Educational Resource

Teacher's Unit

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Primary Researcher: David Stokes

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Mihi / Welcome

Ko Tainui te waka
Ko Taupiri te maunga
Ko Waikato te awa
Ko Tuheitia te Arikinui
Ko Te Whare Taonga o Rahui Pokeka te whare nei rourou, naku te rourou ka ora ai te iwi

Nāu te rourou nāku te rourou ka ora ai te iwi
(With your basket and my basket the people will live)

Kia Ora and Welcome to Waikato Coalfields Museum

This resource pack has been put together with information objects, archives, photographs and library resources available in our collection at the museum. The collection is displayed in an historic homestead, known as The Pines and built for William Tattley in 1890. William Tattley was the mine manager of the Taupiri Coal Mining Company.

Displays explore the lives of coal miners and their families who worked and lived in the Waikato coalfields. Film footage introduces visitors to coal mining past and present, and original exhibits include mining machinery, equipment, personal items, and thousands of photographs.

The museum has a coal mining archive, research library, a collection of historic photographs, local history files, newspaper cuttings and a family history archive.

We look forward to meeting with you and your students at the museum

Nga mihi nui

The team at Waikato Coalfields Museum

The Pines / Waikato Coalfields Museum c.1925 (HM558)

Where to find us: Waikato Coalfields Museum, 26 Harlock Place, Huntly.

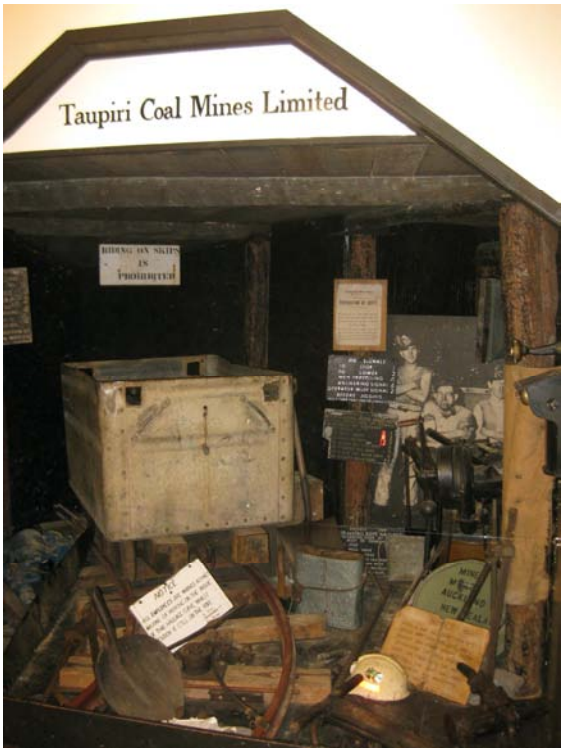
Phone: 07 828 8128 | Fax: 07 828 8120
Email us at: waikatocoalmuseum@paradise.net.nz
Visit us online at: http://www.coal.net.nz/
Opening Hours:
Open daily (7 days) 10.00am - 4.00pm.
Other times by appointment; groups welcome.
Closed: Good Friday, Christmas Day, Boxing Day and New Year's Day.

Introduction

Coal is one of the most significant natural resources in the world, with extensive reserves in almost 100 countries. It is second only to oil as a source of energy and at current levels of proven reserves and consumption, global reserves will last more than twice as long as the combined known reserves of oil and gas. (Morris 6)

The coal of the Waikato region is of high quality, with low levels of impurities and by international comparasion is considered relatively accessible. The commercial history of coal in the Waikato dates back to the mid 1800s. Waikato Coalfields Museum has a collection of coal mining artefacts, photographs, journals, books, official government records and bibliographical records. The museum also holds investigative reports into mining accidents and significant incidents that have occurred throughout the history of the Huntly coalfields.

Since coal mining started in the Waikato in the late 1800s, many changes have taken place in the methods used, ranging from labour intensive underground mining methods, to modern mechanised techniques both opencast and underground. The museum regularly rotates displays of diagrams, photographs, documents and models relating to mining history. Specific items can be brought from storage for viewing if requested in advance.



This display in the museum recreates the Bord and Pillar method of underground mining

Waikato Coalfields Museum Resources

Books
100 Years of Mining (Edwards, H)
Coalmining (Statham, I.C.F)
Mine Statements: for the following years: 1915, 1917, 1918, 1920, 1921, 1924, 1927, 1928, 1930, 1933, 1936, 1940, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1954, 1956 through to 1972.

