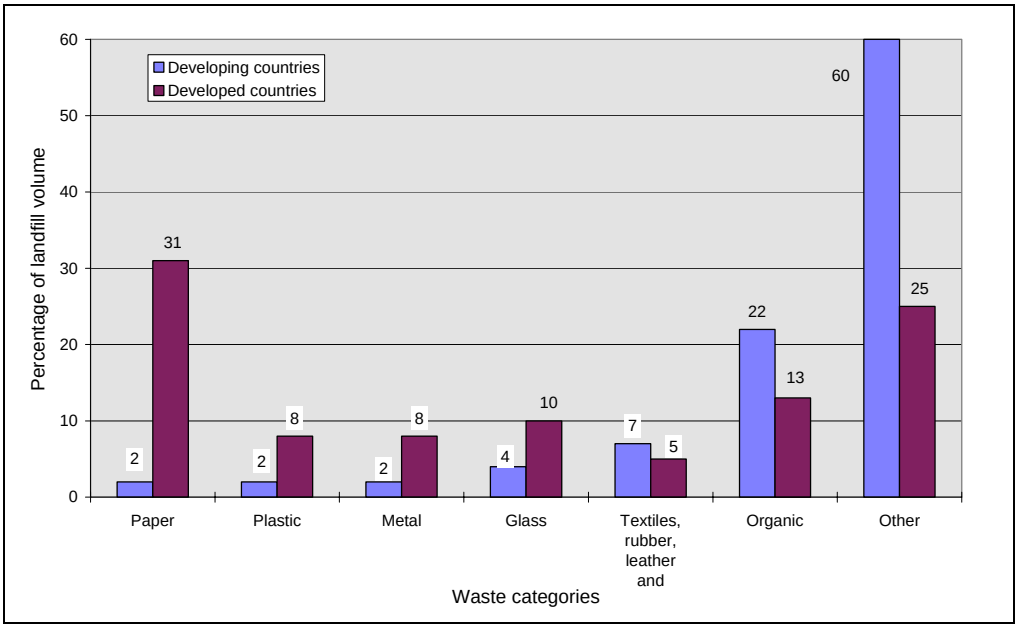


Figure 3.1.5 Composition of waste in developed and developing countries [Cairncross, 1993].

PIAC has also estimated the proportion of total landfilled waste that is packaging waste [PIAC, 1996]. Based on information on the production of packaging provided by the packaging industry and estimates of direct imports and exports of packaging, it was estimated that approximately 453,000 tonnes of packaging waste was generated in New Zealand in 1994. It was estimated that approximately 132,800 tonnes (no standard error given) of recyclable materials were collected for recycling in New Zealand in 1994, based on information collected from waste contractors and councils. This figure includes packaging (e.g. glass, cans) and non-packaging materials (e.g. newspapers).

Using the total landfilled waste figure of 3,180,000 tonnes in 1995, the estimated maximum percent of total landfill waste comprising packaging is: 453,000 / 3,180,000 = 14.2%. However if it is assumed that all the collected recyclables were packaging materials, the estimated minimum percent of total landfilled waste comprising packaging is (452,900 - 132,800) / 3,180,000 = 10.1%. In reality the percentage of packaging waste as a proportion of the total landfilled waste will lie somewhere between 10.1% and 14.2%. This indicates that packaging is a relatively small proportion of the total landfilled waste.

c) Construction and demolition waste

Construction and demolition (C&D) waste includes concrete rubble, demolition waste and wood. At a national level, C&D waste accounts for 17% of the total landfilled waste (Figure 3.1.4), 10% of the residential landfilled waste, and 22% of the industrial landfilled waste.

The construction industry is the largest source (35%) of C&D waste landfilled in the Auckland region in 1995 as shown in Figure 3.1.6. Other sources include residential, manufacturing, wholesale and retail, and other industries.

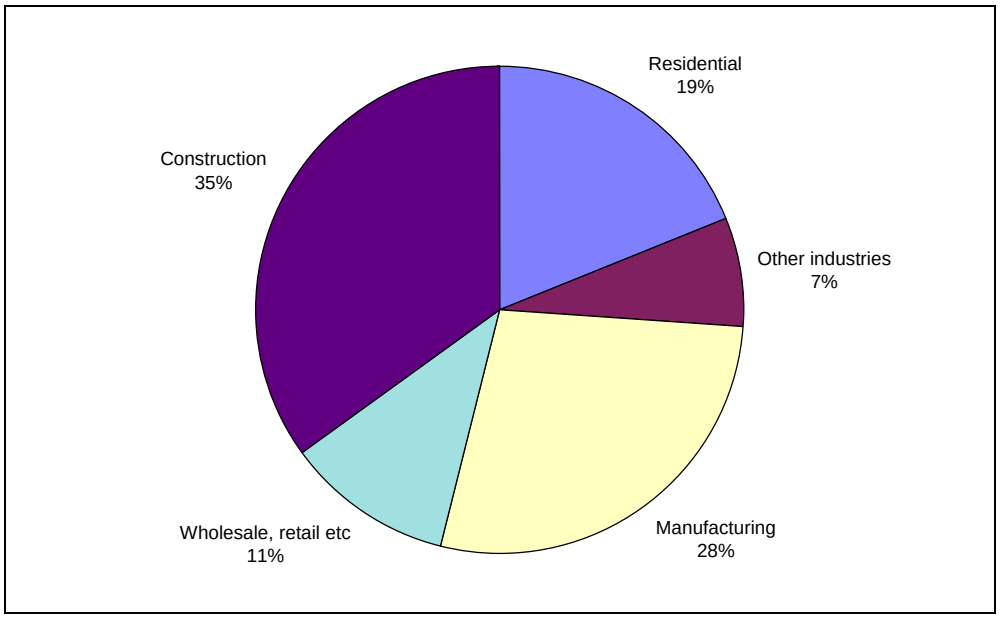


Figure 3.1.6 The main sources of landfilled construction and demolition waste in the Auckland Region in 1995 [Auckland Regional Council and Auckland City Council, 1995].

It should be noted that not all C&D waste is landfilled. In the Auckland region in 1995 nearly 826,000 tonnes (526,000 demolition + 350,000 excavation) were cleanfilled and some C&D waste was diverted (see Figure 3.1.7).

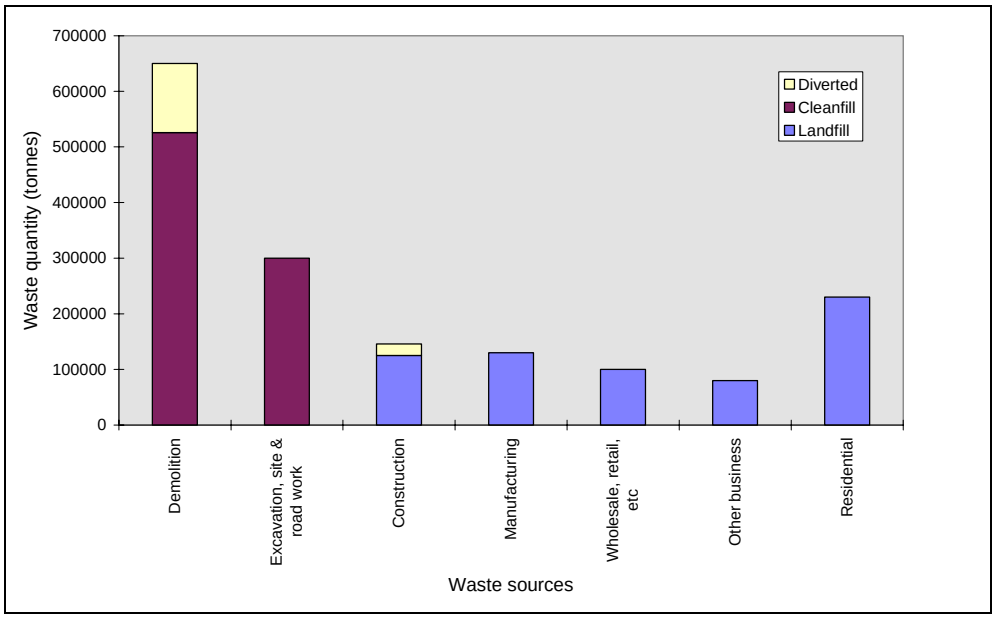


Figure 3.1.7 Major landfill and cleanfill waste streams in the Auckland region in 1995 [Auckland Regional Council and Auckland City Council, 1995].

3.1.2. Residential landfilled waste

a) Total quantities

The component of the residential waste that is landfilled is covered by Module C of the WAP. This module examines residential rubbish bags collected through the kerbside collection system, residential waste taken to landfills by private vehicles, and waste collected through annual or bi-annual "inorganic/hard refuse collections run by many councils. Module B of the WAP is used to determine the weights and composition of residential rubbish bags and bins only.

Module B and C exclude the monitoring of recyclable waste collected through kerbside recycling systems or at transfer stations, and also exclude residential waste collected by private waste contractors, for example, in a skip bin. To gain a total figure of residential waste **generated**, all sources would need to be surveyed. The WAP has not been used for this purpose to date.

In 1995, the total amount of residential waste landfilled in New Zealand was approximately 1,420,000 tonnes (see Figure 3.1.1). Table 3.1.2 shows that the total weight of residential rubbish bags in 1995 was 540,000 tonnes per year, of which 360,000 tonnes (67%) is from urban sources and 180,000 tonnes (33%) is from mixed urban and rural sources. The methodology used to obtain these data and more detailed data are provided in Appendix V .

Table 3.1.2 Breakdown of residential landfilled waste in 1995.

	Residential total waste (tonnes)	Residential bins and bags (tonnes)	"Inorganic/hard" residential waste collections	Residential waste taken to landfill by private vehicles
Total	142,000	54,000	Not available	Not available
Urban	Not available	36,000	Not available	Not available
Other (mixed urban and rural)	Not available	18,000	Not available	Not available

Note: Different methods were used to estimate figures for residential total waste and residential bins and bags.

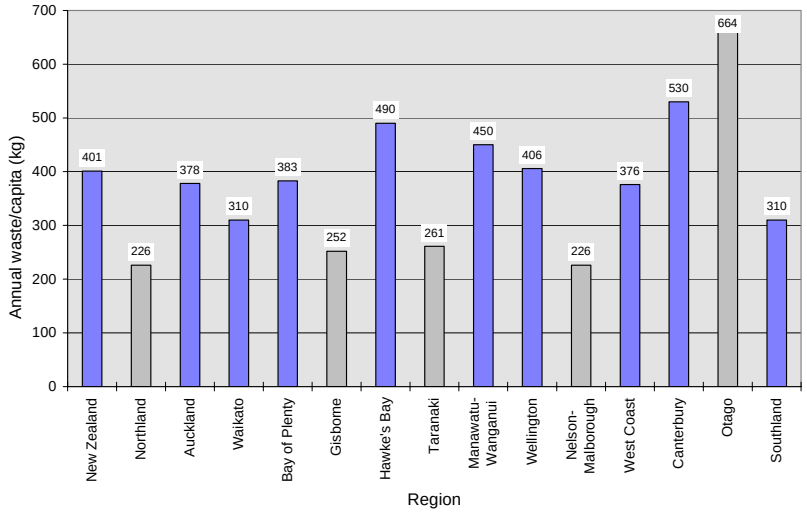
b) Quantities per capita

Using the total residential waste figure of 1,420,000 tonnes for 1995 and the March 1994 population figure of 3,540,700 it is possible to calculate the per capita quantity residential waste landfilled. In 1995, an average of 401 kg of residential waste was generated per capita.

The OECD average was estimated at 500 kg/person in 1992. This was an increase of about 20% from 420 kg/person estimated in 1980 [OECD, 1995]. Using the estimated average residential waste figure of 401 kg/capita, this suggests that New Zealanders dispose of approximately 20% less solid waste than people in the average OECD country.

It should be noted that the definitions used by OECD countries vary from waste from households only, to all waste disposed at facilities used for waste collected by or on the order of local authorities.

Figure 3.1.8 shows the quantities of waste per capita for the different New Zealand regions. It should be noted that the very high figure (Otago region) and the very low figures (Northland, Gisborne, Taranaki, and Nelson-Marlborough) are based on the least reliable methods used to calculate annual landfilled tonnage (see Appendix V). These figures should be interpreted with caution until more reliable estimates are available.



Note: The very high figure (Otago region) and very low figures (Northland, Gisborne, Taranaki, and Nelson-Marlborough) are based on the least reliable methods used to calculate annual landfilled tonnage, and should therefore be interpreted with caution.

Figure 3.1.8 Quantity of residential waste per capita as in 1995 for New Zealand regions.

As shown in Figure 3.1.9, the annual quantity of waste disposed of through rubbish bags is 152.3 kg/capita, 186.1 kg/capita in urban areas and 110.9 kg/capita in other areas (mixed urban and rural). The difference in quantities of waste collected from urban and other areas may reflect the higher coverage of residential collections in urban areas.

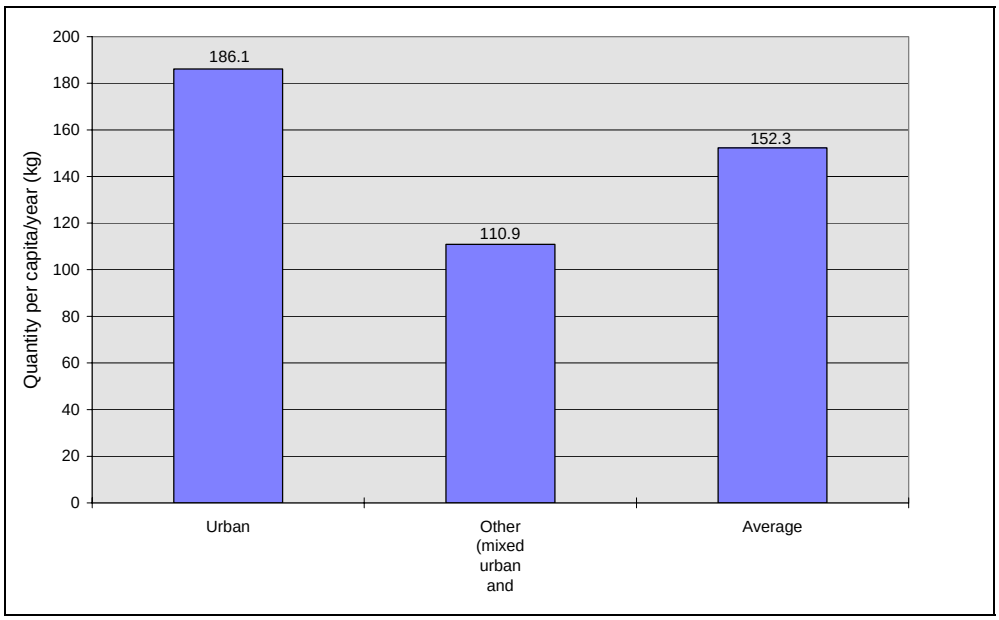


Figure 3.1.9 Annual per capita weight of residential waste bags and bins in New Zealand in 1995.

c) Composition

The composition of landfilled residential waste in 1995 is given in Figure 3.1.10 and is based on the eight WAP waste categories. Figure 3.1.11 shows the composition of residential rubbish bags. More data are provided in Appendix V.

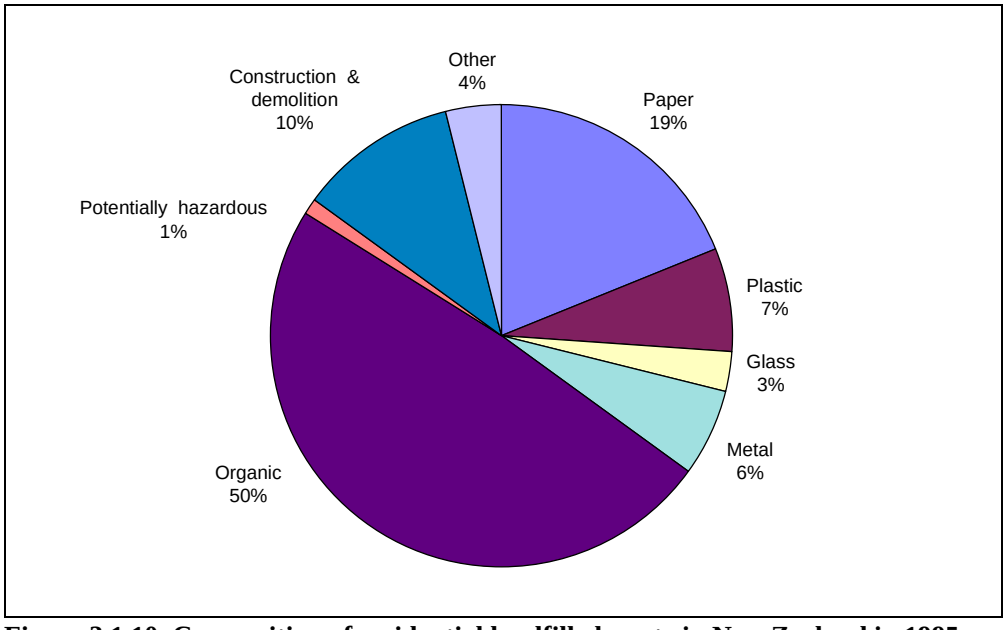


Figure 3.1.10 Composition of residential landfilled waste in New Zealand in 1995.

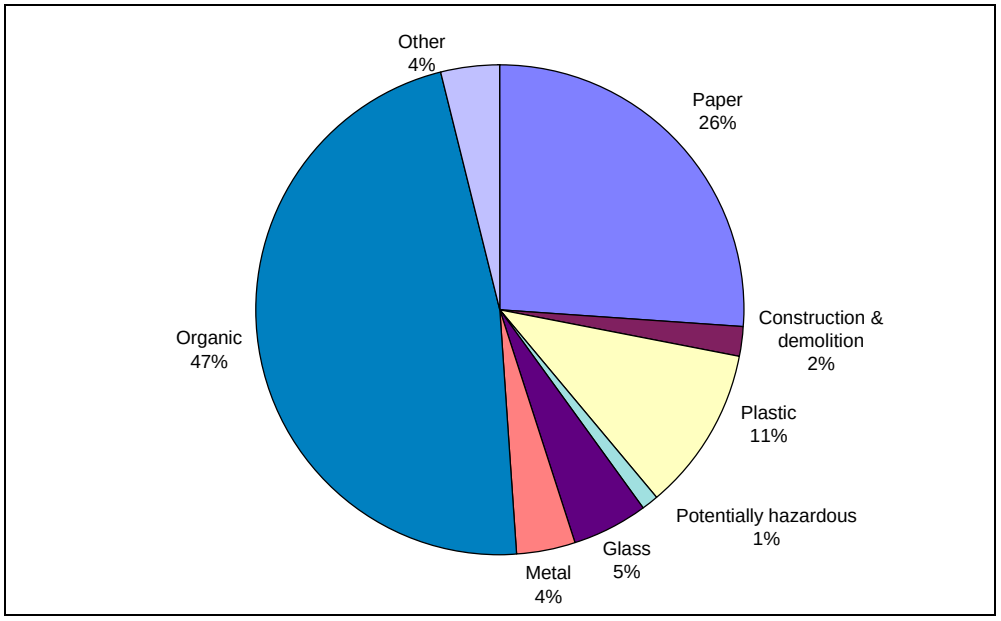


Figure 3.1.11 Composition of residential waste bags and bins in New Zealand in 1995.

The figures show that almost half of all residential waste is organic matter and that paper is the second largest proportion of material in residential waste. Comparing the composition data for landfilled residential waste with residential bags and bins shows that the landfilled residential waste has higher proportions of construction and demolition and organic waste compared to residential bags and bins. These differences reflect the garden (organic) waste and the C&D waste taken to landfills in private vehicles, and construction and demolition waste collected through "inorganic/hard" refuse collections. As a result, the proportions of the other types of waste are lower for residential landfilled waste compared to bags and bins.

3.1.3. Industrial landfilled waste

In 1995, 1,760,000 tonnes of industrial waste were landfilled in New Zealand, which equates to approximately 55% of the total landfilled waste in New Zealand (see figure 3.1.1). Figure 3.1.2 shows the quantities of landfilled industrial waste generated in different regions. Figure 3.1.12 shows the composition of industrial landfilled waste. More background data and information on the methodology used to determine the quantities and composition are provided in Appendix V.

When compared to landfilled residential waste (Figure 3.1.10), landfilled industrial waste has a lower organic component (24% compared to 50%), a higher construction and demolition component (22% compared to 10%), and a higher amount of potentially hazardous waste (15% compared to 1%).

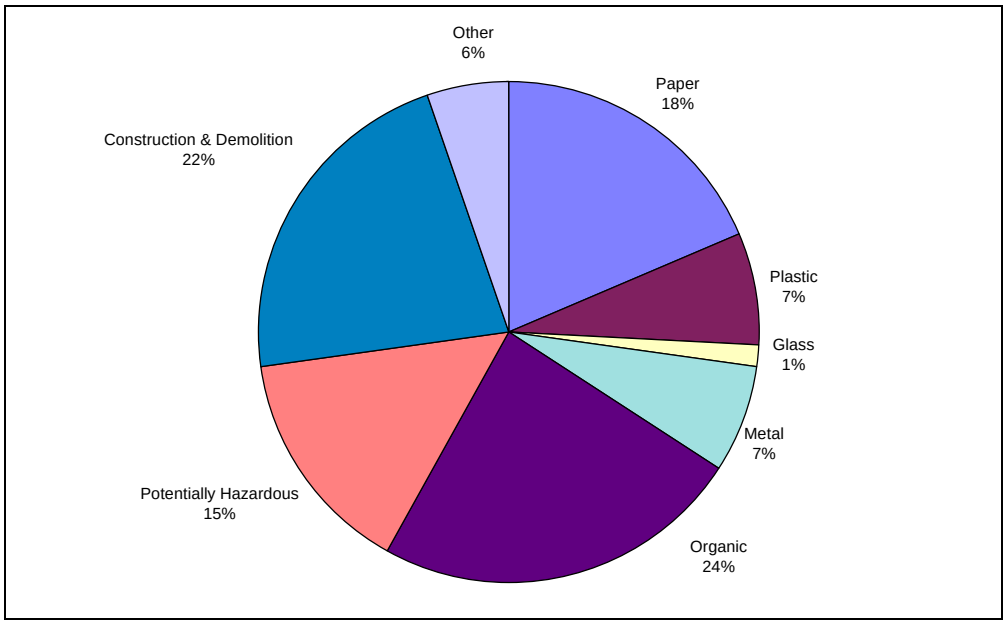


Figure 3.1.12 Composition of landfilled industrial waste in New Zealand in 1995.

3.2. Cleanfilled waste

Currently there is no national record on operating cleanfills in New Zealand. Consequently, there is no national information available on the number, sizes, and locations of cleanfills or on the sources, quantities and composition of waste going to cleanfills.

Cleanfills currently receive most of the waste from the construction industry. Cleanfill waste includes waste such as concrete, brick, asphalt, soil and clay that is not contaminated with materials that will leach in to the environment (e.g. metals, organic material and timber) [Auckland Regional Council and Auckland City Council, 1996]. Auckland Regional Council allows a maximum contamination of 5% for waste to be considered cleanfill waste [Auckland Regional Council, *personal communication*].

Although no national data exists on quantities of cleanfilled waste, a report on C&D waste in the Auckland region indicates that the quantities are significant [Auckland Regional Council and Auckland City Council, 1996]. In the Auckland region approximately 830,000 tonnes of demolition and excavation waste are going to cleanfills per year (see Figure 3.1.7). This is about the same as the total landfilled waste in the Auckland region (approximately 809,000 tonnes per year). It should be noted that as cleanfilled waste is less contaminated than landfilled waste, the potential environmental impacts are less significant.

3.3. Litter

Although the data for total quantity of landfilled waste suggests an increase over time, there is evidence to suggest that the New Zealand public have also become a little more responsible in disposing of their waste. Litter surveys have been conducted twice a year for the past decade by the Keep New Zealand Beautiful Campaign. The surveyors systematically count and classify the litter discarded at over 100 regular sites throughout the country. Although litter represents only a small fraction of the solid waste stream, it is the most visible and widely dispersed fraction and has considerable nuisance value,

especially in scenic areas. Figure 3.3.1 shows that, although substantial amounts of litter are still discarded, the total quantity has declined from 1986 to 1994 [Drum, 1994].

Just over half the litter identified in the biannual surveys is paper (53%) with a quarter being plastic (26%). The remainder is divided among metal (6%, of which half is cans), glass (4%), and miscellaneous items, such as wood, ice cream sticks, food scraps, tyres, rubber items, clothing and construction material. The metal and glass proportions have declined significantly over the decade, while the plastic proportion has increased. Much of the paper, plastic, metal and glass litter comes from discarded packaging, particularly food and drink containers.

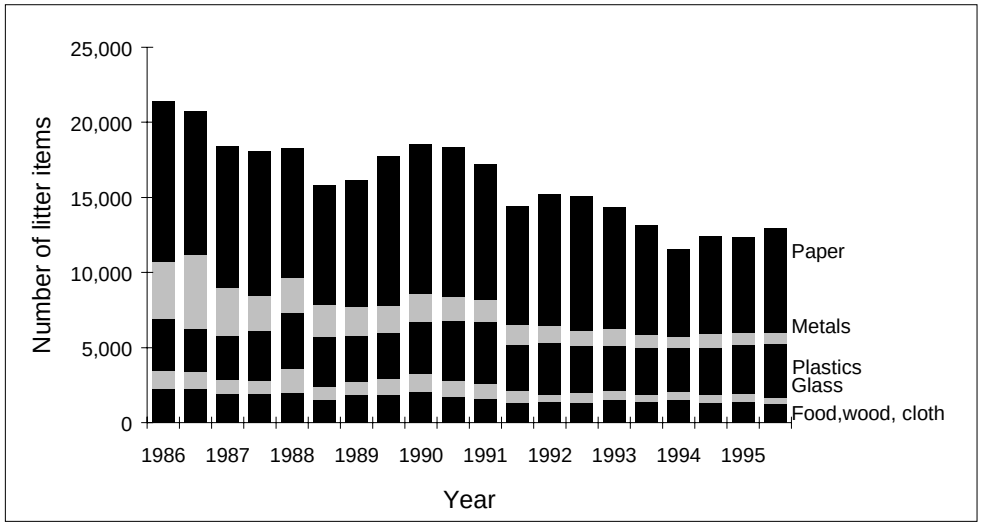


Figure 3.3.1 Litter trends in New Zealand (September 1986 - March 1996) [Keep New Zealand Beautiful*, personal communication*].

3.4. Dumping at sea

Dredging permits are granted by regional councils. Permit applicants can be asked to provide information on the quantities, level of contamination, and disposal methods used. If dredging waste is dumped at sea, a permit must be obtained from regional councils if it is dumped within 12 nautical miles from the coast and from the Maritime Safety Authority if it is dumped between 12 and 200 nautical miles from the coast (Marine Pollution Act, 1974).

The total quantities of dredging waste dumped at sea between 1990 and 1996 are summarised in Figure 3.4.1. In the past four years total quantities have not exceeded 2 million cubic metres. It is notable that the quantities actually dumped at sea are for each year significantly lower that the quantities that the Maritime Safety Authority permitted to be dumped.

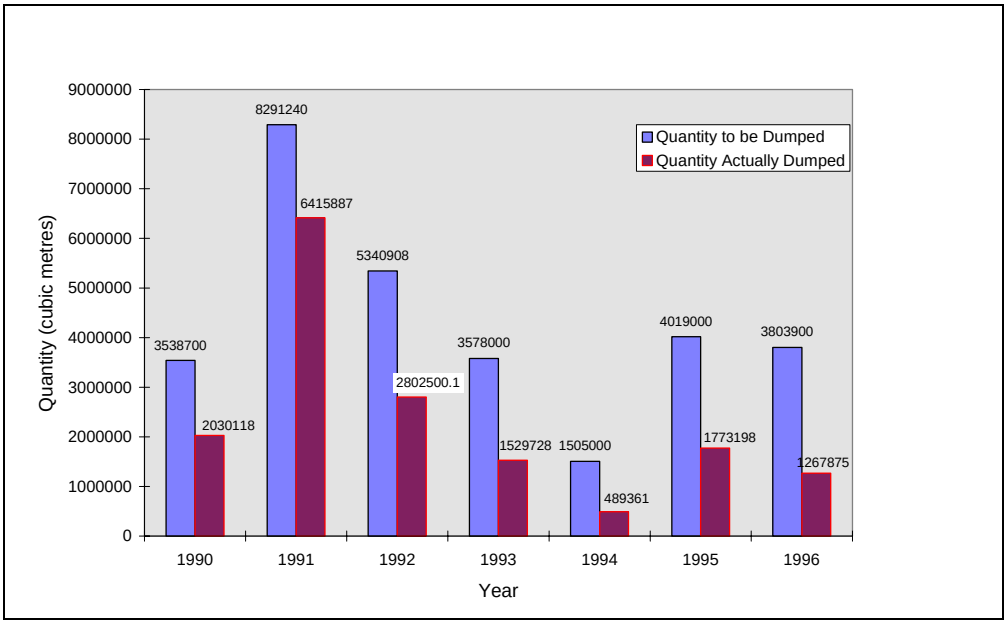


Figure 3.4.1 Quantities of dredging waste dumped at sea in New Zealand between 1990 and 1996 [Maritime Safety Authority, *personal communication*].

3.5. Recycling

3.5.1. Total

Recyclables are collected from households, commercial enterprises and businesses. Collection methods for recyclable materials include collection through kerbside recycling schemes, by waste contractors and by schools, and drop-off at transfer stations, depots at landfills, and personal delivery to recyclers. This level of complexity makes it difficult to obtain accurate data on tonnage recycled.

Little information is available at a national level on recycling. The only national data identified was by the Packaging Industry Advisory Council (PIAC), who calculated approximate tonnes of materials reclaimed for recycling in 1993 and 1994 (see Table 3.5.1). It is likely that total quantities of recyclables collected have increased and recycling coverage areas have been extended since 1994.

Figure 3.5.1 shows the population coverage of recycling schemes. The figures indicate that more that 80% of the New Zealand population has access to one or more recycling schemes for glass, aluminium and paper, followed by approximately 60% coverage for plastic and approximately 50% for steel and organic waste. It should be noted that glass collections in the South Island from 1 March 1996 may be less than past volumes due to limits on the level of freight payments.

Table 3.5.2 summarises the number of landfills that collect materials for recycling. Table 3.5.3 shows the total waste diverted by recycling and other waste minimising activities at New Zealand landfills over a 12 month period.

Table 3.5.1 Production, consumption and collection of recyclable materials in New Zealand in 1993 and 1994 [PIAC 1994, 1996].

	Production		Consumption		Collection for recycling		Collection as % of consumption	
Material	Total 1993	Packaging 1994	Total 1993	Packaging 1994	Total 1993	Packaging 1994	Total 1993	Packaging 1994
Aluminium	270,000	7,785	52,812	6,530	32,130	2,680	11.9%	41%
Steel	Not known	38,295	Not known	39,710	Not known	1,250	Not known	3%
Glass	Not known	88,160	Not known	84,040	Not known	30,340	Not known	36%
Paper & cardboard	798,000	394,000	473,000	215,620	314,412	89,530	39.4%	42%
Plastic	157,423	109,010	119,585	106,990	22,039	9,000	14%	8%
Total	1,375,423	637,250	705,397	453,890	458,581	132,800	32.9%	20.8%

Note:

1. All data are provided in tonnes.
2. Production refers to materials manufactured in New Zealand, including exported packaging.
3. Consumption refers to material use in New Zealand and includes imported materials: consumption = production - exports + imports.
4. Collection means waste collected for recycling after manufacturing and includes post-consumer waste.
5. This table does not include an estimated additional 53,000 tonnes of manufacturing waste reprocessed in-house, which does not appear in the collection figure.

