Hazardous Waste Survey of the Bay of Plenty and Waikato Regions

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Working with our communities for a better environment

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Executive Summary

In 2001, Environment Bay of Plenty and Environment Waikato, with support from the Auckland Regional Council, initiated a project to undertake a hazardous waste survey of the two regions. The project was part-funded by the Ministry for the Environment's (MfE) Sustainable Management Fund. The objective of the survey of hazardous waste was to support the reporting on, and the making of informed decisions about, managing hazardous waste by providing reliable information on the volumes and flows of such waste within the Bay of Plenty and Waikato regions. It was also anticipated that the methodology developed as part of the project, which built on a similar telephone survey undertaken in Auckland in 1996, would be useful as a predictive model for hazardous waste in other parts of New Zealand. The survey had the additional objectives of testing confirmed national environmental indicators for hazardous waste, and the definition of hazardous waste and the New Zealand Waste List proposed by MfE.

Overall, the survey has provided useful background information about the general nature of the hazardous waste streams generated and handled within the Bay of Plenty and Waikato regions, and a useful critique of national hazardous waste definition and classification tools. It has improved the existing information base on:

- The types and relative quantities of hazardous waste generated and processed in the two regions, and the key industry groups involved.
- Priority hazardous waste generated in the two regions, and their relative importance for planning and management purposes.
- Existing problems among hazardous waste generators and operators with respect to appropriately and safely managing hazardous waste as a result of a lack of knowledge, relevant information and appropriate regional hazardous waste facilities.

However, it is noted that the accuracy and completeness of the available data significantly limit the applicability of the results.

The reasons for this are that the survey needed to sub-sample from a large industry population, industries having poor knowledge and information about their waste streams, the unwillingness of some businesses to cooperate, and the uncertainty around the volumes and composition of diluted liquid hazardous (trade) waste streams. Further to this, it was not financially feasible to conduct on-site surveys (as a way of addressing the above problems) at a scale necessary to improve the quality and reliability of the data.

This in turn has significantly affected the ability to develop a statistically robust model for estimating total hazardous waste quantities across the two regions, or other regions in New Zealand. Nonetheless, the predictive model is useful on a selective basis for some key industry groups and priority hazardous waste. Overall, estimated waste quantities should be taken only as an indication of likely rather than absolute quantities and interpreted and used carefully with respect to the underlying statistical variability of the data.

The survey gathered information from 1489 generators and operators (791 who were involved with hazardous waste) and the origins, quantities and differentiation by waste stream of the hazardous waste are presented by region and as a total. Key findings are:

- The Waikato Region had significantly more identified waste streams (827) than the Bay of Plenty (510).

- Estimated quantities of hazardous waste generated were much higher in the Waikato region (some 70,000 tonnes) compared to the Bay of Plenty region (some 24,000 tonnes). Both estimates were attached with a relatively high 95% confidence interval of ±50-60%.

- When breaking down industries into large industries (with more than 20 employees) and small industries (with equal or less than 20 employees), quantity estimates became much better for the small industries. This is mostly because large industries are unique and therefore statistically less representative. Small industries were estimated to generate some 26,000 tonnes of waste in the Waikato, and 14,000 tonnes in the Bay of Plenty region, with a 95% confidence interval of ±30-36%

- Large industries produced more total waste in the Waikato region than the smaller industries. The reverse was the case for the Bay of Plenty Region. This was thought to be in part due to the fact that the Waikato region had a considerably higher number of large industries and also industries with a greater potential to generate liquid and sludge wastes, such as food processing industries.

- Waste profiles, as expected, followed industry profiles. In the Waikato, basic metal and food manufacturing industries dominated while the wood processing, pulp and paper industry dominated in the Bay of Plenty.

- Hazardous waste in sludge and solid form dominated the Waikato figures, while in the Bay of Plenty the solid form was the most significant.

- About 15 priority hazardous wastes were identified in the two regions. Most prominent amongst these were waste from wood processing and the surface treatment of materials, waste oil, batteries, medical waste, and waste from wastewaster treatment processes. The estimates for priority hazardous waste produced by the predictive model are statistically quite robust, with 95% confidence intervals generally below ±20-30%.

While it was intended to provide as complete information as possible on hazardous waste across its life cycle, the survey data was generally not useful for correlating quantities of waste generated with the amount of waste treated or disposed of internally or externally to the regions. This is because of the lack of knowledge and documentation by both hazardous waste generators and operators.

The Report identifies a number of conclusions and makes recommendations. One clear conclusion drawn from the study is that without some form of ***required*** record keeping or reporting system, data on hazardous waste and related policy and management decisions will always have a significant element of assumption or guesswork behind them. It is recommended that any such system should be nationally applied, possibly with an initial focus on priority industries and hazardous waste.

A key observation made within the report is that both operators and generators were looking for more and better information about hazardous waste management and it is recommended that local government take a lead in coordinating a response to this observation.

Overall, it is recommended that future surveys of this nature are not undertaken unless they are to be used to broadly identify or prioritise hazardous waste streams within an area or region for more specific action. The logistical difficulties and costs mean that the applicability of such comprehensive surveys should be considered carefully before initiation.

Contents

List of Appendices

List of Tables

List of Figures

Chapter 1: Introduction

1.1 Setting the Scene

Currently, there is no consistent regulatory or methodology framework for collecting data on hazardous waste in New Zealand. However, without reliable information on the types and quantities of hazardous waste, it is difficult to make informed decisions about the significance of potential adverse effects of hazardous waste on human health and the environment, and how to manage these appropriately. Also, without a standardised methodology, it is difficult to collect consistent data on hazardous waste for monitoring purposes and for making comparisons over time or between locations in New Zealand.

For this reason, Environment Bay of Plenty and Environment Waikato decided to undertake a joint survey of hazardous waste in their regions. Its aim was to assess the quantities and types of hazardous waste present and to develop a robust methodology suitable for transfer to other regions in New Zealand. In addition, the study aimed at developing a predictive model to estimate total hazardous waste quantities generated in the two regions surveyed, and in other regions, without having to undertake a full survey.

Recent work by the Ministry for the Environment (MfE) on hazardous waste includes a definition of hazardous waste and tools for classifying hazardous waste, and a set of national indicators for hazardous waste. This hazardous waste survey of the Bay of Plenty and Waikato regions also aimed at testing these tools in practice and evaluating their usefulness.

The study was funded jointly by the Sustainable Management Fund, Environment Bay of Plenty and Environment Waikato and the Auckland Regional Council. Environment and Business Group Ltd developed the survey methodology and predictive model, in conjunction with the Department of Statistics of the University of Auckland. Opus International Consultants undertook the survey in the Bay of Plenty and Waikato regions. The survey was carried out between January and March 2002.

This report was prepared collaboratively between Environment and Business Group Ltd (Chapters 1, 2, 3, 5, 6 and 7) and Opus International Consultants (Chapters 4 and 7).

1.2 Study Objectives and Outputs

The objectives for the study were to:

(a) Develop a methodology for quantifying hazardous waste that is effective for the Bay of Plenty and Waikato regions and that is applicable to other parts of New Zealand.

(b) Obtain available information on the sources, amounts, types and fates of hazardous waste generated in the Bay of Plenty and Waikato regions, to enable monitoring of the effectiveness of regional policy statements and regional plans and to guide future policy responses.

(c) Test the ease of use and comprehensiveness of the MfE confirmed hazardous waste indicators, draft MfE hazardous waste definition and New Zealand Waste List.

Required outputs for the study included:

- Representative information on the generation, storage, transport, treatment and disposal of hazardous waste in the two regions. This information was to cover the entire lifecycle of hazardous waste, from generation to final disposal (including end use, export and the movement of hazardous waste within and from the regions).
- A model survey design and methodology able to produce the required information and that was transferable to other regions in New Zealand.
- A statistical model to predict total hazardous waste quantities over total industry populations in the two regions surveyed, as well as in other regions in New Zealand.
- A report documenting survey design and methodology, survey results, and predictive data, with appropriate recommendations on the key issues identified and tools used during the survey.

Chapter 2: Managing Hazardous Waste in New Zealand

2.1 Legal Context

2.1.1 Resource Management Act (1991)

The Resource Management Act 1991 (the RMA) gives regional councils and territorial authorities the power to regulate activities in order to control the effects of these activities on the environment.

2.1.1.1 Regional Councils

Under section 30 of the RMA, a regional council is responsible for:

- The control of the use of land for the purpose of the prevention or mitigation of any adverse effects of the storage, use, disposal, or transportation of hazardous substances
- Controlling discharges of contaminants into or onto land, air or water. The definition of contaminants in the RMA would include hazardous waste. Discharges can be controlled through discharge to air, land or water plans and through resource consents.

Under section 35 of the RMA, a regional council is responsible for:

- Gathering information and undertaking research necessary for the regional council to carry out its functions under the RMA.
- Monitoring the state of any part of the environment of its region in order to effectively carry out its functions under the RMA.

Regional councils must prepare regional policy statements (section 61 of the RMA). Within that regional policy statement, a regional council is required to state the region or any part of the region for which a territorial authority or the regional council has responsibility for developing objectives, policies and rules relating to the control of the use of land for the prevention or mitigation of any adverse effects of the storage, use, disposal or transportation of hazardous wastes (section 62 of the RMA).

A regional council has the option to state in its regional policy statement particular responsibilities for particular hazardous substances (section 62 of the RMA, as inserted by the Resource Management Amendment Act 2003). If a regional council elects not to state these, the territorial authority is deemed to have primary responsibility.

A regional council may prepare plans concerning any aspect of any function for which it is responsible. Whenever significant cross-boundary issues are likely to arise, regional councils must consider a combined regional and district plan or a combined regional plan with another region as options (section 80(5)). Preparing such combined plans is not required, but these are options that regional councils can choose.

A regional council must include matters in the regional policy statement over which it has control in relation to discharge of contaminants into or onto land, air or water and discharges of water into water (second schedule matters to be provided for in policy statements).

Section 15 of the RMA prohibits the discharge of contaminants into the environment unless allowed by a rule in a regional plan, by a resource consent, or under section 20 (certain existing landfill activities allowed).

2.1.1.2 District Councils

Under section 31 of the RMA one of the functions of territorial authorities is:

- Control of any actual or potential effects of the use, development, or protection of land, including for the purpose of the prevention or mitigation of any adverse effects of the storage, use, disposal or transportation of hazardous substances.

Territorial authorities must have district plans that assist them in carrying out their functions under the RMA (section 72). Within that district plan, the territorial authority must include any matters for which the territorial authority has responsibility under the RMA in relation to the prevention or mitigation of any adverse effects of the storage, use, disposal or transportation of hazardous substances. District plans must be consistent with regional policy statements and any regional plans. Territorial authorities also have information gathering and monitoring responsibilities within their districts under section 35 of the RMA.

The courts have recognised that there is an overlap of functions between regional councils and territorial authorities in relation to the prevention or mitigation of any adverse effects concerning hazardous substances (sections 30 and 31).

While regional councils are responsible for controlling the use of land for these purposes and territorial authorities are responsible for controlling the effects of the use of land, the Court of Appeal (Canterbury Regional Council vs. Banks Peninsula DC 1995, NZLR 1995) has held that controlling the effects of land use involves some degree of controlling the use itself. Both regional councils and territorial authorities have the full ability to carry out their respective functions, even though regional councils are able to determine who holds primary responsibility for these.

2.1.2 Local Government Act (LGA) 2002

The Local Government Act (LGA) has recently between completely revised from the original 1974 version. It was enacted in 2002 with many of the provisions not coming into force until July 2003.

The LGA now:

- States the purpose of local government.
- Provides a framework and powers for local authorities to decide which activities they undertake, the manner in which they will undertake them and promotes the accountability of local authorities to their communities.

- Provides for local authorities to play a broad role in promoting the social, economic, environmental, and cultural well being of their communities, taking a sustainable development approach.

The LGA 2002, among other matters, also addresses trade wastes and waste management. Some of these wastes comprise hazardous substances.

Section 146 of the new Act enables territorial authorities to make bylaws on a range of matters, including waste and trade waste. Sections 195 and 196 allow the discharge of trade wastes into sewerage drains according to bylaws made under the LGA, provided that there is no breach of the RMA, Building Act 1991 or Health Act.

Part XXXI of the old LGA 1994 continues to be retained under the new Act, with a review planned for the future. This part requires every territorial authority to promote effective and efficient waste management within its district, while having regard to environmental and economic costs and benefits for the district, and ensuring that the management of waste does not cause a nuisance or be injurious to health.

Part XXXI requires every territorial authority to adopt a waste management plan that makes provision for the collection and reduction, reuse, recycling, recovery, treatment, or disposal of waste in the district. Any territorial authority is required to give consideration to the waste hierarchy starting with waste reduction as the highest priority. Further, regional councils are authorised to fund, establish, and manage sites for the regional disposal of hazardous wastes.

The new LGA 2002, through section 286, requires all territorial authorities to have waste management plan specified in Part XXXI of the LGA 1974 in place by 30 June 2005.

Subject to the requirements placed on it in a waste management plan, there is no mandatory requirement for territorial authorities to undertake waste management activities (section 540). If a territorial authority decides to undertake waste management activities it can contract these services out.

2.1.3 The Hazardous Substances and New Organisms Act 1996

The Hazardous Substances and New Organisms Act 1996 (the HSNO Act) sets up a new control framework for hazardous substances. The Act also requires that any hazardous substance that meets the definition of a hazardous substance under the Act to have an approval.

Each approval specifies a range of controls on the hazardous substance according to the range and degree of hazardous properties it presents, covering aspects such as labelling, packaging, handling, disposal, and so on.

Occasionally, hazardous substances need to be disposed of, such as when material has been spilled or is superfluous to requirements. In these instances, the substance-specific disposal controls under the HSNO Act apply.

Generally, hazardous waste in New Zealand consists of mixtures of different hazardous materials. More often than not, hazardous waste comprises chemical components at unknown concentrations, percentages and environmental availability. Because of this, it is often difficult to apply substance-specific disposal controls under the HSNO Act.

In light of these issues, the Environmental Risk Management Authority and the Ministry for the Environment have agreed, that the Ministry will be responsible for

providing guidance on managing mixed hazardous waste. To this end, the Ministry has developed a Hazardous Waste Programme. The Ministry for the Environment has also developed a Waste Strategy that outlines specific targets for hazardous waste.

2.2 Regulatory Framework for Record Keeping on Hazardous Waste

There is currently no legal requirement or framework to keep records or report on hazardous waste generation and management in New Zealand, other than through resource consents issued for specific facilities involved with hazardous waste (for example, landfills or sewage treatment plants). This means it is not possible for agencies to obtain information on hazardous waste on a district, regional or national basis, except by undertaking one-off surveys.

Despite the absence of regulatory mechanisms to manage hazardous waste, the Ministry for the Environment has over recent years developed a range of policies, tools and databases aimed at managing hazardous waste. These are outlined in greater detail below.

2.3 Waste Minimisation Strategy

The Ministry for the Environment released its New Zealand Waste Strategy[1] in 2002. The New Zealand Waste Strategy covers solid, liquid and gaseous waste and recognises that moving towards zero waste and a sustainable New Zealand is a long-term challenge. It sets specific targets for waste minimisation and hazardous wastes being disposed of in trade waste. It has three core goals:

(a) Lowering the social costs and risks of waste.

(b) Reducing the damage to the environment from waste generation and disposal.

(c) Increasing economic benefit by more efficient use of materials.

This strategy promulgates several targets for hazardous waste:

(a) By December 2005, an integrated and comprehensive national hazardous waste management policy will be in place that covers reduction, transport, treatment and disposal of hazardous wastes to effectively manage risks to people and the environment.

(b) By December 2004, hazardous wastes will be appropriately treated before disposal at licensed facilities and current recovery and recycling rates will be established for a list of priority hazardous wastes.

(c) Recovery and recycling rates for priority hazardous waste will increase 20 percent by December 2012.

The New Zealand Waste Management Strategy also has specific targets relating to the trade waste issue, which have implications for hazardous waste being disposed of as trade waste. These are:

[1] Ministry for the Environment, 2002: The New Zealand Waste Strategy. Towards zero waste and a sustainable New Zealand. Ministry for the Environment, Wellington.

(a) By December 2005, all territorial local authorities will have implemented and will be monitoring Model General Trade Waste Bylaws based on the New Zealand Standard Model, Part 23 – Trade Waste, or its equivalent.

(b) By December 2005, all territorial local authorities will ensure that all holders of new or renewed trade waste permits will have in place a recognised waste minimisation and management programme.

A third programme detailed in the Strategy recognises the critical importance of good information, including sound databases, in minimising and managing waste. It provides for the further development and use of waste indicators as part of the environmental reporting project. It also provides for the establishment of sound databases for measuring and monitoring implementation of the Strategy.

2.4 Non-regulatory Tools for Managing Hazardous Waste

Non-regulatory tools for managing hazardous waste developed by the Ministry include: a definition of hazardous waste, the New Zealand Waste List, confirmed national indicators for hazardous waste, methods for record keeping, as well as background information on hazardous waste. One of the requirements of the survey brief was that these tools were to be tested throughout the survey. These tools are described in greater detail below.

2.4.1 New Zealand Definition of Hazardous Waste

The Ministry for the Environment has developed a draft definition of hazardous waste. This definition consists of two key parts:

(a) The W (Waste)-Code: a list of reasons of why materials become waste.

(b) Hazardous thresholds above which a waste is deemed to become hazardous (based on minimum degrees of hazard defined by the Hazardous Substances and New Organisms Act 1996, and other relevant pieces of New Zealand legislation).

The definition is shown in Appendix A1.

2.4.2 New Zealand Waste List

The New Zealand definition of hazardous waste is generic and therefore is not suited to determining whether a waste is hazardous without analytical testing. However, the testing of waste is impractical because much of the hazardous waste generated in New Zealand is highly mixed and variable in composition.

The New Zealand Waste List largely solves the problem of definition by providing a long list of waste types – both hazardous and non-hazardous – that are grouped according to type of industrial process and source. Hazardous wastes are marked with an asterisk and are deemed to be hazardous unless it can be shown through testing that they are not.

Appendix A2 shows an extract of the New Zealand Waste List.

2.4.3 Additional Codes for Classifying Hazardous Waste

In addition to the New Zealand hazardous waste definition and the Waste List, a series of codes can be used to classify a waste to describe its life cycle. These codes include the H-Code (hazardous characteristics code) and the so-called D (disposal) and R (recycling) Codes (Appendices A3 and A4).

2.5 National Indicators for Hazardous Waste

2.5.1 Background

National indicators for hazardous waste are presented in MfE's document "Confirmed indicators for solid waste, hazardous waste and contaminated sites"[2]. A summary of indicators for hazardous waste is provided in Table 1. There are two key indicators: HW1 and HW2. HW1 covers the quantity of hazardous waste disposed of, treated or exported. HW2 covers the quantity of priority hazardous waste generated and stored.

The indicators for hazardous waste are further divided into stages – Stage 1 and Stage 2. Stage 2 indicators are not planned to come on stream until regulations on hazardous waste, covering requirements for record keeping and reporting to regulatory agencies, are in place. Given the current absence of such a system, this survey focused on providing information on Stage 1 indicators.

[2] Confirmed indicators for solid waste, hazardous waste and contaminated sites, 2000. Ministry for the Environment, Wellington

Table 1 Ministry for the Environment confirmed hazardous waste indicators

Stage/ Indicator	Indicator
1/HW1	Quantity of hazardous waste: • accepted at landfills • exported (under Basel Convention) • accepted at treatment facilities • accepted at wastewater treatment facilities
1/HW2	Quantity of priority hazardous waste generated and stored: • imported • transported • discharged to sewer • discharged to land, air and water (On site as defined from the list)
2/HW1	Quantity of hazardous waste discharged to land/air and water. This includes waste: • accepted at landfills • exported (under Basel Convention) • accepted at treatment facilities • accepted at wastewater treatment facilities (Collected under national hazardous waste definition and national hazardous waste monitoring and information systems)
2/HW2	Quantity of priority hazardous waste generated and stored: • required by regulation via National Environmental Standard (Manifest or other system) • storage (possibly minimum thresholds or type of facility) • diffuse sources or WAP methodology (Collected under national hazardous waste definition and national hazardous waste monitoring and information systems)

Note: HW = hazardous waste

Chapter 3: Survey Methodology

3.1 Overview

Hazardous waste typically undergoes a "life cycle" from generation, through different stages such as storage, treatment, recycling, reuse or recovery, to final disposal (including end use or export to other regions or countries). Figure 1 shows an overview of this life cycle.

Often, a hazardous waste will change "ownership" throughout this life cycle, and may therefore be difficult to track and collect information on. The objective of a hazardous waste survey is to capture hazardous waste at critical points in its life cycle, so that as far as possible, a complete picture of the industries, and the types and quantities of hazardous waste involved, can be formed. The term "industry" has been applied in this study to all organisations – commercial or public – with the potential to generate hazardous waste.

For survey design purposes, industries in the two regions were divided into two groups. The first group covered those industries with the potential to generate hazardous wastes ("hazardous waste generators", or "generator" for short). The second part covered businesses involved with hazardous waste as part of their business operations ("hazardous waste operators", or "operator" for short), including hazardous waste treatment plants and disposal facilities such as incinerators, landfills and wastewater treatment plants.

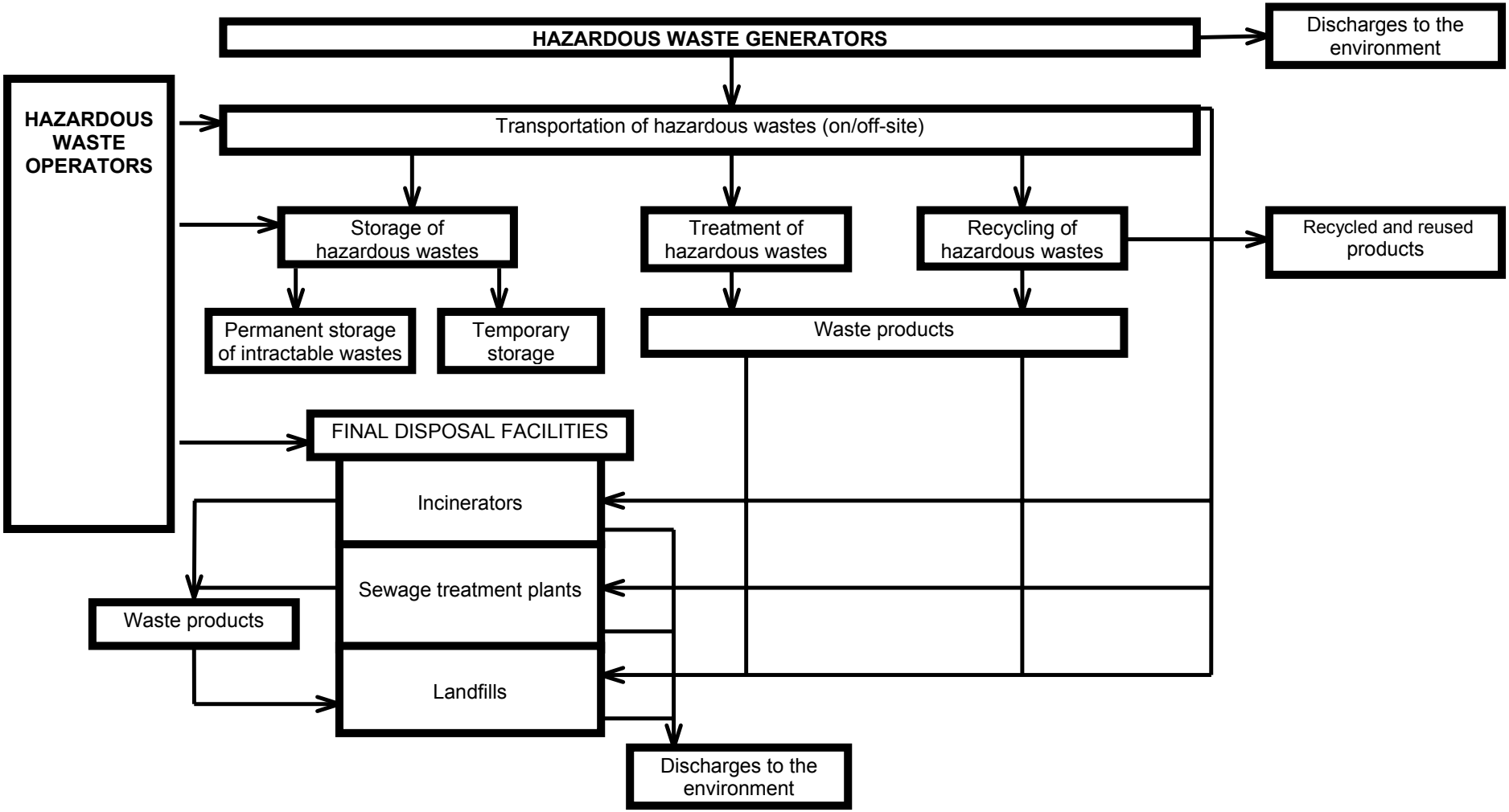
3.2 Study Area

The area covered by the hazardous waste survey was defined by the regional boundaries of Environment Bay of Plenty and Environment Waikato, respectively. This area was expanded to capture hazardous waste operators distributed throughout the remainder of New Zealand, where these operators were involved in either the import from, or export of hazardous waste, to the two regions covered by the survey.

3.3 Target Industry Sectors and Hazardous Waste

In developing the methodology for the survey, a systematic approach to categorising industries and hazardous waste was required, so that the methodology and the information generated were based on commonly understood denominators.

Figure 1: Hazardous waste life cycle



3.3.1 Australia and New Zealand Standard Industry Classification (ANZSIC) Code

Statistics New Zealand uses the ANZSIC (Australia and New Zealand Standard Industry Classification) Code for categorising industrial activity information in New Zealand. The Code is based on seventeen main industry divisions (Table 2), and a six-digit coding system to describe industries to a progressively more precise level. Because of its wide and official use within New Zealand, it was decided to adopt the Code for the classification of industries in the survey.

All major ANZSIC divisions were included in the survey, with the exception of Division H (accommodation, cafes and restaurants), Division J (communication services) and Division K (finance and insurance), as these divisions were thought to have a low likelihood of generating significant quantities of hazardous waste.

Table 2 ANZSIC main industry divisions

Category	Description
A	Agriculture, forestry and fishing
B	Mining
C	Manufacturing
D	Electricity, gas and water supply
E	Construction
F	Wholesale trade
G	Retail trade
H	Accommodation, cafes and restaurants
I	Transport and storage
J	Communication services
K	Finance and insurance
L	Property and business services
M	Government administration and defence
N	Education
O	Health and community services
P	Cultural and recreational services
Q	Personal and other services

From the remaining divisions, all industry categories considered likely to generate, store or dispose of hazardous waste were selected - either because of the types of processes or raw materials involved, or because they had the potential to generate or be involved with the storage or disposal of hazardous waste.

An overview of business and employment information for New Zealand (1999 and 2000) by ANZSIC Code is shown in Appendix B. Shading highlights those ANZSIC industry categories that were identified by the Project Control Group as likely to be involved with hazardous waste.

3.3.2 Target Hazardous Waste

The Ministry for the Environment draft definition of hazardous waste and the associated New Zealand Waste List (refer section 2 and Appendix A) formed the basis for determining whether a waste was hazardous or not for the purposes of the survey and to classify hazardous waste into unique categories.

The project control group further adapted this definition, as follows:

(a) Organic waste (or high BOD waste) was excluded, unless a particular waste stream fell under the New Zealand definition because of other hazardous properties.

(b) Raw or partially treated sewage (for example, from septic tank cleaning) was included, as the draft New Zealand definition of hazardous waste includes infectiousness as one of its parameters. Sludges from sewage treatment plants were also included, as these are known to contain hazardous contaminants such as metals.

(c) Aqueous liquid hazardous wastes such as trade wastes discharged to sewer were included in the survey. The requirement was that these should be recorded as total mass of hazardous constituent (where such information was available).

(d) Authorised discharges to the environment under the Resource Management Act 1991 (RMA) were excluded from the survey (these were deemed to be already adequately managed in terms of potential environmental effects and risks).

(e) Special waste disposed of at landfills was deemed to be intrinsically hazardous, even if these landfills meet 'non-hazardous' disposal requirements.

3.4 Availability of Business Information

One of the key requirements for the survey was to obtain reliable information on the categories and numbers of industries present in the two regions, as well as on employee numbers as a measure of industry size. Another requirement was to obtain contact details so that individual industries could be contacted for the survey.

3.4.1 Statistics New Zealand

Statistics New Zealand (SNZ) is the main government-funded database on business activities and associated employment in New Zealand. It is legally mandatory for new and existing businesses to supply information on the main activities they engage in, and on the number of persons employed. As a result, the SNZ database is the most complete business database on industrial activities and related employment figures in New Zealand.

SNZ uses the ANZSIC Code for categorising industrial activity information in New Zealand. Summary information can be purchased from SNZ based on a range of geographic units such as mesh blocks, area units (equivalent to suburbs) or the political boundaries of territorial authorities and regional councils.

However, due to privacy legislation, business information supplied by SNZ does not include the name, address, or other contact details for individual businesses.

Consequently, while the SNZ database is ideal for assessing the total number of businesses units in a geographical area and to form the basis for survey design, it is not suitable for drawing a sample for a survey because of the lack of required contact details.

SNZ data was purchased for the survey in order to provide a benchmark of the total number of industries and employees for the two regions and for each ANZSIC category identified in Appendix B. These data were to be used to develop the industry sample for the survey, and for predicting total waste quantities across the whole industry population.

It is noted that SNZ data for the year 2000 (the latest data available in 2001) excluded any information on ANZSIC sub-division A01 (agricultural production). While it is acknowledged that this sub-division generates potentially hazardous waste in significant quantities, it was too large a business population to be covered by the scope of this survey, and may need to be addressed separately at a later stage.

3.4.2 Universal Business Directory

The Universal Business Directory (UBD) is a privately run business database. Listing is free and UBD has consultants throughout New Zealand permanently soliciting businesses to list in the directory.

Unlike the SNZ database, UBD does not use local authority political boundaries to define regions and districts. While the boundaries used for the different regions are similar, adjustments need to be made manually to align them.

One of the major advantages is that UBD business information is classified based on the ANZSIC Code, contains employee numbers and can be purchased commercially. In contrast to SNZ information, names and addresses of businesses by ANZSIC Code and employee numbers can be supplied.

Some of the disadvantages of the UBD database include:

- As listing is not mandatory, the UBD database only covers a fraction of the businesses covered by SNZ. This fraction may vary regionally and is dependent on the efforts and the success of consultants working for the directory and the ease with which individual businesses can be accessed
- Because it is not updated annually like the SNZ database, errors may occur in the UBD database as a result of businesses that have changed location, have gone out of business, have incorrect contact details or duplicate listings. This can result in so-called “dirty” listings.

Because of the compatibility of the SNZ and UBD data in terms of the ANZSIC Code and employee numbers, the UBD directory information was used as the main information source for generating industry contacts for the survey.

3.4.3 Telecom Yellow Pages

The business information contained in the Yellow Pages is not categorised according to the ANZSIC Code and excludes information on employment. Because of the lack of compatibility with the SNZ database, the Yellow Pages were of limited value for drawing a sample for the survey (except for purposes of supplementing and providing business information for the survey of hazardous waste operators).

Similar disadvantages to those outlined for the UBD database apply to the Telecom Yellow Pages.

3.4.4 Other Information Sources

A range of other information sources was identified for access to possible information on hazardous waste for the purpose of a hazardous waste survey. These included:

- Landfill operator records.
- District council trade waste records.
- District and regional council resource consent records.
- Discussions with district and regional council staff.
- Discussions with other businesses that generate, treat, transport or dispose of hazardous waste.

3.4.5 Selection of Industry Information for the Survey

Following an evaluation of the available information sources, the SNZ and UBD databases were used as the primary information sources because:

(a) The SNZ database provides a full record of business statistics in the two regions, which can be used to extrapolate information over the full business population.

(b) Both SNZ and UBD data are categorised according to ANZSIC Code and employee numbers.

(c) The UBD database comprises the names and contact details for industries in the two regions.

(d) Information for both databases is available as EXCEL spreadsheets, which facilitates generation of survey statistics and samples for the survey.

3.4.5.1 New Zealand Statistics Information

NZS data on industries with the potential to be involved with hazardous waste in the two regions in the year 2000 are shown in Tables 3 and 4 (this data includes information on hazardous waste generators and operators). This information is grouped into the number of business units (that is, individual industries) and ranges of employee numbers. The reason for this breakdown is that it was assumed that there was a likely relationship between employee numbers and related production/activity, and hence associated hazardous waste quantities.

Table 3 Numbers of businesses (generators and operators) and employees potentially involved with hazardous waste in the Bay of Plenty region (Source: Statistics New Zealand)

Business Category	Code description	Number of business units					Number of full-time equivalent staff employed				
		EMPLOYEE RANGE									
		1-10	11-20	21-50	>51	TOTAL	1-10	11-20	21-50	>51	TOTAL
A	Agriculture, forestry and fishing	755	45	19	5	824	1,319	645	530	460	2,965
B	Mining	7	0	1	0	8	21	0	45	0	66
C	Manufacturing	1,177	91	87	38	1,393	3,151	1,237	2,700	5,085	12,219
D	Electricity, gas and water supply	14	2	1	1	18	35	25	35	230	319
E	Construction	896	38	12	3	949	1,882	527	350	240	3,005
F	Wholesale Trade	177	17	6	3	203	535	225	195	210	1,180
G	Retail Trade	519	28	2	0	549	1,690	355	45	0	2,060
I	Transport and storage	636	35	17	8	696	1,500	493	505	600	3,084
L	Property and business services	337	9	6	3	355	637	135	170	490	1,420
M	Government administration and defence	62	22	12	7	103	240	312	420	690	1,672
N	Education	66	33	55	18	168	323	503	1,595	1,905	4,315
O	Health and community services	685	30	19	10	744	1,486	445	630	2,345	4,925
P	Cultural and recreational services	8	5	1	0	14	12	70	45	0	123
Q	Personal and other services	490	13	10	3	516	1043	162	300	350	1,890
Business potentially involved with HW		**5,825**	**368**	**248**	**99**	**6,540**	**13,874**	**5,134**	**7,565**	**12,605**	**39,243**
Total businesses		**17,947**	**780**	**424**	**151**	**19,302**	**36,620**	**10,871**	**12,875**	**16,995**	**77,592**
% of businesses potentially involved with HW		**32%**	**47%**	**48%**	**65%**	**34%**	**38%**	**47%**	**59%**	**74%**	**57%**

HW = Hazardous Waste

Table 4 Numbers of businesses (generators and operators) and staff employed potentially involved with hazardous waste in the Waikato region (Source: Statistics New Zealand)

ANZSIC division	Code description	Number of business units					Number of full-time equivalent staff employed				
		EMPLOYEE RANGE									
		1-10	11-20	21-50	>51	TOTAL	1-10	11-20	21-50	>51	TOTAL
A	Agriculture, forestry and fishing	1,233	33	21	5	1,292	1,870	430	700	595	3,575
B	Mining	19	4	3	4	30	60	50	110	270	488
C	Manufacturing	1,701	149	103	71	2,024	4,796	2,090	3,165	9,655	19,812
D	Electricity, gas and water supply	43	5	7	4	59	113	80	250	310	745
E	Construction	1,128	27	32	8	1,195	2,410	356	960	650	4,385
F	Wholesale Trade	337	21	11	1	370	845	289	290	55	1,460
G	Retail Trade	774	45	6	0	825	2,570	575	170	0	3,330
I	Transport and storage	832	49	26	6	913	1,897	670	760	450	3,771
L	Property and business services	417	12	10	9	448	785	165	320	1,140	2,430
M	Government administration and defence	130	26	17	16	189	473	365	550	1,690	
N	Education	178	66	75	26	345	971	985	2,380	3,800	8,150
O	Health and community services	968	39	30	17	1,054	2,028	529	990	3,800	7,355
P	Cultural and recreational services	12	2	5	0	19	21	30	150	0	200
Q	Personal and other services	662	23	12	3	700	1360	306	340	445	2450
Business potentially involved with HW		**8,434**	**501**	**358**	**170**	**9,463**	**20,199**	**6,920**	**11,135**	**22,860**	**61,247**
Total businesses		**25,366**	**1,101**	**618**	**250**	**27,335**	**51,182**	**15,139**	**18,845**	**30,320**	**115,658**
% of businesses potentially involved with HW		**33%**	**46%**	**57%**	**68%**	**35%**	**39%**	**46%**	**59%**	**75%**	**53%**

HW = Hazardous Waste

The tables show that in the Waikato region, there were approximately 9,127 businesses with the potential to be involved with hazardous waste, comprising a total of 56,827 employees. In the Bay of Plenty region, there were approximately 6,387 businesses with the potential to generate hazardous waste, comprising a total of 36,503 employees.

In both regions, businesses with the potential to generate hazardous waste represented approximately 33% of total business numbers. However, numbers of industries with the potential to generate hazardous waste were found to increase with employee numbers, reaching 60% for businesses exceeding 50 employees. Therefore, large businesses were more likely to generate hazardous waste.

There were 459 large businesses with more than 20 employees each in the Waikato region and 291 in the Bay of Plenty region. These businesses represented approximately 5% of all businesses with the potential of being involved with hazardous waste in both regions, but were also anticipated to produce significant quantities of hazardous waste in relative terms.

3.4.5.2 Universal Business Directory Information

Summary information derived from the UBD database for the two regions is provided in Table 5. This table also provides a comparison with relevant SNZ data, as shown in Tables 3 and 4.

Table 5 shows that the SNZ database provides far more complete information on industries in the two regions compared to the UBD directory. The UBD directory on average covered between 47% and 49% of industries covered by SNZ with the potential to be involved with hazardous waste.

Comparative coverage for the larger industries was much higher, ranging from 63% to 99% for companies with employee numbers exceeding 20). By comparison, the UBD directory covered on average 50% of the SNZ database for industries companies with less than eleven employees.

Table 5 UBD directory information on industries with the potential to generate hazardous waste in the Waikato and Bay of Plenty regions

Employee numbers	Waikato Region		Bay of Plenty Region	
	Number of businesses (% SNZ)	Number of employees	Number of businesses (% SNZ)	Number of employees
0 to 10	3,488 (41%)	11,284	2,505 (43%)	8,026
11 to 20	392 (78%)	5,691	245 (67%)	3,500
21 to 50	226 (63%)	7,181	156 (63%)	5,122
>51	120 (71%)	4,488	98 (99%)	3,468
Total	4,226 (47%)	31,876	3,004 (49%)	23,146

3.5 Sampling Design

3.5.1 Hazardous Waste Generator Survey

3.5.1.1 Background

There were comparatively few hazardous waste operators in the two regions to be surveyed and it was economical to survey all of these. In contrast, there were thousands of hazardous waste generators in the two regions. Because of budget constraints it was necessary to take a sub-sample from the total industry population generating hazardous waste that was statistically robust and representative, and that allowed total generated hazardous waste quantities to be estimated across the entire industry population.

Overall, the design of the hazardous waste generator survey was driven by the need to generate statistically robust and representative data, while remaining within the given budget constraints. Hence, a careful statistical sampling design was required. As a result, statistical experts from the University of Auckland were called in to assist with this process.

3.5.1.2 Previous Auckland Region Hazardous Waste Surveys

As part of the statistical design process, it was necessary to establish information on the likely variability of data generated be a hazardous waste survey. Initial guidance was obtained from data generated in earlier surveys of hazardous waste in the Auckland region in 1990[3] and again in 1995/96[4]. Both surveys were based on different approaches and definitions of hazardous waste, but helped to yield useful comparative information on the nature of hazardous waste data and their variability.

The 1990 survey showed that industries within the manufacturing, transport, and community/social industries appeared to contribute to over 95% of the total quantities of hazardous waste found by the survey. As a result, the 1996 survey focused on these particular industrial activities. Among these industries, it was found that manufacturing industries generated over 99% of the hazardous waste generated.

The 1996 survey also provided key information on the relative quantities of hazardous waste generated by different industry divisions, and the statistical variability of hazardous waste data. The extent of data variability was influenced significantly by “diluted liquid hazardous (or trade) waste”, which had been included in the survey by definition, and which made up 98% of the total quantities of hazardous waste generated.

Approximately 50% of trade waste quantities surveyed in the Auckland 1996 survey were made up of high strength liquid organic wastes. These were specifically excluded from the definition of hazardous waste in survey of the Bay of Plenty and Waikato regions. As a result, the Auckland 1996 data was re-evaluated by excluding these wastes.

Table 6 shows a summary of hazardous waste data for the Auckland 1996 survey, grouped by the NZSIC code (the precursor to the ANZSIC Code) and ANZIC code. This table shows the quantities of hazardous waste generated by each industrial

[3] Auckland Regional Council 1990: Regional waste survey. Prepared by Royds Garden Ltd.

[4] Auckland Regional Council 1996: The Auckland Region hazardous waste survey 1996. Prepared by Environment and Business Group Ltd and the Auckland Regional Council.

sub-division surveyed, together with information on the variability of that data. The table shows that there is a range of waste quantities and associated variabilities in different industrial sub-divisions.

Table 6 also shows that ANZSIC Division C (Manufacturing) exhibited the greatest quantities, averages and standard deviations (a statistical measure of variability) compared to other major divisions. It was assumed that similar data could be expected for the Bay of Plenty and Waikato regions, and that therefore this division had to be sampled at a proportionately higher level compared to the other divisions.

3.5.1.1 Statistical Design

(a) **Overview**

The key objective for the generator survey was to estimate, as precisely as possible, the total amount of hazardous waste generated in the two regions, and to provide information on the quantity and variation of hazardous waste generated to the lowest industrial division possible. It was also intended to provide a model design that could be applied to other regions in New Zealand.

Key limitations for the survey design included:

- The high level of variability of hazardous waste data collected during the Auckland 1996 hazardous waste survey
- The requirement to use representative hazardous waste data collected in the survey to estimate total hazardous waste quantities in the two regions
- Budget limitations which determined that only a certain number of hazardous waste generators could be surveyed in each region
- The need to use the UBD database as the sampling frame for the survey, which was known to represent only a fraction of the target sampling population as determined by the SNZ database.

The high level of data variability observed in earlier surveys indicated the need to divide the industry population into a few large groups from which samples could be drawn to maximise the precision and robustness of the estimators produced. Hence, the need to use survey information for predictive purposes resulted in the loss of detail on total hazardous waste quantities and types generated by lower level industry categories. This was accepted as one of the drawbacks at the outset of the study.

(b) **Overview of Stratified Cluster Sample Design**

Taking into account the study objectives and the limitations outlined above, the statistical design for the generator survey was based on a **Stratified Cluster Sample Design**. In this design, the overall generator population is divided into a series of defined strata, each predicted to produce a cluster of waste streams in either gaseous, liquid, sludge or solid form. The following strata were chosen:

- Region.
- Industry type.
- Size of industry (assessed employee numbers <= 20 and >20).

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Table 6 Auckland region 1996 hazardous waste survey – information on waste quantities and variabilities

NZSIC Code	ANZSIC Code	Description	Number of companies	Number of waste streams	Total quantity (tonnes)	Average (tonnes)	Standard deviation	Coefficient of Variation(1)
31	C21	Food, beverage, tobacco manufacture	34	54	208,215	3,856	16,614	431%
32	C22	Textiles, apparel and leather goods manufacture	14	25	173,687	6,947	14,212	205%
33	C23	Wood processing and wood product manufacture	34	61	4,597	75	284	377%
34	C24	Manufacturing of paper and paper products; printing and publishing	50	119	210	2	5	303%
35	C25	Manufacture of chemicals and chemical, petroleum, coal, rubber and plastic products	80	147	59,376	404	1,926	477%
36	C26	Concrete, clay, glass, plaster, masonry, asbestos and related mineral product manufacture	13	21	87,444	4164	13,169	316%
37	C27	Basic metal industries	11	52	1,832,316	35,237	207,708	589%
38	C28	Manufacture of fabricated metal products, machinery and equipment	125	223	23,477	105	743	706%
39	C29	Other manufacturing industries	3	3	0.01	0.00233	0.00153	65%
7	I	Transport and storage	36	69	3,937	57	223	391%
91	M	Public administration and defence	1	5	37	7	13	179%
92	N	Sanitary and cleaning services	10	13	15	1	3	226%
93	O	Social and related community services	104	257	1,429	6	57	1027%
94	P	Recreational and cultural services	3	7	260	37	77	208%
95	Q	Personal and household services	71	161	9127	57	497	877%
Grand Total			**589**	**1,217**	**2,404,129**	**1,975**	**43,360**	**2,195%**

(1) Coefficient of variation: the ratio of the standard deviation over the mean in percent; that is a measure of the degree of variability around the mean

The division of data into regions was necessary because the two regional councils required information that was specific to each region, for the purpose of reporting, as well as developing policy and programmes for hazardous waste management.

As discussed in section 3.5.1.3 (a), there was a need to divide the total industry population into a few groups that allowed a statistically representative and robust sample to be taken. To this end, ANZSIC industry divisions and sub-divisions were grouped into a series of **study categories**. This grouping into study categories was based on:

- The intention to generate representative data, it was decided to survey all major ANZSIC divisions (with the exception of Division H [accommodation, cafes and restaurants], Division J [communications services] and Division K [finance and insurance]
- The similarity of industrial activity and the potential to generate hazardous waste (refer to Appendix B for those ANZSIC industry codes with the potential to create hazardous waste)
- The similarity of waste quantities generated and associated variabilities, as established in previous Auckland hazardous waste surveys (refer Table 6).

Table 7 shows the study categories that were created in this way for the generator survey, and the allocation of ANZSIC divisions and sub-divisions into these categories. Manufacturing industries were divided into three study categories, based on the comparatively large quantities of waste produced by these industries, and inherent high levels of variability observed in the Auckland Region 1996 survey. Appendix C shows a more detailed breakdown of the grouping of the individual ANZSIC sub-divisions into these study categories

Table 7 Major study categories chosen for generator survey

Study category	ANZSIC Codes		Abbreviated Definition
A	A	Agriculture, hunting and trapping	Agriculture etc
B	B	Mining	Mining
Ca	C27	Metal product manufacturing	Metal product manufacturing
Cb	C21	Food, beverage and tobacco manufacturing	Food, textile and non-metallic manufacturing
	C22	Textile, clothing, footwear and leather manufacturing	
	C26	Non-metallic mineral product manufacturing	
Cc	C23	Wood and paper product manufacturing	Wood, machinery and other manufacturing
	C24	Printing, publishing and recorded media manufacturing	
	C25	Petroleum, coal, chemical and associated product manufacturing	
	C28	Machinery and equipment manufacturing	
	C29	Other manufacturing	
D[5]	D	Electricity, gas and water supply	Electricity, gas and water supply
E	E	Construction	Construction

[5] Note that any hazardous waste operators in this category are excluded and surveyed separately.

Study category	ANZSIC Codes		Abbreviated Definition
F	F	Wholesale trade	Wholesale trade
G	G	Retail trade	Retail trade
I	I	Transport and storage	Transport and storage
L	L	Property and business services	Property and business services
O	O	Health and community services	Health and community services
Q	Q	Personal and other services	Personal and other services
Za[6]	M	Government administration and defence	Government, education
	N	Education	
	P	Cultural and recreational services	

Based on an evaluation of SNZ data (refer Tables 4 and 5), it was also decided to split the sample population into industries with equal or less than, or over 20 employees. Industries with more than 20 employees ("large" industries) had been found to comprise approximately 5% of the total sample population, and were anticipated to have a much higher likelihood of generating hazardous waste.

It was also anticipated that many of these large industries were more likely to be one-off facilities and thus more likely to generate a higher level of variability. It was therefore decided to survey all large industries in the two regions, except for those study categories where no significant linkage was expected between industry size and hazardous waste generation (study categories F, G and Za).

(c) **Sample Allocation**

The size of the sample drawn in each survey category was derived from the formula for optimal allocation of samples in stratified sampling. Based on this formula, sample size is proportional to the product of the number of firms in each stratum and the standard deviation of the quantity of hazardous waste generated by that stratum (based on the 1996 Auckland survey). For those industry divisions not surveyed in 1996, a standard deviation was used that was based on the least variable sectors in the 1996 survey. This was based on information from the Auckland 1990 survey that these divisions appeared to generate minor quantities of hazardous waste.

The final generator sample was determined with the **optimal sample allocation formula**. Denoting the total number of firms in stratum or study category *i* by N_i, and the standard deviation by s_I, the fraction of the total sample of size *n* to be taken in stratum or study category *i* is given by n_i where $n_i = n \times fraction_i$ or

$$n_i = n \times \frac{N_i s_i}{N_A s_A + N_B s_B + \cdots + N_{Za} s_{Za}}$$

Based on budget limitations and an estimate of how long it might take to survey an individual industry, a range of scenarios was worked through assuming a sample of 1,200, 1,600 and 1,800 generators. This was evaluated against budget constraints and the need to achieve a minimum coverage for the two regions based on the expected data variability.

In summary, sampling design was based on the following factors:

[6] Local Government agencies are excluded and surveyed as hazardous waste operators.

1 An optimal sample number of 1,600 was chosen, distributed between the Bay of Plenty and Waikato regions in proportion to SNZ statistics.

2 The actual sample was drawn from the UBD database, which constituted the sampling frame, and which provided the necessary contact details for industries for surveying purposes.

3 All large industries with more than 20 employees covered by the UBD Directory were surveyed, while a statistically representative and random sample was taken from remaining businesses. The only exceptions to this were study categories F (wholesale trade), G (retail trade) and Za (government administration and defence, education, and cultural and recreational services) for which no distinct relationship between employee numbers and hazardous waste quantities was expected.

4 Because of the historically high levels of variability of hazardous waste quantities in study categories Ca (metal product manufacturing) and Cb (food, textile and non-metallic mineral manufacturing) it was decided to sample all industries covered by the UBD database with equal or less than 20 employees in these study categories.

5 Sample numbers for the remaining study categories were made on a relative basis using the optimal sample allocation formula.

6 Minimum sample size was 10, except where the UBD database had industry listings of less than 10.

Based on the above assumptions, the sample allocations for hazardous waste generators in the Bay of Plenty and Waikato regions are shown in Table 8.

Further details on sampling design and the application of the optimal sample allocation formula is shown in Appendix J.