Objects, Archives, Photographs
Banjo coal shovel, Davy safety lamp, Shot firer, Spragg, Coal cutters, Coal graders

Audio / Visual Resources
Oral History project [ongoing]

Geology

Coal Formation

Vegetation is the source of coal, rotting and compacting over millions of years. It is then layered with other materials, forming seams of coal. "A fault is a crack in the earth's crust, accompanied by vertical displacement (or movement) of the coal beds either upwards or downwards from its original position." (Statham 46) The coal in New Zealand has taken 'only' 65 million years to form. (Park 1) Comparatively, it is said to have a larger energy content (weight for weight) than North American coal from West Virginia, which is 286-360 million years old. (Hieb 1) Rather than age, it is the depth to which coal has been compacted that determines its energy content (due to the pressure placed upon it). Further, neither the pressure exerted over time or tectonic movement necessarily correspond to the depth at which the coal is found. In New Zealand we are fortunate that a large part of the available coal is reasonably shallow by international standards, thus making it easier and cheaper to mine.

Coal Types and Properties

Waikato coal is sub-bituminous, with a low sulphur content of less than 5 percent – rendering it more marketable by world standards. The sub-bituminous coal (particularly at the Rotowaro Mine) "has low ash, low-sulphur and high reactivity." (Solid Energy Coals of New Zealand) Coal with a low-sulphur content produces fewer pollutant emissions after being burned. This is becoming increasingly important with the Emissions Trading Scheme being entered into by international governments. On an international standard the qualities of New Zealand sub-bituminous coal make it sought after by the world-wide steel manufacturing industry. (Coal Association of New Zealand)

The following table outlines the conditions under which different coal types form:

COAL TYPE	DEPTH OF BURIALS	MAX TEMP during burial	MOISTURE CONTENT	FIXED CARBON CONTENT
PEAT	0 – 0.2 km	0 - 25 C	50 - 80%	10 - 20%
LIGNITE	0.2 - 1.5 km	25 - 40 C	30 - 50%	20 - 35%
SUB-BITUMINOUS	1.5 - 2.5 km	45 - 75 C	10 - 30%	35 - 45%
BITUMINOUS	2.5 - 6 km	75 - 180 C	5 - 10%	45 - 85%
ANTHRACITE	> 6 km	> 180 C	> 5%	80 - 96%

(NZMIA Resources for Schools 1)

Coal Products

During the mining of coal four main products are generated:

- Coal
- Gas
- Coking coal
- Coke

Coal and coking coal differ from each other in terms of quality. Gas is sometimes released during the mining of coal, or it can be found by itself in the absence of coal, particularly after the movement of the ground over time.

Coking coal is used as a reducing agent in the creation of iron ore. Coking coal burns at a higher temperature and is less volatile, due to the impurities being burned off earlier.

Each of the above materials is then processed into a range of retail and industrial products. See the table and illustration on pages 11 – 12 for further information.

Coal
Coal is sorted into varying grades and sizes for use in industry or the home, depending on the needs of the end user. Huntly coal is highly sort after for this purpose and is exported, in particular to Japan, Chile, China, India and Australia.

Gas
The presence of natural gas is a product that is sometimes found at the site of coal mines. This is produced because of the process that decomposition plays in the formation of coal. However, gas is not always found with coal. The gas can either be burned off or if present in sufficient quantities can be collected and may be used for the generation of electricity.

Coking coal
Coking coal is produced when coal is burned at a very high temperature. This removes the volatile gases such as hydrocarbons, benzene and nearly all the sulphur content. Most of the water is also burned off. Coking coal is then used in the manufacturing of steel, where coal must be as volatile and as ash free as possible.

Coke
Coke is the carbonaceous material that is produced when low-ash, low-sulphur coal is burnt. It is a solid but porous material that is used in the production of steel and also as a fuel.

Waikato Coalfields Museum Resources

Books
Coalmining (Statham, I.C.F)
Introduction to Mining (Stoces, B)

Objects, Archives, Photographs
Information concerning the differences between coal types of lignite, bituminous, sub-bituminous, anthracite on display charts donated by Solid Energy
Examples of Coal Carts from early Underground Coal Mines
Coal Samples
Fosils and Rocks (2002.4.1, 2010.91.1 –2010.97.1)