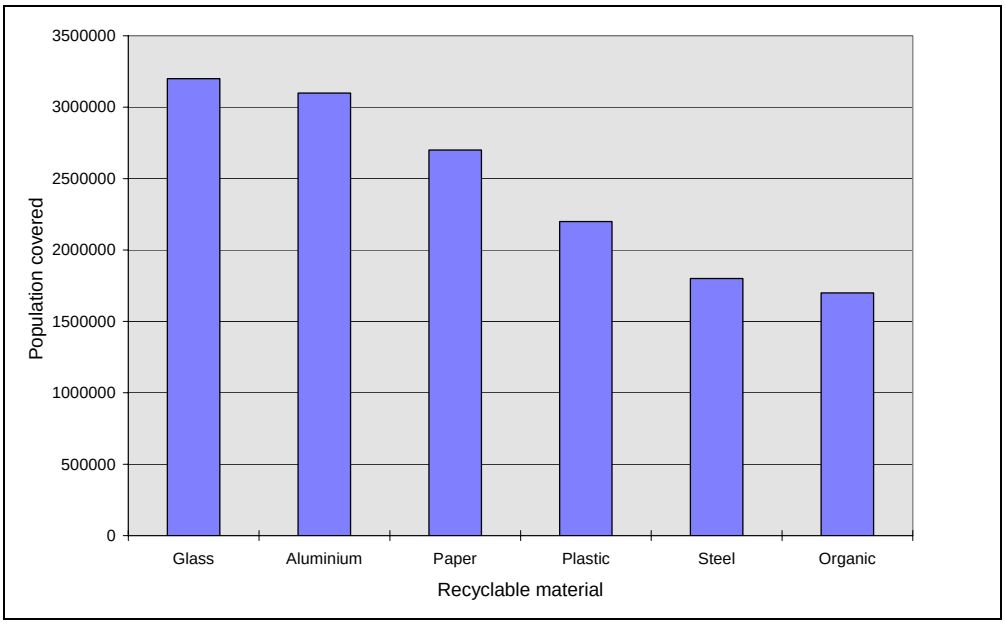


Figure 3.5.1 Population serviced by recycling schemes in 1994 [PIAC, 1996].

Table 3.5.2 Types of materials recycled at landfills in New Zealand as at March 1995 [Ministry for the Environment, 1997(b)].

Types of material	Number of landfills
Glass	80
Car bodies	46
Metals/scrap metal	56
Paper/newspaper	37
Whiteware	34
Plastic	31
Alloy/aluminium cans	27
Steel/scrap steel	24
Timber/wood	18
Green waste/compost	20
Cardboard	16
Used oil	18
Aluminium	10
Clothing/textiles	9
Firewood	5
Steptoe operation/anything saleable	9
Other	12
Not known	1

Table 3.5.3 Total waste diverted by waste-minimising activities at New Zealand landfills in the last 12 months (as at March 1995) [Ministry for the Environment, 1997(b)].

Quantity (tonnes)	Number
Up to 49	15
50-99	16
100-499	14
500-999	13
1000-4999	5
5000+	5
Don’t know	27
No reply	27

At a local or regional level, quantities of industrial waste and residential waste collected or deposited for recycling have been estimated by a number of councils as shown in Table 3.5.4. These are estimates only, rounded to the nearest 10 tonnes. As no standard error was given for any of the figures, nothing can be said about the reliability of the data. Recyclable materials are also collected in other cities and regions, but no data are available to the Ministry.

Table 3.5.4 Estimated quantities of materials collected for recycling in New Zealand cities and regions.

City or region	Recyclable materials collected (tonnes/year)										Comments
	Total	Paper & cardboard	Plastic	Alum - inium	Tin	Metal	Batteries	Organic	Oil	Glass	
Auckland City	6,590			130	600					5,060	1995/96 kerbside recycling [Auckland City Council, *personal communication*]
Waitakere City	12,880	3,330	480	80	370	3,280	50	3,410		1,880	1995/96, kerbside & transfer stations [Waitakere City Council, *personal communication*]
North Shore City	11,250	8,000	550	100	400					2,200	Kerbside recycling, year unknown [North Shore City Council, *personal communication*]
Wellington City	5,280	3,230	340			310				1,400	Kerbside 1995/96 [Works Consultancy Services Ltd, 1996(a)]
Lower Hutt	2,110	1,430		20	80					580	Kerbside recycling 1995/96 [Hutt City Council, *personal communication*]
Gisborne District	250	240	10								Collection by waste contractors, Dec 95-Dec 96 included, diverted to annual tonnage [Gisborne District Council, *personal communication*]
Palmerston North City	1,538										Landfill site & recycling centre, July 94 - March 95, diverted to annual tonnage [Woodward-Clyde Ltd, 1995]
Marlborough District	1,520	1,100		30						390	Collection by waste contractors, July 1994 - June 1995 [Marlborough District Council, 1995]
Christchurch City	46,990	15,530	20			27,110			2,400	1,930	[MAF Consultancy Services, 1992] collection by recycling firms, 1992

Note: Quantities rounded to nearest ten tonnes.

3.5.2. Residential

Data on the quantities of waste segregated for recycling from residential sources in New Zealand are scarce. There is no national figure for quantities of residential waste recycled. A number of recycling systems are currently in place for residential waste, including [Wellington City Council, *personal communication*]:

- kerbside recycling collection bins provided for households (in part of or for the entire city) by (see Table 3.5.4):
  - Auckland City Council
  - Waitakere City Council
  - North Shore City Council
  - Hutt City Council
  - Wellington City Council
  - (Christchurch City Council may commence in 1997);

- kerbside collection of specific materials for recycling if they are placed in suitable bags (e.g. supermarket bags) alongside regular residential waste bins or bags. The waste collection contractors collect these materials at the same time as the residential waste collection:
  - New Plymouth City Council
  - Wanganui City Council
  - Upper Hutt City Council;

- collection of recyclable materials at "drop off" sites or transfer stations for some materials (e.g. aluminium cans, glass, newspapers or cardboard), is common in most districts throughout New Zealand.

Wellington City Council has undertaken an evaluation of the solid waste generated, landfilled and recycled in Wellington City. The data are summarised in Table 3.5.5. The proportions of recyclable materials landfilled and recycled are shown in Figure 3.5.2. This figure indicates that a relatively small portion of potentially recyclable materials is recycled in Wellington City.

Table 3.5.5 Summary of solid waste disposed in Wellington City [Works Consultancy Services, 1996(a)].

Solid waste issue	1994/95	1995/96	Percentage change
Total landfilled waste (industrial & municipal). Note: volumes of compacted waste were multiplied by 1.5 to obtain weights.	276,025 tonnes	254,190 tonnes	- 7.9 %
Number of municipal waste bags collected per household per week	1.06	0.94	- 11.3 %
Total municipal recyclables collected for recycling (recycling stations & kerbside collection scheme)	4,510 tonnes	5,270 tonnes	+ 14.4 %
Per capita municipal recyclables collected for recycling (taking the population increase into account)	0.034 tonnes	0.030 tonnes	- 11.8 %
Percentage of recyclables landfilled	94 %	92.5 %	- 2.5 %

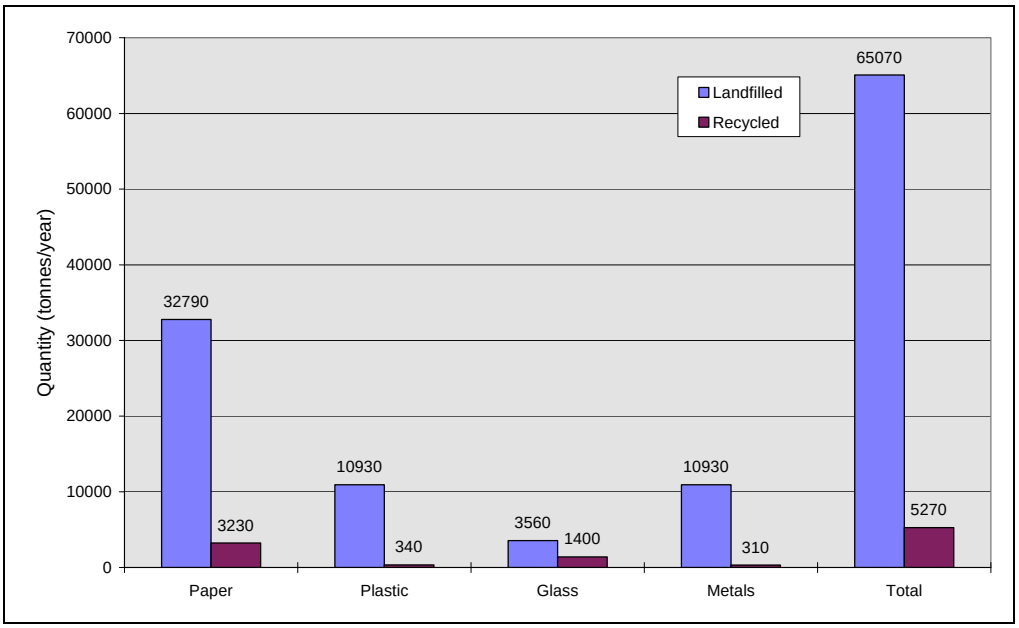


Figure 3.5.2 Quantities of recyclable materials landfilled and recycled in 1996 in Wellington City [Works Consultancy Services, 1996(a)].

3.6. Reduction

No data are available regarding waste reduction for New Zealand nationally or locally. The only information found was the reduction in the use of packaging materials over the last ten years, estimated by PIAC (1996). Typical packages in 1994 weigh much less than in 1985. Reductions in packaging volumes result from "light-weighting" (e.g. lighter soft drink bottles) or the use of lightweight materials and design improvements. Table 3.6.1 shows that the packaging waste stream would be 100,810 tonnes larger per year if packaging would weighed as much as it did in 1985.

In spite of the significant reductions in specific packaging materials achieved in New Zealand over the last decade, total packaging volumes have not reduced because of the absolute growth in volume of products and services requiring packaging.

Table 3.6.1 Average weight reduction of packaging material type - comparison between 1985 and 1994 [PIAC, 1996].

Material	1994 consumption component produced in NZ (tonnes)	Change of packaging weights between 1985 and 1994	Annual tonnes saved as in 1994 compared to 1984
Aluminium	4,730	- 14 %	770
Glass	68,210	- 15 %	12,040
Paper	147,610	- 20 %	36,900
Plastic	80,370	- 37 %	47,200
Steel	23,970	- 14 %	3,900

4. LIQUID WASTE

4.1. Introduction

Liquid waste includes wastewater or sewage, stormwater, point source discharges and non-point source discharges.

In 1996 the *National Wastewater Treatment Plant Database* was completed, which was the first attempt to compile comprehensive national information on wastewater and public wastewater treatment plants in New Zealand. This chapter has mainly been drawn from data from this Database which is owned and operated by the New Zealand Water and Wastes Association (NZWWA). Data on wastewater, presented in section 4.2, includes wastewater quantities and qualities. Sludge generated by wastewater treatment plants is also discussed in this section, although it is strictly speaking considered a solid waste. It should be noted that the Database covers public wastewater treatment plants only, and in many cases the data supplied are incomplete. Information on other methods of sewage disposal, including privately owned and operated treatment plants (e.g. at an industrial site) and septic tanks, has not been found.

National monitoring data on non-point discharges of liquid waste in New Zealand is presented in section 4.3.

The Ministry of Agriculture completed a study on freshwater quality in New Zealand and the influence of agriculture on quality [Smith et al., 1993]. As the study focused on water quality rather than quantities of waste disposed into surface water bodies, information from this report has not been included in this Chapter.

4.2. Wastewater at public wastewater treatment plants

There are 258 public wastewater treatment plants operating in New Zealand. The sizes of the plants vary significantly. The smallest plant, the Waitoria plant in Whangarei, serves a population of 12. The largest plant is Mangere wastewater treatment plant in Manakau City and serves a population of approximately 700,000. Therefore data presented in this section should be interpreted with caution as in many cases data are provided for the number of plants rather than for the population served or the average daily flow.

A summary table for a number of wastewater treatment plants for 1995/96 is included in Appendix VI [NZWWA, 1996].

4.2.1. Wastewater quantities

a) Influent quantities

The influent of a wastewater treatment plant is the water coming into the plant, which is expressed as average daily flows (ADF) or m^3 per day. The Database provides ADFs of influents for 135 of the 258 treatment plants, of which measured ADFs are available for 43 plants and estimated ADFs are available for 92 plants. The measured ADFs and the average flow per capita for the 43 plants are shown in Table 4.2.1. The remainder of the plants do not monitor or did not report influent quantities.

Table 4.2.1 Measured influent quantities for 43 wastewater treatment plants in New Zealand in 1995/96 [Woodward-Clyde, 1996].

Local authority	Treatment plant	Population covered	Avg. daily flow (m3/d)	Flow /capita (measured)
Ashburton District Council	Ashburton Oxidation Pond	15000	8331	0.56
Christchurch City Council	Belfast WWTP	3600	1409	0.39
Christchurch City Council	Christchurch WWTP	314000	148000	0.47
Christchurch City Council	Templeton WWTP	2350	923	0.39
Hamilton City Council	Hamilton WWTP	105300	40640	0.39
Hastings District Council	Hastings Wastewater Facility	50000	47215	0.94
Hutt City Council	Seaview Milliscreen Plant	108000	20810	0.19
Hutt City Council	Wainuiomata WWTP (High Rate)	11100	4692	0.42
Invercargill City Council	Clifton WWTP	48785	21905	0.45
Kapiti Coast District Council	Otaki WWTP	6500	1981	0.30
Kapiti Coast District Council	Paraparaumu WWTP	18500	4844	0.26
Kapiti Coast District Council	Waikanae WWTP	7000	2750	0.39
Marlborough District Council	Blenheim	18000	16943	0.94
Marlborough District Council	Havelock	500	165	0.33
Marlborough District Council	Spring Creek	325	60	0.18
New Plymouth District Council	New Plymouth WWTP	48519	20693	0.43
New Plymouth District Council	Waitara WWTP	7000	4593	0.66
North Shore City Council	North Shore WWTP	151000	43400	0.29
Opotiki District Council	Opotiki Service Treatment Plant	3500	1200	0.34
Rodney District Council	Whangaparaoa	10000	1419	0.14
Rotorua District Council	Rotorua WWTP	50000	20531	0.41
Ruapehu District Council	Hikumutu Sewage Treatment Plant	6000	2312	0.39
South Waikato District Council	Arapuni	254	59	0.23
South Waikato District Council	Putaruru	3992	931	0.23
South Waikato District Council	Tirau	707	280	0.40
South Waikato District Council	Tokoroa	15959	4148	0.26
Taupo District Council	Acacia Bay	1400	351	0.25
Taupo District Council	Atiamuri (Hydro Village)	120	28	0.23
Taupo District Council	Kinloch WWTP	1300	124	0.10
Taupo District Council	Mangakino WWTP	1500	500	0.33
Taupo District Council	Motuoapa WWTP	728	39	0.05
Taupo District Council	Omori-Kuratau	1800	1285	0.71
Taupo District Council	Taupo	16000	4994	0.31
Taupo District Council	Turangi WWTP	4500	1200	0.27
Taupo District Council	Waitahanui	900	111	0.12
Taupo District Council	Whakamaru (Hydro Village)	240	48	0.20
Tauranga District Council	Chapel Street WTP	53000	14400	0.27
Upper Hutt City Council	Maymorn WWTP	210	90	0.43
Watercare Services Ltd	Mangere WWTP	700000	262000	0.37

Local authority	Treatment plant	Population covered	Avg. daily flow (m3/d)	Flow /capita (measured)
Wellington City Council	Moa Point Milliscreening Plant	120000	65578	0.55
Whangarei District Council	Langs Beach	17	4.8	0.28
Whangarei District Council	Ngunguru	500	108	0.22
Whangarei District Council	Whangarei	40000	14997	0.37
Total		1,948,106	779,048.8	
Weighted average (N=43, with correction for population)				0.41
Average (N=43)				0.33
Minimum				0.05
Maximum				0.94
Standard deviation				0.19
Standard deviation (%)				56.60%

Using the weighted average ADF per capita of 0.41 m^3 (Table 4.2.1), the total influent ADF for the New Zealand population covered by public wastewater plants can be calculated. Population coverage is available for only 237 of the 258 treatment plants. The total population covered by these 237 plants is 2,890,000. The total influent ADF for these 237 plants is approximately 1,185,100 m^3/day. If the New Zealand March 1994 total population figure of 3,540,700 is used, the New Zealand influent ADF is approximately 1,451,700 m^3/day. Therefore it is estimated that the New Zealand influent ADF lies somewhere between 1.1 and 1.5 million m^3/day.

The estimated and measured influent ADFs can be used to calculate a total figure of wastewater generated in New Zealand. Figures for 1995/96 are shown in Table 4.2.2.

This calculation suggests that the total quantity of wastewater generated by a population of 2,890,600 is between 1.1 and 1.3 million m^3 per day (based on only 237 plants). As this data is only based on the estimates and/or measurements supplied for 135 treatment plants, and does not include the 21 plants for which no population figures were supplied, it should be considered only as an indicative. The reliability of this calculation has not been investigated.

Table 4.2.2 Influent quantities for New Zealand wastewater treatment plants in 1995/96 [Woodward-Clyde, 1996].

Calculation of ADF	Number of treatment plants	Total ADF (m^3/day)	Population covered	ADF/capita (m^3/day)	Total ADF for New Zealand (2,890,600)
Measured	43	796,100	1,948,100	0,41	1,185,146
Estimated	135	1,146,900	2,677,700	0.43	1,242,958

Wastewater also has a solid component. The small particles suspended in the wastewater are called “suspended solids” (SS). By multiplying the SS value with the influent flow, the dry solid component of the wastewater can be calculated. Using the population served figures from Table 4.2.1 the dry solid component per capita per day can be calculated. Of the 258 treatment plants, 17 have monitored the solid component values in wastewater. This information is provided in Table 4.2.3.

Table 4.2.3 Quantities of dry solids entering 17 New Zealand wastewater treatment plants in 1995/96 [Woodward-Clyde, 1996].

Local authority	Wastewater treatment plant (WWTP)	ADF (m3/day)	SS (g/m3)	Dry solids (kg/day)	Dry solids (kg/capita/ day)
Christchurch City Council	Belfast WWTP	1409	255	360	0.10
Christchurch City Council	Christchurch WWTP	148000	164	24270	0.77
Hamilton City Council	Hamilton WWTP	40640	357	14510	0.14
Hutt City Council	Wainuiomata WWTP (High Rate)	4692	233	1090	0.10
Kapiti Coast District Council	Otaki WWTP	1981	182	360	0.06
Kapiti Coast District Council	Paraparaumu WWTP	4844	231	1120	0.06
Kapiti Coast District Council	Waikanae WWTP	2750	246	680	0.10
New Plymouth District Council	New Plymouth WWTP	20693	187	3870	0.08
New Plymouth District Council	Waitara WWTP	4593	105.5	480	0.07
North Shore City Council	North Shore WWTP	43400	295	12800	0.85
Palmerston North City Council	Palmerston North Sewage Treatment Plant	28000	300	8400	0.13
Rotorua District Council	Rotorua WWTP	20531	160	3280	0.07
South Waikato District Council	Putaruru	931	256	240	0.06
South Waikato District Council	Tokoroa	4148	288	1190	0.07
Tauranga District Council	Chapel Street WTP	14400	297	4280	0.08
Watercare Services Ltd	Mangere WWTP	262000	426	111610	0.16
Whangarei District Council	Whangarei	14997	238	3570	0.09
Average					0.09
Standard deviation					0.24
Weighted average (corrected for population served)					0.16 = 59 per year

Note: SS per day calculated using the measured ADF with the exception of Palmerston North.

For the 17 plants included in Table 4.2.3, the weighted average of dry solids/capita/year is approximately 59 kg. This figure includes residential and industrial wastewater. Therefore, to make a comparison with the quantities of waste landfilled in New Zealand, per capita total figures (industrial and residential) rather than per capita residential figures should be used. The total landfilled waste per capita per year is approximately 898 kg. This suggests that the quantity of solid waste disposed through the public sewage system could be almost 7% of the solid waste going to landfills. It should be noted, however, that the dry solids figure is based on data from 17 treatment plants only, and that the standard error in these data is high. These data should only be considered as in order of magnitude estimates only, and must therefore be interpreted with caution.

b) Effluent quantities

The effluent of a wastewater treatment plant is the outgoing wastewater stream. No data are available on quantities of effluent, as generally the quantities of influent of treatment plants are monitored only.

Information on the means of disposal of effluent wastewater from treatment plants is provided by the Database. Figure 4.2.1 shows the discharge methods for effluent wastewater used by New Zealand treatment plants. Over half the plants (53%) discharge effluent to surface water, including rivers, lakes and estuaries, followed by disposal to land (22%), to the ocean (10%) and into harbours (9%). For 17 plants (6%) the disposal

method for effluent wastewater is not known. It should be noted that the figure provides information on the number of treatment plants discharging by each method. It does not consider quantities of effluent discharged by each method.

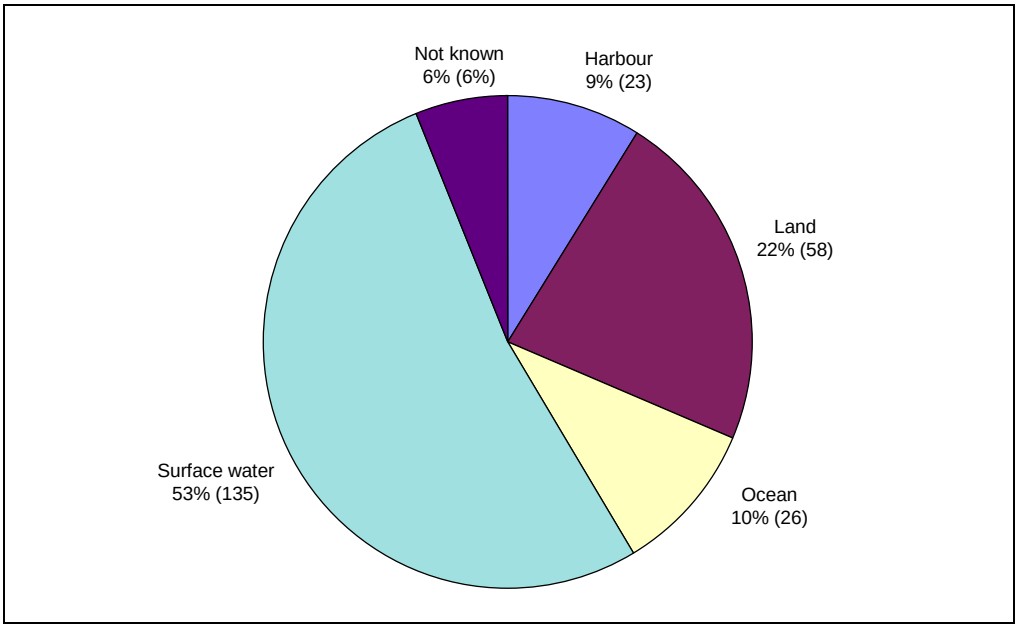


Figure 4.2.1 Disposal of effluent wastewater by 258 New Zealand wastewater treatment plants in 1995/96 [Woodward-Clyde, 1996].

4.2.2. Wastewater quality

Influent wastewater quality is determined by the source of the waste stream. Effluent wastewater quality is determined by the level of treatment.

Treatment plants use primary, secondary and/or tertiary treatment methods as described in Chapter 2. The definitions of these treatment methods are not used consistently, and it was therefore decided not to include information on treatment methods used by treatment plants in the chapter.

Generally, two methods of wastewater treatment dominate in New Zealand: oxidation ponds (including facultative, aerated and maturation ponds), and variations of activated sludge processes. Anaerobic ponds are used by industry for off-site partial or complete effluent treatment and are therefore not included in the Database.

Typical pollutants in treatment influent and effluent waste streams are suspended solids, nutrients (nitrates, nitrites and phosphates), bacteria, and ammonia. Industrial discharges and stormflows to the waste water treatment plants can contribute a range of other pollutants, such as metals and organochlorines. Wastewater also contains organic matter. The biochemical oxygen demand (BOD) is a measure for the amount of oxygen required for the degradation of organic matter by organisms.

A number of these parameters are monitored by some treatment plants. As there is no national monitoring requirement, not all plants monitor the same parameters. For example, only 24 of the 258 treatment plants monitor faecal coliform. Monitoring is often determined by conditions of consents determined by the local authority.

Table 4.2.4 summarises the quality parameters measured by a number of New Zealand wastewater treatment plants as in 1995/96. The table shows that the quality of influents

and effluents varies widely amongst treatment plants, due to the different techniques used and differences in efficiency of the treatment plants. Furthermore, the quality of the effluent provides limited information on the effects on the receiving environment, which depend on factors such as dispersion and ecosystem values.

The estimated average influent to New Zealand wastewater treatment plants of 0.41 m^3/capita/day is comparable with an international average of about 0.35-0.4 m^3/capita/day. However, based on the average biochemical oxygen demand of 92 g/capita/day for 19 treatment plants, the New Zealand influent is relatively strong. Assuming the European Union population equivalent figure of 60 g/capita/day of BOD (BOD_5 = over a 5-day period), the New Zealand population equivalent would be about one-and-a-half times the 2,890,552 million served by 237 public wastewater treatment plants.

As all data is obtained at the wastewater treatment plants, the database does not distinguish between different sources of wastewater, such as industrial and residential, different types of industries, or manufacturing and commercial enterprises. This means that an analysis of different sources of wastewater cannot be made.

Table 4.2.4 Quality parameters of influent and effluent wastewater of New Zealand wastewater treatment plants in 1995/96 [Woodward-Clyde, 1996].

Parameter	Environmental effect	Aspect	Average per capita	Average	Minimum	Maximum	Standard deviation	% Standard deviation	Number of treatment plants
Biochemical oxygen demand (BOD) (g/m^3)	Oxygen depletion	Influent	92.3	225	147	464	79.8	35.5%	19
		Effluent	11.1	27	2	720	126.9	470.1	31
		% Removal	36.3	88.5	51.0	98.6	11.7	13.2%	16
Suspended solids (SS) (g/m^3)	Aesthetic pollution, smothering, light absorption	Influent	102.5	250.5	105.5	497	95.4	38.1%	18
		Effluent	16.8	41	7	507	103.0	251.2	31
		% Removal	33.8	82.4	-237.4	96.6	83.7	102%	15
Nutrients (nitrates, nitrites, phosphates) (g/m^3)	Eutrophication	Influent	0.2	0.4	0	1.2	0.5	134%	8
		Effluent	0.7	1.6	0.2	11.9	3.8	242%	18
Ammonia (N as NH4) (g/m^3)	Toxicity, oxygen depletion	Influent	11.1	27.0	15.6	52.2	10.4	38%	15
		Effluent	7.5	18.2	0.4	32	10.9	60%	15
Faecal coliforms (bacteria) (g/m^3)	Disease	Influent	7.8	19.1	1.9	123	29.4	154%	15
		Effluent	7.4	18.0	0.1	25,000	6395.72	35532%	24
Metals	Toxicity	No information provided by database							

4.2.3. Sludge

Sludge is a by-product of wastewater treatment processes. Of the 258 treatment plants, 35 monitor sludge quantities and 21 monitor and treat sludge prior to disposal. The majority (202 plants) do neither, not monitor nor treat sludge.

Monitored quantities of sludge are available for only nine treatment plants. Table 4.2.5 on the next page gives quantities of sludge generated at nine treatment plants. Sludge includes primary sludge, resulting from primary wastewater treatment, secondary sludge from secondary treatment, comminuted sludge from primary treatment, and treated sludge, which is sludge that has been treated to remove contaminants prior to disposal.

Sludge can be disposed of in a number of ways, including use as a fertiliser by the agricultural sector or by the public, incineration, landfilling, and other reuses such as soil extender or compost. Figure 4.2.2 suggests that landfilling is the most common disposal option, for the 84 treatment plants surveyed. Reliable proportions of the different disposal methods used can only be determined when disposal methods used by the remaining 175 treatment plants are also known. The figure does not provide information on the relative quantities of sludge discharged by each method.

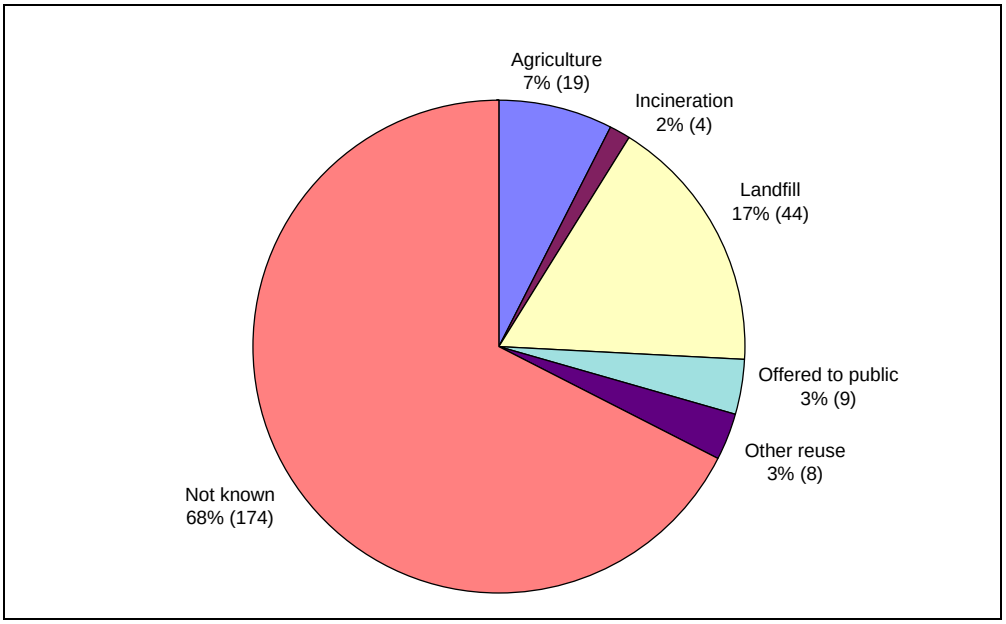


Figure 4.2.2 Disposal of sludge by 258 New Zealand wastewater treatment plants in 1995/96 [Woodward-Clyde, 1996].

Table 4.2.5 Quantities of sludge (dry solids) generated by 9 New Zealand wastewater treatment plants in 1995/96 [Woodward-Clyde, 1996].