(d) **Sampling Design Constraints**

Table 8 shows that even though it was intended to sample all industries, in reality the UBD database (which was used to draw the sample) covered only a fraction of the Statistics New Zealand database (which was used to estimate the full survey population). In addition, a number of industries could not be surveyed. This resulted in a number of constraints for the sampling design, as follows:

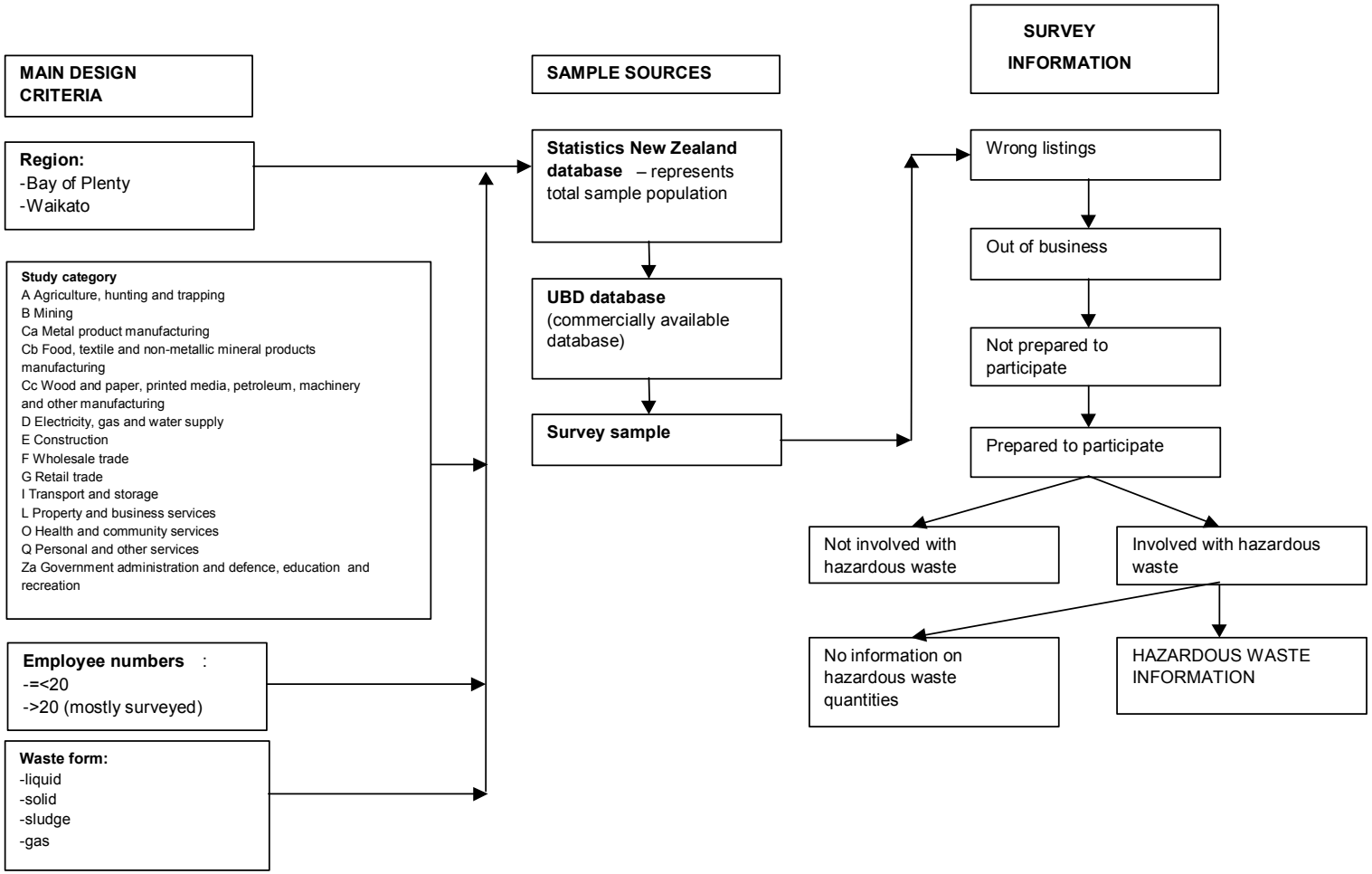
- The respondent was wrongly listed or listed in duplicate.
- The respondent had gone out of business.
- The respondent elected not to participate or was too busy.
- The respondent did not know whether the industry generated any hazardous waste.
- The respondent had no or insufficient information on hazardous waste generated by the industry.

Figure 2 shows an outline of the generator survey design and associated constraints as outlined above.

Table 8 Sample allocation for hazardous waste generators

Study category	Abbreviated definition	SNZ database		UBD Directory		No of samples required	
Waikato Region / employee range		**0-20**	**>20**	**0-20**	**>20**	**0-20**	**>20**
A	Agriculture etc	1,266	26	109	8	26	8
B	Mining	23	7	8	1	8	1
Ca	Metal product manufacturing	334	22	173	15	173	15
Cb	Food, textile and non-metallic manufacturing	344	55	250	37	250	37
Cc	Wood, machinery and other manufacturing	1,172	97	813	69	143	69
D	Electricity, gas and water supply	48	11	36	6	10	5
E	Construction	1,142	40	213	12	24	12
F	Wholesale trade	358	12	90	7	10	0
G	Retail trade	819	6	524	4	17	0
I	Transport and storage	881	32	201	25	21	25
L	Property and business services	429	19	140	10	10	10
O	Health and community services	1,007	47	514	25	21	25
Q	Personal and other services	583	5	405	4	29	4
Za	Government, education etc	339	124	351	107	10	0
Sub-Total		**8,780**	**512**	**3,827**	**330**	**752**	**211**
Bay of Plenty Region / employee range		**0-20**	**>20**	**0-20**	**>20**	**0-20**	**>20**
A	Agriculture etc	800	24	64	4	12	4
B	Mining	7	1	5	1	5	1
Ca	Metal product manufacturing	208	9	174	9	174	9
Cb	Food, textile and non-metallic manufacturing	200	36	167	24	167	24
Cc	Wood, machinery and other manufacturing	860	80	607	58	79	58
D	Electricity, gas and water supply	16	2	18	3	10	3
E	Construction	926	14	202	4	14	4
F	Wholesale trade	194	9	50	7	10	0
G	Retail trade	547	2	373	1	10	0
I	Transport and storage	671	25	168	27	12	27
L	Property and business services	346	9	100	5	10	5
O	Health and community services	715	29	340	13	11	13
Q	Personal and other services	438	5	286	3	16	3
Za	Government, education etc	168	90	162	87	10	0
Sub-Total		**6,193**	**347**	**2,714**	**246**	**540**	**151**
TOTAL		**14,973**	**859**	**6,541**	**576**	**1,292**	**362**

Figure 2 Generator survey design and information generation



3.5.2 Hazardous Waste Operator Survey

Hazardous waste operators include businesses involved with the handling of hazardous waste, such as transport, storage, treatment and recycling/reuse, but also facilities involved in the final disposal of hazardous waste, such as landfills, sewage treatment plants and incinerators. The survey also covered businesses that export hazardous waste to other regions and overseas.

3.5.2.1 Hazardous Waste Operators in the Bay of Plenty, Waikato and other New Zealand Regions

Because of the relatively small number of hazardous waste operators in the Bay of Plenty and Waikato regions, all were included in the survey. In the more rural regions of New Zealand, district councils play a pivotal role in managing a range of hazardous waste related operations, in particular landfills, sewage treatment plants and waste transfer stations. They are also involved with hazardous waste collections from the agricultural and domestic sectors, and export of hazardous wastes to other regions or overseas. They were therefore considered to be hazardous waste operators.

The project brief required import and export of hazardous waste into and from the two regions to be recorded. In order to capture these data it was necessary to survey hazardous waste operators outside of the two regions as well.

Three main information sources were used to identify hazardous waste operators: Statistics New Zealand (SNZ), UBD and the Yellow Pages. To ensure that all hazardous waste operators inside and outside of the two regions were captured, the form used for the survey incorporated questions on the details of waste operators used by industries generating hazardous waste. This information was to be used to complement the information collated from the UBD and Yellow Pages databases.

In all, SNZ reported 117 businesses, UBD 107 businesses and the Yellow Pages 102 businesses for the Waikato, Bay of Plenty and Auckland Regions (where a major proportion of hazardous waste was expected to go). UBD reported some 384 companies involved in waste in the North Island (excluding the Bay of Plenty and the Waikato). The Yellow Pages reported some 250 companies. Approximately 72 of these were assessed as potentially involved with hazardous waste.

3.5.2.2 Information needed on Wastewater Treatment Plants and Landfills

Generally, information on hazardous waste operators was obtained in the same way as for the generators (that is, based on a standard survey questionnaire). However, wastewater treatment plants (in particular, sewage treatment plants) and landfill operations needed special consideration.

Sewage treatment plants typically receive mixed and diluted inflows from domestic and industrial (trade waste) sources. Records on trade and domestic contribution are often not available in rural regions due to the absence of a trade waste bylaw and licensing system. Therefore, it was decided that liquid hazardous waste flowing into sewage treatment plants needed to be recorded as a contaminant mass flow. This required obtaining information on contaminant concentrations and flow volumes of both trade and domestic inflows, and subtracting one from the other to obtain contaminant mass flows derived from trade waste sources.

Landfills normally receive hazardous waste in the form of “Special Waste”, that is, pre-treated hazardous waste. It was assumed that special waste was hazardous in terms of the definition of hazardous waste (even though it may be deemed non-hazardous for land filling purposes).

3.6 Survey implementation

3.6.1 Consultation and Publicity

3.6.1.1 Background

As part of developing the methodology for the hazardous waste survey of the Bay of Plenty and Waikato regions, a public information strategy was developed to ensure wide dissemination of information about the survey and a high level of response to the survey.

The public information strategy aimed at improving the response rate and quality of responses through:

- Advising the target audience of the fact that a hazardous waste survey was to be carried out in the two regions
- Explaining the purpose and objectives of the survey
- Priming the target audience on the nature and detail of information required
- Providing information on the results of the survey and how they were to be used.

The anticipated outcomes were to:

- Enlist the goodwill and support of the community and businesses to participate in the survey
- Raise awareness and knowledge on hazardous waste and associated issues
- Ensure that the survey generated high quality information on hazardous waste.

The target audience was identified as follows:

- Regional council officers involved with solid and liquid hazardous waste
- Territorial council officers involved with solid and liquid hazardous waste
- Private waste operators
- Relevant business and trade organisations
- Key hazardous waste generators
- All businesses potentially involved with hazardous waste
- The wider community.

Key messages disseminated during the public information campaign included:

- A request to assist Environment Bay of Plenty and Environment Waikato to collect information on hazardous waste in the two regions, in an effort to better manage this waste and avoid adverse environmental effects in the future
- Assistance to businesses with identifying hazardous waste and providing information on how to treat/dispose of hazardous waste
- Timing of survey
- Explanation of confidentiality issues.

3.6.1.2 Information Dissemination

The following channels were selected to disseminate information about the survey:

- Media releases through regional and local newspapers, regional and territorial council newsletters, business/trade association publications as well as local TV and radio stations.
- Workshops (targeted at both hazardous waste generators and operators).
- The survey itself.

A media release was circulated about one week before the commencement of the survey, covering all key regional media including daily and weekly newspapers, and radio stations. Several radio interviews were carried out with the manager of the Project Control Group.

In addition to the media releases, four information workshops were held for a selected number of hazardous waste generators and operators in both Hamilton and Tauranga. These workshops reached a relatively small fraction of the generator and operator population. However, the feedback provided valuable information for improving the survey methodology and materials.

The survey itself was an essential element of the public information strategy, as part of the role of the surveyors involved was to disseminate information on hazardous waste and educate businesses in this process.

A range of information sources was prepared as part of the materials developed for the survey that could be used to inform and educate businesses about the survey. This included a one-page flyer about the survey. Each surveyor was also given a list of contacts to pass on to businesses that had expressed an interest in obtaining more information.

3.6.2 Survey Process

3.6.2.1 Background

This section provides an overview of the process developed for the survey. This covers:

- Selection of surveying methods
- Confidentiality
- Surveyor selection
- Surveyor training
- Sample generation
- Survey process
- Data management
- Quality control.

3.6.2.2 Adopted Surveying Methods

The following survey methods were adopted:

- Telephone survey using a standard form

- Faxing/mail-out of questionnaire where necessary.

Telephone surveys are a useful tool for gathering quantitative and qualitative information, as probability-based sampling procedures can be implemented even for large populations. They are generally seen as the most efficient way of surveying because of the speed with which the target audience can be reached and the minimisation of any time and costs associated with travel.

Other techniques, such as the mail-out of questionnaires or the drop-off/pick-up of questionnaires rely on a positive response from the businesses. Generally, the response to mail-outs is poor, as shown by the 3% return rate obtained from the mail out of questionnaires during the 1990 Auckland hazardous waste survey.

On-site auditing and interviewing was also rejected even though originally considered, mainly because of the high cost involved and the time constraints for completing the survey, especially in rural areas with large travel distances.

The Auckland 1996 hazardous waste survey had a very high response rate (97%) based on a telephone survey backed up by information sent out on a selective basis, and a few on-site interviews. It was therefore decided to adopt the same method for the Bay of Plenty and Waikato survey.

Despite the success of using telephone interviewing for the Auckland survey, it was expected that the response rate was going to be lower because of developments in telemarketing over the intervening period of time. Telephone surveying is becoming increasingly popular among marketers because of the above outlined reasons. As a result, more pressure is being put on potential target audiences, and their time and privacy.

The telephone survey method was expected to provide medium to high quality information. The method also enabled individual surveyors to interview several businesses of the same industry type in succession and to gradually build up industry-specific expertise on hazardous waste. This is in contrast to field surveys, where the common denominator is location and a surveyor may question a variety of businesses and industry types in one day.

3.6.2.3 **Confidentiality**

There is currently no legal requirement for businesses in New Zealand to provide information on hazardous waste. Therefore, the success of the survey relied on the goodwill and co-operation of the businesses surveyed. The preservation of confidentiality of information was recognised as very important, and one of the key factors influencing whether a business would participate or not.

In particular, assurances needed to be given that the information collected could not be used for any monitoring or enforcement purposes by the regional councils involved in the survey, or divulged to any other person or organisation.

It was expected that some businesses selected for the survey would need specific assurance of the confidentiality of the information supplied. Therefore, a confidentiality agreement was developed and signed by the managers of the two regional councils and the consultants involved in the survey (Opus International Consultants and Environment and Business Group Ltd) and sent out to businesses on request.

In addition to the above, surveyors involved in this project were also obliged to keep the information discussed over the telephone or received in the strictest confidence.

Where there was indication that illegal activities occurred – whether knowingly or unknowingly – this information was still confidential.

However, surveyors were encouraged to point any problems out to the businesses concerned, together with ideas how to rectify the problem and whom to contact in such an effort. Each surveyor was provided with a list of relevant contact persons to contact in cases where additional information needed to be provided.

3.6.2.4 Surveyor Selection

Given some of the difficulties experienced with telephone surveys and the highly technical nature of the survey subject, selection and training of the surveyors was considered to be very important. It was therefore necessary to employ surveyors with a background in a technical subject and tertiary education where possible, and preferably with experience in hazardous substances or waste management.

The survey was timed to coincide with university holidays and efforts were made to find post-graduate students with a technical background from the University of Waikato. A job description and interview script was developed to facilitate selection of people most suited to the technical and personally demanding nature of the work.

Opus International Consultants Ltd carried out interviews of potential surveyors in Hamilton. Applicants were generally found to be of a uniformly high standard and twelve surveyors were eventually selected.

3.6.2.5 Surveyor Training

An intensive one-day training course was carried out to provide the surveyors with relevant information on hazardous waste, the forthcoming survey, and the survey materials. The training course was prepared and presented by Environment and Business Group Ltd staff. Input was also sought from the National Research Bureau, a professional survey firm, for specialist training on conducting telephone surveys.

The key goals of the training course were to:

- Familiarise surveyors with the approach to the survey and the materials used.
- Familiarise surveyors with definitions of and codes used for classifying hazardous wastes.
- Convey the importance of a conscientious approach to data collection and coding.
- Enable surveyors to inform businesses of how the information would be used, if asked.
- Encourage a friendly, confident approach to businesses being interviewed.
- Provide guidance on dealing with generators unwilling to co-operate.

Emphasis was placed on the need for strict confidentiality. The surveyors were provided with a list of contact persons within regional and district councils who could be contacted if interviewees had any specific questions relating to hazardous waste and its management in the two regions.

Due to the complex technical nature of the survey, and the associated document and quality control requirements, it was anticipated that meetings and training sessions were going to be required on an ongoing basis. To this end, it was

recommended that daily meetings were held where any issues and problems could be addressed.

It was also recommended that surveyors were fully supervised for at least 50% of the time, with a supervisor available if needed for the rest of the time. It was anticipated that surveyors would require a higher level of supervision during the initial phases of the survey while becoming confident with the wide range of businesses and wastes they were encountering.

This intensive training and supportive work environment was needed to encourage the development of a strong team spirit and commitment to the survey on the part of the surveyors to ensure high quality data.

3.6.2.6 Sample selection and Generation of Industry Lists

The samples for each study category were taken from the UBD database (refer Table 7). A completely randomised sample was taken from businesses with employee numbers of less than 20. All other businesses with more than 20 employees were surveyed except those study categories where there was no expected relationship between employee numbers and hazardous waste quantities, that is, study categories F, G and Za.

Once businesses had been selected, they were then grouped into “industry lists”, that is, lists of businesses involved in the same or similar activities to simplify the work for the surveyors. Industry lists were further grouped by employment number, so that surveyors could start with small to medium sized companies first, whilst evolving their skills and experience.

Large and complex industries were assembled into separate industry lists. Both large generators and hazardous waste operators (some 80 businesses) were handled by professional engineering and science staff, whereas student surveyors surveyed the rest of the selected businesses.

3.6.2.7 Data Entry and Management

For data evaluation purposes, it was necessary to enter the information contained on the survey forms into an electronic database. Because of the number of underlying codes and data entry options, and the resulting relationships it was necessary to develop this database in Microsoft ACCESS.

Data entry was based on two main electronic forms, one to describe the nature of the business concerned and canvass general opinions and the second form focused on the individual hazardous waste streams generated by the individual businesses.

3.6.2.8 Quality Control

Quality control is an important aspect of any survey to ensure the accuracy of the information obtained. However, quality control activities can take up a significant proportion of the budget, and therefore need to be well justified and planned.

Several key aspects of the survey process focused on quality control. This included:

- Survey quality control.
- Document quality control.
- Data entry quality control.

(a) Survey Quality Control

Controls built into surveying activities included:

- Close liaison between the surveyors and their supervisor.
- Use of industry lists.
- Re-surveying of approximately 5% of industries surveyed (covering approximately 100 hazardous waste generators and about five operators via telephone for verification purposes) by surveyors different to those involved in the original survey.

(b) Document Quality Control

To keep track of the survey process and progress, a file cover and survey register had to be filled in for each business contact and survey form. Every business was allocated a unique identification number.

(c) Data Entry Quality Control

Quality control checks on data entry included:

- Data entry was carried out by surveyors to make sure appropriate knowledge on technical matters and the survey was applied when entering data.
- No surveyor was permitted to enter his/her own survey forms.
- All electronic data entries were double-checked by a different surveyor.

3.6.2.9 Survey Process

To ensure that high quality data was obtained, it was necessary to formalise a survey process that would be followed consistently by all involved in the survey. The steps involved in starting off with an industry list, initiating contact and completing a survey form to completing all requirements for quality and document control, were as follows:

- Generation of an industry contact list for each study category and ANZSIC sub-division.
- Familiarisation of surveyor with waste streams likely to be generated by that industry sector, with the help of the survey supervisor.
- First phone call to establish contact with relevant representative of business.
- Establish whether hazardous waste is generated or received.
- Fax/e-mail short version of survey form and supporting information to business if deemed necessary.
- Fax/e-mail confidentiality agreement for return by business if desired.
- Subsequent phone call(s) to complete questionnaire.
- Completion of survey form.
- Checks of survey forms by survey supervisor.
- Completion of document control requirements.
- Data entry.

- Complete quality control requirements.

As mentioned earlier, in order to build up the surveyors' expertise and confidence as quickly as possible and to minimise the risk of errors, each surveyor was given an industry list of similar businesses. They then studied several sources of information about the waste streams likely to be generated by that industry group and discussed these with a supervisor to ensure that any uncertainties were cleared up before the first firm was called.

For some sectors where likely types of wastes were not able to be determined beforehand, surveyors needed to contact the first business on the industry list, explain about the survey and ask for assistance with wastes likely to be generated by that sector.

Where firms were initially uncooperative, surveyors explained the purpose and value of the survey. They also pointed out that selection of firms for interview was random and that the results were totally confidential, and the reporting of data was done in such a way that no industry could be identified. If persistent difficulty was encountered with a business, the surveyors discussed the matter with a supervisor to decide if further approaches were desirable, or whether a replacement firm should be interviewed.

3.6.3 Survey Materials

The materials and instructions for the survey were included in a stand-alone document. Each of the surveyors and the professional staff involved with the survey received a copy of the survey materials. A table of contents of the survey materials is shown in Appendix D and a copy of the survey form is provided in Appendix E.

The survey form used for the survey was designed to enable a full description and classification of the hazardous waste streams in question and to determine the quantities involved. Also, a range of other questions were included, such as on the nature of on-site treatment facilities, use of external transporters and hazardous waste operators, the nature of record keeping, and any expected future changes in hazardous waste quantities. The survey form also contained some open-ended questions about the quality and relevance of hazardous waste related services in the two regions.

The same survey form was used for both hazardous waste generators and operators, and surveyors were required to clearly differentiate between hazardous waste generators and operators.

The survey form comprised the following main components:

PART A	Description of hazardous waste stream (narrative).
PART B	Description of hazardous waste activities (such as, generation, receipt, storage, treatment and disposal).
PART C	Hazardous waste classification (using the codes used for the New Zealand definition of hazardous waste (W-Code), the New Zealand Waste List (L-Code), the hazardous characteristics code (H-Code), disposal and recycling code (D-Code and R-Code).
PART D	Description of hazardous waste quantities (in tonnes for sludge, solids and liquids) and cubic metres (for gases), by each

	hazardous waste activity.
PART E	Hazardous waste constituents (as a concentration, where such information is available).
PART F	Description of any on-site treatment facilities.
PART G	Description of off-site treatment (with names of contractors requested).
PART H	Transport of hazardous waste (with names of contractors requested).
PART I	Nature and methods of record keeping.
PART J	Expected changes in future quantities of hazardous waste generated.
General Comments	Inviting comment on any issues related to hazardous waste services in the regions.

Chapter 4: Survey Results

4.1 Overview

This section provides the actual results of the survey, prior to any statistical predictions being carried out. This means that for hazardous waste generators, only the data for the statistical sub-sample actually surveyed is presented. Statistical estimates across the full hazardous waste generator population are presented and discussed in section 5.

While the actual data on hazardous waste generators presented in this section are not accurate or complete in absolute terms, they provide important information that cannot be provided through statistical prediction. This is because statistical predictions on hazardous waste quantities could only be carried out for a few relatively high-level industry categories due to expected data variability (refer section 3.5).

The value of actual survey data presented in this section lies in the opportunity to compare and evaluate hazardous waste generator quantities. Quantities can be broken down into low-level industry categories, waste forms and types, and analysed for detail such as treatment types and disposal pathways. In turn, the two regional councils can use this information to identify priority industries and waste types, and form the basis for policy and management decisions.

4.2 Constraints

A number of constraints affected the ability to collect complete and accurate information during the survey. Some of these constraints were discussed in section 3.5.1.3 (d) and Figure 2 as part of survey design. These constraints are further elaborated below in light of the experiences gathered during the actual survey.

4.2.1 Knowledge of Waste Stream Characteristics and Quantities

Many respondents surveyed did not know what hazardous waste their company actually generated, and most generators had difficulty in quantifying and/or in stating the concentration of hazardous contaminants in their waste streams. Consequently, the information gathered on quantities of hazardous waste was highly variable in reliability and accuracy. A number of examples are listed below.

1 Where the hazardous waste was stored in a container on site and collected at regular intervals by a hazardous waste operator, an indication of quantity was more easily obtainable. In this case the respondent simply described the dimensions of the container and how often it was collected. Visual estimates

were converted to tonnages using conversion factors agreed to as part of the methodology development.

2 Where total waste stream quantity data were not available, the interviewer tried to establish the annual chemical usage on the respondent's site. This task proved difficult. After several telephone calls, a few respondents did complete reasonable lists of hazardous chemical quantity usage, mainly based on invoices from chemical suppliers.

3 Where hazardous waste was discharged to a municipal or industrial wastewater treatment plant, the waste is potentially too diluted to retain hazardous characteristics or it is simply 'lost' in the final effluent and/or sludge. The quantity of potentially hazardous diluted liquid was therefore consistently under-reported for the following two key pathways:

- Private industrial wastewater treatment plants where no data is held on the hazardous characteristics of the liquid waste. Typically, operators only monitor parameters that assist with plant operation and in particular parameters that may upset the treatment process and in turn lead to non-conforming effluent in terms of their resource consent (for example, volume, pH, total suspended solids, chemical oxygen demand, nitrate, phosphorus);
- Municipal wastewater treatment plants where few or no trade waste quantity limits have been agreed between the generator and the territorial local authority, and little monitoring of hazardous constituents in the wastewater is undertaken.

4 As the survey progressed, surveyors found they had to prompt respondents, particularly where the background information indicated hazardous waste streams were likely to be being produced but the business was adamant that there were none. Often, one generator on an industry list would identify a number of waste streams, while other generators on the same list indicated that the same type of processes produced no such hazardous wastes streams. Therefore, a number of businesses that claimed to have no hazardous waste streams could reasonably have been expected to have some. For example, a panel beater, an electroplater and a timber processor claimed to generate no hazardous waste streams.

Overall, surveyors were frequently faced with making judgement calls on whether or not a stream was hazardous without full facts. For example, toner caused a problem due to the fact that some toners contain hazardous substances while others do not. Generators by and large could not assist with this determination and seemed to treat all toner as hazardous.

The examples listed above have implications for the reliability and accuracy of the information collected. This must be borne in mind when interpreting the findings of the survey.

4.2.2 Accessibility of Data

In many cases, businesses had difficulty retrieving data on waste, and some did not keep relevant records. This has implications for the reliability of the data collected during the survey. Specific issues potentially affecting accessibility of data are outlined below:

- The survey was voluntary in nature, so people who participated went out of their way to do so. A consequence of modern business pressure was that often the

participants had insufficient time to compile the data for the survey so more estimates were given than actual figures

- Language difficulties in some industry types (for example, small food-manufacturing facilities such as bakeries) created some difficulty in extracting information
- Bigger industries typically had a designated environmental staff member and therefore more knowledge of their waste streams. However, if this staff member was not available, it was often difficult for anyone else to access the information
- The quantities and characteristics of liquid diluted hazardous waste streams discharged to wastewater treatment plants were typically not readily available due to the rare statutory requirement to report on inflowing waste streams and the limited range of parameters sampled for. More data than was obtained is likely to exist.
- Many respondents found it easier to provide information on the types and volumes of raw chemicals used on-site, rather than on the quantities or concentrations of chemicals discharged as wastewater from industrial processes. Records on raw chemicals were often retrievable from purchasing invoices recorded in accounting systems. These data effectively record raw material usage rather than waste generation.

4.2.3 Information on Hazardous Waste Generators with On-site Treatment and Disposal Facilities

In the Waikato and Bay of Plenty regions many of the larger generators interviewed had on-site pre-treatment or treatment systems, and some generators had private disposal facilities such as a landfill. The majority of these sites had difficulties in quantifying hazardous waste or concentrations of waste streams going into these facilities and/or did not have the resources to retrieve the data requested within the survey period. A number expressed the opinion that the information was already being supplied to their regional council as part of complying with their resource consents and did not consider it necessary to retrieve the information again for the survey. However, in most cases, resource consents do not require monitoring of incoming waste streams of either treatment or disposal facilities but focus on the discharges from these facilities to the environment to ensure that these do not cause any adverse environmental effects. Hence, in most cases, data on incoming waste streams is not available.

This was further exacerbated by the project control group's decision to exclude from the survey any waste produced and discharged on-site under resource consents, as it was decided this was already adequately managed. Some survey participants used this exclusion as a reason to not fully participate in the survey. This means that potentially significant sources of hazardous waste generated within the region were not picked up by the survey.

4.2.4 Double-counting of Waste Streams

Waste frequently travelled via several generators/operators before reaching a treatment or disposal site. This leads to the possibility of the double counting of waste streams where a specific waste was transferred between multiple operators – each of whom may have been surveyed - or where small amounts were amalgamated into larger transport volumes.

The data does not provide the ability to estimate the extent of this double counting.

4.3 Overall Survey Statistics

4.3.1 Definition of 'generator' and 'operator'

'Generators' are defined as those industries with the potential to generate hazardous wastes (refer Figure 1).

'Operators' are defined as businesses involved with hazardous waste as part of their business operations. Examples of operators include:

- Tanker truck operators that cart liquid waste and/or septic tank waste.
- Councils that receive liquid waste in their municipal wastewater treatment plants or solid hazardous waste at transfer stations.
- Private firms that treat and dispose of liquid and solid hazardous waste.

4.3.2 Survey Statistics for Hazardous Waste Generators and Operators

In total, 1,905 generators were surveyed (Table 9). Of these, 226 were out of business or wrongly listed as manufacturers in the UBD (12%), and a further 323 firms were not prepared to participate (17%). Of the 1,356 firms that did participate, 696 (51.3%) generated hazardous waste in a total of 1,572 waste streams.

A total of 262 hazardous waste operators were contacted, of which 133 were prepared to participate in the survey.

In the Bay of Plenty region (Table 10) a total of 781 generators were contacted with 210 (27%) being either out of business, wrongly listed or not willing to participate. Of the 571 firms that did participate, 270 (47.3%) generated hazardous waste, producing 583 hazardous waste streams in total.

In the Waikato region (Table 11) a total of 1,125 generators were contacted with 339 (30%) being either out of business, wrongly listed or not willing to participate. Of the 785 firms that did participate, 426 (62.2%) had hazardous waste and produced 989 hazardous waste streams.

Table 12 shows the numbers of hazardous waste operators contacted in the Bay of Plenty and Waikato regions, and also outside of these regions. These operators were found to produce 330 waste streams. Information was not received to be able to adequately describe 135 of these waste streams.

Table 9 Overview of survey statistics

Source	Number of companies contacted	Prepared to participate	Not prepared to participate	Wrong listings (includes multiple listings)	Out of business	Involved with HW (generation or receipt)	Number of waste streams generated	Number of waste streams without information on quantities
Total Generators	1,905	1,356	323	144	82	696	1,572	283
Total Operators	262	133	71	56	2	95	330	135
Grand Total	**2,167**	**1,489**	**394**	**200**	**84**	**791**	**1,902**	**418**

Table 10 Survey statistics for generators in the Bay of Plenty region

Study category	Abbreviated definition	Number of businesses SNZ	Number of businesses UBD	Number of samples required	Number of companies contacted	Prepared to participate	Not prepared to participate	Wrong listings (includes multiple listings)	Out of business	Involved with HW (generation or receipt)	Number of waste streams generated	Number of waste streams without info on quantities
A	Agriculture etc	824	68	16	21	13	6		2	7	14	2
B	Mining	8	6	6	6	6				3	5	
Ca	Metal product manufacturing	217	183	183	179	129	22	20	8	51	68	13
Cb	Food, textile and non-metallic manufacturing	236	191	191	196	142	31	16	7	31	61	13
Cc	Wood, machinery and other manufacturing	940	665	137	173	127	28	15	3	75	170	23
D	Electricity, gas and water supply	18	21	13	18	13	3		2	4	7	1
E	Construction	940	206	18	27	17	7	2	1	9	17	3
F	Wholesale trade	203	57	10	16	12	3	1		6	11	
G	Retail trade	549	374	10	16	13	2	1		13	48	3
I	Transport and storage	696	195	39	43	37	4		2	26	74	25
L	Property and business services	355	105	15	20	15	2	1	2	10	22	7
O	Health and community services	744	353	24	26	20	5		1	17	55	9
Q	Personal and other services	443	289	19	29	18	10		1	13	27	8
Za	Government, education etc	258	249	10	10	8	2			4	4	3
TOTAL		**6,431**	**2,962**	**691**	**781**	**571**	**125**	**56**	**29**	**270**	**583**	**110**

Table 11 Survey statistics for generators in the Waikato region

Study category	Abbreviated definition	Number of businesses SNZ	Number of businesses UBD	Number of samples required	Number of companies contacted	Prepared to participate	Not prepared to participate	Wrong listings (includes multiple listings)	Out of business	Involved with HW (generation or receipt)	Number of waste streams generated	Number of waste streams without info on quantities
A	Agriculture etc	1,292	117	34	43	30	10	2	1	21	46	4
B	Mining	30	9	9	10	7	1	1	1	7	14	3
Ca	Metal product manufacturing	356	188	188	188	135	28	16	9	65	86	11
Cb	Food, textile and non-metallic manufacturing	399	287	287	281	182	41	38	20	67	185	34
Cc	Wood, machinery and other manufacturing	1,269	882	212	299	212	55	21	11	113	263	35
D	Electricity, gas and water supply	59	40	15	22	14	4	3	1	3	3	1
E	Construction	1,182	225	36	48	41	6	1		24	53	17
F	Wholesale trade	370	97	10	16	12	2	1	1	7	21	1
G	Retail trade	825	528	17	25	19	1	3	2	17	55	8
I	Transport and storage	913	226	46	57	42	13	1	1	28	60	19
L	Property and business services	448	150	20	25	17	7		1	11	27	5
O	Health and community services	1,054	539	46	50	42	7	1		40	129	29
Q	Personal and other services	588	409	33	51	23	22		5	19	40	4
Za	Government, education etc	507	458	10	10	9	1			4	7	2
TOTAL		**9,292**	**4,155**	**963**	**1,125**	**785**	**198**	**88**	**53**	**426**	**989**	**173**

Table 12 Survey statistics for operators in all regions

Location	Study category	Abbreviated definition	Number of companies contacted	Prepared to participate	Not prepared to participate	Wrong listings (includes multiple listings)	Out of business	Involved with HW (generation or receipt)	Number of waste streams generated	Number of waste streams without information on quantities
Out of Region	X	Waste operators	90	17	60	13		17	52	
Bay of Plenty	X+ Zb	Waste operators	73	48	3	21	1	39	56	5
Bay of Plenty	Zb	Local and regional government							52	42
Waikato	X + Zb	Waste operators	99	68	8	22	1	39	64	
Waikato	Zb	Local and regional government							106	88
TOTAL			**262**	**133**	**71**	**56**	**2**	**95**	**330**	**135**

4.4 Generator Data

4.4.1 Total Hazardous Waste Quantities Generated

Tables 13 and 14 summarise the quantities of hazardous waste generated by waste form. Approximately 84% of the waste quantities generated were liquid in nature. These waste streams were generally further diluted prior to discharge. Generators reported very few gaseous waste streams, primarily because the majority of these are generally covered by resource consents and so were excluded from the survey.

Table 13 Total hazardous waste quantities generated by region and form (including diluted liquid waste)

Region	Waste form	Number of waste streams	% of total for both regions	Sum of generation (tonnes)	Average of generation (tonnes)	Standard Deviation of generation	% of total for both regions
Bay of Plenty	Gas	3	0.2	0.1	0.0	0.0	0.0
Bay of Plenty	Liquid	316	20.2	42,647.7	135.4	1,744.8	17.9
Bay of Plenty	Solid	195	12.5	1,942.7	10.0	42.9	0.8
Bay of Plenty	Sludge	66	4.2	4,467.8	67.7	371.6	1.9
Waikato	Gas	5	0.3	1.5	0.3	0.4	0.0
Waikato	Liquid	530	33.9	167,452.6	316.0	4,468.3	70.1
Waikato	Solid	343	22.0	11,841.4	34.5	343.8	5.0
Waikato	Sludge	104	6.7	10,502.5	101.0	520.6	4.4
TOTAL		**1,562**		**238,856.2**			

Table 14 Waste form as percentage of total hazardous waste quantities (including diluted liquid waste)

Form	Quantity (tonnes)	% Total
Gas	1.6	0.0
Liquid	210,100.2	88.0
Solid	13,784.1	5.8
Sludge	14,970.3	6.2
TOTAL	**238,856.2**	**100.00**

Significantly more waste was recorded for the Waikato region in comparison with the Bay of Plenty region. This can be attributed to the Waikato region having a greater number of survey participants and also a higher number of industries overall. Quantities of waste generated in the two regions, by study category and region, are recorded in Table 15.

Table 15 Hazardous waste generation by study category and region (including diluted liquid waste)

Study Category	Abbreviated Definition[7]	Bay of Plenty Generation (tonnes)	Waikato Generation (tonnes)	Combined Generation (tonnes)
A	Agriculture etc	14.8	292.9	307.7
B	Mining	305.9	52.9	358.8
Ca	Metal product manufacturing	860.8	1999.9	2,860.8
Cb	Food, textile and non-metallic manufacturing	10,344.1	45,037.8	55,382.0
Cc	Wood, machinery and other manufacturing	4,310.1	141,394.6	145,704.7
D	Electricity, gas and water supply	1.0	0.4	1.3
E	Construction	62.2	118.2	180.4
F	Wholesale trade	13.3	11.7	25.0
G	Retail trade	90.2	76.5	166.7
I	Transport and storage	2,117.1	93.0	2,210.1
L	Property and business services	48.3	35.3	83.6
O	Health and community services	619.9	599.9	1,219.9
Q	Personal and other services	30,270.4	46.4	30,316.8
Za	Government, education etc	0.0	39.0	39.0
TOTAL		**49,058.1**	**189,798.5**	**238,856.8**

4.4.2 Issues with Diluted Liquid Hazardous Waste Streams (Trade Waste)

Diluted liquid hazardous waste streams include all waste streams substantially diluted with water that can be discharged to a municipal or private on-site wastewater treatment plant without further treatment. These waste streams were found to have a significant effect on total hazardous waste quantities generated in the two regions.

In the Bay of Plenty region, Manufacturing industries (C) overall generated the largest quantities of hazardous waste, with the exception of a Personal and other services industry (Q) outlier value in the Bay of Plenty region. This outlier value was caused by one diluted liquid hazardous waste stream, accounting for 30,000 tonnes (61%) of the total waste quantity generated in that region. In the Waikato region, the three largest diluted liquid hazardous waste streams (90,000, 49,000, and 6,000 tonnes) accounted for 147,000 tonnes (73%) of the generated waste quantity – all three waste streams were from the Cb or Cc study categories.

Such large diluted liquid hazardous waste streams were found to distort the overall data significantly in terms of relative quantities. In addition, diluted liquid hazardous waste streams represented a significant problem for this study as it was very difficult to obtain reliable and accurate data (refer section 4.2.3). In many cases, data could not be obtained at all, hence affecting how representative this information is for the industries in question.

[7] For a more complete listing refer to Table 7.

As a result, the Project Control Group decided that diluted liquid hazardous waste streams were to be analysed separately from the other waste streams to reduce the margin of error in analysis. This included those waste streams that generators identified as being the raw chemical component of a dilute waste stream prior to dilution. These diluted liquid hazardous waste streams are discussed in section 4.4.5 of this report.

4.4.3 **Quantitative Hazardous Waste Data** (excluding liquid diluted waste)

4.4.3.1 **Hazardous Waste Quantities by Waste Form and Company Size**

Tables 16 and 17 record the tonnage of waste by form for each region, divided into companies with less than or equal to 20 employees and those with greater than 20 employees. Table 18 shows data for both regions combined. With the dilute liquid hazardous waste streams removed, the data indicates that nearly 50% of the waste identified was in the form of sludge, and only 4.5% was liquid.

Table 16 Hazardous waste quantities generated in the Bay of Plenty region by industry size and form (excluding diluted liquid waste)

Number of employees	Waste Form	Number of waste streams	Percentage of waste streams by region	Sum of generation (tonnes)	Average of generation (tonnes)	Standard deviation of generation	Percentage of region's generation
<20	Gas	2	0.4	0.1	0.0	0.0	0.0
<20	Liquid	150	29.4	261.9	1.8	5.0	3.9
<20	Solid	122	23.9	1,028.8	8.4	27.9	15.3
<20	Sludge	33	6.5	438.3	13.3	25.5	6.5
>20	Gas	1	0.2	0.0	0.0		0.0
>20	Liquid	97	19.0	276.5	2.9	5.45	4.1
>20	Solid	73	14.3	913.9	12.5	60.5	13.6
>20	Sludge	32	6.3	3,821.5	119.4	531.3	56.7
TOTAL		**510**	**100**	**6,741.1**			**100**

Table 17 Hazardous waste quantities generated in the Waikato region by industry size and form (excluding diluted liquid waste)

Number of employees	Waste Form	Number of waste streams	Percentage of waste streams by region	Sum of generation (tonnes)	Average of generation (tonnes)	Standard deviation of generation	Percentage of region's generation
<20	Gas	4	0.5	1.3	0.3	0. 5	0.0
<20	Liquid	223	27.0	217.7	1.0	3.1	1.0
<20	Solid	210	25.4	1,691.7	8.1	66.2	7.4
<20	Sludge	59	7.1	2,355.6	39.9	150.6	10.3
>20	Gas	1	0.1	0.2	0.2		0.0
>20	Liquid	153	18.5	584.9	3.8	11.1	2.6
>20	Solid	132	16.0	9,949.7	75.4	546.4	43.4
>20	Sludge	45	5.4	8,146.8	181.0	770.1	35.5
TOTAL		**827**	**100**	**22,947.9**			**100**

In total, both regions together generated 1,337 waste streams and an overall quantity of 29,689 tonnes of hazardous waste in gaseous, liquid, sludge or solid form.

Table 18 Total hazardous waste quantities by form (excluding diluted liquid waste)

Waste Form	Quantity (tonnes)	% Total
Gas	1.6	0.0
Liquid	1,341.0	4.5
Solid	13,584.1	45.8
Sludge	14,762.3	49.7
TOTAL	**29,689.0**	**100.0**

In the Bay of Plenty region, businesses with 20 or less staff generated 60% of the waste streams but only 28% of total hazardous waste quantities. Similarly in the Waikato region, smaller companies generated 60% of the waste streams and 44% of the total hazardous waste quantities. This indicates that small companies generate a larger variety of waste, but in relatively small quantities.

4.4.3.2 Hazardous Waste Quantities by Company Size and ANZSIC Sub-division

Tables 19 and 20 present the quantities of hazardous waste generated by ANZSIC sub-division (this is one level lower than the study categories) and industry size (expressed as companies with equal of less than, or more than 20 employees) for the two regions. These data are useful for identifying which industries seem to generate the most hazardous wastes.

In the Bay of Plenty, the Chemical, Plastic and Rubber Processing and Manufacturing industries (C25) with more that 20 employees contributed by far the highest percentage of hazardous waste generated (46% of total waste with diluted waste removed). This was followed by Metal Finishing and Manufacturing (C27) with 20 or fewer employees (10%), Wood and Paper Processing (C23) with more than 20 employees (8%) and Hospital and Health Services (O86) with more that 20 employees (5%).

In the Waikato region, 47% of hazardous waste recorded during the survey was from the Food and Beverage Manufacturing industries (C21) with more than 20 employees. A significant portion of waste identified in this category arose from ash generated by coal-fired boilers. Concrete and Ceramic Manufacturing (C26) with more than 20 employees produced 21% of the waste recorded. These waste streams included highly alkaline wash water and sludges that the generators considered to be hazardous. A further 9% of hazardous waste recorded in the Waikato was from Ceramic and Concrete Manufacturing (C26) with less than 20 employees, 8% from Wood and Paper Processing (C23) with more than 20 employees and 5% from the Metal Finishing and Product Manufacturing (C27) with 20 or fewer employees.

The relative contribution of companies with less than 20 employees appears to vary, depending on the industry type. For example, such smaller companies produced the bulk of metal finishing waste. In contrast, the mining industry wastes recorded during the survey were primarily from companies with more than 20 employees. If an industry type is characterised by a greater number of smaller industries rather than large ones, it stands to reason that the contribution of smaller industries to total waste generation will be proportionately greater.

Table 19 Hazardous waste quantities generated by ANZSIC sub-division in the Bay of Plenty region (excluding diluted liquid waste)

Number of employees	ANZSIC Code	ANZSIC Code explanation	Number of waste streams	% of region's waste streams	Sum of generation	% of regions waste	Average of generation	Standard deviation of generation
<20	A02	Agricultural Services	10	1.96	3.33	0.05	0.33	0.63
<20	B14	Mining	1	0.20	1.80	0.03	1.80	
<20	C21	Food and Beverage Manufacturing	6	1.18	13.67	0.20	2.28	4.80
<20	C22	Textile and Leather Processing and Manufacturing	3	0.59	0.33	0.00	0.11	0.08
<20	C23	Wood and Paper Processing	10	1.96	299.15	4.44	29.92	50.74
<20	C24	Printing and Publishing	3	0.59	1.04	0.02	0.35	0.27
<20	C25	Chemical, Plastic and Rubber Processing and Manufacturing	8	1.57	40.10	0.59	5.01	8.54
<20	C26	Ceramic and Concrete Manufacturing	8	1.57	306.27	4.54	38.28	42.07
<20	C27	Metal Finishing and Manufacturing	61	11.96	691.82	10.26	11.34	32.00
<20	C28	Automotive and Electrical Equipment Manufacturing	55	10.78	195.04	2.89	3.55	8.59
<20	C29	Building and Furniture Manufacturing	2	0.39	0.03	0.00	0.02	0.02
<20	D36	Electricity and Gas Supply	3	0.59	0.06	0.00	0.02	0.00
<20	D37	Water and Sanitation	3	0.59	0.92	0.01	0.31	0.25
<20	E42	Building Construction and Servicing	14	2.75	10.92	0.16	0.78	2.66
<20	F45	General Product Wholesaling	2	0.39	2.45	0.04	1.22	1.66
<20	F46	Motor Vehicle Dismantling	9	1.76	10.86	0.16	1.21	2.33
<20	G53	Automobile Repair and Servicing	46	9.02	40.19	0.60	0.87	1.60
<20	I61	Road Transport	4	0.78	5.58	0.08	1.40	2.27
<20	I63	Water Transport	3	0.59	1.04	0.02	0.35	0.57
<20	I64	Air Transport	1	0.20	0.01	0.00	0.01	
<20	I66	Transport Services	4	0.78	20.88	0.31	5.22	8.94
<20	I67	Storage	3	0.59	0.00	0.00	0.00	0.00
<20	L77	Equipment Hiring and Leasing	10	1.96	43.49	0.65	4.35	7.54
<20	L78	Research, Pest Control and Cleaning Services	6	1.18	0.02	0.00	0.00	0.00
<20	M81	Government Administration	1	0.20	0.00	0.00	0.00	

Number of employees	ANZSIC Code	ANZSIC Code explanation	Number of waste streams	% of region's waste streams	Sum of generation	% of regions waste	Average of generation	Standard deviation of generation
<20	O86	Hospital and Medical Services	23	4.51	33.76	0.50	1.47	6.24
<20	Q95	Personal Services, including photographic and emergency services	8	1.57	6.41	0.10	0.80	1.04
>20	A03	Forestry and logging	2	0.39	11.46	0.17	5.73	6.04
>20	B14	Mining	3	0.59	304.06	4.51	101.35	172.04
>20	C21	Food and Beverage Manufacturing	16	3.14	3.47	0.05	0.22	0.37
>20	C22	Textile and Leather Processing and Manufacturing	1	0.20	1.04	0.02	1.04	
>20	C23	Wood and Paper Processing	34	6.67	506.62	7.52	14.90	56.67
>20	C24	Printing and Publishing	10	1.96	69.87	1.04	6.99	10.88
>20	C25	Chemical, Plastic and Rubber Processing and Manufacturing	15	2.94	3,109.71	46.13	207.31	772.81
>20	C27	Metal finishing and Manufacturing	4	0.78	4.99	0.07	1.25	1.11
>20	C28	Automotive and Electrical Equipment Manufacturing	21	4.12	37.52	0.56	1.79	1.85
>20	C29	Building and Furniture Manufacturing	3	0.59	2.44	0.04	0.81	0.67
>20	D36	Electricity and Gas Supply	1	0.20	0.00		0.00	
>20	E42	Building Construction and Servicing	3	0.59	51.24	0.76	17.08	28.51
>20	G53	Automobile Repair and Servicing	1	0.20	0.01	0.00	0.01	
>20	I61	Road Transport	23	4.51	49.37	0.73	2.15	5.06
>20	I64	Air Transport	8	1.57	6.42	0.10	0.80	1.66
>20	I67	Storage	21	4.12	4.41	0.07	0.21	0.87
>20	L77	Equipment Hiring and Leasing	1	0.20	3.00	0.04	3.00	
>20	M81	Government Administration	2	0.39	0.00	0.00	0.00	0.00
>20	N84	Further Education	1	0.20	0.01	0.00	0.01	
>20	O86	Hospital and Medical Services	28	47.46	582.80	5.35	20.81	85.42
>20	Q95	Personal Services, including photographic and emergency services	3	0.59	263.50	3.91	87.83	140.50
>20	Q96	Waste Disposal Services	2	0.39	0.00	0.00	0.00	0.00
		TOTAL – BAY OF PLENTY	**510**		**6,741.07**			

Table 20 Hazardous waste quantities generated by ANZSIC sub-division in the Waikato region (excluding diluted liquid waste)

Number of employees	ANZSIC Code	ANZSIC Code explanation	Number of waste streams	% of region's waste streams	Sum of generation	% of regions waste	Average of generation	Standard deviation of generation
<20	A02	Agricultural Services	27	3.26	31.93	0.14	1.18	2.59
<20	A03	Forestry and logging	4	0.48	26.33	0.11	6.58	9.15
<20	B11	Coal Mining	2	0.24	1.80	0.01	0.90	0.14
<20	B14	Mining	4	0.48	0.41	0.00	0.10	0.11
<20	C21	Food and Beverage Manufacturing	21	2.54	16.04	0.07	0.76	1.28
<20	C22	Textile and Leather Processing and Manufacturing	2	0.24	0.15	0.00	0.08	0.06
<20	C23	Wood and Paper Processing	10	1.21	46.72	0.20	4.67	14.35
<20	C24	Printing and Publishing	13	1.57	39.28	0.17	3.02	9.92
<20	C25	Chemical, Plastic and Rubber Processing and Manufacturing	13	1.57	32.09	0.14	2.47	7.53
<20	C26	Ceramic and Concrete Manufacturing	19	2.30	2,112.54	9.21	111.19	254.44
<20	C27	Metal finishing and Manufacturing	71	8.59	1,633.09	7.12	23.00	113.02
<20	C28	Automotive and Electrical Equipment Manufacturing	84	10.16	52.35	0.23	0.62	1.32
<20	C29	Building and Furniture Manufacturing	5	0.60	0.61	0.00	0.12	0.13
<20	D36	Electricity and Gas Supply	1	0.12	0.27	0.00	0.27	
<20	D37	Water and Sanitation	1	0.12	0.00	0.00	0.00	
<20	E42	Building Construction and Servicing	32	3.87	92.60	0.40	2.89	10.58
<20	F45	General Product Wholesaling	2	0.24	0.90	0.00	0.45	0.07
<20	F46	Motor Vehicle Dismantling	16	1.93	9.26	0.04	0.58	0.76
<20	G53	Automobile Repair and Servicing	54	6.53	76.51	0.33	1.42	3.33
<20	I61	Road Transport	20	2.42	29.51	0.13	1.48	3.05
<20	I64	Air Transport	1	0.12	0.45	0.00	0.45	
<20	I66	Transport Services	3	0.36	4.70	0.02	1.57	1.29
<20	I67	Storage	3	0.36	0.00	0.00	0.00	0.00
<20	L77	Equipment Hiring and Leasing	9	1.09	7.65	0.03	0.85	1.41
<20	L78	Research, Pest Control and Cleaning Services	5	0.60	25.42	0.11	5.08	8.71
<20	M81	Government Administration	2	0.24	0.00	0.00	0.00	0.00

Number of employees	ANZSIC Code	ANZSIC Code explanation	Number of waste streams	% of region's waste streams	Sum of generation	% of regions waste	Average of generation	Standard deviation of generation
<20	O86	Hospital and Medical Services	60	7.26	13.45	0.06	0.22	0.67
<20	Q95	Personal Services, including photographic and emergency services	12	1.45	12.22	0.05	1.02	1.50
>20	A02	Agricultural Services	8	0.97	19.95	0.09	2.49	5.52
>20	A03	Forestry and logging	2	0.24	14.40	0.06	7.20	6.79
>20	B11	Coal Mining	4	0.48	4.81	0.02	1.20	2.40
>20	B14	Mining	2	0.24	7.50	0.03	3.75	1.77
>20	B15	Mineral exploration	2	0.24	38.40	0.17	19.20	23.76
>20	C21	Food and Beverage Manufacturing	59	7.13	10,897.52	47.49	184.70	854.03
>20	C22	Textile and Leather Processing and Manufacturing	2	0.24	1.84	0.01	0.92	0.96
>20	C23	Wood and Paper Processing	70	8.46	1,893.78	8.25	27.05	112.87
>20	C24	Printing and Publishing	8	0.97	5.16	0.02	0.65	0.88
>20	C25	Chemical, Plastic and Rubber Processing and Manufacturing	7	0.85	116.12	0.51	16.59	36.95
>20	C26	Ceramic and Concrete Manufacturing	4	0.48	4,790.00	20.87	1,197.50	2,335.27
>20	C27	Metal finishing and Manufacturing	8	0.97	39.52	0.17	4.94	8.71
>20	C28	Automotive and Electrical Equipment Manufacturing	40	4.84	159.49	0.69	3.99	8.93
>20	D36	Electricity and Gas Supply	1	0.12	0.10	0.00	0.10	
>20	E42	Building Construction and Servicing	19	2.30	25.53	0.11	1.34	4.56
>20	I61	Road Transport	28	3.39	52.31	0.23	1.87	2.59
>20	I66	Transport Services	2	0.24	2.80	0.01	1.40	1.41
>20	L78	Research, Pest Control and Cleaning Services	1	0.12	0.02	0.00	0.02	
>20	M81	Government Administration	2	0.24	0.02	0.00	0.01	0.01
>20	O86	Hospital and Medical Services	59	7.13	580.95	2.53	9.85	35.87
>20	Q95	Personal Services, including photographic and emergency services	3	0.36	31.48	0.14	10.49	17.93
		TOTAL - WAIKATO	**827**		**22,947.97**			
		GRAND TOTAL	**1,337**		**29,689.04**			

4.4.3.3 Hazardous Waste Quantities by 4-digit New Zealand Waste List Code

Tables 21 and 22 summarise the total quantities of hazardous waste recorded by the 4-digit Waste Code from the New Zealand Waste List (refer Appendix A-2) in the respective regions, with the dilute liquid waste streams removed. These tables emphasise the *waste type* rather than ANZSIC sub-division, as previously detailed in Table 20.

