

workingpaper

Evaluating the Mineral Production Dataset

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Authors

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Report 10: *The State of New Zealand's Resources*

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About the Resource Project Team

The Resource Project Team comprises of Jessica Prendergast, Nicola Bradshaw, Chris Aitken, Lisa Bazalo, Jean-Charles Perquin, and Steph Versteeg. Each team member has placed a significant amount of time and effort into each Working Paper and the corresponding datasets.

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Naturally any errors or matters of opinion remain the responsibility of the authors.

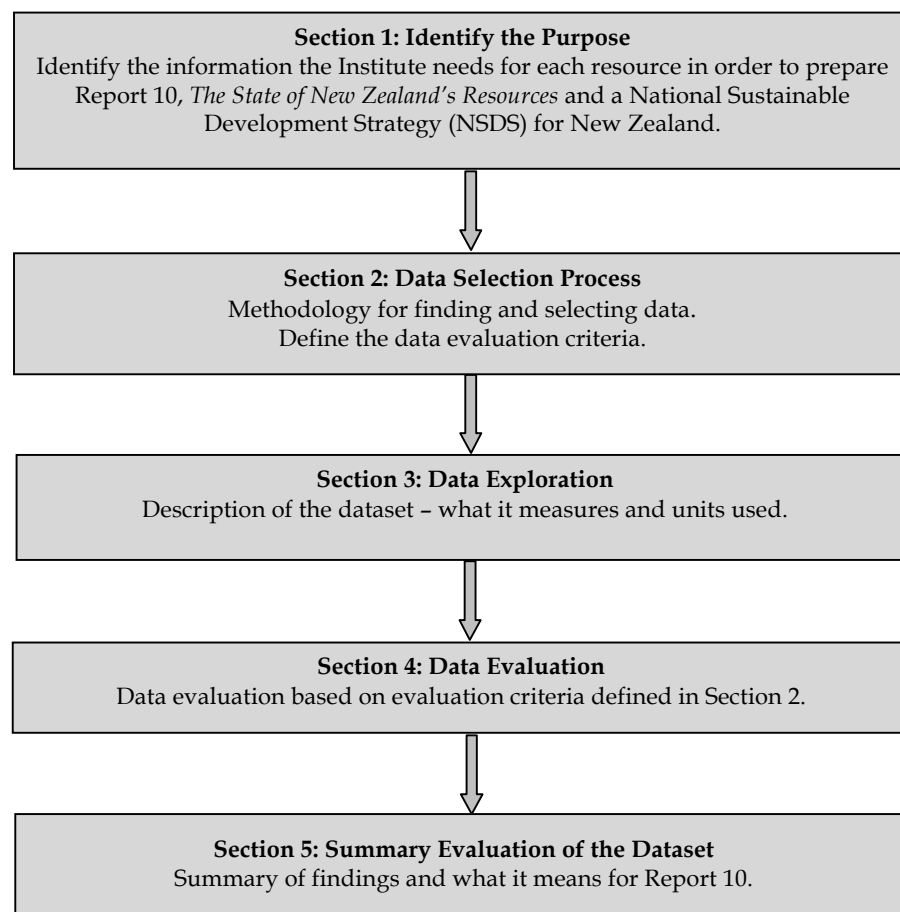
1. Purpose

This Working Paper is one of a series of 11 papers prepared as background to the Sustainable Future Institute's Report 10, *The State of New Zealand's Resources* (SFI, in press). Report 10 aims to provide an overview of available data and information covering a range of resources, and to discuss the use, availability and appropriateness of the data in the preparation of a National Sustainable Development Strategy (NSDS).

The purpose of this Working Paper is to describe the process by which the Institute collected, collated and presented a selection of mineral data relating to the production of metals and non-metals in New Zealand. The datasets are summarised and evaluated for completeness, accuracy, relevance, appropriateness of sources and public availability. This paper also discusses the purpose for which the data was collected by its custodians, and why the Institute has selected this data for its reporting. The content of the dataset is not interpreted or analysed; rather, our purpose is to evaluate the usefulness of this dataset for the purposes of Report 10.

Following this evaluation any gaps and resulting limitations in using the selected data are assessed, as well as its relevance and reliability in relation to the Institute's purpose of using the comprehensive series of datasets to inform the development of an NSDS for New Zealand.

Figure 1 The Five-step Process for Evaluating the Institute's Datasets



1. Purpose

1.1 The Sustainable Future Institute

The Institute is an independently funded think tank based in Wellington, New Zealand. Earlier work by the Institute has indicated that New Zealand is well behind other developed countries on its international obligations to develop and implement a National Sustainable Development Strategy (NSDS) (SFI, 2007). It is hoped that *Project 2058* will help inform ministers, policy analysts and members of the public about key events and trends in New Zealand's past, and alternative strategies for the future. With this in mind, this Working Paper is a step towards the Institute's goal of preparing an NSDS for New Zealand in 2011.