Local authority	Treatment plant	Primary sludge		Secondary sludge		Communited sludge		Treated sludge
		Dry tonnes	% dry solids	Dry tonnes	% dry solids	Dry tonnes	% dry solids	Dry tonnes
Christchurch City Council	Christchurch WWTP	815.2*	3.9*			830	3.9	
Hamilton City Council	Hamilton WWTP		4.29					
Hutt City Council	Wainuiomata WWTP (High Rate)		5.3*				5.3	10.5
Invercargill City Council	Clifton WWTP	136*	5.85*			136	5.85	
North Shore City Council	North Shore WWTP	9.9	4.3					
Rotorua District Council	Rotorua WWTP	47.9	3.8	76	2.87			
South Waikato District Council	Tokoroa WWTP		4.5					
Tauranga District Council	Chapel Street WWTP	3.65*	4*			3.65	4	50.3
Watercare Services Ltd	Mangere WWTP	2,420	3.9	300	1.4			

4.3. Point and non-point source discharges

Limited data was found on point and non-point source discharges. Figure 4.3.1 summarises the estimated annual discharges of nitrogen into surface water. The figure shows that agriculture is the main source of nitrogen discharges. Other non-point sources of nitrogen discharge are native and exotic forests. Other point sources of nitrogen discharge are urban sewage and pulp and paper plants.

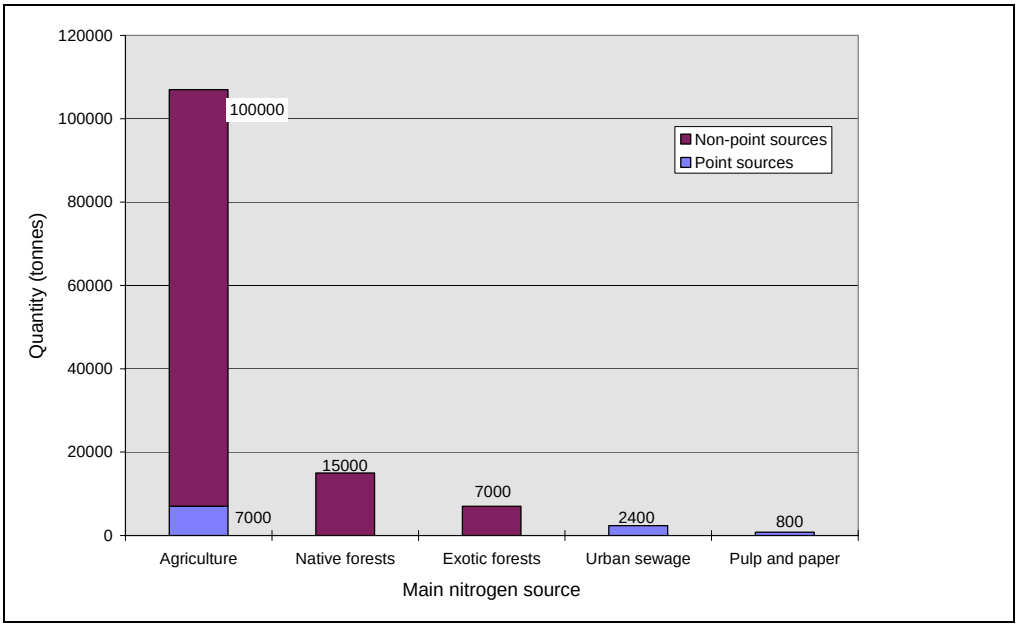


Figure 4.3.1 Estimated yearly nitrogen loadings to New Zealand surface waters [Cooper, 1992].

Figure 4.3.2 shows the main point sources of organic pollution (BOD) in surface water in New Zealand. Meat processing factories and farm dairies (cow sheds) are the largest point sources of discharged BOD in surface water. Smaller point sources of BOD are dairy factories, pulp and paper mills, piggeries, and wastewater treatment plants. It is notable that wastewater treatment plants are relatively successful in reducing the BOD levels before they discharge of wastewater effluents in surface water.

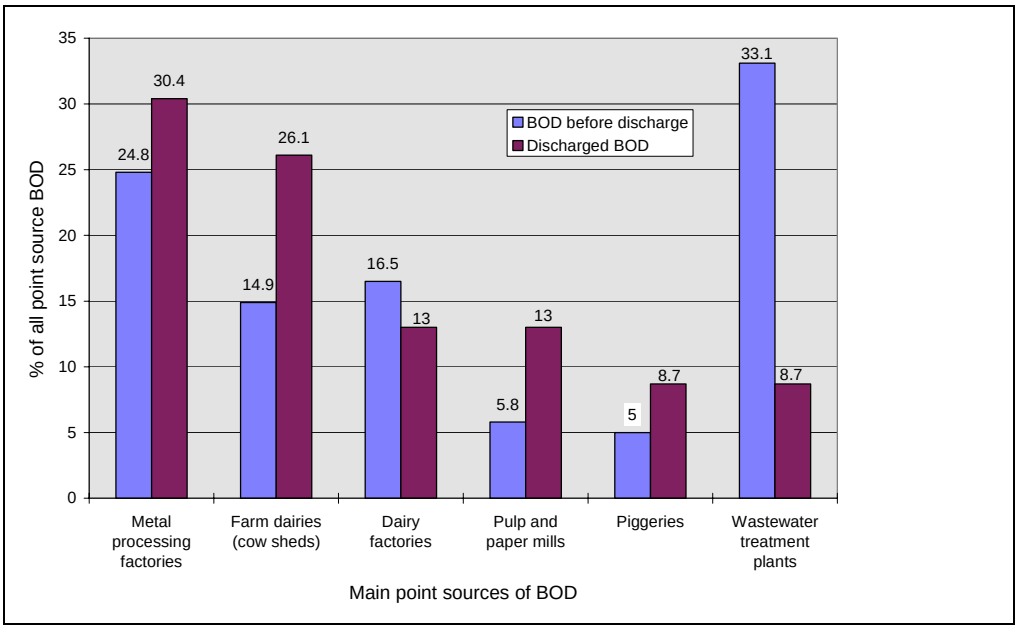


Figure 4.3.2 The major point sources of organic pollution (BOD_5) in surface water [Hickey and Rutherford, 1996].

5. GASEOUS WASTE

5.1. Introduction

Air emissions or gaseous waste have been given less attention than solid and liquid waste, generally because of the "invisible" nature of the waste and the dispersed form of disposal. The lack of attention in New Zealand has also been due, in part, to better air quality compared to many other countries. This situation is changing as local authorities carry out their responsibilities under the Resource Management Act. Several councils have recently completed regional inventories of air emissions. These include Auckland, Gisborne, Taranaki and Canterbury. Others have efforts underway or plan to conduct inventories. In addition, national inventories are available for greenhouse gases. National inventories are being compiled by the National Institute of Atmospheric and Water Research (NIWA) for the ambient air pollutants (those covered by the Ministry for the Environment's Ambient Air Quality Guidelines, 1994) as part of a Sustainable Management Fund project on air quality. This will be completed by July 1997. At present, draft reports are available that provide inventories on a sectoral basis - transport, industrial, area, and natural [NIWA, 1996 (a,b,c,d)] .

A more detailed and accurate inventory of land transport emissions is being developed as part of the Light Duty Vehicle Fleet Strategy, an effort underway at the Ministry of Transport. Heavy duty vehicles will be inventoried later in 1997.

The discussion below covers greenhouse gases (section 5.2) and air emission data from the Auckland region (section 5.3) in the form of case studies.

5.2. Greenhouse gases

Greenhouse gases are given much attention worldwide due to the possible contribution to global warming or climate change. Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), other nitrogen oxides (NO_x) and carbon monoxide (CO), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphurhexafluoride (SF_6), sulphur dioxide (SO_2), and non-methane volatile organic compounds (NMVOCs).

New Zealand has developed an inventory of emissions and sinks of the most significant greenhouse gases [Ministry for the Environment, 1994(b), 1997(c)]. The first inventory was 1990-based and has been updated annually to monitor trends in emissions and sinks, and to evaluate the effectiveness of policy trends.

The inventory focuses on all greenhouse gases mentioned above. National data is provided for sources and sinks of these gases using the Intergovernmental Panel on Climate Change (IPCC) categories of energy, industrial processes, solvent and other product use, agriculture, land use change and forestry, and waste. In keeping with the IPCC guidelines, emissions from international bunkers (marine and air) are treated separately.

Table 5.2.1 and Table 5.2.2 present summary inventories for 1990 and 1995 respectively. Where 1995 data were not available, 1994 data were used. The summary table shows that

Table 5.2.1 Summary report for New Zealand's greenhouse gas inventory in 1990 [Ministry for the Environment, 1997(c)].

Greenhouse gas source and sink categories	CO_2 emissions	CO_2 removals	CH_4	N_2O	No_x	CO	NMVOC	HFCs	PFCs	SFs	SO_2
Total national emissions and removals	25,476	-17,703	1,809	48	114	724	182	neg	0.09	0.02	16
All energy (fuel combustion & fugitive)	23,089		32	3	110	656	140				ne
Industrial processes	2,387		neg	nr	2	1	17	neg	0.09	0.02	16
Solvent and other product use							25				
Agriculture			1,514	45	neg	4					
Land use change and forestry			7	neg	2	63					
Waste			256	ne							
International bunkers (aviation & marine)	2,413	-17,703	neg		27	6	ne				

Note:
1. Ne = not estimated, neg = negligible, nr = not reported.
2. Al data presented in gigagrams (Gg) and rounded to the nearest number except for HFCs, PFCs and SFs.

Table 5.2.2 Summary report for New Zealand's greenhouse gas inventory in 1995 [Ministry for the Environment, 1997(c)].

Greenhouse gas source and sink categories	CO_2 emissions	CO_2 removals	CH_4	N_2O	NO_x	CO	NMVOC	HFCs	PFCs	SFs	SO_2
Total national emissions and removals	27,367	-13,796	1,734	46	133	771	207	0.140	0.030	0.180	21
All energy (fuel combustion & fugitive)	24,631		35	2	129	725	160				ne
Industrial processes	2,736		neg		3	1	19	0.140	0.030	0.180	21
Solvent and other product use				44			28				
Agriculture			1,460			4 (1994)					
Land use change and forestry		-13,796(1994)	5 (1994)	neg	1 (1994)	41 (1994)					
Waste			234	ne							
International bunkers (aviation & marine)	2,736		0.25	0.06	30	6	ne				ne

Note
1. Ne = not estimated, neg = negligible, nr = not reported.
2. All data presented in gigagrams (Gg) and rounded to the nearest number except for HFCs, PFCs and SFs.

through planted forests an estimated 13,796 Gg of CO_2 was absorbed in 1994. This takes into account the 1,369 Gg of CO_2 that was emitted through forest clearing and fires. In 1995 agriculture is New Zealand's main source of methane (CH_4) and nitrous dioxide (N_2O) emissions. Transport is the main source of CO_2, NO_x, CO and non-methane volatile organic compounds (NMVOC) in New Zealand. The main source of perfluorocarbons (PFCs) in New Zealand is from aluminium smelting.

Figure 5.2.1 compares the total greenhouse gas emissions in New Zealand for 1990 and 1995. The figure shows that the emissions of greenhouse gases have increased since 1990, with the exception of methane (CH_4) and nitrous dioxide (N_2O). The total absorption of CO_2 by planted forests has reduced since 1990.

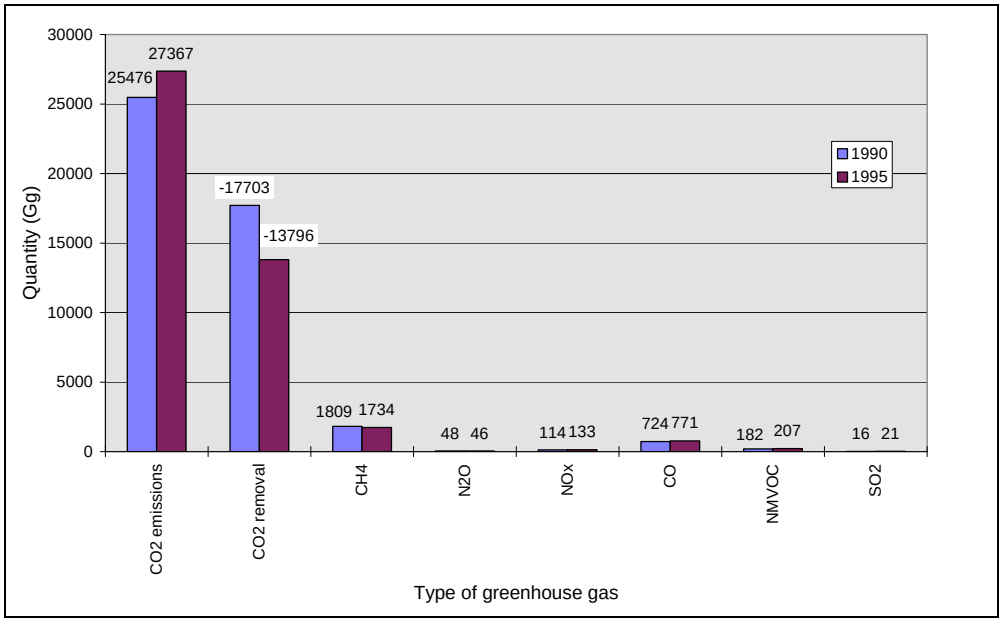


Figure 5.2.1 Comparison of some greenhouse gas emissions between 1990 and 1995 in New Zealand [Ministry for the Environment, 1997(c)].

Figure 5.2.2 compares the fluorine-containing greenhouse gases, including perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulphurhexafluoride (SF_6). Although the quantities of these gases emitted are relatively low compared to the other greenhouse gases, their contributions to the greenhouse effect are significantly larger.

It should be noted that standard errors are not quoted for most data presented in this report. Therefore changes between 1990 and 1995 should be considered as indicative estimates only.

Figure 5.2.3 presents data on emissions of carbon dioxide from all sectors in 1990. At this time, the largest source of carbon dioxide emissions in New Zealand was the transport sector which accounted for 34% of total carbon dioxide emissions in 1990. Electricity generation and other transformation activities (including gas used in the petrochemicals industry) accounted for 27% of the total. Carbon dioxide emissions from industrial processes contributed 10% of the total, with fuel combustion in the industrial, commercial/industrial and agricultural/forestry sectors accounting for 17%, 5% and 4% of the total respectively. The remaining emissions (less than 4%) came from the residential sector, fugitive fuel, and other sources. This data is not yet available for 1995. However, it is probable that the relative proportions will not have changed significantly.

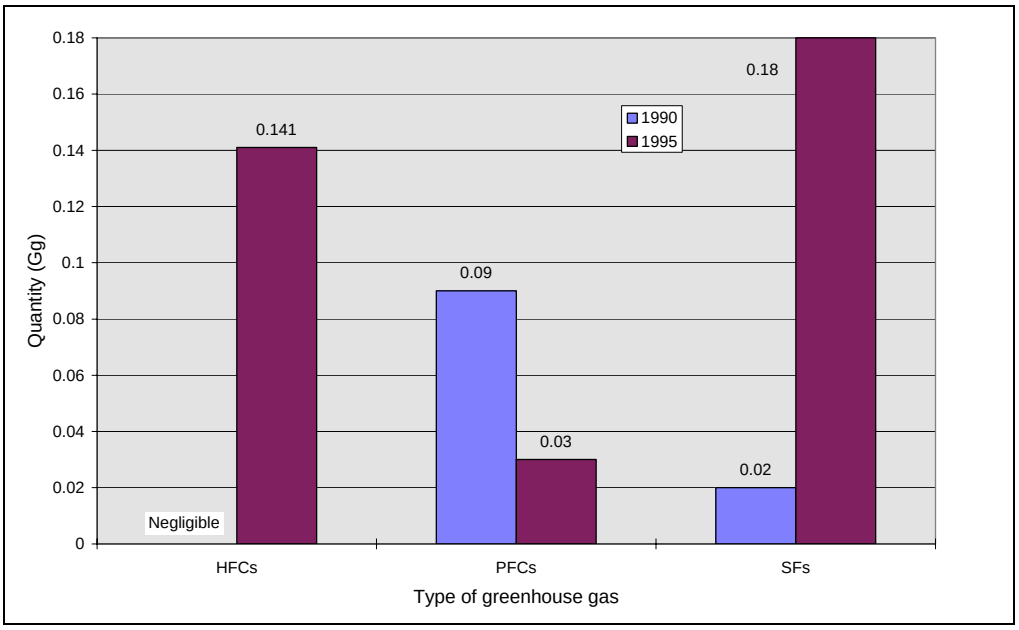


Figure 5.2.2 Comparison of fluorine-containing greenhouse gas emissions between 1990 and 1995 in New Zealand [Ministry for the Environment, 1997(c)].

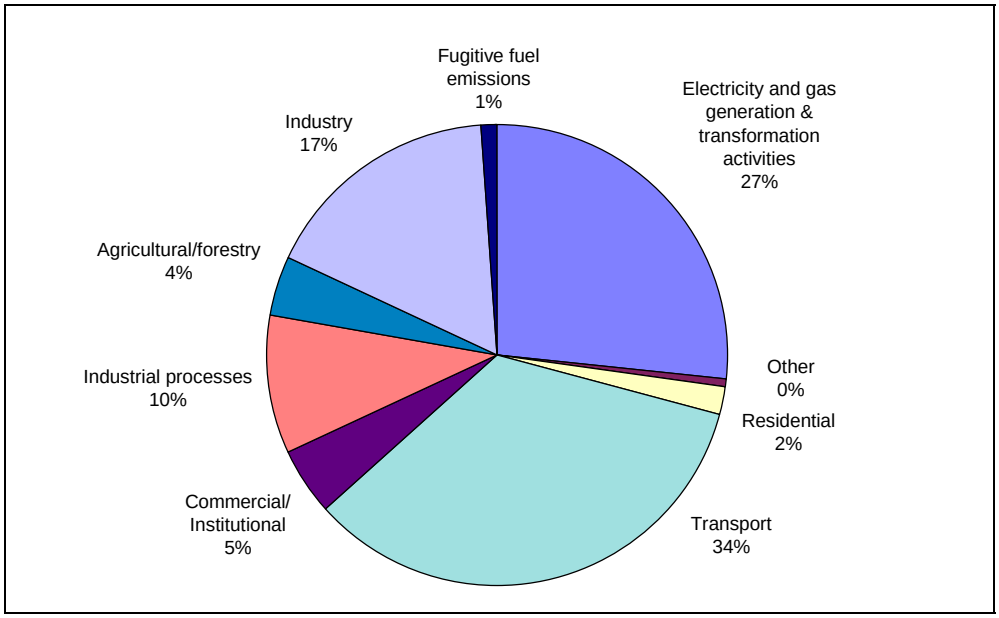


Figure 5.2.3 Carbon dioxide emission from all sectors in New Zealand in 1990 [Ministry for the Environment, 1994(b)].

Figure 5.2.4 shows the 1990 energy sector carbon dioxide emissions generated by transport and energy related fuel consumption. Oil contributed 52% of total energy sector carbon dioxide, with the main source being the transport sector which accounted for around 72% of all oil emissions. Gas and coal accounted for 34% and 14% respectively. Less than 1% of carbon dioxide emissions were derived from geothermal.

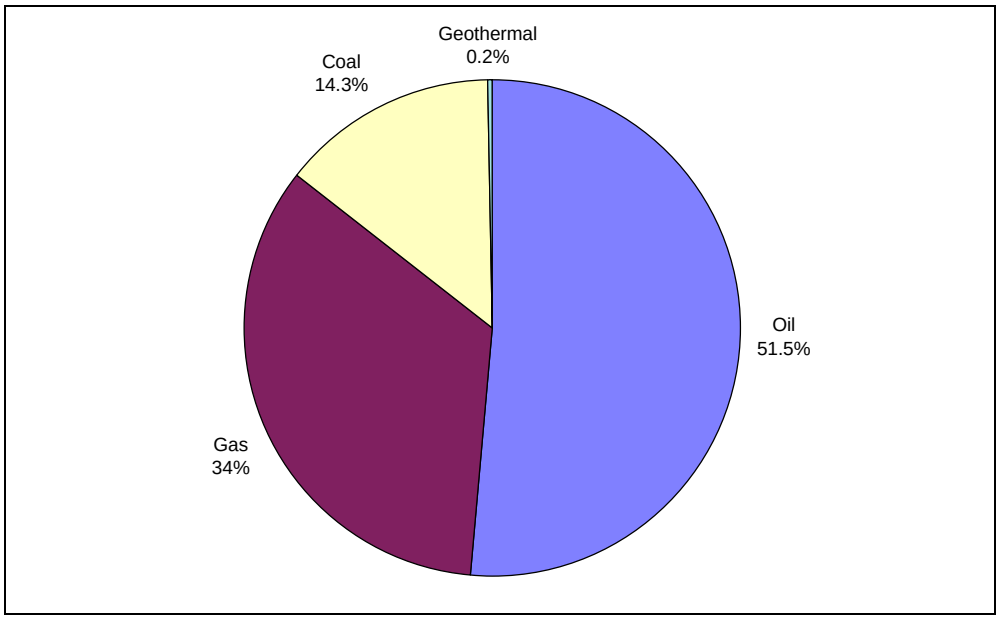


Figure 5.2.4 Carbon dioxide emissions by fuel in New Zealand in 1990 [Ministry for the Environment, 1994(b)].

For more information see *Climate Change, the New Zealand Response* [Ministry for the Environment, 1994(b), 1997(c)].

5.3. Regional air emissions inventories: the Auckland region

The Auckland Air Emissions Inventory project was carried out to provide an inventory of pollutant emissions to air, resulting from activities within the Auckland region. Data obtained will be used as a planning tool for evaluating the effectiveness of policy options to reduce air pollution in the Auckland region.

The computerised air emissions inventory includes the anthropogenic emissions from transport, domestic and commercial activities, industry, plus biogenic sources (vegetation, soil and ocean). Emissions of volatile organic compounds (VOC, excluding methane), NO_x CO, SO_2, CO_2 and airborne particles from these sources have been estimated.

Information regarding the background and methodology used is provided in Appendix VII. It should be noted that substantial uncertainty and errors may exist in inventory data. These mostly arise because emission estimates were generally based on either the limited experimental test data, laboratory rather than actual world testing, or the use of general emission factors rather than measurements at specific sites.

Figure 5.3.1 presents data on total annual emissions in the Auckland study region and the relative contribution of key sources. Emissions were monitored on summer days and on winter days because the outside temperature is a main factor of influence of the quantities emitted. Table 5.3.1 and Table 5.3.2 include data on typical emissions for a summer day and winter day respectively in the region in 1993. The data shows that total emissions increase by roughly 15% from summer to winter. On the basis of the data obtained, growth estimates of total emissions have been estimated for the year 2003. For more detailed analysis and for the 2003 estimates refer to the Auckland Air Emissions Inventory report [Auckland Regional Council, 1997].

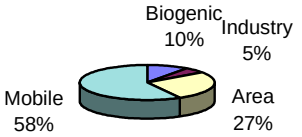
5.3.1. Emissions from transport

Transport sources of emissions include emissions from motor vehicles, marine pleasure craft/shipping, rail and aviation.

Mobile sources of emissions include the emissions from motor vehicles, marine pleasure craft/shipping, rail and aviation. Total mobile sources have been estimated to contribute 117 tonnes of VOC, 87 tonnes of NO_x, 764 tonnes of CO, 2 tonnes of SO_2, 3 tonnes of TSP and 6,800 tonnes of CO_2 per average summer week day in the Auckland region in 1993. These values represent 70, 86, 95, 27 and 20% respectively, of total anthropogenic emissions in the region.

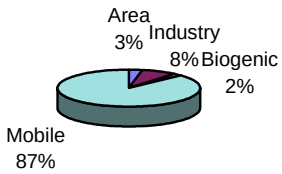
Motor vehicles have been identified as the dominant contributor to transport source emissions, and to the airshed. They account for approximately 98% of VOC emissions and 95% of NO_x emissions within the mobile source category for an average week day. Mobile source emissions are estimated to vary significantly with season and day of the week, as a result of the influence of the outside temperature on the quantities emitted.

a) Volatile Organic Compounds



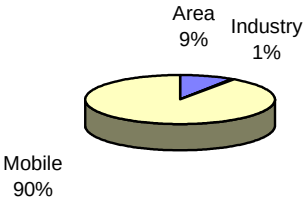
71,000 tonnes/year

b) Oxides of Nitrogen



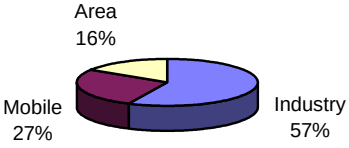
36,340 tonnes/year

c) Carbon Monoxide



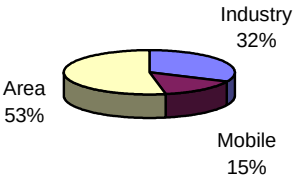
332,700 tonnes/year

d) Sulphur Dioxide



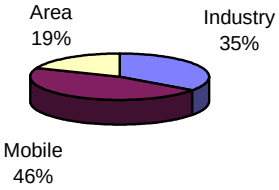
2,310 tonnes/year

e) Particles



6,240 tonnes/year

f) Carbon Dioxide



5,342,000 tonnes/year

Figure 5.3.1 Total emissions in the Auckland region in 1993 and the relative contribution of key sources [Auckland Regional Council, 1997].

Table 5.3.1 Average summer week day emissions, Auckland 1993 [Auckland Regional Council, 1997].

	Quantity (tonnes/day)						% of total anthropogenic emissions					
Category	CO_2	VOC	NO_x	CO	SO_2	TSP	CO_2	VOC	NO_x	CO	SO_2	TSP
Transport	6,778c	117	87	764	2	2	47.9	70.4	85.6	95.0	27.0	19.5
Domestic/commercial activity[3]	2,133	38	3	37	1	4	15.1	22.7	2.7	4.6	15.5	29.0
Major industrial & commercial	5,235	11.5	11.8	3.5	3.7	6.6	37.0	6.9	11.7	0.4	57.5	51.5
Total anthropogenic	14,145	166	101	804	6	13	100	100	100	100	100	100
Biogenic	-	26	3	-	-	-						
Total emissions	14,145	191	104	804	6	13						

Note:
1. Emissions less than 0.005 tonnes/day rounded to zero (-).
2. Totals may not appear additive due to rounding.
3. Emissions of CO_2 due to aviation have not been estimated because of the inherent uncertainty in assigning these emissions to the inventory TSP was not estimated because there are no available emission rates.

Table 5.3.2 Average winter week day emissions, Auckland 1993 [Auckland Regional Council, 1997].

	Tonnes/day						% of total anthropogenic emissions					
Category	CO_2	VOC	NOx	CO	SO_2	TSP	CO_2	VOC	NOx	CO	SO_2	TSP
Transport	6,769	109	87	887	2	2	41.7	51.7	84.4	84.5	25.7	8.4
Domestic/commercial activity[3]	4,231	90	4	160	1	21	26.1	42.8	4.1	15.2	19.3	69.9
Major industrial & commercial	5,232	11.0	12	3.5	4	6	32.2	5.5	11.5	0.3	55.0	21.6
Total anthropogenic	16,232	11.0	12	3.5	4	6	100	100	100	100	100	100
Biogenic	-	13	1	-	-	-						
Total emissions	16,232	223	104	1,053	7	29						

Note:
1. Emissions less than 0.005 tonnes/day were rounded to zero (-);
2. Totals may not appear additive due to rounding;
3. Emissions of CO_2 due to aviation have not been estimated because of the inherent uncertainty in assigning these emissions to the inventory TSP was not estimated because there are no available emission rates.

On a hot summer day for example, VOC emissions from motor vehicles are estimated to increase by approximately 50% over an average summer day.

5.3.2. Emissions from domestic and small commercial sources

Domestic and commercial sources of air emissions include domestic fuel combustion, lawn mowing, solvent use, service stations, service station refueling and use of surface coatings and thinners. Emissions from domestic and commercial activity were estimated as 38 tonnes of VOC, 2.5 tonnes of NO_x, 36.7 tonnes of CO, 1.0 tonne of SO_2, 3.7 tonnes of TSP and 2,133 tonnes of CO_2 on an average summer week day in Auckland in 1993. The use of surface coatings and thinners by domestic, commercial and small industrial premises represents the largest stationary source of VOC. Other significant sources include leakage of natural gas, domestic/commercial solvent use and service station/refueling.

On a typical winter week day emissions from domestic/commercial activity account for 90 tonnes of VOC, 4 tonnes of NO_x, 160 tonnes of CO, 1.0 tonne of SO_2, 21 tonnes of TSP and 4,231 tonnes of CO_2. The increase in emissions arises from domestic fuel combustion which takes place almost exclusively in winter. This source is the dominant source of particles emitted in the region covered by the inventory airshed and accounts for 70% of all particle emissions.

5.3.3. Emissions from major industrial and major commercial premises

Major industrial and commercial premises account for approximately 11.5 tonnes of VOC, 11.9 tonnes of NO_x, 3 tonnes of CO, 4 tonnes of SO_2, 7 tonnes of TSP and 5,235 tonnes of CO_2 per average summer week day in Auckland. Major industry accounts for approximately 6.9%, 11.7%, 0.4%, 57.5%, 51.5% and 37.0% of total anthropogenic VOC, NO_x, CO, SO_2, TSP and CO_2 emissions respectively in Auckland. These sources are the major emitters of SO_2 and TSP during summer. However, during winter, although the emissions remain relatively constant, they only contribute 22% to the total TSP load because of the dominance of domestic solid fuel combustion.

Approximately 32% of NO_x emitted by major industrial and commercial sources in Auckland was emitted from near-ground sources with the remainder emitted from tall chimneys.

5.3.4. Emissions from biogenic sources

Emissions of VOC and NO_x from biogenic sources (vegetation, soil and ocean) in the Auckland Study Region have been estimated for summer and winter conditions. Under average summer time conditions, 26 tonnes of VOC/day and 3 tonnes of NO_x/day are emitted in ASR. Approximately 19% of VOC are estimated to be isoprene, 23% cineole and 58% other VOC. Emissions of VOC were estimated to increase by approximately 36% on a hot summer day (16-26°C) and decrease by 50% on an average winter day (relative to average summer day conditions).

6. HAZARDOUS WASTE

6.1. Introduction

Limited national information is available on quantities of hazardous waste generated and disposed of in New Zealand. Most of the monitoring work that has been undertaken on hazardous waste has focused on the collection of general hazardous substances in a region, or on a specified hazardous substance. In many cases the monitoring initiatives have not distinguished between residential and industrial hazardous waste. For this reason, hazardous waste data has been presented in this section as "topics" or "case studies" rather than using the structure applied in the previous chapters.

The topics covered in this chapter include acceptance of hazardous waste at New Zealand landfills (section 6.2), regional hazardous waste surveys in the Auckland region (section 6.3) and the Otago region (section 6.4), regional hazardous waste collections (section 6.5), exported hazardous waste (section 6.6), the Used Oil Recovery Programme (section 6.7) and contaminated sites and soil clean-up (section 6.8).

6.2. Disposal of hazardous waste

Hazardous waste that is generated or stockpiled can be disposed of by a number of methods, including:

- disposal as residential waste, with subsequent disposal to landfill;
- discharge into the sewer or stormwater system under trade waste bylaws and the resource consent process;
- disposal by direct discharge to the environment, stormwater or sewer;
- disposal to landfill under managed disposal conditions (disposed as special waste);
- collection by a hazardous waste contractor, who subsequently
    - disposes the waste to landfill, or
    - treats the waste with acceptable treatment methods to remove hazardous properties, and then disposes the remaining material to landfill or trade waste sewer.