This type of information is expected to provide regional councils with a valuable insight into the types of waste generated in their respective regions. The information should also prove useful when considering data collection initiatives and the development of disposal-pathway tracking systems, as well as providing valuable input into regional and national indicator programmes.

From Table 21, it can be seen that nearly 50% (3341 tonnes) of hazardous waste in the Bay of Plenty region was comprised of "Wastes from wastewater treatment plants not otherwise specified" (19 08). While this represents a very significant portion of the total waste generated, it should be noted that the majority of this particular stream is sludge sent to industrial trade waste.

The Bay of Plenty "Wastes from wood processing and the production of panels and furniture" stream (03 01) amounted to 876 tonnes, representing just over 13% of the region's waste, and is mostly disposed of in landfills. The majority of the hazardous constituents in this stream are those used in the wood preservation process, while the volume generated directly from the "Wastes from Wood Preservation" stream accounted for only 0.02% (1.7 tonnes) of the region's waste.

A further significant Bay of Plenty waste stream was the "Wastes from natal care, diagnosis, treatment or prevention of disease in humans" (18 01, 13%). While the "Wastes from wood processing …" and "Wastes from natal care …" streams accounted for over 25% of the region's waste, it should be noted that the volumes from which the respective tonnages were derived were largely "visual estimates" made by the generators and should therefore be treated as such.

In the Waikato region, the largest quantity of waste recorded was 8500 tonnes of "Wastes from power stations and other combustion plants" (10 01), and represented 37.04% of the region's total. The entire waste stream was composed of coal ash from coal-fired boilers used in the food and beverage manufacturing industries.

This figure does not represent the total quantity of this waste (10 01) produced in the Waikato region, as some facilities generating this waste were not included in the survey[8]. Also, the NZ Waste List does not record this waste stream as being hazardous, although the potentially high boron content and alkalinity of ash is of concern if inappropriate disposal practices are adopted.

The second key Waikato waste stream (28%) was recorded under "Wastes from Waste Water Treatment Plants not otherwise specified" (19 08). As in the case of the Bay of Plenty region, this figure was made up of a considerable volume of sludge from on-site wastewater pre-treatment and treatment plants, most of which ended up being disposed of as trade waste. Another significant waste stream (10%) was recorded under "Wastes from wood processing and the production of panels

[8] Waste streams discharged from generator/disposal facilities to the environment covered by resource consents were not included in the survey, as these were already deemed to be adequately managed. However, even though incoming waste streams to these facilities were to be covered by the survey, more often than not, such information was not available or was deemed to be available from consent monitoring records and so a number of generators declined to participate. Therefore, such information has not been included in this analysis.

and furniture" (03 01). This may be an overestimate given the potential errors in converting data based on a visual estimate to a precise quantity.

Table 21 Hazardous waste generation in the Bay of Plenty region by 4-digit L code (excluding diluted liquid waste)

Waste Code 4d	Waste Code Definition[9]	No. of waste streams	Generation (tonnes)	% of own region's waste	% of total both regions
01 03	Wastes from processing of metalliferous minerals	1	300.00	4.45	1.01
02 01	Wastes from agriculture etc	2	3.40	0.05	0.01
03 01	Wastes from wood processing etc	34	876.69	13.01	2.95
03 02	Wastes from wood preservation	4	1.66	0.02	0.01
04 02	Wastes from the textile industry	2	11.12	0.16	0.04
06 02	Wastes from the MFSU[10] of bases	1	1.20	0.02	0.00
06 06	Wastes from the MFSU of sulphur	1	0.00	0.00	0.00
07 06	Wastes from the MFSU of fats etc	1	0.01	0.00	0.00
08 01	Wastes from MFSU of paint etc	18	77.37	1.15	0.26
08 03	Wastes from MFSU of printing inks	32	0.73	0.01	0.00
08 04	Wastes from MFSU of adhesives etc	6	31.84	0.47	0.11
09 01	Wastes from the photographic industry	18	77.17	1.14	0.26
10 01	Wastes from power stations and other combustion plants	1	0.37	0.01	0.00
10 11	Wastes from manufacture of glass etc	1	0.12	0.00	0.00
11 01	Wastes coating of metals	19	25.88	0.38	0.09
12 01	Wastes from shaping of metals	4	7.75	0.11	0.03
12 03	Wastes from water and steam degreasing processes (except 11)	10	7.37	0.11	0.02
13 01	Waste hydraulic oils	5	3.87	0.06	0.01
13 02	Waste engine, gear and lubricating oils	104	327.49	4.86	1.10
13 05	Oil/water separator contents	8	104.02	1.54	0.35
13 07	Wastes of liquid fuels	12	7.56	0.11	0.03
13 08	Oil wastes not otherwise specified	1	1.20	0.02	0.00
14 06	Waste organic solvents, refrigerants etc	39	42.62	0.63	0.14
15 02	Absorbents, filter materials etc	14	4.01	0.06	0.01
16 01	Wastes from electrical and electronic equipment	40	10.40	0.15	0.04
16 02	End-of-life vehicles and from dismantling vehicles an	2	36.00	0.53	0.12
16 03	Off-specification batches and unused products	3	15.10	0.22	0.05
16 05	Gases in pressure containers and discarded chemicals	1	0.03	0.00	0.00
16 06	Batteries and accumulators	35	33.30	0.49	0.11
16 08	Spent catalysts	1	10.00	0.15	0.03
17 02	Wood, glass and plastic	1	4.00	0.06	4.76
17 04	Metals (including their alloys)	2	0.46	0.01	0.00
17 06	Insulation materials and asbestos-containing construction materials	6	71.00	1.05	0.24
18 01	Wastes from health care	39	861.60	12.78	2.90
19 02	Wastes from physico/chemical waste treatment	2	2.08	0.03	0.01
19 08	Wastes from wastewater treatment plants [not otherwise specified]	15	3,341.45	49.57	11.25
20 01	Separately collected fractions (except 15 01)	10	9.71	0.14	0.03
20 03	Other municipal wastes, including septic tank waste	15	432.50	6.42	1.46
	BAY OF PLENTY TOTAL	**510**	**6,741.07**	**100.00**	**22.71**

9 For a full explanation of the codes refer to Appendix A2.

10 MFSU is the manufacture, formulation, supply and use.

Table 22 Hazardous waste generation in the Waikato region by 4-digit L-code (excluding diluted liquid waste)

4-digit Waste Code	Waste Code Definition[11]	No. of waste streams	Generation (tonnes)	% of own region's waste	% of total both regions
01 05	Drilling muds and other drilling wastes	2	38.40	0.17	0.13
02 01	Wastes from agriculture etc	3	16.61	0.07	0.06
03 01	Wastes from wood processing etc	41	2,260.96	9.85	7.62
03 02	Wastes from wood preservation	5	16.04	0.07	0.05
06 02	Wastes from the MFSU of bases	2	19.01	0.08	0.06
07 05	Wastes from the MFSU of pharmaceuticals	1	5.00	0.02	0.02
07 06	Wastes from the MFSU of fats etc	3	100.08	0.44	0.34
08 01	Wastes from MFSU of paint etc	34	172.49	0.75	0.58
08 02	Wastes from MFSU of other coatings (including ceramic materials)	1	21.60	0.09	0.07
08 03	Wastes from MFSU of printing inks	38	4.37	0.02	0.01
08 04	Wastes from MFSU of adhesives etc	6	42.73	0.19	0.14
09 01	Wastes from the photographic industry	28	17.07	0.07	0.06
10 01	Wastes from power stations and other combustion plants (except 19)	2	8,500.00	37.04	28.63
10 02	Wastes from the iron and steel industry	1	5.00	0.02	0.02
10 12	Wastes from manufacture of ceramic goods, bricks, tiles and construction products	1	0.05	0.00	0.00
10 13	Wastes from manufacture of cement etc,	4	1,134.00	4.94	3.82
11 01	Wastes from coating of metals	34	551.50	2.40	1.86
11 05	Wastes from hot galvanising processes	1	0.01	0.00	0.00
12 01	Wastes from shaping of metals	12	31.32	0.14	0.11
12 03	Wastes from water and steam degreasing processes (except 11)	6	3.08	0.01	0.01
13 01	Waste hydraulic oils	15	16.21	0.07	0.05
13 02	Waste engine, gear and lubricating oils	155	372.76	1.62	1.26
13 03	Waste insulating and heat transmission oils	6	68.62	0.30	0.23
13 05	Oil/water separator contents	8	32.82	0.14	0.11
13 07	Wastes of liquid fuels	6	2.21	0.01	0.01
13 08	Oil wastes not otherwise specified	3	0.43	0.00	0.00
14 06	Waste organic solvents, refrigerants etc	55	66.98	0.29	0.23
15 02	Absorbents, filter materials etc	25	5.14	0.02	0.02
16 01	End-of-life vehicles and wastes from dismantling vehicles	67	13.49	0.06	0.05
16 02	Wastes from electrical and electronic equipment	6	2.42	0.01	0.01
16 05	Gases in pressure containers and discarded chemicals	1	0.02	0.00	0.00
16 06	Batteries and accumulators	65	31.82	0.14	0.11
17 01	Concrete, bricks, tiles and ceramics	1	8.00	0.03	0.03
17 06	Insulation materials and asbestos-containing construction materials	5	51.50	0.22	0.17
17 09	Other construction and demolition wastes	1	0.03	0.00	0.00
18 01	Wastes from health care	79	630.50	2.75	2.12
18 02	Wastes from veterinary research etc	20	67.21	0.29	0.23
19 08	Wastes from waste water treatment plants [not otherwise specified]	39	6,339.69	27.63	21.35
20 01	Separately collected fractions (except 15 01)	28	7.21	0.03	0.02
20 03	Other municipal wastes	17	2,291.60	9.99	7.72
	WAIKATO TOTAL	**827**	**22,947.97**	**100.00**	**77.29**
	GRAND TOTAL - TABLES 21 and 22		**29,689.04**		

4.4.3.4 Priority Hazardous Waste

One of the requirements for the survey was to identify priority waste types for the Waikato and Bay of Plenty regions from the survey results in terms of the:

- Volume of hazardous waste produced.
- Number of waste streams.
- The level of hazard the waste poses to health and the environment.

In terms of the Resource Management Act 1991, this required consideration of the scale and nature of both actual and potential adverse effects, including effects of low probability and high potential impact. Table 23 presents a summary of the priority wastes found by 4-digit New Zealand Waste List code for each region. Chapter 5 uses a model to extrapolate total predicted quantities for the combined regions.

Table 23 Priority hazardous waste by 4-digit waste code (excluding diluted liquid waste)

4-digit Waste Code	Explanation	BOP (tonnes)	BOP (%)	Waikato (tonnes)	Waikato (%)
01 03	Wastes from physical and chemical processing of metalliferous minerals	300.00	4.45	0[12]	0
02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing	3.40	0.05	16.61	0.07
03 01	Wastes from wood processing and the production of panels and furniture	876.69	13.01	2,260.96	9.85
03 02	Wastes from wood preservation	1.66	0.02	16.04	0.07
08 01	Wastes from MFSU and removal of paints and varnish	77.37	1.15	172.49	0.75
08 04	Wastes from MFSU of adhesives and sealants	31.84	0.47	42.73	0.19
09 01	Wastes from the photographic industry	77.17	1.14	17.07	0.07
10 01	Wastes from power stations and other combustion plants	0.37	0.01	8,500.00	37.04
10 13	Wastes from the manufacture of cement, lime and plaster	0.00	0.00	1,134.00	4.94
11 01	Wastes from chemical surface treatment of metals	25.88	0.38	551.50	2.40
12 01	Wastes from shaping and physical and mechanical surface treatment of metals	7.75	0.11	31.32	0.14
13 02	Waste engine, gear and lubricating oil	327.49	4.86	372.76	1.62
14 06	Waste organic solvents, refrigerants and propellants	42.62	0.63	66.98	0.29
16 06	Batteries and accumulators	33.30	0.49	31.82	0.14
18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	861.60	12.78	630.50	2.75
19 08	Wastes from wastewater treatment plants	3,341.45	49.57	6,339.69	27.63
20 03	Other municipal waste including septic tank waste	432.5	6.42	2291.6	9.99

[11] For a full explanation of the codes refer to Appendix A2.

[12] In the Waikato Region a number of mining companies did not participate in the survey, because their wastes were disposed of in compliance with resource consents.

Appendix F contains an analysis of which industries and processes generated the priority waste stream quantities recorded above.

Table 23a identifies a number of different waste types from the New Zealand Waste List (4-digit code) and explains why each waste has been nominated as a priority waste. The basis for this selection was the criteria listed in section 4.4.3.4 above.

Table 23a Summary of Priority Wastes

Waste Code	Waste description	Explanation of Why Waste is a Priority Waste			
		Large number of generators	Large waste streams	Bio-accumulative constituents	Has caused sites to be contaminated
01 03	Wastes from physical and chemical processing of metalliferous minerals		X	X	X
02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing			X	
03 01	Wastes from wood processing and the production of panels and furniture	X	X		
03 02	Wastes from wood preservation			X	X
08 01	Wastes from MFSU and removal of paints and varnish	X			
08 04	Wastes from MFSU of adhesives and sealants	X			
09 01	Wastes from the photographic industry	X		X	
10 01	Wastes from power stations and other combustion plants		X		X
10 13	Wastes from the manufacture of cement, lime and plaster		X		
11 01	Wastes from chemical surface treatment of metals	X		X	
12 01	Wastes from shaping and physical and mechanical surface treatment of metals				
13 02	Waste engine, gear and lubricating oil	X		X	X
14 06	Waste organic solvents, refrigerants and propellants	X			
16 06	Batteries and accumulators			X	
18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	X			
19 08	Wastes from wastewater treatment plants		X	X	
20 03	Other municipal waste including septic tank waste		X		

(a) 01 03 - Wastes from Physical and Chemical Processing of Metalliferous Minerals

The number of generators in this industry group is limited however extraction industries typically produce large amounts of hazardous sludge from wastewater treatment processes. The sludge contains process chemicals (for example, arsenic for gold extraction) and concentrations of impurities from the parent material from which the metalliferous mineral was extracted. Survey data on this waste type is likely to be an underestimate, as several companies did not participate in the survey, with the most common reason being that their waste disposal practices were already adequately controlled under resource consents.

These wastes are toxic/ecotoxic and bio-accumulative. The waste is a priority waste because quantities are potentially large and the wastes are present at existing contaminated sites (for example, Tui Mine near Te Aroha). The best options for management of priority wastes arising from current processing of minerals are through the promotion of cleaner production initiatives followed by containment in storage structures designed for long-term security.

(b) 02 01 - Wastes from Agriculture, Horticulture, Aquaculture, Forestry, Hunting and Fishing

Individual farmers, horticulturists and agricultural spray contractors were excluded from the survey but individual chemical suppliers and contractors from these sectors were included. The wastes are generally surplus chemicals. Some are from household sources and are typically collected in hazardous chemical sheds at transfer stations. The household quantities are small but agricultural chemicals are a priority waste because they are bio-accumulative and toxic/ecotoxic even in small quantities.

Previous studies (for example, The Hamilton City Household Hazardous Waste Project [13]) have shown that approximately 25% of agricultural chemicals are intractable. Intractable chemicals can be broadly defined as persistent environmental chemicals that are not easily destroyed by conventional available treatment methods. Best practice disposal for intractable chemicals in New Zealand is currently often restricted to storage followed by collection and export for high temperature incineration.

The best option for management of priority wastes such as agricultural chemicals is waste minimisation including investigating purchasing the precise amounts needed and careful storage and handling. Also, reuse of agricultural chemicals through waste exchange is a sound method of disposal, assuming the chemicals are not redundant and intractable.

(c) 03 01 - Wastes from Wood Processing and the Production of Panels and Furniture

Sawdust was produced in enormous quantities by this industry, particularly in the Bay of Plenty. The vast majority was sourced from untreated timber. Other sources of sawdust and cuttings were considered hazardous because the timber has been treated, finger jointed (contains glue) or came from fibreboard (contains glue and resin). Industries contributing to this waste stream varied due to the widespread use of treated timber in manufacturing operations, and included wood and paper

[13] *The Hamilton City Household Hazardous Waste Project - Quantifying the Problem of Household Hazardous Wastes*, P. Blutner, et al., Environment Waikato, Hamilton City Council, Waste Management Conference, November 1994, Christchurch

processing, metal finishing and manufacturing, furniture manufacturing and building construction, as well as wood and paper processing.

These types of off cuts and sawdust are a priority waste because of the large quantities recorded, and the residual treatment chemicals, glues and resins are toxic/ecotoxic. Sawdust and cuttings may be disposed of at modern municipal solid waste landfills. The best option for management of sawdust and off-cuts from treated timber is through the promotion of cleaner production initiatives for the suppliers and waste minimisation for the processors.

(d) 03 02 - Wastes from Wood Preservation

A range of chemicals is used in wood preservation, such as copper and CCA (copper/chrome/arsenic). Improved treatment processes and operational standards have led to the replacement of CCA (copper/chrome/arsenic) in recent years with LOSP (Light Organic Solvent Preservative) however CCA remains in use where timber is prepared for marine applications. LOSP and CCA are both toxic and ecotoxic, as well as bio-accumulative. CCA is also responsible for many contaminated sites in the two regions. Industries reported as producing this waste were wood and paper processing, and metal finishing and manufacturing.

The best option for management of wood preservation wastes is through the promotion of cleaner production initiatives and waste minimisation (including investigating purchasing the precise amounts needed as well as careful storage and handling).

(e) 08 01 - Wastes from MFSU and Removal of Paints and Varnishes

Waste paints and varnishes were amongst the most common hazardous wastes disposed of to landfill. Paints and varnishes, as well as the chemicals used to remove them are flammable/ecotoxic. The main industrial sources in the two regions were the metal finishing and manufacturing industry, the automotive and electrical equipment manufacturing industry groups and the building construction and servicing sector.

The disposal of paints and varnishes is often poorly managed. Because of the high number of waste streams involved, they are deemed a priority wastes. The chemicals used to remove paints and varnishes are also priority wastes because they are more concentrated and more ecotoxic than paints and varnishes.

(f) 08 04 - Wastes from MFSU of Adhesives and Sealants

Waste adhesives and sealants are toxic/ecotoxic. In addition, adhesives and some sealants are flammable. These chemicals are priority wastes because their discharge as a trade waste is prohibited. The main industrial source recorded for these waste streams was the wood and paper processing group, although a Bay of Plenty company in the chemical, plastic and rubber processing and manufacturing industry category also reported a significant quantity being generated.

The best option for management of adhesives and solvents is through the promotion of waste minimisation initiatives (including purchasing the precise amounts needed and careful storage and handling).

(g) 09 01 - Wastes from the Photographic Industry

Film processing and X-Ray facilities in the health sector generate photographic industry wastes. Toxic and ecotoxic compounds contained in photographic waste

include silver, as well as acidic and fixing solutions. The main industries generating these waste streams included the printing and publishing industry, medical services and personal services categories.

Silver has a high value and cleaner production methods to recover the metal are becoming more sophisticated. Cleaner production is the best option for managing all photographic wastes.

(h) 10 01 - Wastes from Power Stations and Other Combustion Plants

Bottom and fly ash was generated in large quantities in Bay of Plenty and Waikato regions as a consequence of the combustion of coal and natural gas at various facilities. The bulk of waste streams recorded for this waste type during the survey was generated from the food and beverage manufacturing industry. The hazardous characteristics of the ashes include ecotoxicity due to alkalinity and high boron content, while the flue gases are toxic/ecotoxic (for example, dioxin). These wastes have been designated a priority waste because the ash and flue gases are produced in large quantities.

The reduction in natural gas production is seeing a corresponding increase in coal extraction. Coal is not as clean burning as natural gas and production of sulphate and nitrate compounds and other gaseous hazardous wastes is on the increase. Stricter regulations and the promotion of cleaner production measures are the best management options.

(i) 10 13 - Wastes from the Manufacture of Cement, Lime and Plaster

The number of businesses in this industry group was limited. The wastes generated are a priority waste because they are alkaline, ecotoxic and disposed of in large quantities. The best options for management of lime and plaster wastes is promoting cleaner production initiatives and the recycling of waste streams.

(j) 11 01- Wastes from Chemical Surface Treatments of Metals

Hot dip galvanisers are an example of this type of industry. The pickling acids are corrosive/toxic/ecotoxic, and the zinc and chromates are toxic/ecotoxic, as well as bio-accumulative. Industries generating such wastes in the two regions included wood and paper processing, metal finishing and manufacturing, and automotive and electrical equipment manufacturing.

Zinc and chromates have a relatively high economic value, and cleaner production methods to recover these metals are becoming more sophisticated. Promoting cleaner production is the best management option for these wastes.

(k) 12 01 - Wastes from Shaping and Physical and Mechanical Surface Treatment of Metals

Machining oils used in industry are often soluble, which makes them easier to refine for reuse. This waste is a priority waste because machining oils and emulsions are difficult to separate from metal cuttings for treatment. Industries generating this waste stream included metal finishing and manufacturing, agricultural services, and automotive and electrical equipment manufacturing.

The best option for management of metal surface treatment wastes is the promotion of waste minimisation initiatives (including purchasing the precise amounts needed and careful storage and handling).

(l) 13 02 Waste Engine Gear and Lubricating Oil

If waste oil is not too diluted with water and other impurities, it can be burnt as a fuel. However, when the oils become too diluted, they become difficult to dispose of. Waste oils often contain toxic, ecotoxic and bio-accumulative compounds, including contaminated metal cuttings, combustion products (for example, benzene) and anti freeze.

Waste oil is a priority waste because it is disposed of by almost all industries, and a high number of waste streams were reported during the survey. Therefore, it comes with a broad range of impurities and in large quantities overall. Unfortunately, the economics of re-refining of waste oil is dependent on the willingness of petrochemical industries to take back oil and the global price of crude oil. The preferred option for management of oily wastes is currently burning as a fuel rather than re-refining for economic reasons.

(m) 14 06 - Waste Organic Solvents, Refrigerants and Propellants

Solvents are used by many industries as thinners and cleaning agents. In the past, halogenated solvents like tri-chloroethylene were used because of their superior cleaning properties and non-flammability. In recognition of their carcinogenic property, other chemicals like turpentine are now used which are non-carcinogenic but flammable. In the past, refrigerants and propellants were commonly halogenated, but their ozone-depleting properties (for example, CFC's) have led to non-halogenated alternatives. Solvents are a priority waste because they are flammable/ecotoxic, are sourced from a broad range of industries, and contain many impurities. Refrigerants and propellants are priority wastes because they are ecotoxic/toxic, especially if halogenated. The best option for management of these wastes is through the promotion of cleaner production initiatives.

(n) 16 06 - Batteries and Accumulators

Lead acid batteries are widely used in vehicles and have bio-accumulative and corrosive/toxic/ecotoxic properties. Nickel cadmium batteries have similar properties, with cadmium being particularly ecotoxic. Batteries were recorded as a hazardous waste stream generated by a wide range of industries, with those associated with transport activities, equipment repair and servicing, building construction and maintenance being the main sources.

Waste batteries and accumulators are a priority wastes because many are not recyclable and the heavy metals (sometimes mercury) are bio-accumulative and toxic/ecotoxic. Lead has a relatively high economic value, and the recycling of batteries has been sufficiently economic for the recycling of lead-acid batteries at a facility in Lower Hutt. The best options for management of all other types of battery and accumulator wastes is through the promotion of cleaner production initiatives.

(o) 18 01 - Waste from Natal Care, Diagnosis, Treatment or Prevention of Disease in Humans

Wastes from the health industry are often hazardous because they are infectious. Dental wastes commonly include mercury. The quantities are tiny, but mercury is ecotoxic. Most infectious medical wastes in New Zealand are destroyed by high temperature incinerators.

This waste type was selected as a priority waste on the basis of the quantities generated in the two regions, and the apparent confusion over how it should be disposed of. The records kept of such waste streams were very patchy, making

estimates the only way of deriving quantities. Therefore, it is possible that the volumes reported during the survey are an over estimate of actual quantities produced.

(p) 19 08 - Waste from Wastewater Treatment Plants

Industrial wastewater treatment yields hazardous wastes in the form of sludges. Some sludges are derived from biological treatment processes and disposed of to landfill. Other sludges contain contaminants derived from industry processes. They are priority wastes because of the hazardous characteristics of the contaminants, often bio-accumulative and ecotoxic, as well as due to the large quantities reported in both regions.

Dewatering can reduce the volume of sludge for disposal, however the most appropriate disposal option really depends on the contaminant types and loadings, which were not generally obtainable during the survey.

(q) 20 03 - Other Municipal Waste Including Septic Tank Waste

Septic tank waste was included as a hazardous waste in the survey because it is infectious, and may also contain toxic and ecotoxic compounds derived from household and other chemicals. The large scale of waste quantities reported as being received by operators indicates that this is a significant waste stream needing careful management. The primary disposal method for these wastes is to a modern municipal wastewater plant incorporating secondary or tertiary treatment technology.

(r) Other Potential Priority Waste

Operator data discussed later in this report identify a number of waste streams that also should be considered priority wastes, including landfill leachate (19 07), contaminated soil (17 05), additional sludges from wastewater treatment plants (19 08) and large quantities of septic tank wastewater (20 03).

17 05 Contaminated Soil

Auckland operators reported receiving 2100 tonnes of contaminated soil from the Waikato for disposal at landfills. The industry source of this material was not divulged to the survey team. No generator participating in the survey reported such a waste stream. It is likely that the owners of sites where these waste streams originated from were not contacted during the survey, as mostly the clean up of contaminated sites is a result of historical and not current processes. The issue of potentially contaminated sites is currently under investigation by both regional and district councils.

19 07 Landfill Leachate

Both Bay of Plenty and Waikato operators reported receiving large quantities of landfill leachate that was discharged as trade waste into municipal wastewater treatment plants. Landfill leachate is a potential source of toxic and ecotoxic heavy metals, and other bio-accumulative contaminants that emanate from the waste deposited in the landfill of origin.

4.4.3.5 Hazardous Waste Disposal Pathways

Once a hazardous waste has been generated, there are a variety of paths it can follow during handling, treatment and final disposal (Figure 1). An understanding of pathways and waste quantities is essential in order to determine potential adverse effects in the receiving environment (refer Figure 1).

Table 24 records the quantities of waste reported by generators as being stored, treated or disposed of on site in the respective regions, by waste form and size of business. This table also records off-site recycling, discharge to trade waste and export from region quantities, in addition to setting out the quantities being transported by road as recorded during the survey.

(a) Storage

Waikato had significantly more hazardous waste stored on-site in comparison to the Bay of Plenty. In fact, companies with less than 20 employees reported providing storage for nearly double the waste quantities they generated, particularly for sludge. On closer examination of the sources of sludge, it became apparent that this was due to large volumes of sludge from concrete manufacture reportedly being stored in ponds on site. The quantity of solid waste stored on site in both regions could be related back to the amount of wood contaminated with hazardous substances being held on various sites.

An important point to note is that the quantity of contaminated wood being stored was generally calculated by extrapolation from a visual estimate.

Taking the above into account, the levels of on-site storage in comparison to levels being generated does not indicate a cause for concern that hazardous waste is being stockpiled on generator sites.

(b) On-site Treatment and/or Disposal

Some waste streams received on-site treatment prior to final disposal. Treatments ranged from pre-treatment prior to being transported off-site for disposal, to full treatment prior to on-site disposal under a resource consent. The range of disposal pathways used and on-site treatments provided is further discussed in sections 4.4.3.7 and 4.4.3.9 of this report.

Generators in the Bay of Plenty region reported that 45% of the waste produced received some sort of on-site treatment, but that less than 0.5% was disposed of on site. This percentage receiving on-site treatment is skewed by one major treatment plant sludge waste stream produced by the ‘chemical, plastic and rubber manufacturing industry’ that was eventually discharged to trade waste.

Waikato region survey participants reported 2.5% of waste streams as receiving some form of on-site treatment, with 20% being disposed of on-site. Waikato on-site disposal quantities were primarily from two discrete waste streams from the ‘wood and paper processing industry’ and ‘food and beverage manufacturing industry’, respectively. It can be seen from these results that the variable nature of data collected means that a single stream can skew the apparent results on a regional basis.

(c) Recycling/reuse

The quantities of hazardous waste recorded as being recycled on- or off-site are listed in Table 24 for both regions and as a grand total. Recycle or reuse quantities were recorded for 870 tonnes out of the 30,000 tonnes of hazardous waste reported by survey participants (approximately 3%).

The majority of recycled or reused waste streams were predictably oil- or solvent-based, and from a wide range of industry types. Section 4.4.3.6 gives a further breakdown on the type of recycling attributed to different waste streams. There were still a number of potentially recyclable waste streams identified by survey participants as going to final disposal at landfills, through trade waste or illegally. This indicates that more education and awareness is also needed to promote recycling or reuse opportunities.

(d) Transport

The generators that participated reported that most of the non-diluted liquid hazardous waste hazardous waste generated was transported from their facilities. The combined data set recorded 76% as being transported from the generators' facilities, although in the Bay of Plenty region the percentage was closer to 53%.

The majority of waste reported as being transported from sites by road is in solid or sludge form (over 95%). In the Bay of Plenty, the largest hazardous quantities recorded as being transported off site were the streams: 'Wastes from treatment plants' (19 08) at 3,300 tonnes, 'Human medical waste' (18 01) at 900 tonnes, and the 'Wood products contaminated with hazardous substances' (03 01) at 900 tonnes (Table 21). The most common stream in the Bay of Plenty was 'Waste engine, gear and lubricating oils' (13 02), with over 20% of all waste streams identified being oily wastes. There are a number of the waste streams that were completely recorded as being transported off site from all company sources. Some more liquid based hazardous waste streams had closer to 50% being transported off site by road for treatment and/or disposal (for example, 'Wastes from the photographic industry' - 09 01).

The Waikato region has two larger-quantity hazardous waste streams reported by participants as being transported off site. These are treatment plant sludge (19 08 – 16,340 tonnes) and boiler ash (10 01 – 8,500 tonnes). Table 22 lists the other significant streams, which include wood products contaminated with hazardous substances (03 01) at 2,300 tonnes and waste from the manufacture of cement, lime, plaster and products (10 13) at 1,100 tonnes. This latter waste code had one sludge waste stream being sent to landfill, which represents the bulk of the quantity reported (over 90%). Half the photographic industry waste streams identified in the Waikato region were recorded as being transported off site, with the remainder either go to trade waste or on-site disposal. Similarly, only approximately 38% of the wastes from wastewater treatment plants were recorded as being transported off site. The remainder was disposed of on-site.

There were smaller quantities of liquid hazardous waste also being transported by road, including oil, solvents and other specially collected waste streams. The majority of non-diluted hazardous waste produced by generator facilities appears to be being transported by road to treatment or final disposal sites.

(e) Discharge to Trade Waste

In the Bay of Plenty region, approximately 50% of the non-dilute waste streams reported by participants went to trade waste systems. In contrast, a far lower proportion (<1%) of the Waikato region non-diluted hazardous waste streams were reported as going to trade waste. However, the Bay of Plenty result is skewed by one large treatment plant sludge waste stream produced by the 'chemical, plastic and rubber manufacturing industry' that is disposed of via trade waste. It can be seen from these results that the variable nature of data collected means that a single stream can skew the apparent results on a regional basis when not all industries have participated.

(f) Export

The majority of waste quantity reported as being exported by generators in both regions during the survey was solid waste (3% of total waste recorded). This was mainly comprised of medical waste that was collected by Auckland operators from the Hospital, Medical and Personal Services industry categories. Export of waste is discussed in more detail in section 4.4.3.8.

Table 24 Hazardous waste storage, treatment, disposal and transport in both regions (excluding diluted liquid waste)

Region	Employee Number	Waste form	Generation	On-site storage	Off- site storage	On-site treatment	On-site disposal	Off-site treatment	Transport from facility	On-site recycle reuse	Off-site recycle / reuse	Discharge to trade waste	Export from region
Bay of Plenty	<20	Gas	0.08	0.09				0.06	0.06	0.03			0.06
Bay of Plenty	<20	Liquid	261.92	62.54		0.00	4.18	109.12	235.27	1.10	126.39	3.14	17.00
Bay of Plenty	<20	Solid	1028.84	327.13			14.17	906.13	961.79	0.15	24.92	60.00	2.11
Bay of Plenty	<20	Sludge	438.30	126.68		33.57		420.34	422.08			17.40	30.00
Sub-Total	**<20**		**1729.1**	**516.4**	**0.0**	**33.6**	**18.3**	**1435.6**	**1619.2**	**1.3**	**151.3**	**80.5**	**49.2**
Bay of Plenty	>20	Gas	0.00										
Bay of Plenty	>20	Liquid	276.53	54.09		4.63	3.85	89.87	204.57		133.27	47.68	18.91
Bay of Plenty	>20	Solid	913.90	90.37	0.00		5.00	901.57	908.89		7.33		572.44
Bay of Plenty	>20	Sludge	3821.51	585.75		3001.00		490.94	810.94		10.00	3320.37	4.84
Sub-Total	**<20**		**5011.9**	**730.2**	**0.0**	**3005.6**	**8.9**	**1482.4**	**1924.4**	**0.0**	**150.6**	**3368.0**	**596.2**
TOTAL	**ALL**		**6741.1**	**1246.7**	**0.0**	**3039.2**	**27.2**	**2918.0**	**3543.6**	**1.3**	**301.9**	**3448.6**	**645.4**
Waikato	<20	Gas	1.32	0.07				1.30	1.32				0.02
Waikato	<20	Liquid	217.67	68.71		1.54	1.37	52.49	204.81	2.59	152.76	10.50	3.15
Waikato	<20	Solid	1691.65	1335.04	0.02	0.00	0.48	1636.89	1694.55	0.10	57.94		11.34
Waikato	<20	Sludge	2355.64	6518.76	2.00	33.09	1000.07	2302.41	2322.72	2.00	22.06	0.00	0.26
Sub-Total	**<20**		**4266.3**	**7922.6**	**2.0**	**34.6**	**1001.9**	**3993.1**	**4223.4**	**4.7**	**232.8**	**10.5**	**14.8**
Waikato	>20	Gas	0.20	0.20				0.20	0.20				
Waikato	>20	Liquid	584.91	142.73		24.55	24.11	237.13	447.65	106.05	209.18	5.74	41.02
Waikato	>20	Solid	9949.74	155.69			724.53	9207.28	9225.24		17.96		338.10
Waikato	>20	Sludge	8146.84	1485.94	0.80	495.03	2740.00	5347.17	5368.37	2.40		5.00	12.20
Sub-Total	**<20**		**18681.5**	**1784.4**	**0.8**	**519.6**	**3488.6**	**14791.6**	**15041.3**	**108.5**	**227.1**	**10.7**	**391.3**
TOTAL	**ALL**		**22947.8**	**9706.9**	**2.8**	**554.2**	**4490.6**	**18784.7**	**19264.7**	**113.1**	**459.9**	**21.2**	**406.1**
GRAND TOTAL			**29688.8**	**10953.6**	**2.8**	**3593.4**	**4517.7**	**21702.7**	**22808.3**	**114.4**	**761.8**	**3469.8**	**1051.4**

4.4.3.6 Recycle/reuse Codes – NZ Draft Hazardous Waste Definition

The R-codes were used in the survey to describe hazardous waste in terms of the recycling/recovery/reuse routes adopted. This code has been adopted from overseas models refer Appendix A-4).

The quantities of hazardous waste recorded as being recycled on or off site are listed in Table 25 for both regions as a combined total. Of the approximately 30,000 tonnes of hazardous waste generated, only 688 tonnes were recycled or reused in some way. The majority of this occurred in non-specified ways.

Table 25 Recycling and reuse of hazardous waste (excluding diluted liquid waste)

Recycle Code	Code Explanation	Number of waste streams	Generation (tonnes)
R1	Use as a fuel	5	8.4
R2	Solvent reclamation/regeneration	38	103.4
R3	Recycling/reclamation of organic substances not used as solvents	13	27.4
R4	Recycling/reclamation of metals	16	65.0
R5	Recycling/reclamation of other inorganic compounds	23	1.2
R6	Regeneration of acids or bases	1	2.5
R9	Used oil re-refining	141	461.4
R10	Land treatment resulting in benefit to agriculture	1	43.3
R13	Accumulation of materials pending any of the above	3	0.4
R14	Reconditioning drums	2	0.0
Sub Total		**243**	**688.0**
R15	Other or Unknown	1,094	28,976.5
TOTAL		**1,337**	**29,689.0**

Table 25 shows that used oil re-refining (R9) and solvent reclamation were the most frequent methods of recycling/reuse indicated by participants. An over-representation of streams recorded in the R15 (Other) category is partially a result of the database requiring an entry in both recycling and disposal codes (one of these being “Non-Applicable”), and partially a result of a lack of knowledge by generators. Anecdotally, many generators admitted to not knowing what happened to their waste once it was taken off site.

4.4.3.7 Disposal codes – NZ Draft Hazardous Waste Definition

The D-codes were used in the survey to describe hazardous waste in terms of the disposal routes adopted (Appendix A-4). These codes have been adopted from overseas models and have generally not been modified, except by adding an additional code for “discharge to trade waste (7a)”.

The quantities of hazardous waste recorded as being disposed of in various ways are listed in Table 26 for both regions as a combined total.

In terms of the number of waste streams going to different D codes the highest proportion were recorded as D16 (Other). This is partly as a result of the database

requiring an entry to be made under both Disposal and Recycling codes, leading to an over representation of 'Other'.

The next highest numbers of streams and quantity were for Deposit Into or Onto Land (D1) at approximately 9000 tonnes. Land Treatment (D2) had a high quantity (10,000 tonnes) recorded against it but relatively few waste streams.

As with the recycling codes referred to previously, anecdotally many generators admitted to not knowing what happened to their waste streams once they were taken off-site. A breakdown of D16 (Other) from Table 26 was calculated and 375 streams were reported by respondents who did not know where their waste went, while 469 streams recorded a "Not Applicable" against this code. Therefore, the R-codes yielded minimal useful information.

Table 26 Disposal of hazardous waste (excluding diluted liquid waste)

Disposal Code	Definition	Number of waste streams	Quantity (tonnes)
D1	Deposit into or onto land	274	8,858.1
D2	Land treatment	7	10,769.0
D4	Surface impoundment	9	498.7
D5	Specially engineered landfill	7	16.6
D6	Release into a fresh water body - not under a consent	3	0.3
D7a	Discharge to trade waste	74	423.5
D8	Biological treatment not specified elsewhere	3	3,000.0
D9	Physico-chemical treatment	13	23.3
D10	Incineration on land	40	1,242.9
D12	Permanent storage	6	1.0
D13	Blending or mixing prior to any of the above	5	29.4
D14	Repacking prior to any of the above	1	0.1
D15	Storage pending any of the above	48	128.4
D16	Other	847	4,697.9
TOTAL		**1,337**	**29,689.0**

Some of the explanations from respondents concerning disposal code D16 (Other) indicate a general lack of knowledge or understanding of disposal requirements for hazardous waste streams. For instance, responses including 'mashed into the ground', 'released slowly into the environment (illegal)', and 'evaporates on workshop floor' indicate that some undesirable practices are still occurring. There were 64 waste streams identified during the survey that generators admitted were being disposed of illegally, 58 of these could not be quantified by the company involved. In addition, there were many more instances in which hazardous waste is put out with the general refuse, which is undesirable.

4.4.3.8 Import/export of Hazardous Waste

Potentially significant cross-boundary issues can arise when hazardous waste is transported from one region to another for disposal or recycling. Therefore, a closer look at the destination of waste streams is warranted. Table 27 records the destination of various hazardous waste streams reported by participating generators in the two regions.

Table 27 Destination of hazardous waste streams exported by generators to other regions (excluding diluted liquid waste)

Source region	4-digit waste code	Waste code definition	Generation (tonnes)	Number of waste streams	Export (tonnes)	Destination region	Totals exported by destination (tonnes)
Waikato	08 03	Wastes from MFSU of printing inks	0.01	1	0.01	Wellington	
		Sub-Total Waikato to Wellington				**Wellington**	**0.01**
Waikato	16 02	Wastes from electrical and electronic equipment	0.01	1	0.01	Taranaki	
		Sub-Total Waikato to Taranaki				**Taranaki**	**0.01**
Bay of Plenty	13 02	Waste engine, gear and lubricating oils	16.50	3	16.50	South Island	
Waikato	13 02	Waste engine, gear and lubricating oils	4.00	2	3.33	South Island	
		Sub-Total Waikato to South Island				**South Island**	**19.83**
Bay of Plenty	14 06	Batteries and accumulators	0.05	1	0.05	Overseas	
Waikato	16 06	Waste organic solvents, refrigerants and propellants	0.05	1	0.05	Overseas	
		Sub-Total to overseas				**Overseas**	**0.10**
Bay of Plenty	03 02	Wastes from wood preservation	0.84	1	0.84	Auckland	
Bay of Plenty	08 01	Wastes from MFSU and removal of paint and varnish	1.00	2	1.00	Auckland	
Bay of Plenty	12 01	Wastes from shaping and physical and mechanical surface treatment of metals and	1.68	2	1.68	Auckland	
Bay of Plenty	13 02	Waste engine, gear and lubricating oils	0.50	1	0.50	Auckland	
Bay of Plenty	14 06	Waste organic solvents, refrigerants and propellants	14.07	3	14.07	Auckland	
Bay of Plenty	15 02	Absorbents, filter materials, wiping cloths and protective clothing	0.01	1	0.01	Auckland	
Bay of Plenty	16 03	Off-specification batches and unused products	5.00	1	5.00	Auckland	
Bay of Plenty	16 06	Batteries and accumulators	2.00	1	2.00	Auckland	
Bay of Plenty	18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	603.70	15	603.70	Auckland	
		Sub-Total to Auckland from Bay of Plenty					**626.80**
Waikato	03 01	Wastes from wood processing and the production of panels and furniture	2.40	1	2.40	Auckland	
Waikato	03 02	Wastes from wood preservation	3.80	2	3.80	Auckland	

Source region	4-digit waste code	Waste code definition	Generation (tonnes)	Number of waste streams	Export (tonnes)	Destination region	Totals exported by destination (tonnes)
Waikato	08 01	Wastes from MFSU and removal of paint and varnish	0.40	1	0.40	Auckland	
Waikato	08 03	Wastes from MFSU of printing inks	2.40	1	2.40	Auckland	
Waikato	11 01	Wastes from chemical surface treatment and coating of metals and other materials	0.82	4	0.82	Auckland	
Waikato	12 01	Wastes from shaping and physical and mechanical surface treatment of metals and	0.40	1	0.40	Auckland	
Waikato	13 02	Waste engine, gear and lubricating oils	368.76	153	28.40	Auckland	
Waikato	13 03	Waste insulating and heat transmission oils	0.40	2	0.40	Auckland	
Waikato	14 06	Waste organic solvents, refrigerants and propellants	10.14	6	8.34	Auckland	
Waikato	15 02	Absorbents, filter materials, wiping cloths and protective clothing	0.10	1	0.10	Auckland	
Waikato	16 01	End-of-life vehicles and wastes from dismantling of end-of-life vehicles and vehicle	0.01	1	0.01	Auckland	
Waikato	16 05	Gases in pressure containers and discarded chemicals	0.02	1	0.02	Auckland	
Waikato	16 06	Batteries and accumulators	0.00	1	0.00	Auckland	
Waikato	18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	287.65	20	287.65	Auckland	
Waikato	18 02	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	57.18	5	57.18	Auckland	
Waikato	19 08	Wastes from waste water treatment plants not otherwise specified	6.00	1	6.00	Auckland	
Waikato	20 01	Separately collected fractions (except 15 01)	3.60	2	3.60	Auckland	
		Sub-Total from Waikato to Auckland				**Auckland**	**401.92**
		Totals to Auckland				**Auckland**	**1,030.72**
		TOTALS	**1,393.49**	**239**	**1,050.67**		

Generators reported exporting a total of approximately 1,051 tonnes of hazardous waste to other regions, 1,022 tonnes of this being sent to Auckland. The majority of waste recorded as exported is medical and veterinary waste (L-code 18). Most waste exported was sent to Auckland. Approximately 19 tonnes of oil was sent to the South Island, presumably to be burnt in the Milburn kiln. A further 28 tonnes of oil was sent to Auckland. Approximately 10 tonnes of batteries were sent from the Waikato to Wellington for recycling.

Bay of Plenty generators reported exporting a total of approximately 627 tonnes of hazardous waste to Auckland, 16.5 tonnes to the South Island and 0.5 tonnes overseas. Waikato generators reported exporting a total of approximately 400 tonnes to Auckland and 3 tonnes to the South Island, with small quantities also going overseas or to Taranaki.

A factor contributing to greater exports being recorded in the Bay of Plenty may be the reduced number of suitable disposal facilities. However given the survey data set limitations, this apparent difference may not be real.

Additional waste streams were reported as being exported by waste operators, which will be discussed in section 4.5 of this report.

4.4.3.9 On-site Treatment Methods – All Waste Streams

Table 28 records the number of waste streams receiving different types of treatment on-site by study category for all waste streams (including diluted liquid hazardous waste). Each waste stream may receive several types of treatment, and any one site may have multiple waste streams, therefore the number of streams cannot be summed. From survey data it would appear that approximately 13.4% of waste generated in the two regions receives some form of on-site treatment prior to final disposal.

Table 28 Types of on-site treatment of waste streams

Study category	Abbreviated Definition[14]	Total no. of waste streams	Chemical treatment	Sedimentation	Filtration	Dewatering	Bio-logical	Solidification	Other
A	Agriculture etc	59		5			1		1
B	Mining	18				1			
Ca	Metal product manufacturing	153	8	4	1	1			6
Cb	Food, textile and non-metallic manufacturing	244	16	37		3	21	2	
Cc	Wood, machinery and other manufacturing	431	8	16	6	4	3	4	1
D	Electricity, gas and water supply	10							
E	Construction	70	1	2				2	3
F	Wholesale trade	30							
G	Retail trade	103		6	1	1			1
I	Transport and storage	134		12			1		1
L	Property and business services	49	1	4			1		
O	Health and community services	184	1	1					2
Q	Personal and other services	67		1	1				2

[14] For a more complete listing refer to Table 7.