1.2 Project 2058

The strategic aim of *Project 2058* is to promote integrated long-term thinking, leadership and capacity building so that Aotearoa/New Zealand can effectively seek and create opportunities, and explore and manage risks, over the next 50 years. In order to achieve this aim, the *Project 2058* team is working to:

1. Develop a detailed understanding of the current national planning landscape, and in particular the government's ability to deliver long-term strategic thinking;
2. Develop a good working relationship with all parties that are working for and thinking about the 'long-term view';
3. Recognise the goals of iwi and hapū, and acknowledge te Tiriti o Waitangi;
4. Assess key aspects of New Zealand's society, asset base and economy in order to understand how they may shape the country's long-term future, such as government-funded science, natural and human-generated resources, the state sector and infrastructure;
5. Develop a set of four scenarios to explore and map possible futures;
6. Identify and analyse both New Zealand's future strengths and weaknesses, and potential international opportunities and threats;
7. Develop and describe a desirable sustainable future in detail, and
8. Prepare a *Project 2058* National Sustainable Development Strategy. (SFI, 2009: 3)

The culmination of *Project 2058*, the creation of a National Sustainable Development Strategy, depends on having an accurate assessment of key aspects of New Zealand society. Earlier reports have dealt in particular with points 1, 3, 5 and 6 above,¹ and this Working Paper is designed to help progress the fourth point: 'Assess key aspects of New Zealand's society, asset base and economy in order to understand how they may shape the country's long-term future ...'

1.3 Mineral Production Resources within an NSDS

Below we ask six strategic questions that drive this research. These are then expanded upon to discuss the use, availability and appropriateness of the data in the preparation of an NSDS.

¹ For a detailed list of published and upcoming reports, see *Project 2058 Methodology: Version 3* (SFI, 2009: 7).

Without accurate, comprehensive, relevant and accessible data to answer the following questions, it will be difficult to develop and execute an informed NSDS for New Zealand.

- **What** are the issues facing minerals and mineral use in New Zealand? Are New Zealanders clear on exactly what these issues are? Does New Zealand have quality data and information to enable us to understand these issues as fully as possible? Are New Zealanders able to establish an informed understanding of the priorities?
- **Why** does New Zealand need to confront issues affecting our minerals? Are there improvements that can be achieved; or practices that need to change? Are current indicators relevant and meaningful to benchmark changes over-time? What is the purpose and the benefit in taking action?
- **When** should New Zealand start to address issues which impact on New Zealand's minerals? Is now the right time? Are current economic, social and environmental conditions conducive? Would it be beneficial to wait and monitor events as they evolve? Are current measures and indicators appropriate to monitor developments? Is there a risk of rushing into short-term action when a long-term approach is needed?
- **Where** do New Zealanders most need to concentrate their efforts to address New Zealand's mineral issues? Which aspects of the issue should be focused on first? Where should New Zealanders begin to ensure the most beneficial and sustainable outcome? Does New Zealand have sufficient knowledge, based on accurate and appropriate data, to assess outcomes?
- **Who** must be engaged to effectively address issues facing minerals in New Zealand? Who needs to be involved if New Zealand is going to successfully tackle these issues? Is data on minerals in New Zealand accessible and transparent to allow those interested to be accurately informed? Are data ownership issues affecting public involvement?
- **How** should New Zealand ensure we have effective management of our minerals? What is the best approach? What skills or techniques are needed? Does New Zealand have comprehensive and accurate information to enable effective management? How can New Zealand learn from international experience to assist in maximising effective and sustainable mineral use?

This working paper does not attempt to answer the above overarching questions. These overarching questions do however inform our purpose for Report 10 and in progressing an NSDS. Data collected for inclusion within this dataset has enabled us to understand the level of accuracy, relevance, comprehensiveness and issues of ownership that exist surrounding publicly available data in New Zealand. The above questions function as a bridge between the dataset, this Working Paper and Report 10; specific questions pertaining to how the selected Institute's dataset will inform the development of an NSDS are outlined in Table 1.

2. Data Selection Process

2.1 Methodology

Report 10a, *Designing a Framework to Monitor New Zealand's Resources* (SFI, 2010a) outlined the process through which the Institute developed the framework for collecting and presenting the data. With this framework in place, the steps towards the completion of Report 10 are: (i) building the datasets for the 11 resource types studied; (ii) evaluating the selected datasets, and (iii) reporting on the findings in relation to the Institute's aim of defining an NSDS for New Zealand. The datasets developed in Step (i) are available on our website.² This Working Paper is one of 11 that form Step (ii), the data evaluation. Step (iii) will be published in Report 10.

The data for the Institute's Mineral Dataset was selected from a variety of static tables extracted from the Crown Minerals website. Data on oil, gas and coal production are covered in the Institute's Energy Dataset and Working Paper. Therefore we have limited the suite of minerals explored to those we primarily identified as metal or non-metal mineral commodities. We acknowledge that data is compiled by Crown Minerals to meet the statutory requirement for the regulating of royalties and royalty payments and therefore the figures do not necessarily represent total production. Further, data represented has been compiled by industry for statistical production and as such cannot be thought to represent total production. We also acknowledge that not all minerals are Crown owned, e.g. iron sand and coal, and that it is therefore difficult for Crown Minerals to provide accurate figures on these commodities. Of further note, this dataset is based on mineral production rather than the extent of existing or potential mineral resources.

The source tables we used to collect the data are listed on the Institute's website under Project 2058 Publications and State of New Zealand's Resources. The Institute has taken the original data and reformatted it in an Excel spreadsheet to facilitate use and analysis. The original data values have been preserved.

2.2 Sources of Data

The Institute supports the free availability of data relating to environmental statistics. With this in mind, we deliberately used only openly accessible data so that we were able to report on its availability and identify potential gaps. This enables us to report on the implications of using only freely available data, and to evaluate the information that can be extracted from these data sources.

We acknowledge that many sources of information exist on New Zealand's minerals that may or may not be publicly available or easily discoverable. Crown Research Institutes (CRIs), universities, national and local government, and other private and public organisations also collect and hold data on minerals.