Increasingly, New Zealand landfills are refusing to accept types of waste, mainly hazardous waste, and therefore other treatment and/or disposal methods have to be sought. Table 6.2.1 shows the percentages of landfills in New Zealand that do not accept certain types of waste.

Table 6.2.1 Waste not accepted at New Zealand landfills as at March 1995 [Ministry for the Environment, 1997(b)].

Waste not accepted	% of landfills
Hazardous waste	92
Medical/vet waste	68
Sewage sludge	66
Animal carcasses	62
Fuels/oils	5
Industrial/commercial	5
Toxic waste/chemicals	4
Only specified wastes accepted	4
Car batteries	3
Farm rubbish/fencing wire	3
Liquid wastes/other sludges	3
Paints	2
Other	14
Not known	1

6.3. Regional Hazardous Waste Surveys: Auckland region

The Auckland Region Hazardous Waste Survey [Environment and Business Group and Auckland Regional Council, 1996] was carried out to collect baseline data on hazardous waste generated in the region. The data were used to develop a long-term management strategy for these wastes in the Auckland region. More specific information about the methodology is provided in Appendix VIII. Quantitative and qualitative results of the survey are summarised in the following sections.

The survey focused on three information sources:

- hazardous waste generators;
- hazardous waste operators;
- final disposal facilities.

Monitoring hazardous waste is a complicated process. Hazardous wastes can follow many different paths from generation to disposal, and often change their form and quantity during this process. It is therefore not possible to create a direct link between the quantities generated and the quantities disposed of. The quantitative information generated by the survey needs to be considered within these constraints.

6.3.1. Hazardous waste generators

An earlier waste survey carried out in the Auckland region [Royds Garden Ltd and Strategic Information Service, 1990] indicated that more than 95% of all hazardous waste are generated by three business sectors: manufacturing; transport, dtorage and communication; and community, social and personal services. According to statistics, these business sectors comprise a total of 23,973 businesses in the Auckland region. The survey was undertaken for 1,862 (8%) of these businesses, of which 609 (33%) were found to generate hazardous waste.

The survey methodology assumed it would be possible to extrapolate the quantitative data obtained from this representative sample to all businesses in the Auckland region. However, it became apparent that this would not be possible because of the considerable variability in the data collected. Each business was so different in its quantity and type of hazardous waste generated that no reliable conclusions about other businesses could be drawn.

It is important to recognise that the quantitative data presented here is not indicative of the total quantities of hazardous waste that may be generated in the Auckland region, and cannot be extrapolated for New Zealand.

a) Quantities of hazardous waste generated in the Auckland region

The 609 businesses interviewed generated 4,617,733 tonnes of the following hazardous waste in the 1995 calendar year:

- liquids (mainly trade waste): 4,511,047 tonnes (97.7%);
- solids: 87,556 tonnes (1.9%);
- sludge: 18,892 tonnes (0.4%);
- powders and gases: 238 tonnes (0.005%).

In total, 1,268 different types of waste or waste streams were generated. Each waste stream contained a discrete quantity of a hazardous waste with specific characteristics, for example waste solvents, waste oil or contaminated clean-up equipment. Figure 6.3.1 summarises the quantities of hazardous waste disposed of in the Auckland region in 1995 by the 609 businesses surveyed. The figure also specifies the disposal methods used.

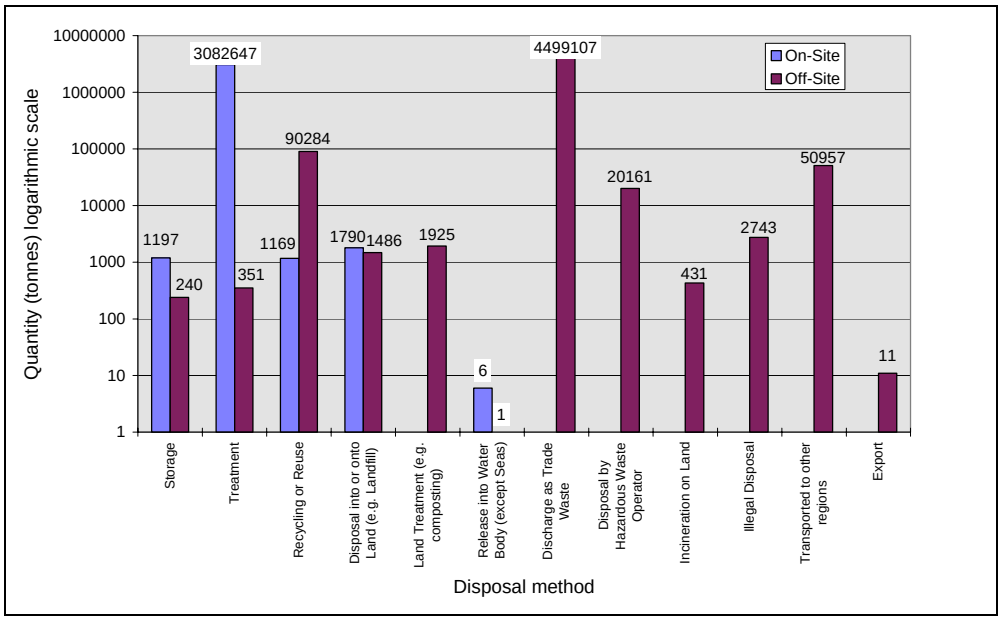


Figure 6.3.1 Estimated total quantities of hazardous waste generated by 609 businesses in the Auckland region in 1995 and waste management methods used [Environment and Business Group Ltd and Auckland Regional Council, 1996].

b) Composition of hazardous waste generated in the Auckland region

The four most common types of waste were:

- acidic and basic solutions or acids and bases in solid form;
- animal waste;
- ashes or cinders;
- industrial wastewater.

The most common types of waste (that is, those types generated in quantities of more than 10,000 tonnes), as described by the Y Codes of the New Zealand Waste Identification Code (NZWIC) (see Appendix II), are listed in Table 6.3.1.

It should be noted that these quantities are more than the total quantity of hazardous waste generated by the 609 businesses, because it is possible for a particular waste stream to be categorised in more than one Y Code category. For example, an industrial wastewater containing a mixture of oil and cadmium can be classified as:

- an industrial organic waste liquid (Y68);
- a waste liquid containing metals (Y69);
- a waste having cadmium constituents (Y26).

Table 6.3.1 Estimated quantities of different types of hazardous waste generated by 609 businesses in the Auckland Region in 1995 [Environment and Business Group Ltd and Auckland Regional Council, 1996].

NZWIC classification	Description	Quantity (tonnes)
Y34	Acidic solutions or acids in solid form	1,917,472
Y69	Other industrial wastewater	1,841,045
Y35	Basic solutions or bases in solid form	1,486,754
Y 63	Ashes or cinders	1,460,066
Y50	Animal waste	1,288,024
Y68	Industrial organic waste liquids	925,610
Y70	Residue from cleaning tanks and equipment	238,598
Y51	Animal/vegetable soaps, fats, waxes, oils	177,903
Y13	Waste from the production and use of resins, latex, plasticisers, glues/adhesives	72,221
Y 49	Inorganic substances without metals	54,964
Y09	Waste oil/water, hydrocarbon/water mixtures, emulsions	42,049
Y12	Waste from the production and use of inks, dyes, pigments, paints, lacquers and/or varnish	32,399
Y23	Zinc compounds	20,730
Y17	Waste resulting from the surface treatment of metals and plastics	17,783
Y06	Waste from the production and use of organic solvents	11,029

c) Sources of hazardous waste generated in the Auckland Region

The vast majority of hazardous wastes were generated by businesses in the manufacturing sector (99.68%). Only small amounts were generated by businesses in the community, social and personal services[3] sector (0.24%) and the transport, storage and communication sector (0.09%). The survey did not identify the quantity of hazardous waste generated by other industry sectors, but it is likely to be relatively small compared to these sectors based on trends identified in the 1990 report.

Figure 6.3.2 identifies the industry groups within the manufacturing sector which generate hazardous waste. The food industry generated almost half of the hazardous waste in 1995. Figure 6.3.3 identifies the services within the community, social and personal services sector which generate hazardous waste. Personal and household services generated the largest part of hazardous waste (84%) within this sector in 1995. The transport, storage and communication sector is not shown because it was not sub-divided into more detailed classifications.

[3] The community, social and personal services sector includes businesses and organisations such as sanitary and cleaning services, health care and veterinary services, educational facilities, repair services including panel beaters and spray painters, and dry cleaners and laundries.

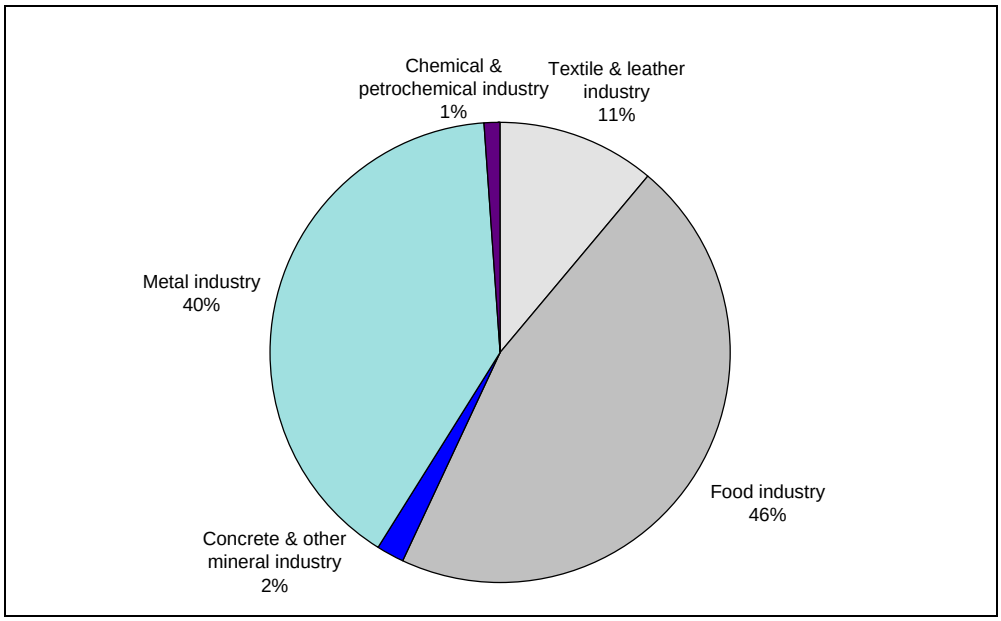


Figure 6.3.2 Sources of hazardous waste generated in the manufacturing sector in the Auckland rgion in 1995 [Environment and Business Group Ltd and Auckland Regional Council, 1996].

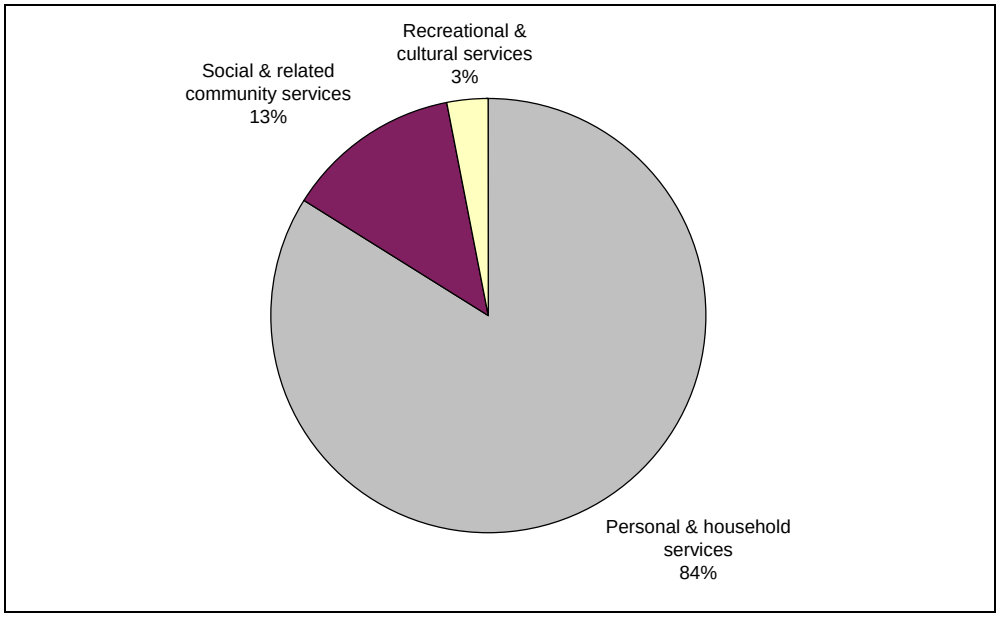


Figure 6.3.3 Sources of hazardous waste generated in the community, social and personal services sector in the Auckland region in 1995 [Environment and Business Group Ltd and Auckland Regional Council, 1996].

6.3.2. Hazardous waste operators

The second group interviewed were the hazardous waste operators, which include only companies involved in the transport, treatment, recycling and/or storage of hazardous waste. Information obtained from these companies was used to develop a picture of the life cycles of hazardous wastes, from their point of origin to the point of disposal.

The survey identified 182 waste operators in the Auckland region (see Figure 6.3.3). Of the 182 interviewed, only 55 (30%) stated that they were involved in the handling of hazardous waste. Eight operators refused to cooperate in the survey, creating an information bias which should be considered in interpreting the data.

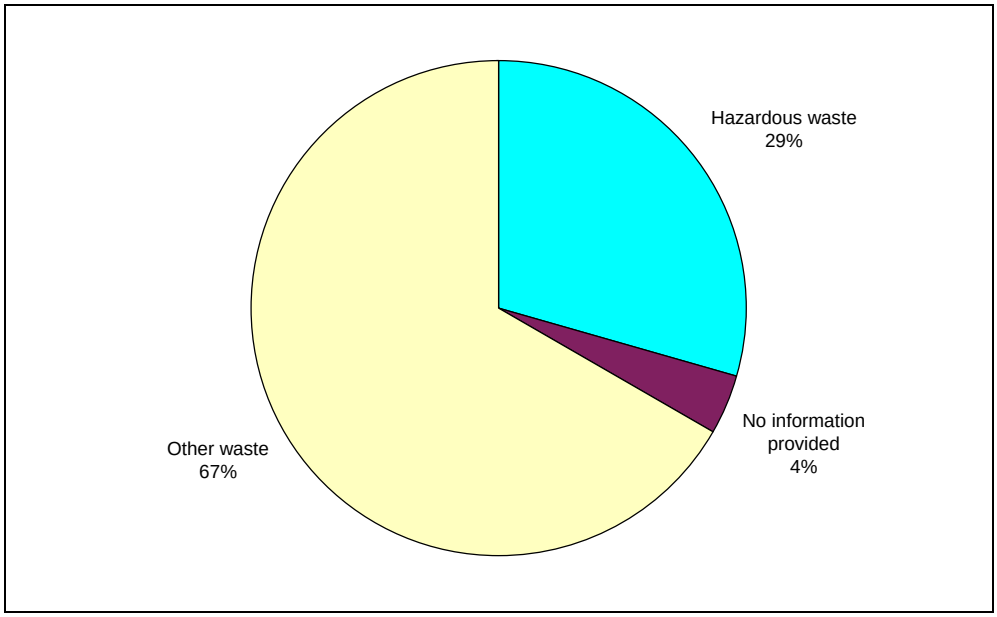


Figure 6.3.4 Types of waste handled by operators in the Auckland region in 1995 [Environment and Business Group Ltd and Auckland Regional Council, 1996].

Figure 6.3.5 summarises the quantities of hazardous waste disposed in the Auckland region in 1995 by 55 hazardous waste operators. The majority of the hazardous waste is disposed of as trade waste or recycled. Only small quantities are incinerated or exported.

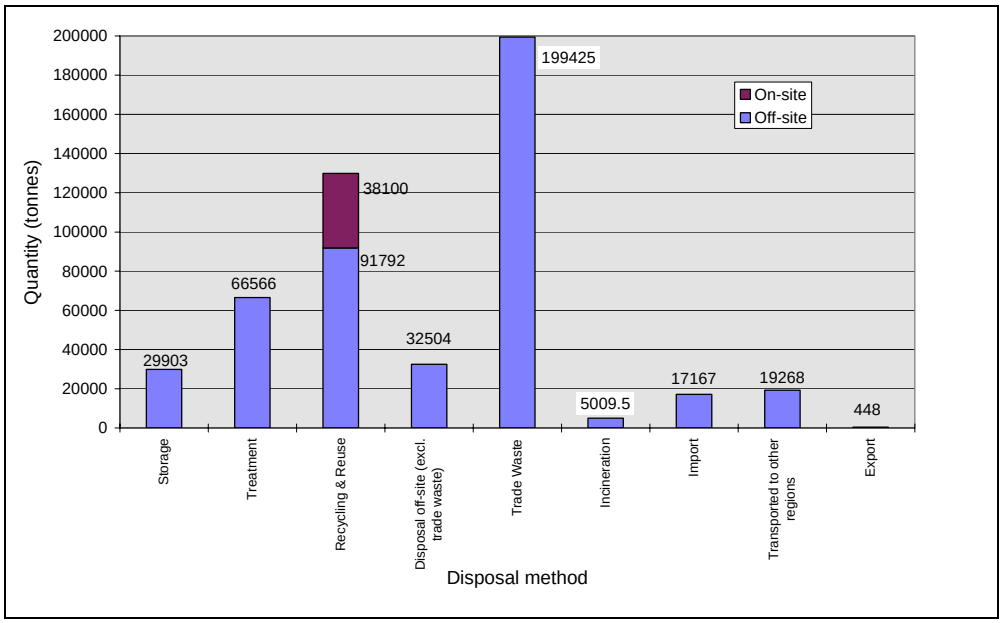


Figure 6.3.5 Estimated quantities of hazardous waste handled and waste management method used by 55 hazardous waste operators in the Auckland region in 1995 [Environment and Business Group Ltd and Auckland Regional Council, 1996].

Important points are summarised below:

- Most hazardous waste operators (45 out of 55) are involved in the transportation of hazardous waste. The remainder were involved in the disposal, treatment or storage of hazardous waste.
- The largest quantities transported were waste oils and animal waste/fat.
- In 1995, about 524 tonnes of intractable waste were in permanent storage. This included 380 tonnes of PCBs (polychorobenzenes), which have since been exported for destruction in France.
- Hazardous waste operators recycled 91,972 tonnes of hazardous waste - most of this was animal waste.
- Approximately 59,619 tonnes of hazardous waste were treated by hazardous waste operators - these were mostly waste containing heavy metals, waste from timber treatment and contaminated soils.

6.3.3. Final disposal facilities

Generally, disposal facilities (sewage treatment plants, landfills and incinerators) represent the end point in the life cycle of a hazardous waste. However, it should be remembered that even these facilities generate "secondary" hazardous waste such as ash, leachate, treated effluent and sludge. These "secondary" hazardous wastes were not considered in this survey. All final disposal facilities in the Auckland region were included in the survey. The data presented in this section are thus more representative for the Auckland region than those in the previous section.

a) Hazardous waste quantities disposed of in the Auckland region

Figure 6.3.6 summarises the quantities of hazardous waste disposed of in the Auckland region in 1995 by six final disposal facilities (two landfills, two incinerators and two sewage plants). The figure also shows the quantities of hazardous waste recycled in the Auckland region in 1995.

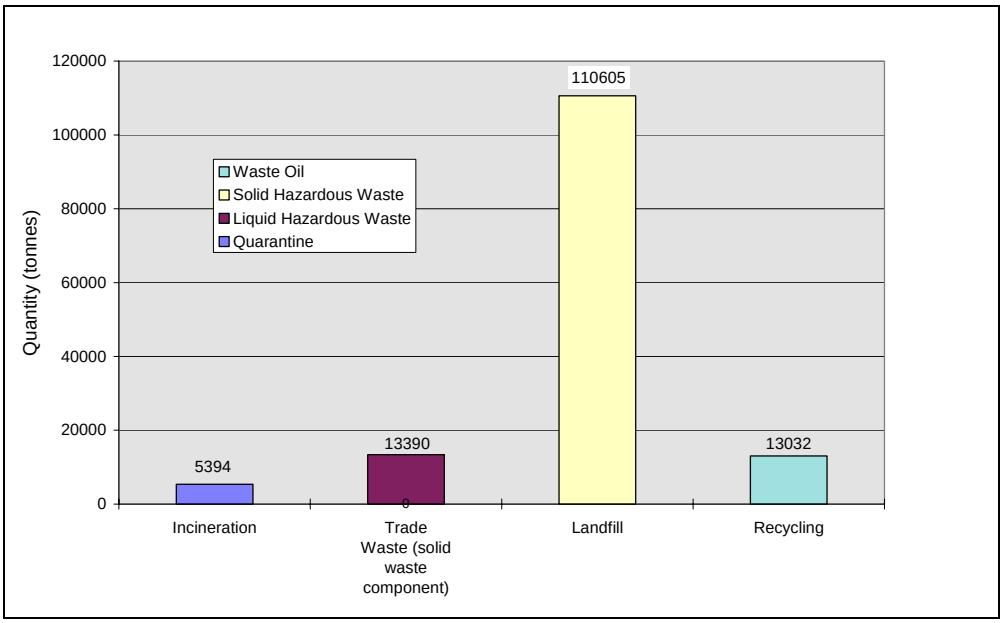


Figure 6.3.6 Estimated quantities of hazardous waste handled and waste management method used at final disposal facilities in the Auckland region in 1995 [Environment and Business Group Ltd and Auckland Regional Council, 1996].

The forms in which hazardous waste was disposed of by the final disposal facilities in the 1995 calendar year include:

- tonnes of liquid trade waste (98.80%);
- tonnes of solid landfilled waste (1.15%);
- tonnes of incinerated waste (0.05%).

b) Hazardous waste in relation to total waste quantities disposed of in the Auckland region

Solid hazardous waste comprised an estimated 15% of the total waste deposited in Auckland's landfills in 1995[4] (110,605 tonnes out of 725,000 tonnes). Liquid trade waste were estimated as 10% of the total amount of sewage received and treated by the Region's sewage treatment plants (9,535,787 tonnes out of 94,541,948 tonnes).

c) Solid components of hazardous waste disposed of as trade waste in the Auckland region

Hazardous waste disposed of as trade waste is water-borne. This means that the hazardous constituents make up only a small percentage of the total quantity because the majority of the waste is water. By measuring a range of contaminants when the waste arrives at the sewage treatment plant and estimating how much of the total sewage received at the plant originated from industrial sources (the trade waste), it is possible to determine a rough estimate of the mass load of hazardous constituents (the solid part of the trade waste) disposed of by Auckland businesses in 1995. This amounts to an estimated 13,390 tonnes. Figure 6.3.7 shows the relative percentage of hazardous waste when only solid components are considered.

[4] This information was derived from a survey of solid waste that was carried out for the financial year 1994/1995 [Auckland Regional Council, 1996].

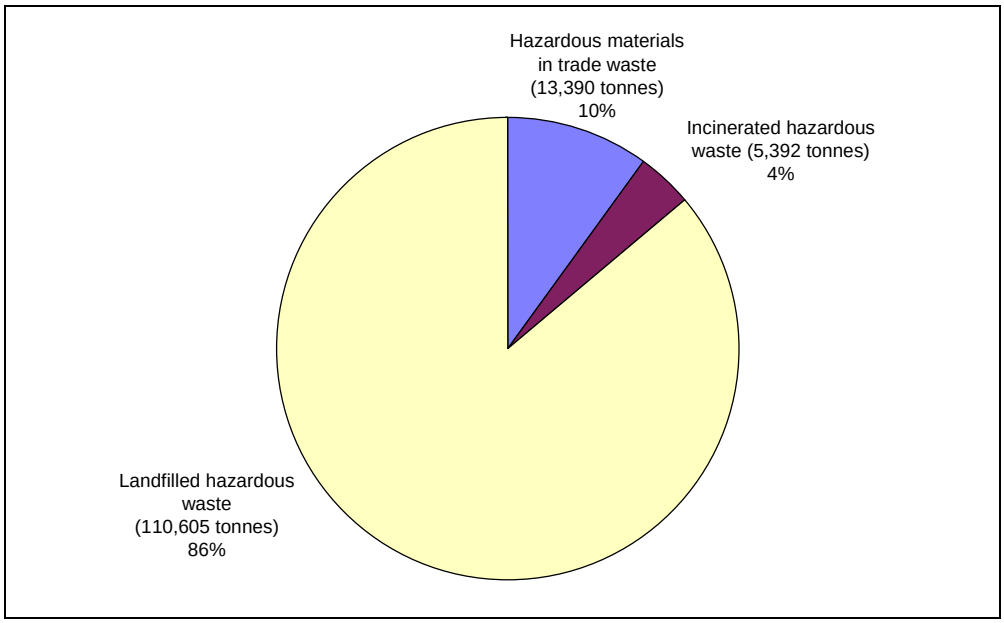


Figure 6.3.7 Solid components of hazardous waste disposed of in the Auckland region in 1995 [Environment and Business Group Ltd and Auckland Regional Council, 1996].

d) Composition of hazardous waste disposed of in the Auckland region

Table 6.3.2 shows the organic and inorganic portions of the hazardous waste disposed of in 1995. Organic wastes are those which have plant or animal origins and which are mainly toxic to the environment (ecotoxic) because of their high BOD_5 loading. The inorganic components of hazardous waste are mainly corrosive and/or toxic.

Table 6.3.2 Organic and inorganic components of hazardous waste disposed of in the Auckland region in 1995 [Environment and Business Group Ltd and Auckland Regional Council, 1996].

Destination of hazardous waste	Total quantities disposed (tonnes)	Water (tonnes)	Solid organic components (animal and plant wastes) (tonnes)	Solid inorganic components (e.g. metals and chemical compounds) (tonnes)
Sewage treatment plant	9,535,787	9,522,397	13,251	139
Landfill	110,605	-	56,639	53,966
Incinerator	5,392	-	-	5,392

Two conclusions which can be drawn from Table 6.3.2 are:

- the vast majority of the liquid trade waste going to the sewage treatment plant is water;
- approximately half of the hazardous wastes going to landfill were organic waste.

6.3.4. Qualitative results

The survey also sought qualitative information to enable the development of hazardous waste management programmes. Qualitative data obtained from the survey provided a detailed picture about current waste management practices and identified areas where improvements are necessary.

Many businesses observed that regulations, education and information provision relating to hazardous wastes need to be improved. For this reason, considerable emphasis was placed on the gathering of qualitative information, ranging from specific questions about record keeping and monitoring of waste through comments on hazardous waste management in general. The most significant findings are summarised below:

- measurement of waste: accurate measurement of the hazardous waste was comparatively rare. About a quarter of the waste streams were not measured at all, while almost half were estimated visually. Only a small number was measured by electronic means, a weighbridge or similar accurate methods;
- record keeping: businesses did not keep records for more than half of the waste streams they generated. Invoices or receipts were the most common types of records kept, and only very few waste streams were recorded by electronic means, manifests or similar mechanisms;
- existing waste management services: the majority of businesses stated that they were generally satisfied with the existing services, but a vocal minority noted that existing services are insufficient, too monopolised or too expensive;
- regulations relating to hazardous waste: a number of businesses stated that current levels of regulation and control are not sufficient;
- education and training: a considerable number of the businesses requested better information about hazardous waste, as well as education and training on handling of this waste.

6.4. Other regional hazardous waste surveys

6.4.1. Taranaki region

From responses to a questionnaire on waste hazardous substance generation within industry in both city and rural ares of Taranaki, an assessment was made of types and quantities of waste likely to be produced by various industrial plants (Table 7.1, Appendix IX). it should be noted that the results of similar surveys in other areas may be significantly influenced by a number of factors. The information below is therefore indicative and descriptive, rather than specific and absolute.

The information is given by industrial activity classification, following the New Zealand Standard Industrial Classification (as at June 1993) as prepared by the Department of Statistics and as used in the *Waste Analysis Protocol*.

It is noted that the quantities are indicative of existing technologies and management practices. It may be possible to significantly reduce the quantities and/or toxicity of the above wastes by application of cleaner production technologies.

6.4.2. Otago region

Otago Regional Council commissioned a survey to assess the acceptability of hazardous waste management practices in the Otago region, and to review options available to the Council to effect improvements. Although the study was mainly focused on the management of hazardous waste, the project also involved the identification of types of hazardous waste generated, quantities generated and quantities stockpiled to date. The data identify industrial (industrial and agricultural) and residential (household) hazardous waste. The total quantities generated per year and quantities stockpiled are summarised in Table 6.4.1. A more detailed breakdown of these data, and the methodology used to estimate quantities of hazardous waste generated, are provided in Appendix X [Works Consultancy Services, 1996(b)].

It should be noted that although the data contained within the above documents both detailed and accurate, the assumptions made in preparing the tables in this section are such that a margin of error of ±20% has been adopted for all bulk quantities of hazardous wastes

Table 6.4.1 Estimated bulk hazardous waste generated and stockpiled in Otago [Works Consultancy Services, 1996(b)].

Waste source	Industrial (tonnes)	Agricultural (tonnes)	Residential (tonnes)	Total (tonnes)
Stockpiled	250,000	50	450	250,500
Stockpiled (intractable)	50,000	10	50	50,060
Generated per year	3,000	10	110	3,120
Generated per year (intractable)	500/yr	2	10	512

Note: industrial hazardous waste predominantly consists of soil/sludge from contaminated sites.

Table 6.5.1 Estimated quantities of unwanted hazardous waste collected by New Zealand councils.

Region/ District/ City	Year	Chemicals collected	Quantities collected to date (tonnes)	Quantities stored or awaiting disposal (tonnes)	Reference
Auckland Region	Ongoing	Mixed at drop-off points	Not known	Not given	Auckland Regional Council, *personal communication*
Bay of Plenty Region	1992-96	Agrichemicals	23.83	14.12	Bay of Plenty Regional Council, 1996
Gisborne District	1996	Agrichemicals	8.0	Not given	Gisborne District Council, *personal communication*
Hamilton City	1994	Residential	3.14	Not given	Works Consultancy Services, 1996
Hawke's Bay Region	1996	Residential	4.86	Not given	Hawke's Bay Regional Council, 1996
Manawatu-Wanganui Region	1995-96	Agrichemicals	58.63	10.78	Manawatu-Wanganui Regional Council, 1996
Northland Region	Not given	Not given	Not given	Not given	
Otago Region	Not given	Industrial (incl. Agricultural) & residential (Note: predominantly soil/sludge from contaminated sites)	300,560	Not given	Works Consultancy Services, 1996 (b)
Southland Region		Agrichemicals	30		Southland Regional Council, *personal communication*
Taranaki Region	1991-92 1995-96	Agrichemicals (rural) Mixed (urban), not yet completed	8.71 10.39	2.49 1.99	Taranaki Regional Council, 1992, 1995, 1996, *personal communication*
Tasman District	1995	Agrichemicals (500 farms)	0.33	Not given	Tasman District Council, 1996
Waikato Region	1992-94 1995-96	Agrichemicals (collection) Mixed (drop-off points)	3.14 1.40	Not given	Blutner et al., 1994; Waikato Regional Council, personal communication
Whangarei District	1993	Residential hazardous waste	0.52	Not given	Ministry for the Environment, 1994 (a)

6.5. Regional hazardous waste collections

Thirteen authorities in New Zealand have organised hazardous waste collections. The key findings are outlined in Table 6.5.1. The most significant type of waste collected is agrichemicals. The majority of the waste collected is being stored until available treatment and disposal options are identified. Where possible waste is sent back to manufacturers or is reused or recycled.