Audio/Visual
DVD: Early Coal Mining Methods
DVD: Coal Corp - Uses for Coal

Coal Supply, Production and Output

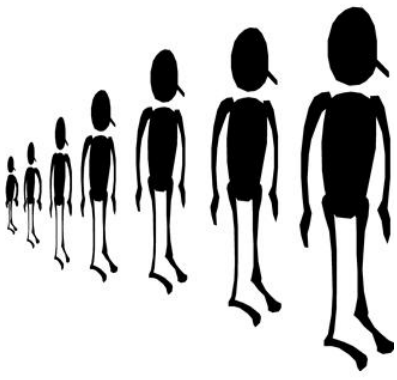
The oil crisis and shortages of the 1970s provided motivation to explore the extent of New Zealand's coal resources nationally including those of the Huntly region. The government began a national survey to ascertain how much coal was in New Zealand and where it was (NZMIA Resources for Schools 2). The quantities of coal discovered were substantial enough to allow for an energy source which did not depend on overseas supply and increased New Zealand's known coal reserves from 2 billion tonnes in 1973 to 8 billion tonnes in 1978. In the mid 1970s the underground Huntly East and Huntly West mines were opened and coal exports to Japan were approved. Estimates at 2010 put New Zealand's coal supply at approximately 16 billion tonnes across both the North and South Islands. (Resources for Schools 3)

The table below provides an analysis of the national production of coal.

New Zealand Coal Production by Region in 2009 (tonnes)			
Region	**Opencast**	**Underground**	**Total**
Waikato	1,380,654	365,918	1,746,912
West Coast	1,766,407	470,124	2,236,531
Canterbury	28,976	0	28,976
Otago	71,193	0	71,193
Southland	480,061	0	480,061
New Zealand Total	3,727,291	836,042	4,563,333

(Crown Minerals)

The demographics of the Huntly population assimilate and reflect the changes inherent in the constant upgrading of mining technology and a consequent drop in labour requirements. Ironically smaller labour numbers now produce a much higher worker/product ratio, "Production rose from yearly average of 550 tonnes per man employed underground in 1952 to 852 tonnes in 1971. The advent of mechanized mining made possible a production rate of 400 tonnes per shift of 13 men" (Jones 27). However, other factors also influence the growth of the community. In 2009 the Huntly population was 7,069 (www.huntly.net.nz), with some of the newer residents now using the town as a base from which to commute to Auckland.