Za	Government, education etc	9		1	1	1			
		1,561	**35**	**89**	**10**	**11**	**27**	**8**	**17**

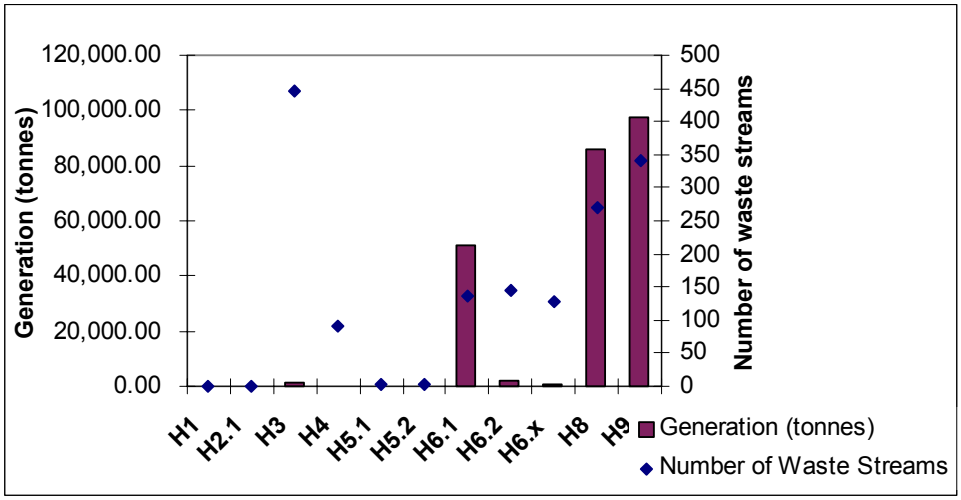
The regions have a number of major industries with on-site treatment and disposal systems. A number of these industries were not able or not prepared to provide information on wastes entering these systems. Only the discharges from the systems are monitored under existing resource consents. Hence, it is likely that the above figures are an underestimate of the percentage of waste receiving on site treatment for the combined regions.

4.4.3.10 Primary Hazardous Characteristics – All Waste Streams

Figure 3 and the associated legend show the hazardous characteristics of all recorded waste streams and compares them with the actual waste quantities. Of interest is that although a large number of waste streams were categorised as flammable liquids, this comprised only a small quantity of waste. This situation also applies to substances classified as H6.2 (infectious) and H6.X (chronically toxic).

Codes H8 and H9 were mostly comprised of diluted waste streams. It should be noted that the surveyors had to classify the waste based on information given to them by the generator. Therefore, the application of the H Code was influenced by the generator's understanding of why the waste stream was hazardous, so the applied codes may not always have been appropriate. The high number of ecotoxic waste streams (H9) may in part be attributable to a lack of knowledge of why else the stream may have been hazardous.

Figure 3 Primary hazardous characteristics



Legend

Code	Characteristics
H1	Explosives
H2.1	Flammable gases
H3	Flammable liquid
H4	Flammable and reactive solids
H5.1	Inorganic oxidisers
H5.2	Organic oxidisers
H6.1	Acute toxicity (through oral, dermal, gas, vapour or gas/mist exposure)
H6.2	Infectious (Land Transport Rule: Dangerous Goods 1999 and NZ Standard 5433:1999 – Transport of Dangerous Goods on Land

Code	Characteristics
H6.x	Chronic toxicity (mutagen, carcinogen, reproductive/developmental toxicity, target organ toxicity)
H7	Radioactivity (Radiation Protection Act 1965 and Radiation Protection Regulations 1982)
H8	Corrosively
H9	Ecotoxicity

4.4.3.11 **Record Keeping**

Generally the record keeping of survey participants was poor. Less than 40% of the identified waste streams had quantities recorded by invoices (Table 29). The majority of measurements provided were estimates of quantities rather than hard data. The accessibility of records was also poor, as many companies had more information on their waste streams but could not retrieve it over the survey period. This has significant implications for the accuracy and ease of interpretation of the data collected.

Table 29 Format of records held, for all generator waste streams in both regions

Study category	Abbreviated definition[15]	Method of record keeping					
		Numbers of generators	Electronic	Hard copy	Invoices	Annual report	Manifest
A	Agriculture etc	59			6	1	
B	Mining	18			10		
Ca	Metal product manufacturing	153	2	1	47	3	
Cb	Food, textile and non-metallic manufacturing	244	11	13	117		
Cc	Wood, machinery and other manufacturing	431	21	11	167	4	3
D	Electricity, gas and water supply	10			3		
E	Construction	70	1	2	31		
F	Wholesale trade	30			6		
G	Retail trade	103			33	1	
I	Transport and storage	134		1	33		
L	Property and business services	49	8	2	33	4	1
O	Health and community services	184	1	6	87		
Q	Personal and other services	67		1	45		
Za	Government, education etc	9	2	0	1		
Total		**1,561**	**46**	**37**	**619**	**13**	**4**
Overall % (not cumulative)			**2.9%**	**2.4%**	**39.7%**	**0.8%**	**0.3%**

[15] For a more complete listing refer to Table 7.

4.4.4 Qualitative Data

4.4.4.1 Generator Comments

In general, generators demonstrated a lack of knowledge about hazardous waste and what was required to handle, treat or dispose of it appropriately. The main concerns expressed were in respect of the cost of waste disposal. Most generators were relatively satisfied with the current situation, although this is in part due to a lack of awareness of the issues.

Many respondents commented on the available hazardous waste disposal services. This included many positive comments. As previously mentioned, the majority of survey participants were satisfied (73%) with the hazardous waste management systems in the Waikato and Bay of Plenty regions. The respondents who were not satisfied were concerned with the lack of local hazardous waste treatment facilities, and the high and variable cost of waste disposal.

The respondents were happy to offer advice about possible improvements. Approximately 25% indicated that there was a real lack of disposal facilities and information/education on hazardous waste and recycling in general.

Hazardous wastes that in the opinion of some respondents could not be disposed of easily included waste oil, batteries and asbestos. There were also one-off examples of waste chemicals that respondents were storing because they did not know where to dispose of them. These included trichloroethylene, thinners, alkalis, acids, kerosene, adhesives, brake fluid and cutting fluid.

A frequent concern raised about hazardous waste disposal was the poor availability of information on what was considered hazardous, what the best course of action was for treatment/disposal, and how much it was likely to cost. Generators commented that operators would not give them a price estimate over the phone, while operators commented that generators often had no idea what was in their waste that they wanted taken away, so providing an estimate of the cost for disposal was not possible.

Generators did come up with a variety of suggestions about possible improvements to hazardous waste services. The direct responses included:

- Smaller or rural areas need somewhere to take their hazardous waste otherwise they keep accumulating.
- Councils should provide an 0800 number for people to ring to find out where to dispose of hazardous waste. Transfer stations could take some small industrial hazardous waste streams.
- Councils should provide places for waste to go. It is too easy to just throw hazardous waste away. Councils should provide information and facilities to encourage people to reduce or reuse waste streams.
- Some collection/disposal services are based in Auckland, and this increases costs.
- Replicate Auckland services, as the only disposal companies available are based in Auckland. There is a need for local disposal options.
- Make a list of all types of facilities closer to the region.
- High temperature burning should be implemented.

- Need to raise awareness of what services are available. Need to encourage the public to deal with their waste in a more environmentally fashion. Also, need to have a system of better control of all disposal operators/contractors. This could be along the lines of some sort of "certification", where operators who meet set criteria are publicised.
- Need a government facility for treating hazardous wastes - attitude is apathetic.
- Need to formalise the system, that is, put into place standard protocols for the industry to follow.

All these suggestions point to a greater involvement required by regional and district councils in providing information, helping find solutions and setting standards.

4.4.4.2 Surveyor Observations

The surveyors themselves made a number of observations over the course of the survey that support the need for better information availability and an improved dissemination process. A number of these are recorded below:

- There was a common misconception that hazardous waste was only lethal or highly toxic to humans, and a lack of awareness of other possible hazards such as eco-toxicity.
- Once an operator has collected a hazardous waste stream, it is no longer seen to be a generator problem. Relatively few generators were aware of where their waste went for disposal after it left their site.
- The majority of generators stated they were satisfied with the hazardous waste services in their area, but at the same time many did not know what hazardous waste was or how it should be managed.
- Complaints were made by generators who had discovered they had hazardous waste and could not get a price for its removal and treatment or alternatively were astonished at the real cost of treatment and disposal quoted to them. A number of respondents also commented that the high cost of waste disposal encouraged illegal disposal methods.

4.4.4.3 Sources for Technical Advice

As part of the survey questionnaire, generators and operators were asked where they go to obtain advice on appropriate treatment of hazardous waste streams. Table 30 records the responses over both regions. Over the two regions, 32% of generators would approach their district council for advice, 9% would approach their regional council and 7% would seek industry or in-house advice on what to do with hazardous waste streams. Of more concern were approximately 23% of generators who had hazardous waste streams but were unsure of where to go to get advice on what to do with them.

This indicates that councils are seen as an important potential source of information to many generators. District council are perceived by many generators as having a significant role to play in the dissemination of advice, but anecdotal comments indicated that many companies looking for information were dissatisfied with the assistance available from both their local and regional councils.

Table 30 Information sources for generators

Source	Waikato %	Bay of Plenty %	Combined %
District Council	32	32	32
Regional Council	9	9	8
Industry/In-house	7	7	8
Chemical Supplier	5	6	5
Waste Operator	2	4	3
Yellow Pages	3	2	2
MS Data Sheets	1	1	1
Other	17	16	18
Don't Know	24	23	23
Total	**100**	**100**	**100**
Total Responses	**853**	**600**	**1,453**

4.4.5 Diluted Liquid Hazardous Waste Data

Diluted waste streams represented a significant problem for this study as the accuracy of the data was questionable, and in many cases data could not be obtained at all, hence affecting how representative this information is for the industries in question. Diluted waste streams were deemed to include all waste streams substantially diluted with water that could be discharged to a wastewater treatment plant without further treatment. This included those waste streams that generators identified as being the raw chemical component of a dilute waste.

Diluted waste streams are considered separately in this report to avoid results being masked by large diluted waste quantities, and to reduce the margin of error in the model predictions, as explained in section 4.4.2. Tables 31 and 32 show the diluted liquid hazardous waste streams.

4.4.5.1 Quantities of Diluted Liquid Hazardous Waste

The survey team experienced real difficulties in determining quantities and concentrations of contaminants in dilute wastewater streams. In such instances, the waste may potentially be too dilute to retain hazardous characteristics or it is simply 'lost' in the final effluent and/or sludge. Many industries produce waste waters that contain a diverse range of hazardous chemicals, but monitoring of individual contaminant concentrations is not routinely undertaken unless there is potential for a breach of a resource consent condition to occur.

Generally treatment plant operators only monitor parameters that assist with plant operation and in particular parameters that may upset the treatment process and in turn lead to non-conforming effluent in terms of their resource consent (for example, Volume, pH, Total Suspended Solids, Chemical Oxygen Demand, Nitrate, Phosphorus).

In a number of cases, municipal wastewater treatment plants had few or no trade waste quantity or quality limits and little monitoring targeted at the hazardous constituents within the wastewater is undertaken. It is likely that some territorial local authorities hold substantially more information on trade waste discharges, however the relevant information could not be retrieved over the survey period.

Generators in the Bay of Plenty region reported generating 42,000 tonnes of diluted hazardous waste, of which 72% was reported as being discharged to trade waste facilities. Figures were distorted by one particularly large wash water waste stream of 30,000 tonnes reported by a 'personal services' (Category Q) industry. The next largest waste quantity was nearly 10,000 tonnes of wash water from the ceramic and concrete manufacturing industry. Most of the waste streams were in fact wash waters from various industry sources.

The 'Waste from agricultural services' included two streams of pesticide that were diluted and sprayed on to pasture for disposal. The 'ceramic and concrete manufacturing industry' and the 'food and beverage manufacturing' industries were the source of the highest number of diluted waste streams in the Bay of Plenty region. On-site treatment was provided to approximately 19% of the quantities reported in this region prior to disposal.

Generators in the Waikato region reported generating 167,000 tonnes of diluted hazardous waste, with 85% being discharged to municipal trade waste facilities. Figures were distorted by three large waste streams reported as fully diluted volumes. These streams originated from the 'chemical, plastic and rubber manufacturing' industry, the 'ceramic and concrete manufacturing' industry and the 'automotive and electrical equipment manufacturing' industries. All were wash waters from various processes.

The 'food and beverage manufacturing' industry, the 'ceramic and concrete manufacturing' industry and the 'personal services' industries were the source of the highest number of diluted waste streams in the Waikato region. Waste from the Waikato 'food and beverage' industry consisted of 49 streams and 7,900 tonnes. This represents a number of waste streams where concentrated chemical use volumes were the only information available and therefore this total does not reflect the final volume of discharge.

4.4.5.2 Data Limitations

Some generators could only supply the quantity of raw chemical used prior to dilution, while others could provide the total estimated volume but no or limited data on contaminant concentrations. Therefore, little analysis can be done on diluted hazardous waste.

The New Zealand Waste Management Strategy has specific targets relating to the trade waste issue that have implications for the collection of relevant data on hazardous waste streams. These are:

1 By December 2005, all territorial local authorities will have implemented and will be monitoring Model General Trade Waste Bylaws based on the New Zealand Standard Model, Part 23 – Trade Waste, or equivalent.

2 By December 2005, all territorial local authorities will ensure that all holders of new or renewed trade waste permits will have in place a recognised waste minimisation and management programme.

A similar approach would need to be extended to private on-site treatment plants to ensure that equivalent data is collected for hazardous wastes disposed of at their facilities.

Table 31 Dilute liquid hazardous waste streams and their disposal path in the Bay of Plenty region

ANZSIC sub-division	ANZSIC Code explanation	4-digit Waste Code	Waste Code explanation	Number of waste streams	Generation (tonnes)	On-site treatment (tonnes)	On-site disposal	Off-site treatment (tonnes)	Trade waste (tonnes)
I67	Storage	02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing	2	1,820.00		1,820.00		
C22	Textile and Leather Processing and Manufacturing	04 02	Wastes from the Textile Industry	1	0.03				0.03
C21	Food and Beverage Manufacturing	06 01	Wastes from MFSU of acids	1	31.20	31.20			31.20
C28	Automotive and Electrical Equipment Manufacturing	06 01	Wastes from MFSU of acids	1	1.00			1.00	
C23	Wood and Paper Processing	08 04	Wastes from MFSU of adhesives and sealants (including waterproofing products)	1	36.50	36.50			36.50
C28	Automotive and Electrical Equipment Manufacturing	10 02	Wastes from the iron and steel industry	1	9.60			9.60	
C27	Metal Finishing and Manufacturing	11 01	Wastes from chemical surface treatment and coating of metals and other materials	2	164.00	164.00			112.00
C21	Food and Beverage Manufacturing	16 05	Gases in pressure containers and discarded chemicals	3	107.00				107.00
C23	Wood and Paper Processing	16 05	Gases in pressure containers and discarded chemicals	2	0.01	0.01			
O86	Hospital and Medical Services	16 05	Gases in pressure containers and discarded chemicals	1	0.70				0.70
Q95	Personal Services, including Photographic and Emergency Services	16 05	Gases in pressure containers and discarded chemicals	8	0.10				0.10
L78	Research, Pest Control and Cleaning Services	16 09	Oxidising substances	2	0.02		0.02		
Q95	Personal Services, including Photographic and Emergency Services	16 09	Oxidising substances	2	0.08				0.08
O86	Hospital and Medical Services	18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	3	2.66			1.96	0.70

ANZSIC sub-division	ANZSIC Code explanation	4-digit Waste Code	Waste Code explanation	Number of waste streams	Generation (tonnes)	On-site treatment (tonnes)	On-site disposal	Off-site treatment (tonnes)	Trade waste (tonnes)
A02	Agricultural Services	20 01	Separately collected fractions (except 15 01)	1	0.04		0.04		
C21	Food and Beverage Manufacturing	20 01	Separately collected fractions (except 15 01)	13	53.88	31.20			25.80
C26	Ceramic and Concrete Manufacturing	20 01	Separately collected fractions (except 15 01)	8	9,827.25	7,912.00	80.25		
C27	Metal Finishing and Manufacturing	20 01	Separately collected fractions (except 15 01)	1	0.00				0.00
C28	Automotive and Electrical Equipment Manufacturing	20 01	Separately collected fractions (except 15 01)	1	0.90			0.90	
C29	Manufacturing nec	20 01	Separately collected fractions (except 15 01)	2	0.62				0.62
G53	Automobile Repair and Servicing	20 01	Separately collected fractions (except 15 01)	1	50.00			50.00	
I61	Road Transport	20 01	Separately collected fractions (except 15 01)	2	209.20			208.00	1.20
I63	Water Transport	20 01	Separately collected fractions (except 15 01)	1	0.13				0.13
I64	Air Transport	20 01	Separately collected fractions (except 15 01)	1	0.05		0.05		
I67	Storage	20 01	Separately collected fractions (except 15 01)	1	0.01				0.01
L78	Research, Pest Control and Cleaning Services	20 01	Separately collected fractions (except 15 01)	3	1.82		0.02		1.80
Q95	Personal Services, including Photographic and Emergency Services	20 01	Separately collected fractions (except 15 01)	2	30,000.07		0.07		30,000.07
Q96	Fire Brigade	20 01	Separately collected fractions (except 15 01)	2	0.28				0.28
TOTAL				**69**	**42,317.15**	**8,174.9**	**1,900.5**	**271.5**	**30,318.2**

Table 32 Diluted liquid hazardous waste streams and their disposal paths in the Waikato region

ANZSIC sub-division	ANZSIC Code explanation	4-digit Waste Code	Waste Code explanation	Number of waste streams	Generation (tonnes)	On-site treatment (tonnes)	On-site disposal	Off-site treatment (tonnes)	Trade waste (tonnes)
A02	Agricultural Services	02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing	1	200.00	200.00			
C21	Food and Beverage Manufacturing	06 01	Wastes from MFSU of acids	3	17.90	17.90	17.90		0.00
C28	Automotive and Electrical Equipment Manufacturing	06 01	Wastes from MFSU of acids	1	0.24			0.24	
C28	Automotive and Electrical Equipment Manufacturing	10 02	Wastes from the iron and steel industry	1	10.00			10.00	
C27	Metal Finishing and Manufacturing	11 01	Wastes from chemical surface treatment and coating of metals and other materials	6	326.77	0.25		326.50	0.27
C28	Automotive and Electrical Equipment Manufacturing	11 01	Wastes from chemical surface treatment and coating of metals and other materials	2	49,002.00			2.00	49,000.00
C28	Automotive and Electrical Equipment Manufacturing	12 03	Wastes from water and steam degreasing processes (except 11)	1	4.00			4.00	
F46	General Product Wholesaling	12 03	Wastes from water and steam degreasing processes (except 11)	1	1.50			1.50	
C21	Food and Beverage Manufacturing	16 05	Gases in pressure containers and discarded chemicals	3	2.70	2.70	2.70		
C23	Wood and Paper Processing	16 05	Gases in pressure containers and discarded chemicals	1	3.00			3.00	
C25	Chemical, Plastic and Rubber Processing and Manufacturing	16 05	Gases in pressure containers and discarded chemicals	1	3.00			3.00	
L78	Research, Pest Control and Cleaning Services	16 05	Gases in pressure containers and discarded chemicals	6	0.38			0.15	0.23
Q95	Personal Services, including Photographic and Emergency Services	16 05	Gases in pressure containers and discarded chemicals	15	1.05				1.05
C21	Food and Beverage Manufacturing	16 09	Oxidising substances	4	1.58	1.20	1.20		0.38
C28	Automotive and Electrical	16 09	Oxidising substances	1	18.00				18.00

ANZSIC sub-division	ANZSIC Code explanation	4-digit Waste Code	Waste Code explanation	Number of waste streams	Generation (tonnes)	On-site treatment (tonnes)	On-site disposal	Off-site treatment (tonnes)	Trade waste (tonnes)
	Equipment Manufacturing								
Q95	Personal Services, including Photographic and Emergency Services	16 09	Oxidising substances	7	0.51				0.51
C25	Chemical, Plastic and Rubber Processing and Manufacturing	16 10	Aqueous liquid wastes bound for offsite treatment	1	90,000.00				90,000.00
O86	Hospital and Medical Services	18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	5	0.08		0.00	0.07	
A02	Agricultural Services	20 01	Separately collected fractions (except 15 01)	4	0.26		0.10		0.16
C21	Food and Beverage Manufacturing	20 01	Separately collected fractions (except 15 01)	49	7,935.54	7,641.35	7,641.79	3.51	290.64
C24	Printing and Publishing	20 01	Separately collected fractions (except 15 01)	1	7.20				
C26	Ceramic and Concrete Manufacturing	20 01	Separately collected fractions (except 15 01)	18	19,262.00	13,600.00	5,018.25	120.00	2,500.00
C28	Automotive and Electrical Equipment Manufacturing	20 01	Separately collected fractions (except 15 01)	2	1.55				1.55
E42	Building Construction and Servicing	20 01	Separately collected fractions (except 15 01)	2	0.07				0.07
G53	Automobile Repair and Servicing	20 01	Separately collected fractions (except 15 01)	1	0.01		0.01		
I61	Road Transport	20 01	Separately collected fractions (except 15 01)	3	3.25		0.13	2.40	0.72
L78	Research, Pest Control and Cleaning Services	20 01	Separately collected fractions (except 15 01)	6	1.83		0.03		1.81
M81		20 01	Separately collected fractions (except 15 01)	1	39.00				39.00
O86	Hospital and Medical Services	20 01	Separately collected fractions (except 15 01)	5	5.46			0.10	5.36
Q95	Personal Services, including Photographic and Emergency Services	20 01	Separately collected fractions (except 15 01)	3	1.15				1.15
TOTAL				**155**	**166,850.0**	**21,463.4**	**12,682.1**	**476.5**	**141,861.0**
GRAND TOTAL TABLES 31 AND 32				**224**	**209,167.2**	**29,638.31**	**14,582.55**	**747.93**	**172,179.11**

4.5 Operator Data

Waste operators were considered to be potentially the most reliable source of information on hazardous waste quantities and management practices. However, survey results indicate that many operators could further improve their waste recording systems.

4.5.1 Definitions

Operators include:

- Tanker truck operators that cart liquid waste and/or septic tank waste.
- Councils that dispose of liquid waste in their municipal wastewater treatment plants and receive solid hazardous waste at transfer stations.
- Private firms that treat and dispose of liquid and solid hazardous waste.

4.5.2 Operators - Sample Size

In total, 262 operators were surveyed (Table 12). Of these, 58 were out of business or wrongly listed (22%), and a further 71 were not prepared to participate (27%). This left 133 operators taking part in the survey.

In the Bay of Plenty region, a total of 73 operators were contacted, with 25 (33%) being either out of business, wrongly listed or not willing to participate. The 48 that did participate produced 56 hazardous waste streams in total. All 5 territorial local authorities and Environment Bay of Plenty participated.

In the Waikato region, a total of 99 operators were contacted, with 31 (31%) being either out of business, wrongly listed or not willing to participate. The 68 firms that did participate produced 64 hazardous waste streams. All 9 territorial local authorities and Environment Waikato participated. Out of region, a total of 90 operators were contacted, with 13 (14%) being out of business and a further 60 firms that did not receive waste from the Bay of Plenty or Waikato regions or that were not prepared to participate (66%). This left 17 companies, which received 52 waste streams in total.

4.5.3 Data Limitations

Private operators typically do not distinguish between diluted and non-diluted liquid hazardous waste. As discussed in section 4.4.2, the Project Control Group decided that the diluted waste streams should be analysed separately from the non-diluted waste streams to reduce the margin of error in analysis. However, in the case of information received from private operators, it was not possible to determine whether streams would be considered to be diluted waste streams or not. Therefore, private operator data has not been totally separated into diluted and non-diluted waste streams.

A number of significant operators were not willing to participate or not able to retrieve precise quantity or contaminant concentration data over the survey period. For landfills and municipal treatment plants (particularly where trade waste bylaws were in place) it was clear that further relevant information was being collected, but not in an easily retrievable format and it could not be retrieved within the survey timetable. In many cases, this was attributed to a lack of staff time and resources to

compile the data required. This has clearly affected the completeness of the data set, and affects the ability to analyse the data meaningfully.

Municipal and private industry wastewater treatment plants also typically did not collect detailed information on the hazardous constituents in waste streams arriving for treatment. Generally, a suite of non-hazardous parameters was monitored (for example, volume, pH, Total Suspended Solids, Chemical Oxygen Demand, nitrate, phosphorus). To assist with council treatment plant operation and in particular parameters that may upset the treatment process and in turn lead to non-conforming effluent. This meant that the complete data required for analysis of total hazardous waste quantities and national indicator calculations could not be collected.

Due to commercial sensitivity issues, little or no information could be obtained on industry specific wastes. This creates some difficulty in establishing a mass balance between wastes being generated by specific industry categories and where they are finally disposed of.

A further complication is the manner in which Waikato and Bay of Plenty private operators function. They generally do not differentiate between the two regions as sources, which makes it impossible to specify what quantity of wastes came from each region. Therefore, Waikato and Bay of Plenty operators are not analysed separately.

4.5.4 Operator Total Quantities Received

Once hazardous waste has been collected by a waste operator there are a variety of paths it can follow during handling, treatment and final disposal. An understanding of the pathways and the significance of them is required in order to assess the appropriateness and the effects of management practices in place.

Table 33 records the quantities and form of waste reported by operators as being received, generated, stored, treated or disposed of on-site in the respective regions by waste form and size of business. This table also records off-site recycling, discharge to trade waste and export from region tonnages on the same basis. Although trade waste quantities, where known, were included in the survey, they were omitted from Table 33 because large diluted waste streams could distort the data significantly. The problem is not so much their size but there were a significant number of similar waste streams missing from the data set due to the information not being able to be supplied over the survey time period.

Table 33 Waste disposal paths – all operator waste streams

Region	Waste form	Received (tonnes)	Operator generated (tonnes)	On-site storage (tonnes)	On-site treatment (tonnes)	On-site disposal (tonnes)	Off-site treatment (tonnes)	On-site recycle/ reuse (tonnes)	Off-site recycle / reuse (tonnes)	Discharge to trade waste (tonnes)	Export from Waikato/BOP (tonnes)	Imported by other regions (tonnes)
Auckland	Liquid	1763.3		2018.0	1037.5	50.0	415.4	573.5	648.0	134.5		1761.6
Auckland	Solid	2499.9	0.2		71.2	2365.8	95.5	13.5	25.2			2495.2
Auckland	Sludge	288.3	19.2		237.4	50.9	218.0			65.3		288.3
Auckland Total		**4551.5**	**19.4**	**2018.0**	**1346.1**	**2466.7**	**728.8**	**587.0**	**673.1**	**199.8**		**4545.1**
Bay of Plenty	Gas	0.5		0.0			0.3	0.1	0.0		0.3	
Bay of Plenty	Liquid	1262.2	13808.7	1.7	53.0	0.3	13824.7	50.0	1186.1	13797.0	1127.0	
Bay of Plenty	Solid	1382.0	0.1	13.6			116.0		1259.5		1255.4	
Bay of Plenty	Sludge	8193.2	3607.3	50.0	4540.0	6000.0	3400.5			2478.0	0.0	
BOP Total		**10837.9**	**17416.1**	**65.3**	**4593.0**	**6000.3**	**17341.6**	**50.1**	**2445.6**	**16275.0**	**2382.7**	
Taranaki	Liquid	60.0			60.0				60.0			60.0
Taranaki Total		**60.0**	**0.0**	**0.0**	**60.0**	**0.0**	**0.0**	**0.0**	**60.0**	**0.0**		**60.0**
Waikato	Gas	0.6					0.5					
Waikato	Liquid	500876.1	30008.0	61.1	500059.7	499825.0	974.0		54.9	30560.0	206.8	
Waikato	Solid	7371.0	11.3	3.7	5000.0	117.0	2058.5	1.1	5202.9		2323.0	
Waikato	Sludge	3020256.2	1325.0	1000.0	9635.2	8435.2	12571.0		75.0	3004626.0	75.0	
Waikato Total		**3528504.0**	**31344.3**	**1064.8**	**514694.9**	**508377.2**	**15604.0**	**1.1**	**5332.8**	**3035186.0**	**2604.8**	
		3543953.4	**48779.7**	**3148.1**	**520694.0**	**516844.2**	**33674.5**	**638.2**	**8511.5**	**3051660.8**	**4987.5**	**4605.1**

Table 34 Waste destinations – all operator waste streams

Originating Region	Waste Code	Waste Code Explanation	Received (tonnes)	Number of waste streams	Exported quantity (tonnes)	Destination Region	Total quantity exported by Waikato/BOP operators
Bay of Plenty	16 06	Batteries and accumulators	1,252.40	8	1,252.40	Wellington	
Waikato	16 06	Batteries and accumulators	173.40	4	183.40	Wellington	
						Wellington Total	**1,435.80**
Bay of Plenty	13 02	Waste engine, gear and lubricating oil	1,126.96	1	1,126.96	South Island	
						South Island Total	**1,126.96**
Bay of Plenty	14 06	Waste organic solvents, refrigerants	0.05	1	0.05	Australia	
						Australia Total	**0.05**
Bay of Plenty	03 02	Wastes from wood preservation	0.00	1	0.00	Auckland	
Bay of Plenty	13 05	Oil/water separator contents	0.00	1	0.00	Auckland	
Bay of Plenty	14 06	Waste organic solvents, refrigerants	0.30	1	0.30	Auckland	
Bay of Plenty	16 06	Batteries and accumulators	5.90	1	3.00	Auckland	
Bay of Plenty	20 03	Other municipal wastes including septic tank waste	0.00	1	0.00	Auckland	
Waikato	04 01	Wastes from the leather and fur industry	6.00	1	6.00	Auckland	
Waikato	06 02	Wastes from the use of bases	200.00	1	200.00	Auckland	
Waikato	08 03	Wastes from printing inks	0.08	1	0.08	Auckland	
Waikato	13 02	Waste engine, gear and lubricating oil	0.80	1	0.80	Auckland	
Waikato	16 06	Batteries and accumulators	18.72	2	18.73	Auckland	
Waikato	17 05	Soil (including excavated from contaminated sites)	2,100.00	2	2,100.00	Auckland	
Waikato	17 06	Insulation and construction materials containing asbestos	15.00	1	15.00	Auckland	
Waikato	18 01	Human medical waste	5.75	1	5.75	Auckland	
Waikato	20 01	Separately collected fractions	75.00	1	75.01	Auckland	
						Auckland Total	**2,424.67**

4.5.4.1 Waste Form, Quantity and Waste Type (New Zealand Waste Code)

Table 33 indicates that operators receive over 3.54 million tonnes of hazardous waste and generate a further 49,000 tonnes by their activities. This quantity generated by operators is primarily made up of leachate from landfills (19 07) and sludge from treatment plant processes (19 08). The waste received includes two large waste streams (500,000 and 3,000,000 tonnes) that account for 99% of the waste quantity identified. These two waste streams are liquid (wastes from oil/water separators) and sludge (septic tank waste) respectively. While these streams do skew the data set significantly, they were retained in the data set as they are discrete waste streams identified by private operators.

Auckland operators reported receiving a total of 4,551 tonnes of hazardous waste from the two regions. Bay of Plenty operators received nearly 11,000 tonnes of waste, with the highest quantities being septic tank sludge (20 03), separately collected fractions (20 01), batteries and accumulators (16 06) and waste oils (13 02).

The Waikato operators reported receiving a huge quantity of septic tank sludge (20 03) as well as a large waste stream of oil/water separator contents (13 05). They also recorded receiving a significant quantity of contaminated soil (17 05), and wastes from shaping and physical and mechanical surface treatment of metals (12 01).

Appendix G records the waste codes of hazardous waste handled by operators, and includes the dilute hazardous waste streams identified during the survey. Two large volume waste streams coded as 02 01 (wastes from agriculture and horticulture) and 02 02 (wastes from processing of meat, fish and animals) are included in Appendix G but not in tables 33 and 34. These streams were aqueous cleaning streams collected by a private operator with no hard data on their contaminant loading characteristics being available.

4.5.4.2 Priority Hazardous Waste Received by Operators

This is discussed in section 5.5 of this report.

4.5.4.3 Treatment and Disposal Methods

The majority of waste operators in the Waikato and Bay of Plenty provided only basic treatment such as sedimentation or solidification on-site. Waste streams requiring more significant treatment were generally exported to Auckland.

4.5.4.4 Hazardous Waste Disposal Pathways

(a) Storage

On-site storage was reported for 1,120 tonnes of waste received by Waikato and Bay of Plenty operators, which is less than 0.5% of total waste received. This level of on-site storage does not indicate a cause for concern that hazardous waste is being stockpiled on operator sites in the Waikato. Anecdotal comments were made to surveyors about the quantity of municipal sewage sludge that could potentially accumulate and cause a problem, however data that was provided does not indicate this is a current problem.

(b) On-site Treatment/disposal

Waikato and Bay of Plenty operators reported treating approximately 513,000 tonnes of hazardous waste on-site. The largest stream was on oil/water interceptor waste (500,000 tonnes) that was treated on site and disposed of on site (cleaned water was discharged to a storm water system). The remaining quantity was primarily solids and sludges that were treated prior to disposal. The sludges reported as being disposed of on operator sites were primarily septic tank sludge (20 03).

(c) Recycling/reuse

Recycling is an important part of hazardous waste management. Operators reported recycling or reusing approximately 9,150 tonnes of hazardous waste streams they received. Roughly 28% or 2,600 tonnes were solvent or oil waste streams. A further 5,000 tonnes was contaminated soil recorded as being reused off-site after treatment. A further 1,500 tonnes represented the batteries collected for recycling. As operators in the Bay of Plenty and Waikato collect waste from both regions without differentiating between them, it is not possible to clearly identify what waste originated in which region specifically.

(d) Trade Waste

Further trade waste volume data was available, particularly from the city councils, but was not sought because there was no accompanying data on hazardous characteristics of individual trade wastes. Nearly 86% of waste received or generated by waste operators was discharged to trade waste for final disposal. This would indicate that trade waste is a major disposal route for hazardous waste in the Waikato and Bay of Plenty regions.

(e) Special Waste to Landfills

An aspect that this survey was intended to cover was the type and quantity of 'special' wastes going to landfills in the two regions. Special waste is hazardous waste that is disposed of at landfills and requires special procedures for waste acceptance and disposal.

While information on special waste quantities is supplied to the Ministry for the Environment (MfE) such information is often collated manually. Time constraints and work pressures on council and private landfill operators, and the fact that the survey period was out of phase with the MfE reporting programme, meant that participants were typically unable to gather information for the survey team. Private operators considered their discharges complied with their resource consents, and a number stated that the extra effort of collecting the information over the survey period was not warranted given that they supplied information at other times of the year as per resource consent conditions.

While lists of what was accepted were available, in most cases quantities received were not. The type of wastes accepted at any landfill depended on the level of containment provided and the resource consent conditions attached to the required permits. Table 35 sets out the wastes accepted at an average and a high level of protection landfill.

Table 35 Waste acceptance at landfills

Average Landfill	Landfill with Higher Protection
• Asbestos • Animal Carcasses/Offal • Septic Tank Sludge (some restrict) • Sewage Screenings • Grease Trap Waste • Paint (<10 litres) • Drums – (triple rinsed) • General Medical Waste • Boiler Ash	• Subject to TCLP compliance on leachate producing wastes: • Hydrocarbon waste • Tannery wastes • Resins • Expired 1080 bait • Non PCP timber treatment waste • Oil interceptor wastes • Photographic chemical waste • Surface metal treatment chemical waste • Pharmaceutical product waste • Poisonous substances • Medical waste • Lab waste (inert) • Lead paint dust

There are landfill site-specific requirements as well. For example, where a landfill is required to cart its leachate away, tight restrictions on liquids characteristically apply. Quantities were sparse due to weigh bridges not being in operation over the last year on many sites. A number of sites have subsequently installed weighbridges, so future data will be more reliable.

(f) Export

Export of hazardous waste by participating operators in the Bay of Plenty and Waikato regions is shown in Table 34 and Appendix G. The fact that operators themselves are also exporting waste demonstrates that the pathways that hazardous wastes follow are complex. A zero value for quantity indicates a waste stream was identified but not quantified.

The three largest waste streams exported are:

- Soil (including excavation from contaminated sites) (code 17 05) – 2,100 tonnes, sent to Auckland for disposal.
- Waste engine, gear and lubricating oils (13 02) – 1,100 tonnes, sent to the South Island, presumably to be burnt in the Milburn kiln.
- Batteries and accumulators 1,400 tonnes, sent to Wellington for recycling.

4.5.5 Qualitative Data – Operator Comments

Many operators took time to make comments. The level of satisfaction with hazardous waste management systems was notably lower for operators (50%) than for the generators (73%). A number of operators expressed concern over the fact that many generators had no idea what was in their waste, and got belligerent when told that until it was characterised the operator could not give them an estimated disposal cost.

The surveying of operators began a short time after the generator survey commenced. Anecdotal comments from operators indicated that there had been an upsurge in enquiries from a number of industry types in the days before they were contacted, which could indicate the survey was indeed assisting to raise awareness of the issues associated with the management of hazardous waste.

Many survey participants offered advice about possible improvements to hazardous waste services. There was generally a good match with responses from the generator survey. Approximately 40% of operators who commented cited lack of disposal facilities, information and education on hazardous waste as concerns. Operators stated that more assistance and resources from district and regional councils (12%) and greater enforcement of regulations (5%) relating to hazardous waste as their most preferred improvements. This response is quite different from generators who instead raised the cost of disposal and lack of recycling as important issues.

It is assumed that operators did not see the cost of disposal as an issue because they are able to pass their costs on to generators. Only one operator considered that improvements were necessary to achieve better environmental outcomes.

Operators suggested the following specific improvements:

- A checklist that lists common disposal methods.
- More policing required of companies about the type of waste they are generating, and what they are actually doing with it. Councils need to put systems in place to ensure hazardous waste is managed appropriately, including providing enforcement manpower.
- Better lines of communication required between generators, waste operators and councils.
- One operator commented that generators were unlikely to keep detailed records on waste streams unless it became a legal requirement.
- Several local operators commented that if the councils got together and built a hazardous waste disposal facility within the region, then transport costs to Auckland could make it financially viable.

Chapter 5: Estimates of Hazardous Waste Quantities

5.1 Overview

An important objective of the survey was the intention to predict total hazardous waste quantities generated across the total industry population in the Bay of Plenty and Waikato. The original survey design broke the sample population into industries with ≤20 employees ("small industries") or >20 employees ("large industries"). All large industries were intended to be sampled, while a statistically representative sub-sample was taken of small industries with (refer Table 8).

Even though it was intended to sample all large industries, in reality the UBD database (which was used to draw the sample) covered only a fraction of the Statistics New Zealand (SNZ) database (which was used to estimate the full survey population). In addition, a range of other limitations to collecting data applies such as graphically shown in Figure 3, and discussed elsewhere in sections 3.5.1.1 and 4.2.

As a result of the limitations in sampling large industries, predictions of total hazardous waste quantities were also made for large industries, in an attempt to estimate hazardous waste quantities across the full SNZ database. It is acknowledged that while this was not planned in the original survey design, such estimates could be acceptable in cases where the variation around the mean was found to be limited.

The approach to predicting waste quantities was linked to the original survey design. This was based on the stratified cluster design; the strata being defined by region, the 14 study categories and industries with less or equal, or more than 20 employees, and the cluster being defined by the waste streams generated by each industry surveyed. As explained earlier, having such broad groups was necessary for the purpose of the predictive model; however one of the drawbacks was the loss of detail for lower level industry categories. However, some of this detail has been captured in section 4.4 as part of the analysis of actual survey results.

Waste quantities were estimated as follows:

- By region, study category and number of employees.
- By waste form (liquids, solids and sludges).
- By priority hazardous waste (waste code).

The predictive model employed was based on the following design, where total waste quantities (TQ) and standard errors (SE) were estimated as follows:

	WHERE:
TQ = N((n$_c$+ n$_0$)/n) $\bar{y}$	Count of waste streams, **n$_c$**
	Average, $\bar{y}$
SE = N (√((1-(n/N)/n)) ((n$_c$+ n$_0$)/n) s	Standard deviation, **s**
	Count of unquantified waste streams, **n$_u$**
	Number of firms with no hazardous waste, **n$_0$**
	Number of firms >= 1 Waste stream, **n – n$_0$ >0**
	Sample size firms participating, **n**
	Statistics New Zealand count, **N**

The translation of this concept into a practical methodology is explained further in Appendix J.

5.2 Understanding the Variability of Quantity Estimates

Due to the variability of waste materials, estimates of waste quantities are only approximate in nature. Similar to the methods used by statisticians in opinion polls, for example, limited samples of hazardous waste generators must be used to describe the characteristics of the whole population. For this reason, this study had to use a representative sample of generators to estimate the complete hazardous waste quantity generated in the two regions.

Estimates of variability are used to explain the degree of variation of data around a mean or a population estimate, in this case estimated hazardous waste quantities. The magnitude of estimates of variability in the case of this study depend on a range of factors, including:

- The number of samples taken in relation to the total sample population within each study category.
- Availability of quantitative information on waste streams encountered.
- The variability in the quantities of waste streams encountered.
- Intrinsic industrial differences between the regions.
- Errors in the database (estimated to be around 10 – 15%).

The standard error tells us how much we can expect any given sample statistic to deviate from the population parameter we are estimating (this is in contrast to the sample standard deviation which tells us how much an individual sampling point deviates from the mean of its sample). The standard error also allows the calculation of confidence intervals, which show us the range within which 90%, 95% or 99% of observations (or predicted hazardous waste quantities) could be expected to lie.

In the tables that follow in this report and Appendices G and I, estimates of uncertainty have been expressed as standard errors and coefficients of variation (that is, the percentage of the standard error of the estimated mean). To obtain the 90% - 95% confidence limits, either the standard error or the coefficient of variation has to be approximately doubled.

As an example, in Table 36 (presenting estimated hazardous waste quantities over both regions by study category) the total predicted quantity of waste for large and small industries was 39,407 tonnes (standard error = 4,823 tonnes; coefficient of variation = 12%) and 53,828 tonnes (standard error = 15,360 tonnes, coefficient of variation = 29%). For all industries, the total predicted waste quantity was 93,235 (standard error = 16,100 tonnes, coefficient of variation = 17%). If we were to translate these estimates of variability into 90% - 95% confidence limits, we would need to approximately double either the standard error of the coefficient of variation. Therefore, for total predicted waste quantities across the two regions, the 90% - 95% confidence limit around the mean would be approximately 93,235 $\pm$ 32,200 tonnes.

5.3 Limitations

In developing the predictive model, account had to be taken of those industries that had gone out of business, were wrongly listed, or were not prepared to participate (refer Figure 2). As the number of these industries was relatively limited, they were treated as if they were a normal part of the survey population. While this is not an ideal situation, this is normal practice in statistical survey design and data evaluation. Further, those industries that generated hazardous waste but were not able to provide information were counted as a hazardous waste generator. However, they were not used to calculate statistical parameters such as means and standard deviations.

Gases and dilute liquid hazardous wastes were omitted from the predictive exercise. For gases very few waste streams were encountered which did not allow predictions. Also, dilute liquid hazardous waste (usually trade waste) was excluded from this exercise, due to the highly variable quality of the information obtained. However, liquid hazardous waste in undiluted form was included.

5.4 Results

5.4.1 Overview

The results presented below present predictions for total waste quantities for the two regions separately and combined, by study category, by waste form (liquid, sludge and solids) and by waste type. Refer to tables 10 to 12 for total population numbers of generators and operators. It is noted that while the results presented appear to be accurate and precise, they are in fact based on data that are of highly variable quality, as noted in section 4. They should therefore be viewed as indications only, and as having greater relevance in relative rather than absolute terms.

5.4.2 Hazardous Waste Generation Quantity Estimates by Study Category

Tables 36 to 38 show estimates for total hazardous waste generation quantities for the two regions combined and separately. An additional breakdown of these data into liquids, sludge and solids is provided in Appendix H.

Table 36 shows that predicted quantities of hazardous waste generated in the two regions combined amounted to 93,235 tonnes, with a coefficient of variation of 17 %. This was made up of predicted quantities for the smaller and larger industries of 39,407 tonnes (coefficient of variation = 12%) and 53,828 tonnes (coefficient of variation = 29%), respectively.

For the Waikato region, the total predicted quantity was 69,864 tonnes (EU = 27%). This consisted of 26,075 tonnes (coefficient of variation = 15 %) from smaller industries and 43,789 tonnes (coefficient of variation = 42 %) from large industries. For the Bay of Plenty region, total quantities were estimated at 24,314 tonnes (coefficient of variation = 24 %), consisting of 14,107 tonnes (coefficient of variation = 18%) and 10,207 tonnes (coefficient of variation = 51%) from smaller and large industries, respectively.

Estimated hazardous waste quantities for the Waikato region were significantly higher compared to the Bay of Plenty region. Further, in the Waikato region, large industries were found to contribute greater quantities of hazardous waste than the smaller ones. The opposite applied to the Bay of Plenty. It is noted that for both regions, the coefficient of variation for the larger industries is relatively high, meaning that the estimates themselves are a lot more variable. Nonetheless, these results reflect the fact that the Waikato region has a greater industry population and also a higher number of large industries.

Hazardous waste quantities estimated for the two regions separately show that the quantity estimates and associated coefficient of variations for the different study categories are quite variable. To a large degree, this can be related to the original sampling design, which was very focused on the manufacturing industries (ANZSIC Division C) and placed less emphasis on the other study categories, on the basis of observations made in earlier hazardous waste surveys in the Auckland region.

However, what the results also bear out is that in fact other study categories also contribute significant quantities of hazardous waste once the full industry population is taken into account (refer Table 8). Results show different trends for the two regions. In the Waikato, study categories Ca and Cb (basic metal and food manufacturing industries) were found to be significant, whereas in the Bay of Plenty study, category Cc (wood processing and pulp and paper industries) was found to dominate. This reflects the different industry profiles in the two regions.

Generally, the level of variability, expressed as coefficients of variation, of the results for the regions combined was lower than for the two regions separately. This is a result of working with a much larger sample.

After splitting the waste quantity estimates into different waste forms, estimates of uncertainty were found to decrease further, mainly because the samples are a lot more homogeneous. Appendix H shows the detailed results for these breakdowns, while Table 39 shows a summary. As is the case for most of the analyses undertaken in this survey, dilute liquid hazardous waste is excluded.

Overall, hazardous waste in sludge and solid form dominated in the Waikato region. Sludge was predominantly generated in the primary produce/food processing (wet) industry, and generated by on-site wastewater treatment systems. Solid hazardous waste was mainly generated by the basic metal, construction and property industry.

Comparatively lower levels of sludge were found in the Bay of Plenty. Solid hazardous wastes were mainly generated by the basic metal, wood processing and construction industry.

Table 36 Estimated hazardous waste generation quantities – both regions combined

Study category	Abbreviated definition		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture etc	Estimate	3,624	220	40%	51%
		SE	1,455	113		
B	Mining	Estimate	18	867	31%	88%
		SE	5	765		
Ca	Metal product manufacturing	Estimate	5,304	84	22%	28%
		SE	1,181	24		
Cb	Food, textile and non-metallic manufacturing	Estimate	5,413	36,596	15%	39%
		SE	792	14,118		
Cc	Wood, machinery and other manufacturing	Estimate	6,325	11,315	24%	50%
		SE	1,489	5,603		
D	Electricity, gas and water supply	Estimate	4	2	22%	0%
		SE	1	0		
E	Construction	Estimate	5,083	339	60%	57%
		SE	3,025	194		
F	Wholesale trade	Estimate	613	0	38%	
		SE	234	0		
G	Retail trade	Estimate	5,654	1	38%	9%
		SE	2,167	0		
I	Transport and storage	Estimate	2,708	265	31%	19%
		SE	849	51		
L	Property and business services	Estimate	3,140	8	46%	33%
		SE	1,432	3		
O	Health and community services	Estimate	967	3,569	48%	59%
		SE	468	2,121		
Q	Personal and other services	Estimate	556	562	22%	57%
		SE	123	318		
Za	Government, education etc	Estimate	0	1	0%	0%
		SE	0	0		
TOTAL		**Estimate**	**39,407**	**53,828**	**12%**	**29%**
		SE	**4,823**	**15,360**		
TOTAL	**(all industries combined)**	**Estimate**		**93,235**		**17%**
		SE		**16,100**		

SE = Standard Error

Table 37 Estimated hazardous waste generation quantities – Bay of Plenty region

Study category	Abbreviated definition		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤20	> 20	≤ 20	> 20
A	Agriculture etc	Estimate	242.2	137.5	56.9%	71.3%
		SE	137.8	98.1		
B	Mining	Estimate	3.2	304.1	0.0%	0.0%
		SE	0.0	0.0		
Ca	Metal product manufacturing	Estimate	1,284.8	5.6	15.7%	10.5%
		SE	201.2	0.6		
Cb	Food, textile and non-metallic manufacturing	Estimate	533.8	12.5	10.3%	13.4%
		SE	55.2	1.7		
Cc	Wood, machinery and other manufacturing	Estimate	6,154.3	6,667.6	31.1%	66.8%
		SE	1,915.1	4,456.2		
D	Electricity, gas and water supply	Estimate	1.4	1.5	23.1%	0.0%
		SE	0.3	0.0		
E	Construction	Estimate	842.4	1,43.5	97.7%	59.9%
		SE	822.6	85.9		
F	Wholesale trade	Estimate	258.1	0.0	54.8%	
		SE	141.4	0.0		
G	Retail trade	Estimate	1,642.2	0.2	40.4%	70.7%
		SE	663.3	0.1		
I	Transport and storage	Estimate	1,252.8	103.0	58.0%	25.7%
		SE	726.3	26.5		
L	Property and business services	Estimate	1,460.0	6.8	65.5%	0.0%
		SE	956.8	0.0		
O	Health and community services	Estimate	245.3	2,275.1	83.2%	118.9%
		SE	204.0	2,704.5		
Q	Personal and other services	Estimate	187.1	549.0	33.0%	68.1%
		SE	61.7	373.8		
Za	Government, education etc	Estimate	0.0	0.1	0.0%	0.0%
		SE	0.0	0.0		
TOTAL		**Estimate**	**14,107.5**	**10,206.5**	**18%**	**51%**
		SE	**2,520.9**	**5,227.8**		
TOTAL	**(all industries combined)**	**Estimate**		**24,314**		**24%**
		SE		**5,804**		

SE = Standard Error

Table 38 Estimated hazardous waste generation quantities – Waikato region

Study category	Abbreviated definition		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture etc	Estimate	3,048.6	96.9	43.3%	79.3%
		SE	1,320.5	76.8		
B	Mining	Estimate	15.2	157.8	44.3%	70.3%
		SE	6.8	111.0		
Ca	Metal product manufacturing	Estimate	4,363.6	90.3	34.5%	34.6%
		SE	1,506.0	31.2		
Cb	Food, textile and non-metallic manufacturing	Estimate	5,547.6	37,096.2	19.3%	49.2%
		SE	1,072.1	18,263.6		
Cc	Wood, machinery and other manufacturing	Estimate	1,315.8	4,409.1	30.0%	44.5%
		SE	394.5	1,960.2		
D	Electricity, gas and water supply	Estimate	1.2	0.4	36.6%	0.0%
		SE	0.4	0.0		
E	Construction	Estimate	3,513.9	127.6	63.9%	72.1%
		SE	2,244.4	91.9		
F	Wholesale trade	Estimate	317.0	0.0	38.1%	
		SE	120.9	0.0		
G	Retail trade	Estimate	3,789.5	0.0	49.1%	
		SE	1,862.0	0.0		
I	Transport and storage	Estimate	1,453.7	176.3	33.9%	18.1%
		SE	493.4	31.9		
L	Property and business services	Estimate	1,655.3	0.5	65.2%	0.0%
		SE	1,079.6	0.0		
O	Health and community services	Estimate	683.8	1,580.6	59.7%	57.1%
		SE	408.3	902.3		
Q	Personal and other services	Estimate	370.1	52.5	29.6%	62.4%
		SE	109.5	32.7		
Za	Government, education etc	Estimate	0.1	0.7	0.0%	0.0%
		SE	0.0	0.0		
TOTAL		**Estimate**	**26,075.4**	**43,788.9**	**15%**	**42%**
		SE	**3,927.3**	**18,391.4**		
TOTAL	**(all industries combined)**	**Estimate**		**69,864**		**27%**
		SE		**18,806**		

SE = Standard Error

Table 39 Estimated hazardous waste quantities for the two regions by form

Region	Waste form		Estimates (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
Waikato	Liquid	Estimate	5,866	1,361	23%	17%
		SE	1,332	227		
	Sludge	Estimate	9,805	17,915	10%	23%
		SE	937	4,077		
	Solid	Estimate	11,412	25,411	20%	42%
		SE	2,334.	10,615		
Bay of Plenty	Liquid	Estimate	4,847	588	19%	19%
		SE	908	111		
	Sludge	Estimate	2,410	6,735	12%	28%
		SE	298	1,904		
	Solid	Estimate	6,830	3,137	17%	78%
		SE	1,141	2,437		

SE = Standard Error

Table 40 shows a breakdown of priority waste quantities generated for the two regions combined. Priority wastes were identified based on actual survey results (refer section 4.4.3.4 and Appendix F). However, a predictive analysis for a hazardous waste type was undertaken when one or more of the following criteria were met:

- The waste occurred in significant quantities or was known to be highly hazardous.
- The number of recorded waste streams exceeded five (required to calculate a mean and a standard deviation).
- The waste was known to be highly hazardous.