6.6. Export of hazardous waste

No information has been found to date regarding the disposal of hazardous waste in New Zealand. An exception is the export of hazardous wastes, which needs to be reported under the Basel Convention. The Basel Convention requires Parties (countries that have signed the Convention) to provide information on the effort taken to reduce transboundary movement of hazardous wastes and measures undertaken for development of technologies for the reduction and/or elimination of the hazardous wastes produced.

Figure 6.6.1 summarises the information on transboundary movements of hazardous wastes involving New Zealand in 1995. The Figure includes the maximum amounts approved for movement; the actual amounts moved will often be significantly less. More detailed information is given in Appendix XI.

Approval was given to export 340 tonnes of PCBs (polychorobenzenes) to France for destruction. The actual export receipts amounted to 120 tonnes in 1995. In 1996 and following years it is intended to routinely report the actual tonnage moved, in addition to the amount approved.

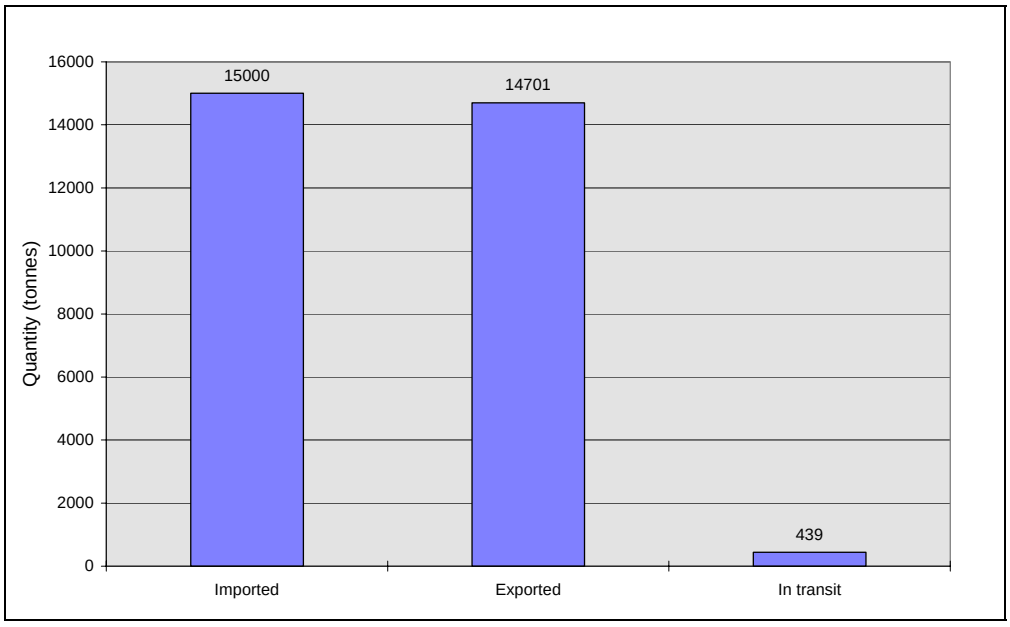


Figure 6.6.1 New Zealand transboundary movements of hazardous wastes in 1995 [Ministry for the Environment, 1996(b)].

6.7. Oil

Each year New Zealanders use between 60 and 70 million litres of lubricating oil. Between 40-60% of this amount is consumed during use. The rest, an estimated 30 million litres a year, requires disposal. That is the equivalent of a lake 100 metres long, 30 metres wide and 10 metres deep.

Of this 30 million litres of used oil that needs to be managed every year, only about a quarter is known to be disposed of in an environmentally responsible way. Dominion Oil re-refines 7 million litres of used oil a year and sells it in the marketplace as motor oil.

The remaining 23 million litres are currently disposed of in ways that may be harmful to the environment. Some examples of incorrect disposal are:

- dumping in landfills (7 million L);
- low temperature burning (5 million L);
- road oiling for dust control (4 million L);
- oiling chain saws/staining fences (3 million L);
- unknown (million L).

In March 1996 the Used Oil Recovery Programme (UORP) was launched by the Minister for the Environment. Its aim is to recover 95% of available used oil by the year 2000 for recycling and reuse. The UORP recommended the development of a nationwide used oil collection programme ensuring used oil is collected to meet strict environmental standards. The oil is then delivered to the approved end users, Milburn New Zealand Ltd and Dominion Oil Ltd. Milburn NZ Limited has been granted a resource consent to burn used oil collected from the programme, to fire one of their cement kilns.

6.8. Contaminated sites and soil clean-up

In 1992, a preliminary survey was undertaken throughout New Zealand to identify potentially contaminated sites [Ministry for the Environment, 1992(a)]. These are sites that are recommended by the Australian and New Zealand Environment and Conservation Council (ANZECC) for assessment because they are or were occupied by an industry which tends to be associated with site contamination. In practice, only a fraction of the identified sites are contaminated (i.e. high-isk sites). The survey identified over 8,000 ANZECC land-use sites in New Zealand that are recommended for assessment. Of these,800 sites are identified as timber treatment sites.

Table 6.8.1 summarises the number of sites recommended for assessment for contaminants on a regional basis and the number of sites that are considered high risk. Since 1992 a number of councils have commissioned or undertaken work to update data on potentially contaminated sites. Where available, updated data have been included in the table.

No information is available on the number of sites which have been “cleaned up” to date, nor of the quantities of hazardous waste resulting from the clean-up of contaminated sites. More information regarding sources and composition is provided in Appendix XII.

Table 6.8.1 Estimated number of ANZECC landuse sites and high-risk sites for different regions [Worley Consultants Ltd, 1992; Regional Councils, *personal communication*].

Region	Estimated total number of sites		
	ANZECC landuse sites as in 1992	ANZECC landuse sites as in March 1997	High-risk sites as in 1992
Northland	416		91
Auckland	1,714		376
Waikato	520	3,000	114
Bay of Plenty	263		58
Gisborne	240		53
Hawkes Bay	418	2,044	92
Taranaki	272	1,121	59
Manawatu/Wanganui	604		132
Wellington	642	881	141
Nelson	205		46
Marlborough	145		32
Canterbury	978		215
West Coast	189		41
Otago	335	393	73
Southland	259		57
Total	7,200		1,580

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GLOSSARY OF ACRONYMS, ABBREVIATIONS

ADF	average daily flow
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZSIC	Australian and New Zealand Standard Industrial Classification
BOD	Biochemical oxygen demand
C&D	Construction and demolition
CFC	chlorofluorcarbon
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
Gg	gigagrammes
HFCs	hydrofluorocarbons
ICM	insulate control monitor
IPCC	Intergovernmental Panel on Climate Change
JANZS	Joint Australian and New Zealand Standard
mSv	milliSievert
NECAL	National Environmental Chemistry and Acoustics Laboratory
NIWA	National Institute of Water & Atmospheric Research Ltd
NMVOCs	non-methane volatile organic compounds
N_2O	nitrous oxide
NO_x	other nitrogen oxides
NZ	New Zealand
NZCIC	New Zealand Chemical Industry Council
NZWIC	New Zealand Waste Identification Code
NZWWA	New Zealand Water and Wastes Association
OECD	Organisation for Economic Cooperation and Development
PFCs	perfluorocarbons
PIAC	Packaging Industry Advisory Council

PCBs	polychlorobenzenes
RM Act	Resource Management Act
SF_6	sulphurhexafluoride
SMF	Sustainable Management Fund
SO_2	sulphur dioxide
SS	suspended solids
TCLP	Toxicity Characteristics Leaching Procedure
TSP	total suspended particles
UNEP	Unites Nations Environment Programme
UORP	Used Oil Recovery Programme
USEPA	United States Environmental Protection Agency
VOC	volatile organic compounds
VKT	vehicle kilometres travelled
WAP	Waste Analysis Protocol
WWTP	wastewater treatment plant

APPENDIX I

Waste-related projects funded by the Sustainable Management Fund

Table I-1 Overview of Sustainable Management Fund projects that are relevant to waste in New Zealand [Ministry for the Environment, 1996(a)].

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
S	4058	Waste Analysis Protocol Survey	WAP survey (modules B & C) in Canterbury	Ken Taylor	Canterbury Regional Council	03 365 3828	03 365 3194
S	4082	Project C&D - Stage 2	Trial several initiatives targeting waste reduction in the construction and demolition industry. They will promote the initiatives using demonstration projects in the three main centres, and then carry out a hands-on feasibility for the development of a recovery network and processing facility for the waste.	Craig Tolley	ARC Environment (Auckland Regional Council)	09 379 4420	09 366 2155
S	4084	Waste Surveys	Conduct Waste Analysis Protocol (WAP) surveys to gather information on the nature, composition and amount of waste being produced in the district. Then they will assess the effectiveness of the waste management plan and initiatives taken in the Gisborne region and this will provide a base for future waste management planning.	Peter Burrows	Gisborne District Council	06 867 2049	06 867 8076
S	4085	Cleaner Production in Retail Stores	To develop eco-city principles within a retail mall in New Zealand. Using Henderson Mall as a case study they will develop cleaner production case studies and guidelines for the retail and construction sectors.	Rachel Brown	Waitakere City Council	09 836 8000	09 836 8057
S	4087	South Island Glass Waste Management	To identify and recommend for further investigation a range of economically and environmentally sustainable options for the management of glass waste in the South Island.	Sarah Gordon	Christchurch City Council	03 379 1660	03 371 1384
S	4097	Waste Analysis Protocol	To undertake Waste Analysis Protocol Surveys in Otago, West Coast, Canterbury, Wellington, Manawatu/Wanganui, Waikato, Auckland.	Alan Street	AgFirst Consultants Environmental Ltd	03 325 2601	03 325 2601
S	4107	Ruapehu District	The scope of the project is to undertake two WAP surveys, module C, in the	Suzienne	Ruapehu	(07) 895 8188	(07) 895

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
		Council Waste Analysis Protocol Survey	Ruapehu District. The objectives of the survey is to gain reliable data to be used in making management decisions including the scope of user charges and potential for waste reduction.	Slegers	District Council		3253
S	4108	Paper Project - Stage 2	Paper is the third largest category of material going to landfill. This is reflected nationally. In a materials-based approach, Auckland City Council's Waste Minimisation Unit has initiated The Paper Project, a three-part, two year project to reduce paper waste going to landfill in the Auckland region.	Jan Burbery	Auckland City Council	(09) 624 2558	(09) 625 6064
S	4102	Analysis of Indirect Imports of Packaging (by weight)	To define more accurately than is currently possible the contribution of indirect imported packaging to the waste stream. The freeing up of the NZ trade environment has resulted in an increased number of companies importing products from overseas and the packaging associated with these needs to be defined.	John Webber	Packaging Industry Advisory Council of New Zealand	09 262 4044	09 262 4111
S	4102	Analysis of Indirect Imports of Packaging (by weight)	To define more accurately than is currently possible the contribution of indirect imported packaging to the waste stream. The freeing up of the NZ trade environment has resulted in an increased number of companies importing products from overseas and the packaging associated with these needs to be defined.	John Webber	Packaging Industry Advisory Council of New Zealand	09 262 4044	09 262 4111
S	4102	Analysis of Indirect Imports of Packaging (by weight)	To define more accurately than is currently possible the contribution of indirect imported packaging to the waste stream. The freeing up of the NZ trade environment has resulted in an increased number of companies importing products from overseas and the packaging associated with these needs to be defined.	J o h n W e b b e r	Packaging Industry Advisory Council of New Zealand	09 262 4044	09 262 4111
L	2026	Oteramika Catchment Project	Characterisation of existing natural and physical resources in catchment. Identify risk issues related to land management and non-point sources of water pollution. Develop programmes to examine/predict effects of land use practices.	Neil McDermott	Southland Regional Council	03 215 6197	03 215 8081

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
			Identify, implement/test them.				
L	2058	Guidelines for controlled wetland treatment of dairy shed oxidation pond discharges	Develop guidelines for the design, construction, planting and operation of constructed wetlands for dairy shed wastewater treatment.	Chris Tanner	NIWA	07 856 7026	07 856 0151
L	2097	Sustainable Environmental Management Systems for Dairy Farmers	To produce a manual on non-point sources of pollution from dairy farming operations that will complement the manual on dairy-shed effluent that has already been prepared. These manuals will provide answers to dairy farmer questions on environmental issues and make recommendations for environmentally sustainable farm management. The information obtained will be disseminated to farmers through 72 field-day presentations and as concise booklets summarising the main points in the manuals.	Jim Barnett	New Zealand Dairy Research Institute	06 350 4649	06 356 1476
L	4008	Establishment of database of Wastewater Treatment Plants	To seek details on all small wastewater treatment plants in the country and place this information on a database. Data collected would be summarised and presented in a report. Data will be interpreted and corrected to a common set of units for direct comparison.	Martin Evans	Woodward-Clyde	09 379 3515	09 379 7550
L	4069	Oil Recovery - Communication and Education Material	Develop and produce educational material to increase public understanding and promote the Used Oil Management Programme. Includes video programme, programme booklet and brochure.	Brian Scott	Castrol NZ Limited	04 801 9222	04 801 9224
L	4092	New Zealand Guidelines: Management of Water Treatment Sludge	Development of national guidelines for the handling, recycling and disposal of wastewater and sludge generated at water treatment plants throughout the country. Information will be gathered to describe the different processes used, their effectiveness, costs, the volumes handled, comparison with current practice overseas, the environmental effects of discharges to land and water, and to summarise relevant details of discharge consents. The guidelines will present handling and disposal methods that meet the requirements of the Resource Management Act.	David Ogilvie	New Zealand Water and Wastes Association	09 817 5478	09 817 5478
L	5047	Toxkit Technology	Toxkit, new generation of microbiotests, developed at the University of Ghent,	John	Wellington	04 801 2794	04 801 2796

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
		and New Zealand Water Quality Guidelines	Belgium. Effective and cost effective way to perform regulatory acute aquatic toxicity screening tests of effluents, aimed at maintaining water quality and protecting biota of receiving waters. Protocols adhere to ASTM/OECD Guidelines. Comparative sensitivity tests, using split effluent samples, will be performed with Toxkit organisms and native species. A training workshop, using Toxkit technology (related to the field of ecotoxicity testing), presented, followed by round-robin intercalibration exercises involving regional laboratories.	Ruck	Polytechnic		
G	3011	Guidelines for the Assessment of Landfill Gas	To assess the type, volume and dispersion of surface landfill gas emissions from three disused landfills. To form guidelines, with worked examples, for an overall assessment of landfill gas emissions into the environment.	Dave Kettell	Works Consultancy Services	04 471 7000	04 471 1397
G	5003	Air Pollution Indicators	Focuses on the use of lichens as indicators of air pollution. To develop the applicability of bio-indicators to a broader geographical extent within NZ, to particular point sources of pollution, and to specific pollutant levels.	Caroline Pratt	Manaaki Whenua - Landcare Research	03 477 4050	03 325 2127
G	5006	Sustainable Air Quality Management	Improve assessment and measurement, monitoring, recording and reporting on air quality. Produce specific techniques and guidelines for local governments on air quality management. Ensure the results of the project are communicated/adopted/understood by major groups.	Gavin Fisher	NIWA	09 570 0770	09 527 0033
G	5034	Vehicle Exhaust Gas Emissions	To establish an inventory on the emissions characteristics of the New Zealand vehicle fleet to enable informed decisions to be made on air quality management plans and any legislation involving motor vehicle emission levels.	Keith Jones	Auckland Uniservices Ltd	09 373 7522	09 373 7412
H	3005	Investigation of Industrial & Trade Waste Sites	Involves the identification of potentially contaminated sites.	Ian Brown	Otago Regional Council	03 474 0827	03 479 0015
H	3007	Contaminated Sites Investigations	To determine the level of hazard, and remedial action needed, for high-risk contaminated sites in Tasman District.	Dennis Bush-King	Tasman District Council	03 544 8176	03 544 7249
H	3008	Mapua Decontamination	Complete assessment of chemical contamination at Mapua, and develop a strategy for remediation.	Dennis Bush-King	Tasman District Council	03 544 8176	03 544 7249
H	3009	Bioremediation -	Involves literature review on bioremediation applications; development of	Caroline	Manaaki	07 838 4441	03 325 2127

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
		treatment option for contaminated sites	guidelines for ecological clean-up levels; identify biotic/abiotic measurements for predicting suitability of bioremediation. Select potential sites. Hold workshop.	Pratt	Whenua - Landcare Research		
H	3010	Contaminated Sites Investigation	Continue previous year's work on assessment strategy. Investigate Napier gasworks site.	Rob van Voorthysen	Hawkes Bay Regional Council	06 835 3164	06 835 3601
H	3012	Oil Industry Contaminated Sites Cleanup Guidelines	Develop guidelines to assist in the cost effective and responsible investigation and clean-up of land-based sites contaminated by hydrocarbons.	Peter Bartlett	Oil Industry Environmental Working Group	04 495 6000	04 495 6002
H	3013	Assessment of PCP levels at timber treatment sites in the Auckland region	Continuation of survey to investigate PCP levels at active/historic sites, and determine sources and extent of environmental degradation.	Craig Tolley	ARC Environment	09 366 2000 ex 7183	09 366 2155
H	3017	Contaminated Sites Management	Continued development and application of assessment of contaminated sites.	Viv Donaldson	Northland Regional Council	09 438 4639	09 438 0012
H	3019	Contaminated Sites - Rapid Hazard Assessment	To investigate 14 sites and develop management strategies.	Jon Cuncliffe	Marlborough District Council	03 578 5249	03 578 6866
H	3022	Mapua Decontamination (2).	This project includes remediation planning; public consultation; and dump site investigation.	Dennis Bush-King	Tasman District Council	03 544 3412	03 544 7249
H	3025	Contaminated Site Risk Assessment Training	To offer training in contaminated site risk assessment to both the regulatory and private sectors through five one-day seminars throughout New Zealand.	Dean Kimpton	Worley Consultants Ltd	09 379 1200	09 379 1210
H	3030	Mapua Clean-up	Implement the contaminant proposal for "cleaning up" the former Fruitgrowers Chemical Company site at Mapua. This project comprises detailed design, site works and ongoing monitoring. It is the end result of three years of investigations of the site.	Dennis Bush-King	Tasman District Council	03 544 3412	03 544 7249
H	3031	Gisborne District Council's	To develop and implement a cost effective Contaminated Sites Management Strategy for the Gisborne District. The strategy will provide protection for the	Peter Burrows	Gisborne District Council		

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
		Contaminated Sites Management Strategy	environment and public health of the region and allow future development of sites which have been assessed and/or remediated to the satisfaction of the Council.				
H	3043	Removal of Contaminated Soil From Residential Properties in Napier	This project involves the removal of contaminated soil from 7 residential properties in Napier, located adjacent to the old Napier Gasworks. After an extensive period of close investigation and analysis, the District Medical Officer of Health confirmed the existence of a high level of cyanide and other gas works waste in the soil up to a depth of 1m. The cleanup will involve the removal and dumping of the contaminated soil, and backfilling with clean fill and top soil.	Paul Dunford	Napier City Council	06 835 7579	06 835 7574
H	3044	Lead Contamination Investigation at Gun Clubs and Wetlands	To undertake an initial investigation of environmental contamination from lead shot at gun clubs and wetlands used for intensive recreational waterfowl shooting. Present and historical site use information and Rapid Hazard Assessment used to prioritise sites for further investigation. Water soil and sediment sampling programme designed and undertaken to characterise high priority sites.	Brigid Casey	Canterbury Regional Council	03 365 3828	03 365 3194
H	4007	Contaminated Site Protocols Project	To develop information collection and management protocols for contaminated sites.	Hilary Chapman	Worley Consultants Ltd	09 379 1200	09 379 1201
H	4014	Survey and Collections of Unwanted Chemicals	To determine the types and quantity of redundant chemicals in both urban and rural situations with the formulation and adoption of a strategy for recycling and storage of intractable chemicals at Council's Eves Valley landfill pending identification of suitable disposal methods.	Dennis Bush-King	Tasman District Council	03 544 8176	03 544 7249
H	4015	Management of Unwanted Chemicals	The project involves theree steps. Use chemical and physical analysis to characterise all unknown wastes; 2) Identify options for utilisation (reuse/recycling) or disposal; 3) Review and report on the above.	Fred McLay	Taranaki Regional Council	06 7657 127	06 765 5097
H	4016	Agrichemical collections	To carry out the collection of unwanted agrichemicals from approximately 30% of the region and to provide for adequate facilities for the safe reception, storage, and disposal of unwanted agrichemicals.	Ed Parks	Bay of Plenty Regional Council	07 308 7289	07 307 2544
H	4019	Urban Collection	The collection of unwanted chemicals from urban areas in the Hawke's Bay region.	Rob van Voorthysen	Hawke's Bay Regional Council	06 835 3164	06 835 3601

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
H	4024	Regional Management of Unwanted Chemicals	The collection of unwanted agricultural chemicals from farms. The chemicals will be treated and either stored or disposed of safely pending arrangements for destruction. An education programme is to be run at the same time, to ensure this chemical legacy is not repeated, and to ensure chemicals are disposed of safely in the future.	Jeffrey McNeil	Manawatu-Wanganui Regional Council	06 357 9009	06 356 7477
H	4040	Hazardous Substances Collection	Collect redundant hazardous substances, mainly agrichemicals, for recycling or disposal.	Peter Burrows	Gisborne District Council	06 867 2049	06 867 8076
H	4048	Collection of Agrichemicals	Investigate and implement collection, storage, and disposal of unwanted chemicals.	Ian Brown	Otago Regional Council	03 474 0827	03 479 0015
H	4049	Hazardous Waste Facilities Investigation	Prepare a strategy to consider the collection, transportation, storage and treatment of hazardous wastes.	Ian Brown	Otago Regional Council	03 474 0827	03 479 0015
H	4051	Waste Analysis Protocol Survey	WAP survey (module A) to analyse the hazardous waste stream in the Auckland region.	Craig Tolley	ARC Environment	09 379 4420	09 366 2155
H	4054	Hazardous Wastes Collection Network	To design and construct a comprehensive, safe and efficient collection and disposal network for small non-commercial quantities of hazardous waste.	Annette Pellowe	Environment Waikato	07 856 7184	07 856 0555
H	4055	Waste Analysis Protocol Survey	WAP survey (modules B & C) in Waikato and Bay of Plenty regions.	Annette Pellowe	Environment Waikato	07 856 7184	07 856 0555
H	4057	Problem Hazardous Waste Management	Collection, identification, transportation, and storage of problem hazardous wastes in Northland.	Viv Donaldson	Northland Regional Council	09 438 4639	09 438 0012
H	4064	Redundant Chemical Collection	Collection of unwanted chemicals in Southland.	Neil McDermott	Southland Regional Council	03 215 6197	03 215 8081
H	4073	Halon Fire Extinguishant Survey	To undertake a survey of the quantity of Halon in hand fire extinguishers and fixed gas flood systems.	R J Fraser	NZ Fire Protection Association	09 523 3311	09 524 9624
H	4091	Hazardous Business Waste Analysis of Hutt Valley Industries	To facilitate the adoption of effective methods of reusing, reducing, recycling or appropriately treating hazardous waste generated by Hutt Valley industries. To provide information for the development of future strategies by Council and	Talebul Islam	Hutt City Council	04 570 6666	04 569 1625

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
			industry, in reducing hazardous wastes impact on the environment.				
H	4093	Problem Hazardous Wastes Management	The objective is to reduce the quantities of problem hazardous wastes being disposed of in a manner which results in adverse environmental effects. This project includes the collection, identification, temporary storage, transport, exchange and long-term storage of problem hazardous wastes for the Northland region for the 1996/97 financial year.	Jerry Nelson	Northland Regional Council	09 438 4639	09 438 0012
H	4101	Collection of Unwanted Agrichemicals	Allows for the continuation and completion of the region-wide collection, sorting, redistribution and safe containment programme which was started in 1995/96.	Ian Brown	Otago Regional Council	03 474 0827	03 479 0015
H	4113	Indentification, Repackaging and Storage of Unwanted Agrichemicals	The identification, repackaging and storage of unwanted agrichemicals that have been previously collected in unwanted chemical collection programmes by a consortium of 7 councils.	Paul Dell	Bay of Plenty Regional Council		
H	6012	Vessel Maintenance Guidelines	Develop set of generic guidelines to avoid/mitigate discharges of toxic bioxides used for cleaning.	Craig Tolley	ARC Environment	09 366 2000	09 366 2155
WM	4002	Environmental Hotels of Auckland (EHOA)	A membership-based environmental initiative is proposed for hotels in the Auckland region. The initiative is to be based on a set of agreed environmental standards which will incorporate the principles outlined in the Ministry's Cleaner Production Guidelines.	Craig Tolley	Auckland Regional Council	09 379 4420	09 366 2155
WM	4023	Cleaner Production in Christchurch	To promote and where possible provide training on waste audit and cleaner production techniques to local businesses and industry by way of a competition and training seminars.	Lindsay Lamont	Christchurch City Council	03 379 1660	03 379 7786
WM	4028	Cleaner Production in Wellington	To progress its Workplace Pride Wellington Programme within the tourism industry. Attempting to build a groundswell of interest in cleaner production within the sector.	Paul Forrest	Wellington City Council	04 801 3787	04 801 3003
WM	4030	Cleaner Production in Supermarkets	To educate the management and staff of supermarkets in cleaner production and waste reduction/reuse techniques, and reduce the amount of waste to the landfill and sewage systems.	C J B Dale	Manakau City Council	09 263 7100	09 262 5151
WM	4032	Cleaner Production in Waitakere City	To encourage the business community of Waitakere City to identify and implement those techniques and technologies necessary to improve	Rachel Brown	Waitakere City Council	09 836 8000	09 836 8001

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
			environmental performance on an ongoing basis.				
WM	4033	Cleaner Production Programme	To make companies aware of their waste and take action to reduce both its volume and hazards.	K L Tate	North Shore City Council	09 486 8400	09 486 8500
WM	4034	CP in the Food Industry	Promote reduction, reuse, recycling and recovery of waste in the food processing industry in Hastings and Napier.		Hastings District Council		
WM	4036	Cleaner Production in Marlborough	To carry out an environmental study by survey of the materials and methods used to look at wastage.	Annie McDonald	Marlborough District Council	03 578 5249	03 578 6866
WM	4038	Cleaner Production in Hamilton	The promotion of the Cleaner Production Guidelines to the Hamilton business and industry.		Hamilton City Council		
WM	4053	Cleaner Production in the Pipfruit Industry	Development of a best-practice guide for orchards and packhouses based on the principles of cleaner production.	Camille Astbury	Works Consultancy Services	04 471 7047	04 471 7770
WM	4065	Cleaner Production Case Studies & Guidelines for Six Industry Sectors	To produce case studies and guidelines to facilitate CP practices, and to assist in transfer of CP technologies to businesses within these industries.	Paul Forrest	Wellington City Council	04 499 4444	04 801 3003
WM	4079	Cleaner Production in Hospitals	Develop an environmental best-practice guide for hospitals based on the Cleaner Production Guidelines. Involves developing drafts, looking at cleaner production options, trialing the guide once developed, reviewing it, launching and circulating it.	Camille Astbury	Works Consultancy Services	04 471 7000	04 471 7770
WM	4088	Cleaner Production in the Metal Products Industry	To produce best practice guides for the metal products industry. The best practice guides will facilitate the adoption of cleaner production within this industry.	Camille Astbury	Works Consultancy Services	04 471 7047	04 471 7770
WM	4089	Cleaner Production in the Fishing Industry	Focus on packaging waste minimisation on fishing vessels and the provision of appropriate storage and disposal facilities for residual wastes. The crayfishing industry in the Southland region will be used as a case study which can then be applied to the rest of New Zealand's various fishing industries. This "pristine" environment was chosen because pollution detracts significantly from its natural character.	Teri McClellan d	Southland Regional Council	03 215 6197	03 215 8081
WM	4090	Introducing Cleaner	Hutt City and Upper Hutt City Councils are proposing a series of six workshops,	Steve	Hutt City	04 570 6666	04 569 1625

Type	No.	Project Title	Description	Contact	Applicant	Work Phone	Fax Number
		Production to Hutt Valley Businesses	specifically aimed at industry types and designed to encourage industry to proceed to cleaner production audits. Workshops will provide each of the 800 industries in the area with the opportunity to participate in a four-hour workshop session, and give information on where to target partnership initiatives. This is the first stage in a comprehensive and long-term commitment by the councils to a cleaner production programme.	McCarthy	Council		
WM	6027	Sustainable Building Guide	To pilot an environmental assessment scheme for new homes called Sustainable Building Guide. It's an environmental audit of a home at the design stage. The pilot will test the robustness of the guide and evaluate homeowners' attitudes to the design.	Adrian Bennett	BRANZ	04 2357 7600	04 3235 6070
WM	6054	Sustainable Viticulture Scheme for the NZ Wine Industry	NZ grape and wine industry, through Winegrowers of NZ, has initiated and provided preliminary evaluation of a Sustainable Viticultural Scheme. This scheme, based on a scorecard that directs vineyard management towards long-term sustainability, requires extensive evaluation in commercial vineyards before it can be available for industry-wide adoption. Funding is sought so the scheme can be evaluated, promoted and developed. The goal is for industry-wide adoption by 2000, protection of the vineyard environment and to secure export market access.	Philip Gregan	Winegrowers of New Zealand	09 303 3527	09 302 2969

Note: abbreviations: S = solid waste
L = liquid waste
G = gaseous waste
H = hazardous waste (including contaminated land)
WM = waste management

APPENDIX II

New Zealand Waste Identification Code (Table Y)

Table II-1 New Zealand Waste Identification Code (NZWIC) - categories of waste to be controlled (Table Y) [Ministry for the Environment, 1992(c)].

