SUSTAINABLE FUTURES 30|50
WHANGAREI DISTRICT

Minerals and Aggregates Background Report

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Executive Summary

The Whangarei District has some history of high value mineral extraction but the majority of its recent activity has been in bulk commodity aggregates, limestone and sand extraction. Some of this quarrying activity supports the cement manufacturing works located at Portland which exports to markets nation-wide.

Other quarrying activity is significant in terms of providing the material for construction of our infrastructure, such as roads and buildings to support growth. As the population of the Whangarei District and the Northland region continues to grow so to will the demand for these resources. We may also see demand for resources available in the Whangarei District increase as the Auckland region continues its northwards expansion and pressure is put on its resource stocks.

Protecting aggregate and mineral resources from being sterilised by conflicting activities, whether they are being currently extracted or have the potential to support the District's future economic well-being, is the key consideration when assessing a preferred future development path for the District through the Sustainable Futures 30/50 project.

Although we cannot say with any certainty where or which resources will be required in 50 or even 30 years time, a more consolidated growth pattern, such as that proposed in Future Three, will support the protection of our mineral and aggregate resources as many will be effected by a continued pattern of sporadic subdivision, particularly in rural areas and along main transport corridors.

A more controlled and regulated planning regime will seek to avoid reverse sensitivity issues and land use conflicts thereby protecting resources and allowing for their future expansion to support our sustainable growth path. Local resources can then be used and we avoid having to import additional resources into our District to support our future population needs.

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1. Introduction

Effective and efficient access to aggregate resources could have a significant impact on the future prosperity of the Whangarei District. Aggregates are used in the construction of the infrastructure, such as roads and buildings, which supports growth. The availability of the aggregate resource directly affects the cost of providing this infrastructure. Other minerals have the potential to bring significant economic prosperity to the District, however their identification and extraction requires detailed exploration work to be carried out and markets to be sought.

Aggregates and minerals are finite and location-fixed resources. The resources cannot be moved and therefore identifying and protecting future resources is important. Any constraints on access, such as tenure of the land and conflicting landuses directly affect the ability for it to be extracted and used in the future.

Managing the environmental effects of extraction is a matter considered in district and regional plans prepared under the Resource Management Act 1991. Such effects can include water quality, air discharges, noise from operations and associated traffic, ecological impacts and reverse sensitivity issues. Whilst these issues might appear complex, many can be avoided and managed by spatial planning which addresses the future needs for minerals and aggregates directly for use within the District and the economic prosperity that can be gained by exports to markets beyond.

The information that is currently available on Whangarei District's mineral and aggregate resources is largely at a regional scale. It is possible however to consider this information in the context of the three scenario futures being assessed through the Sustainable Futures 30/50 project and draw conclusions on which future will best manage our mineral and aggregate resources.

2. Defining the resources and their use

2.1 Minerals

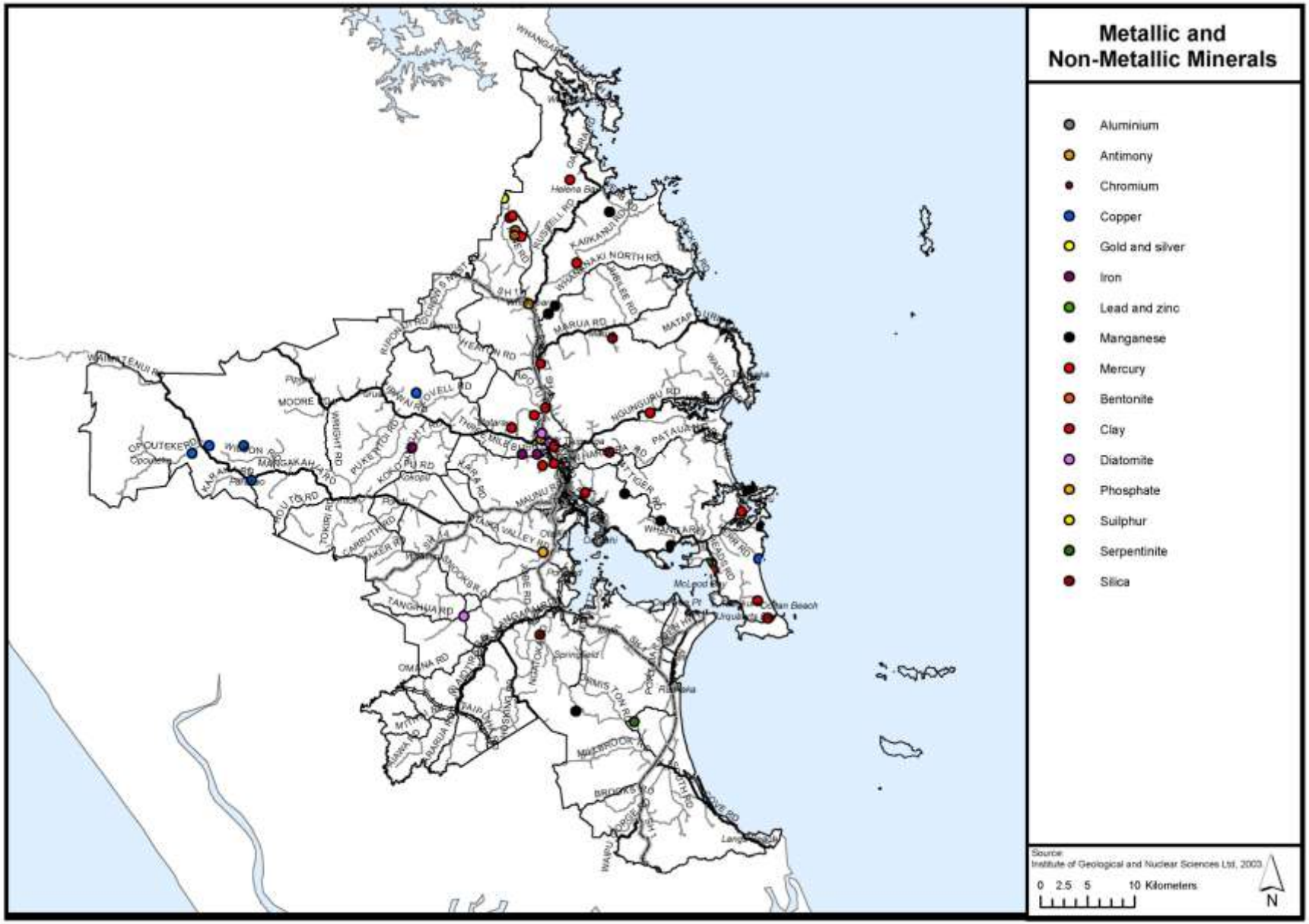
For the purposes for this report, aggregates and other bulk commodities will be assessed separately from other mineral resources. This reflects the assessment that Christie & Barker made in their May 2007 Report for GNS Science "Mineral resource assessment of the Northland Region, New Zealand". Table 1 provides a list of minerals and aggregates that were assessed by Christie & Barker.

Table 1: Minerals included in GNS Science assessment for the Northland Region, May 2007

Bulk Commodities	Rock Aggregate
	Sand
	Building and Dimension Stone
	Limestone
	Coal
	Peat
Metallic Mineral Deposits	Aluminium
	Antimony
	Chromium
	Copper
	Gold-Silver
	Iron
	Manganese
	Mercury
	Nickel
	Zinc
	Lead
Non-metallic Mineral and Rocks	Asbestos
	Barite
	Clays
	Diatomite
	Feldspar
	Kauri Gum
	Phosphate
	Serpentine
	Silica Sand
	Sulphur
	Zeolite

Minerals include those that are metallic (metals) and non-metallic (industrial). Figure 1 shows the location of known mineral occurrences throughout the Whangarei District. As opposed to aggregates, whose markets are generally local, minerals generally have a high value and there is potential for export out of the region (and New Zealand). Metals, in most cases, have large international markets so if any quantity can be produced in the Whangarei District it could be readily sold. Industrial minerals may require the identification of markets and therefore production quantity may be limited.

Figure 1: Map of known metallic and non-metallic mineral occurrences in the Whangarei District



Metallic minerals include hot spring mercury (cinnabar). Cinnabar was discovered at Puhipuhi in 1892 and mined between 1917 and 1945 producing 31.1 tonnes of mercury. Much of this mining was subsidised to meet wartime strategic requirements, and was probably uneconomic (Williams, 1974, cited in Christie and Barker, 2007). Later exploration indicated that the deposit was sub-economic. Since the 1980s exploration of the Puhipuhi field has targeted gold mineralisation. This has to date only involved reconnaissance drilling by BHP Gold (BHP, 1988 cited in Christie and Barker, 2007). There has been no mining of gold from Northland, although a large number of hot-spring Au-Ag (Gold-Silver) prospects are known.