In terms of the quantity estimates, wastes from wood processing (03 01), waste oil (13 01/02/03) and sludge from wastewater treatment plants (19 08) dominated, jointly contributing some 47,000 tonnes.

It is also evident that the estimates of uncertainty for priority wastes are in general quite low for both the smaller and large industries. Again, this can be explained by the fact that wastes within the same hazardous waste type are expected to be a lot more homogeneous.

Table 40 Estimated total waste generation quantities by priority waste type

Waste category	Description		Estimates (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
03 01	Wastes from wood processing and the production of panels and furniture	Estimate	10,043	1,297	10%	15%
		SE	959	192		
03 02	Wastes from wood preservation	Estimate	1.7	32.8	0%	10%
		SE	0.0	3.3		
08 01	Wastes from MFSU and removal of paint and varnish	Estimate	614	42	7%	12%
		SE	43	5		
08 04	Wastes from MFSU of adhesives and sealants (including waterproofing products	Estimate	2.0	134	6%	9%
		SE	0.1	12.6		
09 01	Wastes from the photographic industry	Estimate	296	170	14%	7%
		SE	40	11		
11 01	Wastes from chemical surface treatment and coating of metals and other materials	Estimate	65	998	12%	15%
		SE	8	154		
12 01	Waste from the surface treatment of plastics and metal		558	35.9		
		SE	0	2.8	0%	8%
13 01/02/03	Waste hydraulic oils/Waste engine, gear and lubricating oils/Waste insulating and heat transmission oils	Estimate	8,414	1,096	12%	11%
		SE	1,033	122		
14 06	Waste organic solvents, refrigerants and propellants	Estimate	515	103	16%	7%
		SE	83	7.3		
16 01	End-of-life vehicles and wastes from dismantling of end-of-life vehicles and vehicle maintenance	Estimate	672	8.9	19%	6%
		SE	129	0.6		
16 06	Batteries and accumulators	Estimate	1,519	40.0		
		SE	193	3.1	13%	8%
18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	Estimate	1,693	3,847		
		SE	342	1721	21%	45%
19 08	Wastes from waste water treatment plants not otherwise specified	Estimate	6,485	19,178		
		SE	457	2275	7%	12%
20 01	Separately collected fractions (except 15 01)	Estimate	290	6.3	22%	7%
		SE	63	0.4		
20 03	Other municipal wastes	Estimate	672	6,250	18%	14%
		SE	119	900		

SE = Standard Error

5.5 Comparison between Recorded Quantities and Predicted Quantities of Priority Hazardous Waste

Based on the information presented in sections 4 and 5, it is possible to make a comparison between actual survey and estimated hazardous waste quantities. Actual hazardous waste quantities generated and estimated in the Bay of Plenty region were 6,741 tonnes and 24,314 tonnes respectively. In the Waikato region these figures were 22,948 tonnes and 69,864 tonnes respectively. This clearly demonstrates the much higher amounts predicted than actually surveyed in the two regions. In the Bay of Plenty region, actual survey quantities constituted some 28% of the predicted quantities, while in the Waikato region, this percentage was 32%, a remarkably similar percentage.

A similar comparison was made for the priority waste streams. Table 41 below provides details of those hazardous waste streams and the tonnages recorded in the generator survey (with diluted liquid streams removed) and as extrapolated from the model. Where there is a blank in the "actual survey" field, it is due to no waste being reported as part of the survey. Where it is in the "model prediction" field, it can also be due to there being insufficient waste streams identified for the model to be applied.

Table 41 Comparison of recorded versus predicted priority hazardous waste quantities by priority wastes

Priority Waste Code	Explanation	Actual survey (tonnes)	Model prediction (tonnes)	% Actual over model
01 03	Wastes from physical and chemical processing of metalliferous minerals	300	-	-
02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing	20	-	-
03 01	Wastes from wood processing and the production of panels and furniture	3,137.7	11,340	28%
03 02	Wastes from wood preservation	17.7	34.5	51%
08 01	Wastes from MFSU and removal of paints and varnish	249.9	656.6	38%
08 04	Wastes from MFSU of adhesives and sealants	74.6	136	54%
09 01	Wastes from the photographic industry	94.2	467	20%
10 01	Wastes from power stations and other combustion plants	8,500.4	-	-
10 13	Wastes from the manufacture of cement, lime and plaster	1,134	-	-
11 01	Wastes from chemical surface treatment of metals	577.4	1,036	56%
12 01	Wastes from shaping and physical and mechanical surface treatment of metals	39.1	-	-
13 02	Waste engine, gear and lubricating oil	700.3	9,510	7%
14 06	Waste organic solvents, refrigerants and propellants	109.5	618	18%
16 06	Batteries and accumulators	65.12	1,559	4%
17 05	Contaminated soil	-	-	-
18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	1,492.1	5,564	27%
19 07	Landfill leachate	-	-	-
19 08	Wastes from wastewater treatment plants	9,681.1	25,663	38%
20 03	Other municipal waste including septic tank waste	2,724.1	6,922	39%

Table 41 shows that there are significant differences between the quantities of hazardous waste actually recorded during the survey and the comparable quantity estimates between the different priority wastes. This is to be expected, given that the hazardous waste estimates have been extrapolated over the entire industry population as given by SNZ data.

The relationship of actual versus estimated hazardous waste quantities is also demonstrated again as a percentage. The variability in percentages is due in part to the sampling strategy, where focus was on manufacturing industries.

In most cases, actual survey data were between 20% - 40% of the predicted waste estimates. However, waste oil and batteries were estimated in much higher quantities than actually surveyed. This reflects the fact that these waste are generated very widely across most industry sectors, and that these wastes are indeed priority wastes. Wastes from the 'wood preservation and chemical surface treatment of metals' and 'MFSU (manufacture, formulation, supply and use) of adhesives and sealants' industries exhibited high percentages, indicating that these wastes are limited to few specific industry groups, and that the survey achieved good coverage of these.

Chapter 6: Model for Predicting Hazardous Waste Quantities

6.1 Overview

One of the requirements for the study was to develop a model for predicting quantities and types of hazardous waste by different industry that could be applied repeatedly in the two regions concerned as well as in other regions in New Zealand. It was anticipated that this would take the form of a spreadsheet or similar, that could be easily applied in any other survey scenario.

This survey has demonstrated that the process of statistical survey design and waste estimation, as well as the underlying data collection, processing and management methods, are highly dynamic and complex. In fact, one of the recommendations of the study is not to repeat large-scale surveys of this kind because of the inherent statistical and logistical problems, and also because of the scarcity and lack of reliability and accuracy of actual data available. It is also not recommended that anybody take on the task of a large-scale hazardous waste survey without excellent technical and statistical expertise and plenty of resources, as otherwise the above highlighted problems become insurmountable.

Nonetheless, it was deemed important that as many tools and as much guidance as possible was to be provided to a) predict hazardous waste quantities generated in other parts of New Zealand and b) explain some of the approaches and dynamics of the underlying statistical design.

6.2 Hazardous Waste Generation Predictors

Based on the same approach as for the hazardous waste quantity estimates shown in section 5, a series of hazardous waste 'predictors' were developed. These can be used to estimate hazardous waste quantities anywhere in New Zealand on a 'per business' basis, provided that relevant Statistics New Zealand data are available, and the estimate of uncertainty surrounding the predictors is acceptable (refer section 5.2). These predictors are also extremely good indicators of how much waste would be typically generated by an individual company in a specific study category or through specific priority waste streams.

These predictors have been developed using the amalgamated data from both regions in order to minimise the variability of them as much as possible. Hazardous waste indicators for individual business types broken down by study category are shown in Table 42. A wide range of additional hazardous waste quantity predictors by waste form and priority waste is provided in Appendix I.

Table 42 Predicted hazardous waste quantities generated by individual businesses in both regions

Study category	Description		Estimates (tonnes)/per business type		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture etc	Estimate	1.754	4.394	40.1%	51.3%
		SE	0.704	2.254		
B	Mining	Estimate	0.585	108.402	30.6%	88.2%
		SE	0.179	95.627		
Ca	Metal product manufacturing	Estimate	9.786	2.697	22.3%	28.1%
		SE	2.180	0.759		
Cb	Food, textile and non-metallic manufacturing	Estimate	9.950	402.156	14.6%	38.6%
		SE	1.455	155.139		
Cc	Wood, machinery and other manufacturing	Estimate	3.112	63.927	23.5%	49.5%
		SE	0.733	31.653		
D	Electricity, gas and water supply	Estimate	0.057	0.040	22.3%	0.0%
		SE	0.013	0.000		
E	Construction	Estimate	2.458	6.282	59.5%	57.1%
		SE	1.463	3.584		
F	Wholesale trade	Estimate	1.109	0.000	38.1%	-
		SE	0.423	0.000		
G	Retail trade	Estimate	4.139	0.100	38.3%	9.4%
		SE	1.587	0.009		
I	Transport and storage	Estimate	1.745	4.658	31.4%	19.4%
		SE	0.547	0.902		
L	Property and business services	Estimate	4.051	0.275	45.6%	32.8%
		SE	1.848	0.090		
O	Health and community services	Estimate	0.561	46.961	48.4%	59.4%
		SE	0.272	27.912		
Q	Personal and other services	Estimate	0.544	56.187	22.1%	56.6%
		SE	0.120	31.793		
Za	Government, education etc	Estimate	0.000	0.003	0.0%	27.2%
		SE	0.000	0.001		

The same limitations apply as with the total quantity estimates – particularly with respect to the quality of the underlying data. Therefore, predictors should be used as a management tool, rather than as a tool to develop precise and accurate quantities.

Using predictors alone, whilst being a very useful tool, will not provide the full picture of hazardous waste generated in a district or region if such information is required. Additional surveying may then be required along the method outlined in section 3 and Appendix J. In particular:

- Large industries (with over 20 employees) are fully surveyed. This is because there are usually unique and major facilities that need to be captured for which results cannot be predicted. These large industries normally occur in reasonably small numbers so that a survey of these is economically feasible. However, in some cases, the application of predictors is acceptable, particularly where estimates of uncertainty are low.
- Additional sampling will need to be carried out where estimates of uncertainty are higher than acceptable, but precise and accurate information is needed.

6.3 Survey Design and Hazardous Waste Estimation

As stated in section 6.1, the planning and implementation of a survey of the kind undertaken in the Bay of Plenty and Waikato regions is technically and logistically very challenging. While guidance on 'how-to' can be provided, it is not recommended that a similar survey be implemented anywhere without solid statistical and technical expertise. Appendix J provides general guidance on models for sample design and hazardous waste estimation. The information in Appendix J has been provided by Dr Chris Triggs of the University of Auckland.

Chapter 7: Ministry for the Environment Tools for Hazardous Waste

7.1 Background

An important objective of the survey was to test the various tools the Ministry for the Environment had developed for identifying and classifying, as well as reporting on hazardous waste.

Non-regulatory tools used during the survey included the Ministry for the Environment definition of hazardous waste, the New Zealand Waste List and confirmed indicators for hazardous waste (refer section 2.1).

7.2 Hazardous Waste Definition and NZ Waste List

It was found that the definition and the Waste List generally worked well for defining and describing hazardous waste for the survey. The Waste List was found to cover most hazardous wastes encountered in the survey. Where a hazardous waste could not be clearly matched with the Waste List, "catch-all" categories within each of the major process or source categories were used.

However, it was found that the Waste List does not cater for classifying dilute liquid hazardous wastes (usually trade waste) discharged to both municipal and on-site private wastewater treatment plants. As the survey was intended to capture these wastes, among others, surveyors experienced significant difficulties with classifying them. This was compounded by the fact that the information provided by industries was mostly non-existent or incomplete.

It is concluded that the Waste List in its existing form should not be used for liquid diluted hazardous waste, unless relevant new codes are added to the list. Another alternative is to address trade waste through a different management framework, as it differs significantly from concentrated hazardous wastes and the way these need to be managed.

It was also noted that using the Waste List – especially in the context of a survey, where a wide range of hazardous wastes may be encountered – requires significant training and supervision of the surveyors. However, this is a surmountable problem.

7.3 D and R - Codes

The so-called "D" and "R" codes were used in the survey to describe hazardous waste in terms of the disposal or recycling/recovery/reuse routes adopted. These codes have been adopted from overseas models and have generally not been modified, except by adding an additional code for "discharge to trade waste (7a)". The survey has shown that from these codes, "other" (D16 or R15) was mainly chosen, mainly due to the absence of knowledge where hazardous waste goes once it leaves a site. Therefore, the D and R codes yielded minimal useful information.

Generators reported a number of waste streams that they believed were disposed of to land or landfill (D1). In contrast, operators reported the majority of waste streams being processed by them went to engineered landfills (D5) rather than just to land. This indicates some confusion about which of these codes to best use, as both refer to a disposal option to land or landfill, even though code D5 refers to an engineered landfill. Few generators would have known the difference between a non-engineered and an engineered landfill. These two codes therefore need further explanation.

Also, several D-codes refer to disposal options that are not available in New Zealand, for example, deep injection or incineration at sea. Others refer to disposal to the environment, which by intent was not included into the definition of hazardous waste for this survey, as all discharges with a potential adverse effect on the environment are required to have a resource consent in New Zealand and are therefore deemed to be adequately managed.

Consequently, many of the codes were never used during the survey, indicating that they may not be appropriate or applicable in the New Zealand context. Other codes indicating "don't know" (D16 and R15) were overused, indicating that in general there is very limited knowledge about the routes for the treatment, recycling, reuse and disposal of hazardous waste. It would therefore be useful to revise the codes for use in New Zealand – even if this means by doing so, an international standard would be modified.

7.4 Indicators for Hazardous Waste

The Ministry uses indicators for hazardous waste, together with a wide range of other indicators for the environment, for national and international reporting on the State of the Environment.

Table 43 shows the hazardous waste indicator, together with an overview of information provided by the survey on these data. As mentioned in section 2, reporting on Stage 2 indicators was not possible due to the current absence of a regulatory system.

7.4.1 Stage 1/Hazardous Waste Indicator 1 (1/HW1)

This information was obtained through surveying hazardous waste operators in the Bay of Plenty and Waikato regions. It is noted that 1/HW1 requires only information on total quantities of hazardous waste to be obtained, rather than on different hazardous waste types.

The survey was able to provide reasonably complete data relating to this Indicator. However, the quality and accuracy of these data are questionable, as discussed in section 4 and elsewhere. This applies in particular to trade waste, where very inadequate data was available on the waste streams flowing into wastewater

treatment plants; further exacerbated by the lack of trade waste bylaws and licensing systems in the two regions.

Also, operators of wastewater treatment systems (on-site and public) were less concerned with information about the quality and quantity of inflows to plants, but more so about compliance with resource consent conditions in discharges to receiving environments.

This is mainly a function of how these resource consents are structured, with little focus on managing the quality of the inflow and waste minimisation at source.

7.4.2 Stage 1/Hazardous Waste Indicator 2 (1/HW2)

This indicator focuses on the quantity of priority hazardous waste generated and stored and subsequently transported, discharged to sewer, or discharged to land, air or water (on-site). The latter were understood to cover permitted discharges under the RMA that were specifically excluded from this survey. There is no explanation of what constitutes a "priority" hazardous waste. As a result, it was decided that the survey itself was to form the basis for identifying priority hazardous wastes on a regional basis, as discussed in sections 4 and 5.

As discussed above, information on discharges to sewer was generally not available from generators, and generators overall had very poor knowledge on what happened to hazardous waste once it left the site. Therefore, reliable reporting on HW2 in the survey was limited to generation, storage and transport of priority hazardous waste. Survey data on operators in general is thought to provide more reliable information on the fate of hazardous waste in the two regions.

Table 43 Ministry for the Environment confirmed hazardous waste indicators

Stage/ indicator	Indicator	Available Information
1/HW1 *	Quantity of hazardous waste: • accepted at landfills • exported (under Basel Convention) • accepted at treatment facilities • accepted at wastewater treatment facilities	• covered through this survey (HW operator survey) • not covered • covered through this survey (HW operator survey)
1/HW2	Quantity of priority hazardous waste: • generated and stored: • imported • transported • discharged to sewer • discharged to land, air and water (On site as defined from the list)	• covered through this survey (HW generator survey) • limited data available • NOT APPLICABLE (outside scope of survey)
2/HW1	Quantity of hazardous waste discharged to land/air and water. Includes waste: • accepted at landfills • exported (under Basel Convention) • accepted at treatment facilities • accepted at wastewater treatment facilities (Collected under national hazardous waste definition and national hazardous waste monitoring and information systems)	NOT APPLICABLE (dependent on regulatory system for hazardous waste)
2/HW2	Quantity of priority hazardous waste generated and stored: • required by regulation via National Environmental Standard (Manifest or other system) • storage (possibly minimum thresholds or type of facility) • diffuse sources or WAP methodology (Collected under national hazardous waste definition and national hazardous waste monitoring and information systems)	NOT APPLICABLE (dependent on regulatory system for hazardous waste)

* Note: HW = hazardous waste

Chapter 8: Discussion and Conclusions

8.1 Existing legislation and National Issues

8.1.1 Existing Regulatory and Strategy Framework

The project scope did not include a detailed investigation of the statutory framework or national initiatives that have implications for hazardous waste management. However these do have some bearing on the recommendations made in this chapter.

The Resource Management Act (1991) and the Local Government Act (2002) and amendments to them give powers and responsibilities to regional councils and district councils to control or influence some aspects of waste management and disposal, and the subsequent effects on the environment. Direct control over the effects of individual discharges or land uses is available in the resource consent process, however information allowing the assessment of long term, cumulative effects is not always available. Both regional and district councils produce plans that can consider aspects of waste management issues. These have bearing on the assessment of resource consent applications. In reality, resource consents often focus on monitoring discharges to the environment, rather than on monitoring upstream processes or resource efficiency measures.

Under the Local Government Act, district councils have powers to regulate for waste management, including the development of trade waste bylaws and preparation of waste management plans. However, while waste management plans are mandatory, the preparation of trade waste bylaws is not. In the Bay of Plenty and the Waikato regions, only few territorial authorities operated trade waste bylaws.

The New Zealand Waste Management Strategy sets out the national approach being taken to the management of waste. It provides some guidelines and specific targets relating to hazardous waste:

1 By December 2005, an integrated and comprehensive national hazardous waste management policy will be in place that covers reduction, transport, treatment and disposal of hazardous wastes to effectively manage risks to people and the environment.

2 By December 2004, hazardous wastes will be appropriately treated before disposal at licensed facilities and current recovery and recycling rates will be established for a list of priority hazardous wastes.

3 Recovery and recycling rates for priority hazardous waste will increase 20 percent by December 2012.

Specific targets relating to the issue of aqueous waste streams being delivered to municipal trade waste treatment facilities are:

1 By December 2005, all territorial local authorities will have implemented and will be monitoring Model General Trade Waste Bylaws based on the New Zealand Standard Model, Part 23 – Trade Waste, or equivalent.

2 By December 2005, all territorial local authorities will ensure that all holders of new or renewed trade waste permits will have in place a recognised waste minimisation and management programme.

A third programme detailed in the Strategy recognises the critical importance of good information, including sound databases for minimising and managing waste. It provides for the further development and use of waste indicators as part of the Environmental Indicator Programme. It also provides for the establishment of sound databases for measuring and monitoring implementation of the Strategy.

Many of the recommendations made in this chapter can be linked to the targets and programmes within this strategy document.

8.1.2 Regulatory Framework for Hazardous Waste Tracking and Recording

There is currently no regulatory requirement for keeping records or reporting on hazardous waste in New Zealand. Overall, the consequences of this have been clearly illustrated by this study, as information on hazardous substances was difficult to obtain, and was often incomplete and of poor quality. Not only is there very limited information on hazardous waste being generated, but also on the life cycle of hazardous waste, including storage, treatment, recycling and reuse, and disposal.

Hazardous waste operators and generators mainly focus on meeting minimum requirements under the Resource Management Act (RMA) 1991 for discharges to the environment, but not on collecting information on the generation, storage, transport and disposal of hazardous waste, or on minimising hazardous waste at source. The new Hazardous Substances and New Organisms (HSNO) Act 1996 places selective controls on the disposal of specific hazardous substances, but does not apply to the majority of hazardous wastes as these are generally of a mixed nature. Also, controls under the HSNO Act on disposal are not suitable for mixed hazardous waste or contaminated materials. Requirements for record keeping under the Act are generally limited to extremely hazardous substances.

As a result, unless mandatory requirements for record keeping and reporting for all hazardous wastes are introduced, it will be very difficult to:

1 Obtain accurate and consistent information on hazardous waste in New Zealand, and associated pathways.

2 Report at a national or international level.

3 Make informed decisions about the significance of any associated problems, develop appropriate management strategies and assess their effectiveness.

8.2 Non-regulatory Central Government Tools for Hazardous Waste

Several central government non-regulatory tools for hazardous waste were applied and evaluated as part of this study. This included the draft definition of hazardous waste, the New Zealand Waste List, disposal and recycling codes, as well as national indicators for hazardous waste.

The definition of hazardous waste and the Waste List generally worked well for defining and describing hazardous waste. However, the Waste List does not cover dilute liquid hazardous wastes (usually trade waste) discharged to wastewater treatment plants. Therefore, the Waste List in its existing form should not be used for liquid diluted hazardous waste, unless relevant new codes are added to the list. An alternative is to address trade waste through a different management framework, as it differs significantly from concentrated hazardous wastes and the way these need to be managed.

The New Zealand Waste List covers a large number of both hazardous and non-hazardous wastes, any of which may be encountered in a large-scale survey such as the one undertaken in the Waikato and Bay of Plenty regions. Surveyors using the list require a significant amount of guidance and training to ensure that it is applied consistently.

"D" and "R" codes were used in the survey to describe hazardous waste in terms of the disposal or recycling/recovery/reuse routes adopted. From these codes, "Other" (D16 or R15) was mainly chosen due to the absence of knowledge where hazardous waste goes once it leaves a site. Many of the codes were never used during the survey, indicating that they may not be appropriate or applicable in the New Zealand context. It would therefore be useful to revise the codes for use in New Zealand.

With respect to indicators, the survey was able to provide a reasonable amount of data on Stage 1/Hazardous Waste Indicators 1. However, the data collected during the survey were questionable in terms of their quality and accuracy. This applied in particular to trade waste, where inadequate data was available on waste streams flowing into wastewater treatment plants. As a result, data on trade waste had to be excluded from data evaluation. Discharges to land, air and water were assumed to be adequately managed through resource consents, and were specifically excluded from the survey.

Similarly for HW2, information on discharges to sewer was generally not available and generators overall had poor knowledge on what happened to hazardous waste once it left the site. Therefore, reliable reporting on HW2 in the survey was limited to generation, storage and transport of priority hazardous waste.

Given the lack of a regulatory system for record keeping and reporting on hazardous waste, it is very difficult at this stage to report satisfactorily on the Stage 2 indicators. It is also noted that the wording of the indicators themselves is confusing in parts and should be clarified.

8.3 Availability of Information on Hazardous Waste

8.3.1 Generators

Precise information on the quantities and constituents of hazardous waste streams from the generators surveyed proved to be difficult to obtain, and quite variable in quality. The reasons for this were varied and included:

- Lack of knowledge of what constituted hazardous waste and whether any was generated.
- No formal systems in place to record waste quantities, making visual estimates by generators sometimes the only way of obtaining data within the constraints of the survey methodology.
- No sampling of waste streams undertaken by generators to determine the concentration of hazardous constituents prior to disposal (although some firms noted that waste disposal operators did take occasional samples).
- Information that was not in an easily retrievable format, and the pressures of business realities meant that the staff resources were not available to collate the required information over the survey period. For example, a significant number of companies relied on invoices from waste disposal operators to record the extent of their waste streams.
- A level of distrust by some generators relating to what the information collected would be used for, and resulting reluctance to participate.

8.3.2 Operators

Companies receiving hazardous waste for treatment or disposal (operators) also varied in their ability to provide data. Reasons for the difficulty in providing the data included:

- A number of operators were reluctant to participate due to a level of distrust on what the information collected would be used for.
- Information that was collected was not in an easily retrievable format, and the pressures of business realities meant that the staff resources were not available to collate the required information over the survey period. Again, many of operators were relying on a paper-based invoicing system. In this respect, a number of private waste-handling companies said they were in the process of implementing new computer based recording systems, but information was not loaded for the period the survey was seeking data for.
- Many waste streams were not sampled on a regular basis. Only 10% of the hazardous waste streams identified by operators had data available on the concentration of hazardous constituents they contained.

8.3.3 Information Gaps

In developing the survey methodology, a number of decisions were made on what waste streams would and would not be included in the survey, which had implications for the completeness of the results to determine MfE indicator data. A key decision made by the Project Control Group was to not include wastes discharged under resource consents, as it was considered that such waste streams

were no longer hazardous in nature. This assumes that consent conditions are effective in managing the environmental effects. However it is not certain whether or not this assumption has been confirmed by monitoring data, particularly when the lack of information available on the cumulative quantities and effects of hazardous constituents in discharges has been recognised in the New Zealand Waste Strategy.

Industries with on-site treatment and disposal facilities often also did not have any information on the waste streams entering these facilities, as the focus of their resource consents was on compliance of the discharge from the facilities. Many also indicated that they reported already under the resource consent, and did not see the need for additional reporting outside of this framework, such as for this survey. This had a significant effect on the calculation of the total quantity of hazardous waste generated and treated in each region.

8.4 Survey Design

Target industries (both hazardous waste generators and operators) and hazardous waste covered by the survey were identified based on the ANZSIC Code, and the New Zealand definition of hazardous waste and the New Zealand Waste List.

To identify target industries, a range of different databases had to be used (refer section 3). For example, commercially available databases such as UBD and the Yellow Pages only cover a fraction of the industries listed by Statistics New Zealand, which formed the benchmark for the total industry population, but is covered by privacy legislation.

Also, commercial databases contain listings that are “dirty”, that is, they are wrongly listed, contain industries that are listed more than once, industries that have gone out of business or have changed identity, and so on. In addition, different databases cover varying geographical boundaries. All of these limitations needed to be accounted for in the design of the survey and evaluation of data.

All hazardous waste operators were surveyed in the two regions. However, a statistically representative sub-sample had to be taken from the much larger generator population. The main decision criteria in this context were budget availability and the statistical precision required to be able to predict hazardous waste quantities across the full generator population.

Statistical design was based on earlier surveys of hazardous waste undertaken in the Auckland region in 1990 and 1996, which indicated that the manufacturing industries contributed the greatest quantities of hazardous waste and also the greatest level of statistical variability. Based on this, survey design placed greatest focus on these industries and also industries with more than 20 employees.

It was decided to cover all industries with the potential to generate hazardous waste. This meant that the generator base was very large. To be able to use the survey data for predictive purposes, the generator population was divided into 14 broad study categories, broadly reflecting ANZSIC industry divisions. Any predictions of total hazardous waste quantities had to be limited to these broad study categories, with a consequent loss of detail at lower level industry categories. However, actual survey data could be analysed to a lower ANZSIC level.

The survey methodology was complex and included a wide range of procedures, systems and documentation aimed at optimising the quality of the survey data. Even though the survey process was streamlined, a large amount of information needed to be recorded by the surveyors. Even though most of these had a good

technical background, few had previous knowledge of hazardous waste and the underlying issues and processes. Also, there was no opportunity for training of these surveyors other than just before the start of the survey, which meant that their learning curve was very steep.

The publicity strategy for the survey included workshops and a media release prior to the survey. The project manager of the Project Control Group was interviewed on radio on several occasions. Overall, the success of the strategy in raising the awareness of the public on hazardous waste and the survey was difficult to quantify. However, the survey itself strongly highlighted the lack of fundamental knowledge of industry on what constitutes hazardous waste, and what information/advice is available in the two regions. This in itself was a considerable hurdle the survey needed to overcome, and is a challenge both regions face in seeking to improve the management of hazardous waste.

Overall, carrying out a comprehensive one-off survey of this kind is logistically and technically very challenging. The limited time span imposed by budget limitations creates a high level of performance pressure and gives limited ability to enable surveyors to build experience and confidence, and to rectify any problems.

8.5 Survey Results

8.5.1 Overview

In total, 1,905 generators were surveyed (Table 9). Of these, 226 were out of business or wrongly listed as manufacturers in the UBD (12%), and a further 323 firms were not prepared to participate (17%). Of the 1,356 firms that did participate, 696 (51.3%) generated hazardous waste in a total of 1,572 waste streams.

In total, both regions together generated 1,337 waste streams and an overall quantity of 29,689 tonnes of hazardous waste in gaseous, liquid, sludge or solid form. The main industry sources of the waste recorded were the Food and Beverage Manufacturing (C21), the Concrete and Ceramic Manufacturing (C25), the Wood and Paper Processing (C23), and the Metal Finishing and Product Manufacturing industries (C27).

A significant issue with the reliability of information on hazardous waste quantities arose where the hazardous waste is disposed of by discharging to a municipal or private industrial wastewater treatment plant. In such instances the waste may potentially be too dilute to retain hazardous characteristics or it is simply ‘lost’ in the final effluent and/or sludge. Many industries produce wastewaters that contain a diverse range of hazardous chemicals. These hazardous streams are often discharged into the sanitary systems. Leachate (if collected from a landfill) is also typically discharged into trade waste systems. This is further discussed below.

8.5.2 Diluted Discharges to Trade Waste

Diluted waste streams represented a significant problem for this study as the accuracy of the data is questionable, and in many cases data could not be obtained at all, hence affecting how representative this information is for the industries in question. As a result, diluted liquid hazardous waste streams were analysed separately from the non-diluted waste streams to reduce the margin of error in analysis. Diluted waste streams were deemed to include all waste streams substantially diluted with water that could be discharged to a wastewater treatment plant without further treatment.

The chemicals present in these wastewater systems should be adequately treated prior to any discharge into the environment. In many cases, however, the current level of wastewater treatment is arguably less than adequate to avoid or minimise the environmental effects of these discharges. Many of the municipal wastewater treatment plants in Waikato and Bay of Plenty are either pond systems or based primarily on screening and primary processes rather than the secondary and more advanced treatment processes which would effect high levels of removal of hazardous substances.

As discussed in Chapter 4, the quantity of two key pathways of diluted potentially hazardous waste was consistently under-reported. The two key pathways are:

- Industrial wastewater treatment plants where no data is held on the hazardous characteristics of the liquid waste (where such facilities were private industry sites covered by resource consents, they were excluded from the survey as discussed in a previous section)
- Municipal wastewater treatment plants where few or no trade waste quantity limits have been agreed between the generator and the territorial local authority.

As previously mentioned there are relatively few district councils with operative trade waste bylaws in the two regions. This has implications for the issue of the consistency of the trade waste limits placed on wastewater discharges treated at municipal treatment plants. Typically operators only monitor parameters that assist with plant operation and in particular parameters that may upset the treatment process and in turn lead to non-conforming effluent in terms of their resource consent (for example, Volume, pH, Total Suspended Solids, Chemical Oxygen Demand, Nitrate, Phosphorus).

The New Zealand Waste Management Strategy has specific targets relating to the trade waste issue. These are:

1 By December 2005, all territorial local authorities will have implemented and will be monitoring Model General Trade Waste Bylaws based on the New Zealand Standard Model, Part 23 – Trade Waste, or equivalent.

2 By December 2005, all territorial local authorities will ensure that all holders of new or renewed trade waste permits will have in place a recognised waste minimisation and management programme.

Meeting such targets would involve developing a better understanding of what is in the wastewaters received, and an associated increase in monitoring is likely to result. The public and the environment would benefit from the knowledge of the extent of hazardous contaminants in wastewater, and by ensuring that wastewaters were receiving appropriate treatment. Under a user pays system generators would as a result be exposed to a larger fraction of the full cost of disposal.

This approach would need to be extended to private on-site treatment plants to ensure that a similar response was occurring.

8.5.3 Waste Disposal Pathways – Solid Hazardous Waste to Landfill

Some solid hazardous waste reported as generated by companies appears to not be collected by waste operators interviewed. For example during the survey generators estimated they produced over 3,000 tonnes of wastes from wood processing, which included treated timber sawdust and off cuts, while operators reported handling 34 tonnes. Similarly generators estimated that they produced 65

tonnes of hazardous medical waste, while operators reported handling approximately 4 tonnes. Assuming that the generators have not grossly overestimated the quantities being generated (which could be the case given both waste streams were generally estimated by eye), this hazardous waste may be being transported directly to landfills as part of general municipal waste. The question arises - how much of an issue is this?

The Landfill Guidelines produced by the Centre for Advanced Engineering recognises that some hazardous waste will reach landfills undetected in its statement that:

> "*It is recognised that municipal solid waste from households and small commercial premises that standard waste screening procedures will not detect. However this quantity should not generally exceed 200 ml/tonne or 200 g/tonne."*

In reality, much hazardous waste entering a landfill will be either part of a larger waste stream, or not declared as hazardous by either the general public or the contractor. For this reason, it is very important that landfill operators rigorously monitor and control the waste entering the landfills, as part of their professional landfill management practice, in the same way as they are required to monitor the leachates and landfill gases produced by the landfills (as part of the resource consenting process).

More information is required before the significance of the amount of hazardous waste being disposed of in general refuse can be determined.

8.6 Qualitative Feedback

8.6.1 Sources of Advice

As part of the survey questionnaire generators and operators were asked where they go to obtain advice on appropriate treatment of hazardous waste streams. Over the two regions 32% of generators would approach their district council for advice, 9% would approach their regional council and 7% would seek industry or in-house advice on what to do with hazardous waste streams. Of more concern are the approximately 23% of generators who had hazardous waste streams but were unsure of where to go to get advice on what to do with them. Operators who responded reported that 39% would seek advice of their district council, 32% would ask a consultant (for example, industrial chemist, OSH), 18% would seek in-house knowledge and 2% would ask their regional council for advice.

District councils were therefore perceived to be a significant source of advice but many do not have policies to address issues in their waste plans, or do not have trade waste bylaws to provide specific guidance on what is considered hazardous waste and how it should be handled. A number of businesses anecdotally commented that their local council's advice generally consisted of telling them to call a professional waste disposal company, which they considered an inadequate response.

8.6.2 Hazardous Waste Services and Areas for Improvement

When asked whether they were satisfied with the available hazardous waste services, and what improvements could be made to such services, 73% generators indicated they were generally satisfied with the hazardous waste services in the two regions. The main areas for improvement suggested were in reducing the cost of

waste disposal, providing more information on hazardous waste treatment and disposal, and providing more disposal facilities.

The feedback from operators indicated that 50% were satisfied with the available services. Operators suggested that improvements could be made by the councils providing better disposal facilities within the regions, more educational material on what to do with hazardous waste and better enforcement of existing rules. Anecdotal comments showed that many operators were concerned that generators were still being irresponsible about hazardous waste disposal through ignorance as well as for financial reasons. Operators suggested that more enforcement and policing of generators by regulatory bodies are required to ensure that waste streams were being appropriately disposed of. Several operators reported a marked increase in queries regarding appropriate disposal of waste streams that they attributed to the survey itself helping to raise awareness of the disposal issues.

A significant issue identified by operators was that generators often do not know exactly what is in their waste (constituents and concentrations), so operators cannot give an accurate guide as to the likely cost of disposal. This creates frustration for all parties. If costs are high and quantities relatively small there is always the risk that generators will dispose of waste streams inappropriately, such as by disposing of hazardous waste with the municipal solid wastes going to landfills.

8.7 Predictions of Total Generator Hazardous Waste Quantities

Predictions of total hazardous waste quantities were made for the two regions by study category, waste form (solids, sludge and liquids, excluding waste gases and trade waste) and priority hazardous waste types.

Predictions were made for industries with less or equal than, or more than 20 employees (“small” and “large”) industries. Although all large industries (with the exception of study categories F [wholesale trade], G [retail trade] and Za [government agencies and services]) were sampled in the survey, the UBD database only covered a fraction of the SNZ database, which was used as the “benchmark” for hazardous waste generator numbers in the two regions. Therefore, the predictive model was used to extrapolate surveyed hazardous waste quantities for both small and large industries in relation to the total SNZ generator population.

The magnitude of the variability around estimated hazardous waste quantities has been expressed as a standard error and coefficient of variation. As indicated in the report, in order to obtain the 90% – 95% confidence interval, both the standard error and coefficient of variation have to approximately doubled. This will give an indication of the expected variability around the predicted hazardous waste quantities.

Predicted hazardous waste quantities for the two regions combined amounted to 93,235 tonnes, with an estimate of uncertainty (coefficient of variation, or the variability around the estimated mean) of 17%. For the Waikato region, total predicted quantities amounted to 69,864 (coefficient of variation = 29%) and for the Bay of Plenty region, total quantities were estimated at 24,314 tonnes (coefficient of variation = 24%). The coefficient of variation for the large industries was relatively high in both regions. This was expected due to the presence of large and one-off facilities.

Hazardous waste quantities and associated coefficient of variations for the different study categories were quite variable. In the Waikato, study categories Ca and Cb (basic metal and food manufacturing industries) were found to be significant,

whereas in the Bay of Plenty study category Cc (wood processing and pulp and paper industries) was found to dominate. Wastes from wood processing (03 01), waste oil (13 01/02/03) and sludge from wastewater treatment plants (19 08) dominated, jointly contributing some 47,000 tonnes.

These results confirmed the assumption made during the original survey design that the manufacturing industries generate the largest amounts of hazardous waste. Further, the results showed that other study categories also contribute significant quantities of hazardous waste, once the full industry population is taken into account. However, due to the much lower number of samples taken for these study categories, the coefficient of variations were also much higher and therefore the predictions more variable.

Generally, the variability of waste estimates tended to decline with increasing size and homogeneity of the sample used. Therefore, variabilities were lower for quantity predictions for the two regions combined, and grouped by waste form and priority wastes.

In order to enable the findings of the study to be applied elsewhere in New Zealand, a range of waste "predictors" were developed. These are expressed on a "per individual business" basis. Individual predictors can be used to predict hazardous waste quantities for each study category, or obtain an idea on the quantity of individual waste streams generated within each priority waste type. In applying these predictors, attention needs to be paid to the variability of the predictors, as this will affect the precision of the waste estimates. In general, given the limited quality of the underlying data, predictors should only ever be used as guide, rather than as a tool to obtain precise and accurate quantities.

8.8 Comparison of Model and Survey Results

The limitations of the data able to be collected have been discussed in Chapters 4 and 6 of this report. While the reliability of the data has been shown to be questionable, information could be gleaned from comparing the quantities reported by generators against the predictions arrived at by extrapolating the model.

Actual hazardous waste quantities generated and estimated in the Bay of Plenty regions were 6,741 tonnes and 24,314 tonnes, respectively. In the Waikato regions, these figures were 22,948 tonnes and 69,864 tonnes, respectively. This clearly demonstrates the much higher amounts predicted than actually surveyed in the two regions. In the Bay of Plenty region, actual survey quantities constituted some 28% of the predicted quantities, while in the Waikato region, this percentage was 33%, a remarkably similar percentage.

For priority hazardous wastes, actual survey data ranged between 20% - 40% of the predicted waste estimates – indicating a level of consistency with total waste estimates for the two regions. However, waste oil and batteries were estimated in much higher quantities than actually surveyed. This reflects the fact that these waste are generated very widely across most industry sectors, and that these wastes are indeed priority wastes. Wastes from the 'wood preservation' and 'chemical surface treatment of metals' industries exhibited high percentages, indicating that these wastes are limited to few specific industry groups, and that the survey achieved good coverage of these.

8.9 Comparison with Other Hazardous Waste Surveys

8.9.1 Auckland Survey 1996

As a consequence of the different waste categories and codes used in the 1996 Auckland survey, quantitative results are not directly comparable. The Waikato and Bay of Plenty regions have more industries with on-site treatment and disposal facilities than Auckland, and overall have less strict control on trade waste (relatively few district councils in the two regions have formulated trade waste bylaws).

The qualitative issues identified by the 1996 Auckland survey included:

- Accurate information on waste streams was generally not available.
- Record keeping was generally poor and invoices or receipts were the most common types of records kept.
- Generators generally displayed a low level of knowledge of the wastes they generated and their hazardous constituents.
- The roles and responsibilities of various council and regulatory agencies was not well understood.
- There was a need for better information about hazardous wastes and how to handle them.

This survey encountered these very same issues. This indicates strongly that hazardous waste management methods in New Zealand have not advanced particularly far in the last seven years, or that the implications of the Auckland survey have not resulted in action being taken by the adjacent regions to address the deficiencies identified.

8.9.2 Canterbury Survey 1996

The Canterbury survey was undertaken to provide the Canterbury Waste Joint Standing Committee with a detailed analysis of viable options for the management of certain, high priority waste streams. The report focussed on an identified list of priority wastes produced and disposed or stockpiled in the region, and involved surveying targeted industry groups likely to produce these wastes. The unit rates of the priority hazardous waste outputs from these industries have been established from survey results, Hazardous waste production rates detailed by the Ministry for the Environment 'Hazardous Waste Management Handbook', June 1994, and landfill disposal records.

The Waikato/Bay of Plenty survey methodology utilised a very broad definition of hazardous waste in order to establish a solid benchmark, and a different system of waste classification codes. As a consequence, quantitative results are not directly comparable. In addition, the Waikato/Bay of Plenty survey covered a wider range of industry types, and sought to determine what the priority wastes were from the survey results.

The Canterbury survey has had more success in quantifying waste streams, partially as a result of specifically targeting the priority waste streams under investigation.

8.10 Recommendations for Further Surveys

Until industry knowledge, and record keeping on the quantities, types and constituents of hazardous waste generated improves, the effectiveness of broad scale telephone surveys will remain very limited. On a smaller scale but more focused basis, such as for a specific priority waste or industry, a survey of generators would be much more useful. In many cases, direct surveying including site visits would be beneficial in order to understand the issues better and to overcome the lack of interest and knowledge of respondents.

Overall, the survey of the Bay of Plenty and Waikato regions has been very useful in establishing which industries and waste types should be given priority for further investigation and policy/management focus.

In conclusion, it is recommended that any future survey methodology employed under the existing regulatory framework incorporate the following aspects:

- A focus on priority hazardous wastes or industries
- Direct contact with generators and operators participating in the survey
- Detailed cross checking with other databases such as information supplied as part of resource consent conditions or trade waste permits.

8.11 Need for Councils to Act

A number of the findings above will require the combined action by regional and district councils. These relate to information gathering to determine the significance of the actual and potential effects of existing hazardous waste management methods, to facilitating information dissemination and encouraging best practice in waste generation (cleaner production), management and disposal practices, as well as developing policy and management plans.

Added effort should also be put into investigating the feasibility of licensing and/or mandatory hazardous waste recording systems for waste operators and/or waste generators within the given frameworks of the resource management and local government legislation.

The ultimate aim of any regional council programme is to promote the New Zealand Waste Management Strategy as well as to ensure that private and public sector management of hazardous waste treatment facilities meets international best practice.

Chapter 9: Recommendations

Based on the discussion in Chapter 7 and the findings of this report a series of recommendations are outlined below.

9.1 Central Government

1 That record keeping and reporting on hazardous waste is made a mandatory requirement in New Zealand, in line with expectations under the National Indicator Programme. Such mandatory requirements could initially focus on priority hazardous wastes, hazardous waste operators, and major hazardous waste generators.

2 That the non-regulatory tools already developed by the Ministry for the Environment are used for developing a mandatory record keeping and reporting system. This will also enable the second stage National Indicators for hazardous waste to be implemented.

3 That the National Indicators for hazardous waste are revised in keeping with what is possible to achieve given the current absence of regulatory requirements for record keeping and reporting. That the wording of the Indicators is revised and clarified.

4 That guidance is provided on the structure and use of the New Zealand Waste List. That the New Zealand Waste List is expanded to include new categories for diluted liquid hazardous (trade) waste. That additional guidance and training materials are developed to assist with the use and application of the New Zealand Waste List.

5 That the codes to describe the pathways for disposal and recycling (D- and R-Codes) are revised for New Zealand purposes.

9.2 Local Government

1 That in the absence of comprehensive national requirements for record keeping and reporting, alternatives are considered within the existing framework of the Resource Management and Local Government Acts.

2 That regional councils work together with district councils in reviewing, developing and implementing waste management plans under both sets of legislation to ensure that all forms of waste are managed on an integrated basis. Ensure that regional policy statements and plans define and address the issues and responsibilities associated with hazardous waste management and assist district councils with their plans.

3 That the targets of the New Zealand Waste Strategy are incorporated into regional and district waste management plans.

4 That in the absence of a formal waste tracking and recording system, a more rigorous investigation of waste acceptance and waste monitoring at solid waste disposal sites in accordance with the National Guidelines for Solid Waste Acceptance Criteria be initiated.

5 That resource consents for discharges from hazardous waste treatment and disposal facilities to the environment include requirements to monitor the quantity and quality of incoming waste streams. That for wastewater treatment plants, this includes monitoring of hazardous constituents in incoming waste streams and any sludge generated.

6 That the development of trade waste bylaws is recommended for all municipal wastewater treatment plants in the Bay of Plenty and Waikato regions receiving industrial wastes. That district councils be encouraged to, and assisted in, developing Model General Trade Waste Bylaws based on the New Zealand Standard Model, Part 23 – Trade Waste consistent with the National Waste Strategy target.

7 That district and regional councils investigate incorporating “Codes of Practice” into conditions for Trade Waste permits and resource consents. This may entail changes to regional and district plans.

8 That industry are encouraged and facilitated to develop Codes of Practice or best practice guidelines for waste handling and disposal, and facilitated to encourage cleaner production and waste minimisation practices.

9 That efforts targeting monitoring and reporting programmes on priority hazardous waste generators and operators are increased, to obtain a better understanding of the actual and potential effects on the environment. This would include monitoring of the effectiveness of conditions of resource consent and trade waste authorisations.

10 That the cumulative impacts of the discharge of hazardous waste under current disposal practices are assessed to determine the significance of their adverse effects.

11 That the need and feasibility for additional hazardous waste treatment and disposal facilities in the combined regions is investigated.

12 That recycling initiatives such as ‘Waste Exchanges’ are encouraged and facilitated.

9.3 Information and Education

1 That a stronger knowledge base on hazardous waste is built among industry in the two regions. Information on hazardous waste and available management options needs to be readily accessible. This can be achieved through a long-term education and publicity campaign.

2 That education and enforcement programmes be developed at district and regional level to ensure that generators are disposing of their wastes appropriately.

3 That efforts be put into developing a consistent source of information and advice for generators on how to identify and manage hazardous waste streams appropriately, and in accordance with the New Zealand Waste Strategy. This could be achieved by preparing and disseminating Codes of Practice or best practice guidelines waste handling and disposal, and for different priority hazardous wastes. Such information will ensure consistency across both regions.

4 That education and dissemination of information for the general public and industries regarding waste minimisation and cleaner production methods in respect of hazardous wastes takes places.

5 That councils seek to establish industry partnerships to encourage industries to take ownership of their waste streams and assist in the identification of appropriate minimisation, treatment and disposal options for their typical waste streams.

9.4 Future Surveys

1 That comprehensive and one-off surveys of hazardous waste are used only if there is a need to identify key industries and priority hazardous waste stream for an area or region, or if a general picture of the hazardous waste environment for an area is required. The expense and logistical difficulties coupled with the limited quality and precision of the data produced means that such surveys have limited applicability.

2 That in order to calibrate/validate results of this survey, specific priority waste streams or industry groups be targeted for face to face interviews to confirm whether the degree of caution recommended in using survey results is warranted in reality.

3 That smaller-scale surveys are carried out focusing on individual industry groups or priority hazardous waste streams, and using experienced staff. This will likely be logistically and financially more effective in collecting and disseminating high quality information on hazardous waste in the longer term.

4 That further investigation into the quantities and types of wastewater being discharged to trade waste systems be initiated to determine the extent of the risk represented by the hazardous waste streams involved.

5 That any future surveys include investigation/collation of information on waste entering private treatment and disposal facilities covered by resource consents.