Code	Description
A	**Waste streams**
Y1	Clinical waste from medical care in hospitals, medical centres and clinics
Y2	Waste from the production and preparation of pharmaceutical products
Y3	Waste pharmaceuticals, drugs and medicines
Y4	Waste from the production, formulation and use of biocides and phytopharmaceuticals
Y5	Waste from the manufacture, formulation and use of wood-preserving chemicals
Y6	Waste from the production, formulation and use of organic solvents
Y7	Waste from heat treatment and tempering operations containing cyanides
Y8	Waste mineral oils unfit for their original intended use
Y9	Waste oils/water, hydrocarbons/water mixtures, emulsions
Y10	Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)
Y11	Waste tarry residues arising from refining, distillation and any pyrolytic treatment
Y12	Waste from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish
Y13	Waste from production, formulation and use of resins, latex plasticisers, glues/ adhesives
Y14	Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on people and/or the environment are not known
Y15	Waste of an explosive nature
Y16	Waste from production, formulation and use of photographic chemicals and processing materials
Y17	Waste resulting from surface treatment of metals and plastics
Y18	Residues arising from industrial waste disposal operations
B	**Waste having as constituents:**
Y19	Metal carbonyls
Y20	Beryllium; beryllium compounds
Y21	Hexavalent chromium compounds
Y22	Copper compounds
Y23	Zinc compounds
Y24	Arsenic; arsenic compounds
Y25	Selenium; selenium compounds
Y26	Cadmium; cadmium compounds
Y27	Antimony; antimony compounds
Y28	Tellurium; tellurium compounds
Y29	Mercury; mercury compounds
Y30	Thallium; thallium compounds
Y31	Lead; lead compounds
Y32	Inorganic fluorine compounds excluding calcium fluoride
Y33	Inorganic cyanides
Y34	Acidic solutions or acids in solid form
Y35	Basic solutions or bases in solid form
Y36	Asbestos (dust and fibres)
Y37	Organic phosphorus compounds
Y38	Organic cyanides

Y39	Phenols; phenol compounds including chlorophenols
Y40	Ethers
Y41	Halogenated organic solvents
Y42	Organic solvents excluding halogenated solvents
Y43	Any congenor of polychlorinated dibenzo-furan
Y44	Any congenor of polychlorinated dibenzo-p-dioxin
Y45	Organohalogen compounds other than substances referred to in this appendix (e.g. Y39, Y41, Y42, Y43, Y44)

C	**Categories of waste requiring special consideration**
Y46	Wastes collected from households
Y47	Residues arising from the incineration of household wastes
Y48	Radioactive substances

APPENDIX III

Landfill Census

Introduction

The aim of the Landfill Census was to gather baseline data on various aspects of landfill management in New Zealand and provide a robust methodology for future surveys. The Census objectives were to:

- monitor uptake of the Landfill Guidelines;
- identify constraints to the implementation of the Government Waste Policy;
- monitor compliance with the Resource Management Act 1991;
- provide information for international reporting requirements;
- provide baseline data on landfill management so that future trends could be monitored.

The 1997 publication [Ministry for the Environment, 1997] provides information from the 1995 Landfill Census for the general reader. The information has been provided in three different ways:

- the discussion of broad topic areas
- the provision of regional information
- the presentation of the question by question data.

The results of the Census have shown areas where improvements in landfill management are necessary.

Methodology

Planning for the Landfill Census began in 1994. A team co-ordinated by Worley Consultants undertook a scoping exercise and survey preparation. This was followed by more detailed work on the questionnaire design. The National Research Bureau (NRB) was then awarded the contract to undertake a pilot survey and the main survey.

Data collection

Data for the Landfill Census were obtained from a postal questionnaire completed by landfill regulators and operators. All regulators and operators were sent, by courier or mail, an appropriate questionnaire with an accompanying covering letter of introduction, instructions for completing the Census, and a stamped, addressed envelope for return of the questionnaire. The results of self-completion questionnaires provide information on the respondent's view or knowledge of a situation which may differ somewhat from another person's view or from on-site inspection.

Sampling was undertaken in two stages. The first involved contacting the 16 regulator organisations and identifying the person in the position of "Consents Manager" within each. These people were asked to identify the landfills and landfill operators within their jurisdiction. Questionnaires were then sent to the operators identified.

Two separate questionnaires were sent out from early to mid 1995, one to all regulators of landfills, and the other to all landfill. The regulator recipients were the resource consent managers at regional and unitary authorities. The landfill operator recipients were the people responsible for the landfills in the organisation that held the resource consents.

These recipients were chosen as those most likely to know about the spectrum of landfill management activity.

The questionnaire follow-up was a three-step process, and was identical for both regulators and operators. If the respondent had not returned the questionnaire within two weeks a telephone follow-up was made by one of NRB's interviewers to determine why the questionnaire had not been returned. The main reasons were that they hadn't got around to it, hadn't received it, or it was already in the post.

If the questionnaire had still not been returned one week after this, a postal follow-up was undertaken, reminding respondents of the survey and asking them to return their questionnaire within a week. Another copy of the questionnaire and stamped addressed envelope was enclosed.

Further telephone calls were made where necessary to respondents who still did not return their questionnaires. Particular attention was made here to regulators, as without their help it was not possible to contact operators.

The regulator questionnaires were couriered out on 8 March 1995 and the last was returned on 10 May 1995. The first operator questionnaires were posted on 22 March 1995 and the close-off date was 15 June 1995. Several questionnaires returned after this date have subsequently been included in the analysis.

The Census was undertaken during a transitional period for landfill resource consents and did not provide a true reflection of compliance with consent requirements. Therefore, a follow-up letter dated 26 September 1995 was sent to landfill regulators asking for the current status of the consents for landfills in their region. Responses to this letter were still being solicited in December and January 1996.

The Census was run on the understanding that responses would remain confidential. The data input method and data analysis were to ensure the confidentiality of responses.

Data comparison

To make comparison between quantities of wastes at different landfills, a conversion factor is needed to convert volume of waste to weight of waste. The factor used was:
$1m^3$ = 0.5 tonne. This rate of conversion was chosen after discussion with a number of waste management organisations.

The size of the landfills was determined on the annual weight of waste deposited at the landfill. The definitions are:

- small: (500 tonnes or less)
- medium: (501 to 5000 tonnes)
- large: (over 5,000 tonnes)
- unknown: landfills for which no annual weight of waste could be ascertained.

The annual weight of waste deposited was calculated in one of three ways:

- operators told of their annual waste figure;
- the total weight of waste deposited to this date was divided by the number of years the landfill has been open. (Where volume figures were given, the conversion factor was used);
- the population of the locality served was multiplied by the annual waste factor. (This factor was derived by taking an average of the annual waste figure divided by the population figure for all those landfills which supplied both of these figures);
- The populations served were grouped into three categories for this report: small (up to 999 people}, medium (1,000 - 9,999 people) and large (10,000 people and over).

Results

The response rate was high for a postal survey, with all 16 regulators returning questionnaires, and initially 84 of the 103 operators returning their questionnaires. Four late returns were not included in the initial results.

The 15 non-respondent operators were evenly spread through the country, and most operated only one landfill. However, this has meant full information is available only in the Auckland, Bay of Plenty, Gisborne, Hawke's Bay, Marlborough, and Southland regions.

The Census identified 327 landfills; detailed information was obtained for 271 of these. The 1987 Department of Health survey identified 462 landfills. This reduction in landfill numbers is probably due to closure and consolidation of landfills.

The Landfill Census provided information on four groups:

- regulator response (16 of 16);
- landfills identified by regulators (327);
- operator response (88 of 103);
- detailed information on landfills supplied by operators **(**271).

The results are presented in terms of general topic areas:

- waste policy and the Landfill Guidelines;
- Resource Management Act issues;
- landfill information;
- landfill monitoring and practice;
- managing hazardous wastes;
- landfill information;
- closed sites.

Waste-related questions from the 1995 Landfill Census are provided in Table III-1. Quantitative data regarding waste have been included in Chapter 3 of this report.

Table III-1 Questions relating to waste issues asked to landfills as part of the Landfill Census [Ministry for the Environment, 1997].

Question	Yes	No	No reply/ don't know
Landfill with leachate collection system	35	233	3
Leachate treatment system	25	243	3
Leachate monitoring system	47	22	3
Diversions for stormwater	110	158	3
Stormwater treatment system	25	243	2
Stormwater monitoring	29	240	2
Gas collection or extraction system	5	261	5
Gas monitoring system	8	254	9
Control of dust in past 12 months	30	236	5
Control of noise in past 12 months	10	256	5
Control of odour in past 12 months	38	228	5
Control of litter in past 12 months	153	113	5
Waste monitoring	105	66	0
Management plan	166	102	3
Aftercare plan	135	129	5
Burning occurred in past 12 months	142 Accidental 102 Intentional 33 Both = 6 No reply = 1	129	0
Any types of waste not accepted	211	60	0
Activities aimed at minimising waste	Recycling 118 Composting 21 Waste exchange/ reuse = 9	141	10

APPENDIX IV

Waste Analysis Protocol

Poor data have hindered the development of coherent and integrated waste management in New Zealand. Although regional data have been collected in the past collection has not been undertaken nationally or consistently until the development of the Waste Analysis Protocol (WAP) in 1992 [Ministry for the Environment, 1992(c)]. The WAP is a set of guidelines on the gathering of waste data to consistently obtain statistically robust information on the amount, composition and source of solid and hazardous waste streams to enable effective comparison between districts and regions, and over time. The WAP uses three methods or modules to monitor three categories of waste. The types of waste covered by the three modules A, B and C, together with the monitoring methods used, are summarised in Table IV-1.

The WAP has defined eight categories to record the composition of waste. These categories, used for each module, are paper, plastic, glass, metal, organic, construction, potentially hazardous, and other waste. The categories are described in Chapter 2 of this report.

Following the development of the WAP, WAP surveys have been undertaken throughout New Zealand. Until September 1995 a number WAP surveys were undertaken for landfills for an area representing 65% of the New Zealand population. WAP surveys have provided a significant amount of data on waste quantities and composition [Blake and Sweet, 1995]. For more information see the *New Zealand Waste Analysis Protocol* [Ministry for the Environment, 1992(c)].

Table IV-1 Different modules of the New Zealand Waste Analysis Protocol [Ministry for the Environment, 1992(c)].

Module	Type of waste	Purpose	Method
A	Potentially hazardous industrial waste	To: • provide a system and methodology applicable to the generation, management, treatment and disposal of potentially industrial hazardous waste; • identify where problems are likely to be occurring in the management of potentially hazardous waste; • reliably classify and quantify the amount of hazardous waste generated and disposed of.	• desk study • material flow approaches • questionnaires with appropriate follow-up administered to all, or a randomly selected sample of industries in the survey area • identification by inspection of manifest sheets and or loads of waste entering treatment or disposal facilities.
B	Residential waste bags and bins	To obtain a quantitative estimate of the quantity and composition of solid waste arising from domestic premises within the survey district.	• collecting refuse bins and bags put out for kerbside collection from selected "households" (includes refuse put out for kerbside collection by small commercial premises e.g. dairies and hostels) • transport to a sorting station • sorting the refuse into a minimum of 8 categories • weighing and recording the information • statistical analysis and reporting.
C	Residential and industrial waste	To quantify and characterise the waste entering a treatment or disposal facility (e.g. transfer station, landfill, incineration plant).	• weighing most large vehicle loads entering the site and a proportion of smaller vehicle loads • sampling a proportion of incoming loads in each category and sorting and weighing a sample of refuse from these • visually classifying the remaining loads (or a high proportion of them) where appropriate.

APPENDIX V

Collation of WAP and 1995 Landfill Census Data

Background

Data obtained from WAP surveys and the 1995 Landfill Census was aggregated in a statistically valid way to obtain national figures of landfilled waste in New Zealand. The available data represented only a small fraction of the landfills in New Zealand on a strictly numerical basis. However, WAP survey data and operator estimates of annual tonnage were available for most of the major landfills (>50,000 tonnes per year) and for many large landfills (>5,000 tonnes). As a result, the coverage was approximately 60% of the estimated total waste going to landfills. Data from the WAP surveys and the Landfill Census were extrapolated to provide an initial picture of the composition of waste on a regional and national basis. The study also required "filling of gaps" in a logical and statistically appropriate way to cover all landfills and therefore create a regional and national picture of waste compositions.

The estimates of total, industrial, and residential waste going to landfills were based on the "at disposal site" surveys (WAP Module C) and annual tonnage data identified in the Landfill Census. For the estimates of residential waste bags and bins, the "at source" surveys (WAP Module B) were used along with Population Census data. The methodology used and results obtained follows. Detailed information regarding the calculation methods used and assumptions made to obtain the aggregated data can be made available upon request to the Ministry for the Environment.

Landfilled waste (WAP module C)

Module C of WAP is used to determine quantities and composition of landfilled industrial and residential waste. The procedure used to build up the overall waste picture of waste going to landfills involved:

- reducing the available WAP survey data to a standard form (the standard 8 WAP categories for business and residential waste);
- analysing the standardised WAP data to provide waste composition data for landfill groups (based on annual tonnage) and for identifiable major landfills;
- analysing annual tonnage and population data from the Landfill Census to develop a process for estimating annual waste tonnage for landfills where no process was available;
- categorising landfills from the Landfill Census in terms of their size (annual waste tonnage) (see Table V-1);
- using these categories to link landfills that had not been surveyed, with relevant waste composition data based on similar-sized landfills and regional population;
- applying the waste composition data to the annual tonnage estimate for each landfill to calculate weight estimates for each category of waste;
- aggregating this waste composition data on a regional and national basis.

Table V-1 Summary of landfill size groups.

Region		Landfill size group							Total
		Up to 1,000 tonnes	1,001 - 5,000 tonnes	5,001 - 20,000 tonnes	20,001 - 50,000 tonnes	Over 50,000 tonnes	Major landfills	Special waste only	
Northland	No.	3	4	1	1	-	-	-	9
	Tonnes	710	7,540	8,620	59,320	-	-	-	76,190
	% Region	0.9%	9.9%	11.3%	77.9%				
Auckland	No.	-	-	-	1	-	5	-	6
	Tonnes	-	-	-	33,080	-	775,770	-	808,850
	% Region				4.1%		95.9%		
Waikato	No.	3	4	11	1	2	-	-	21
	Tonnes	2,500	11,130	109,610	26,310	184,890	-	-	334,440
	% Region	0.7%	3.3%	32.8%	7.9%	55.3%			
Bay of Plenty	No.	2	2	3	1	1	1	-	10
	Tonnes	8,710	7,260	24,540	22,980	64,330	90,320	-	218,140
	% Region	4.0%	3.3%	11.2%	10.5%	29.5%	41.4%		
Gisborne	No.	2	2	1	-	-	-	-	5
	Tonnes	1,110	2,640	27,570	-	-	-	-	31,320
	% Region	3.5%	8.4%	88.0%					
Hawke's Bay	No.	2	2	2	-	-	1	-	7
	Tonnes	910	2,020	21,650	-	-	93,240	-	117,820
	% Region	0.8%	1.7%	18.4%			79.1%		
Taranaki	No.	5	3	2	1	-	-	-	11
	Tonnes	1,120	9,250	16,290	36,100	-	-	-	62,760
	% Region	1.8%	14.7%	26.0%	57.5%				
Manawatu & Wanganui	No.	15	9	4	2	1	-	-	31
	Tonnes	5,060	23,530	41,800	59,920	70,000	-	-	200,310
	% Region	2.5%	11.7%	20.9%	29.9%	34.9%			
Wellington	No.	1	1	3	2	2	2	1	12
	Tonnes	620	2,700	28,410	68,450	238,650	195,300	2,390	536,520
	% Region	0.1%	0.5%	5.3%	12.8%	44.5%	36.4%	0.4%	
Nelson & Marl-borough	No.	6	3	2	1	-	-	-	12
	Tonnes	2,670	6,680	24,440	45,820	-	-	-	79,610
	% Region	3.4%	8.4%	30.7%	57.5%				
West Coast	No.	18	1	1	-	-	-	-	20
	Tonnes	5,470	4,900	5,750	-	-	-	-	16,120
	% Region	33.9%	30.4%	35.7%					
Canterbury	No.	34	16	5	2	-	1	1	59
	Tonnes	12,380	36,120	56,360	51,730	-	241,790	2,800	401,180
	% Region	3.1%	9.0%	14.0%	12.9%		60.3%	0.7%	
Otago	No.	22	6	2	-	2	-	-	32
	Tonnes	6,630	22,850	13,100	-	194,830	-	-	237,410
	% Region	2.8%	9.6%	5.5%		82.1%			
Southland	No.	2	4	-	1	-	-	-	7
	Tonnes	20	12,330	-	49,080	-	-	-	61,430
	% Region	0.0%	20.1%		79.9%				
New Zealand Total	No.	115	57	37	13	8	10	2	242
	Tonnes	47,920	148,950	378,150	452,790	752,690	1,396,420	5,190	3,182,110
	% Region	1.5%	4.7%	11.9%	14.2%	23.7%	43.9%	0.2%	

Using the WAP data, reasonable estimates of waste composition were identified for each region and New Zealand as a whole. However, several limited numbers of WAP surveys and limited information available in the Landfill Census, in particular the lack of accurate data on annual tonnage, made it necessary to use other methods to estimate the annual tonnage of the 251 landfills. The four methods used are described in Table V-2. Estimates of the annual waste tonnage were obtained for all but 9 of the 251 landfills included in the Landfill Census data. These landfills provided information on a population of 3.0 million. Table V-3 summarises the methods used to estimate annual waste tonnage for New Zealand and for different regions. Table V-4 provides a summary of the estimated waste composition for each region and for New Zealand as a whole.

Table V-2 Methods used to estimate annual waste tonnage.

Method to estimate annual tonnage (in order of preference)	Number of landfills	Comments
Waste recorded during WAP Survey period	10	All major landfills (>50,000 tonnes per year)
Operator's estimate from the Landfill Census	60	Some large (>20,000 T/yr) and some medium landfills (5,000 - 20,000 T/yr)
Based on "population served"	233	Calculated by multiplying the population it serves by an annual per capita waste factor: - up to 5,000 people served: 1,078 tonnes/person +/- 0.20 - 5,001-20,000 people served: 0.958 tonnes/person +/- 0.16 - >20,000 people served: 0.919 tonnes/person +/- 0.10
Based on "average annual tonnage to date"	74	Calculated by dividing the total waste deposited into the landfill to date by the number of years the landfill had been open, i.e. the average tonnage per year
No estimates available	9	
Total	> 251	For several landfills more than one estimate was available

Residential waste bags and bins (WAP Module B)

WAP Module B is used to determine compositions of residential waste bags and bins. The procedure used to aggregate existing data to obtain quantities and composition of residential waste bags and bins at a regional and national level involved:

- reducing the available WAP survey data to a standard form, i.e. the standard 8 WAP categories;
- deriving an estimate of the annual tonnage of residential waste bags and bins for each survey;
- estimating the population covered by each survey using the 1994 population estimates and calculating estimates of the average quantity of waste per person;
- analysing the per person waste estimates to derive representative per person figures and corresponding weighted estimates of the waste composition;
- applying these estimates to the population of each region and aggregating this waste composition data on a regional and national basis.

Table V-3 Methods used to estimate annual tonnage for New Zealand and different regions.

Region		Method of estimation \ Direct from WAP Survey	Operators' weight estimates	Operators' volume estimates	Based on population	Based on avg/year	Total
Northland	No.	-	1	-	8	-	9
	Tonnes	-	59,320	-	16,870	-	76,190
	% Region		77.9%		22.1%		
Auckland	No.	5	-	-	1	-	6
	Tonnes	775,770	-	-	33,080	-	808,850
	% Region	95.9%			4.1%		
Waikato	No.	-	3	2	13	3	21
	Tonnes	-	85,490	19,500	80,660	148,780	334,430
	% Region		25.6%	5.8%	24.1%	44.5%	
Bay of Plenty	No.	1	1	2	6	-	10
	Tonnes	90320	8,000	11,300	108,520	-	218,140
	% Region	41.4%	3.7%	5.2%	49.7%		
Gisborne	No.	-	-	-	5	-	5
	Tonnes	-	-	-	31,330	-	31,330
	% Region				100.0%		
Hawke's Bay	No.	1	-	-	6	-	7
	Tonnes	93,240	-	-	24,580	-	117,820
	% Region	79.1%			20.9%		
Taranaki	No.	-	4	-	6	1	11
	Tonnes	-	36,980	-	25,740	40	62,760
	% Region		58.9%		41.0%	0.1%	
Manawatu & Wanganui	No.	-	4	2	25	-	31
	Tonnes	-	89,100	25,200	86,020	-	200,320
	% Region		44.5%	12.6%	42.9%		
Wellington	No.	2	1	3	5	1	12
	Tonnes	195,300	15,000	25,820	116,610	183,800	536,530
	% Region	36.4%	2.8%	4.8%	21.7%	34.3%	
Nelson & Marlborough	No.	-	1	6	5	-	12
	Tonnes	-	45,820	25,320	480	-	79,620
	% Region		57.5%	31.8%	10.7%		
West Coast	No.	-	-	-	20	-	20
	Tonnes	-	-	-	16,120	-	16,120
	% Region				100.0%		
Canterbury	No.	1	2	3	53	-	59
	Tonnes	241,790	3,030	47,000	109,360	-	401,180
	% Region	60.3%	0.8%	11.7%	27.3%		
Otago	No.	-	-	3	29	-	32
	Tonnes	-	-	8,350	229,060	-	237,410
	% Region			3.5%	96.5%		
Southland	No.	-	2	-	5	-	7
	Tonnes	-	7,000	-	54,420	-	61,420
	% Region		11.4%		88.6%		
New Zealand Total	No.	10	19	21	187	5	242
	Tonnes	1,396,420	349,740	162,490	940,840	332,620	3,182,110
	% Region	43.9%	11.0%	5.1%	29.6%	10.5%	

Table V-4 Aggregated landfilled waste quantities and compositions in 1995 based on data from Landfill Census & WAP surveys

		% NZ Total		Weight (tonnes)	% NZ Total	Waste composition (WAP categories)	Paper	Plastic	Glass	Metal	Organic	Con & dem	Other	Pot haz total	Pot haz "special"
New Zealand															
Annual weight (tonnes)	3,182,120	100	Industrial	1,762,350	100	Tonnes	327,210	123,540	27,970	117,950	417,920	383,370	103,680	260,710	209,490
Number of landfills	242	100	% Ind	55.4%		95% CI +/-	7,180	4,770	1,820	7,010	12,480	9,610	9,680	Not avl.	
Population served	3,254,284	100				Proportion	18.6%	7.0%	1.6%	6.7%	23.7%	21.8%	5.9%	14.8%	
Population, March 94	3,540,700	100				95% CI +/-	0.2%	0.4%	0.7%	0.6%	0.3%	0.3%	0.9%	Not avl.	
			Residential	1,419,770	100	Tonnes	265,840	100,870	39,590	82,510	711,750	150,480	59,810	8,920	
			% Res	44.6%		95% CI +/-	4,630	3,580	1,490	3,030	8,370	8,780	7,780	1,240	
						Proportion	18.7%	7.1%	2.8%	5.8%	50.1%	10.6%	4.2%	0.6%	
						95% CI +/-	0.2%	0.4%	0.4%	0.4%	0.1%	0.6%	1.3%	1.4%	
			Total	3,182,120	100	Tonnes	593,050	224,410	67,560	200,460	1,129,670	533,850	163,490	269,630	
				100%		95% CI +/-	8,540	5,960	2,350	7,640	15,030	13,020	12,420	Not avl.	
						Proportion	18.6%	7.1%	2.1%	6.3%	35.5%	16.8%	5.1%	8.5%	
						95% CI +/-	0.1%	0.3%	0.3%	0.4%	0.1%	0.2%	0.8%	Not avl.	
Northland															
Annual weight (tonnes)	76,190	2.4	Industrial	45,600	2.6	Tonnes	4,500	1,530	280	1,460	9,350	5,950	610	21,920	21,360
Number of landfills	9	3.7	% Ind	59.9%		95% CI +/-	600	260	50	280	990	710	220	Not avl.	
		% NZ		Weight	% NZ	Waste composition (WAP categories)									Pot haz

		Total		(tonnes)	Total		Paper	Plastic	Glass	Metal	Organic	Con & dem	Other	Pot haz total	"special"
Population served	80,700	2.5				Proportion	9.9%	3.4%	0.6%	3.2%	20.5%	13.0%	1.3%	48.1%	
Population, March 94	135,400	3.8				95% CI +/-	1.3%	1.7%	1.8%	1.9%	1.1%	1.2%	3.6%	Not avl.	
			Residential	30,590	2.2	Tonnes	4,690	1,790	940	1,920	16,950	3,140	990	170	
			% Res	40.1%		95% CI +/-	190	90	60	170	490	250	100	30	
						Proportion	15.3%	5.9%	3.1%	6.3%	55.4%	10.3%	3.2%	0.6%	
						95% CI +/-	0.4%	0.5%	0.6%	0.9%	0.3%	0.8%	1.0%	1.8%	
			Total	76,190	2.4	Tonnes	9,190	3,320	1,220	3,380	26,300	9,090	1,600	22,090	
				100%		95% CI +/-	630	280	80	330	1,110	760	240	Not avl.	
						Proportion	12.1%	4.4%	1.6%	4.4%	34.5%	11.9%	2.1%	29.0%	
						95% CI +/-	0.7%	0.8%	0.7%	1.0%	0.4%	0.8%	1.5%	Not avl.	
Auckland															
Annual weight (tonnes)	808,860	25.4	Industrial	429,910	24.4	Tonnes	46,660	23,220	9,190	37,580	38,480	95,410	53,150	126,220	105,000
Number of landfills	6	2.5	% Ind	53.2%		95% CI +/-	3,220	3,070	1,540	6,170	7,480	3,380	9,100	Not avl.	
Population served	967,100	29.7				Proportion	10.9%	5.4%	2.1%	8.7%	9.0%	22.2%	12.4%	29.4%	
Population, March 94	1,002,700	28.3				95% CI +/-	0.7%	1.3%	1.7%	1.6%	1.9%	0.4%	1.7%	Not avl.	
			Residential	378,950	26.7	Tonnes	85,620	35,330	13,160	19,630	153,660	45,190	23,580	2,780	
			% Res	46.8%		95% CI +/-	3,940	3,440	1,400	2,640	6,290	8,210	6,020	1,160	

		% NZ Total		Weight (tonnes)	% NZ Total		Waste composition (WAP categories)								Pot haz "special"
							Paper	Plastic	Glass	Metal	Organic	Con &	Other	Pot haz	

												dem		total	
					Proportion	22.6%	9.3%	3.5%	5.2%	40.5%	11.9%	6.2%	0.7%	
					95% CI +/-	0.5%	1.0%	1.1%	1.3%	0.4%	1.8%	2.6%	4.2%	
			Total	808,860	Tonnes	132,280	58,550	22,350	57,210	192,140	140,600	76,730	129,000	
				100%	95% CI +/-	5,090	4,610	2,090	6,710	9,780	8,880	10,910	Not avl.	
					Proportion	16.4%	7.2%	2.8%	7.1%	23.8%	17.4%	9.5%	15.9%	
					95% CI +/-	0.4%	0.8%	0.9%	1.2%	0.5%	0.6%	1.4%	Not avl.	
Waikato															
Annual weight (tonnes)	334,430	10.5	Industrial	226,590	Tonnes	50,900	18,320	3,540	14,490	69,260	50,710	9,490	9,880	7,040
Number of landfills	21	8.7	% Ind	67.8%	95% CI +/-	2,220	1,220	340	1,120	3,550	3,030	1,140	Not avl.	
Population served	222,000	6.8			Proportion	22.5%	8.1%	1.6%	6.4%	30.6%	22.4%	4.2%	4.4%	
Population, March 94	348,200	9.8			95% CI +/-	0.4%	0.7%	1.0%	0.8%	0.5%	0.6%	1.2%	Not avl.	
			Residential	107,860	Tonnes	19,030	6,650	2,720	6,770	58,810	9,720	3,560	600	
			% Res	32.2%	95% CI +/-	440	180	110	380	1,130	540	1,950	50	
					Proportion	17.6%	6.2%	2.5%	6.3%	54.5%	9.0%	3.3%	0.6%	
					95% CI +/-	0.2%	0.3%	0.4%	0.6%	0.2%	0.6%	5.5%	0.8%	
			Total	334,450	Tonnes	69,930	24,970	6,260	21,260	128,070	60,430	13,050	10,480	
				100%	95% CI +/-	2,270	1,240	360	1,180	3,730	3,080	2,260	Not avl.	
		% NZ		Weight	% NZ					**Waste composition (WAP categories)**				Pot haz
		Total		(tonnes)	Total		Paper	Plastic	Glass	Metal	Organic	Con & dem	Other	Pot haz total	"special"

						Proportion	20.9%	7.5%	1.9%	6.4%	38.3%	18.1%	3.9%	3.1%	
						95% CI +/-	0.3%	0.5%	0.6%	0.6%	0.3%	0.5%	1.7%	Not avl.	
Bay of Plenty															
Annual weight (tonnes)	218,150	6.9	Industrial	134,870	7.7	Tonnes	23,470	8,860	1,670	7,560	47,850	29,950	5,150	10,360	7,960
Number of landfills	10	4.1	% Ind	61.8%		95% CI +/-	2,470	1,450	280	1,430	5,620	4,200	1,750	Not avl.	
Population served	193,800	6.0				Proportion	17.4%	6.6%	1.2%	5.6%	35.5%	22.2%	3.8%	7.7%	
Population, March 94	217,700	6.1				95% CI +/-	1.1%	1.6%	1.7%	1.9%	1.2%	1.4%	3.4%	Not avl.	
			Residential	83,280	5.9	Tonnes	14,590	5,180	1,930	4,930	44,270	9,380	2,550	450	
			% Res	38.2%		95% CI +/-	690	240	110	510	1,570	1,080	1,310	50	
						Proportion	17.5%	6.2%	2.3%	5.9%	53.2%	11.3%	3.1%	0.5%	
						95% CI +/-	0.5%	0.5%	0.6%	1.0%	0.4%	1.2%	5.1%	0.1%	
			Total	218,150	6.9	Tonnes	38,060	14,040	3,600	12,490	92,120	39,330	7,700	10,810	
				100%		95% CI +/-	2,560	1,470	300	1,520	5,830	4,340	2,190	Not avl.	
						Proportion	17.4%	6.4%	1.7%	5.7%	42.2%	18.0%	3.5%	5.0%	
						95% CI +/-	0.7%	1.0%	0.8%	1.2%	0.6%	1.1%	2.8%	Not avl.	

		% NZ Total		Weight (tonnes)	% NZ Total	Waste composition (WAP categories)	Paper	Plastic	Glass	Metal	Organic	Con & dem	Other	Pot haz total	Pot haz "special"
Gisborne															
Annual weight (tonnes)	31,330	1.0	Industrial	20,130	1.1	Tonnes	1,770	620	190	600	4,080	1,520	300	11,050	11,030
Number of landfills	5	2.1	% Ind	64.3%		95% CI +/-	360	130	70	120	670	330	190	Not avl.	
Population served	33,600	1.0				Proportion	8.8%	3.1%	0.9%	3.0%	20.3%	7.6%	1.5%	54.9%	
Population, March 94	44,400	1.3				95% CI +/-	2.0%	2.1%	3.7%	2.0%	1.6%	2.2%	6.3%	Not avl.	
			Residential	11,200	0.8	Tonnes	1,900	680	350	730	6,250	890	340	60	
			% Res	35.7%		95% CI +/-	120	50	30	130	330	140	70	10	
						Proportion	17.0%	6.1%	3.1%	6.5%	55.8%	7.9%	3.0%	0.5%	
						95% CI +/-	0.6%	0.7%	0.9%	1.8%	0.5%	1.6%	2.1%	1.7%	
			Total	31,330	1.0	Tonnes	3,670	1,300	540	1,330	10,330	2,410	640	11,110	
				100%		95% CI +/-	380	130	80	180	750	360	200	Not avl.	
						Proportion	11.7%	4.1%	1.7%	4.2%	33.0%	7.7%	2.0%	35.5%	
						95% CI +/-	1.0%	1.0%	1.5%	1.4%	0.7%	1.5%	3.1%	Not avl.	
Hawke's Bay															
Annual weight (tonnes)	117,820	3.7	Industrial	48,700	2.8	Tonnes	8,220	2,660	520	1,190	14,610	2,780	640	18,080	4,600
Number of landfills	7	2.9	% Ind	41.3%		95% CI +/-	960	360	80	230	1,130	510	190	Not avl.	