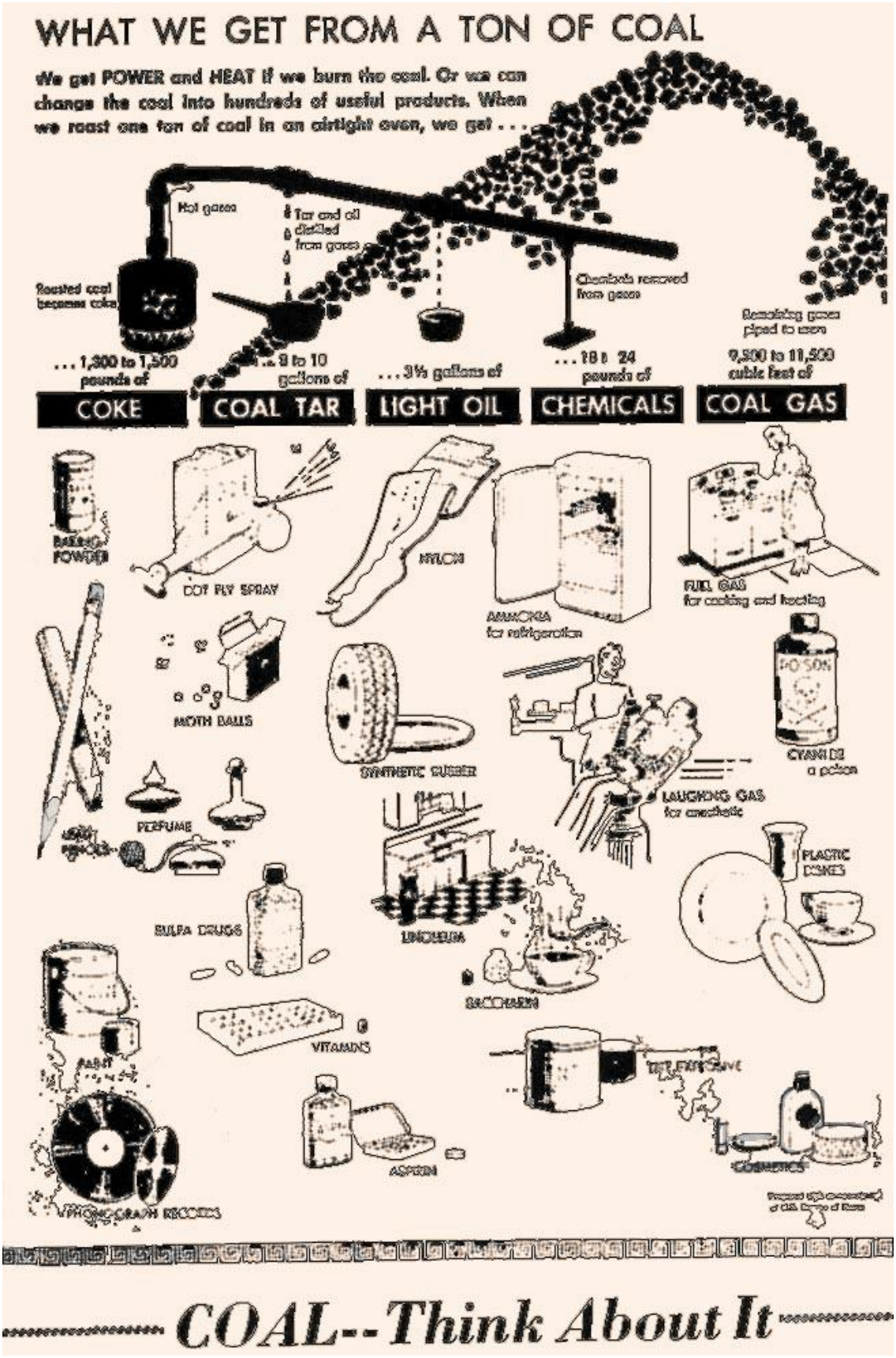


The Coal Tree

By-products of coal after varying degrees of processing

COAL		
GAS	**COAL**	**COKE**
AMMONIA LIQUOR	Liquid ammonia	Wool scouring
		Soap
		Washing powder
		Household ammonia
		Sulphate of ammonia
		Explosives
CARBOLIC OIL	Phenol	Explosives
	Creosols	Weed killers
		Tanning
		Sheep dipping
	Xylenos	Antiseptics & disinfectants
NAPTHALENE OIL		Moth balls
		Plastics
	Napthalene	Fire lighters
	Phthalic anhydride	Dyes
ANTHRACINE OILS		Dyes
		Fruit tree sprays
		Road tar
		Rust prevention
PITCH		Roofing
		Briquettes
CREOSOTE OIL		Tar fuel oil
		Timber preservative
		Aviation fuel
LIGHT OILS	Pyridine	Pharmaceuticals
		Photo chemicals
	Naphthas	Brake lining rubber
		Linoleum
BENZOLE	Xylene	Perfume
		Printing inks
		Paint & lacquer
	Toluene	TNT
		Saccharine
	Benzene	Analine dyes
		Nylon
		DDT
MOTOR BENZOLE		Petrol
SULPHURIC ACID		Sulphate of ammonia
		Galvanising
		Electrolyte

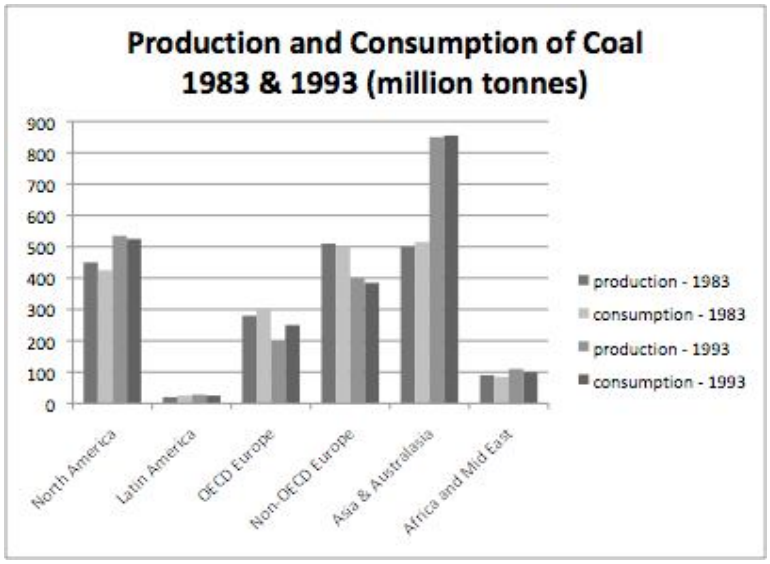
(Coal Corp)



(Coalwood, West Virginia)

The Importance of Coal as an Energy Source

Worldwide, coal is an important source of energy. Compared to alternatives - hydro, geothermal and nuclear - it is cheap to source, high in energy and relatively abundant for the current rate of consumption. Compared with its international counterparts New Zealand coal is low in sulphur and phosphorous content and also in ash. New Zealand coalfields also yield low-ash, low sulphur, sub-bitumous coal. Both types of coal possess qualities that render them attractive to global markets. As New Zealand mines in excess of its own requirements, it is able to export coal to other countries, particularly Japan, Chile, China, India and Australia. (Solid Energy New Zealand)



This graph displays international production and consumption trends. The data for New Zealand has been included with Australia and Asia. A point to note is that the Asia/Australia group produce a larger quantity of coal of which a significant proportion is exported to other regions.