Chapter 10: Appendices

Appendix A-1 Draft New Zealand Definition of Hazardous Waste (April 2001)

Hazardous waste is defined as any substance, material or object that is included in the following Waste Categories (W-Code):

Waste Categories (W-Code)

1 Production and consumption residues not otherwise specified below

2 Off-specification products

3 Products whose date for appropriate use has expired

4 Materials spilled, lost or having undergone other mishap, including any materials, equipment, etc., contaminated as a result of the mishap

5 Materials contaminated or soiled as a result of planned actions (e.g. residues from cleaning operations, packing materials, containers)

6 Unusable parts (e.g. reject batteries, exhausted catalysts)

7 Substances that no longer perform satisfactorily (e.g. contaminated acids, contaminated solvents, exhausted tempering salts)

8 Residues of industrial processes (e.g. slags, still bottoms, spent filters)

9 Residues from pollution abatement processes (e.g. scrubber sludges, baghouse dusts, spent filters)

10 Machining/finishing residues (e.g. lathe turnings, mill scales)

11 Residues from raw materials extraction and processing (e.g. mining residues, oil field slops)

12 Adulterated materials (e.g. oils contaminated with PCBs)

13 Any materials, substances or products whose use has been banned by law

14 Products for which the holder has no further use (e.g. agricultural, household, office, commercial and shop discards)

15 Contaminated materials, substances or products resulting from remedial action with respect to land

and that:

Exceed the minimum degrees of hazard for hazardous substances specified by Hazardous Substances Minimum Degrees of Hazard Regulations 2000 under the Hazardous Substances and New Organism Act 1996 (HSNO), or

Meet the definition for infectious waste included in the Land Transport Rule: Dangerous Goods 1999 and NZ Standard 5433: 1999 – Transport of Dangerous Goods on Land[16], or

Meet the definition for radioactive material included in the Radiation Protection Act 1965 and Regulations 1982.17

[16] Substances known, or reasonably expected, to contain pathogens, including bacteria, viruses, ricksettia, parasites, fungi or recombinant micro-organisms (hybrid or mutant) that are known, or reasonably expected, to cause infectious disease in humans or animals that are exposed to them.

[17] Radioactive material means any article containing a radioactive substance giving it a specific radioactivity exceeding 100 kilobecquerels per kilogram and a total radioactivity exceeding 3 kilobecquerels.

Appendix A-2 New Zealand Waste List (L-Code) – Extract

Note: Wastes marked with an asterisk (*) are potentially hazardous and may be subject to management controls. For the complete Waste List please refer to the Ministry for the Environment's website www.mfe.govt.nz

01 Wastes resulting from exploration, mining, quarrying, and physical and chemical treatment of minerals

01 01 Wastes from mineral excavation

01 01 01	wastes from mineral metalliferous excavation
01 01 02	wastes from mineral non-metalliferous excavation

01 03 Wastes from physical and chemical processing of metalliferous minerals

01 03 04*	acid-generating tailings from processing of sulphide ore
01 03 05*	other tailings containing hazardous substances
01 03 06	tailings other than those mentioned in 01 03 04 and 01 03 05
01 03 07*	other wastes containing hazardous substances from physical and chemical processing of metalliferous minerals
01 03 08	dusty and powdery wastes other than those mentioned in 01 03 07
01 03 09	red mud from alumina production other than the wastes mentioned in 01 03 07
01 03 99	wastes not otherwise specified

01 04 Wastes from physical and chemical processing of non-metalliferous minerals

01 04 07*	wastes containing hazardous substances from physical and chemical processing of non-metalliferous minerals
01 04 08	waste gravel and crushed rocks other than those mentioned in 01 04 07
01 04 09	waste sand and clays
01 04 10	dusty and powdery wastes other than those mentioned in 01 04 07
01 04 11	wastes from potash and rock-salt processing other than those mentioned in 01 04 07
01 04 12	tailings and other wastes from washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11
01 04 13	wastes from stone cutting and sawing other than those mentioned in 01 04 07
01 04 99	wastes not otherwise specified

01 05 Drilling muds and other drilling wastes

01 05 04	fresh-water drilling muds and wastes
01 05 05*	oil-containing drilling muds and wastes
01 05 06*	drilling muds and other drilling wastes containing hazardous substances
01 05 07	barite-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06
01 05 08	chloride-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06
01 05 99	wastes not otherwise specified

02 Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing

02 01 Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing

02 01 01	sludges from washing and cleaning
02 01 02	animal-tissue waste
02 01 03	plant-tissue waste
02 01 04	waste plastics (except packaging)
02 01 06	animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated off-site
02 01 07	wastes from forestry
02 01 08*	agrochemical waste containing hazardous substances
02 01 09	agrochemical waste other than those mentioned in 02 01 08
02 01 10	waste metal
02 01 99	wastes not otherwise specified

Appendix A-3 Hazardous Characteristics Code (H-Code)

Code	Characteristics
H1	Explosives
H2.1	Flammable gases
H3	Flammable liquid
H4	Flammable and reactive solids
H5.1	Inorganic oxidisers
H5.2	Organic oxidisers
H6.1	Acute toxicity (through oral, dermal, gas, vapour or gas/mist exposure)
H6.2	Infectious (Land Transport Rule: Dangerous Goods 1999 and NZ Standard 5433:1999 – Transport of Dangerous Goods on Land
H6.x	Chronic toxicity (mutagen, carcinogen, reproductive/developmental toxicity, target organ toxicity)
H7	Radioactivity (Radiation Protection Act 1965 and Radiation Protection Regulations 1982)
H8	Corrosivity
H9	Ecotoxicity

LEGEND
The above hazardous characteristics codes are based on the Hazardous Substances and New Organisms Act 1996 and associated regulations, with exception of code H6.2 (infectious characteristics), which is based on Land Transport Rule: Dangerous Goods 1999 and NZ Standard 5433:1999 – Transport of Dangerous Goods on Land; and H7 (radioactive characteristics) which is based on the Radiation Protection Act 1965 and Radiation Protection Regulations 1982.

Appendix A-4 Disposal and Recycling Codes (D- and R- Code)

OPERATIONS WHICH DO NOT LEAD TO THE POSSIBILITY OF RESOURCE RECOVERY, RECYCLING, RECLAMATION, DIRECT RE- USE OR ALTERNATIVE USES	
D1	Deposit into or onto land (e.g., landfill, etc.)
D2	Land treatment, (e.g., biodegradation of liquid or sludgy discards in soils, etc.)
D3	Deep injection, (e.g., injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc.)
D4	Surface impoundment, (e.g., placement of liquid or sludge discards into pits, ponds or lagoons, etc.)
D5	Specially engineered landfill, (e.g., placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)
D6	Release into a water body except seas/oceans
D7	Release into seas/oceans including sea-bed insertion
D7a	Discharge to trade waste and a public sewage treatment plant
D8	Biological treatment not specified elsewhere
D9	Physico-chemical treatment not specified elsewhere
D10	Incineration on land
D11	Incineration at sea
D12	Permanent storage (e.g., emplacement of containers in a secure place, etc.)
D13	Blending or mixing prior to submission to any of the above operations
D14	Repackaging prior to submission to any of the above operations
D15	Storage pending any of the above operations
D16	Other (specify)
OPERATIONS WHICH MAY LEAD TO RESOURCE RECOVERY, RECYCLING, RECLAMATION, DIRECT RE-USE OR ALTERNATIVE USES	
R1	Use as a fuel (other than in direct incineration) or other means to generate energy
R2	Solvent reclamation/regeneration
R3	Recycling/reclamation of organic substances which are not used as solvents
R4	Recycling/reclamation of metals and metal compounds
R5	Recycling/reclamation of other inorganic materials
R6	Regeneration of acids or bases
R7	Recovery of components used for pollution abatement
R8	Recovery of components from catalysts
R9	Used oil re-refining or other reuses of previously used oil
R10	Land treatment resulting in benefit to agriculture or ecological improvement
R11	Uses of residual materials obtained from any of the operations numbered R1-R10
R12	Exchange of wastes for submission to any of the operations numbered R1- R11
R13	Accumulation/storage of material intended for any operation numbered R1- R11
R14	Recycling/reconditioning/laundering of drums
R15	Other (specify)

Appendix B ANZSIC Business Categories

(Businesses with the potential to generate hazardous waste are highlighted)

Overview of businesses in New Zealand and number of full-time (equivalent) employees[1][2] by ANZSIC Code:

Comparison between 1999 and 2000 with 1997 Industry Coverage for Economically Significant Enterprises[3]

ANZSIC[4]	Description	Geographic Units		Full-time Equivalents	
		1999	2000	1999	2000
A021200	Shearing Services	314	313	3,600	3,950
A021300	Aerial Agricultural Services	120	135	350	360
A021900	Services to Agriculture nec	3,167	3,687	10,960	12,510
A022000	Hunting and Trapping	100	129	230	280
A030100	Forestry	3,932	4,272	2,070	1,860
A030200	Logging	641	659	3,620	4,050
A030300	Services to Forestry	520	584	2,680	3,380
A041100	Rock Lobster Fishing	293	311	660	630
A041300	Finfish Trawling	542	630	1,910	1,970
A041400	Squid Jigging	2	1	3	3
A041500	Line Fishing	592	653	1,030	1,080
A041900	Marine Fishing nec	159	165	270	260
A042000	Aquaculture	337	391	970	930
	TOTAL AGRICULTURE, FORESTRY AND FISHING	10,719	11,930	28,340	31,270
B110100	Black Coal Mining	43	35	700	550
B110200	Brown Coal Mining	4	5	55	50
B120000	Oil and Gas Extraction	23	21	570	460
B131100	Iron Ore Mining	2	3	100	95
B131400	Gold Ore Mining	55	57	450	330
B131500	Mineral Sand Mining	3	4	6	6
B131900	Metal Ore Mining nec	16	13	65	60
B141100	Gravel and Sand Quarrying	137	135	810	770
B141900	Construction Material Mining nec	155	168	800	940
B142000	Mining nec	18	26	130	190
B151100	Petroleum Exploration (Own Account)	8	10	9	3
B151200	Petroleum Exploration Services	26	27	55	65
B151400	Mineral Exploration Services	11	9	25	80
B152000	Other Mining Services	16	11	120	75
	TOTAL MINING	517	524	3,880	3,650
C211100	Meat Processing	213	204	20,690	20,940
C211200	Poultry Processing	36	39	1,870	1,810
C211300	Bacon, Ham and Smallgood Manufacturing	78	85	1,870	1,750
C212100	Milk and Cream Processing	35	32	850	1,130
C212200	Ice Cream Manufacturing	21	24	470	480
C212900	Dairy Product Manufacturing nec	72	75	6,250	6,270
C213000	Fruit and Vegetable Processing	108	107	3,890	3,750
C214000	Oil and Fat Manufacturing	31	41	370	340
C215100	Flour Mill Product Manufacturing	21	20	350	280
C215200	Cereal Food and Baking Mix Manufacturing	16	19	480	500
C216100	Bread Manufacturing	90	91	2,730	2,020
C216200	Cake and Pastry Manufacturing	162	151	2,070	1,740
C216300	Biscuit Manufacturing	13	14	720	710
C217100	Sugar Manufacturing	3	3	170	170
C217200	Confectionery Manufacturing	73	78	1,250	1,370
C217300	Seafood Processing	162	175	5,310	5,220
C217400	Prepared Animal/Bird Feed Manufacturing	83	83	730	710
C217900	Food Manufacturing nec	247	277	4,320	4,480
C218100	Soft Drink, Cordial and Syrup Manufacturing	37	45	830	1,270
C218200	Beer and Malt Manufacturing	63	70	1,220	1,210

ANZSIC[4]	Description	Geographic Units		Full-time Equivalents	
		1999	2000	1999	2000
C218300	Wine Manufacturing	161	179	1,690	2,050
C218400	Spirit Manufacturing	14	13	160	170
C219000	Tobacco Product Manufacturing	6	4	400	310
C221100	Wool Scouring	34	36	530	530
C221200	Synthetic Fibre Textile Manufacturing	31	31	210	230
C221400	Wool Textile Manufacturing	50	50	1,870	1,870
C221500	Textile Finishing	32	34	250	310
C222100	Made-Up Textile Product Manufacturing	410	426	2,340	2,450
C222200	Textile Floor Covering Manufacturing	30	28	860	920
C222300	Rope, Cordage and Twine Manufacturing	18	18	220	250
C222900	Textile Product Manufacturing nec	117	135	800	920
C223100	Hosiery Manufacturing	12	12	220	200
C223200	Cardigan and Pullover Manufacturing	43	43	490	490
C223900	Knitting Mill Product Manufacturing nec	38	39	900	850
C224000	Clothing Manufacturing	993	1,066	8,590	8,730
C225000	Footwear Manufacturing	55	52	1,010	960
C226110	Leather Tanning and Fur Dressing excluding Fellmongery	58	57	1,590	1,490
C226120	Fellmongery	18	16	430	460
C226200	Leather/Leather Substitute Product Manufacturing	100	100	430	420
C231100	Log Sawmilling	427	482	6,160	7,080
C231200	Wood Chipping	12	11	100	140
C231300	Timber Resawing and Dressing	101	105	1,220	1,380
C232100	Plywood and Veneer Manufacturing	34	37	1,690	1,980
C232200	Fabricated Wood Manufacturing	17	21	720	820
C232300	Wooden Structural Component Manufacturing	995	1,083	5,000	5,290
C232900	Wood Product Manufacturing nec	413	459	1,970	2,190
C233100	Pulp, Paper and Paperboard Manufacturing	22	24	3,100	2,880
C233200	Solid Paperboard Container Manufacturing	23	25	650	640
C233300	Corrugated Paperboard Container Manufacturing	19	18	1,430	1,320
C233400	Paper Bag and Sack Manufacturing	5	7	400	400
C233900	Paper Product Manufacturing nec	65	69	1,720	1,640
C241200	Printing	1,025	1,048	9,480	9,340
C241300	Services to Printing	346	333	1,950	1,890
C242100	Newspaper Printing or Publishing	291	293	6,040	5,930
C242200	Other Periodical Publishing	260	283	1,770	1,690
C242300	Book and other Publishing	224	239	1,520	1,410
C243000	Recorded Media Manufacturing and Publishing	18	25	45	55
C251000	Petroleum Refining	2	1	340	290
C252000	Petroleum and Coal Product Manufacturing nec	33	32	280	220
C253100	Fertiliser Manufacturing	63	63	1,000	890
C253200	Industrial Gas Manufacturing	13	11	230	240
C253300	Synthetic Resin Manufacturing	107	109	1,940	2,030
C253400	Organic Industrial Chemical Manufacturing nec	17	16	320	500
C253500	Inorganic Industrial Chemical Manufacturing nec	23	26	320	390
C254100	Explosive Manufacturing	10	10	35	55
C254200	Paint Manufacturing	97	114	1,060	1,160
C254300	Medicinal and Pharmaceutical Product Manufacturing	93	98	1,250	1,270
C254400	Pesticide Manufacturing	14	15	160	150
C254500	Soap and Other Detergent Manufacturing	50	56	1,220	1,220
C254600	Cosmetic and Toiletry Preparation Manufacturing	47	58	630	610
C254700	Ink Manufacturing	22	24	280	250
C254900	Chemical Product Manufacturing nec	83	78	620	620
C255100	Rubber Tyre Manufacturing	31	33	610	850
C255900	Rubber Product Manufacturing nec	80	77	840	760
C256100	Plastic Blow Moulded Product Manufacturing	35	33	480	520
C256200	Plastic Extruded Product Manufacturing	64	62	1,610	1,520
C256300	Plastic Bag and Film Manufacturing	44	47	1,320	1,380
C256400	Plastic Product Rigid Fibre Reinforced Manufacturing	114	125	1,120	1,110
C256500	Plastic Foam Product Manufacturing	19	25	160	220
C256600	Plastic Injection Moulded Product Manufacturing	245	256	3,520	3,640
C261000	Glass & Glass Product Manufacturing	124	129	1,170	1,110
C262100	Clay Brick Manufacturing	13	11	130	120
C262200	Ceramic Product Manufacturing	15	14	180	200
C262300	Ceramic Tile and Pipe Manufacturing	16	19	45	45
C262900	Ceramic Product Manufacturing nec	176	164	530	500
C263100	Cement and Lime Manufacturing	5	3	360	280
C263200	Plaster Product Manufacturing	30	33	300	390
C263300	Concrete Slurry Manufacturing	169	156	1,350	1,380
C263400	Concrete Pipe and Box Culvert Manufacturing	56	52	790	720
C263500	Concrete Product Manufacturing nec	177	179	1,290	1,200

ANZSIC[4]	Description	Geographic Units		Full-time Equivalents	
		1999	2000	1999	2000
C264000	Non-Metallic Mineral Product Manufacturing nec	96	106	640	680
C271100	Basic Iron and Steel Manufacturing	46	42	1,990	2,020
C271200	Iron and Steel Casting and Forging	86	94	760	940
C271300	Steel Pipe and Tube Manufacturing	37	47	120	150
C272200	Aluminium Smelting	2	2	920	860
C272300	Copper, Silver, Lead, Zinc Smelting, Refining	1	1	30	40
C272900	Basic Non-Ferrous Metal Manufacturing nec	15	15	190	150
C273100	Aluminium Rolling, Drawing, Extruding	24	26	770	680
C273200	Non-Ferrous Metal Rolling, Drawing, Extruding nec	18	17	820	830
C273300	Non-Ferrous Metal Casting	50	51	540	540
C274100	Structural Steel Fabricating	284	301	2,790	2,580
C274200	Architectural Aluminium Product Manufacturing	316	351	2,370	2,570
C274900	Structural Metal Product Manufacturing nec	406	423	2,610	2,620
C275100	Metal Container Manufacturing	46	48	1,390	1,300
C275900	Sheet Metal Product Manufacturing nec	304	311	2,460	2,590
C276100	Hand Tool and General Hardware Manufacturing	108	128	900	1,000
C276200	Spring and Wire Product Manufacturing	95	100	1,190	1,290
C276300	Nut, Bolt, Screw and Rivet Manufacturing	16	15	230	230
C276400	Metal Coating and Finishing	334	329	1,600	1,630
C276500	Non-Ferrous Pipe Fitting Manufacturing	30	32	280	270
C276900	Fabricated Metal Product Manufacturing nec	1,026	1,054	5,010	5,040
C281100	Motor Vehicle Manufacturing	64	54	330	270
C281200	Motor Vehicle Body Manufacturing	182	184	1,080	1,220
C281300	Automotive Electrical and Instrument Manufacturing	17	20	85	110
C281900	Automotive Component Manufacturing nec	322	320	2,230	1,970
C282100	Shipbuilding	91	96	1,040	1,000
C282200	Boatbuilding	496	580	2,610	3,410
C282300	Railway Equipment Manufacturing	52	29	1,870	770
C282400	Aircraft Manufacturing	129	150	3,400	3,440
C282900	Transport Equipment Manufacturing nec	33	32	260	230
C283100	Photographic and Optical Good Manufacturing	24	29	170	190
C283200	Medical and Surgical Equipment Manufacturing	192	205	900	1,110
C283900	Professional and Scientific Equipment Manufacturing nec	85	99	460	540
C284100	Computer and Business Machine Manufacturing	90	97	510	410
C284200	Telecommunication, Broadcasting and Transceiving Equipment Manufacturing	64	61	1,310	1,160
C284900	Electronic Equipment Manufacturing nec	181	190	2,050	1,690
C285100	Household Appliance Manufacturing	62	56	3,780	3,850
C285200	Electric Cable and Wire Manufacturing	17	14	650	700
C285300	Battery Manufacturing	8	8	200	240
C285400	Electric Light and Sign Manufacturing	63	62	540	440
C285900	Electrical Equipment Manufacturing nec	260	256	3,190	2,770
C286100	Agricultural Machinery Manufacturing	336	346	2,250	2,200
C286200	Mining and Construction Machinery Manufacturing	13	18	85	130
C286300	Food Processing Machinery Manufacturing	25	30	95	130
C286400	Machine Tool and Part Manufacturing	225	245	1,530	1,580
C286500	Lifting and Material Handling Equipment Manufacturing	111	131	850	920
C286600	Pump and Compressor Manufacturing	43	47	160	180
C286700	Commercial Space Heating and Cooling Equipment Manufacturing	45	50	400	450
C286900	Industrial Machinery and Equipment Manufacturing nec	2,074	2,194	10,910	10,970
C291100	Prefabricated Metal Building Manufacturing	36	42	140	160
C291900	Prefabricated Building Manufacturing nec	65	60	650	650
C292100	Wooden Furniture and Upholstered Seat Manufacturing	1,590	1,694	7,020	7,290
C292200	Sheet Metal Furniture Manufacturing	134	131	1,420	1,480
C292300	Mattress Manufacturing (except Rubber)	11	12	420	380
C292900	Furniture Manufacturing nec	73	94	450	550
C294100	Jewellery and Silverware Manufacturing	317	350	900	990
C294200	Toy and Sporting Good Manufacturing	188	209	660	730
C294900	Manufacturing nec	482	499	2,230	2,330
	TOTAL MANUFACTURING	21,708	22,850	234,220	236,240
D361000	Electricity Supply	341	234	5,580	4,910
D362000	Gas Supply	28	29	490	310
D370100	Water Supply	128	99	880	810
D370200	Sewerage and Drainage Services	132	62	820	580
	TOTAL ELECTRICITY, GAS AND WATER SUPPLY	629	424	7,780	6,600
E411100	House Construction	10,411	11,198	19,740	20,870

ANZSIC[4]	Description	Geographic Units		Full-time Equivalents	
		1999	2000	1999	2000
E411200	Residential Building Construction nec	60	66	140	170
E411300	Non-Residential Building Construction	1,123	1,198	8,470	8,740
E412100	Road and Bridge Construction	600	590	9,520	8,920
E412200	Non-Building Construction nec	1,029	1,038	6,350	8,080
E421000	Site Preparation Services	1,463	1,597	5,550	6,160
E422100	Concreting Services	629	700	1,740	1,990
E422200	Bricklaying Services	967	1,038	2,120	2,430
E422300	Roofing Services	770	861	1,880	2,000
E422400	Structural Steel Erection Services	128	144	410	420
E423100	Plumbing Services	2,874	3,057	7,290	7,660
E423200	Electrical Services	3,746	4,071	11,460	12,600
E423300	Air Conditioning and Heating Services	423	455	2,250	2,330
E423400	Fire and Security System Services	432	471	1,660	1,920
E424100	Plastering and Ceiling Services	1,301	1,481	2,760	3,230
E424200	Carpentry Services	2,271	2,526	3,820	4,170
E424300	Tiling and Carpeting Services	1,406	1,529	2,630	2,740
E424400	Painting and Decorating Services	3,258	3,449	7,910	8,530
E424500	Glazing Services	343	404	1,060	1,190
E425100	Landscaping Services	621	730	1,390	1,660
E425900	Construction Services nec	799	913	3,590	3,920
	TOTAL CONSTRUCTION	34,654	37,516	101,700	109,710
F451100	Wool Wholesaling	212	211	1,080	860
F451200	Cereal Grain Wholesaling	65	62	470	400
F451900	Farm Produce and Supplies Wholesaling nec	1,044	1,129	3,960	3,930
F452100	Petroleum Product Wholesaling	207	195	1,590	1,170
F452200	Metal and Mineral Wholesaling	389	392	2,380	2,210
F452300	Chemical Wholesaling	465	470	2,430	2,290
F453100	Timber Wholesaling	549	540	5,160	5,260
F453900	Building Supplies Wholesaling nec	1,040	1,142	6,340	6,850
F461100	Farm/Construction Machinery Wholesaling	481	523	2,490	2,740
F461200	Professional Equipment Wholesaling	268	295	1,330	1,610
F461300	Computer Wholesaling	821	861	5,090	5,390
F461400	Business Machine Wholesaling nec	415	424	2,920	2,980
F461500	Electrical and Electronic Equipment Wholesaling nec	991	1,162	6,530	7,060
F461900	Machinery and Equipment Wholesaling nec	1,560	1,607	7,580	7,530
F462100	Car Wholesaling	279	380	970	1,220
F462200	Commercial Vehicle Wholesaling	145	163	890	1,110
F462300	Motor Vehicle New Part Dealing	947	953	5,190	4,560
F462400	Motor Vehicle Dismantling and Used Part Dealing	352	361	1,210	1,210
F471100	Meat Wholesaling	160	156	930	900
F471200	Poultry and Smallgood Wholesaling	54	56	250	360
F471300	Dairy Produce Wholesaling	127	123	1,530	1,370
F471400	Fish Wholesaling	157	163	750	630
F471500	Fruit and Vegetable Wholesaling	253	258	2,000	2,180
F471600	Confectionery and Soft Drink Wholesaling	242	284	900	1,080
F471700	Liquor Wholesaling	178	216	1,270	1,130
F471800	Tobacco Product Wholesaling	24	27	240	260
F471900	Grocery Wholesaling nec	944	1,040	8,010	8,130
F472100	Textile Product Wholesaling	307	330	1,480	1,420
F472200	Clothing Wholesaling	490	526	1,800	1,770
F472300	Footwear Wholesaling	77	87	360	400
F473100	Household Appliance Wholesaling	215	227	1,150	1,280
F473200	Furniture Wholesaling	146	165	470	510
F473300	Floor Covering Wholesaling	83	73	430	430
F473900	Household Good Wholesaling nec	221	233	1,200	1,390
F479100	Photographic Equipment Wholesaling	75	81	450	470
F479200	Jewellery and Watch Wholesaling	143	159	410	440
F479300	Toy and Sporting Good Wholesaling	345	370	1,240	1,220
F479400	Book and Magazine Wholesaling	191	196	1,240	1,080
F479500	Paper Product Wholesaling	504	528	3,570	3,850
F479600	Pharmaceutical and Toiletry Wholesaling	333	369	3,630	3,540
F479900	Wholesaling nec	3,461	3,702	9,610	10,060
	TOTAL WHOLESALE TRADE	18,960	20,239	100,520	102,260
G511010	Supermarkets	395	403	24,700	25,600
G511020	Groceries and Dairies	2,274	2,357	7,230	7,090
G512100	Fresh Meat, Fish and Poultry Retailing	727	737	2,710	2,710
G512200	Fruit and Vegetable Retailing	489	516	1,800	1,840

ANZSIC[4]	Description	Geographic Units		Full-time Equivalents	
		1999	2000	1999	2000
G512300	Liquor Retailing	649	668	2,420	2,480
G512400	Bread and Cake Retailing	821	904	3,760	4,040
G512500	Takeaway Food Retailing	2,991	3,195	10,430	10,790
G512600	Milk Vending	363	369	1,360	1,350
G512900	Specialised Food Retailing nec	501	554	1,380	1,470
G521000	Department Stores	276	277	11,400	11,260
G522100	Clothing Retailing	2,452	2,493	7,750	7,910
G522200	Footwear Retailing	462	463	1,520	1,610
G522300	Fabric and other Soft Good Retailing	576	567	2,020	2,030
G523100	Furniture Retailing	670	713	2,980	3,090
G523200	Floor Covering Retailing	330	353	1,420	1,480
G523300	Domestic Hardware and Houseware Retailing	952	977	4,610	4,780
G523400	Domestic Appliance Retailing	1,028	1,101	4,490	4,700
G523500	Recorded Music Retailing	210	204	640	650
G524100	Sport and Camping Equipment Retailing	789	801	2,740	2,870
G524200	Toy and Game Retailing	175	178	460	470
G524300	Newspaper, Book and Stationery Retailing	1,173	1,193	5,200	5,340
G524400	Photographic Equipment Retailing	115	128	450	510
G524500	Marine Equipment Retailing	212	215	700	810
G525100	Pharmaceutical, Cosmetic and Toiletry Retailing	1,174	1,180	6,560	6,610
G525200	Antique and Used Good Retailing	978	1,080	1,940	2,140
G525300	Garden Supplies Retailing	362	401	1,710	1,780
G525400	Flower Retailing	482	507	1,120	1,100
G525500	Watch and Jewellery Retailing	517	533	2,140	1,870
G525900	Retailing nec	4,744	4,968	11,110	11,560
G526100	Household Equipment Repair Services (Electrical)	804	894	2,050	2,100
G526900	Household Equipment Repair Services nec	546	544	1,180	1,150
G531100	Car Retailing	1,631	1,789	11,780	12,200
G531200	Motor Cycle Dealing	249	268	1,090	1,130
G531300	Trailer and Caravan Dealing	51	57	140	140
G532100	Automotive Fuel Retailing	1,621	1,658	10,990	10,930
G532200	Automotive Electrical Services	458	477	1,380	1,470
G532300	Smash Repairing	1,941	1,984	7,030	6,950
G532400	Tyre Retailing	530	532	2,170	2,170
G532900	Automotive Repair and Services nec	3,680	3,932	11,510	12,150
	TOTAL RETAIL TRADE	38,398	40,170	176,040	180,270
H571000	Accommodation	3,433	3,713	21,240	22,100
H572000	Pubs, Taverns and Bars	1,118	1,237	7,850	8,470
H573000	Cafes and Restaurants	4,705	5,455	32,270	36,590
H574000	Clubs (Hospitality)	403	401	2,320	2,420
	TOTAL ACCOMMODATION, CAFES AND RESTAURANTS	9,659	10,806	63,690	69,560
I611000	Road Freight Transport	4,962	5,109	21,620	22,410
I612100	Long Distance Bus Transport	123	116	1,310	1,300
I612200	Short Distance Bus Transport (including Tramway)	392	452	3,890	3,830
I612300	Taxi and other Road Passenger Transport	2,330	2,478	3,930	4,260
I620000	Rail Transport	188	80	2,030	2,270
I630100	International Sea Transport	34	40	330	380
I630200	Coastal Water Transport	117	133	1,200	1,050
I630300	Inland Water Transport	40	48	350	470
I640100	Scheduled International Air Transport	85	99	3,570	3,780
I640200	Scheduled Domestic Air Transport	129	128	3,850	3,940
I640300	Non-Scheduled Air and Space Transport	343	343	650	680
I650100	Pipeline Transport	3	3	12	15
I650900	Transport nec	94	101	210	230
I661100	Parking Services	106	109	380	380
I661900	Services to Road Transport nec	25	28	140	110
I662100	Stevedoring	40	49	710	920
I662300	Port Operators	84	76	1,880	1,940
I662900	Services to Water Transport nec	58	72	220	410
I663000	Services to Air Transport	87	95	1,340	1,250
I664100	Travel Agency Services	1,387	1,503	6,770	7,150
I664200	Road Freight Forwarding	79	81	510	460
I664300	Freight Forwarding (except Road)	277	258	2,830	2,580
I664400	Customs Agency Services	126	138	720	710
I664900	Services to Transport nec	161	187	770	940
I670100	Grain Storage	4	5	12	12

ANZSIC[4]	Description	Geographic Units		Full-time Equivalents	
		1999	2000	1999	2000
I670900	Storage nec	428	508	2,590	3,240
	TOTAL TRANSPORT AND STORAGE	11,702	12,239	61,810	64,680
J711100	Postal Services	880	915	9,820	12,790
J711200	Courier Services	2,469	2,581	5,120	5,070
J712000	Telecommunication Services	568	400	12,530	9,420
	TOTAL COMMUNICATION SERVICES	3,917	3,896	27,470	27,270
K731000	Central Bank	3	3	310	290
K732100	Banks	1,426	1,016	22,190	19,470
K732200	Building Societies	24	26	180	190
K732300	Credit Unions	91	83	260	210
K732400	Money Market Dealers	1	1	12	12
K732900	Deposit Taking Financiers nec	68	69	980	1,010
K733000	Other Financiers	354	357	1,340	1,190
K734000	Financial Asset Investors	3,829	4,392	1,090	530
K741100	Life Insurance	124	106	2,650	2,880
K741200	Superannuation Funds	1,277	1,262	6	0
K742100	Health Insurance	100	92	750	700
K742200	General Insurance	377	358	4,710	5,140
K751100	Financial Asset Broking Services	304	402	1,340	1,690
K751900	Services to Finance and Investment nec	1,354	1,661	4,510	5,000
K752000	Services to Insurance	1,533	1,718	4,700	5,150
	TOTAL FINANCE AND INSURANCE	10,865	11,546	45,030	43,440
L771110	Residential Property Body Corporates	87	133	12	9
L771190	Residential Property Operators nec	1,156	1,574	1,120	1,180
L771210	Commercial Property Body Corporates	208	241	75	35
L771290	Commercial Property Operators and Developers nec	31,699	36,734	11,510	10,950
L772000	Real Estate Agents	7,354	7,991	13,200	14,510
L773010	Holder Investor Farm Animals	246	394	170	230
L773090	Non-Financial Asset Investors nec	1,642	1,737	740	670
L774100	Motor Vehicle Hiring	939	1,060	2,240	2,290
L774200	Other Transport Equipment Leasing	242	289	730	830
L774300	Plant Hiring or Leasing	1,416	1,527	3,720	3,810
L781000	Scientific Research	237	249	5,540	5,420
L782100	Architectural Services	1,836	1,983	3,990	4,320
L782200	Surveying Services	339	364	1,680	1,850
L782300	Consultant Engineering Services	2,892	3,481	10,820	11,800
L782900	Technical Services nec	585	635	2,250	2,390
L783100	Data Processing Services	172	159	1,880	1,670
L783200	Information Storage & Retrieval Services	61	83	430	1,590
L783300	Computer Maintenance Services	277	313	830	960
L783400	Computer Consultancy Services	4,863	5,799	12,230	15,630
L784100	Legal Services	2,258	2,455	14,120	14,400
L784200	Accounting Services	2,972	3,358	14,160	14,510
L785100	Advertising Services	1,023	1,157	5,680	6,620
L785200	Commercial Art and Display Services	1,635	1,910	4,000	4,430
L785300	Market Research Services	214	143	1,800	1,860
L785400	Business Administrative Services	279	337	5,070	4,260
L785500	Business Management Services	7,890	9,660	16,590	19,490
L786100	Employment Placement Services	495	649	6,020	7,100
L786200	Contract Staff Services	96	132	1,250	1,750
L786300	Secretarial Services	497	545	1,570	1,630
L786400	Security and Investigative Services (except Police)	648	702	4,550	4,590
L786500	Pest Control Services	144	166	500	510
L786600	Cleaning Services	1,899	2,070	12,510	13,370
L786700	Contract Packing Services nec	67	79	1,040	1,200
L786900	Business Services nec	4,078	4,404	14,890	15,020
	TOTAL PROPERTY AND BUSINESS SERVICES	80,446	92,513	176,910	190,900
M811100	Central Government Administration	1,061	1,033	28,380	26,700
M811300	Local Government Administration	783	629	12,260	11,450
M812000	Justice	153	147	2,270	2,570
M813000	Foreign Government Representation	1	-	-	-
M820000	Defence	70	69	11,870	10,880

ANZSIC[4]	Description	Geographic Units		Full-time Equivalents	
		1999	2000	1999	2000
	TOTAL GOVERNMENT ADMINISTRATION AND DEFENCE	2,068	1,878	54,770	51,600
N841000	Preschool Education	2,208	2,286	6,860	7,140
N842100	Primary Education	2,313	2,299	34,500	33,590
N842200	Secondary Education	362	360	22,750	21,290
N842300	Combined Primary and Secondary Education	52	57	1,240	1,250
N842400	Special School Education	49	48	1,260	1,250
N843100	Higher Education	97	106	23,920	24,280
N843200	Technical and Further Education	36	40	1,800	1,530
N844000	Other Education	2,326	2,430	12,260	12,480
	TOTAL EDUCATION	7,443	7,626	104,580	102,810
O861100	Hospitals (except Psychiatric Hospitals)	276	269	39,170	39,780
O861200	Psychiatric Hospitals	24	24	2,430	2,160
O861300	Nursing Homes	31	44	390	620
O862100	General Practice Medical Services	2,979	3,247	9,020	9,190
O862200	Specialist Medical Services	1,285	1,456	3,050	3,270
O862300	Dental Services	1,281	1,393	3,970	4,060
O863100	Pathology Services	219	186	2,170	1,900
O863200	Optometry and Optical Dispensing	353	399	1,210	1,280
O863300	Ambulance Services	133	168	780	940
O863500	Physiotherapy Services	647	702	1,330	1,330
O863600	Chiropractic Services	302	336	580	610
O863900	Health Services nec	2,508	2,744	14,740	16,900
O864000	Veterinary Services	541	571	2,370	2,430
O871000	Child Care Services	674	766	4,500	4,960
O872100	Accommodation for the Aged	799	812	15,520	16,350
O872200	Residential Care Services nec	931	471	5,410	5,580
O872900	Non-Residential Care Services nec	958	1,083	5,860	7,360
	TOTAL HEALTH AND COMMUNITY SERVICES	13,941	14,671	112,490	118,730
P911100	Film and Video Production	882	1,137	2,240	2,560
P911200	Film and Video Distribution	46	53	180	160
P911300	Motion Picture Exhibition	76	87	840	870
P912100	Radio Services	170	184	1,810	1,930
P912200	Television Services	64	68	2,130	2,170
P921000	Libraries	278	283	3,380	2,740
P922000	Museums	166	177	1,200	1,260
P923100	Zoological and Botanic Gardens	31	31	280	340
P923900	Recreational Parks and Gardens	145	162	1,370	1,310
P924100	Music and Theatre Productions	276	280	780	770
P924200	Creative Arts	1,421	1,650	1,890	1,990
P925100	Sound Recording Studios	93	112	200	210
P925200	Performing Arts Venues	108	127	430	540
P925900	Services to the Arts nec	272	303	540	560
P931100	Horse and Dog Racing	609	636	1,660	1,690
P931200	Sports Grounds and Facilities nec	752	852	3,910	4,320
P931900	Sports and Services to Sports nec	2,998	3,116	4,090	4,790
P932100	Lotteries	7	7	25	18
P932200	Casinos	5	6	2,360	2,590
P932900	Gambling Services nec	168	177	630	640
P933000	Other Recreation Services	1,068	1,245	3,530	3,850
	TOTAL CULTURAL AND RECREATIONAL SERVICES	9,635	10,693	33,440	35,300
Q951100	Video Hire Outlets	389	421	1,530	1,660
Q951900	Personal and Household Goods Hiring nec	162	207	350	530
Q952100	Laundries and Dry-Cleaners	611	649	3,290	3,540
Q952200	Photographic Film Processing	282	292	1,190	1,150
Q952300	Photographic Studios	646	681	1,180	1,250
Q952400	Funeral Directors, Crematoria and Cemeteries	361	379	770	840
Q952500	Gardening Services	1,824	2,097	3,500	3,940
Q952600	Hairdressing and Beauty Salons	2,657	2,844	7,450	7,850
Q952900	Personal Services nec	310	381	1,150	1,240
Q961000	Religious Organisations	455	518	1,530	1,790
Q962100	Business and Professional Associations	909	812	2,160	1,750
Q962200	Labour Associations	144	219	460	720
Q962900	Interest Groups nec	2,505	2,680	5,810	6,600

ANZSIC[4]	Description	Geographic Units 1999	Geographic Units 2000	Full-time Equivalents 1999	Full-time Equivalents 2000
Q963100	Police Services	430	437	8,570	8,610
Q963200	Corrective Centres	107	136	3,680	3,890
Q963300	Fire Brigade Services	457	457	2,240	1,640
Q963400	Waste Disposal Services	668	715	2,530	2,850
Q970000	Private Households Employing Staff	15	15	60	40
	TOTAL PERSONAL AND OTHER SERVICES	**12,932**	**13,940**	**47,490**	**49,870**
	NEW ZEALAND TOTAL	**288,193**	**313,461**	**1,380,160**	**1,424,150**

(1) Figures have been rounded, and discrepancies may occur between sums of component items and totals. All percentages have been calculated using rounded figures.
(2) Full-time Equivalent Persons Engaged (FTE) equal the sum of the full-time employees and working proprietors plus half the part-time employees and working proprietors.
(3) Generally defined as enterprises with greater than $30,000 annual GST expenses or sales, or enterprises in a GST exempt industry.
(4) Agriculture production (ANZSIC subdivision A01) is excluded from these statistics.

Appendix C Study Categories and Associated ANZSIC Codes

Study category	ANZSIC Codes	ANZSIC Code Titles
A	A021300	Aerial Agricultural Services
A	A021900	Services to Agriculture nec
A	A022000	Hunting and Trapping
A	A030100	Forestry
A	A030200	Logging
B	B110100	Black Coal Mining
B	B110200	Brown Coal Mining
B	B120000	Oil and Gas Extraction
B	B131100	Iron Ore Mining
B	B131200	Bauxite Mining
B	B131300	Copper Ore Mining
B	B131400	Gold Ore Mining
B	B131600	Nickel Ore Mining
B	B131700	Silver-Lead-Zinc Ore Mining
B	B131900	Metal Ore Mining nec
B	B142000	Mining nec
B	B151100	Petroleum Exploration (Own Account)
B	B151200	Petroleum Exploration Services
B	B151400	Mineral Exploration Services
B	B152000	Other Mining Services
Ca	C271100	Basic Iron and Steel Manufacturing
Ca	C271200	Iron and Steel Casting and Forging
Ca	C271300	Steel Pipe and Tube Manufacturing
Ca	C272100	Alumina Production
Ca	C272200	Aluminium Smelting
Ca	C272300	Copper, Silver, Lead and Zinc Smelting, Refining
Ca	C272900	Basic Non-Ferrous Metal Manufacturing nec
Ca	C273100	Aluminium Rolling, Drawing, Extruding
Ca	C273200	Non-Ferrous Metal Rolling, Drawing, Extruding nec
Ca	C273300	Non-Ferrous Metal Casting
Ca	C274100	Structural Steel Fabricating
Ca	C274200	Architectural Aluminium Product Manufacturing
Ca	C274900	Structural Metal Product Manufacturing nec
Ca	C275100	Metal Container Manufacturing
Ca	C275900	Sheet Metal Product Manufacturing nec
Ca	C276100	Hand Tool and General Hardware Manufacturing
Ca	C276200	Spring and Wire Product Manufacturing
Ca	C276300	Nut, Bolt, Screw and Rivet Manufacturing
Ca	C276400	Metal Coating and Finishing
Ca	C276500	Non-Ferrous Pipe Fitting Manufacturing
Ca	C276900	Fabricated Metal Product Manufacturing nec
Cb	C211100	Meat Processing
Cb	C211200	Poultry Processing
Cb	C211300	Bacon, Ham and Smallgood Manufacturing

Study category	ANZSIC Codes	ANZSIC Code Titles
Cb	C212100	Milk and Cream Processing
Cb	C212200	Ice Cream Manufacturing
Cb	C212900	Dairy Product Manufacturing nec
Cb	C213000	Fruit and Vegetable Processing
Cb	C214000	Oil and Fat Manufacturing
Cb	C215100	Flour Mill Product Manufacturing
Cb	C215200	Cereal Food and Baking Mix Manufacturing
Cb	C216100	Bread Manufacturing
Cb	C216200	Cake and Pastry Manufacturing
Cb	C216300	Biscuit Manufacturing
Cb	C217100	Sugar Manufacturing
Cb	C217200	Confectionery Manufacturing
Cb	C217300	Seafood Processing
Cb	C217400	Prepared Animal and Bird Feed Manufacturing
Cb	C217900	Food Manufacturing nec
Cb	C218100	Soft Drink, Cordial and Syrup Manufacturing
Cb	C218200	Beer and Malt Manufacturing
Cb	C218300	Wine Manufacturing
Cb	C218400	Spirit Manufacturing
Cb	C219000	Tobacco Product Manufacturing
Cb	C221100	Wool Scouring
Cb	C221200	Synthetic Fibre Textile Manufacturing
Cb	C221300	Cotton Textile Manufacturing
Cb	C221400	Wool Textile Manufacturing
Cb	C221500	Textile Finishing
Cb	C222100	Made-Up Textile Product Manufacturing
Cb	C222200	Textile Floor Covering Manufacturing
Cb	C222300	Rope, Cordage and Twine Manufacturing
Cb	C222900	Textile Product Manufacturing nec
Cb	C223100	Hosiery Manufacturing
Cb	C223200	Cardigan and Pullover Manufacturing
Cb	C223900	Knitting Mill Product Manufacturing nec
Cb	C224000	Clothing Manufacturing
Cb	C225000	Footwear Manufacturing
Cb	C226110	Leather Tanning and Fur Dressing excluding Fellmongery
Cb	C226120	Fellmongery
Cb	C226200	Leather and Leather Substitute Product Manufacturing
Cb	C261000	Glass and Glass Product Manufacturing
Cb	C262100	Clay Brick Manufacturing
Cb	C262200	Ceramic Product Manufacturing
Cb	C262300	Ceramic Tile and Pipe Manufacturing
Cb	C262900	Ceramic Product Manufacturing nec
Cb	C263100	Cement and Lime Manufacturing
Cb	C263200	Plaster Product Manufacturing
Cb	C263300	Concrete Slurry Manufacturing
Cb	C263400	Concrete Pipe and Box Culvert Manufacturing
Cb	C263500	Concrete Product Manufacturing nec
Cb	C264000	Non-Metallic Mineral Product Manufacturing nec
Cc	C231100	Log Sawmilling
Cc	C231200	Wood Chipping
Cc	C231300	Timber Resawing and Dressing
Cc	C232100	Plywood and Veneer Manufacturing

Study category	ANZSIC Codes	ANZSIC Code Titles
Cc	C232200	Fabricated Wood Manufacturing
Cc	C232300	Wooden Structural Component Manufacturing
Cc	C232900	Wood Product Manufacturing nec
Cc	C233100	Pulp, Paper and Paperboard Manufacturing
Cc	C233200	Solid Paperboard Container Manufacturing
Cc	C233300	Corrugated Paperboard Container Manufacturing
Cc	C233400	Paper Bag and Sack Manufacturing
Cc	C233900	Paper Product Manufacturing nec
Cc	C241100	Paper Stationery Manufacturing
Cc	C241200	Printing
Cc	C241300	Services to Printing
Cc	C242100	Newspaper Printing or Publishing
Cc	C242200	Other Periodical Publishing
Cc	C242300	Book and other Publishing
Cc	C243000	Recorded Media Manufacturing and Publishing
Cc	C251000	Petroleum Refining
Cc	C252000	Petroleum and Coal Product Manufacturing nec
Cc	C253100	Fertiliser Manufacturing
Cc	C253200	Industrial Gas Manufacturing
Cc	C253300	Synthetic Resin Manufacturing
Cc	C253400	Organic Industrial Chemical Manufacturing nec
Cc	C253500	Inorganic Industrial Chemical Manufacturing nec
Cc	C254100	Explosive Manufacturing
Cc	C254200	Paint Manufacturing
Cc	C254300	Medicinal and Pharmaceutical Product Manufacturing
Cc	C254400	Pesticide Manufacturing
Cc	C254500	Soap and Other Detergent Manufacturing
Cc	C254600	Cosmetic and Toiletry Preparation Manufacturing
Cc	C254700	Ink Manufacturing
Cc	C254900	Chemical Product Manufacturing nec
Cc	C255100	Rubber Tyre Manufacturing
Cc	C255900	Rubber Product Manufacturing nec
Cc	C256100	Plastic Blow Moulded Product Manufacturing
Cc	C256200	Plastic Extruded Product Manufacturing
Cc	C256300	Plastic Bag and Film Manufacturing
Cc	C256400	Plastic Product Rigid Fibre Reinforced Manufacturing
Cc	C256500	Plastic Foam Product Manufacturing
Cc	C256600	Plastic Injection Moulded Product Manufacturing
Cc	C281100	Motor Vehicle Manufacturing
Cc	C281200	Motor Vehicle Body Manufacturing
Cc	C281300	Automotive Electrical and Instrument Manufacturing
Cc	C281900	Automotive Component Manufacturing nec
Cc	C282100	Shipbuilding
Cc	C282200	Boatbuilding
Cc	C282300	Railway Equipment Manufacturing
Cc	C282400	Aircraft Manufacturing
Cc	C282900	Transport Equipment Manufacturing nec
Cc	C283100	Photographic and Optical Good Manufacturing
Cc	C283200	Medical and Surgical Equipment Manufacturing
Cc	C283900	Professional and Scientific Equipment Manufacturing nec
Cc	C284100	Computer and Business Machine Manufacturing
Cc	C284200	Telecommunication, Broadcasting and Transceiving Equipment

Study category	ANZSIC Codes	ANZSIC Code Titles
		Manufacturing
Cc	C284900	Electronic Equipment Manufacturing nec
Cc	C285100	Household Appliance Manufacturing
Cc	C285200	Electric Cable and Wire Manufacturing
Cc	C285300	Battery Manufacturing
Cc	C285400	Electric Light and Sign Manufacturing
Cc	C285900	Electrical Equipment Manufacturing nec
Cc	C286100	Agricultural Machinery Manufacturing
Cc	C286200	Mining and Construction Machinery Manufacturing
Cc	C286300	Food Processing Machinery Manufacturing
Cc	C286400	Machine Tool and Part Manufacturing
Cc	C286500	Lifting and Material Handling Equipment Manufacturing
Cc	C286600	Pump and Compressor Manufacturing
Cc	C286700	Commercial Space Heating and Cooling Equipment Manufacturing
Cc	C286900	Industrial Machinery and Equipment Manufacturing nec
Cc	C291100	Prefabricated Metal Building Manufacturing
Cc	C291900	Prefabricated Building Manufacturing nec
Cc	C292100	Wooden Furniture and Upholstered Seat Manufacturing
Cc	C292200	Sheet Metal Furniture Manufacturing
Cc	C292300	Mattress Manufacturing (except Rubber)
Cc	C292900	Furniture Manufacturing nec
Cc	C294100	Jewellery and Silverware Manufacturing
Cc	C294200	Toy and Sporting Good Manufacturing
Cc	C294900	Manufacturing nec
D	D361000	Electricity Supply
D	D362000	Gas Supply
D	D370100	Water Supply
X	D370200	Sewerage and Drainage Services
E	E412100	Road and Bridge Construction
E	E422300	Roofing Services
E	E423200	Electrical Services
E	E423300	Air Conditioning and Heating Services
E	E423400	Fire and Security System Services
E	E424100	Plastering and Ceiling Services
E	E424300	Tiling and Carpeting Services
E	E424400	Painting and Decorating Services
F	F451900	Farm Produce and Supplies Wholesaling nec
F	F452100	Petroleum Product Wholesaling
F	F452200	Metal and Mineral Wholesaling
F	F452300	Chemical Wholesaling
F	F453100	Timber Wholesaling
F	F462400	Motor Vehicle Dismantling and Used Part Dealing
G	G532100	Automotive Fuel Retailing
G	G532200	Automotive Electrical Services
G	G532300	Smash Repairing
G	G532900	Automotive Repair and Services nec
I	I611000	Road Freight Transport
I	I612100	Long Distance Bus Transport
I	I612200	Short Distance Bus Transport (including Tramway)
I	I612300	Taxi and Other Road Passenger Transport
I	I620000	Rail Transport
I	I630100	International Sea Transport

Study category	ANZSIC Codes	ANZSIC Code Titles
I	I630200	Coastal Water Transport
I	I630300	Inland Water Transport
I	I640100	Scheduled International Air Transport
I	I640200	Scheduled Domestic Air Transport
I	I640300	Non-Scheduled Air and Space Transport
I	I650900	Transport nec
I	I661900	Services to Road Transport nec
I	I662200	Water Transport Terminals
I	I662300	Port Operators
I	I662900	Services to Water Transport nec
I	I663000	Services to Air Transport
I	I664200	Road Freight Forwarding
I	I664300	Freight Forwarding (except Road)
I	I670900	Storage nec
L	L774100	Motor Vehicle Hiring
L	L774200	Other Transport Equipment Leasing
L	L774300	Plant Hiring or Leasing
L	L781000	Scientific Research
L	L786500	Pest Control Services
L	L786600	Cleaning Services
Q	Q952100	Laundries and Dry-Cleaners
Q	Q952200	Photographic Film Processing
Q	Q952300	Photographic Studios
Q	Q952400	Funeral Directors, Crematoria and Cemeteries
Q	Q952500	Gardening Services
Q	Q952600	Hairdressing and Beauty Salons
Za	Q963100	Police Services
Q	Q963300	Fire Brigade Services
X	Q963400	Waste Disposal Services
Za	M811100	Central Government Administration
Zb	M811300	Local Government Administration
Za	M820000	Defence
Za	N842100	Primary Education
Za	N842200	Secondary Education
Za	N842300	Combined Primary and Secondary Education
Za	N843100	Higher Education
Za	N843200	Technical and Further Education
O	O861100	Hospitals (except Psychiatric Hospitals)
O	O861200	Psychiatric Hospitals
O	O861300	Nursing Homes
O	O862100	General Practice Medical Services
O	O862200	Specialist Medical Services
O	O862300	Dental Services
O	O863100	Pathology Services
O	O863200	Optometry and Optical Dispensing
O	O863300	Ambulance Services
O	O863500	Physiotherapy Services
O	O863600	Chiropractic Services
O	O863900	Health Services nec
O	O864000	Veterinary Services
Za	P923100	Zoological and Botanic Gardens
Za	P923900	Recreational Parks and Gardens

Appendix D Table of Contents of Survey Materials

Table of contents of survey materials:

7 Appendices

Appendix E Survey Form

Region (BOP/Waikato)

UBD Code

Generator (G) /Operator (O): _____

Business code: _____

ANZSIC code: _____

Study category _____

Prepared to participate in survey **YES / NO**

Involved with hazardous waste **YES / NO**

Date survey checked: _____

Quality control checker's name: _____

Confidentiality agreement: **YES / NO**

Date: _____

Interviewer: _____

Name of business: _____

Contact person: _____

Title: _____

Street address: _____

Postal address: _____

Phone: _____ **Fax:** _____

E-mail: _____

Nature of industrial activity: _____

Number of Employees: _____

Technical background of contact _____

If there is no technical person where do you obtain expertise from:
(i.e., regional council, consultant, none, etc) _____

PART A: DESCRIPTION OF HAZARDOUS WASTE STREAM(S)

This part of the survey establishes whether a business is involved with hazardous waste, either as a generator or an operator. In this context, use the information on hazardous waste, including the Hazardous Waste Prompt Sheet.