	% NZ		Weight	% NZ	Waste composition (WAP categories)	Pot haz

		Total		(tonnes)	Total		Paper	Plastic	Glass	Metal	Organic	Con & dem	Other	Pot haz total	"special"
Population served	25,500	0.8				Proportion	16.9%	5.5%	1.1%	2.4%	30.0%	5.7%	1.3%	37.1%	
Population, March 94	141,000	4.0				95% CI +/-	1.2%	1.4%	1.5%	1.9%	0.8%	1.8%	3.0%	Not avl.	
			Residential	69,120	4.9	Tonnes	11,840	4,560	2,100	3,500	38,140	5,490	2,590	900	
			% Res	58.7%		95% CI +/-	260	90	90	180	600	310	100	340	
						Proportion	17.1%	6.6%	3.0%	5.1%	55.2%	7.9%	3.7%	1.3%	
						95% CI +/-	0.2%	0.2%	0.4%	0.5%	0.2%	0.6%	0.4%	3.8%	
			Total	117,820	3.7	Tonnes	20,060	7,220	2,620	4,690	52,750	8,270	3,230	18,980	
				100%		95% CI +/-	990	370	120	290	1,280	600	210	Not avl.	
						Proportion	17.0%	6.1%	2.2%	4.0%	44.8%	7.0%	2.7%	16.1%	
						95% CI +/-	0.5%	0.5%	0.5%	0.6%	0.2%	0.7%	0.7%	Not avl.	
Taranaki															
Annual weight (tonnes)	62,750	2.0	Industrial	34,560	2.0	Tonnes	4,840	1,670	360	1,550	10,310	5,730	700	9,400	8,930
Number of landfills	11	4.5	% Ind	55.1%		95% CI +/-	520	230	60	240	890	610	210	Not avl.	
Population served	78,409	2.4				Proportion	14.0%	4.8%	1.0%	4.5%	29.8%	16.6%	2.0%	27.2%	
Population, March 94	107,900	3.0				95% CI +/-	1.1%	1.4%	1.7%	1.5%	0.9%	1.1%	3.0%	Not avl.	
			Residential	28,190	2.0	Tonnes	4,470	1,710	920	1,810	15,570	2,660	900	150	
			% Res	44.9%		95% CI +/-	180	100	50	140	400	190	80	20	

		% NZ Total		Weight (tonnes)	% NZ Total	**Waste composition (WAP categories)**								Pot haz "special"
							Paper	Plastic	Glass	Metal	Organic	Con &	Other	Pot haz	

												dem		total	
						Proportion	15.9%	6.1%	3.3%	6.4%	55.2%	9.4%	3.2%	0.5%	
						95% CI +/-	0.4%	0.6%	0.5%	0.8%	0.3%	0.7%	0.9%	1.3%	
			Total	62,750	2.0	Tonnes	9,310	3,380	1,280	3,360	25,880	8,390	1,600	9,550	
				100%		95% CI +/-	550	250	80	280	980	640	220	Not avl.	
						Proportion	14.8%	5.4%	2.0%	5.4%	41.2%	13.4%	2.5%	15.2%	
						95% CI +/-	0.6%	0.7%	0.6%	0.8%	0.4%	0.8%	1.4%	Not avl.	
Manawatu-Wanganui															
Annual weight (tonnes)	200,320	6.3	Industrial	95,760	5.4	Tonnes	19,280	6,790	1,440	6,200	32,140	21,560	3,230	5,120	3,940
Number of landfills	31	12.8	% Ind	47.8%		95% CI +/-	930	450	150	460	1,600	1,200	450	Not avl.	
Population served	210,710	6.5				Proportion	20.1%	7.1%	1.5%	6.5%	33.6%	22.5%	3.4%	5.3%	
Population, March 94	232,500	6.6				95% CI +/-	0.5%	0.7%	1.0%	0.7%	0.5%	0.6%	1.4%	Not avl.	
			Residential	104,580	7.4	Tonnes	17,360	6,410	2,810	6,430	56,540	10,900	3,560	570	
			% Res	52.2%		95% CI +/-	400	180	100	290	960	530	1,850	60	
						Proportion	16.6%	6.1%	2.7%	6.1%	54.1%	10.4%	3.4%	0.5%	
						95% CI +/-	0.2%	0.3%	0.4%	0.5%	0.2%	0.5%	5.2%	1.1%	
			Total	200,340	6.3	Tonnes	36,640	13,200	4,250	12,630	88,680	32,460	6,790	5,690	
				100%		95% CI +/-	1,020	490	170	540	1,870	1,320	1,910	Not avl.	
		% NZ Total		Weight (tonnes)	% NZ Total		**Waste composition (WAP categories)**								Pot haz "special"
							Paper	Plastic	Glass	Metal	Organic	Con & dem	Other	Pot haz total	

						Proportion	18.3%	6.6%	2.1%	6.3%	44.3%	16.2%	3.4%	2.8%	
						95% CI +/-	0.3%	0.4%	0.4%	0.4%	0.2%	0.4%	2.8%	Not avl.	
Wellington															
Annual weight (tonnes)	536,530	16.9	Industrial	370,070	21.0	Tonnes	89,420	32,700	5,720	24,610	94,540	91,630	15,990	15,460	9,840
Number of landfills	12	5.0	% Ind	69.0%		95% CI +/-	4,110	2,220	720	2,230	5,990	5,930	1,830	Not avl.	
Population served	580,385	17.8				Proportion	24.2%	8.8%	1.5%	6.7%	25.5%	24.8%	4.3%	4.2%	
Population, March 94	410,000	11.6				95% CI +/-	0.5%	0.7%	1.3%	0.9%	0.6%	0.6%	1.1%	Not avl.	
			Residential	166,470	11.7	Tonnes	29,150	10,720	3,880	10,410	83,070	21,260	6,740	1,240	
			% Res	31.0%		95% CI +/-	1,380	650	280	820	2,870	1,840	1,310	220	
						Proportion	17.5%	6.4%	2.3%	6.3%	49.9%	12.8%	4.0%	0.7%	
						95% CI +/-	0.5%	0.6%	0.7%	0.8%	0.3%	0.9%	1.9%	1.8%	
			Total	536,540	16.9	Tonnes	118,570	43,420	9,600	35,020	177,610	112,890	22,730	16,700	
				100%		95% CI +/-	4,330	2,310	770	2,370	6,640	6,210	2,250	Not avl.	
						Proportion	22.1%	8.1%	1.8%	6.5%	33.1%	21.0%	4.2%	3.1%	
						95% CI +/-	0.4%	0.5%	0.8%	0.7%	0.4%	0.6%	1.0%	Not avl.	

		% NZ Total		Weight (tonnes)	% NZ Total	Waste composition (WAP categories)	Paper	Plastic	Glass	Metal	Organic	Con & dem	Other	Pot haz total	Pot haz "special"
Nelson-Marlborough															
Annual weight (tonnes)	79,610	2.5	Industrial	53,210	3.0	Tonnes	8,100	2,790	660	2,730	17,620	9,400	1,190	10,720	10,080
Number of landfills	12	5.0	% Ind	66.8%		95% CI +/-	840	340	120	360	1,480	920	370	Not avl.	
Population served	75,550	2.3				Proportion	15.2%	5.2%	1.2%	5.1%	33.1%	17.7%	2.2%	20.1%	
Population, March 94	116,600	3.3				95% CI +/-	1.0%	1.2%	1.8%	1.3%	0.8%	1.0%	3.1%	Not avl.	
			Residential	26,400	1.9	Tonnes	4,090	1,540	800	1,660	14,660	2,650	850	150	
			% Res	33.2%		95% CI +/-	150	70	40	140	400	200	80	30	
						Proportion	15.5%	5.8%	3.0%	6.3%	55.5%	10.0%	3.2%	0.6%	
						95% CI +/-	0.4%	0.5%	0.5%	0.8%	0.3%	0.8%	0.9%	2.0%	
			Total	79,610	2.5	Tonnes	12,190	4,330	1,460	4,390	32,280	12,050	2,040	10,870	
				100%		95% CI +/-	850	350	130	380	1,540	940	380	Not avl.	
						Proportion	15.3%	5.4%	1.8%	5.5%	40.5%	15.1%	2.6%	13.7%	
						95% CI +/-	0.7%	0.8%	0.9%	0.9%	0.5%	0.8%	1.9%	Not avl.	
West Coast															
Annual weight (tonnes)	16,120	0.5	Industrial	3,410	0.2	Tonnes	520	170	50	230	1,200	710	70	460	450
Number of landfills	20	8.3	% Ind	21.2%		95% CI +/-	80	30	10	50	160	120	30	Not avl.	

	% NZ		Weight	% NZ	Waste composition (WAP categories)	Pot haz

		Total		(tonnes)	Total		Paper	Plastic	Glass	Metal	Organic	Con & dem	Other	Pot haz total	"special"
Population served	15,916	0.5				Proportion	15.2%	5.0%	1.5%	6.7%	35.2%	20.8%	2.1%	13.5%	
Population, March 94	33,800	1.0				95% CI +/-	1.5%	1.8%	2.0%	2.2%	1.3%	1.7%	4.3%	Not avl.	
			Residential	12,700	0.9	Tonnes	2,140	860	490	860	6,920	980	390	60	
			% Res	78.8%		95% CI +/-	120	80	40	80	230	90	50	10	
						Proportion	16.9%	6.8%	3.9%	6.8%	54.5%	7.7%	3.1%	0.5%	
						95% CI +/-	0.6%	0.9%	0.8%	0.9%	0.3%	0.9%	1.3%	1.7%	
			Total	16,110	0.5	Tonnes	2,660	1,030	540	1,090	8,120	1,690	460	520	
				100%		95% CI +/-	140	80	40	100	280	150	60	Not avl.	
						Proportion	16.5%	6.4%	3.4%	6.8%	50.4%	10.5%	2.9%	3.2%	
						95% CI +/-	0.5%	0.8%	0.7%	0.9%	0.3%	0.9%	1.3%	Not avl.	
Canterbury															
Annual weight (tonnes)	401,180	12.6	Industrial	158,000	9.0	Tonnes	37,390	12,700	2,250	10,070	37,090	32,610	7,340	18,550	17,720
Number of landfills	59	24.4	% Ind	39.4%		95% CI +/-	2,850	1,900	370	1,280	2,550	3,390	1,460	Not avl.	
Population served	460,956	14.2				Proportion	23.7%	8.0%	1.4%	6.4%	23.5%	20.6%	4.6%	11.7%	
Population, March 94	458,800	13.0				95% CI +/-	0.8%	1.5%	1.6%	1.3%	0.7%	1.0%	2.0%	Not avl.	
			Residential	243,180	17.1	Tonnes	43,320	15,320	5,630	14,350	133,900	21,520	8,180	960	
			% Res	60.6%		95% CI +/-	1,600	600	300	900	3,790	1,890	870	150	
		% NZ Total		Weight (tonnes)	% NZ Total		**Waste composition (WAP categories)**								Pot haz "special"
							Paper	Plastic	Glass	Metal	Organic	Con &	Other	Pot haz	

												dem		total	
						Proportion	17.8%	6.3%	2.3%	5.9%	55.1%	8.8%	3.4%	0.4%	
						95% CI +/-	0.4%	0.4%	0.5%	0.6%	0.3%	0.9%	1.1%	1.6%	
			Total	401,180	12.6	Tonnes	80,710	28,020	7,880	24,420	170,990	54,130	15,520	19,510	
				100%		95% CI +/-	3,270	1,990	480	1,570	4,570	3,880	1,700	Not avl.	
						Proportion	20.1%	7.0%	2.0%	6.1%	42.6%	13.5%	3.9%	4.9%	
						95% CI +/-	0.4%	0.7%	0.6%	0.6%	0.3%	0.7%	1.1%	Not avl.	
Otago															
Annual weight (tonnes)	237,410	7.5	Industrial	111,900	6.3	Tonnes	27,050	9,800	1,730	7,630	30,410	27,630	5,210	2,440	990
Number of landfills	32	13.2	% Ind	47.1%		95% CI +/-	1,240	720	190	650	1,920	1,780	650	Not avl.	
Population served	251,135	7.7				Proportion	24.2%	8.8%	1.5%	6.8%	27.2%	24.7%	4.7%	2.2%	
Population, March 94	189,100	5.3				95% CI +/-	0.5%	0.7%	1.1%	0.9%	0.6%	0.6%	1.2%	Not avl.	
			Residential	125,500	8.8	Tonnes	23,190	8,400	2,970	7,620	65,380	12,790	4,510	640	
			% Res	52.9%		95% CI +/-	610	270	120	350	1,320	740	3,570	70	
						Proportion	18.5%	6.7%	2.4%	6.1%	52.1%	10.2%	3.6%	0.5%	
						95% CI +/-	0.3%	0.3%	0.4%	0.5%	0.2%	0.6%	7.9%	1.1%	
			Total	237,400	7.5	Tonnes	50,240	18,200	4,700	15,250	95,790	40,420	9,720	3,080	
				100%		95% CI +/-	1,380	770	230	740	2,330	1,920	3,630	Not avl.	
		% NZ		Weight	% NZ		**Waste composition (WAP categories)**								Pot haz
		Total		(tonnes)	Total		Paper	Plastic	Glass	Metal	Organic	Con & dem	Other	Pot haz total	"special"

						Proportion	21.2%	7.7%	2.0%	6.4%	40.3%	17.0%	4.1%	1.3%	
						95% CI +/-	0.3%	0.4%	0.5%	0.5%	0.2%	0.5%	3.7%	Not avl.	
Southland															
Annual weight (tonnes)	61,420	1.9	Industrial	29,630	1.7	Tonnes	5,110	1,710	360	2,030	10,960	7,790	620	1,050	540
Number of landfills	7	2.9	% Ind	48.2%		95% CI +/-	590	260	60	350	1,070	850	200	Not avl.	
Population served	58,523	1.8				Proportion	17.2%	5.8%	1.2%	6.9%	37.0%	26.3%	2.1%	3.5%	
Population, March 94	102,600	2.9				95% CI +/-	1.2%	1.5%	1.7%	1.7%	1.0%	1.1%	3.2%	Not avl.	
			Residential	31,790	2.2	Tonnes	4,450	1,730	900	1,900	17,650	3,910	1,070	180	
			% Res	51.8%		95% CI +/-	250	110	70	200	670	400	130	60	
						Proportion	14.0%	5.4%	2.8%	6.0%	55.5%	12.3%	3.4%	0.6%	
						95% CI +/-	0.6%	0.6%	0.8%	1.1%	0.4%	1.0%	1.2%	3.3%	
			Total	61,420	1.9	Tonnes	9,560	3,440	1,260	3,930	28,610	11,700	1,690	1,230	
				100%		95% CI +/-	640	280	100	400	1,260	940	240	Not avl.	
						Proportion	15.6%	5.6%	2.1%	6.4%	46.6%	19.0%	2.8%	2.0%	
						95% CI +/-	0.7%	0.8%	0.8%	1.0%	0.4%	0.8%	1.4%	Not avl.	

APPENDIX VI

New Zealand Wastewater Treatment Plants

National Database of Wastewater Treatment Plants in New Zealand

A *National Database of Wastewater Treatment Plants in New Zealand* was developed by Phasos Systems Ltd and Woodward-Clyde New Zealand Ltd. The development of the database was funded through the Ministry for the Environment's Sustainable Management Fund, by the New Zealand Water and Wastewater Association (NZWWA) and by Woodward-Clyde New Zealand Ltd. The database is owned and operated by NZWWA.

Two questionnaires were sent to New Zealand councils. The first sought basic information about contact details, the number of treatment plants, treatment types and methods used, and whether monitoring was undertaken. The second sought specific information on the physical size of the treatment units, flow information and process data information.

The questionnaire results were incorporated in a Microsoft Access database. The details included in the database are:

- influent volumes and quality;
- off-site pre-treatment facilities;
- equivalent population served;
- type of treatment plant;
- details of each discrete treatment step;
- physical dimensions of plant components;
- design capacity;
- plant performance;
- effluent quality details;
- sludge volume;
- final disposal methods;
- any other relevant information.

For more information about the database contact NZWWA or the Ministry for the Environment.

NZWWA Operations and Research Group for Drainage

NZWWA holds annual meetings of the Operations and Research Group for Drainage to discuss collection systems of wastewater treatment plants. A report containing information on a number of wastewater treatment plants is published for these meetings. Table VI-1 provides a summary for of a number of wastewater treatment plants for 1995/96 [NZWWA, 1996].

Table VI-1 Summary for a selected number of wastewater treatment plants in New Zealand in 1995/96 [NZWWA, 1996].

Parameter	Mangere	Christ-church	North Shore	Hamilton	Inver-cargill	Rotorua	New Plymouth	Hutt Wainui -omata	Hutt Valley Milliscreen	Tauranga Chapel St	Tauranga Te Maunga	Whangarei	Nelson
Connected population (X1000)	720	314	151	105	49.0	50.0	48.5	20.0	108.0	53.0	22.0	40	25.0
Average flow ($x10^3$ m^3/day)	282	155	42.1	40.5	19.4	19.7	19.3	4.5	43.6	15.4	6	15.3	13.2
Est. proportion of flow from trade waste (%)	8.5		4							7.9	13.7		
Average BOD_5 received (t/day)	83	38.4	10.1	8.4	3.7	2.81	2.6	0.77	7.1	3.5	2.9	3.08	4.1
Est. proportion of BOD_5 from trade waste (%)	45	21.4		13	17		16			15.7	55		70
Overall BOD_5 removed (%)	90.6	85.8	93.9	44.5	81.4	93.8	98.5	87		94	97	96	94
Non-filtrable residue received (t/day)	83	30	11.4	11.5	4.2	2.9	4	0.94	4.8	4.1	3.2	4.08	7.4
Est. proportion of non-filtrable residue from trade waste (%)	24									5.2	12		
Overall non-filtrable residue removed (%)	90.4	73	89.3	74.6	87.1	93.0	98	93.5		94	74	97	92
Total coliforms in influent ($x10^6$/100 ml)		67.6	102	40	66.3	2.9							
Total coliforms in effluent ($x10^6$/100 ml)		0.092	0.24	0.044	0,027								
Total coliforms removal (%)		99.0	99.7	99.89	99.95	93.3							
Faecal coliforms in influent ($x10^6$/100 ml)	18	5.9	52.3	14	7.47		3.5			14.7	17.3	14.9	
Faecal coliforms in effluent ($x10^6$/100 ml)	0.024	0.009	0.09	0.225	0.0028		0.000004	0.021	0.003	0.000056	0.5	0.0001	
Faecal coliforms removal (%)	99.9	99.8	99.93	98.4	99.98		>99.99			99.99	97	99.93	
Indicator organism in influent ($x10^6$/100 ml)										1.8	3		
Indicator organism in effluent ($x10^6$/100 ml)					0.13					0.000022	0.035		0.00012
Indicator organism removal (%)										99.99	99		
Avg total residue to digesters (t/day)	79.7	31.2	10.7							4.9			

Parameter	Mangere	Christ-church	North Shore	Hamilton	Inver-cargill	Rotorua	New Plymouth	Hutt Wainui-omata	Hutt Valley Milliscreen	Tauranga Chapel St	Tauranga Te Maunga	Whangarei	Nelson
Avg volatile residue to digesters (t/day)	64		8.7							4.2			
Gas production/unit total residue added (m^3/t)	503	571	353							308			
Gas production/unit volatile residue added	629		436	580	336					356			
Measured gas yield/unit volatile matter destroyed (m^3/kg)	1.13			0.88						0.6			
Digester loading (kg total residue/m^3 capacity *day)	1.73	2.08	3.3	2.4	1.89					1.9			
Digester loading (kg volume residue/m^3 capacity *day)	1.38	1.63		2.00	1.40					1.9			
Digester detention time (days)	24.8		16.5							20			
Total annual power consumption ($x10^3$ kWh)										2820			
Total actual rainfall (mm)	1406		1428							1440	1541		

APPENDIX VII

Auckland Air Emissions Inventory

Background

The Auckland Air Emissions Inventory project was initiated by the Auckland Regional Council (1997). The study has been undertaken by Environment Protection Authority, Victoria, Australia (EPA), in collaboration with the National Institute of Water and Atmospheric Research, Auckland (NIWA). The inventory of pollutant emissions to air in the region is to be used as a planning tool for evaluating of policy options to reduce air pollution in Auckland. This project represents the most comprehensive study of its type carried out in New Zealand.

The computerised air emissions inventory includes anthropogenic emissions from industry, motor vehicles, area-based sources, and biogenic sources. Emissions of volatile organic compounds (VOC, excluding methane), oxides of nitrogen (NO_x), carbon monoxide (CO), sulphur dioxide (SO_2), carbon dioxide (CO_2) and airborne particles from these sources have been estimated. Emissions of VOC have been identified according to individual chemical species (e.g. propane, benzene and formaldehyde) for each emission source. NOx emissions have been classified into nitric oxide and nitrogen dioxide. In addition, airborne particles have been classified into total suspended particles (TSP) and particles less than 10 micron diameter (PM10).

The region selected for this study includes the major urban areas of the Auckland region and includes significant sources located outside the urban regions. The absolute boundaries of the study region are shown in Figure VII-1. The study region covers a total area of 8,613 km^2.

Emissions from each source have been estimated for an average week day on an hourly basis according to grid cell (3 km x 3 km), height, and season (summer/winter) for the base year 1993. Emissions have also been estimated for the year 2003. Emissions were monitored on summer days and on winter days because the outside temperature is a main factor of influence of the quantities emitted.

The emissions inventory has been designed in modules to enhance versatility in policy development, urban planning, health risk analysis and urban airshed modelling.

Inventory Design

The inventory includes four major modules: mobile sources (vehicles on public roads), stationary sources (industry), area-based sources (domestic fuel combustion, drycleaning, etc.) and biogenic sources (emissions of VOC and NO_x from vegetation and soils). A conceptual model of the inventory is presented in Figure VII-2.

Data used in the estimation of the inventory emissions have been obtained from a variety of sources including the Department of Statistics (population and consumption data), ARC (traffic vehicle kilometres travelled (VKT) estimates, vegetation distribution), various industry groups and other government departments. In addition, data on domestic activities contributing to air pollution in the region were obtained from a phone poll carried out by Phoenix Research Ltd, and data on industrial activity was obtained from a written questionnaire and from ARC Resource Consent Applications. Emission rates have been estimated from the EPA motor vehicle testing station databases, USEPA publications and various other literature sources.

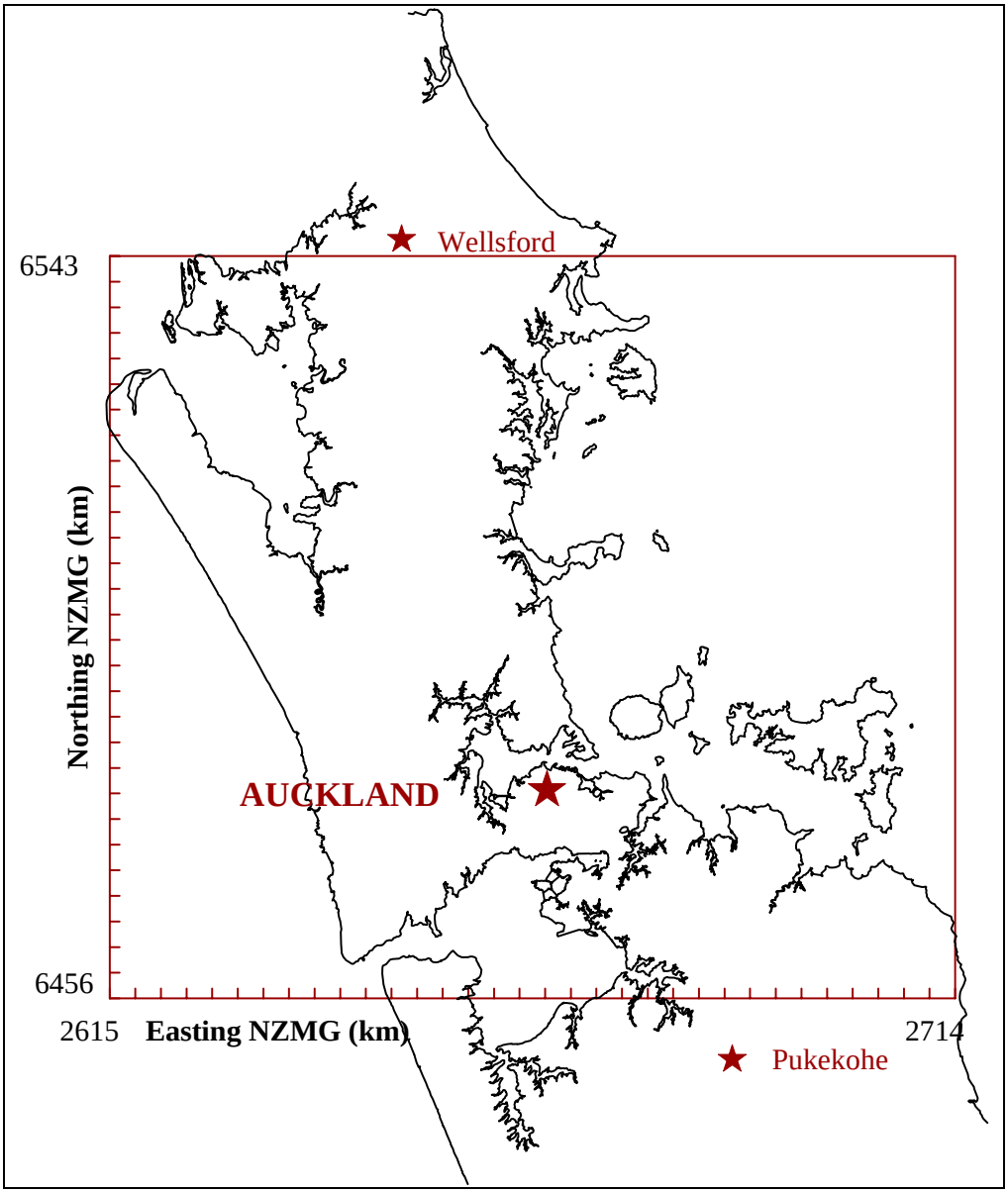


Figure VII-1 Definition of the Auckland Study Region [Auckland Regional Council, 1997].

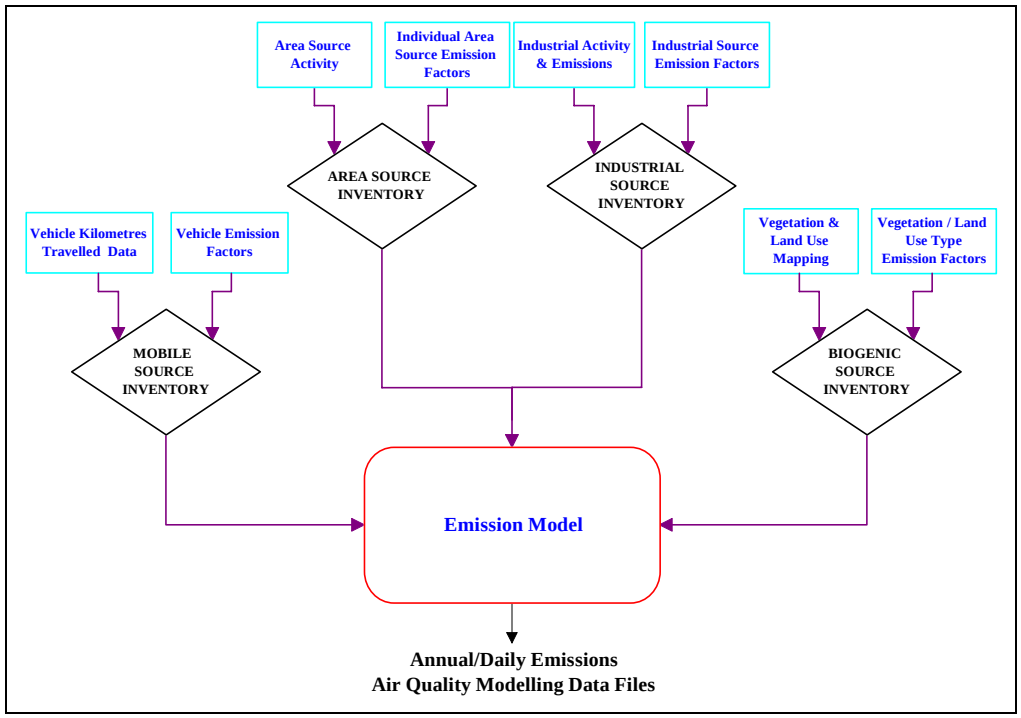


Figure VII-2 Structure of the Auckland Air Emissions Inventory [Auckland Regional Council, 1997].

Methodology

Emissions from domestic and commercial sources

Emissions from ten major domestic or commercial source categories have been estimated. These include domestic fuel combustion, lawn mowing, solvent use, service stations, service station refuelling and use of surface coatings and thinners. Domestic/commercial sources represent numerous small emitters which are treated collectively on an area basis.

A survey of 1,000 residents in the Auckland Study Region (ASR) was undertaken to generate data on activity patterns (temporal profiles and consumption) for domestic fuel usage, waste combustion, lawn mowing and boating. The survey was undertaken by Phoenix Research using telephone interviews based on a questionnaire developed by EPA and ARC.

Emissions from major industrial and commercial premises

Emissions from a total of 114 near-ground and 24 elevated discharge points have been calculated. Near-ground emission sources include low-level stack discharges and fugitive emissions from major industrial premises. Elevated discharge points represent tall stacks which have been documented with stack characteristics.

Emissions were estimated using data from a comprehensive questionnaire survey of major industrial and commercial premises in the region. Questionnaires were mailed to 236 industrial sites within the study region. Of these 114 returns were processed for the inventory, representing a response rate of almost half. Supplementary information, and information from major premises which had not responded to the questionnaire was obtained from ARC resource consent applications.

Classification for urban airshed modelling

The ASR emissions inventory has been designed to be fully compatible with the input data requirements of the CALGRID urban airshed photochemical model. This will ensure that the results of the inventory can be used for future airshed modelling. Presentation of data in this form has necessitated the transformation of individual VOC and NO_x species into CIT/LCC equivalents. Individual chemical species profiles have been retained in the inventory to allow transformation to other chemical surrogate models if required.

Emission estimation uncertainty

The inventory established for the ASR provides data based on the best available information for mobile sources, diffuse domestic/commercial sources, major industrial premises and biogenic sources in the region. The inventory methodology has been developed and updated over many years that the EPA has been undertaking emissions inventory for urban areas throughout Australia.

Despite these efforts, it must be recognised that substantial uncertainty and errors may exist in inventory data. These mostly arise because emission estimates are based on either limited experimental test data, laboratory rather than real-world testing, or the use of general emission factors rather than measurements at specific sites. Verification of emission inventories is usually undertaken using modelling and ambient air quality data.

The ASR inventory has not included any experimental measurements to verify the emission rates reported and very little local experimental data is available to verify the emissions. Although the reported emissions represent the best available estimates at the present time it would be valuable to obtain experimental data to validate the inventory. It is recommended that as new emission measurement data becomes available, the inventory be updated to employ these new data; and that as new major industrial sites are developed, they be incorporated into the inventory estimates.