(Morris)

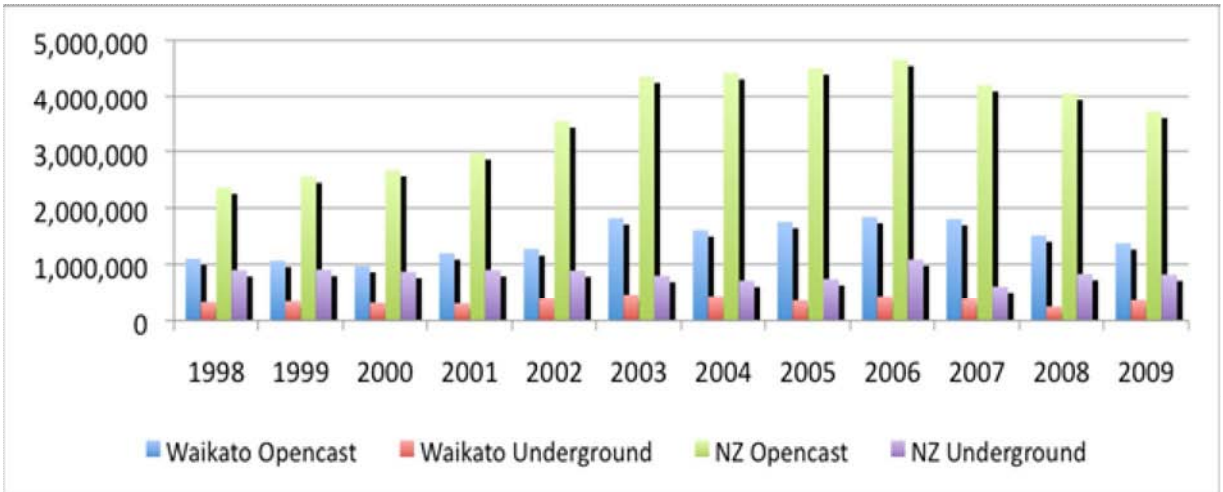
The following table shows how the mining of coal on a regional and national basis has changed for the Waikato and New Zealand.

Waikato and New Zealand Coal Production by Method 1998-2009 (in tonnes)

	Waikato Opencast	Waikato Underground	NZ Opencast	NZ Underground
1998	1,117,570	331,080	2,389,515	914,365
1999	1,081,822	347,432	2,584,672	921,058
2000	985,965	320,816	2,701,067	884,568
2001	1,214,528	309,277	2,996,125	915,271
2002	1,282,835	392,991	3,553,958	904,981
2003	1,825,204	474,966	4,367,086	812,826
2004	1,611,739	441,968	4,428,564	726,830
2005	1,758,831	361,078	4,512,727	754,435
2006	1,849,290	440,519	4,666,280	1,101,631
2007	1,811,488	390,322	4,215,535	619,873
2008	1,518,169	251,217	4,064,143	845,278
2009	1,380,654	365,918	3,727,291	836,042

(Crown Minerals)

Waikato and New Zealand Coal Production by Method 1998-2009 (in tonnes)



(Crown Minerals)

Energy Consumption by Fuel Type for 2007

(World Coal Institute Country Profile – New Zealand 2009)

A comparison of New Zealand's consumption of coal in relation to other energy sources in 2007. This relates to all energy consumption (including, but not limited to, electricity).

(New Zealand)	
	%
Oil	37.7
Gas	22.6
Geothermal	12.5
Hydro	11.3
Coal	9.2
Other Renewables*	6.7
Waste Heat	0.1
* wind, biogas, wood, and solar water heating	

(World Coal Institute Country Profile – New Zealand 2009)

Currently New Zealand's electricity generation is dominated by hydro-electric (approximately 60% between 2005-2007). Coal power amounted to 32%, with the other sources comprising of geothermal, wind and biomass resources (wood, agricultural bi-products and domestic waste). (Mason et al 1)

In 2010 the consumers of coal mined in the Huntly region included:

- Export markets - Japan, Chile, China, India and Australia
- Glenbrook Steel Mill
- Major factories
- Private customers

Coal and Early New Zealand History

Taupiri

Historically, Maori used coal as a source of fuel for heating and cooking. As had Maori before them, the Europeans used coal from its most accessible sites. "In 1842 the Reverend B Ashwell established a Church of England mission station on the Waikato River opposite Taupiri mountain. A few miles south of the mission station, a landslide had uncovered an outcrop of coal on the same side of the bank." (Stokes 1) In 1850 Dr Purchas of the mission spent time in the area and mapped out areas in Kupake, and at Papahorohoro. In accordance to the provisions of the Land Act 1840, the government promised to provide Maori with the facilities to exploit the find. In 1859 the New Zealand Government undertook a survey of the area. (Stokes)

Taupiri Mission Station
c. 1840s (HM303)

Waikato Wars

Coal played an important part in the European victory of the Waikato Land Wars of the 1860s. River steamers were used to transport troops and supplies along the Waikato River. (Edwards 3) Coal found in the cliffs, alongside the river, was used by the British for the fuelling the steamers.