² www.sustainablefuture.info

For various reasons including privacy, commercial sensitivity, cost of dissemination or commercial sale price of the data, there are many datasets on New Zealand's resources that are inaccessible to the public. Without extensive research, funding or expertise to assist in the interpretation of the data, many others remain unavailable. The Institute has focused on open data, therefore no efforts have been made to retrieve the other datasets. This is a limitation of this project as gaps identified by the Institute could potentially be filled by these other data sources.

For example, GNS Science, a Crown Research Institute, holds a minerals database called the Geological Resource Map of New Zealand (GERM) which contains relevant information (see GNS Science, n.d.). GNS have the most comprehensive understanding of both existing and potential mineral resources in New Zealand, in comparison to most other organisations that collect data for production and regulation purposes. We are also aware that private mining lease owners and companies such as Wellington-based Kenex, which provides geographic information services (GIS) and exploration services to the exploration and mining industries, are likely to hold further data relevant to this dataset (see Kenex, 2006). However, data that is held by organisations external to government, and is not readily accessible to the public, has not been retrieved for the Institute's dataset. Data included within this working paper and its accompanying dataset is quantifying mineral production in New Zealand and is therefore not looking at all existing or potential mineral resources.

The Institute searched for and compiled its dataset in 2009. What we have selected and then discussed within this report reflects data which fit our purpose within the environmental data landscape at the time of research.

As data availability increases rapidly on an ongoing basis, it would not be practical to include within this Working Paper all datasets relevant to minerals in New Zealand. Report 10 investigates the past, present and future of the environmental data landscape in New Zealand. It also provides a list of alternative sources of information pertaining to New Zealand resources. When appropriate, we have mentioned complimentary data sources in this Working Paper.

Data on New Zealand resources is often produced and targeted to industry experts. This makes a thorough analysis and evaluation of datasets a complex task for the uninitiated. We have referred to the original source documents to support our evaluation of the datasets.

2.3 Mineral Dataset Evaluation Criteria

The Institute has developed a series of criteria to support the effective evaluation of its datasets and to consider the data in the context of our wider work programme. Each criterion is supplemented with questions to direct attention to relevant areas for consideration. The aim is to structure the analysis of each dataset in a way that is consistent and replicable across the 11 datasets. In this Working Paper, these criteria are applied to the Minerals Dataset as a whole and to the different indicators and sources that comprise the dataset.

The criteria and guiding questions are outlined in Table 1, below.

Table 1 Criteria for Evaluating the Institute's Datasets

Criteria for evaluation	Guiding questions
Comprehensive time series	<p>For how long has the data been collected?</p> <p>Are there gaps in the records?</p> <p>Are data/indicators consistent and comparable over time?</p>
Quality data	<p>What is the scope and range of indicators; are there any gaps?</p> <p>Is data comprehensive and detailed?</p> <p>How is data classified/categorised?</p> <p>Is the data local/regional/national?</p> <p>Is the data internationally comparable and valid?</p> <p>Is the data accurate – is there any sampling bias?</p> <p>Are error bars calculated?</p> <p>Is the data relevant and able to be interpreted with meaning?</p>
Appropriate sources	<p>How many sources are drawn on, and what are they?</p> <p>Who owns the data?</p> <p>Why, how and where is the data collected/measured?</p> <p>Is the data original data, self-reported/obtained by survey?</p> <p>Is the data collection and analysis informed by sound assumptions?</p> <p>Is data reliable, independent, verifiable and/or of international standard?</p> <p>Is the data subject to (external) review?</p>
Publicly available	<p>Is the data easy to access?</p> <p>Is the data located online, in publicly available reports or databases, or within an institution?</p> <p>Is the data freely available?</p>

2.4 Selected Sources

In order to find possible sources of data to establish a baseline portrait of minerals in New Zealand, the websites of agencies and organisations with relevant links to New Zealand's mineral industry were reviewed for all publications which provided information and data on mineral production. A search was undertaken to find online datasets and statistics, documentation on the data collection and its uses, and specific publications on mineral production, as well as publications such as annual reports. Organisations whose websites were searched included, but were not limited to, Crown Minerals, the Institute of Geological and Nuclear Sciences (GNS Science) and the New Zealand Minerals Industry Association.

The most comprehensive source of publicly available data on New Zealand's minerals was found to be Crown Minerals, the division of the Ministry of Economic Development that manages New Zealand's Crown Minerals Estate. It is responsible for collecting production

data for industrial rocks and minerals from quarries across New Zealand. Crown Minerals' facts and figures, in particular their annual *Mining Production Statistics*, form the basis of the Institute's Minerals Dataset. Data on the production of metals and non-metals was sourced from the Crown Minerals website.

It should be noted that the agency responsible for the government's Crown Minerals Estate has changed over time. In the past 40 years different divisions of the Ministry of Energy, Ministry of Commerce, Department of Conservation, Department of Labour and Ministry of Economic Development have all monitored the estate. The Crown Minerals group was established by the Crown Minerals Act 1991 and has been responsible for the estate since this date. Prior to this, there were many legislative and institutional changes which affected the monitoring of Crown Minerals in New Zealand. With New Zealand's political reforms between the 1980's and the 1990's responsibility for Crown Minerals changed from the Mines Department to the Department of Conservation with the introduction of the Resource Management Act 1991. In 2000 the Crown Minerals group was placed within the Ministry of Economic Development for practical reasons. However, it provides information for the years between 1970 and 1999 in the *1970-1999 Mining Production Statistics* dataset on its website. The production of this dataset required the gathering of information from multiple sources, mainly annual return statements and mining reviews. A reference in the notes section of the *1970-1999 Mining Production Statistics* identifies the source of the data for each year (Crown Minerals, 2010a).