APPENDIX VIII

The Auckland Region Hazardous Waste Survey 1996

Background

A hazardous waste survey was undertaken in the Auckland region during 1996 as part of a Hazardous Waste Management Programme initiated by the Auckland Regional Council (ARC) in 1995. The purpose of the survey was to collect baseline data on the generation, handling and disposal of hazardous waste in the Auckland region. This information is essential for the long-term management of hazardous waste. The data gathered enable identification of the nature and extent of the problems associated with hazardous waste.

The objectives of the ARC Hazardous Waste Management Programme are:

- to identify sources, types and quantities of hazardous waste in the Auckland Region;
- to develop strategies for the minimisation, tracking, treatment and safe disposal of hazardous waste.

The ARC Hazardous Waste Management Programme has four stages:

- **Hazardous waste analysis**: this work was completed in September 1996, and the results are described in this report.
- **Management options**: this and the next stage of the programme (treatment and disposal options) will consider the information gathered during the waste analysis stage and develop strategies, identify priorities and establish specific programmes to manage hazardous waste. The emphasis will be on education and reduction of hazardous waste.
- **Treatment and disposal options**: to complement the work undertaken in Stage 2 above, the data collected during the waste analysis will be evaluated to assess whether current treatment and disposal methods and facilities in the region are adequate.
- **Long-term management issues**: hazardous waste management involves a wide range of activities from land-use planning to the development of suitable monitoring programmes. These issues are addressed on an ongoing basis.

Hazardous waste included

For this survey a hazardous waste has been defined as any substance which:

- is listed in the New Zealand Waste Identification Code (NZWIC)(see Appendix II);
- exceeds USEPA TCLP (Toxicity Characteristics Leaching Procedure) criteria[5];
- conforms with the specifications of the Hazardous Substances and New Organisms Act 1996;
- has the potential to cause significant adverse environmental effects as defined under the Resource Management Act 1991, for example trade waste discharges and industrial organic waste;
- is a "special" waste, that is a hazardous waste which was treated before being disposed of at a landfill;

[5] The United States Environmental Protection Agency (USEPA) has established specific values for a range of materials to describe the degree of leaching that is permissible after the waste has been treated and immobilised. The test applied to measure the leaching is termed "Toxicity Characteristic Leaching Procedure" (TCLP).

- is a mixed hazardous waste such as cess pit and grease trap waste, contaminated soil or treated timber;
- is radioactive.

Organic wastes such as those generated by the food processing industry were also included because they have a very high biochemical oxygen demand (BOD) and need to be treated before they can be disposed of.

The following wastes were specifically excluded from the survey:
- domestic sewage, including liquids and sludges from domestic septic tanks;
- domestic solid waste;
- industrial point-source discharges to air, land or water which have a resource consent under the Resource Management Act 1991;
- solid waste from growing and harvesting activities which are used as fertilisers;
- empty containers and remaining residues;
- scrap metal that is recycled or re-used.

Methodology

The full life cycle of hazardous waste was considered, including generation, handling and disposal. To collect as much data as possible, the survey team focused on three different sectors involved with hazardous waste:
- hazardous waste generators;
- hazardous waste operators;
- final disposal facilities.

Each group was surveyed through questionnaires and telephone interviews. They were asked about the types and quantities of hazardous waste they handled in the 1995 calendar year. This provided valuable information which produced an interesting and useful picture of the way hazardous wastes were generated and managed in the Auckland region in 1995. Figure VIII-1 summarises these groups and the information they were able to give.

Because New Zealand has no mandatory reporting system for hazardous waste, participation in the survey was entirely voluntary for all the businesses surveyed. To encourage participation, confidentiality was of utmost importance, and businesses were offered the opportunity of signing a confidentiality agreement.

Throughout the survey, the media were enlisted to ensure that information about the survey was communicated to the public in general and to the business community in particular. This included various articles in the general press and suburban newspapers, a radio interview, a newsletter and an information flyer.

Because there is no legal requirement for businesses to accurately record and report hazardous waste, the survey team needed to ensure that the quality of the information obtained was as high as possible. Therefore, great care was taken with the training of the interviewers and the quality control of data collection and processing.

Despite this emphasis on quality control, the survey results are only as good and reliable as the data that was received. For this reason, it is important to note that the quantitative results presented in this report are estimates only, and that the qualitative results are derived from the comments of those interviewed. It is very difficult to determine how reliable and representative this information is.

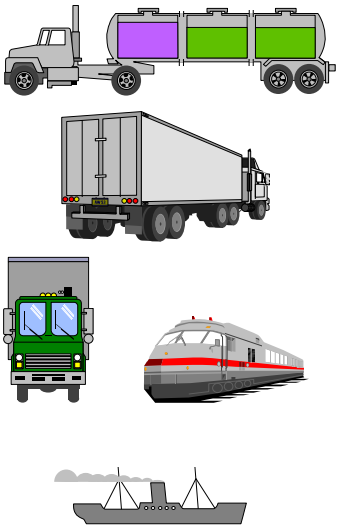
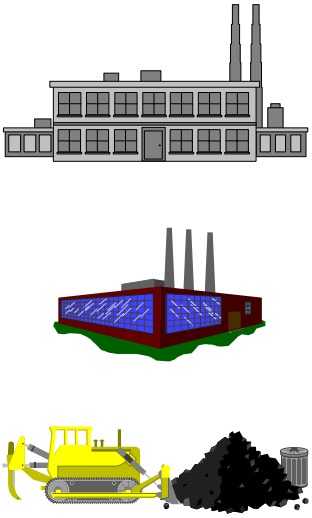
Hazardous Waste Generators	Hazardous Waste Operators	Final Disposal Facilities
Individual businesses generating hazardous waste	**Businesses involved in the transport, treatment, recycling and storage of hazardous waste**	**Landfills, incinerators and sewage treatment plants**
		
Large number of businesses - 8% surveyed	Small number of businesses - majority surveyed	Very small number of facilities - all surveyed
Detailed information about types and sources of hazardous wastes	**Detailed information about handling of hazardous wastes, for example treatment and recycling methods**	**Information about total quantities of hazardous wastes disposed of in the Auckland region**

Figure VIII-1 Information sources for the 1996 Auckland Region Hazardous Waste Survey [Environment and Business Group Ltd and Auckland Regional Council, 1996].

APPENDIX IX

Types of Waste Hazardous Substances Generated in the Taranaki Region

Table IX-1 Types of waste hazardous substances generated in the Taranaki region [Ministry for the Environment, 1994(a)].

NZSIC grouping	Industrial activity and waste per activity
1 Agriculture, hunting, forestry and fishing	11 Agriculture and hunting • Agrichemical spray contractors – accumulated spray containers = up to one hundred or more (several per week); – redundant chemicals; – old vertebrate. • Dairy companies – sludge from dairy processes – caustic cleaners = 4m^3 per week – acidic cleaners = 2m^3 per week – workshop wastes = oils and cleansing materials – laboratory wastes 12 Forestry and logging • Sawmills: – tanalised sawdust and offcuts = several m^3 per week
2. Mining and Quarrying	21 Coal Mining 22 Crude Petroleum and Natural Gas Production Contact Taranaki Regional Council for information on petroleum exploration wastes. 23 Metal Ore Mining - cyanide - spent catalyst - - toxic by-products. 24 Other Mining and Quarrying
3 Manufacturing	31 Food, Beverage, Tobacco 32 Textile, Apparel and Leathergoods • Tanneries: – contaminated degreasing solvents; – dyes, pigments, bleaching agents; – animal matter 1 m^3/month; – chemical containing sludges: organic acids, chrome salts, sulphides, detergents, ammonia 1 m^3/year; – wool scours, detergents, mothproofing agents (permethins). 33 Wood Processing and Wood Product Manufacture • Timber treatment – boron residues = 5-10 L/week; – antisapstain residues = 10-20 L/week; – CCA residues = 1-10 L/week; – pentachlorophenol residues; – several containers per month; – CCA wastes 1000 - 10000 L;(1) – TBT. 34 Manufacturing of Paper Products; Printing and Publishing • Printers: – photographic chemicals; – inks, solvents, cleansers and sludges = 10 - 100 L/week.

	35 Manufacture of Chemicals and of Chemical, Petroleum, Coal, Rubber and Plastic Products • Hot mix asphalt manufacture: – 300 drums of 200-L contaminated drums per year - contaminated by asphalt and similar – machinery oil, machinery cleansers; – solvents. • Fibreglass fabrication: – fibreglass offcuts, containers with hardened solvents, plasticisers, adhesives, resins, epoxies = 10-100 kg/month; – paint container residues • Paint manufacture: – resins and paint wastes 200 - 10,000 L;(1) – solvents; – trace heavy metals from drying agents and pigments. • Pesticides: – pesticide residues and byproducts 20-10,000 L.(1) • Bulk chemical suppliers – acidic, alkaline residues = several m^3/week. • Chemical and petrochemical manufacturers: – off-specification products, solvents, acids, alkalis, spent catalysts, containers, laboratory wastes, refining slops, water treatment sludges, ion exchange resins; – solvents 200-10,000 L.
	36 Concrete, Clay, Glass, Plaster, Masonry, Asbestos, and Related Mineral Product Manufacture
	37 Basic Metal Industries • Foundry: – machinery. • Metal plating and galvanising: – solutions and sludges of nickel, tin, chromium, zinc and/or other metals - acidic. Several m^3, once per year; – cleaning solutions and sludges - acids (sulphuric, nitric, hydrochloric, phosphoric, ammonium salts) or basic (hydroxide); – metal-based skimmings - normally recovered; – alkaline cyanide solutions or containers - normally continuously discharged to trade waste; – electroplating wastes 2000-10000 L;(1) – galvanising wastes 3000-7000 L; (1) – heavy metal dusts 2000-8000 kg. (1)
	38 Manufacture of Fabricated Metal Products, Machinery and Equipment • Metal workshops: – machinery turnings - metals (normally recycled) - 100 kg/week; – zinc/dichromate etching bath solutions - acidic; – lubricant containers = 20-80 per year; – machinery oils, cutting oils; – oil/water mixtures off presses: up to 10 m^3/week. • Aluminium fabricators, powder coat paints: – cutting oils = 1 L/week; – thinners, resins = 1 L/week; – solvent containers = a few L/week; – acidic cleaners; – paint containers and residues.
	39 Other Manufacturing Industries
4 Electricity, Gas and Water	41 Electricity, Gas and Steam • Electrical generation – PCBs; – oil (workshops).
	42 Water Works and Supply
5 Construction	51 Construction of Buildings • Cement lime
	52 Construction Other Than Building
	53 Ancillary Construction Services

	• Demolition yards, furniture restoration: – dry paint residues: 1-10 kg/month; – paint stripper residues: caustic, methylene chloride, acidic (phosphoric hydrochloric) containing high paint residue levels = 1-10 m^3/year; – contaminated containers (paints, cleansers). • Paint/surface application contractors: – 500 kg per week of abrasive blasting media, containing low levels of paint fragments and other abraded material, e.g. lead, zinc, chromium; – emptied paint containers – contaminated thinners, solvents (usually evaporated to dryness). • Insulation installation: – asbestos residues = possibly several hundred kg.
6 Wholesale and Retail Trade and Restaurants and Hotels	61 Wholesale Trade 62 Retail Trade • Photo laboratories: – residues collected on filters = less than 1 kg/week; – spent chemicals = 1-10 L/week; – photographic wastes 20-1000 L. (1) • Drycleaners: – perchloroethylene wastes and sludges = 1.5-10 kg/week; – alkalis. 63 Restaurants and Hotels • Hotels, restaurants etc: – grease trap wastes - fats, greases, oils =1-2 m^3 6-monthly or yearly.
7 Transport, Storage and Communication	71 Transport and Storage • Motor vehicle servicing and repairs: – asbestos dusts, brake linings; – contaminated degreasers, solvents = 5-10 L/week; – used oil = 10-100 L/week; – oil contaminated engine parts, filters = 100 L/week; – brake fluids = 1 L/week; – batteries, battery fluids = 1-5/week; – rust treatment residues = 5-30 L/week; – paint containers; – radiator additives; – antifreeze and corrosion inhibitors. • Heavy vehicle fleets: – several batteries per year; – oil = 10 L/week. • Paint shops: – strippers, solvents, paints (liquid, dusts) containers. • Oil and petrol terminals: – leaded sludges and scales from desludging storage tanks = up to 300 kg every five years; – oil-contaminated sludges and scales = 2 m^3 every five years; – interceptor sludges 100-200 L/month • Road sweepings and stormwater sump clearage: – lead/zinc/bacteriological contaminated road sweepings = 30-40 m^3/day; – stormwater sump. 72 Communication
8 Business and Financial Services	81 Financing 82 Insurance 83 Real Estate and Business Services
9 Community, Social and Personal Services	91 Public Administration and Defence • Educational institutions: – assorted laboratory chemicals; – contaminated swimming bath chemicals.

	92 Sanitary and Cleaning Services • Pest control: – contaminated containers = 50 L/week; synthetic pyrethoids, dursban, methyl bromide, organophosphates - containers may be steel, aluminium or cardboard. • Cleaning services: – contaminated containers, disinfectants, cleaners. 93 Social and Related Community Services • Medical laboratories, hospitals: – sharps; – pharmaceuticals; – laboratory wastes – laboratory media; – photographic developers. 94 Recreational and Cultural Services 95 Personal and Household Services • Vet clinics: – cage linings, animal droppings = 2-10 rubbish bags per week; – animal tissue, including carcases = several animals per week ($0.25m^3$); – medicine residues, sharps, containers, photographic chemicals, and other surgery wastes = 1 bag per week. 96 International and Extra-territorial Bodies

Note (1): Quantities in this table are included as an approximate guide to the amount of waste hazardous substances produced by individual waste generators. Actual quantities will vary considerably depending on the size of the facility and the technology utilised.

APPENDIX X

Hazardous Waste Generation in the Otago Region

This appendix is taken in its entire form from "*Otago Regional Council: Collection, storage, treatment and disposal of hazardous wastes - options report*" [Works Consultancy Services Ltd, 1996]. All estimates in this appendix can be considered to be derived from the following broad definitions:

- hazardous substances are substances which pose a present or future threat to humans and/or the environment;
- hazardous wastes can be defined as hazardous substances which are unwanted and economically unusable.

The tables in this section include:

Table X-1	Estimated volumes of industrial hazardous waste generated in the Otago region in 1996;
Table X-2	Estimated volumes of agricultural chemicals generated in the Otago region in 1996;
Table X-3	Estimated volumes of household hazardous waste generated in the Otago region in 1996.

These tables represent estimated total volumes of hazardous wastes that are likely to be generated from different industrial, agricultural and domestic practices. The estimates were obtained using the following methodology:

- a telephone survey of a cross-section of industries in Otago;
- typical industrial discharges and hazardous waste outputs (see Appendix IX);
- rural and domestic populations in Otago;
- known numbers of industries in different sectors in Otago;
- bulk hazardous chemical collections undertaken in other regions in New Zealand;
- National Waste Surveys.

It should be noted that although the data contained within the above documents are both detailed and accurate, the assumptions made in preparing the tables are such that a margin of error of ±20% has been adopted for all bulk estimated volumes of hazardous waste reported.

Table X-1 Estimated volumes of industrial hazardous waste generated in the Otago region in 1996 [Works Consultancy Services, 1996(b)].

Industry	No. of businesses in Otago	Hazardous wastes produced	Estimated total hazardous waste produced
Agrichemical spray contractors	5	Empty containers Unused chemicals - pesticides - herbicides - animal remedies	 5 m^3/yr
Aircraft maintenance	3	Aviation fuel Waste oil	10 L/yr 10 L/yr
Asbestos disposal	3	Asbestos	20 m^3/month
Asphalt manufacture	1	Asphalt cont. drums Hydrocarbon materials - solvents - waste oils	300 x 200L contaminated drums per year 10 L/yr 100 L/yr
Asphalt applicators	7	Asphalt cont. drums Hydrocarbon materials - solvents - waste oils	100 x 200 contaminated drums per year 10 L/yr 100 L/yr
Brake and clutch servicing	8	Asbestos linings Used brake fluid Empty brake fluid containers	1T/yr 2000 L/yr 5 m^3 of empty containers per year
Chemical suppliers - agricultural	3	General agrichemicals Fertilisers / phosphates Chemical residues	 1 T/year
Chemical suppliers - industrial/technical	5	Solvents Hydrocarbons / oils Acid / alkali Heavy metals Adhesives / resins	 1000 L/month
Chemical and petrochemical manufacturers	2	Solvents Hydrocarbons Waste chemicals /sludges	 100-200 L/month (sludges)
Cleaning services	20	Cleaning products Disinfectants	50 m^3/month 10 m^3 per month (containers)
Dairy companies	3	Acid solutions Caustic solutions Waste oils	2 m^3/week 4 m^3/week 1 L/week
Dry cleaners	14	Perchlorethylene Carbon tetrachloride Ethane Trichloroethylene	100 kg/week 10 kg/week 10 kg/week 10 kg/week
Electricity generation	3	PCBs Waste oils	Assumed removed 1 L/week
Electroplaters and galvanisers	3	Zinc Chromium Acids Cadmium Nickel Tin	 10,000 L/yr

Industry	No. of businesses in Otago	Hazardous wastes produced	Estimated total hazardous waste produced
		Cyanide	
Engine repairs	40	Waste oil Hydrocarbons Heavy metals Solvents Acid / alkali Refrigerants Antifreeze Empty containers	2000 L/yr 10 L/yr 100 m^3/yr 10 L/yr 100 L/yr 10 L/yr 10 L/yr 100 m^3/yr
Fertiliser manufacturer bulk store	 5 10	Sulphuric acid Phosphates Oil	1,000 L/yr 200 kg/yr 1,000 L/yr
Fibreglass fabrication	7	Adhesives, resins, epoxies Fibreglass offcuts Paint residues	100 kg/month 10 m^3/month 10 m^3/month
Foundries	6	Machinery oils Solvents Metal/paint dusts	500 L/yr 100 L/yr 100 kg/yr
Gold mining	1	Cyanide Metal ores	10 L/week 10 m^3/month
Hospitals, medical centres and medical laboratories	30	Human tissue and wastes Pharmaceutical residues Sharps Photographic chemicals Radioactive materials	Mediwaste Incinerator treats 30-40 T/month
Muffler and exhaust repairs	10	Waste oil Metals and oxides	1000 L/yr
Oil/petrol terminals	4	Hydrocarbon sludges	5 m^3/yr
Paint applicators and spray painters	8	Paint flakes/residues - lead - zinc - chromium Solvents	1000 kg/yr 10 L/week
Paint strippers	5	Dry paint flakes/residues - lead - zinc - chromium Stripping chemicals Solvents/thinners	1000 kg/week 10 L/week 10 L/week
Paint retailers	21	Empty containers Strippers/solvents Waste paints/residues	100 m^3/week 10 L/week 100 kg/week
Painting contractors	20	Empty containers Paint fragments - lead - zinc - chromium Thinners/solvents	10 m^3/week 1000 kg/week 10 L/week
Paint manufacture	3	Resins and paint wastes Solvents Trace metals/pigments	1000 L/week 100 L/week 10 kg/week
Pest control	15	Bromides Organophosphates	1000 L/week contaminated containers
Photo laboratories	2	Spent chemicals Spent filters	10 L/week 1 kg/week

Industry	No. of businesses in Otago	Hazardous wastes produced	Estimated total hazardous waste produced
		Photographic wastes	20 L/week
Printers	36	Photographic chemicals Solvents Acid / alkali Chromium	100 kg/week 100 L/week -} 1000 L/week -}
Road maintenance (road sweepings)	20 (No. of towns)	Lead Zinc	100 T/month
Slipways (boat maintenance)	3	Flakes and residues from cleaning of boat/ship hulls: Tri-butyl tin (TBT) Arsenic Mercury Lead Cadmium Chromium	= 100 kg/yr
Service Stations	150	Waste oils/lubricants Solvents	750 m^3/yr 5000 l/yr
Scrap metal dealers	9	Battery acid Radiator fluids	5 l/day 50 l/day
Tanning	6	Heavy metals (chromium) Formaldehyde Dyes Acids	100 kg/yr 1,000 l/day ongoing discharge of diluted acid
Textiles	3	Asbestos Dyes	10m3/yr 150m3/yr
Timber treatment sites	47	Contaminated soils and sludges CCA salts Boron sludge Waste oil Chemical drums	100,000 m^3 10 m^3/yr 10 m^3/yr 500 l/yr 100 m^3/yr
Vehicle Fleet Operators, (say more than 20 vehicles)	100(est.)	Batteries Waste oil Brake fluid	100 batteries / year 200 L/week 10 L/week
Vet Clinics	23	Animal tissue Medicine residues Sharps }	- 100 kg/week
Woolscours	2	Detergents Permethins }	- 1 m^3/month
Total intractables	N/a	Industrial hazardous wastes	250,000 T 50,000 T

Table X-2 Estimated volumes of agrichemicals generated and stockpiled in the Otago region in 1996 [Works Consultancy Services, 1996(b)].

Chemical groupings	Breakdown (uses, trade names and chemical compositions)	Estimated total quantities	
		Existing (tonnes)	Ongoing (tonnes/ year)
Animal remedies (5.6 %)	• Arsenic sheep/cattle dip (As) • Bacterial drenches and dips (trichlorfon) • Cattle lice control sprays • Dehorning pastes • Flea/fly spray (Malathion) • Footrot fluid • Dewormers (dowzene) • Others	2.8	0.5
Deregistered chemicals (7.2 %)	• DDT, DDE, DDD, TDE • 2,4,5-T • Aldrin, dieldrin • Various intractable organics • Toxic organochlorine and organophosphorus pesticides • Others	3.6	N/a
Fungicides (6.9 %)	• Copper, chromium, arsenic • Pentachlorophenol (PCP) • DDT • Cuprous oxide • Dichlorophen • Dimethirimol • Others	3.5	1.0
Herbicides (42.3 %)	• Tordon - (2,4,D, pichloram. 2,4,5-T) • Weedkillers - (2,4,D and 2,4,5-T) • Amitrole + Dalapon + Sima • Sodium arsenate • Arsenic pentoxide • Mineral ol • Hydramethynon • Others	22	4.6
Insecticides (11.4 %)	• Borer killers (lindane, chlordane) • Metaldehyde • Boric aid • Sodium borate • Diazinon • Gammexane • Pyrethrins • Mineral oil • Others	5.7	1.2
Other chemicals (10.7 %)	• Creosote • Waste oil • Methylated spirits • Hydrocarbons • Asbestos • Fertilisers • Others	5.4	1.1
Unidentified chemicals (15.9 %)	• Various (much the same as above, only unlabelled or old/deteriorated containers.	7	0.6
Total Total intractables	• Agrichemicals	50 10	10 2

Table X-3 Estimated volumes of household hazardous waste generated in the Otago region in 1996 [Works Consultancy Services, 1996(b)].

Type of waste	Estimated total (stockpiled) in the Otago Region (tonnes)	Estimated total (ongoing) in Otago (tonnes/year)
Waste oil	1.4	0.5
Oil based paints	0.7	0.3
Water based paint	0.4	0.1
Solvents	0.7	0.3
Car batteries	50,000	10,000 /year
DDT, DDE, TDE, DDD	3	1
Aldrin, Dieldrin, Lindane	3	1
Moss killers	1.5	0.5
Fungicides	3	1
Herbicides	7	2
Insecticides	3	1
Corrosives (acids)	3.5	1
Aerosols	1.5	0.5
Cleaners / detergents	70	50
Empty containers with residual chemicals	350	50
Total Total intractables	450 50	110 10

APPENDIX XI

The New Zealand Basel Convention Annual Report 1995

Introduction

This report addresses New Zealand's 1995 Basel Convention reporting requirements. The Ministry for the Environment is the designated focal point for the preparation of this report. The Ministry of Commerce is the Competent Authority which has supplied most of the information.

General

The Basel Convention requires Parties to provide information on any efforts taken to reduce transboundary movement of hazardous wastes and measures undertaken for development of technologies for the reduction and/or elimination of the production of hazardous wastes.

In 1995 substantial progress has been made on the management of hazardous wastes in New Zealand, including:

- progress of the Hazardous Substances and New Organisms Act through Parliament (it became an Act in June 1996);
- surveys of waste generation, including hazardous waste going to landfills, as well as its generation by industry and households;
- regional collections of unwanted or redundant agricultural chemicals;
- promotion of cleaner production and voluntary waste reduction agreements with industry (eg the used oil recovery programme);
- programme to investigate organochlorine wastes and disposal technology.

Transboundary movements

Table XI-1 summarises the information on transboundary movements and hazardous wastes involving New Zealand in 1995. The table includes the maximum amounts approved for movement. It should be noted that the actual amounts moved are often significantly less. For example, approval was given to export 340 tonnes of PCB for destruction in France. The actual export receipts amounted to 120 tonnes in 1995. From 1996 onwards it is intended to routinely report the actual tonnage moved, as well as the amount approved.

Accidents involving transboundary movements of hazardous wastes

No accidents involving the transboundary movement of hazardous wastes have been reported.

Changes to definitions of hazardous wastes

No changes have been made to the definition of hazardous waste.

Decisions to ban or limit the import or export of hazardous wastes

No specific decisions were made which would ban, or limit, the export or import of hazardous wastes.

Information on health effects of transport of hazardous wastes

No health effects due to the transport of hazardous wastes have been recorded.

Information on bilateral, multilateral and regional agreements

New Zealand has been involved in only one Article 11 arrangement over the last twelve months. On 16 September 1995 this country signed the Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes within the South Pacific Region, known as the Waigani Convention. New Zealand has not yet ratified the Convention, however, so its provisions have yet to be implemented in New Zealand.

The Waigani Convention represents a regional approach to waste management. It allows the Forum Island Countries (FICs) to export hazardous wastes to Australia and New Zealand, but the latter are not permitted to export wastes to the FICs. These differentiated responsibilities reflect the fragile environments in the FICs and recognise that they are not always equipped to deal with hazardous wastes. The Waigani Convention also prohibits imports of radioactive wastes into the Convention area (i.e. the FICs, Australia, and New Zealand).

Table XI-1 New Zealand transboundary movements of hazardous wastes in 1995 [Ministry for the Environment, 1996].

Waste type	Approved amounts (tonnes)	Basel category	OECD category	Characteristics	Origin	Destination	Transit country	Disposal operations
Imported waste								
Spent lead acid batteries	15,000	Y31/Y34	AA170	H12	Australia	NZ	N/A	R4
Exported waste								
Vanadium slag	8000	No Code	GC070	H12	NZ	China	Hong Kong	R4
Vanadium slag	6000	No Code	GC070	H12	NZ	Russia	Latvia	R4
PCBs	340	Y10	Y10	H12	NZ	France	Tahiti	D10
Aluminium dross	19	No Code	GB030	H11	NZ	Australia	Direct	R5
Tungsten carbide grinding residue	8	Y17	GA080	H11	NZ	Germany	Direct	R5
Zinc oxide baghouse dust	75	Y23	GA160	H11	NZ	Australia	Direct	R4
Spent cell lining	120	No Code	AA050	H11	NZ	Australia	Direct	R5
Copper alloy dross	100	Y22	AA040	H11	NZ	UK	Direct	R4
Spent lead acid batteries	39	Y31/Y34	AA170	H12	NZ	Phillipines	Direct	R4
Waste in transit (awaiting export)								
Low grade tankhouse slimes	400	No Code	Not known	H6.1	Australia	Belgium	NZ	R4
Aluminium alkyl	Not known	No Code	AB010	H6.1/H11	Australia	USA	NZ	Not known
Precious metal plant solids	39	No Code	GA030	H6.1	Australia	Belgium	NZ	R4

APPENDIX XII

Generation of Hazardous Waste from Contaminated Sites in New Zealand

Definition

The Australian and New Zealand Environment and Conservation Council (ANZECC) and National Health and Medical Research Council (NHNRC) (1992) define a contaminated site as:

> *" site at which hazardous substances occur at concentrations above background levels[6] and where assessment indicates it poses, or is likely to pose, an immediate or long-term hazard to human health or the environment."*

Contaminated sites can potentially create large amounts of waste which will require some form of management, ranging from disposal or treatment. An indication of the number of sites in New Zealand, and the associated volumes of wastes likely to be associated with some form of clean-up needs to be considered.

Assessing the number of contaminated sites in New Zealand

The ANZECC in consultation with the NHMRC have jointly put together the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites in New Zealand (1992). The purpose of the guidelines is to provide a consistent framework for the proper assessment and management of contaminated sites.

ANZECC lists some specific industries and landuses which have a higher probability of contaminating a sites. This list has formed the basis of much of the work being carried by regional councils throughout the country. The specific industries and landuse which have been associated with site contamination are listed in Table XII-1.

Table XII-1 Industries and landuse associated with site contamination [ANZECC and NHMRC, 1992].

Acid/alkali plant and formulation	Agricultural/horticultural activities	Airports
Asbestos production and disposal	Chemicals manufacture and formulation	Defence works
Drum reconditioning works	Dry cleaning establishments	Electrical manufacturing (transformers)
Electroplating and heat treatment premises	Engine works	Explosive industry
Gas works	Iron and steel works	Landfill sites
Metal treatment	Mining and extractive industries	Oil production and storage
Paint formulation and manufacture	Pesticide manufacture and formulation	Pharmaceutical manufacture and formulation
Power stations	Railway yards	Scrap yards
Service stations	Sheep and cattle dips	Smelting and refining
Tanning and associated wastes	Waste storage and treatment	Wood preservation

[6] Background levels are the ambient levels of a contaminant in the local area under consideration.

The ANZECC guidelines note that the "exact level of site contamination associated with any particular industrial, commercial or agricultural practice will depend upon the standard of management, including the past regulatory framework and of safety procedures employed at individual sites" [ANZECC and NHMRC, 1992].

Preliminary studies of the likely extent of potentially contaminated sites, based on this ANZECC landuse list, indicates that there may be over 8000 potentially contaminated sites in New Zealand. These are made up of 7200 sites identified in a 1992 report, approximately 800 timber treatment sites, and a number of agricultural sites such as sheep and cattle dip sites [Worley Consultants Ltd, 1992].

Sources of Contamination

Three particular sources of potential contamination have been the subject of guidelines prepared by the Ministry for the Environment, including:

- timber treatment sites;
- gasworks sites;
- petroleum hydrocarbon contaminated sites.

These particular contaminants have been chosen because of a combination of their prevalence and their potential effects of human health and the environment. Subsequent to the release of the *Health and Environmental Guidelines for Selected Timber Treatment Chemicals* a number of regional councils have undertaken to assess timber treatment sites for their potential to have an adverse effect on human health and the environment [Ministry for the Environment and Ministry of Health, 1993].

The major groups of polluting substances associated with these three industries are listed in Table XII-2.

Table XII-2 Polluting substances associated with timber treatment sites, gaswork sites and petroleum hydrocarbon sites [Ministry for the Environment and Ministry of Health, 1993].

Timber treatment sites	Gaswork sites	Petroleum hydrocarbon sites
Arsenic	Polyaromatic hydrocarbons	Total petroleum hydrocarbons
Boron	Phenols	Benzene, toluene, ethylbenzene, xylene
Chromium (III)	Benzene, toluene, ethylbenzene, xylene	Polyaromatic hydrocarbons
Chromium (VI)	Cyanide	
Pentachlorophenol		
Dioxins and furans		