Copper deposits are recorded at Pakotai, Parakao and Purua. The Parakao deposit was worked by the Copper Queen mine in 1962-63 and produced 1926 tonnes of copper ore (Rowe, 1963 cited in Christie and Barker, 2007). Bog Iron has been mined intermittently in the past from a deposit near Kamo. It produced 26,156 tonnes of ore up until 1961. Manganese deposits are present in a belt of Waipapa Group rocks which extend from Whangaroa Bay in the Far North District, to Whangarei Harbour. The most significant manganese deposits in the Northland region were worked between 1878 and 1911 and this included extraction at Parua Bay of over 2000 tonnes of ore. Several other smaller deposits are present and some were worked in the 1800s. These included 50 tonnes extracted at Owai Stream, Helena Bay and small mines at Otonga, near Hikurangi and Ohaewai, near Parua Bay. Bell (1976, cited in GNS Science, 2007) reported that the deposit at Hukerenui contains about 150,000 tonnes of mineralised rock.

Polymetallic vein zinc and lead deposits are present at Reef Bay, near Kauri mountain. There has been no past production of zinc and lead in Northland and further detailed geological mapping would be required to accurately assess its future potential (Christie and Barker, 2007).

Industrial minerals include clays of which there are five geologically distinct genetic types found in Northland. Deposits of rhyolite-hosted halloysite clay and volcanic-related kaolinite clay have been recorded at Ocean Beach and McLeod's Bay. Kaolin clay was extracted at Kauri and used for the manufacture of refractory bricks by Kamo Green Refractories. Clay from coal measures at Kamo was also used by Kamo Green Refractories to produce industrial refractory products such as crucibles and fire brick (MacFarlan & Barry, 1991, cited in Christie and Barker, 2007). Potters clay or potters earth has been recorded at Puhipuhi. Sedimentary kaolinite clay has previously been mined at Whau Valley and Opuawhanga. A known Bentonite clay deposit is located at Puhipuhi but the geological information suggests that there may be undiscovered deposits across parts of the district. Diatomite has been extracted from two locations in the District in the past. Eight hundred tonnes were extracted between 1941 and 1975 near Ruatangata railway station. Two deposits at Springs Flat, Kamo produced 1000 tonnes between 1938 and 1952 (Petty, 1978 cited in Christie and Barker, 2007).

Feldspar is found in dune, beach and marine sands of Quaternary age. Sands between Whangarei Heads and Warkworth contain feldspar, with sand near Ruakaka containing 65-70% feldspar. The Northland east coast feldspar sand deposits contain large resources of glass grade alumina. Processing would be required to remove peat and heavy minerals but there is sufficient tonnage present to establish a major plant. Inferred resources of 240 million tonnes have been estimated at Ruakaka (Christie and Barker, 2007). Feldspar is a common raw material in the production of ceramics and geopolymers (http://en.wikipedia.org/wiki/Feldspar).

Known diapiric serpentinite (serpentine) outcrops are located at McLeod's Bay and Rauranui. Recent exploration has occurred at McKenzies's, Waipu including a ground magnetic survey and trenching. This indicated that additional deposits are present but covered by at least 5 metres of overburden (Christie and Barker, 2007). Zeolites are present in stone which is extracted at Paradise Quarry, Portland. The stone is marketed as "Paradise Stone" and is used in landscaping and building projects throughout the North Island and Pacific Islands (http://www.paradisequarry.com/).

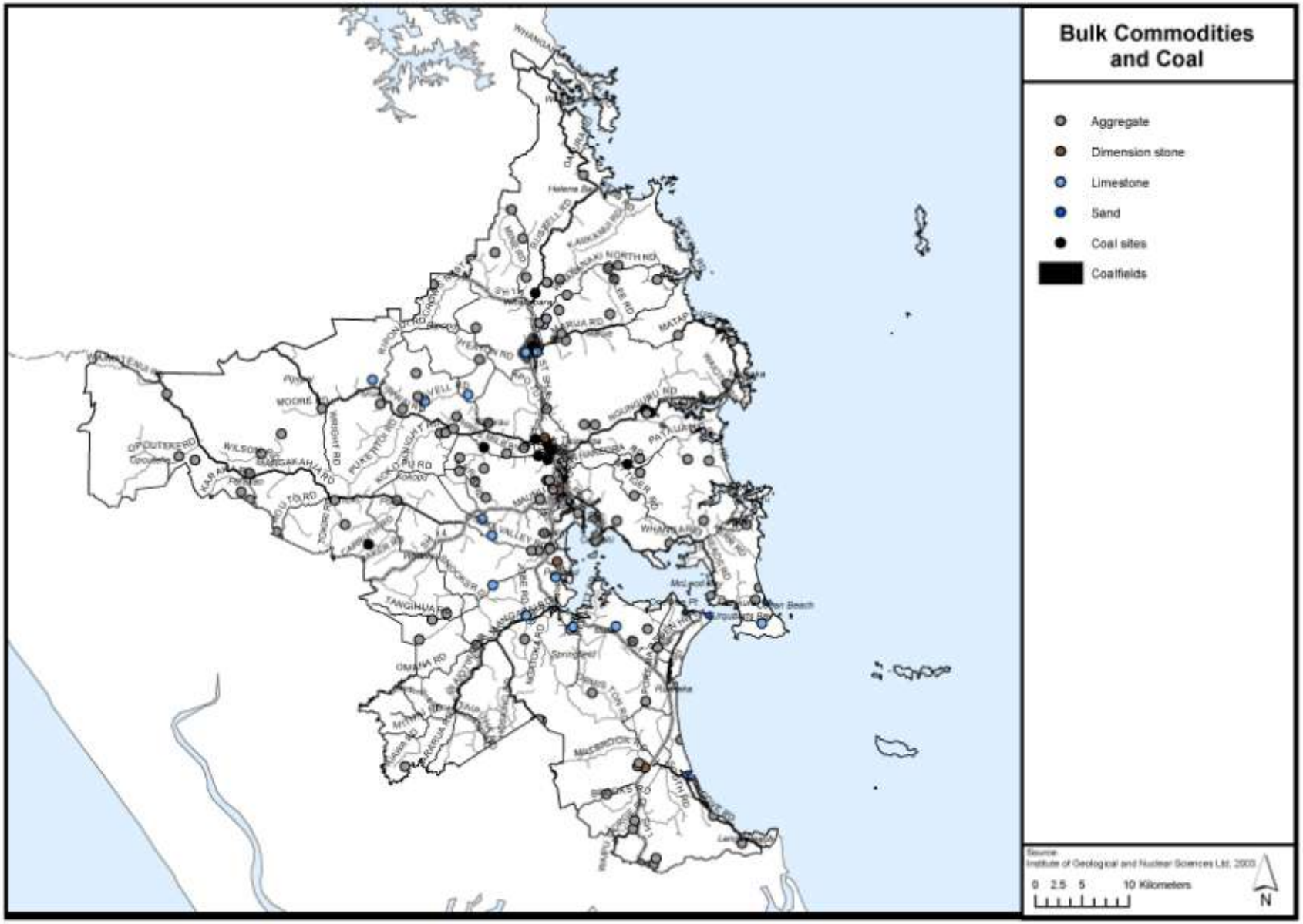
2.2 Aggregates and coal

Figure 2 shows the location of aggregate and coal resources across the Whangarei District. The map is a combination of working and closed quarry locations and coal fields. Aggregate production is a significant industry within the Whangarei District. Almost all of the mineral production within the Whangarei District (with the exception of decorative stone) is aggregate, sand or limestone primarily used for building or infrastructure. Table 2 shows the total tonnes and total value of mineral production for the Whangarei District and also shows how this compares with the Northland District as a whole and our neighbouring Districts.

The Otaika quarry is one of only two quarries within Northland that produce more than 500,000 tonnes of rock aggregate per year. Two quarries at Loop Road, Otaika and Mountfield, Waipu produce between 100,000 and 500,000 tonnes of rock aggregate annually. There are a large number of small (<50,000 t per year) aggregate quarries, worked intermittently and spread across the Whangarei District to utilise local deposits and minimise transport costs. The Otaika Quarry, operated by Winstone Aggregates, is the only quarry in the Whangarei District currently producing sealing chip, concrete aggregate and other high quality products. There are another four quarries in the Northland Region producing high quality aggregates. The location of these quarries will generally be dictated by market requirements, and provides a distribution network that minimises trucking distances in supplying the major sealed roads and other markets.