The fact that all the data used for the development of the Institute's Minerals Dataset comes from government sources should not be seen as an endorsement of these official sources over private companies, but reflects the limitations of the availability of data at time of data collection.

2.5 Purpose for which the Data was Initially Collected

Most of the data collected by Crown Minerals relates to minerals owned by the Crown as prescribed by legislation. The Crown owns all of New Zealand's naturally occurring gold and silver, along with approximately half of all in-ground coal, metallic and non-metallic minerals, industrial rocks and building stones (Statistics New Zealand, 2006: 405). Any mining or exploration for Crown-owned minerals requires a permit granted under the Crown Minerals Act 1991 (Part 1, s25). Permit holders are required under Regulation 38 of the Crown Minerals (Minerals and Coal) Regulations 2007 to supply to the Secretary,³ no later than 40 working days after the annual anniversary of the commencement of the permit:

- (a) a report on the mining activities that have taken place under the permit during the past year; and
- (b) details of the mining activities that are proposed under the permit in the current year.

³ Secretary means the chief executive of the Ministry of Economic Development as per Crown Minerals Act 1991, s 2.

3. Data Exploration

In order to collect data on minerals that are not owned by the Crown, Crown Minerals requests that private quarry owners submit an Annual Return of Industrial Rocks and Minerals (ARIRM) for statistical purposes, although this is not mandatory. Since there is no legal requirement to do so, the possibility of an unknown production quantity of minerals failing to be recorded must be acknowledged. These returns are completed annually in April (for the previous calendar year's production), and the information is then collated and made available on the Crown Minerals website (R. Neale, Crown Minerals, personal communication, 18 June 2010).

Crown Minerals collects the data for government policy and planning purposes and to fulfil statutory requirements (including but not limited to the Crown Minerals Act 1991). The Crown Minerals Act does not deal with environmental considerations. All environmental regulatory responsibility is assigned to the Resource Management Act 1991. Other legislation which is informed by data on New Zealand's minerals includes: Crown Minerals (Minerals and Coal) Regulations 2007; Crown Minerals (Minerals fees) Regulations 2006; the Maritime Transport Act; Marine Oil Response Strategies, and New Marine Pollution Controls.

2.6 Additional sources

The Institute's 11 working papers, prepared as background papers to Report 10, *The State of New Zealand's Resources*, are selective in their use of specific information and data from within a broader pool of information. The boundaries set for these working papers were tightly focused on openly accessible online data available as at February 2009, the original time of data collection for the Institute's accompanying datasets. For further reading and comparisons which fall outside of our collection strategies we suggest the Parliamentary Library for information on mineral production in New Zealand. Mining operators were required to make statutory declarations from New Zealand's earliest mining days, these and old geological surveys, along with editions of the New Zealand Year Book which hold information on the monetary value of mineral production prior to 1989, can be found at the Parliamentary Library.

3. Data Exploration

New Zealand's mineral industry plays a large role in the economic growth of New Zealand, and it is intrinsic to our current standard of living and our daily lives. Minerals are used in the production and distribution of things people take for granted, such as food, shelter, energy and water (NZMIA, n.d.). Minerals also contribute to sectors of the economy such as construction (aggregates and limestone for cement), transport (road aggregates), primary industry (ironsand), agriculture (fertiliser) and manufacturing (industrial minerals) (MED, 2009a).

The Minerals Dataset looks at mineral production and production value, not mineral stock or stock value. It would be interesting to consider the relative values of these indicators in order to explore the rate at which we are exploiting our mineral resources.

Statistics New Zealand states:

An accurate assessment of the management of the resource requires an analysis of physical and monetary stock (and flow) data over a long period (Statistics New Zealand, n.d.).

There are inherent uncertainties in collecting complete data on mineral stocks. No model to date has been capable of accurately measuring mineral stocks in their entirety. Currently, the sole indicator relied upon is the annual production quantities of minerals.

According to our dataset, the production value of minerals was over NZ\$899 million in 2007 and around \$1.17 billion dollars in 2008. Statistics New Zealand states that, in 2007, mining and quarrying directly contributed \$890 million to Gross Domestic Product (GDP), which is equivalent to 0.53% of total GDP (Statistics New Zealand, 2009: Table 2.1). It should be noted that this includes coal mining, which is not a part of the Institute's Minerals Dataset (it is however presented in the Institute's Energy Dataset), but does not include any secondary industries, such as manufacturing, derived from this mineral production. Other fossil fuels such as oil, gas and gas condensate are also important minerals produced within New Zealand, but again these are included within the Energy Dataset (SFI, 2010).

The minerals dataset is divided into two categories: (i) metals, and (ii) non-metals, as illustrated in Table 2, below.