The utilisation of this resource gave the British an extensive advantage over the Maori forces. They were able to transport large shiploads of troops, merchandise, weaponry, and supplies along a passage that was otherwise difficult to police. This advantage was largely due to the geography of the coal seam at Kupakupa.
In 1842 coal had been discovered at this site after a landslide on land belonging to the first Maori monarch, Kingi PotatauTe Wherowhero. During the time of the Land Wars Kupakupa was used to supply the coal needed to power the gunboats necessary for the transport of British troops, equipment and supplies into the Waikato heartland. The choice of the Kupakupa coalfields to supply this fuel was sealed by its physical location: it lay within the cliffs above the river. This "… enabled the coal to be shot directly into the bunkers of the steamers. The seam was opened up by the government to provide fuel for the steamers and this was the first seam that was successfully systematically worked in New Zealand." (Edwards 3) After 1878, when the rail line reached Huntly, the coal was brought across the river to a small railway siding and railed from there to Auckland. (ibid)

Waikato Coalfields Museum Resources

Books
The Penguin History of New Zealand (King, M.)

Objects, Archives, Photographs
Photograph of Taupri Mission Station (as shown above)

The Huntly Coalfields

The majority of the early Huntly coalfields were owned by the Ralph family, who arrived in New Zealand in 1849. The area was surveyed in 1859 by Ferdinand Hochsetter and the Ralph family moved to Huntly after the Waikato Land Wars and began mining in 1876 using a drive and drift style method. Service in the British Military entitled Anthony Ralph to 300 acres of Waikato land whilst his son-in-law was awarded 200 acres. In the 1870s the Ralphs purchased additional land on the east side of the river, where Anthony's son Robert had also discovered coal, from local Maori and the Taupiri Mining Company was born. (Edwards 4) Over a short period of time, the ownership and responsibility for Taupiri Mining Company changed rapidly. The Ralph family started operations in 1876 and by 1883 the company merged with the Waikato Coal Company to form the Waikato Coal and Shipping Company. In 1899, due to a fall in demand, it was decided to amalgamate four of the mining companies in the area and to focus on just one of the mines in the area. This was the Ralph's Taupiri Mine. (Edwards 3)

Most of the coal at the Ralph Mine had been won by 1887. It was then decided to sink an underground shaft a mile further north to reach coal that was known to exist at a greater depth. (ibid) Coal became increasingly difficult to locate as the seams were fragmented, due to earth movement over time. This eventually led to the implementation of opencast mining.

In the "new" Ralph's Taupiri mine, ventilation was wholly natural, that is there was no aid in the way of fans. Although enough air went down the mines, there was no means of conducting this air to areas where it was most needed. This was because the stoppings, designed to close off disused areas of the mine, were ineffective. (Edwards 6) After the coal was removed from the mine shaft, it then had to be transported from the mine site. The coal slack (dust residue from coal), a danger because of its flammable nature, was extracted in buckets from the mines to allow access to the coal. Miners were not paid for removing the coal slack from mines, as it was of no marketable value. The slack gathered was used as a surface for pavements, as an 'improvement' from the ever-present mud.

Prior to the opening of Huntly's combined rail/road bridge in 1914, the main means for locals crossing the Waikato River was by punt. Stock, produce, people and equipment, including horse and buggy, came across the river this way. A jetty stood at a point opposite the present BNZ Bank and here boats (particularly the sternwheel paddle steamer 'Freetrader') could moor to load and discharge produce. The landing stage of the punt - or ferry - was also in this area. This punt travelled on pontoons attached to a wire rope, propelled by the current of the river.

The opening of the rail/road bridge in 1914 and subsequently the Tainui Bridge in 1959, facilitated easy vehicular access between the east and west sides of Huntly. Prior to the construction of the first bridge, coal had to be transported to the east side of the river before being processed. The removal of this extra stage in the production process was significant. In particular the advent of the road / rail bridge enabled mines to be opened up to the west of Huntly and towns such as Pukemiro, Rotowaro and Glen Afton townships grew to support these mines.