In the Whangarei District, feldspathic sand deposits are present both onshore and offshore from Ocean Beach and south to the beyond the district boundary. Sand for construction has been in the past extracted from a sand bar deposit at Waipu River mouth, and nearshore deposits at Ocean Beach and in Bream Bay have been dredged in the past (Hilton, 1989, cited in Christie and Barker, 2007). Semenoff Sand Supplies Ltd onshore operation at Waipu supplies sand to the Whangarei market (Christie and Barker, 2007).

Figure 2: Aggregate and coal resource locations within the Whangarei District



Small quantities of building and dimension stone are currently quarried in the Whangarei District including scoria at Kamo. Production of building and dimension stone are likely to only make a very small contribution to Northland mineral production in comparison to other aggregate commodities in the future, however, they have shaped much of our District's heritage and key public buildings nation-wide. Prehistoric Maori, and later European settlers, farmed the basalt lava fields and collected the loose stones to build the now protected dry stone walls which are a feature across various parts of the District. Whangarei 'Marble', a shelly, dull yellow, cream or pink-tinted limestone (Whangarei Limestone) has been extracted commercially since the 1920s. A quarry beside Waro railway station, Hikurangi and others around Whangarei supplied ornamental polished panels for a number of buildings throughout New Zealand in the 1920s to 1950s (eg. Napier Post Office; Wellington Central Library; Dunedin Post Office) (Christie and Barker, 2007).

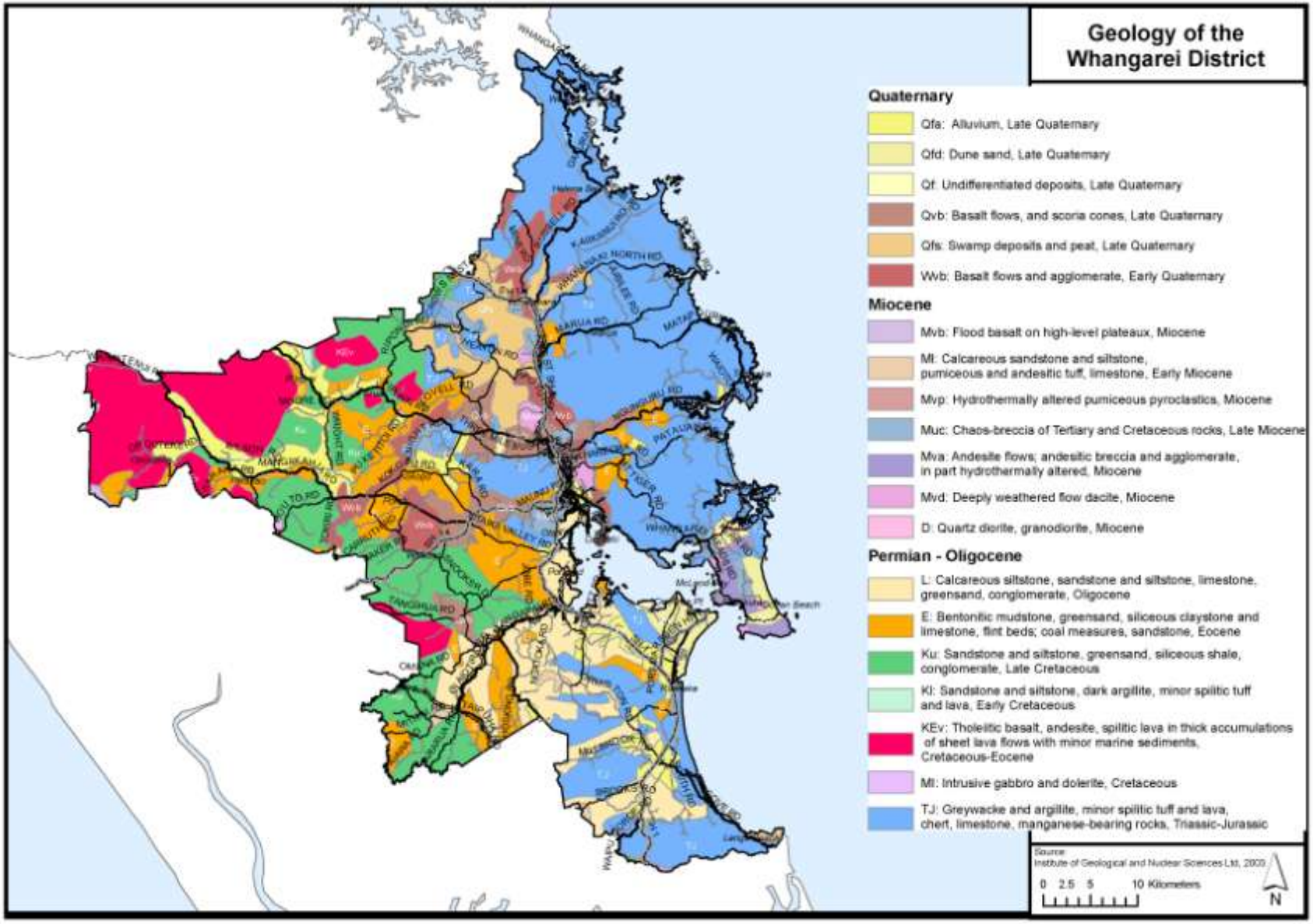
The Whangarei District produced 990,880 tonnes of limestone used for marl and cement in 2005 with an additional 33,804 tonnes produced for use in agriculture. The Whangarei District is dominated by two major and distinctive limestone units – crystalline Whangarei Limestone and argillaceous Mahurangi Limestone. Both limestones are used in the manufacture of cement at Golden Bay Cement Ltd's plant at Portland. Mahurangi Limestone is quarried at Tikorangi Hill, Portland and supplies approximately 75% of the cement kiln raw feed. Whangarei Limestone is quarried at Wilsonville, 20km north of Whangarei, and is trucked to Portland. Other smaller sites and quarries are spread across the District.

Mahurangi Limestone is also used as a road aggregate, especially in areas where other aggregate materials of better quality are scarce. Lime is used for binding unsealed roads and in stabilisation of road aggregate. Argillaceous limestone is ideal for farm tracks as it is less abrasive than most other hard rock aggregates. Lime is also used in the manufacture of agricultural fertilisers. As there are no burnt lime works in Northland all of the limestone produced and used for fertiliser is applied as crushed limestone, in some instances with other fertiliser additives.

Table 2: Northland mineral production in 2005 by district and total. All values in tonnes except for the dollar values in the last row. Source: Crown Minerals unpublished data, cited by Christie and Barker, 2007.

Mineral Commodity	Far North	Kaipara	Whangarei	Northland
Building and Dimension stone	-	-	1,200	1,200
Clay for brick, tiles etc	-	-	-	0
Clay for pottery and ceramics	15,370	-	-	15,370
Decorative pebbles including scoria	-	-	45,000	45,000
Limestone and marl for cement	-	-	990,880	990,880
Limestone for agriculture	80.540	178,339	33,804	292,683
Limestone for industry & roading	41,107	51,903	-	93,010
Rock for reclamation & protection	11,021	-	8,797	19,818
Rock, sand and gravel for building	8,703	276,020	356,939	641,662
Rock, sand and gravel for roading	533,149	652,411	590,188	1,775,748
Rock, sand, gravel & clay for fill	55,557	27,000	338,031	420,588
Sand for industry	2,204	108,000	1,942	112,146
Total tonnes	**747,651**	**1,293,673**	**2,366,781**	**4,408,105**
Total $ value	**$19,984,119**	**$13,530,085**	**$22,090,134**	**$55,604,338**

Figure 3: Geology of the Whangarei District



There are no active coal mines in the Whangarei District, however about 2.2 million tonnes were produced at the coalfields of Hikurangi, Kamo, Kiripaka and Whareora between 1865 and 1982. Nationally, large resources of coal are available in the Waikato and Southland and whilst some coal may remain in local fields unless a new local industry develops which could provide the impetus to develop a field, significant use in the future is unlikely. High sulphur content within our coalfields also make future extraction of this resource unlikely. Peat deposits occur in the Hikurangi area although no assessment has been made of their potential future value (Christie and Barker, 2007).