3. Data Exploration

Table 2 Minerals Dataset Summary Table

Source: SFI, 2010b

Dataset Category	Data Custodian	Data Presented		Dates and Measures	Data Reporting Frequency
Production of metals	Crown Minerals	Gold	Magnetite (ironsand)	1970–2008 (Tonnes)	Annual
		Silver		1989–2008 (NZ\$)	
Production of non-metals	Crown Minerals	Amorphous silica	Other	1970–2008 (Tonnes) 1989–2008 (NZ\$)	Annual
		Bentonite	Perlite		
		Building and dimension stone	Pounamu		
		Clay for brick, tiles	Pumice		
		Clay for pottery and ceramics	Recycled material		
		Total clay	Rock for reclamation & protection		
		Coal	Rock, sand and gravel for building		
		Decorative pebbles including scoria	Rock, sand and gravel for roading		
		Diatomite	Rock, sand, gravel & clay for fill		
		Dolomite for agriculture	Total rock		
		Dolomite for industry	Sand for industry		
		Total dolomite	Serpentine		
		Limestone and marl for cement	Silica sand		
		Limestone for agriculture	Talc		
		Limestone for industry & roading	Zeolite		
Total limestone					

Metal production data

The metals category provides information on the quantity of each metal produced per year (by tonne) dating back to 1970. The total annual value of production of each metal (\$NZ) is available from 1989. Data is presented up to 2008, and was retrieved from the Crown Minerals database.

The metals category covers gold, silver and magnetite (ironsand), since these are the only metals currently utilised at economically significant rates and therefore reported on (Statistics New Zealand, 2000: 6). However, physical stocks of other metallic minerals do exist, and they may become economically significant in the future (ibid.). In its stock account Statistics New Zealand (2000: 11) briefly discusses aluminium, antimony, chromium, copper, lead and zinc, manganese, mercury, molybdenum, platinum group metals and tungsten (also see Nathan, 2009).

An excerpt from the metals category is provided in Figure 2 below to give an indication of the content and layout of the dataset. Note that data from 1972 to 2006 is excluded below for representation purposes.

Figure 2 Excerpt from the Metal Production Dataset

Source: SFI, 2010b

Indicator	Attribute	1970	1971		2007	2008	Data source table #	
2.1 Production of metals	gold	t ¹²¹	0.35	0.29		10.76	16.27	2a 2b
		\$NZ	..	..		329,451,725.94	626,027,733.14	2b 2c
	silver	t	0.51	2.07		10.57	31.02	2a 2b
		\$NZ	..	..		6,164,564.36	18,963,822.11	2b 2c
	magnetite (ironsand)	t	143,435.00	575,881.00		1,723,726.00	2,020,227.00	2a 2b
		\$NZ	..	..		..	..	2b 2c

Non-metal production data

A number of minerals fall into the non-metals category, as noted in Table 2 above. The Institute's Mineral Dataset provides information on the quantity of each non-metal produced per year (by tonne) dating back to 1970, and the total annual value of production (\$NZ) from 1989. Data is presented up to 2008. This data was retrieved from the Crown Minerals database.

In the years following 1989, production values are provided for some but not all non-metal minerals in the dataset. Statistics New Zealand states that market values are not always readily available for minerals (Statistics New Zealand, 2000: 7). It is possible to produce relevant estimates of Net Present Value (NPV) (ibid.), but this information is not available in the Crown Minerals dataset.

An excerpt from the non-metals category is shown in Figure 3, to give an indication of the content and layout of the dataset. Note that data from 1972 to 2006 was excluded below for representation purposes.

Figure 3 Excerpt from the Non-metal Production Dataset

Source: SFI, 2010b

Indicator	Attribute	1970	1971		2007	2008	Data source table #	
2.2 Production of non metals	limestone and marl for cement	t	1,523,437.50	1,535,795.68		10,248.00	2,018,194.00	2a 2b
		\$NZ	..	..		..	..	2b 2c
	limestone for agriculture	t	1,158,625.83	1,281,363.29		2,180,294.00	1,918,071.00	2a 2b
		\$NZ	..	..		39,122,983.40	34,458,747.63	2b 2c
	limestone for industry & roading	t	124,095.92	115,747.06		2,902,687.00	874,460.00	2a 2b
		\$NZ	..	..		28,357,613.86	32,989,009.12	2b 2c

4. Data Evaluation

In this section we evaluate the data presented in the Minerals Dataset based on the criteria set in Table 1.

4.1 Comprehensive Time Series

No monetary value reported for mineral production prior to 1989

The minerals dataset covers the years from 1970 until 2008, however data is not consistently available throughout these years and a number of data points are unknown. The most conspicuous absence is the monetary value of mineral production prior to 1989. Statistics New Zealand states that market values are not always readily available for minerals, and while it is possible, as we noted earlier, to produce relevant estimates of Net Present Value (NPV), not all the necessary information required to do so is available in the Crown Minerals dataset (Statistics New Zealand, 2000: 7). This lack of reported data could be due to the number of management changes surrounding New Zealand's mineral estate that occurred between 1970 and 2000. Monetary values prior to 1989, although not publicly available online, are accessible through the Parliamentary Library and more specifically the New Zealand Year Book.

No survey of quarry production undertaken in 1997

No survey of quarry production was conducted in the 1997 calendar year; it is not clear from the publically available information why no survey was conducted for this year. The *Mining Production Statistics* note that in some years, production quantities for particular commodities have not been located from source documents. This inconsistency may also be due to changes in reporting practices from financial years (March to June) to reporting by calendar years, which may have been due to institutional changes. Of note, the New Zealand Government's fiscal and financial reporting year begins on July 1 and concludes on June 30 of the following year. The company and personal financial year begins on April 1 and finishes on March 31 and applies to company and personal income tax. Other gaps are the result of changes in mining activity, for example the suspension or commencement of the commercial extraction of a mineral commodity. Since Crown Minerals (MED) began collecting and quantifying data in 2000, mineral representation has been consistent from that date onwards.

Trends between 1970 and 2008 can be established

Despite the gaps in some fields, the data does provide an indication of trends in mineral production and commodity values over this period, as well as enabling any spikes and drops to be clearly identified. Year on year trends and break points can be generated and are the best use for gaining knowledge from the data and it is not uncommon for industry to use records as a baseline.