The aim is to help the interviewee establish what a hazardous waste is and to identify any hazardous waste the business is involved in on a preliminary basis. Describe the hazardous waste streams the business concerned generated and/or received in 2001 and addressing each waste stream individually.

A hazardous waste stream is a discrete hazardous waste that is either generated or received by a Hazardous Waste Generator or Operator. "Discrete" means it is distinct in terms of its source/originating process, its form (liquid, solid, sludge or gas), its characteristics and constituents. If there are more than five different hazardous waste stream types, please use another survey form.

Hazardous waste stream	Received (R) Generated (G)	Description of hazardous waste stream (including hazardous characteristics and constituents, if known)
1		
2		
3		
4		
5		

PART B: WHAT HAZARDOUS WASTE ACTIVITIES WERE YOU CARRYING OUT IN 2001?

This part of the survey tries to establish what hazardous waste related activities a business is involved in on a preliminary basis. The specific methods for storage, treatment, recycling/reuse and disposal will be addressed in greater detail later on in the survey. Tick the appropriate box(es) below.

- ☐ *Generation*
- ☐ *Receipt/processing of hazardous waste*
- ☐ *Transport*
- ☐ *On-Site Storage*
- ☐ *Off-Site Storage*
- ☐ *On-Site Treatment*
- ☐ *Off-Site Treatment*
- ☐ *On-Site Recycling/Re-use*
- ☐ *Off-Site Recycling/Re-use*
- ☐ *On-Site Disposal*
- ☐ *Off-Site Disposal*
- ☐ *Import into Waikato/Bay of Plenty*
- ☐ *Export from Waikato/Bay of Plenty*

PART C: HAZARDOUS WASTE CLASSIFICATION

This part addresses the classification of each waste stream, as outlined in the Attachments. For each waste stream, please insert the appropriate codes below.

	WASTE STREAM				
	1	**2**	**3**	**4**	**5**
Waste Form **Waste form (liquid=L, sludge=SL, solid=S, gas=G)**					
Waste category *(Attachment A)*					
Waste code *(Attachment B)*					
Hazardous characteristic (primary) *(Attachment C)*					
Method of treatment or disposal *(Attachment D)*					
Method of recycling/ re-use *(Attachment D)*					

PART D: HAZARDOUS WASTE QUANTITIES

Please enter below, for hazardous waste stream, the quantities the business dealt with over **the 2001 calendar year**, using the units provided below. If waste quantities are provided on a daily or monthly basis, please indicate this specifically in each cell (i.e. per day or per month).

Note: that there may be more than one quantity in the column for each waste; for example, a waste may be generated and then stored and/or disposed of, as an example. However, you may only choose only ONE off-site activity (Categories I – L).

WASTE STREAMS
Annual Hazardous Waste Quantities (2001 calendar year)[18]
Tons (for liquids and solids) and m^3 (for gases)
(note: 1000 litres = 1000 kilograms = 1 ton)

	1	2	3	4	5
A. Waste form (liquid=L, sludge=SL, solid=S, gas=G					
B. Generation					
C. Received					
D. On-site storage (maximum quantity at any stage)					
E. On-site treatment					
F. On-site disposal					
G. On-site recycle/re-use					
H. Transport from facility (via road vehicle)					
I. Off-site storage (maximum quantity at any stage)					
J. Off-site recycle/re-use (HW operator)					
K. Off-site treatment or disposal (HW operator)					
L. Discharge to trade waste					
M. Import into region i. quantity ii. source location					
N. Export from region i. quantity ii. destination					

[18] *if other units are used, such as m3/day or tons/month, please indicate the different units in the respective fields.*

PART E: HAZARDOUS WASTE CONSTITUENTS

The list below provides a few examples of possible contaminants that may be contained in a hazardous waste. Sometimes, information on the concentrations of waste contaminants is available and should then be noted below as an average. The list provides just a few examples of many hundreds of possible contaminants. If the contaminants in questions are listed, note the concentrations alongside. If they are not, please note them down in the left-hand column. **Only list a maximum of five contaminants per waste.**

CONSTITUENT	**WASTE STREAMS (indicate concentrations such as mg/l, g/kg, g/m^3, %, etc.)**				
	1	**2**	**3**	**4**	**5**
Acrylonitrile					
Arsenic					
Barium					
Benzene					
Cadmium					
Carbon tetrachloride					
Chlordane					
Chlorobenzene					
Chloroform					
Chromium					
Cresol					
Polychorinated biphenyls (PCB)					
Cyanide					
Dichlorobenzene					
Dichloroethane					
Formaldehyde					
Hexachloroethane					
Lead					
Lindane					
Mercury					
Nitrobenzene					
Pentachlorophenol					
Phtalate esters					
Selenium					
Silver					
Sulphides					
Styrene					
Tetrachloroethylene					
Toluene					
Total halogenated compounds					
Trichloroethylene					
Trichlorophenol					
Vinyl Chloride					
Xylene					

PART F: ON-SITE TREATMENT OF HAZARDOUS WASTES

If you treat hazardous waste on-site, please tick the appropriate box(es) below.

TREATMENT METHOD	WASTE STREAM (Y/N) 1	2	3	4	5
a) neutralisation/chemical					
b) settling/sedimentation					
c) filtration					
d) dewatering					
e) biological					
f) solidification					
g) other					

PART G. OFF-SITE TREATMENT/DISPOSAL OF HAZARDOUS WASTES

NAMES OF HAZARDOUS WASTE OPERATORS	**WASTE STREAM** ***(tick appropriate boxes)***				
	1	**2**	**3**	**4**	**5**
a)					
b)					
c)					
d)					

PART H: TRANSPORTATION OF HAZARDOUS WASTES

NAMES OF HAZARDOUS WASTE TRANSPORTERS	**WASTE STREAM** *(tick appropriate boxes)*				
	1	**2**	**3**	**4**	**5**
a) own transport facility:					
b)					
c)					
d)					

PART I: RECORD KEEPING

A. Name type of records kept:	WASTE STREAM				
	1	2	3	4	5
a) electronic					
b) hard copy					
c) invoices or receipts					
d) annual reports					
e) manifests					
f) other (specify)					

B. Measurement of Quantities	WASTE STREAM				
	1	2	3	4	5
a) electronic device					
b) pump					
c) weighbridge					
d) visual estimate					
e) other					

PART J: DO YOU EXPECT ANY CHANGES IN WASTE QUANTITIES OVER THE NEXT YEAR?

Please enter below, for each activity and hazardous waste stream, the quantities you expect to deal with in **the 2002 calendar year**. If waste quantities are listed on a weekly or monthly basis, please indicate this (i.e. per week or per month). Otherwise, use the units as indicated below.

WASTE STREAMS
Annual Hazardous Waste Quantities[19]
Tons (for liquids and solids) and m^3 (for gases)
(note: 1000 litres = 1000 kilograms = 1 ton)

Anticipated change (using the same units as in Part E) *Use the following codes:* *- (less); + (more); N/C (no change)*	1	2	3	4	5

[19] *if other units are used, such as m3/day or tons/month, please indicate the different units in the respective fields.*

GENERAL COMMENTS

1 Are you satisfied with currently available waste treatment/disposal services in the Waikato/Bay of Plenty Regions?

2 What improvements do you suggest?

3 Do you need any assistance to help you to manage your hazardous wastes better?

4 What assistance would you benefit from?

Other Comments

Appendix F Source of Priority Waste Streams by Industry Type

Region	ANZSIC Code	ANZSIC Code explanation	Waste code	Number of waste streams	Generation (tonnes)
01 03 - Wastes from physical and chemical processing of metalliferous minerals					
Bay of Plenty	B14	Mining	01 03	1	300
02 01 - Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing					
Bay of Plenty	Q95	Personal Services, including Photographic and Emergency Services	02 01	2	3.40
Waikato	A02	Agricultural Services	02 01	3	16.61
03 01 - Wastes from wood processing and the production of panels and furniture					
Bay of Plenty	C23	Wood and Paper Processing	03 01	5	299.00
Bay of Plenty	C27	Metal Finishing and Manufacturing	03 01	29	577.69
Waikato	C23	Wood and Paper Processing	03 01	8	770.11
Waikato	C27	Metal Finishing and Manufacturing	03 01	26	1450.61
Waikato	C28	Automotive and Electrical Equipment Manufacturing	03 01	2	1.13
Waikato	C29	Building and Furniture Manufacturing	03 01	1	0.30
Waikato	E42	Building Construction and Servicing	03 01	4	38.82
03 02 - Wastes from Wood Preservation					
Bay of Plenty	C23	Wood and Paper Processing	03 02	3	1.64
Bay of Plenty	C27	Metal Finishing and Manufacturing	03 02	1	0.02
Waikato	C23	Wood and Paper Processing	03 02	4	16.00
Waikato	C27	Metal Finishing and Manufacturing	03 02	1	0.04
08 01 - Wastes from MFSU and removal of paint and varnish					
Bay of Plenty	C23	Wood and Paper Processing	08 01	2	0.02
Bay of Plenty	C25	Chemical, Plastic and Rubber Processing and Manufacturing	08 01	5	1.00
Bay of Plenty	C27	Metal Finishing and Manufacturing	08 01	7	73.25
Bay of Plenty	C28	Automotive and Electrical Equipment Manufacturing	08 01	1	2.00
Bay of Plenty	D36	Electricity and Gas Supply	08 01	1	0.02
Bay of Plenty	G53	Automobile Repair and Servicing	08 01	1	1.04
Bay of Plenty	I61	Road Transport	08 01	1	0.03
Waikato	C23	Wood and Paper Processing	08 01	1	0.02
Waikato	C27	Metal Finishing and Manufacturing	08 01	13	156.90
Waikato	C28	Automotive and Electrical Equipment Manufacturing	08 01	7	10.87
Waikato	C29	Building and Furniture Manufacturing	08 01	1	0.00
Waikato	E42	Building Construction and Servicing	08 01	10	4.16
Waikato	I66	Transport Services	08 01	1	0.40
Waikato	O86	Hospital and Medical Services	08 01	1	0.15
08 04 - Wastes from MFSU of adhesives and sealants					
Bay of Plenty	C23	Wood and Paper Processing	08 04	3	29.72
Bay of Plenty	C25	Chemical, Plastic and Rubber Processing and Manufacturing	08 04	1	2.00
Bay of Plenty	C27	Metal Finishing and Manufacturing	08 04	1	0.08
Bay of Plenty	C29	Building and Furniture Manufacturing	08 04	1	0.04
Waikato	C23	Wood and Paper Processing	08 04	4	42.51

Region	ANZSIC Code	ANZSIC Code explanation	Waste code	Number of waste streams	Generation (tonnes)
Waikato	C28	Automotive and Electrical Equipment Manufacturing	08 04	1	0.02
Waikato	C29	Building and Furniture Manufacturing	08 04	1	0.20
09 01 - Wastes from the photographic industry					
Bay of Plenty	C24	Printing and Publishing	09 01	6	69.48
Bay of Plenty	O86	Hospital and Medical Services	09 01	9	5.25
Bay of Plenty	Q95	Personal Services, including Photographic and Emergency Services	09 01	3	2.44
Waikato	C24	Printing and Publishing	09 01	4	2.61
Waikato	O86	Hospital and Medical Services	09 01	19	8.46
Waikato	Q95	Personal Services, including Photographic and Emergency Services	09 01	5	6.00
10 01 - Wastes from power stations and other combustion plants					
Bay of Plenty	C21	Food and Beverage Manufacturing	10 01	1	0.37
Waikato	C21	Food and Beverage Manufacturing	10 01	2	8500
10 13 - Wastes from manufacture of cement, lime and plaster and articles and products					
Waikato	C26	Ceramic and Concrete Manufacturing	10 13	4	1134
11 01 - Wastes from chemical surface treatment and coating of metals and other materials					
Bay of Plenty	C27	Metal Finishing and Manufacturing	11 01	16	24.68
Bay of Plenty	C28	Automotive and Electrical Equipment Manufacturing	11 01	2	0.00
Bay of Plenty	C29	Building and Furniture Manufacturing	11 01	1	1.20
Waikato	C21	Food and Beverage Manufacturing	11 01	3	0.57
Waikato	C23	Wood and Paper Processing	11 01	1	490.00
Waikato	C27	Metal Finishing and Manufacturing	11 01	22	27.81
Waikato	C28	Automotive and Electrical Equipment Manufacturing	11 01	8	33.11
12 01 - Wastes from shaping and physical and mechanical surface treatment of metals					
Bay of Plenty	C23	Wood and Paper Processing	12 01	3	1.75
Bay of Plenty	C28	Automotive and Electrical Equipment Manufacturing	12 01	1	6.00
Waikato	A02	Agricultural Services	12 01	3	9.40
Waikato	B14	Mining	12 01	1	0.05
Waikato	C27	Metal Finishing and Manufacturing	12 01	2	14.40
Waikato	C28	Automotive and Electrical Equipment Manufacturing	12 01	6	7.47
13 02 - Waste engine, gear and lubricating oils					
Bay of Plenty	A02	Agricultural Services	13 02	4	3.04
Bay of Plenty	A03	Forestry and Logging	13 02	1	10.00
Bay of Plenty	B14	Mining	13 02	2	5.80
Bay of Plenty	C21	Food and Beverage Manufacturing	13 02	6	13.10
Bay of Plenty	C22	Textile and Leather Processing and Manufacturing	13 02	1	0.03
Bay of Plenty	C23	Wood and Paper Processing	13 02	9	44.16
Bay of Plenty	C25	Chemical, Plastic and Rubber Processing and Manufacturing	13 02	2	2.50
Bay of Plenty	C26	Ceramic and Concrete Manufacturing	13 02	2	0.15
Bay of Plenty	C27	Metal Finishing and Manufacturing	13 02	4	3.04
Bay of Plenty	C28	Automotive and Electrical Equipment Manufacturing	13 02	26	137.69
Bay of Plenty	D36	Electricity and Gas Supply	13 02	2	0.01
Bay of Plenty	D37	Water and Sanitation	13 02	2	0.90
Bay of Plenty	E42	Building Construction and Servicing	13 02	5	1.29
Bay of Plenty	F45	General Product Wholesaling	13 02	1	0.05

Region	ANZSIC Code	ANZSIC Code explanation	Waste code	Number of waste streams	Generation (tonnes)
Bay of Plenty	F46	General Product Wholesaling	13 02	4	8.16
Bay of Plenty	G53	Automobile Repair and Servicing	13 02	10	24.15
Bay of Plenty	I61	Road Transport	13 02	10	46.38
Bay of Plenty	I63	Water Transport	13 02	1	0.01
Bay of Plenty	I64	Air Transport	13 02	1	0.00
Bay of Plenty	I66	Transport Services	13 02	1	18.60
Bay of Plenty	I67	Storage	13 02	3	0.25
Bay of Plenty	L77	Equipment Hiring and Leasing	13 02	5	8.02
Bay of Plenty	N84	Further Education	13 02	1	0.01
Bay of Plenty	Q95	Personal Services, including Photographic and Emergency Services	13 02	1	0.16
Waikato	A02	Agricultural Services	13 02	13	7.70
Waikato	A03	Forestry and Logging	13 02	4	20.40
Waikato	B11	Coal Mining	13 02	3	6.60
Waikato	B14	Mining	13 02	3	7.50
Waikato	C21	Food and Beverage Manufacturing	13 02	12	37.50
Waikato	C23	Wood and Paper Processing	13 02	16	105.73
Waikato	C24	Printing and Publishing	13 02	1	0.00
Waikato	C25	Chemical, Plastic and Rubber Processing and Manufacturing	13 02	6	15.52
Waikato	C26	Ceramic and Concrete Manufacturing	13 02	3	10.40
Waikato	C27	Metal Finishing and Manufacturing	13 02	5	8.54
Waikato	C28	Automotive and Electrical Equipment Manufacturing	13 02	35	39.66
Waikato	D36	Electricity and Gas Supply	13 02	2	0.37
Waikato	E42	Building Construction and Servicing	13 02	4	1.75
Waikato	F45	General Product Wholesaling	13 02	2	0.90
Waikato	F46	General Product Wholesaling	13 02	5	6.20
Waikato	G53	Automobile Repair and Servicing	13 02	14	58.38
Waikato	I61	Road Transport	13 02	20	40.23
Waikato	I64	Air Transport	13 02	1	0.45
Waikato	I66	Transport Services	13 02	1	1.20
Waikato	L77	Equipment Hiring and Leasing	13 02	3	3.24
Waikato	O86	Hospital and Medical Services	13 02	1	0.40
Waikato	Q95	Personal Services, including Photographic and Emergency Services	13 02	1	0.10
14 06 - Waste organic solvents, refrigerants and propellants					
Bay of Plenty	B14	Mining	14 06	1	0.06
Bay of Plenty	C21	Food and Beverage Manufacturing	14 06	1	0.00
Bay of Plenty	C22	Textile and Leather Processing and Manufacturing	14 06	1	1.04
Bay of Plenty	C23	Wood and Paper Processing	14 06	3	1.67
Bay of Plenty	C24	Printing and Publishing	14 06	1	0.04
Bay of Plenty	C25	Chemical, Plastic and Rubber Processing and Manufacturing	14 06	2	14.00
Bay of Plenty	C27	Metal Finishing and Manufacturing	14 06	4	12.84
Bay of Plenty	C28	Automotive and Electrical Equipment Manufacturing	14 06	16	10.33
Bay of Plenty	E42	Building Construction and Servicing	14 06	3	0.70
Bay of Plenty	G53	Automobile Repair and Servicing	14 06	1	0.01
Bay of Plenty	I61	Road Transport	14 06	2	0.19
Bay of Plenty	I64	Air Transport	14 06	2	0.18
Bay of Plenty	I66	Transport Services	14 06	1	1.56

Region	ANZSIC Code	ANZSIC Code explanation	Waste code	Number of waste streams	Generation (tonnes)
Bay of Plenty	Q95	Personal Services, including Photographic and Emergency Services	14 06	1	0.01
Waikato	A02	Agricultural Services	14 06	1	0.02
Waikato	C21	Food and Beverage Manufacturing	14 06	5	6.40
Waikato	C22	Textile and Leather Processing and Manufacturing	14 06	3	1.87
Waikato	C23	Wood and Paper Processing	14 06	3	6.13
Waikato	C24	Printing and Publishing	14 06	4	37.29
Waikato	C25	Chemical, Plastic and Rubber Processing and Manufacturing	14 06	1	0.01
Waikato	C26	Ceramic and Concrete Manufacturing	14 06	1	0.00
Waikato	C27	Metal Finishing and Manufacturing	14 06	4	0.04
Waikato	C28	Automotive and Electrical Equipment Manufacturing	14 06	12	4.92
Waikato	E42	Building Construction and Servicing	14 06	8	1.55
Waikato	F46	General Product Wholesaling	14 06	1	1.00
Waikato	G53	Automobile Repair and Servicing	14 06	2	0.06
Waikato	I61	Road Transport	14 06	1	2.40
Waikato	L77	Equipment Hiring and Leasing	14 06	1	0.36
Waikato	L78	Research, Pest Control and Cleaning Services	14 06	1	0.02
Waikato	O86	Hospital and Medical Services	14 06	3	3.52
Waikato	Q95	Personal Services, including Photographic and Emergency Services	14 06	4	1.38
16 06 - Batteries and accumulators					
Bay of Plenty	A02	Agricultural Services	16 06	1	0.16
Bay of Plenty	C21	Food and Beverage Manufacturing	16 06	1	0.00
Bay of Plenty	C22	Textile and Leather Processing and Manufacturing	16 06	1	0.18
Bay of Plenty	C28	Automotive and Electrical Equipment Manufacturing	16 06	3	0.25
Bay of Plenty	C29	Building and Furniture Manufacturing	16 06	5	8.96
Bay of Plenty	E42	Building Construction and Servicing	16 06	1	0.00
Bay of Plenty	F45	General Product Wholesaling	16 06	2	0.05
Bay of Plenty	F46	General Product Wholesaling	16 06	1	2.40
Bay of Plenty	G53	Automobile Repair and Servicing	16 06	2	2.60
Bay of Plenty	I61	Road Transport	16 06	5	10.70
Bay of Plenty	I63	Water Transport	16 06	5	3.80
Bay of Plenty	I64	Air Transport	16 06	1	0.03
Bay of Plenty	I67	Storage	16 06	1	0.00
Bay of Plenty	L78	Research, Pest Control and Cleaning Services	16 06	4	4.15
Waikato	A02	Agricultural Services	16 06	2	0.01
Waikato	C21	Food and Beverage Manufacturing	16 06	4	0.44
Waikato	C23	Wood and Paper Processing	16 06	10	0.86
Waikato	C25	Chemical, Plastic and Rubber Processing and Manufacturing	16 06	7	5.26
Waikato	C27	Metal Finishing and Manufacturing	16 06	1	0.15
Waikato	C28	Automotive and Electrical Equipment Manufacturing	16 06	2	1.64
Waikato	E42	Building Construction and Servicing	16 06	17	5.93
Waikato	F45	General Product Wholesaling	16 06	1	0.00
Waikato	F46	General Product Wholesaling	16 06	3	1.50
Waikato	G53	Automobile Repair and Servicing	16 06	8	8.45

Region	ANZSIC Code	ANZSIC Code explanation	Waste code	Number of waste streams	Generation (tonnes)
Waikato	I61	Road Transport	16 06	7	6.89
Waikato	I66	Transport Services	16 06	1	0.50
Waikato	L77	Equipment Hiring and Leasing	16 06	1	0.04
Waikato	O86	Hospital and Medical Services	16 06	3	0.17
18 01 - Wastes from natal care, diagnosis, treatment or prevention of disease in humans					
Bay of Plenty	O86	Hospital and Medical Services	18 01	37	611.20
Bay of Plenty	Q95	Personal Services, including Photographic and Emergency Services	18 01	2	250.40
Waikato	C24	Printing and Publishing	18 01	2	0.27
Waikato	L78	Research, Pest Control and Cleaning Services	18 01	1	20.25
Waikato	O86	Hospital and Medical Services	18 01	71	573.76
Waikato	Q95	Personal Services, including Photographic and Emergency Services	18 01	5	36.22
19 08 - Wastes from waste water treatment plants not otherwise specified					
Bay of Plenty	C23	Wood and Paper Processing	19 08	1	0.20
Bay of Plenty	C25	Chemical, Plastic and Rubber Processing and Manufacturing	19 08	1	3000.00
Bay of Plenty	C26	Ceramic and Concrete Manufacturing	19 08	5	306.00
Bay of Plenty	C27	Metal Finishing and Manufacturing	19 08	1	1.20
Bay of Plenty	C28	Automotive and Electrical Equipment Manufacturing	19 08	1	0.15
Bay of Plenty	I61	Road Transport	19 08	3	3.40
Bay of Plenty	L77	Equipment Hiring and Leasing	19 08	2	28.00
Bay of Plenty	Q95	Personal Services, including Photographic and Emergency Services	19 08	1	2.50
Waikato	A02	Agricultural Services	19 08	1	2.00
Waikato	A03	Forestry and Logging	19 08	2	20.33
Waikato	C21	Food and Beverage Manufacturing	19 08	3	31.00
Waikato	C23	Wood and Paper Processing	19 08	7	493.50
Waikato	C25	Chemical, Plastic and Rubber Processing and Manufacturing	19 08	1	1.00
Waikato	C26	Ceramic and Concrete Manufacturing	19 08	13	5750.09
Waikato	C28	Automotive and Electrical Equipment Manufacturing	19 08	3	3.38
Waikato	I61	Road Transport	19 08	7	32.00
Waikato	I66	Transport Services	19 08	1	2.40
Waikato	L77	Equipment Hiring and Leasing	19 08	1	4.00
20 03 - Other municipal wastes, including septic tank waste					
Bay of Plenty	C21	Food and Beverage Manufacturing	20 03	2	1.50
Bay of Plenty	C23	Wood and Paper Processing	20 03	2	420.00
Bay of Plenty	I63	Water Transport	20 03	1	1.00
Bay of Plenty	I64	Air Transport	20 03	1	0.00
Bay of Plenty	I67	Storage	20 03	8	0.00
Bay of Plenty	L77	Equipment Hiring and Leasing	20 03	1	10.00
Waikato	A02	Agricultural Services	20 03	2	9.10
Waikato	C21	Food and Beverage Manufacturing	20 03	10	2274.50
Waikato	C23	Wood and Paper Processing	20 03	3	8.00
Waikato	I61	Road Transport	20 03	1	0.00
Waikato	I67	Storage	20 03	1	0.00

Appendix G Operator waste streams transported off-site

Region	Waste Code	Waste Code explanation	Received (tonnes)	Generation (tonnes)	Number of waste streams	Export (tonnes)	Destination
Auckland	02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing	3.02		3	3.02	Auckland
Auckland	03 02	Wastes from Wood Preservation	52.46		3	52.46	Auckland
Auckland	04 01	Wastes from leather and fur industry	56.30		2	56.30	Auckland
Auckland	07 01	Wastes from the MFSU of basic organic chemicals	100.00		1	100.00	Auckland
Auckland	08 01	Wastes from MFSU and removal of paint and varnish	81.96		3	81.96	Auckland
Auckland	08 03	Wastes from MFSU of printing inks	12.69		2	12.69	Auckland
Auckland	08 04	Wastes from MFSU of adhesives and sealants (including waterproofing products)	74.40		2	74.40	Auckland
Auckland	09 01	Wastes from the photographic industry	12.30		3	12.30	Auckland
Auckland	10 02	Wastes from the iron and steel industry	65.90		1	65.90	Auckland
Auckland	11 01	Wastes from chemical surface treatment and coating of metals and other materials	541.36		5	541.36	Auckland
Auckland	11 02	Wastes from non-ferrous hydrometalurgical processes	4.60		1	4.60	Auckland
Auckland	13 01	Waste hydraulic oils	0.60		1	0.60	Auckland
Auckland	13 02	Waste engine, gear and lubricating oils	930.41		3	930.41	Auckland
Auckland	13 08	Oil wastes not otherwise specified	50.00		1	50.00	Auckland
Auckland	14 06	Waste organic solvents, refrigerants and propellants	27.30		3	27.30	Auckland
Auckland	16 05	Gases in pressure containers and discarded chemicals	20.00		3	20.00	Auckland
Auckland	16 06	Batteries and accumulators	26.00		2	26.00	Auckland
Auckland	17 05	Contaminated soil, stones and dredging spoil	2365.80		4	2,365.80	Auckland
Auckland	18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	4.00		1	4.00	Auckland
Auckland	18 02	Wastes from care, diagnosis, treatment or prevention of disease in animals	7.50		1	7.50	Auckland
Auckland	19 08	Wastes from waste water treatment plants not otherwise specified	6.90		1	6.90	Auckland
Auckland	20 01	Separately collected fractions (except 15 01)	96.00		1	96.00	Auckland
Auckland	20 03	Other municipal wastes, including septic tank waste	12.00		1	12.00	Auckland
		Auckland operator Totals	**4551.5**		**48**	**4551.5**	
Bay of Plenty	02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing	2.23	0.06	7		
Bay of Plenty	02 03	Wastes from fruit, vegetable and cereal processing	0.00		1		

Region	Waste Code	Waste Code explanation	Received (tonnes)	Generation (tonnes)	Number of waste streams	Export (tonnes)	Destination
Bay of Plenty	03 01	Wastes from wood processing and the production of panels and furniture	32.00		2		
Bay of Plenty	03 02	Wastes from Wood Preservation	0.00		1		Auckland
Bay of Plenty	07 01	Wastes from the MFSU of basic organic chemicals	103.00	5.30	3		
Bay of Plenty	08 01	Wastes from MFSU and removal of paint and varnish	0.52		2		
Bay of Plenty	08 03	Wastes from MFSU of printing inks	0.03	0.01	2		
Bay of Plenty	13 02	Waste engine, gear and lubricating oils	23.97	0.50	9		
Bay of Plenty	13 02	Waste engine, gear and lubricating oils	1126.96		1	1,126.96	South Island
Bay of Plenty	13 05	Oil/water separator contents	0.00		1	0.00	Auckland
Bay of Plenty	13 07	Wastes of liquid fuels	0.00	10.00	1		
Bay of Plenty	13 08	Oil wastes not otherwise specified		1.08	0		
Bay of Plenty	14 06	Waste organic solvents, refrigerants and propellants	0.05		1	0.05	Auckland
Bay of Plenty	14 06	Waste organic solvents, refrigerants and propellants	0.30		1	0.30	
Bay of Plenty	16 01	Wastes from electrical and electronic equipment	1.05		2		
Bay of Plenty	16 05	Gases in pressure containers and discarded chemicals	0.15		1		
Bay of Plenty	16 06	Batteries and accumulators	14.70		9		
Bay of Plenty	16 06	Batteries and accumulators	5.90		1	3.00	Auckland
Bay of Plenty	16 06	Batteries and accumulators	1252.40		8	1,252.40	Wellington
Bay of Plenty	16 10	Aqueous liquid wastes for off site treatment	0.60	0.10	12		
Bay of Plenty	17 05	Contaminated soil, stones and dredging spoil	16.00		1		
Bay of Plenty	17 06	Insulation materials and asbestos-containing construction materials	59.00		4		
Bay of Plenty	19 07	Landfill leachate		13797.00	0		
Bay of Plenty	19 08	Wastes from waste water treatment plants not otherwise specified	6.00	3500.00	3		
Bay of Plenty	20 01	Separately collected fractions (except 15 01)	3276.87	24.00	2		
Bay of Plenty	20 03	Other municipal wastes, including septic tank waste	4916.20	78.00	5		
		Bay of Plenty Operator Totals	**10837.925**	**17416.0518**	**80**	**2382.708**	
Taranaki	13 03	Waste insulating and heat transmission oils	60		1	60	Taranaki
		Taranaki Operator Totals	**60**		**1**	**60**	
Waikato	02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing	22000.24		11		
Waikato	02 02	Wastes from processing of meat fish and other animals	410000.00		5		
Waikato	02 05	Wastes from the dairy products industry	0.00		2		

Region	Waste Code	Waste Code explanation	Received (tonnes)	Generation (tonnes)	Number of waste streams	Export (tonnes)	Destination
Waikato	03 01	Wastes from wood processing and the production of panels and furniture	2.00		2		
Waikato	04 01	Wastes from leather and fur industry	520.00		2		
Waikato	04 01	Wastes from leather and fur industry	6.00		1	6.00	Auckland
Waikato	06 02	Wastes from the MFSU of bases	200.00		1	200.00	Auckland
Waikato	08 01	Wastes from MFSU and removal of paint and varnish	15.52		2		
Waikato	08 03	Wastes from MFSU of printing inks	0.00	0.56	1		
Waikato	08 03	Wastes from MFSU of printing inks	0.08		1	0.08	Auckland
Waikato	09 01	Wastes from the photographic industry	40.00		1		
Waikato	11 01	Wastes from chemical surface treatment and coating of metals and other materials	3.50		2		
Waikato	12 01	Wastes from shaping and physical and mechanical surface treatment of metals and	2000.00		1		
Waikato	13 01	Waste hydraulic oils	45.60		1		
Waikato	13 02	Waste engine, gear and lubricating oils	39.72	8.00	15		
Waikato	13 02	Waste engine, gear and lubricating oils	0.80		1	0.80	Auckland
Waikato	13 05	Oil/water separator contents	500000.00	200.00	1		
Waikato	14 06	Waste organic solvents, refrigerants and propellants	0.52		1		
Waikato	15 02	Absorbents, filter materials, wiping cloths and protective clothing	1.36		2		
Waikato	16 01	Wastes from electrical and electronic equipment	3.00		1		
Waikato	16 05	Gases in pressure containers and discarded chemicals	0.62		2		
Waikato	16 06	Batteries and accumulators	4.48	0.25	11		
Waikato	16 06	Batteries and accumulators	18.72	0.01	3	18.73	Auckland
Waikato	16 06	Batteries and accumulators	173.40	10.00	0	173.40	Wellington
Waikato	16 10	Aqueous liquid wastes for off site treatment	1.20		18		
Waikato	17 05	Contaminated soil, stones and dredging spoil	5000.00		1		
Waikato	17 05	Contaminated soil, stones and dredging spoil	2100.00		2	2,100.00	Auckland
Waikato	17 06	Insulation materials and asbestos-containing construction materials	5.20		1		
Waikato	17 06	Insulation materials and asbestos-containing construction materials	15.00		1	15.00	Auckland
Waikato	18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	0.02		1		
Waikato	18 01	Wastes from natal care, diagnosis, treatment or prevention of disease in humans	5.75		1	5.75	Auckland
Waikato	19 07	Landfill leachate		30000.00	0		
Waikato	19 08	Wastes from waste water treatment plants not otherwise specified	542.00	1125.00	2		
Waikato	19 09	Wastes from water treatment	3.00		1		
Waikato	20 01	Separately collected fractions (except 15 01)	661.24	0.50	7		
Waikato	20 01	Separately collected fractions (except 15 01)	75.00	0.01	2	75.01	Auckland

Region	Waste Code	Waste Code explanation	Received (tonnes)	Generation (tonnes)	Number of waste streams	Export (tonnes)	Destination
Waikato	20 03	Other municipal wastes, including septic tank waste	3,019,020		7		
		Waikato Totals	**3,962,504**	**31,344**	**114**	**2,594.8**	

Appendix H Generator Hazardous Waste Estimates

Table H-1 Estimated hazardous waste generation quantities: Liquid waste – Bay of Plenty Region

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	224.0	137.5	40.6%	71.3%
		SE	90.9	98.1		
B	Mining	Estimate	3.2	4.1	0.0%	0.0%
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	45.7	6.4	14.6%	15.8%
		SE	6.7	1.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	20.7	10.1	14.7%	8.3%
		SE	3.0	0.8		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	1,674.0	311.7	26.9%	15.6%
		SE	449.9	48.5		
D	Electricity, gas and water supply	Estimate	1.4	1.3	18.2%	0.0%
		SE	0.2	0.0		
E	Construction	Estimate	57.9	3.5	22.4%	18.0%
		SE	12.9	0.6		
F	Wholesale trade	Estimate	160.6	0.0	69.3%	
		SE	111.2	0.0		
G	Retail trade	Estimate	1,263.6	0.0	47.6%	70.7%
		SE	600.9	0.0		
I	Transport and storage	Estimate	1,033.2	70.9	46.8%	20.5%
		SE	483.7	14.5		
L	Property and business services	Estimate	201.5	5.4	28.9%	0.0%
		SE	58.2	0.0		
O	Health and community services	Estimate	3.8	19.2	18.6%	24.0%
		SE	0.7	4.6		
Q	Personal and other services	Estimate	157.7	18.3	28.5%	0.0%
		SE	44.9	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.1		0.0%
		SE	0.0	0.0		
TOTAL		**Estimate**	**4,847.2**	**588.5**	**19%**	**19%**
		SE	**907.6**	**110.5**		
TOTAL	**(all industries combined)**	**Estimate**		**5436**		**17%**
		SE		**914**		

SE = Standard Error

Table H-2 Estimated hazardous waste generation quantities: Sludge waste - Bay of Plenty Region

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.0	0.0		
		SE	0.0	0.0		
B	Mining	Estimate	0.0	300.0		0.00%
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	33.4	0.0	4.3%	
		SE	1.4	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	512.6	1.2	5.5%	0.00%
		SE	28.3	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	514.2	6,408.6	14.3%	29.7%
		SE	73.8	1,903.9		
D	Electricity, gas and water supply	Estimate	0.0	0.0	16.9%	
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	6.0	0.0	16.9%	
		SE	1.0	0.0		
I	Transport and storage	Estimate	118.4	17.1	0.00%	14.2%
		SE	0.0	2.4		
L	Property and business services	Estimate	1,195.3	0.0	24.0%	
		SE	287.3	0.0		
O	Health and community services	Estimate	0.3	4.2	0.0%	0.0%
		SE	0.0	0.0		
Q	Personal and other services	Estimate	29.2	4.2	0.0%	0.0%
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**2,409.5**	**6,735.3**	**12%**	**28%**
		SE	**298.0**	**1,903.9**		
TOTAL	**(all industries combined)**	**Estimate**		**9,145**		**21%**
		SE		**1,927**		

SE = Standard Error

Table H-3 Estimated hazardous waste generation quantities: Solid waste - Bay of Plenty Region

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	18.2	0.0	40.1%	
		SE	7.3	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	1,290.0	0.0	11.5%	
		SE	148.9	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.5	0.1	5.3%	7.6%
		SE	0.0	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	3,776.8	61.8	23.7%	23.6%
		SE	893.5	14.6		
D	Electricity, gas and water supply	Estimate	0.0	0.0	0.0%	
		SE	0.0	0.0		
E	Construction	Estimate	784.6	140.0	79.6%	0.0%
		SE	624.5	0.0		
F	Wholesale trade	Estimate	97.5	0.0	27.6%	
		SE	26.9	0.0		
G	Retail trade	Estimate	599.6	0.0	40.1%	
		SE	240.3	0.0		
I	Transport and storage	Estimate	13.1	11.9	41.8%	22.2%
		SE	5.5	2.6		
L	Property and business services	Estimate	0.6	0.0	29.7%	
		SE	0.2	0.0		
O	Health and community services	Estimate	246.7	2,298.2	73.4%	105.1%
		SE	181.1	2,415.3		
Q	Personal and other services	Estimate	1.8	625.0	0.0%	51.6%
		SE	0.0	322.7		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.6	0.0	57.2%	0.0%
		SE	0.3	0.0		
TOTAL		**Estimate**	**6,830**	**3,137**	**17%**	**78%**
		SE	**1,141**	**2,437**		
TOTAL	**(all industries combined)**	**Estimate**		**9,969**		**27%**
		SE		**2,691**		

SE = Standard Error

Table H-4 Estimated hazardous waste generation quantities: Liquid waste – Waikato Region

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	567.4	96.9	32.4%	69.3%
		SE	183.7	67.1		
B	Mining	Estimate	15.2	38.0	44.3%	15.5%
		SE	6.8	5.9		
Ca	Basic metal industries	Estimate	56.6	77.7	18.5%	28.3%
		SE	10.5	22.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	3.2	124.7	7.2%	17.8%
		SE	0.2	22.2		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	583.7	762.9	27.9%	26.5%
		SE	163.1	201.8		
D	Electricity, gas and water supply	Estimate	1.2	0.4	0.0%	0.0%
		SE	0.0	0.0		
E	Construction	Estimate	59.9	126.5	25.1%	55.6%
		SE	15.1	70.4		
F	Wholesale trade	Estimate	268.2	0.0	39.2%	
		SE	105.1	0.0		
G	Retail trade	Estimate	3,032.6	0.0	42.5%	,
		SE	1287.6	0.0		
I	Transport and storage	Estimate	484.6	89.1	23.7%	14.7%
		SE	114.7	13.1		
L	Property and business services	Estimate	376.3	0.1	43.3%	0.0%
		SE	162.8	0.0		
O	Health and community services	Estimate	20.5	42.8	37.7%	23.0%
		SE	7.7	9.8		
Q	Personal and other services	Estimate	366.5	1.6	17.0%	0.0%
		SE	62.3	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.1	0.0	0.0%	,
		SE	0.0	0.0		
TOTAL		**Estimate**	**5,836.0**	**1,360.5**	**23%**	**17%**
		SE	**1,331.7**	**226.8**		
TOTAL	**(all industries combined)**	**Estimate**		**7,196**		**19%**
		SE		**1,351**		

SE = Standard Error

Table H-5 Estimated hazardous waste generation quantities: Sludge waste - Waikato Region

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	1,591.6	0.0	26.7%	0.0%
		SE	425.1	0.0		
B	Mining	Estimate	0.0	89.8		53.7%
		SE	0.0	48.2		
Ca	Basic metal industries	Estimate	363.6	0.3	7.8%	0.0%
		SE	28.4	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	6,002.0	15,625.0	13.6%	25.9%
		SE	815.8	4,045.7		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	253.7	2,083.3	16.0%	24.2%
		SE	40.7	504.8		
D	Electricity, gas and water supply	Estimate	0.0	0.0		
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	16.7	0.0	27.6%	
		SE	4.6	0.0		
I	Transport and storage	Estimate	1,370.4	116.6	12.4%	13.8%
		SE	170.0	16.1		
L	Property and business services	Estimate	171.6	0.0	0.0%	
		SE	0.0	0.0		
O	Health and community services	Estimate	5.5	0.0	0.0%	
		SE	0.0	0.0		
Q	Personal and other services	Estimate	29.4	0.0	15.4%	
		SE	4.5	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**9,804.5**	**17,915.0**	**10%**	**23%**
		SE	**936.8**	**4,077.4**		
TOTAL	**(all industries combined)**	**Estimate**		**27,720**		**15%**
		SE		**4,184**		

SE = Standard Error

Table H-6 Estimated hazardous waste generation quantities: Solid waste - Waikato Region

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	870.1	0.0	41.7%	
		SE	363.2	0.0		
B	Mining	Estimate	0.0	0.0		43.6%
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	3,943.3	1.2	25.5%	0.0%
		SE	1,005.4	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.7	22,196.7	9.4%	47.6%
		SE	0.1	10,558.8		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	469.3	1,614.8	39.0%	47.9%
		SE	183.2	773.4		
D	Electricity, gas and water supply	Estimate	0.0	0.0	0.0%	
		SE	0.0	0.0		
E	Construction	Estimate	3,453.4	0.2	53.9%	26.9%
		SE	1,861.9	0.0		
F	Wholesale trade	Estimate	50.5	0.0	21.3%	
		SE	10.7	0.0		
G	Retail trade	Estimate	634.7	0.0	31.0%	
		SE	196.8	0.0		
I	Transport and storage	Estimate	63.9	12.6	24.0%	19.3%
		SE	15.3	2.4		
L	Property and business services	Estimate	1,306.6	0.0	62.3%	
		SE	813.8	0.0		
O	Health and community services	Estimate	615.2	1,533.4	52.6%	49.9%
		SE	323.5	764.7		
Q	Personal and other services	Estimate	4.4	52.3	36.0%	51.0%
		SE	1.6	26.7		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.7	0.0%	0.0%
		SE	0.0	0.0		
TOTAL		**Estimate**	**11,412.2**	**25,411.9**	**20%**	**42%**
		SE	**2,334.3**	**10,614.7**		
TOTAL	**(all industries combined)**	**Estimate**		**36,824**		**30%**
		SE		**10,868**		

SE = Standard Error

Table H-7 Estimated total waste generation quantities by priority waste type: Waste type 03 01: Wastes from wood processing and the production of panels and furniture

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.0	0.0		
		SE	0.0	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	4,903.5	1.0	15.6%	0.0%
		SE	763.9	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	3,227.3	1294.4	8.7%	14.8%
		SE	280.3	191.8		
D	Electricity, gas and water supply	Estimate	0.0	1.5		
		SE	0.0	0.0		
E	Construction	Estimate	1,911.6	0.0	26.6%	
		SE	507.9	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	0.0	0.0		
		SE	0.0	0.0		
L	Property and business services	Estimate	0.0	0.0		
		SE	0.0	0.0		
O	Health and community services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**10,042.5**	**1,297.0**	**10%**	**15%**
		SE	**959.2**	**191.8**		
TOTAL	**(all industries combined)**	**Estimate**		**11,339**		**9%**
		SE		**978**		

SE = Standard Error

Table H-8 Estimated total waste generation quantities by priority waste type: Waste type 03 02: Wastes from wood preservation

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.0	0.0		
		SE	0.0	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	0.0	0.1	0.0%	0.0%
		SE	0.0	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	1.7	31.2	0.0%	10.5%
		SE	0.0	3.3		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.0%
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	0.0	0.0		
		SE	0.0	0.0		
L	Property and business services	Estimate	0.0	0.0		
		SE	0.0	0.0		
O	Health and community services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**1.7**	**32.8**	**0%**	**10%**
		SE	**0.0**	**3.3**		
TOTAL	**(all industries combined)**	**Estimate**		**35**		**9%**
		SE		**3**		

SE = Standard Error

Table H-9 Estimated total waste generation quantities by priority waste type: Waste type 08 01: Wastes from MFSU and removal of paint and varnish

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.0	0.0		
		SE	0.0	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	504.9	0.1	8.4%	0.0%
		SE	42.2	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	1.6	24.7	5.3%	8.1%
		SE	0.1	2.0		
D	Electricity, gas and water supply	Estimate	0.1	1.5	0.0%	0.0%
		SE	0.0	0.0		
E	Construction	Estimate	61.8	14.7	16.2%	32.6%
		SE	10.0	4.8		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	45.8	0.0	0.0%	
		SE	0.0	0.0		
I	Transport and storage	Estimate	0.0	0.7		12.8%
		SE	0.0	0.1		
L	Property and business services	Estimate	0.0	0.0		
		SE	0.0	0.0		
O	Health and community services	Estimate	0.0	0.4		0.0%
		SE	0.0	0.0		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**614.1**	**42.2**	**7%**	**12%**
		SE	**43.4**	**5.2**		
TOTAL	**(all industries combined)**	**Estimate**		**656**		**7%**
		SE		**44**		

SE = Standard Error

Table H-10 Estimated total waste generation quantities by priority waste type: Waste type 08 04: Wastes from MFSU of adhesives and sealants (including waterproofing products)

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.0	0.0		
		SE	0.0	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	0.2	0.0	0.0%	
		SE	0.0	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	1.9	132.8	7.0%	9.5%
		SE	0.1	12.6		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.0%
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	0.0	0.0		
		SE	0.0	0.0		
L	Property and business services	Estimate	0.0	0.0		
		SE	0.0	0.0		
O	Health and community services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**2.0**	**134.3**	**6%**	**9%**
		SE	**0.1**	**12.6**		
TOTAL	**(all industries combined)**	**Estimate**		**136**		**9%**
		SE		**13**		

SE = Standard Error

Table H-11 Estimated total waste generation quantities by priority waste type: Waste type 09 01: Wastes from the photographic industry

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.0	0.0		
		SE	0.0	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	15.0	125.7	5.78%	7.90%
		SE	0.9	9.9		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.00%
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	0.0	0.0		
		SE	0.0	0.0		
L	Property and business services	Estimate	0.0	0.0		
		SE	0.0	0.0		
O	Health and community services	Estimate	7.8	43.0	9.26%	12.59%
		SE	0.7	5.4		
Q	Personal and other services	Estimate	273.6	0.0	14.62%	
		SE	40.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**296.4**	**170.3**	**14%**	**7%**
		SE	**40.0**	**11.3**		
TOTAL	**(all industries combined)**	**Estimate**		**467**		**9%**
		SE		**42**		

SE = Standard Error

Table H-12 Estimated total waste generation quantities by priority waste type: Waste type 11 01: Wastes from chemical surface treatment and coating of metals and other materials

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.0	0.0		
		SE	0.0	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	57.2	60.6	13.8%	22.9%
		SE	7.9	13.9		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	1.1	0.0	0.3%	0.0%
		SE	0.0	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	6.9	936.0	13.4%	16.4%
		SE	0.9	153.0		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.0%
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	0.0	0.0		
		SE	0.0	0.0		
L	Property and business services	Estimate	0.0	0.0		
		SE	0.0	0.0		
O	Health and community services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**65.2**	**998.1**	**12%**	**15%**
		SE	**8.0**	**153.6**		
TOTAL	**(all industries combined)**	**Estimate**		**1063**		**14%**
		SE		**154**		

SE = Standard Error

Table H-13 Estimated total waste generation quantities by priority waste type: Waste type 12 01: Wastes from shaping and physical and mechanical treatment of metals and plastics

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	516.5	3.4	0.0%	53.3%
		SE	0.0	1.8		
B	Mining	Estimate	0.2	0.0	0.0%	
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	26.3	4.1	0.0%	0.0%
		SE	0.0	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	1.7	26.9	0.0%	8.0%
		SE	0.0	2.1		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.0%
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	0.0	0.0		
		SE	0.0	0.0		
L	Property and business services	Estimate	0.0	0.0		
		SE	0.0	0.0		
O	Health and community services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**544.7**	**35.9**	**0%**	**8%**
		SE	**0.0**	**2.8**		
TOTAL	**(all industries combined)**	**Estimate**		**581**		**0%**
		SE		**3**		