2.3 Available data

Christie and Barker (2007) used the GERM database to assess the location of mineral occurrences for each specific deposit type. The GERM database was mostly compiled prior to 1994, with production figures to 1993, the last year the Ministry of Energy (now Crown Minerals of Ministry of Economic Development) published annual production statistics for individual operations. The post-1993 operational and production status of many of the mining operations may have changed and some new operations may have commenced (Christie and Barker, 2007). Christie and Barker (2007) also used geological information to assess the likelihood of undiscovered deposits. The mineral resource assessment maps provided in their report are essentially a combination of the geological information and the GERM data. Figure 3 shows the geology of the Whangarei District.

Some research was carried out during the preparation of this paper to establish if changes in operations to that which was included in the GERM database were evident. A resource consent was granted in 2006 for a small quarry on Omaikao Road, near Ngunguru, not previously identified in the GERM database, although the quarry had been in operation for 20 years the scale of its activities, up to 5000m³ per annum means that it was probably missed. Consents are currently being sought for two quarries not previously identified in GERM; Ngatiti Quarry at Takahiwai proposing to extract up to 20,000m³ of aggregate per annum and Bream Bay Quarry proposing to extract up to 50,000m³ per annum. The latter was previously a farm quarry. Carrs Quarry at One Tree Point, located within a Mineral Extraction Resource Area in the District Plan, is currently seeking consent to extract 250,000m³ per annum. In the 5 year period to June 2007, extraction from the existing quarry averaged 32,000m³ per annum (Engineering Outcomes, 2008). In the 1994 GERM database, the quarry was listed as closed. Central Mountfield Quarry Ltd was granted consent in 2008 to extract up to 250,000m³ per annum at their Mountfield Road, Waipu quarry. The GERM database states that production from this quarry was 14,043 tonne in 1988.

Although this research was not a comprehensive collection of data on currently consented quarrying operations it does demonstrate that relying on the GERM database for current information could be problematic for spatial planning purposes. It is however a useful tool and starting point for information. Whilst production levels and currently operating quarry information may be dated, it does show known locations of the resource and this would be useful for future spatial planning purposes. Likewise, relying on the identified Mineral Extraction Areas in the Whangarei District Plan to cover all current and future

operations anticipated in the District would not be adequate for future spatial planning purposes but their locations are relevant.

3. Current economic value

Table 2 shows that in 2005 mineral production directly contributed $22,090,134 to the Whangarei District economy. Infometrics (2009) state that mining and quarrying directly employed 41 people and cement production employed 407 people in the year to March 2008 in the Whangarei District. Around 20% of production in Whangarei comes from manufacturing activities, with almost 10% being production from the oil refinery. Following this, wood processing is the second most important manufacturing activity (2.2%) and cement production and transport equipment manufacturing each accounting for 1.2% of GDP to March 2008. In terms of the total GDP of the Whangarei District mining is not a significant contributor, as other sectors such agriculture, forestry and fishing, and finance, property and business services dominate (Walton, 2007).

As the single largest employer in the mining and cement manufacture sector, Golden Bay Cement, who owns the Portland Cement Works and the Portland Quarry, directly employs 141 staff at the works and quarry. It is estimated that Golden Bay Cement generates another 124 jobs in supporting industries and 169 from induced effects in the Whangarei District. In monetary terms the operation adds approximately $60 million per annum in value to the District economy and $243 million to the gross output of the District (Tonkin and Taylor, 2008).

4. Planning for minerals and aggregates

4.1 Managing issues associated with extraction

There are essentially two key strands to the resource management issues associated with minerals and aggregates. Firstly, managing the effects associated with extraction and secondly, how to plan for the future of the resources.

The nature of quarrying and mineral extraction activities means that resource consents are generally required from both the regional and district councils to undertake activities. The regional council will consider applications for land use consent (associated with the earthworks), water, discharge and coastal permits. The district council will deal with the land use consents associated with the earthworks as they relate to district matters. Such issues that are likely to arise during the consenting process include, but may not be limited to, vegetation removal and ecological effects, rehabilitation, visual effects, noise effects, vibration effects, water quality, earthworks, stockpiling and overburden, and reverse sensitivity effects. The range of effects associated with quarrying and mineral extraction means that consenting can be complex. Also the environment in which the activities are proposed to occur can also present issues. For example, sand extraction in coastal areas and gravel extraction from river beds which may have high natural character

or ecological value. It is therefore important for the District Plan to avoid extraction taking place where major adverse effects will occur.

Reverse sensitivity is a particular issue for quarrying activities. Reverse sensitivity occurs when conflicting activities, particularly residential activities, locate around existing quarrying operations. Common reverse sensitivity issues relate to noise, vibration, traffic and dust effects. Individually such concerns can be managed by standards and rules imposed through consent conditions or the District Plan. Another approach is to use land use planning and controls to discourage potential conflicting activities in certain areas (Hill Young Cooper, 2009).

4.2 Future planning for the resources

Planning for the future extraction of minerals and aggregates can be done by having general policies in the District Plan to protect access to aggregate resources, identifying locations and protecting aggregate resources in the Plan and/or establishing specific zones or areas within the Plan. Protecting access to aggregate resources recognises that the economic viability of quarry operations is highly dependent on reasonable access to the resource. This is because aggregate has a low value relative to weight so the costs increase significantly the further or longer they have to be transported. Identifying access routes for aggregate and protecting these may help to avoid zoning changes that may lead to restraint on extraction (Hill Young Cooper, 2007). This may also avoid reserve sensitivity issues such as traffic and dust effects. Existing quarry sites are easily identifiable and, as is the case with the Whangarei District Plan, these can be appropriately zoned and buffers established. The Whangarei District Plan uses a Mineral Extraction Area zoning in the District Plan to provide for the operation of existing quarrying activities. The problem with this approach is that whilst it may protect existing operations and provide a buffer between active operating areas and neighbouring activities, it does not protect future aggregate resources.

Research discussed in section 2.3 of this report, identified that consents are being sought for expansion of existing quarries or establishment of new quarries that are not within Mineral Extraction Areas as shown in the District Plan. There are a number of issues that arise out of this. Firstly, gaining consents for new quarry operations could become increasingly difficult as urban development has expanded into areas where the resource is located. Secondly, the community in these areas may have no idea that such activities could be carried out in the future, as there is no signal in the District Plan or other public documents. Thirdly, the environmental effects of such activities have to be assessed on an ad hoc, case-by-case basis. The Whangarei District Plan goes someway to address the latter issue by providing an extensive list of matters to which its discretion should be restricted to should resource consent be required for mineral extraction in the Countryside Environment. The same matters would be considered as part of a Quarry Management Plan which is a requirement for activities within a Mineral Extraction Area. A Quarry Management Plan would also consider future management and rehabilitation of the site.

Planning approaches need to recognise that planning for the future of the resource extends well beyond the 10-year life of a District Plan. It is difficult to predict demand for particular mineral resources and future

improvements in technology which could make extraction of resources economically viable potentially with less impact on the surrounding environment. Therefore a range of policies and planning tools may be required to address issues associated with minerals and aggregates both sitting within the District Plan itself and as part of the future planning for urban expansion and population growth.

5. Future potential

Christie and Barker (2007) analysed the potential future production for mineral and aggregate resources in the Northland Region. The production scenario they developed showed that for the Whangarei District the annual production could increase 467% and that this could be achieved in 15 years. This would require a sufficient level of exploration to define the new resources and that, if discovered, the production could then be developed. This production scenario is a combination of expanding existing production, primarily in aggregates, limestone and sand, and new mining operations for several metallic and non-metallic minerals. In total, the production scenario is worth $125,304,811 compared with $22,090,134 in 2005. Table 3 shows how the scenario compares across the three northland districts and the region as a whole.

Walton (2007) utilised the production scenario developed by Christie and Barker (2007) to determine the potential economy-wide impacts. They identified that Whangarei District's GDP would be lifted by nearly $98 million, of which over $50 million of this would be in sectors other than mining. Christie and Barker (2007) concluded their assessment by stating:

> *"Production of aggregate and limestone is likely to increase provided the Northland economy and population continue to grow. There is potential to expand the market for aggregate by exporting to Auckland. Risks include sterilisation of aggregate resources by urban development and possible site-specific constraints on quarry development." (p.139)*

This demonstrates how demand for aggregate and limestone products is linked to wider economic and population growth either within the region or beyond. The continued urban expansion of the Auckland Region could promote demand for exporting aggregate resources available within the Whangarei District. The Puhoi to Wellsford Road of National Significance Project is an example of the large infrastructure projects which will be required to support such urban expansion (NZTA, 2010). The first stage of the project, Puhoi to Warkworth, is expected to be substantially completed in the next 10 years (http://www.nzta.govt.nz/network/rons/index.html#puhoi). Walton (2007) discusses how the demand for aggregate in Northland has correlated well in the past 5-6 years with the growth in the regional population. This accords with the simple hypothesis that an expanding population requires additional housing and infrastructural assets, which in turn creates increased demand for building materials, including aggregate. It is therefore with more certainty that we can assume that as the population of the Whangarei District and Northland Region grows, demand for aggregate and limestone will continue to increase.