Consistency of indicators over time

Taking into account the limitations noted above, data and indicators across the minerals dataset are consistent and therefore relatively comparable over time. Many of the minerals for which reporting commenced in 1970, most likely in response to the growth of the industry,

have been measured using a consistent approach. Crown Minerals usually review and manipulate data to ensure year on year consistencies. Inconsistencies that are common within reported data include: data is sometimes reported in financial years (March to June) and other times by calendar years; companies collection methods vary greatly; and variations of units i.e. some companies' measure production levels in in weight for shipping purposes while others measure in volume.

The main indicators and measures contained in the minerals dataset are suitable for monitoring the future development of trends in mineral production, provided that the availability of information and data to effectively and sustainably manage mineral production in New Zealand continues.

4.2 Quality Data

Maintenance of thorough records by Crown Minerals

The maintenance of thorough records on the production of minerals in New Zealand is necessary for government, industry and those concerned with sustainable mining practices. The Crown Minerals database, from which the Institute's dataset is sourced, is intended to provide general information on mineral production in New Zealand to the public, and there is an underlying assumption that the information within it is an accurate representation of mineral production in New Zealand. Crown Minerals states that 'every effort has been taken to ensure that the information set out is accurate', but warns website users that the information provided for mineral commodities is based on industry-wide surveys, and that there may be variations in yearly production due to information not being supplied during the survey period (MED, 2009b). Institutional changes, legislation changes and changes in recording periods (i.e. from financial to calendar year returns) also affect the comprehensiveness and maintenance of thorough records held by Crown Minerals.

Comprehensive coverage of metal and non-metal minerals of commercial value

The scope of indicators assessed within the minerals dataset allows for comprehensive reporting on the status of metal and non-metal minerals of commercial value produced in New Zealand. The Institute has adopted 26 primary categories of minerals from the Crown Minerals online dataset for which the production quantity and value statistics were available. The scope of data presented, categories of data, and indicators are shown in Table 2. The Institute chose these categories and measures as they were the most comparable over time.

Additional breakdown of industrial production by commodity and region available

From 2000, the Crown Minerals spreadsheets include a breakdown of industrial production by commodity and region. The Institute's dataset has a national focus, and as such did not provide a geographical breakdown of mineral production by regional location.

Reporting on additional measures to make the dataset more comprehensive

From 2000 the information made available on the Crown Minerals website extends beyond a national summary of production quantities and trade values, to include a breakdown of production at individual mining sites and across the regions. Whilst this is a positive development, the Institute believes there are other interesting aspects surrounding mining

4. Data Evaluation

activity in New Zealand that could be included in the datasets. For example, the area of each quarry, export quantities, the number of permits granted per year, the cost effectiveness of the overall activity and the private interests involved. The Institute recognises that the current Crown Minerals monitoring system does assess and present some of this information in the annual reports, however adding it to the Crown Minerals datasets would make it more comprehensive.

Internationally comparable reporting format

Data on mineral production in New Zealand, indicators, and measures are generated in an internationally comparable format, increasing both its relevance and its ability to be interpreted meaningfully. Consistent and comparable reporting of data on mineral production enables the information to be included within global mineral statistics reports. One such report is the annual publication of *World Mineral Production* which contains production statistics, by country, for the majority of economically significant mineral commodities (BGS, 2010). This consistency in the reporting of data on mineral production allows comparisons to be made with other countries which produce similar metal and non-metal minerals.

Sampling methodologies not documented

Sampling methodologies were not documented in the Crown Minerals publications from which the Institute's data was sourced. Sampling bias is inherent in the data collection process due to the large range of private companies and staff across the country that collect production data. However, data method standards and guidelines are in place, both within companies and set by government to ensure sampling bias is limited as much as possible.

4.3 Appropriate Sources

Data available from authoritative sources

The Institute's Minerals Dataset contains data sourced from New Zealand's Crown Minerals group, whose role is to manage the 'Government's oil, gas, minerals and coal resources, known as the Crown Mineral Estate, and to advise on policy, operational regulation and promote investment in the mineral estate' (Crown Minerals, 2010b). The Crown has the widest view of, and access to, obtaining mineral production data, due to the commercial sensitivity of the information.

Data on mineral production is collected by Crown Minerals for government policy and planning purposes and to fulfil statutory requirements, namely the regulating of royalties and royalty payments, and therefore it is in the Crown's interest for the information to be of a high standard of accuracy. This data is collected by Crown Minerals through a request to mining permit holders to submit an Annual Return of Industrial Rocks and Minerals for statistical purposes. As noted in Section 2, this return is not mandatory, and as such the possibility of a quantity of mineral production failing to be recorded must be acknowledged. Private companies have inherent differences in technical expertise, resources and needs; however standards and guidelines to enable consistency in reporting are set to counteract agency difference in collection methods and abilities.

Data is compiled from statutory annual returns from companies and is not representative as total complete production. Data can be verified through a royalty return audit but with private companies that are not required to lodge a royalty return data is taken on good faith. Despite this, there remains some question about the reliability of data submitted voluntarily by private companies with varying needs and resources.