SE = Standard Error

Table H-14 Estimated total waste generation quantities by priority waste type: Waste types 13 01/03/03: Waste hydraulic oils/Waste engine, gear and lubricating oils/Waste insulating and heat transmission oils

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	817.1	216.3	24.1%	39.9%
		SE	197.1	86.3		
B	Mining	Estimate	17.3	40.8	22.9%	9.8%
		SE	4.0	4.0		
Ca	Basic metal industries	Estimate	18.8	25.8	11.2%	22.8%
		SE	2.1	5.9		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	27.9	110.1	13.1%	11.3%
		SE	3.6	12.5		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	1325.8	458.9	15.5%	16.9%
		SE	205.4	77.3		
D	Electricity, gas and water supply	Estimate	3.4	1.5	12.3%	0.0%
		SE	0.4	0.0		
E	Construction	Estimate	30.7	75.7	13.6%	35.9%
		SE	4.2	27.2		
F	Wholesale trade	Estimate	613.8	0.0	32.1%	
		SE	197.1	0.0		
G	Retail trade	Estimate	3794.5	0.0	23.3%	
		SE	885.4	0.0		
I	Transport and storage	Estimate	1455.5	155.4	27.6%	14.5%
		SE	401.2	22.6		
L	Property and business services	Estimate	304.8	7.6	17.1%	0.0%
		SE	52.0	0.0		
O	Health and community services	Estimate	0.0	1.4		12.7%
		SE	0.0	0.2		
Q	Personal and other services	Estimate	4.5	1.6	0.0%	0.0%
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	1.2		0.0%
		SE	0.0	0.0		
TOTAL		**Estimate**	**8414.2**	**1096.4**	**12%**	**11%**
		SE	**1033.2**	**122.0**		
TOTAL	**(all industries combined)**	**Estimate**		**9511**		**11%**
		SE		**1040**		

SE = Standard Error

Table H-15 Estimated total waste generation quantities by priority waste type: Waste types 14 06: Waste organic solvents, refrigerants and propellants

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	1.4	0.0	0.0%	
		SE	0.0	0.0		
B	Mining	Estimate	0.0	0.5		0.0%
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	28.2	0.0	12.3%	
		SE	3.5	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.1	21.7	5.3%	10.6%
		SE	0.0	2.3		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	350.7	58.9	23.4%	11.6%
		SE	82.1	6.8		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.0%
		SE	0.0	0.0		
E	Construction	Estimate	27.1	6.1	10.7%	9.9%
		SE	2.9	0.6		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	4.8	0.0	16.3%	
		SE	0.8	0.0		
I	Transport and storage	Estimate	55.0	4.5	0.0%	19.6%
		SE	0.0	0.9		
L	Property and business services	Estimate	13.3	0.1	0.0%	0.0%
		SE	0.0	0.0		
O	Health and community services	Estimate	0.0	9.6		0.0%
		SE	0.0	0.0		
Q	Personal and other services	Estimate	34.1	0.3	18.9%	0.0%
		SE	6.5	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**514.7**	**103.1**	**16%**	**7%**
		SE	**82.5**	**7.3**		
TOTAL	**(all industries combined)**	**Estimate**		**617**		**13%**
		SE		**83**		

SE = Standard Error

Table H-16 Estimated total waste generation quantities by priority waste type: Waste types 16 01: End-of-life vehicles and wastes from dismantling of end-of-life vehicles and vehicle maintenance

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	8.3	0.0	20.7%	
		SE	1.7	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.1	5.1	0.0%	10.0%
		SE	0.0	0.5		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	67.4	0.2	13.4%	2.6%
		SE	9.0	0.0		
D	Electricity, gas and water supply	Estimate	0.1	1.5	15.7%	0.0%
		SE	0.0	0.0		
E	Construction	Estimate	0.1	0.0	0.0%	
		SE	0.0	0.0		
F	Wholesale trade	Estimate	17.2	0.0	36.3%	
		SE	6.2	0.0		
G	Retail trade	Estimate	575.3	0.0	22.3%	
		SE	128.9	0.0		
I	Transport and storage	Estimate	2.6	2.0	4.2%	10.2%
		SE	0.1	0.2		
L	Property and business services	Estimate	0.4	0.0	0.0%	
		SE	0.0	0.0		
O	Health and community services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**675.5**	**8.9**	**19%**	**6%**
		SE	**128.7**	**0.6**		
TOTAL	**(all industries combined)**	**Estimate**		**680**		**19%**
		SE		**129**		

SE = Standard Error

Table H-17 Estimated total waste generation quantities by priority waste type: Waste types 16 06: Batteries and accumulators

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	22.5	0.0	9.10%	
		SE	2.0	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	3.6	0.0	6.3%	
		SE	0.2	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.9	2.4	4.1%	13.4%
		SE	0.0	0.3		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	131.7	11.3	16.1%	16.5%
		SE	21.2	1.9		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.0%
		SE	0.0	0.0		
E	Construction	Estimate	2.5	0.1	12.8%	0.0%
		SE	0.3	0.0		
F	Wholesale trade	Estimate	434.5	0.0	30.7%	
		SE	136.7	0.0		
G	Retail trade	Estimate	848.7	0.0	15.7%	
		SE	133.5	0.0		
I	Transport and storage	Estimate	72.5	23.8	12.6%	10.5%
		SE	9.1	2.5		
L	Property and business services	Estimate	1.9	0.0	25.3%	
		SE	0.5	0.0		
O	Health and community services	Estimate	0.0	0.7		8.7%
		SE	0.0	0.1		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**1,518.8**	**40.0**	**13%**	**8%**
		SE	**192.5**	**3.1**		
TOTAL	**(all industries combined)**	**Estimate**		**1,559**		**12%**
		SE		**193**		

SE = Standard Error

Table H-18 Estimated total waste generation quantities by priority waste type: Waste types 18 01: Wastes from natal care, diagnosis, treatment or prevention of disease in humans

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.0	0.0		
		SE	0.0	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	2.3	0.0	7.6%	
		SE	0.2	0.0		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.0%
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	0.0	0.0		
		SE	0.0	0.0		
L	Property and business services	Estimate	747.3	0.0		
		SE	0.0	0.0		
O	Health and community services	Estimate	790.1	3,376.5	43.45%	50.82%
		SE	338.1	1,716.0		
Q	Personal and other services	Estimate	153.7	468.7	33.16%	28.41%
		SE	51.0	133.2		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**1,693.4**	**3,846.7**	**20%**	**45%**
		SE	**341.9**	**1,721.1**		
TOTAL	**(all industries combined)**	**Estimate**		**5,540**		**32%**
		SE		**1,755**		

SE = Standard Error

Table H-19 Estimated total waste generation quantities by priority waste type: Waste types 19 08: Wastes from waste water treatment plants not otherwise specified

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	1,281.4	0.0	24.2%	
		SE	310.2	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	2.6	0.0	0.0%	
		SE	0.0	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	3,051.4	11,480.6	5.9%	16.3%
		SE	180.0	1,869.0		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	16.1	7,640.1	4.2%	17.0%
		SE	0.7	1296.2		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.0%
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	952.4	51.6	7.0%	9.6%
		SE	66.7	5.0		
L	Property and business services	Estimate	1,181.0	0.0	23.3%	
		SE	275.2	0.0		
O	Health and community services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Q	Personal and other services	Estimate	0.0	4.2		0.0%
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**6,484.9**	**19,178.0**	**7%**	**12%**
		SE	**457.0**	**2,274.5**		
TOTAL	**(all industries combined)**	**Estimate**		**25,663**		**9%**
		SE		**2,320**		

SE = Standard Error

Table H-20 Estimated total waste generation quantities by priority waste type: Waste types 20 01: Municipal waste - separately collected fractions

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	2.3	0.0	0.00%	
		SE	0.0	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.4	2.0	1.99%	11.26%
		SE	0.0	0.2		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	83.5	0.0	7.95%	0.00%
		SE	6.6	0.0		
D	Electricity, gas and water supply	Estimate	0.0	1.5		
		SE	0.0	0.0		
E	Construction	Estimate	12.6	0.0	20.52%	
		SE	2.6	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	0.0	0.0		
		SE	0.0	0.0		
L	Property and business services	Estimate	190.8	0.0	32.85%	
		SE	62.7	0.0		
O	Health and community services	Estimate	0.1	2.7	0.00%	12.74%
		SE	0.0	0.3		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**289.6**	**6.3**	**22%**	**7%**
		SE	**63.1**	**0.4**		
TOTAL	**(all industries combined)**	**Estimate**		**296**		**21%**
		SE		**63**		

SE = Standard Error

Table H-21: Estimated total waste generation quantities by priority waste type: Waste types 20 03: Other municipal wastes

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	522.2	0.0	22.9%	
		SE	119.3	0.0		
B	Mining	Estimate	0.0	0.0		
		SE	0.0	0.0		
Ca	Basic metal industries	Estimate	0.0	0.0		
		SE	0.0	0.0		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	43.7	5,483.1	1.0%	16.3%
		SE	0.4	895.8		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.0	765.2		10.7%
		SE	0.0	82.1		
D	Electricity, gas and water supply	Estimate	0.0	1.5		0.0%
		SE	0.0	0.0		
E	Construction	Estimate	0.0	0.0		
		SE	0.0	0.0		
F	Wholesale trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
G	Retail trade	Estimate	0.0	0.0		
		SE	0.0	0.0		
I	Transport and storage	Estimate	105.8	0.0	0.0%	
		SE	0.0	0.0		
L	Property and business services	Estimate	0.0	0.0		
		SE	0.0	0.0		
O	Health and community services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Q	Personal and other services	Estimate	0.0	0.0		
		SE	0.0	0.0		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.0	0.0		
		SE	0.0	0.0		
TOTAL		**Estimate**	**671.7**	**6,249.8**	**18%**	**14%**
		SE	**119.3**	**899.6**		
TOTAL	**(all industries combined)**	**Estimate**		**6,922**		**13%**
		SE		**907**		

SE = Standard Error

Appendix I Generator Hazardous Waste Predictors

Table I-1: Estimated hazardous waste generation predictors: Liquid waste

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.397	4.393	27.0%	45.5%
		SE	0.107	1.999		
B	Mining	Estimate	0.585	4.878	30.6%	22.4%
		SE	0.179	1.091		
Ca	Basic metal industries	Estimate	0.194	2.435	12.3%	25.3%
		SE	0.024	0.617		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.053	1.471	15.7%	14.0%
		SE	0.008	0.205		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.969	5.939	18.8%	17.5%
		SE	0.182	1.037		
D	Electricity, gas and water supply	Estimate	0.055	0.040	14.3%	0.0%
		SE	0.008	0.000		
E	Construction	Estimate	0.055	2.156	19.2%	48.5%
		SE	0.011	1.046		
F	Wholesale trade	Estimate	0.796	0.000	43.3%	
		SE	0.345	0.000		
G	Retail trade	Estimate	3.108	0.100	34.5%	
		SE	1.073			
I	Transport and storage	Estimate	0.973	2.810	29.0%	17.1%
		SE	0.282	0.479		
L	Property and business services	Estimate	0.731	0.275	26.8%	32.8%
		SE	0.196	0.090		
O	Health and community services	Estimate	0.015	0.977	29.2%	15.9%
		SE	0.004	0.155		
Q	Personal and other services	Estimate	0.501	1.849	15.3%	35.9%
		SE	0.077	0.664		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.001	0.0%	
		SE	0.000			

SE = Standard Error

Table I-2: Estimated hazardous waste generation predictors: Sludge

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.873	0.001	22.3%	0.0%
		SE	0.195	0.000		
B	Mining	Estimate	0.000	84.625		51.1%
		SE	0.000	43.210		
Ca	Basic metal industries	Estimate	0.630	0.008	6.1%	0.0%
		SE	0.038	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	10.595	172.848	9.9%	19.9%
		SE	1.053	34.319		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.338	49.928	10.2%	25.3%
		SE	0.034	12.628		
D	Electricity, gas and water supply	Estimate	0.001	0.000	0.0%	
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000		
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.015	0.000	24.0%	
		SE	0.004	0.000		
I	Transport and storage	Estimate	1.125	2.077	13.0%	11.5%
		SE	0.146	0.239		
L	Property and business services	Estimate	2.000	0.000	19.3%	
		SE	0.387	0.000		
O	Health and community services	Estimate	0.001	0.041	19.8%	0.0%
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.057	0.417	7.2%	0.0%
		SE	0.005	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-3: Estimated hazardous waste generation predictors: Solid waste

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.470	0.000	42.8%	
		SE	0.201	0.000		
B	Mining	Estimate	0.000	0.005		0.0%
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	9.292	0.033	16.7%	0.0%
		SE	1.553	0.005		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.002	238.477	5.2%	36.2%
		SE	0.000	86.248		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	1.809	9.320	22.5%	40.2%
		SE	0.407	3.747		
D	Electricity, gas and water supply	Estimate	0.001	0.000	15.7%	
		SE	0.000	0.000		
E	Construction	Estimate	2.402	4.170	49.0%	51.3%
		SE	1.176	2.140		
F	Wholesale trade	Estimate	0.313	0.000	23.2%	
		SE	0.073	0.000		
G	Retail trade	Estimate	0.900	0.000	24.2%	
		SE	0.218	0.000		
I	Transport and storage	Estimate	0.051	0.448	20.1%	18.2%
		SE	0.010	0.082		
L	Property and business services	Estimate	1.161	0.000	67.8%	
		SE	0.787	0.000		
O	Health and community services	Estimate	0.521	46.340	42.7%	51.9%
		SE	0.222	24.061		
Q	Personal and other services	Estimate	0.005	58.621	32.2%	44.3%
		SE	0.002	25.963		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.003	0.0%	
		SE	0.000	0.001		

SE = Standard Error

Table I-4: Estimated hazardous waste generation predictors: Waste Code 03 01: Wastes from wood processing and the production of panels and furniture

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.000	0.000		
		SE	0.000	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	9.047	0.033	15.6%	0.0%
		SE	1.409	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	1.588	7.313	8.7%	14.8%
		SE	0.138	1.083		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.924	0.000	26.6%	
		SE	0.246	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.000	0.000		
		SE	0.000	0.000		
L	Property and business services	Estimate	0.000	0.000		
		SE	0.000	0.000		
O	Health and community services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-5: Estimated hazardous waste generation predictors: Waste Code 03 02: Wastes from wood preservation

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.000	0.000		
		SE	0.000	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.000	0.004	0.0%	0.0%
		SE	0.000	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.001	0.176	0.0%	10.5%
		SE	0.000	0.018		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000		
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.000	0.000		
		SE	0.000	0.000		
L	Property and business services	Estimate	0.000	0.000		
		SE	0.000	0.000		
O	Health and community services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-6: Estimated hazardous waste generation predictors: Waste Code 08 01: Wastes from MFSU and removal of paint and varnish

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.000	0.000		
		SE	0.000	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.931	0.004	8.4%	0.0%
		SE	0.078	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.001	0.140	5.3%	8.1%
		SE	0.000	0.011		
D	Electricity, gas and water supply	Estimate	0.001	0.000	0.0%	
		SE	0.000	0.000		
E	Construction	Estimate	0.030	0.272	16.2%	32.6%
		SE	0.005	0.089		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.034	0.000	0.0%	
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.000	0.012		12.8%
		SE	0.000	0.002		
L	Property and business services	Estimate	0.000	0.000		
		SE	0.000	0.000		
O	Health and community services	Estimate	0.000	0.005		0.0%
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-7: Estimated hazardous waste generation predictors: Waste Code 08 04: Wastes from MFSU of adhesives and sealants (including waterproofing products)

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.000	0.000		
		SE	0.000	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.000	8.252	0.0%	0.0%
		SE	0.000	3.299		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.001	0.750	7.0%	9.5%
		SE	0.000	0.071		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000		
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.000	0.000		
		SE	0.000	0.000		
L	Property and business services	Estimate	0.000	0.000		
		SE	0.000	0.000		
O	Health and community services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-8: Estimated hazardous waste generation predictors: Waste Code 09 01: Wastes from the photographic industry

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.000	0.000		
		SE	0.000	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.007	0.710	5.8%	7.9%
		SE	0.000	0.056		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000		
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.000	0.000		
		SE	0.000	0.000		
L	Property and business services	Estimate	0.000	0.000		
		SE	0.000	0.000		
O	Health and community services	Estimate	0.005	0.566	9.3%	12.6%
		SE	0.000	0.071		
Q	Personal and other services	Estimate	0.268	0.000	14.6%	
		SE	0.039	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-9: Estimated hazardous waste generation predictors: Waste Code 11 01: Wastes from chemical surface treatment and coating of metals and other materials

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.000	0.000		
		SE	0.000	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.106	1.956	13.8%	22.9
		SE	0.015	0.447		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.002	0.000	0.3%	0.0%
		SE	0.000	0.000		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.003	5.288	13.4%	16.4%
		SE	0.000	0.864		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000		
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.000	0.000		
		SE	0.000	0.000		
L	Property and business services	Estimate	0.000	0.000		
		SE	0.000	0.000		
O	Health and community services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-10: Estimated hazardous waste generation predictors: Waste Code 12 01: Wastes from shaping and physical and mechanical treatment of metals and plastics

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.250	0.067	0.0%	53.2%
		SE	0.000	0.036		
B	Mining	Estimate	0.006	0.000	0.0%	
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.049	0.133	0.0%	0.0%
		SE	0.000	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.001	0.152	0.00%	8.00%
		SE	0.000	0.012		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000		
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.000	0.000		
		SE	0.000	0.000		
L	Property and business services	Estimate	0.000	0.000		
		SE	0.000	0.000		
O	Health and community services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-11: Estimated hazardous waste generation predictors: Waste Code 13 01/02/03: Waste hydraulic oils/Waste engine, gear and lubricating oils/Waste insulating and heat transmission oils

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.396	4.327	24.1%	39.9%
		SE	0.095	1.727		
B	Mining	Estimate	0.578	5.094	22.9%	9.8%
		SE	0.132	0.502		
Ca	Basic metal industries	Estimate	0.035	0.833	11.2%	22.8%
		SE	0.004	0.190		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.051	1.210	13.1%	11.3%
		SE	0.007	0.137		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.652	2.593	15.5%	16.9%
		SE	0.101	0.437		
D	Electricity, gas and water supply	Estimate	0.054	0.040	12.3%	0.0%
		SE	0.007	0.000		
E	Construction	Estimate	0.015	1.403	13.6%	35.9%
		SE	0.002	0.504		
F	Wholesale trade	Estimate	1.110	0.000	32.1%	
		SE	0.356	0.000		
G	Retail trade	Estimate	2.778	0.000	23.3%	
		SE	0.648	0.000		
I	Transport and storage	Estimate	0.938	2.727	27.6%	14.5%
		SE	0.259	0.396		
L	Property and business services	Estimate	0.393	0.273	17.1%	0.0%
		SE	0.067	0.000		
O	Health and community services	Estimate	0.000	0.018		12.7%
		SE	0.000	0.002		
Q	Personal and other services	Estimate	0.004	0.160	0.0%	0.0%
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.006		0.0%
		SE	0.000	0.000		

SE = Standard Error

Table I-12: Estimated hazardous waste generation predictors: Waste Code 14 06: Waste organic solvents, refrigerants and propellants

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.001	0.000	0.0%	
		SE	0.000	0.000		
B	Mining	Estimate	0.000	0.015		0.00%
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.052	0.000	12.3%	
		SE	0.006	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.000	0.239	5.3%	10.6%
		SE	0.000	0.025		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.173	0.333	23.4%	11.6%
		SE	0.040	0.039		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.013	0.113	10.7%	9.9%
		SE	0.001	0.011		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.003	0.000	16.3%	
		SE	0.001	0.000		
I	Transport and storage	Estimate	0.035	0.079	0.0%	19.6%
		SE	0.000	0.015		
L	Property and business services	Estimate	0.017	0.002	0.0%	0.0%
		SE	0.000	0.000		
O	Health and community services	Estimate	0.000	0.126		0.0%
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.033	0.030	18.9%	0.0%
		SE	0.006	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-13: Estimated hazardous waste generation predictors: Waste Code 16 01: End-of-life vehicles and wastes from dismantling of end-of-life vehicles and vehicle maintenance

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.004	0.000	20.7%	
		SE	0.001	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.000	0.057	0.0%	10.0%
		SE	0.000	0.006		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.033	0.001	13.4%	2.6%
		SE	0.004	0.000		
D	Electricity, gas and water supply	Estimate	0.001	0.000	15.7%	
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000	0.0%	
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.031	0.000	36.3%	
		SE	0.011	0.000		
G	Retail trade	Estimate	0.421	0.000	22.3%	
		SE	0.094	0.000		
I	Transport and storage	Estimate	0.002	0.035	4.2%	10.2%
		SE	0.000	0.004		
L	Property and business services	Estimate	0.001	0.000	0.0%	
		SE	0.000	0.000		
O	Health and community services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-14: Estimated hazardous waste generation predictors: Waste Code 16 06: Batteries and accumulators

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.011	0.000	9.1%	
		SE	0.001	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.007	0.000	6.3%	
		SE	0.000	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.002	0.027	4.1%	13.4%
		SE	0.000	0.004		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.065	0.064	16.1%	16.5%
		SE	0.010	0.011		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.001	0.003	12.8%	0.0%
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.786	0.000	31.5%	
		SE	0.247	0.000		
G	Retail trade	Estimate	0.618	0.000	15.7%	
		SE	0.097	0.000		
I	Transport and storage	Estimate	0.047	0.418	12.6%	10.5%
		SE	0.006	0.044		
L	Property and business services	Estimate	0.002	0.000	25.3%	
		SE	0.001	0.000		
O	Health and community services	Estimate	0.000	0.009		8.7%
		SE	0.000	0.001		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-15: Estimated hazardous waste generation predictors: Waste Code 18 01: Wastes from natal care, diagnosis, treatment or prevention of disease in humans

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.000	0.000		
		SE	0.000	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.001	0.000	7.6%	
		SE	0.000	0.000		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000		
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.000	0.000		
		SE	0.000	0.000		
L	Property and business services	Estimate	0.964	0.000	0.0%	
		SE	0.000	0.000		
O	Health and community services	Estimate	0.459	44.428	42.8%	50.8%
		SE	0.196	22.578		
Q	Personal and other services	Estimate	0.151	46.867	33.2%	28.4%
		SE	0.050	13.316		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-16: Estimated hazardous waste generation predictors: Waste Code 19 08: Wastes from waste water treatment plants not otherwise specified

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.620	0.000	24.2%	
		SE	0.150	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.005	0.000	0.0%	
		SE	0.000	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	5.609	126.160	5.9%	16.3%
		SE	0.331	20.539		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.008	43.165	4.2%	17%
		SE	0.000	7.323		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000		
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.614	0.905	7.01%	9.61%
		SE	0.043	0.087		
L	Property and business services	Estimate	1.524	0.000	23.30%	
		SE	0.355	0.000		
O	Health and community services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.000	0.417		0.00%
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		
TOTAL		**Estimate**				
		SE				
TOTAL	**(all industries combined)**	**Estimate**				
		SE				

SE = Standard Error

Table I-17: Estimated hazardous waste generation predictors: Waste Code 20 01: Municipal waste – separately collected fractions

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.001	0.000	0.0%	
		SE	0.000	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.001	0.022	2.0%	11.3%
		SE	0.000	0.003		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.041	0.000	8.0%	0.0%
		SE	0.003	0.000		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.006	0.000	20.5%	
		SE	0.001	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.000	0.000		
		SE	0.000	0.000		
L	Property and business services	Estimate	0.246	0.000	32.9%	
		SE	0.081	0.000		
O	Health and community services	Estimate	0.000	0.036	0.0%	12.7%
		SE	0.000	0.005		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Table I-18: Estimated hazardous waste generation predictors: Waste Code 20 03: Other municipal wastes

Study category	Description		Total estimated quantity generated per industry sector (tonnes)		Coefficient of variation (%)	
		Estimate Standard Error	Employee numbers		Employee numbers	
			≤ 20	> 20	≤ 20	> 20
A	Agriculture, forestry and fishing	Estimate	0.253	0.000	22.85%	
		SE	0.058	0.000		
B	Mining	Estimate	0.000	0.000		
		SE	0.000	0.000		
Ca	Basic metal industries	Estimate	0.000	0.000		
		SE	0.000	0.000		
Cb	Food, beverage & tobacco, textiles & leather goods, building materials	Estimate	0.080	60.253	0.95%	16.34%
		SE	0.001	9.844		
Cc	Wood processing, pulp and paper & printing, chemicals, plastics, rubber, fabricated metal	Estimate	0.000	4.323		10.73%
		SE	0.000	0.464		
D	Electricity, gas and water supply	Estimate	0.000	0.000		
		SE	0.000	0.000		
E	Construction	Estimate	0.000	0.000		
		SE	0.000	0.000		
F	Wholesale trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
G	Retail trade	Estimate	0.000	0.000		
		SE	0.000	0.000		
I	Transport and storage	Estimate	0.068	0.000	0.00%	
		SE	0.000	0.000		
L	Property and business services	Estimate	0.000	0.000		
		SE	0.000	0.000		
O	Health and community services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Q	Personal and other services	Estimate	0.000	0.000		
		SE	0.000	0.000		
Za	Government administration and defence, education, cultural and recreational services	Estimate	0.000	0.000		
		SE	0.000	0.000		

SE = Standard Error

Appendix J Sampling Design and Hazardous Waste Prediction Models

J1 Sampling design for estimating generation of hazardous waste

Information on businesses with the potential to generate hazardous waste in the two regions is available from Statistics New Zealand (SNZ), as shown in Table 8 of the main report. The sample to be taken from the overall generator population is a cluster sample, as it is not possible to know in advance how many different waste streams any business generates, or the form or waste type of any waste stream. However, once a business has been selected, information on all the hazardous waste streams generated will be recorded. In designing a stratified sampling sample, the basic sampling unit is the individual business.

The adopted sampling design is a **Stratified Cluster Sample Design**. In this design, the overall generator population is divided into a series of defined strata, each predicted to produce a cluster of waste streams in either gaseous, liquid, sludge or solid form. The following strata are chosen:

- Region
- Industry type
- Size of industry (assessed employee numbers ≤20 and >20)

A key requirement for sampling design is the knowledge of the likely variability of the data generated, which in turn has a significant influence on the precision of the estimated waste quantities. For this survey, information on the expected variability of data was extracted from earlier surveys of hazardous waste in the Auckland region (1990 and 1995). For any new survey of hazardous waste, the data produced by the survey of the Bay of Plenty and Waikato regions in 2001 provides the necessary standard deviations (a measure of variability around the average) of hazardous waste quantities generated per business in each stratum (refer Tables J-1 and J-2).

For sampling design purposes, the standard deviations of hazardous waste quantities generated combined across both regions are used (refer Table J-3). It is desirable to take a larger sample in a stratum if the stratum contains more businesses, or if the businesses in that stratum are highly variable in the amount of hazardous waste they produce.

Thus, strata with a relatively large number of businesses or with a relatively high standard deviation per business will be more intensively sampled. The products of the stratum standard deviations and the number of businesses in each stratum are used to assign weights. After a total sample size has been chosen, these weights are then used to partition the total sample size between the strata.

The summarised standard deviations recorded in the survey of the Bay of Plenty and Waikato regions in Table J-3 show that four strata (study categories D and F > 20, and Za ≤20 and >20) have standard deviations of zero. If these figures are used, these strata will never be sampled in future surveys. Therefore, for calculations we will take the standard deviation from the adjoining strata. For

stratum Za, the standard deviation is set equal to half the smallest observed standard deviation.

When considering a new hazardous waste survey in any geographical locality in New Zealand, it is assumed that there are approximately 10,000 businesses with the potential to generate hazardous waste. The hypothetical SNZ business statistics for this region are shown in Table J-4.

Table J-1: Survey statistics across both regions for businesses with ≤20 employees

Study category	Description	Number of businesses	Number of waste streams	Total hazardous waste (tonnes)	Average hazardous waste (tonnes)	Standard deviation of hazardous waste (tonnes)
A	Agriculture etc	20	41	61.59	1.54	3.74
B	Mining	5	7	4.01	0.67	0.68
Ca	Metal product manufacturing	101	131	2,324.89	18.45	87.55
Cb	Food, textile and non-metallic manufacturing	45	59	2,449.00	46.21	158.80
Cc	Wood, machinery and other manufacturing	103	202	706.36	3.70	14.36
D	Electricity, gas and water supply	5	8	1.26	0.16	0.20
E	Construction	23	44	103.21	2.35	9.14
F	Wholesale trade	12	28	22.46	0.83	1.48
G	Retail trade	29	99	116.67	1.30	2.80
I	Transport and storage	21	42	62.16	1.83	3.86
L	Property and business services	14	30	76.58	2.84	6.01
O	Health and community services	30	83	17.21	0.23	0.66
Q	Personal and other services	14	20	18.63	0.98	1.32
Za	Government, education etc	3	3	0.00	0.00	0.00

Table J-2: Survey statistics across both regions for businesses > 20 employees

Study category		Number of businesses	Number of waste streams	Total hazardous waste (tonnes)	Average hazardous waste (tonnes)	Standard deviation of hazardous waste (tonnes)
A	Agriculture etc	5	7	26.36	3.77	5.05
B	Mining	4	11	354.77	39.42	98.35
Ca	Metal product manufacturing	11	12	44.51	4.05	7.46
Cb	Food, textile and non-metallic manufacturing	23	82	15,693.87	245.22	996.53
Cc	Wood, machinery and other manufacturing	80	207	5,900.71	30.57	226.90
D	Electricity, gas and water supply	2	2	0.10	0.10	
E	Construction	9	21	76.57	4.79	13.02
G	Retail trade	1	1	0.01	0.01	
I	Transport and storage	31	82	115.30	1.99	3.67
L	Property and business services	2	2	3.02	1.51	2.11
O	Health and community services	27	87	1,163.74	15.11	59.81
Q	Personal and other services	6	8	294.98	42.14	92.35
Za	Government, education etc	5	5	0.03	0.01	0.01

Table J-3: Standard deviations of amount of hazardous waste produced per business for combined Bay of Plenty and Waikato regions combined

Study category		Standard deviation of hazardous waste quantities (tonnes)	
		≤20 employees	> 20 employees
A	Agriculture etc	3.74	5.05
B	Mining	0.68	98.35
Ca	Metal product manufacturing	87.55	7.46
Cb	Food, textile and non-metallic manufacturing	158.80	996.53
Cc	Wood, machinery and other manufacturing	14.36	226.90
D	Electricity, gas and water supply	0.20	(0.00) 0.20
E	Construction	9.14	13.02
F	Wholesale trade	1.48	(0.00) 1.48
G	Retail trade	2.80	3.67
I	Transport and storage	3.86	2.11
L	Property and business services	6.01	59.81
O	Health and community services	0.66	92.35
Q	Personal and other services	1.32	0.01
Za	Government, education etc	(0.00) 0.005	(0.00) 0.005

Table J-4: Number of businesses in each study category in example region with a total of 10,000 businesses potentially generating hazardous waste

Study category		Number of businesses (SNZ)	
		≤20 employees	> 20 employees
A	Agriculture etc	1350	30
B	Mining	20	5
Ca	Metal product manufacturing	360	60
Cb	Food, textile and non-metallic manufacturing	350	25
Cc	Wood, machinery and other manufacturing	1300	120
D	Electricity, gas and water supply	30	10
E	Construction	1350	35
F	Wholesale trade	375	5
G	Retail trade	900	10
I	Transport and storage	1000	40
L	Property and business services	500	20
O	Health and community services	1150	50
Q	Personal and other services	665	10
Za	Government, education etc	225	5
Total		**9575**	**425**

For logistical and budget reasons, it has been decided that a total sample of 900 businesses will be taken in the region concerned. Due to the knowledge that businesses with >20 employees ('large' businesses) are more likely to be one-off businesses (therefore generating a high level of variability), and also more likely to generate larger quantities of hazardous waste, it is planned to sample all businesses with >20 employees.

Thus, there is a residual sample of n = 900 – 425 = 475 businesses to spread over the businesses with 20 or fewer employees. The **optimal sample allocation formula** is then used to allocate a total sample size among the strata. This formula is shown and further described below.

Denoting the total number of businesses in stratum i by N_i, and the standard deviation by s_i the fraction of the total sample of size n to be taken in stratum or Study category i is given by n_i where $n_i = n \times fraction_i$ or

$$n_i = n \times \frac{N_i s_i}{N_A s_A + N_B s_B + \cdots + N_{Za} s_{Za}}$$

Based on the above approach, the initial sample allocations are given in Table J-5.

Table J-5: Initial sample allocation based on strict 'optimal' allocation formula.

Study category	Number of businesses (SNZ)	Standard deviation (tonnes)	Product of SNZ x standard deviation	Fraction of total standard deviation	Initial sample allocation for businesses with ≤20 employees
A	1350	3.74	5,049	0.04247	20.18
B	20	0.68	13.6	0.00011	0.05
Ca	360	87.55	31,518	0.26514	125.94
Cb	250	158.8	39,700	0.33397	158.64
Cc	1300	14.36	18,668	0.15704	74.60
D	30	0.2	6	5.05E-05	0.02
E	1350	9.14	12,339	0.1038	49.31
F	375	1.48	555	0.00467	2.22
G	900	2.8	2,520	0.0212	10.07
I	1000	3.86	3,860	0.03247	15.42
L	500	6.01	3,005	0.02528	12.01
O	1150	0.66	759	0.00639	3.03
Q	665	1.32	877.8	0.00738	3.51
Za	225	0.005	1.125	9.5E-06	0.00
Total	**9,575**		**118,872**	**1**	**475.00**

Table J-5 shows immediately that the suggested allocation has some undesirable features. Initially, all suggested sample sizes are rounded to the nearest integer. However, three study category strata (B, D and Za) have suggested samples sizes of less than one business. A further six of the fourteen study categories have suggested sample sizes less than 10. It is also possible that one or more study categories with the largest standard deviation in the 2001-2002 survey have a suggested sample size that is greater than the total number of businesses in the study category. These issues are further discussed below.

If the suggested sample size in a stratum (or strata) is greater than the number of businesses in that stratum, the total number of businesses is allocated to the sample. Thus, all the businesses in that stratum will be (or are attempted to be) sampled. Following this, the remaining sample units can be re-allocated to the other strata. To achieve this, the standard deviation in the stratum where the full number of businesses will be sampled is set to zero, thus giving it a fraction of zero.

For example, if everyone of the 20 businesses in study category D is sampled, the standard deviation per business in study category D is set to zero and the sample size to 20. Then, a sample of size 475 – 20 = 455 would be allocated to the remaining strata.

Once there are no more study categories in which the suggested sample size is not higher than the total number of businesses in that category, there some study categories in which the suggested sample size is negligible. It is a reasonable compromise to choose a small standard sample size of say, five businesses, and randomly sample at least that number in each study category where the suggested sample size is less than 5.

Thus, in study categories B, D, F, O, Q and Za, the sample size is set to 5 and the standard deviations to zero. The total sample to be allocated is then reduced to 475 – 25 = 450. From this, the final sample allocation is completed as shown in Table J-6.

Table J-6 Final adjustments to sample design

Study Category	Total umber of businesses (SNZ)	Initial sample from businesses with ≤20 employees	Rounded and adjusted sample
A	1350	20	19
B	20	0	5
Ca	360	126	122
Cb	350	159	153
Cc	1300	75	72
D	30	0	5
E	1350	49	48
F	375	2	5
G	900	10	10
I	1000	15	15
L	500	12	12
O	1150	3	5
Q	665	4	5
Za	225	0	5
Total	**9,575**	**475**	**481**

Table J-6 shows that the total sample size has increased by 6 units to 481, which is deemed to be acceptable. Alternatively, the number of business units sampled in study category Cb could be reduced from 153 to 135. Increasing the total sample size increases survey costs, while reducing the number of businesses sampled in the most variable strata increases the variability, or slightly reduces the precision of the resulting estimate. However, taking even a small sample in each stratum gives useful information about the hazardous waste produced in that stratum and some measure of the variability from business to business in that study category.

J2 Hazardous waste prediction model

The key goal for a hazardous waste prediction model is to produce an estimate of the total average amount of hazardous waste generated and an estimate of uncertainty in the estimate, for the two regions combined and separately, and for each study category, by waste form and type.

As outlined in Section J1, the sampling design adopted is based on a stratified cluster sampling scheme, where the strata are defined by region, study category and business size. The total number of sampling units, i.e. businesses, within each stratum or cell is derived from Statistics New Zealand. The sampling design is carried out as an iterative process using the optimal sample allocation formula, using standard deviations derived as part of the Bay of Plenty and Waikato regions hazardous waste survey (refer Section J1). For each combination of stratification variables, each business that is chosen is part of the sampling frame is surveyed.

At the outset, it is not possible to know the number of hazardous waste streams that any business generates, or the type and form of hazardous waste in a waste stream (gas, liquid, sludge or solid), or the volume of HW produced. Information on every waste stream produced by a firm is recorded. Thus, within a stratum (a combination of region, study category and business size), there is a cluster sample of waste streams. Within each stratum, and waste type and form, the total average quantity generated and its standard error are estimated.

The following provides an overview of the method for predicting hazardous waste quantities and associated estimates of uncertainty.

(e) Quantity estimates

1 For each form of waste (liquids, solids and sludges, with gaseous and diluted liquid waste excluded) and a series of priority hazardous waste

2 For each stratum, that is by region, study category and business size (businesses with equal to or less than, or more than 20 employees)

(f) Basic variables:

3 Total number of businesses, N, from Statistics New Zealand

4 Number of businesses sampled in stratum

5 Number of businesses with no hazardous waste, n_0

6 Within each of the $n - n_0$ businesses with one or more waste streams:

number of waste streams where amount HW produced is unquantified, n_u

count of quantified waste streams, n_c

average hazardous waste quantity per waste stream,

standard deviation of amount of quantified hazardous waste (associated formulae are derived from cluster sampling)

(g) Analysis:

7 For each business surveyed, the mean amount of quantified and unquantified hazardous waste (and standard error) is estimated. The amount of hazardous waste in each of the unquantified waste streams is estimated using the mean hazardous waste quantity in the quantified waste streams.

8 The average amount of hazardous waste generated per business is estimated by multiplying the total number of waste streams, $n_c + n_u$, by the mean amount of hazardous waste in each quantified waste stream. This is multiplied by $n - n_0$ to give an estimate of the total amount of HW produced in the sample, and (its standard error).

9 The stratified cluster sampling formulae is then applied to combine estimates and standard errors across strata.

(h) Example: Waikato region: liquid waste, study category A

1 Data inputs are shown below for a hypothetical example of survey statistics, according to the critical variables listed above.

Study category	Statistics	Data	
		≤20 employees	> 20 employees
A	Number of waste streams	41	7
	Average hazardous waste quantity	1.540	3.766
	Standard deviation	3.742	5.045
	Number of unrecorded waste streams	0	0
	Businesses with more than one waste stream	20	5
	Sample size of businesses participating	36	6
	Total number of businesses (SNZ)	2066	50

2 Calculations for businesses with 20 or fewer employees:

mean number of waste streams per firm, $\bar{m} = \frac{n_c + n_0}{n} = \frac{19+0}{25} = 0.76$

estimate of total waste per firm, $\frac{n_c + n_0}{n}\bar{y} = 0.76 \times 0.625 = 0.4748$

estimate of total waste for all firms in stratum,

$$\hat{\tau} = N\frac{n_c + n_0}{n}\bar{y} = 1266 \times 0.4748 = 601.1$$

standard error of estimate,

$$s.e.(\hat{\tau}) = N\sqrt{\frac{\left(1 - n/N\right)}{n}}\,\bar{m}\,s = 1266 \times \sqrt{\frac{\left(1 - 25/1266\right)}{25}} \times 0.76 \times 1.1106 = 211.59$$

3 Calculations for businesses with more than 20 employees:

mean number of waste streams per firm, $\bar{m} = \frac{n_c + n_0}{n} = \frac{4+0}{4} = 1.0$

estimate of total waste per firm, $\frac{n_c + n_0}{n}\bar{y} = 1.0 \times 3.725 = 3.725$

estimate of total waste for all firms in stratum,

$$\hat{\tau} = N\frac{n_c + n_0}{n}\bar{y} = 26 \times 3.725 = 96.85$$

standard error of estimate,

$$s.e.(\hat{\tau}) = N\sqrt{\frac{\left(1 - n/N\right)}{n}}\,\bar{m}\,s = 26 \times \sqrt{\frac{\left(1 - 4/26\right)}{4}} \times 1.0 \times 5.61 = 67.08$$

4 Combining the results for all strata the estimate of total average waste quantity generated across all study categories is the sum of the estimate in each stratum, and the standard error of the total average hazardous waste quantity is estimated by the square root of the sum of the squares of the separate standard errors from each stratum.

(i) Example

Tables J-7 to J-9 give an actual example of the above calculations with real survey data, demonstrated for the hazardous waste estimates for the Bay of Plenty and Waikato regions combined (also refer to Tables 36 and 42 of the main report). These tables provide the input data for the model (J-7), and the estimated total average hazardous waste quantities (and associated standard errors) for each and all study categories (J-8), as well as for individual businesses (J-9). Table J-9 provides a range of 'predictors', which can be used to estimate hazardous waste quantities in other localities, provided that relevant SNZ data is available.

Table J-7 Raw data input and calculation of total hazardous waste estimates and hazardous waste predictors (for Bay of Plenty and Waikato regions, all waste forms and types excluding gaseous and diluted liquid hazardous waste)

Study category	Description	Raw data		Total hazardous waste estimate and standard error		Hazardous waste predictor and standard error	
		≤20 employees	> 20 employees	≤20 employees	> 20 employees	≤20 employees	> 20 employees
A	Number of waste streams	41	7	3623.534	219.6833	1.753889	4.393667
	Average hazardous waste quantity	1.540	3.766	1454.612	112.7051	0.704071	2.254103
	Standard deviation	3.742	5.045				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	20	5				
	Sample size of businesses participating	36	6				
	Total number of businesses (SNZ)	2066	50				
B	Number of waste streams	7	11	17.535	867.218	0.5845	108.4023
	Average hazardous waste quantity	0.668	39.419	5.364618	765.0146	0.178821	95.62682
	Standard deviation	0.675	98.354				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	5	4				
	Sample size of businesses participating	8	4				
	Total number of businesses (SNZ)	30	8				
Ca	Number of waste streams	131	12	5304.166	83.61733	9.786283	2.697333
	Average hazardous waste quantity	18.452	4.046	1181.388	23.52281	2.179683	0.7588
	Standard deviation	87.550	7.457				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	101	11				
	Sample size of businesses participating	247	18				
	Total number of businesses (SNZ)	542	31				
Cb	Number of waste streams	59	82	5412.744	36596.19	9.949898	402.1559

Study category	Description	Raw data		Total hazardous waste estimate and standard error		Hazardous waste predictor and standard error	
		≤20 employees	> 20 employees	≤20 employees	> 20 employees	≤20 employees	> 20 employees
	Average hazardous waste quantity	46.208	245.217	791.7151	14117.69	1.455359	155.1394
	Standard deviation	158.804	996.534				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	45	23				
	Sample size of businesses participating	274	50				
	Total number of businesses (SNZ)	544	91				
Cc	Number of waste streams	202	207	6324.566	11315.16	3.112483	63.92745
	Average hazardous waste quantity	3.698	30.574	1489.054	5602.578	0.732802	31.65298
	Standard deviation	14.363	226.901				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	103	80				
	Sample size of businesses participating	240	99				
	Total number of businesses (SNZ)	2032	177				
D	Number of waste streams	8	2	3.653818	0.52	0.057091	0.04
	Average hazardous waste quantity	0.157	0.100	0.815956	0	0.012749	0
	Standard deviation	0.203	0.000				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	5	2				
	Sample size of businesses participating	22	5				
	Total number of businesses (SNZ)	64	13				
E	Number of waste streams	44	21	5082.553	339.2078	2.457714	6.281625
	Average hazardous waste quantity	2.346	4.786	3024.596	193.5258	1.462571	3.583812
	Standard deviation	9.141	13.020				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste	23	9				

Study category	Description	Raw data		Total hazardous waste estimate and standard error		Hazardous waste predictor and standard error	
		≤20 employees	> 20 employees	≤20 employees	> 20 employees	≤20 employees	> 20 employees
	stream						
	Sample size of businesses participating	42	16				
	Total number of businesses (SNZ)	2068	54				
F	Number of waste streams	28	0	613.4613	0	1.109333	0
	Average hazardous waste quantity	0.832	0.000	233.7236	0	0.422647	0
	Standard deviation	1.481	0.000				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	12	0				
	Sample size of businesses participating	21	2				
	Total number of businesses (SNZ)	553	21				
G	Number of waste streams	99	1	5653.654	0.8	4.138839	0.1
	Average hazardous waste quantity	1.296	0.100	2167.237	0.074833	1.586557	0.009354
	Standard deviation	2.798	0.010				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	29	1				
	Sample size of businesses participating	31	1				
	Total number of businesses (SNZ)	1366	8				
I	Number of waste streams	42	82	2708.099	265.4832	1.744909	4.6576
	Average hazardous waste quantity	1.828	1.988	849.1149	51.41064	0.54711	0.901941
	Standard deviation	3.857	3.666				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	21	31				
	Sample size of businesses participating	44	35				
	Total number of businesses (SNZ)	1552	57				
L	Number of waste streams	30	2	3139.857	7.687273	4.051429	0.274545

Study category	Description	Raw data		Total hazardous waste estimate and standard error		Hazardous waste predictor and standard error	
		≤20 employees	> 20 employees	≤20 employees	> 20 employees	≤20 employees	> 20 employees
	Average hazardous waste quantity	2.836	1.510	1431.961	2.520049	1.847691	0.090002
	Standard deviation	6.009	2.107				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	14	2				
	Sample size of businesses participating	21	11				
	Total number of businesses (SNZ)	775	28				
O	Number of waste streams	83	87	966.8524	3569.063	0.561471	46.96136
	Average hazardous waste quantity	0.230	15.114	468.2377	2121.315	0.271915	27.91204
	Standard deviation	0.656	59.813				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	30	27				
	Sample size of businesses participating	34	28				
	Total number of businesses (SNZ)	1722	76				
Q	Number of waste streams	20	8	555.8778	561.8667	0.544444	56.18667
	Average hazardous waste quantity	0.980	42.140	122.9406	317.9255	0.120412	31.79255
	Standard deviation	1.324	92.349				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste stream	14	6				
	Sample size of businesses participating	36	6				
	Total number of businesses (SNZ)	1021	10				
Za	Number of waste streams	3	5	0.101625	0.743333	0.000188	0.003333
	Average hazardous waste quantity	0.001	0.006	0	0.202272	0	0.000907
	Standard deviation	0.000	0.005				
	Number of unrecorded waste streams	0	0				
	Businesses with more than one waste	3	5				

Study category	Description	Raw data		Total hazardous waste estimate and standard error		Hazardous waste predictor and standard error	
		≤20 employees	> 20 employees	≤20 employees	> 20 employees	≤20 employees	> 20 employees
	stream						
	Sample size of businesses participating	8	9				
	Total number of businesses (SNZ)	542	223				

Table J-8 Total hazardous waste estimates (for Bay of Plenty and Waikato regions, all waste forms and types excluding gaseous and diluted liquid hazardous waste)

Study category	Statistic	Hazardous waste estimates and standard errors		Sample sizes and SNZ count		Coefficient of variation	
		≤20 employees	> 20 employees	≤20 employees	> 20 employees	≤20 employees	> 20 employees
A	Estimate	3624	220	36	6	40%	51%
	Standard Error	1455	113	2066	50		
B	Estimate	18	867	8	4	31%	88%
	Standard Error	5	765	30	8		
Ca	Estimate	5304	84	247	18	22%	28%
	Standard Error	1181	24	542	31		
Cb	Estimate	5413	36596	274	50	15%	39%
	Standard Error	792	14118	544	91		
Cc	Estimate	6325	11315	240	99	24%	50%
	Standard Error	1489	5603	2032	177		
D	Estimate	4	2	22	5	22%	0%
	Standard Error	1	0	64	13		
E	Estimate	5083	339	42	16	60%	57%
	Standard Error	3025	194	2068	54		
F	Estimate	613	0	21	2	38%	#DIV/0!
	Standard Error	234	0	553	21		
G	Estimate	5654	1	31	1	38%	9%
	Standard Error	2167	0	1366	8		
I	Estimate	2708	265	44	35	31%	19%
	Standard Error	849	51	1552	57		
L	Estimate	3140	8	21	11	46%	33%
	Standard Error	1432	3	775	28		
O	Estimate	967	3569	34	28	48%	59%
	Standard Error	468	2121	1722	76		
Q	Estimate	556	562	36	6	22%	57%
	Standard Error	123	318	1021	10		
Za	Estimate	0	1	8	9	0%	0%
	Standard Error	0	0	542	223		
Sub-total by business size		**39407**	**53828**	**14877**	**847**	**12%**	**29%**
		4823	**15360**				
Total all businesses			**93235**		**15724**		**17%**
			16100				

Table J-9 Hhazardous waste predictors (for Bay of Plenty and Waikato regions, all waste forms and types excluding gaseous and diluted liquid hazardous waste)

Study category	Statistic	Hazardous waste predictors and standard errors		Coefficient of variation	
		≤20 employees	> 20 employees	≤20 employees	> 20 employees
A	Estimate	1.754	4.394	40.14%	51.30%
	Standard Error	0.704	2.254		
B	Estimate	0.585	108.402	30.59%	88.21%
	Standard Error	0.179	95.627		
Ca	Estimate	9.786	2.697	22.27%	28.13%
	Standard Error	2.180	0.759		
Cb	Estimate	9.950	402.156	14.63%	38.58%
	Standard Error	1.455	155.139		
Cc	Estimate	3.112	63.927	23.54%	49.51%
	Standard Error	0.733	31.653		
D	Estimate	0.057	0.040	22.33%	0.00%
	Standard Error	0.013	0.000		
E	Estimate	2.458	6.282	59.51%	57.05%
	Standard Error	1.463	3.584		
F	Estimate	1.109	0.000	38.10%	#DIV/0!
	Standard Error	0.423	0.000		
G	Estimate	4.139	0.100	38.33%	9.35%
	Standard Error	1.587	0.009		
I	Estimate	1.745	4.658	31.35%	19.36%
	Standard Error	0.547	0.902		
L	Estimate	4.051	0.275	45.61%	32.78%
	Standard Error	1.848	0.090		
O	Estimate	0.561	46.961	48.43%	59.44%
	Standard Error	0.272	27.912		
Q	Estimate	0.544	56.187	22.12%	56.58%
	Standard Error	0.120	31.793		
Za	Estimate	0.000	0.003	0.00%	27.21%
	Standard Error	0.000	0.001		