The statement above by Walton (2007) includes the risk of sterilisation of aggregate resources by urban development. This will be a key consideration when assessing the three future development scenarios proposed by 30/50 Sustainable Futures.

Table 3: Mining production scenario.

	Far North	Kaipara	Whangarei	Northland
Total mining production	$201,300,215	$25,766,096	$125,304,811	$352,371,122
2005	$19,984,119	$13,530,085	$22,090,134	$55,604,339
% increase from 2005	907%	90%	467%	534%
$ increase from 2005	$181,316,096	$12,236,011	$103,214,677	$296,766,783

Source: Christie and Barker (2007)

6. Comparison of the Three Futures

As part of the 30/50 Sustainable Futures project, three alternative futures for the district over the next 30/50 years have been developed at a broad contextual level. The three futures are presented to stimulate debate as to the preferred future settlement pattern for the district over the next 50 years. The following is a brief analysis of the most plausible impacts on the potential for future aggregate and mineral resource extraction and impacts on existing extraction activities. This assessment is at a broad level and uses the GERM database which, as has been discussed earlier in this report, does not show recently consented or proposed quarry operations.

Future One represents a lightly regulated, market led approach to development and, in general, reflects land development in the district over the past 10-20 years. It is presented as a continuation of this lightly regulated, largely market driven approach to land development and can be seen as a baseline against which to evaluate the other two options, in addition to being an alternative development path in its own right.

Futures Two is an intermediate position between Futures One and Three. It represents a moderately controlled, less consolidated development path based upon a three tier settlement pattern. These tiers consist of: twin cities at Whangarei and Marsden Point/Ruakaka competing with each other for higher level service provision; urban and coastal settlements with some associated urban sprawl and ribbon development; and rural urban development largely at village level with some sporadic development throughout the rural area.

Future Three represents a managed, consolidated development path based upon a structured five tier settlement pattern. This hierarchical arrangement is as follows: Whangarei City as the primary district and regional urban centre with a strong, protected and enduring CBD; a satellite town at Marsden Point/Ruakaka which complements (but does not compete with) Whangarei City; five urban villages within greater Whangarei; one rural (Hikurangi) and two coastal growth nodes at Parua Bay and Waipu; and two rural villages along with eight coastal villages located along the coastline from Waipu Cove in the south to Oakura in the north.

For the purposes of this assessment metallic and non-metallic minerals will be considered separately from bulk commodities.

6.1 Future One: Lightly Regulated/Market Led Development

Under Future One - Business as Usual - urban development will be dispersed throughout the district, with concentrations in Whangarei, Marsden Point/Ruakaka, other urban, rural and coastal locations and along transport corridors. There will be a continuation of urban sprawl and sporadic development on the urban fringes; residential and commercial ribbon development along the coast; residential, commercial and industrial development along transport corridors; and scattered residential, commercial, and industrial development in the Bream Bay area.

There will also be a continuation of widely dispersed sporadic rural residential development throughout the district including both Countryside and Coastal Countryside Environments. In particular, there will be widespread rural residential development scattered throughout all rural areas; widespread rural residential sprawl and ribbon development along the coast and transport corridors.

Under Future One, metallic and non-metallic mineral resources have a greater chance of being sterilised by continued urban sprawl on the urban fringes, ribbon development along the coast, and by the dispersed rural residential development throughout the district, than under the other two futures being assessed. This is evident in Figure 4 where sprawl is shown to occur to the north of Kamo in the Kauri and Hikurangi areas and along Whangarei Heads. Any potential for future mining of these mineral resources is likely to become more difficult, and potentially more costly, as alternative access may be required due to urban settlement along main transport corridors.

Figure 5 shows the impact of a lightly regulated/market led development scenario on aggregate, limestone and sand resources. Of particular concern would be impacts on resources in the Matarau/Ruatangata, southern Otaika and Bream Bay areas from urban sprawl and rural residential development. It is worth noting that Figure 5 is a composition of working and closed quarrying sites to show resource locations. For existing operations, lightly regulated urban sprawl is likely to result in increased reverse sensitivity issues and difficulties obtaining consents for on-going or expanded operations due to community opposition. Access routes to and from existing operations may become more populated making these no longer suitable for heavy vehicles.

The potential for new quarry operations to establish is also likely to become more difficult as most of the resources are located in rural areas which will be subject to dispersed sporadic rural residential development. Land fragmentation from continuing subdivision in rural areas may also affect potential access to future resources. Ultimately a future one development path may result in the district becoming an importer of some mineral and aggregate resources and loosing the potential for it to become significant exporter adding to local GDP and providing employment opportunities. A future one development scenario would also mean

that new quarrying activities could seek to locate in areas of high natural character or ecological value without appropriate controls in place to manage environmental effects or assess proposals.

6.2 Future Two: Twin City/Urban and Coastal Spread

Under Future Two, the settlement pattern represents a moderately controlled and partly consolidated development path. It includes twin cities at Whangarei and Marsden Point/Ruakaka based upon significant residential, commercial and industrial development at Marsden Point/Ruakaka; urban and coastal settlements with some associated urban sprawl and ribbon development along the coast and transport corridors; and rural urban development largely at village level with some sporadic rural residential development throughout the rural area.

Figure 6 shows the impact of Future Two on metallic and non-metallic mineral resources. Known mineral deposits will still be threatened by ribbon development along the coast in the Whangarei Heads area and undiscovered deposits could be threatened by sporadic rural residential development throughout the rural area sterilising potential access by fragmenting land and ribbon development along key transport routes. Future Two does, however, present a better opportunity than Future One to protect known mineral resources and adapt planning regulation as information on deposits becomes available.

A moderately controlled and partially consolidated development path presented by Future Two will better protect aggregate resources than Future One. Figure 7 shows that most known bulk commodities are away from coastal areas and these will largely be protected. Sand quarrying activities could still be impacted by ribbon development along the coast under a Future Two scenario. Ribbon development along transport routes and some sporadic rural residential development throughout the rural area could still result in reverse sensitivity issues and make future access to some aggregate resources difficult. This could cause particular difficulties in the Portland/Otaika and possibly Bream Bay areas if sporadic rural residential development occurs around existing quarry operations and access routes. Although there is a concentration of resources in the Kamo and Hikurangi nodal areas these are mostly the location of coal fields which Christie and Barker (2007) did not consider to be a high value future resource due to its quality.