No information in the *Mining Production Statistics* provided on where or by whom minerals were produced

The Crown Minerals database does not provide information on where, or by whom, minerals were produced. Information on the ownership, type and location of mining leases is not provided, nor is information on whether minerals are destined for the local or export market, and in what proportions. Compilation of information on a company's mineral activities can be highly commercially sensitive. New Zealand stock exchange's (NZX) public company rules interface declare that if this information is provided to Crown Minerals it must also be declared to the stock exchange (NZX Ltd, section 10.10). Resultantly, industry competition can gain competitive information. This becomes further complicated as many of companies operating in New Zealand's minerals industry are listed internationally, most commonly on the Australian Securities Exchange (ASX), the NASDAQ, and Canada's Toronto Stock Exchange (TSX). Therefore a company by company break down of information is not given. This data would be useful for those interested in attempting to assess mining with a regional component of analysis, or in examining the economic benefits of mining, such as public vs. private ownership of profits. Additional sources such as the Crown Minerals Online Exploration Database (Crown Minerals, 2010c) must be consulted and analysed for further information on these topics.

4.4 Public Availability

All data publicly available and well documented

It is the aim of this project to assess publicly available data, i.e. data that is able to be accessed by parties independent of those who collect or present it. The Crown Minerals datasets fit these criteria as they are freely available to the public via the agency's website.

The *Mining Production Statistics* are easily accessible following internal links on the Crown Minerals website. Data recorded prior to 2000 has been documented in one spreadsheet, and the same structure has been used for subsequent years. The spreadsheets provided by Crown Minerals all have a clear format, are well-labelled and indicated the original source of the information where this was not Crown Minerals. In addition, information on production trends is found on the Crown Minerals website and within their annual reports. For example, the 2008/09 year delivered the highest gold production from New Zealand mines since 1970 (Crown Minerals, 2009:15).

5. Summary Evaluation of the Dataset

The Institute chose the *Mining Production Statistics Crown Minerals* dataset to inform its upcoming Report 10 and an NSDS as it was deemed to be comprehensive and reliable. Whilst the dataset has many limitations, it provided the Institute with the necessary information to establish a baseline of the minerals production industry in New Zealand. Table 3 below summarises the Institute's evaluation of the dataset.

Table 3 Summary of Minerals Data Evaluation

	Strengths	Weaknesses
Comprehensive time series	<ul style="list-style-type: none"> ▪ Timeframe for measured variables from 1970 ▪ Trends between 1970 to 2008 can be established ▪ Indicators consistent over time ▪ Consistent data on production dates back to 1970 ▪ Consistent data on production value dates back to 1989 	<ul style="list-style-type: none"> ▪ Lack of historical records prior to 1970 ▪ No monetary value reported for mineral production prior to 1989 ▪ No survey of quarry production undertaken in 1997 ▪ Changes to legislation and institutions ▪ Basis is Crown owned minerals – some totally owned by the Crown and others only partially i.e. lime and coal
Quality Data	<ul style="list-style-type: none"> ▪ Maintenance of thorough records by Crown Minerals ▪ Comprehensive reporting on metal and non-metal minerals of commercial value ▪ Additional breakdown of industrial production by commodity and region available ▪ Internationally comparable reporting format 	<ul style="list-style-type: none"> ▪ Sampling methodologies not documented ▪ Reporting on additional measures to make the dataset more comprehensive ▪ Reporting requirements have changed over time due to both legislative and institutional changes
Appropriate Sources	<ul style="list-style-type: none"> ▪ Data available from authoritative sources ▪ Royalty cross check for Crown owned minerals 	<ul style="list-style-type: none"> ▪ Data available from authoritative sources ▪ No information in the Mining Production Statistics provided on where or by whom minerals were produced ▪ A breakdown of whether minerals are destined for the local or export market, and in what proportions is not provided ▪ Information on the ownership, type and location of mining leases is not provided
Publicly available	<ul style="list-style-type: none"> ▪ All data publicly available and well documented 	

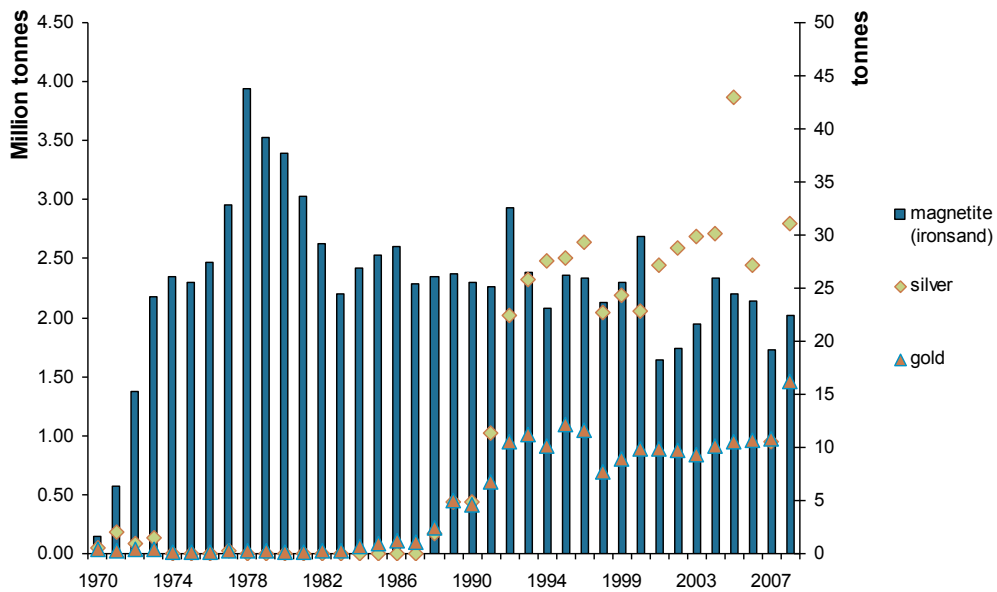
The Institute acknowledges that other sources will need to be consulted in order to gain a complete and comprehensive overview of the minerals industry in New Zealand. The Institute's dataset does not answer the questions outlined in Section 1.3, but can provide background statistics to support reporting analysis and argumentation.