Tainui Bridge Opening.
A barrier of coal was ceremonially shovelled aside to mark the opening of the Tainui Bridge, November 1959.
(HM963)

Waikato Coalfields Museum Resources

Books
100 Years of Mining (Edwards, H)

Objects, Archives, Photographs
Ralph's Mine – Numerous photographs, maps and paper archives
Ralph's Mine – mining equipment

Tainui Bridge Opening
Numerous photographs
Original flags from Tainui Bridge Opening in 1959 – 1987.91.1-1987.92.1
Original programme for the Tainui Bridge Opening in 1959
Aerial photographs of bridge
Photographs of construction of the bridge

Audio Visual
DVD: Coal – Fueling the Future : Part 1 Coal and the Environment

Mining Methods

Underground and Opencast Mining

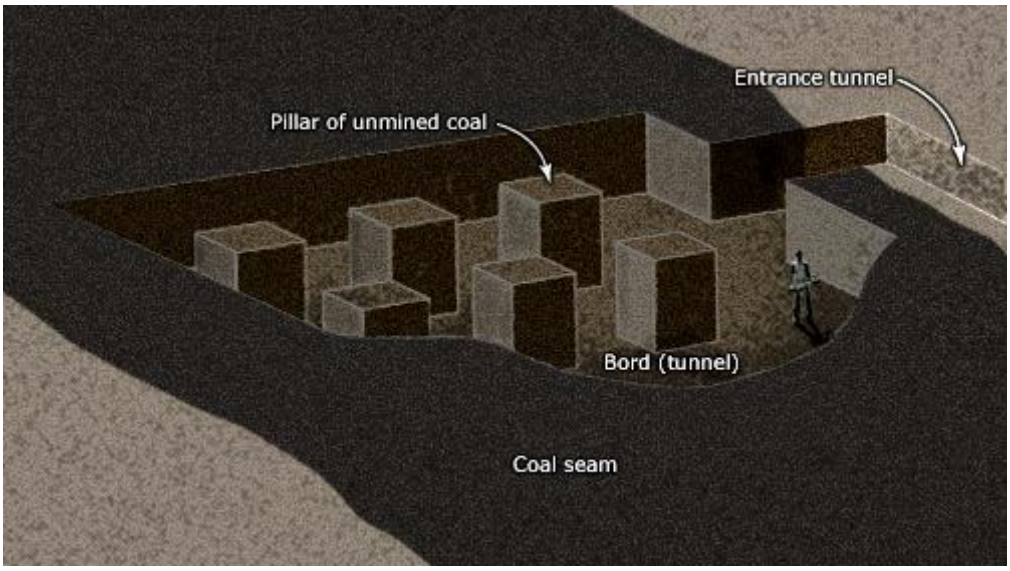
Currently two methods of mining are used in the Waikato coalfields: underground and opencast mining. Underground mining results in the removal of coal from a tunnel network via one of two methods. One uses a short wall mining machine, which continually cuts into the face of coal feeding it onto a network of conveyor belts. The second supports the mine with timber pit-props. By contrast opencast mining removes coal from ground level by working the mine from ground level down.

Rotowaro Opencast Mine
(2005.39.1)

Historically, underground mining used dynamite blasting to loosen the coal from tunnel walls. This method required the hand drilling of a hole of about 3-4 cm in width and 60cm to 2m in depth. An explosive charge was placed inside the hole and the fuse was ignited. A number of charges would be set along the coal-face. (Stoces 94-5) After blasting the broken rock was removed from the face, new blast holes drilled and another round of explosives fired. Great care was necessary due to lack of ventilation and gases given off by the explosive charges.

Bord and Pillar System

Initially coal was mined in workings supported by the 'bord and pillar' system. Pillars of unmined rock were left in place to support the roof of the mine. "… the haulage road (for the extraction of the coal) was supported by solid coal until the whole pillar was extracted. This was (and still is) an important feature affecting safety." (Statham 136) The bord and pillar method is still in use worldwide.