Figure 4: Future One and Known Metallic and Non-metallic Mineral Locations

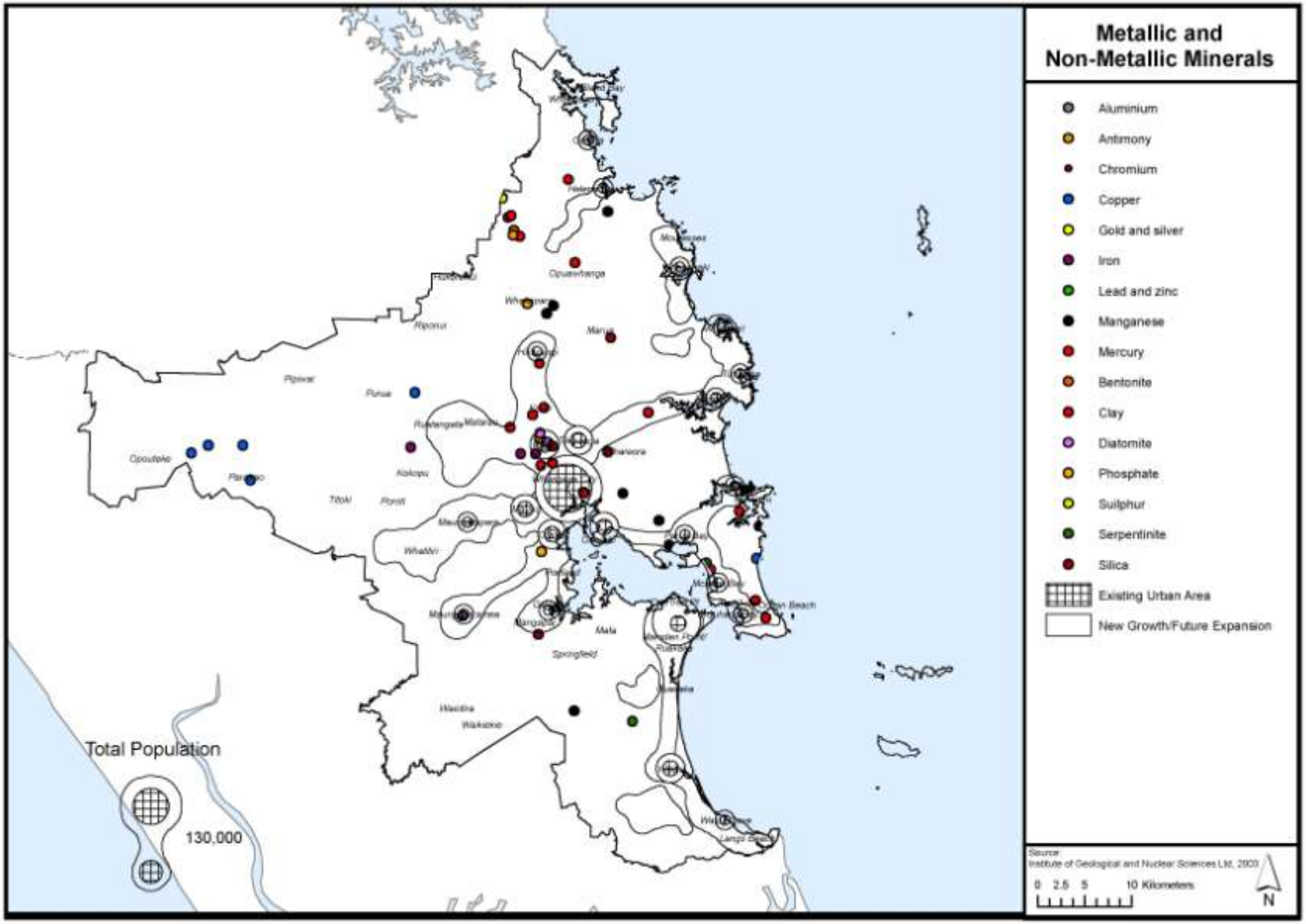


Figure 5: Future One and Aggregate, Limestone and Sand Resources

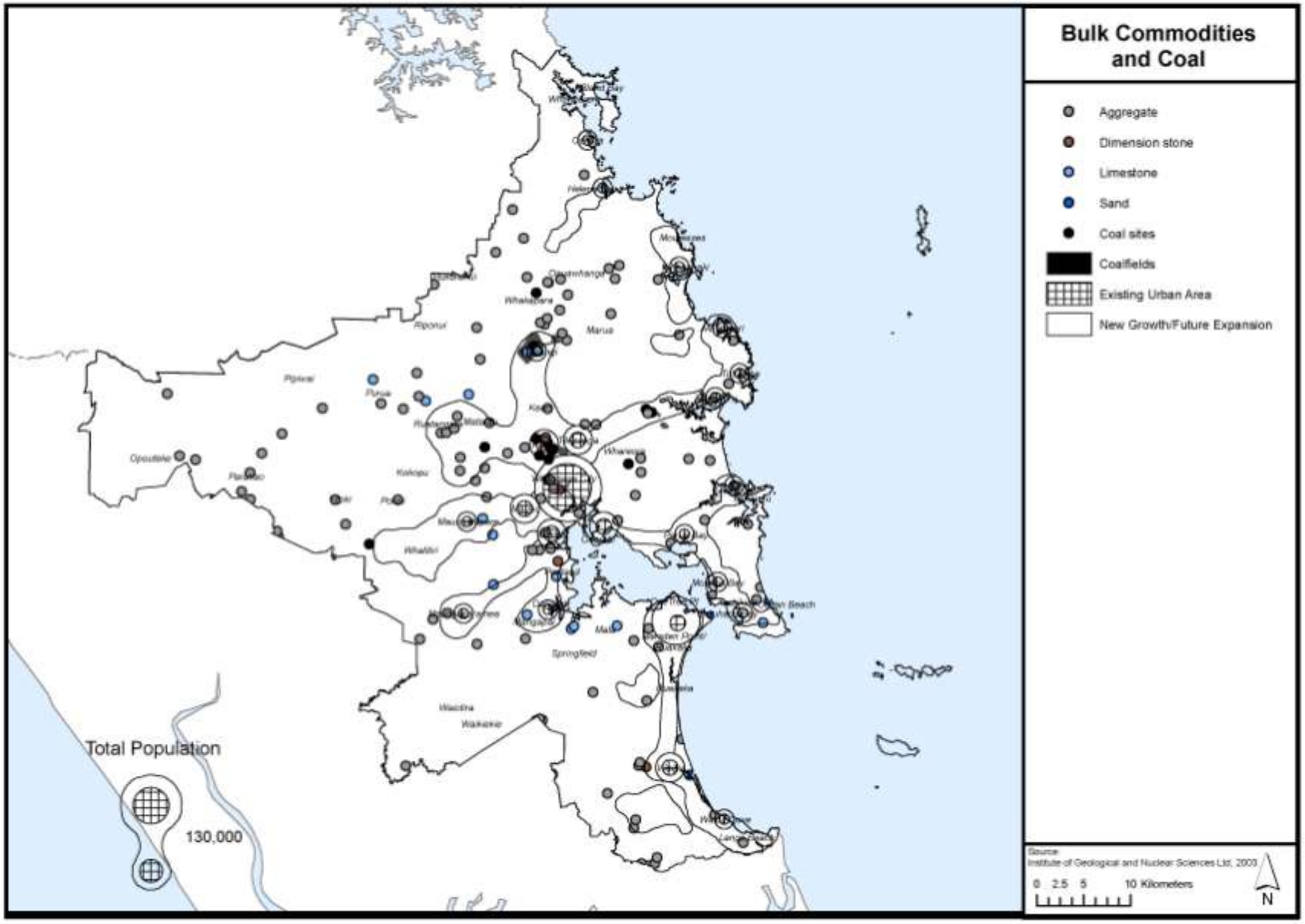


Figure 6: Future Two and Known Metallic and Non-metallic Mineral Locations

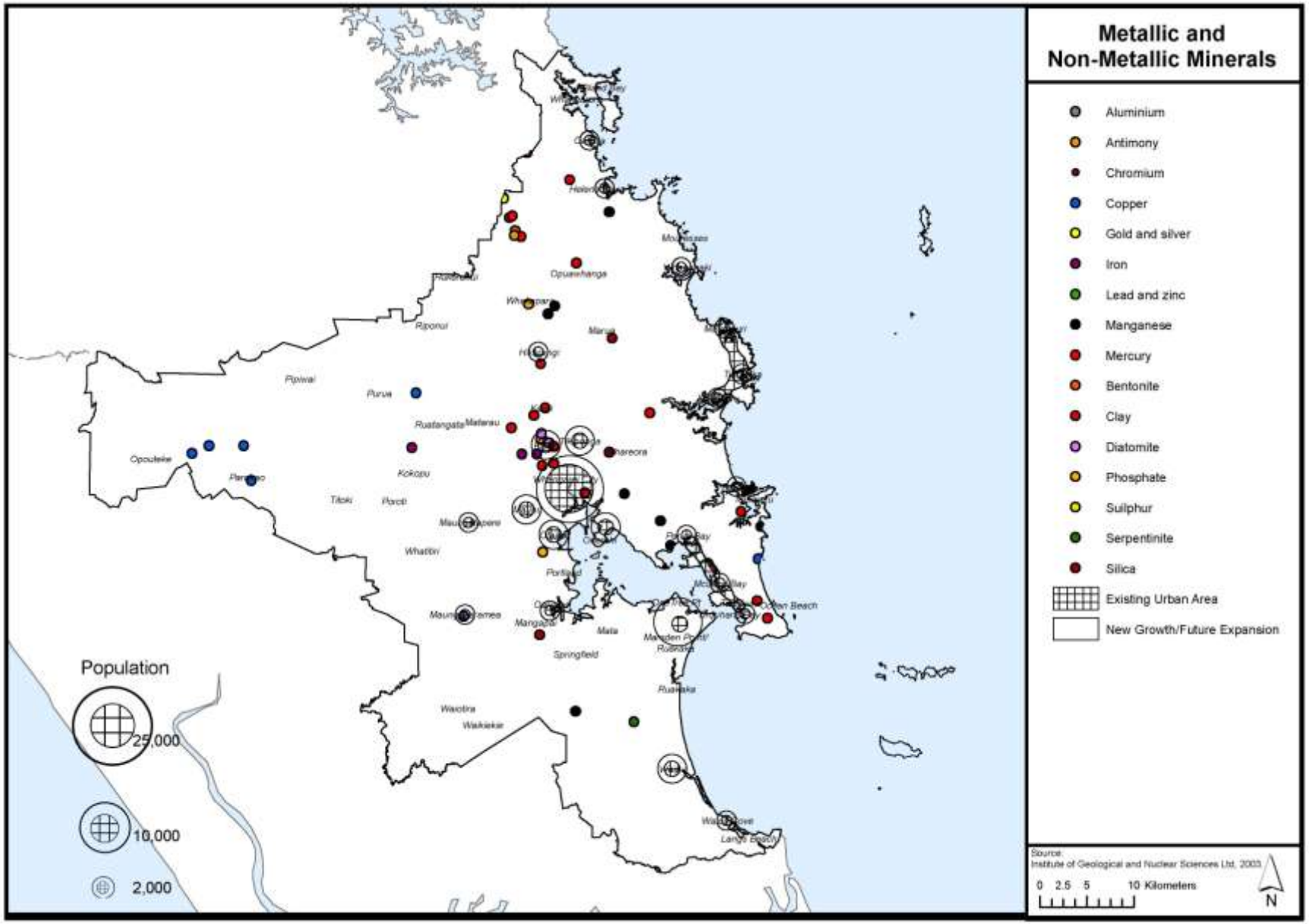
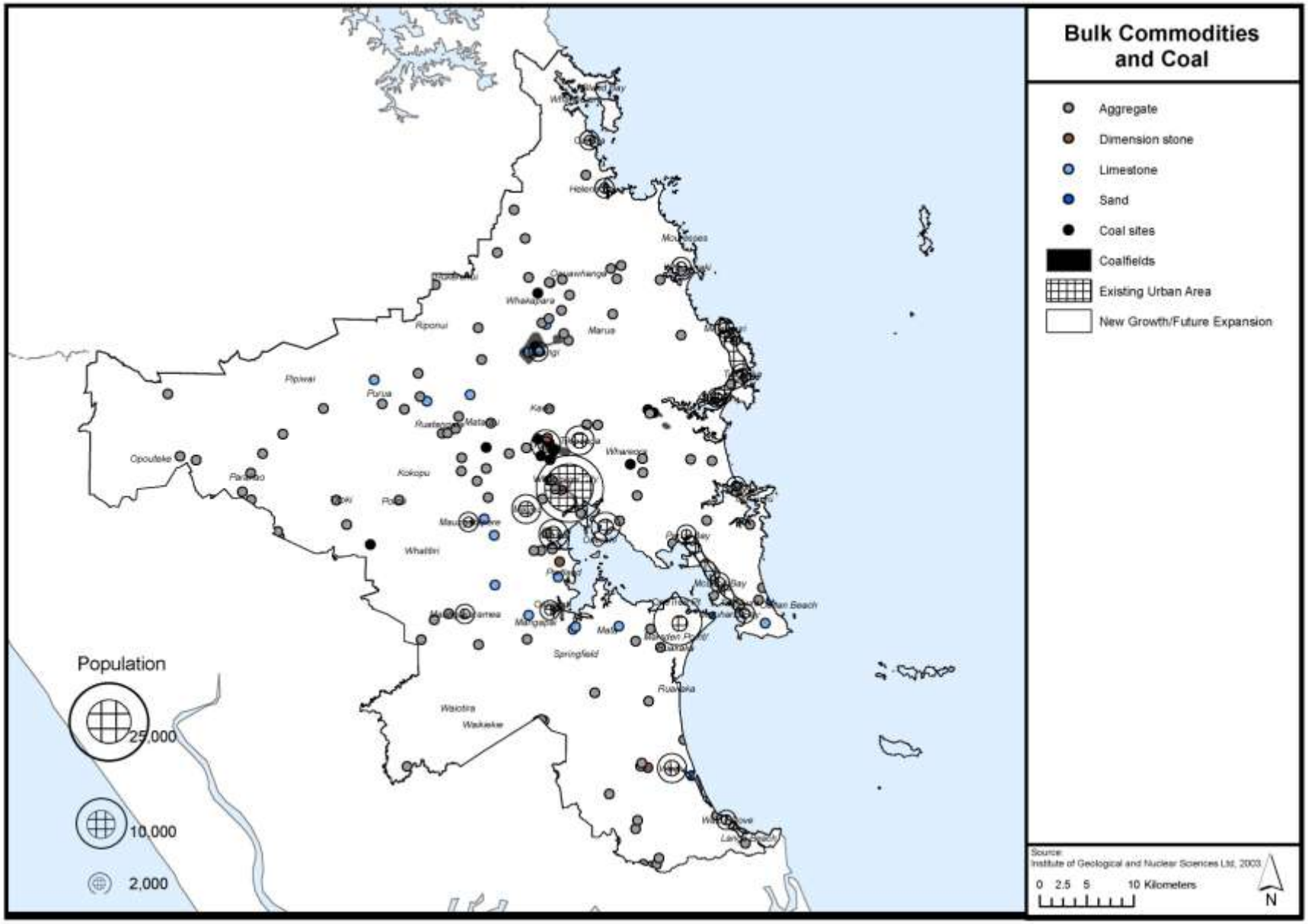


Figure 7: Future Two and Aggregate, Limestone and Sand Resources



6.3 Future Three: Satellite Town/Rural and Coastal Villages

Future Three represents a controlled, consolidated development path. Whangarei City is the primary district and regional centre with a strong, enduring CBD and five urban villages within the greater Whangarei area. Strong urban containment provisions will prevent urban sprawl around the City fringes. Marsden Point/Ruakaka grows to a town of around 15,000 people which complements Whangarei City. Prescriptive land use planning prevents sprawling development and ensures a consolidated pattern of residential, industrial and commercial development. One rural growth node at Hikurangi and two coastal growth nodes at Parua Bay and Waipu allow for consolidated residential, industrial and commercial development in the coastal and rural areas. Two rural villages and eight coastal villages allow for consolidated residential (and limited commercial) development along the coast and in the countryside. As a consequence of this tiered settlement pattern, rural residential and lifestyle development will be tightly controlled.