Currently, mineral production and extraction is monitored primarily for the calculation of payment of royalty returns to the Crown.. However, it is vital that production is also monitored with a view to maintain and protect both our mineral resources and the

conservation estate. It is hoped that a high standard of regular data_collection and monitoring, using consistent measures, is maintained and reviewed frequently with these aims in mind.

An example of how the data may be used is presented in figure 4 below.

Figure 4 Gold, Silver and Magnetite Production Since 1970
Adapted from SFI, 2010b



References

- British Geological Survey (BGS) (2010). Natural Environment Research Council. *World Mineral Production 2004-2008*. Keyworth, Nottingham. Retrieved November 15, 2010 from <http://www.bgs.ac.uk/mineralsuk/statistics/worldStatistics.html>
- Crown Minerals (2009). *Annual report 2008-2009*. Retrieved June 10, 2010 from <http://www.crownminerals.govt.nz/cms/pdf-library/about/Annual%20Report%202008-2009.pdf>
- Crown Minerals (2010a). *1970-1999 Mining production statistics*. Retrieved July 28, 2010 from <http://www.crownminerals.govt.nz/cms/minerals/facts-and-figures>
- Crown Minerals (2010b). *Crown Minerals about: Business units*. Retrieved July 28, 2010 from <http://www.crownminerals.govt.nz/cms/about>
- Crown Minerals (2010c). *Crown Minerals Online Exploration Database*. Retrieved November 15, 2010 from <https://data.crownminerals.govt.nz/GOLD/system/mainframe.asp>
- Crown Minerals Act 1991. Retrieved July 28, 2010 from http://www.legislation.govt.nz/act/public/1991/0070/latest/DLM242536.html?search=ts_act_crown+minerals_resel&p=1&sr=1
- Crown Minerals (Minerals and Coal) Regulations 2007. Retrieved July 28, 2010 from <http://legislation.govt.nz/regulation/public/2007/0399/latest/DLM1120013.html>
- Institute of Geological and Nuclear Sciences (GNS Science) (n.d.). *GERM: The geological resource map of New Zealand*. Retrieved July 30, 2010 from <http://data.gns.cri.nz/minerals/germ/index.jsp>
- Kenex (2006). *Kenex*. Retrieved July 30, 2010 from <http://kenex.co.nz/default/default.asp>
- Ministry of Economic Development (MED) (2009a). *Minerals: Overview*. Retrieved June 10, 2010 from <http://www.crownminerals.govt.nz/cms/minerals/overview>
- Ministry of Economic Development (MED) (2009b). *Minerals: Facts and figures*. Retrieved June 10, 2010 from <http://www.crownminerals.govt.nz/cms/minerals/facts-and-figures>
- Nathan, S. (2009). Mining and underground resources: Metals known but not mined. *Te Ara: The encyclopedia of New Zealand*. Retrieved August 3, 2010 from <http://www.teara.govt.nz/en/mining-and-underground-resources/3>
- New Zealand Mining and Exploration Association (NZMIA) (n.d.). *New Zealand Minerals Industry Association: National minerals strategy*. Retrieved June 21, 2010 from http://www.minerals.co.nz/html/main_topics/minerals_industry_in_nz/minerals_strategy.html

- NZX Limited (2010). *NZSX/NZDX Listing Rules*. Retrieved February 28, 2011 from http://static.stuff.co.nz/files/NZSX_NZDX_Listing_Rules.pdf
- Statistics New Zealand (2000). *Mineral monetary and physical stock account 1994-2000*. Retrieved June 17, 2010 from <http://www.stats.govt.nz/publications/nationalaccounts/minerals/interpretation-of-the-mineral-stock-account.aspx>
- Statistics New Zealand (2006). *New Zealand Official Yearbook 2006*. Auckland: David Bateman.
- Statistics New Zealand (2009). *National accounts: Year ended March 2009 – GDP breakdown – Table 2.1*. Retrieved August 3, 2010 from http://www.stats.govt.nz/browse_for_stats/economic_indicators/nationalaccounts/nationalaccounts_hotpyemar09.aspx
- Statistics New Zealand (n.d.). *Interpretation of the mineral stock account*. Retrieved August 9, 2010 from http://www.stats.govt.nz/browse_for_stats/environment/natural_resources/minerals/interpretation-of-the-mineral-stock-account.aspx
- Sustainable Future Institute (SFI) (2007). *A National Sustainable Development Strategy: How New Zealand measures up against international commitments*. Report 1. Retrieved March 10, 2010 from <http://www.sustainablefuture.info>
- Sustainable Future Institute (SFI) (2009). *Project 2058 Methodology: Version 3*. Retrieved March 10, 2010 from <http://www.sustainablefuture.info>
- Sustainable Future Institute (SFI) (2010a). *Designing a framework to monitor New Zealand's resources*. Report 10a. Retrieved May 12, 2010 from <http://www.sustainablefuture.info>
- Sustainable Future Institute (SFI) (2010b). *Dataset 2: Minerals*. Retrieved July 1, 2010 from <http://www.sustainablefuture.info>
- Sustainable Future Institute (SFI) (in press). *The state of New Zealand's resources*. Report 10.