Figure 8 shows metallic and non-metallic mineral resources as they would be impacted by a Future Three development path. It should again be noted that the information presented in Figure 8 only shows the location of known mineral deposits. However, the benefit of a Future Three development path is as more information becomes available on mineral resources this can be used in spatial planning and if necessary to control conflicting development from locating near the resources and therefore protecting their future potential. The consolidation of urban development into urban, rural and coastal nodes, and rural and coastal villages will attempt to ensure that ribbon development along the coast and transport corridors will be avoided and this should ensure that main access routes for potential future extraction of minerals are not compromised.

Future Three provides the opportunity to plan for future aggregate resource requirements and support the expansion of existing quarrying operations by avoiding conflicting landuses, such as lifestyle and rural residential development from locating nearby. Known aggregate resource locations can be protected through spatial planning which buffers existing quarries from conflicting landuses and protects access corridors so that operations are shielded from reverse sensitivity issues. Under Future Three the imperative to establish new quarrying operations can be balanced against landscape, cultural and ecological issues so that locations avoid sensitive environments. Through strategic spatial planning, increased demand for aggregate resources can be anticipated and directed to appropriate locations. Figure 9 shows that particular care will need to be taken with regard to protection of the aggregate resources in the southern Otaika area but future three presents the best opportunity to do this through carefully controlled urban development in this area rather than the less controlled alternatives.

Figure 8: Future Three and Known Metallic and Non-metallic Mineral Locations

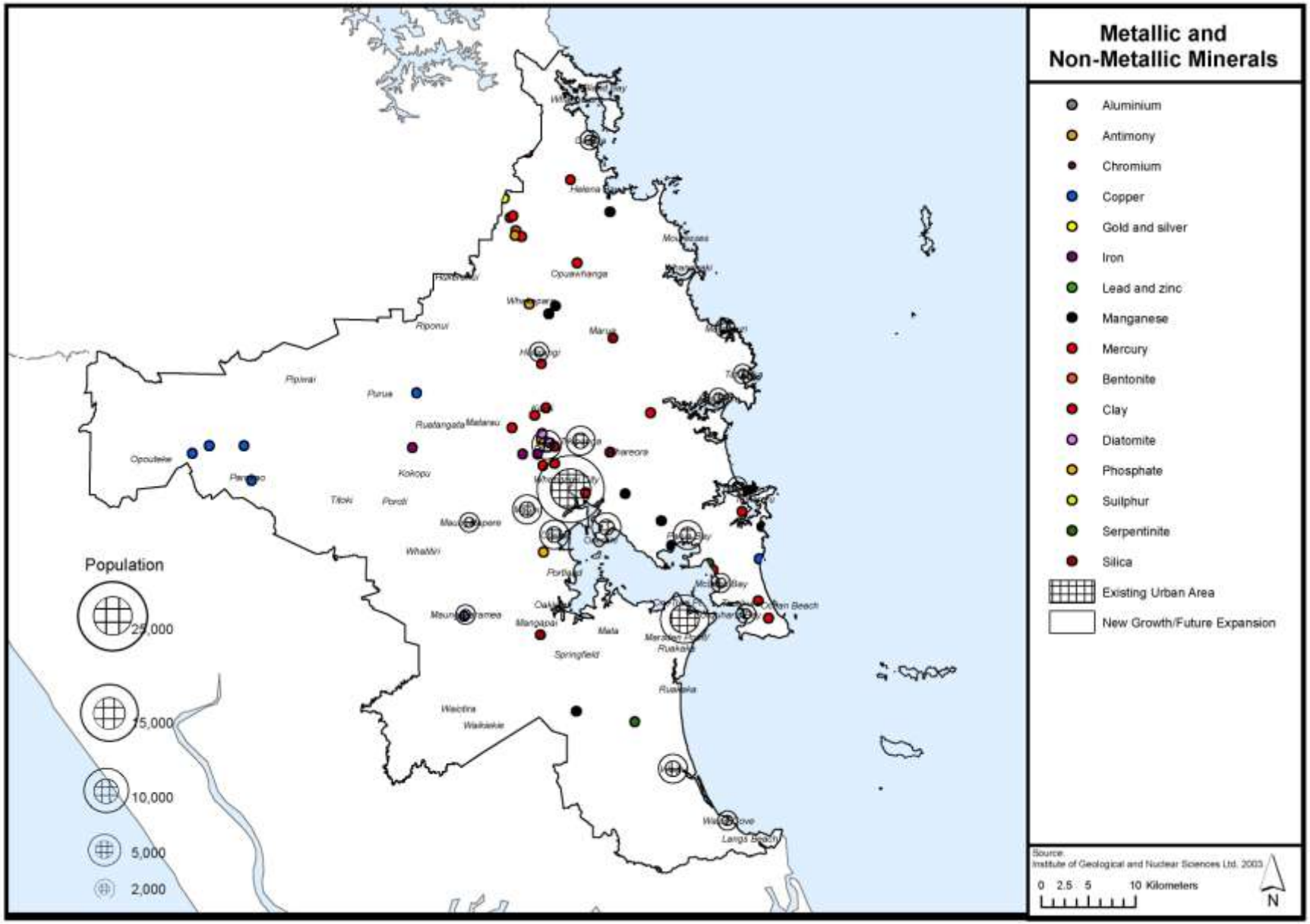
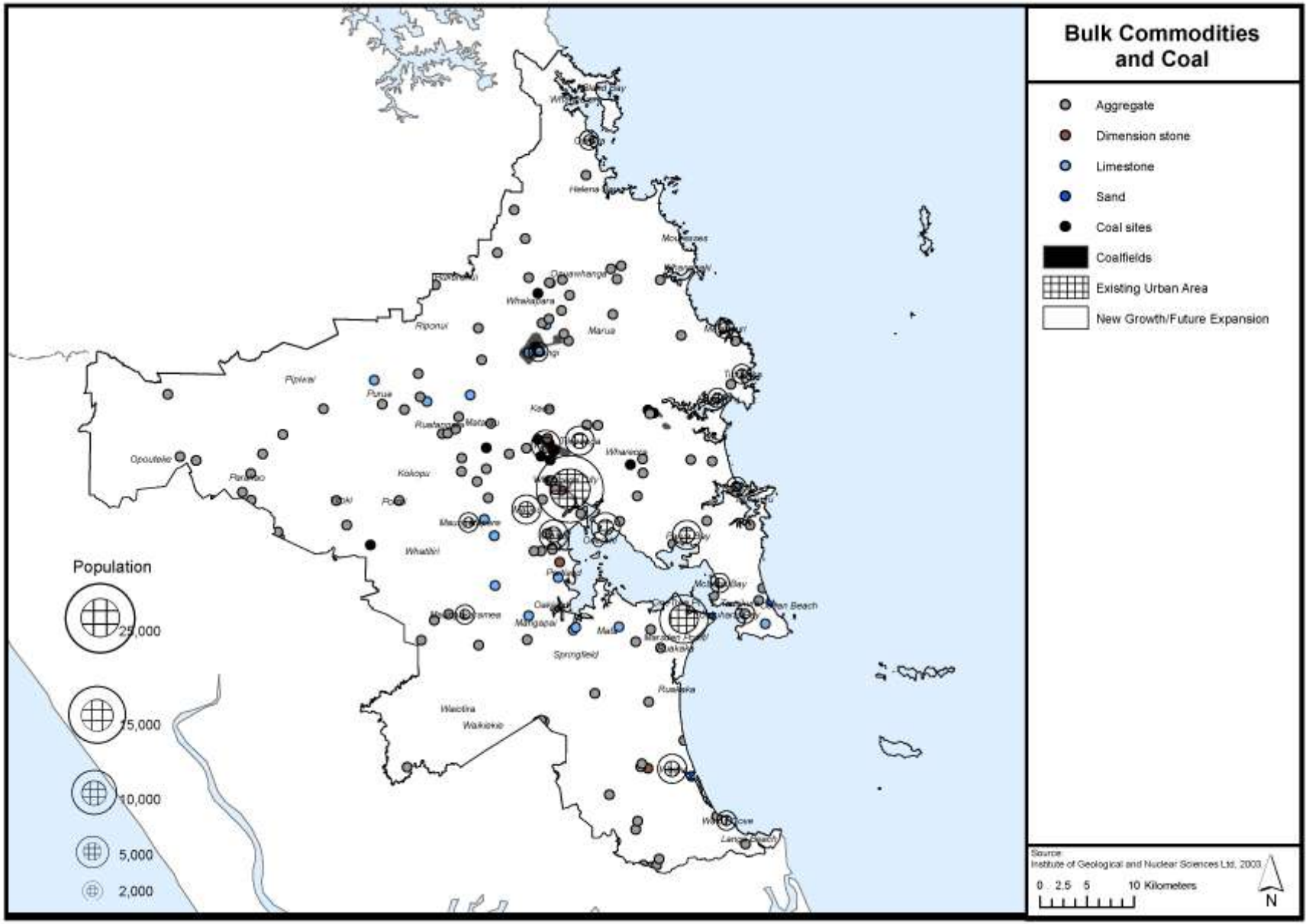


Figure 9: Future Three and Aggregate, Limestone and Sand Resources



7. Conclusions

It is difficult to assess with any accuracy the mineral and aggregate resource needs for the Whangarei District for the next 30 to 50 years. A simple hypothesis can be accepted that as the population of the district grows so to will our requirements for aggregate for building and infrastructure use. We can also expect that as urban expansion occurs within and even outside the Northland Region the demand for aggregate resources available within the Whangarei District may also increase. The more we can avoid the sterilisation of these resources through conflicting neighbouring development, the more we can position ourselves to take advantage of the full potential that these resources hold for our future economic well-being.

Of the three future development paths considered for the Sustainable Futures 30/50 project, Future Three presents the best opportunity to support existing quarrying operations and plan for future needs whilst avoiding inappropriate locations. It will also allow quarrying to be planned in a consistent way across the district so that information included as part of Quarry Management Plans is required for all new quarries whether they are within existing Mineral Extraction Zones, as currently identified in the District Plan, or not. This will add robustness to the consenting process and consistency to monitoring. Protecting key transport corridors will be important for existing quarries and potential new operations. These can be identified as part of the spatial planning process when locating urban, rural residential and lifestyle development so as to avoid conflicts and future constraints.

There is some history in the Whangarei District of mining for higher value minerals and evidence to suggest that deposits exist within the District which requires further exploration. As exploration information becomes available, spatial planning can be used to future-proof access to these resources. In the interim, a more consolidated development pattern, such as that presented by Future Three, should ensure that opportunities are not lost and further land fragmentation does not hinder their future potential.

8. References

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