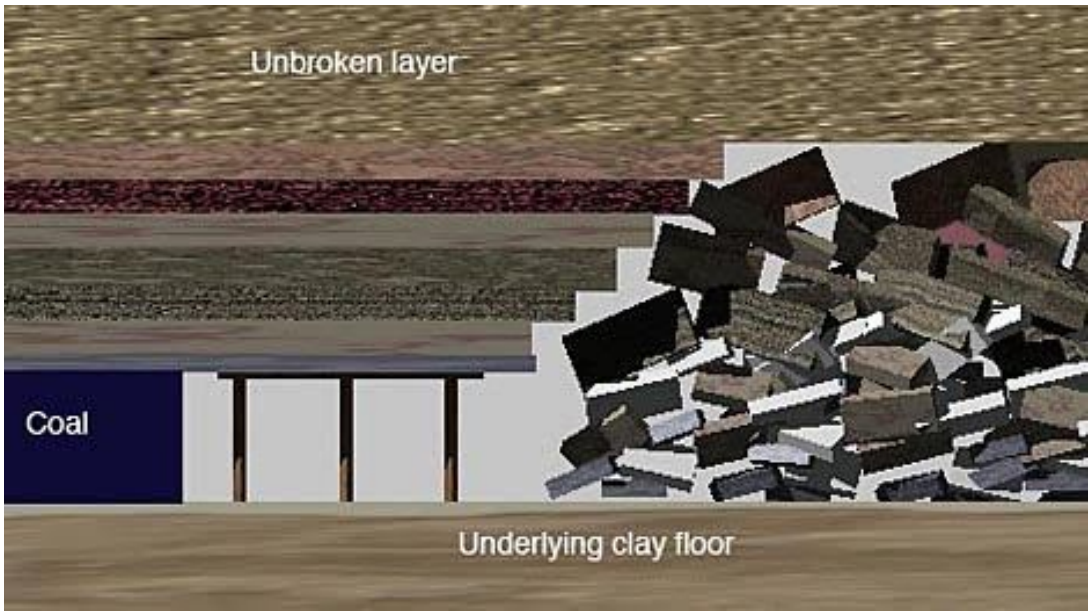
This diagram shows the layout of Bord and Pillar Mining

(Sherwood and Phillips)
<http://www.TeAra.govt.nz/en/coal-and-coal-mining/6/2>

Timber Pit-props

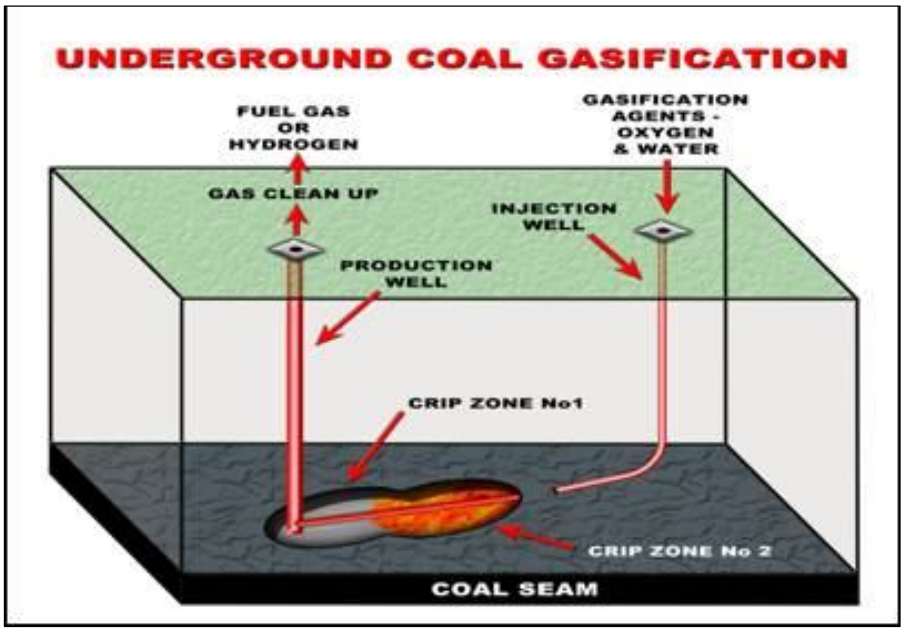
Historically, the most important materials for mine working supports were timber pit-props. This system had numerous advantages for the mining companies. The timber was cheap, light-weight, easily transported and took up relatively little space. It was easy to cut to size within the confines of the mine. The props demonstrated elasticity over time and could accomdate the roof pressure, explosions and the effects of ground movement. The noise of cracking in the timber gave warning to miners that the roof was moving and this assisted with evacuation warnings. These cracks and any broken pieces were easy to repair. (Stoces)

This diagram of timber pit-props in the mining environment shows pre-mechanised longwall mining of coal.



Modern Mining Methods

Mining methods yet to be tried in the Waikato coalfields will allow for deep seams to be extracted. Solid Energy expects an underground Coal Gasification plant will be built by the beginning of 2011. Two vertical parallel tunnels will be drilled to coal seams that would be otherwise inaccessible.



(Sharma)

A demonstration of the process of underground coal gasification.

Oxygen and an ignition source will be located in the first tunnel, whilst steam and a turbine will be attached to the second tunnel. This will allow the energy to be harnessed. Any danger, fire or pressure will be dealt with through pressure release systems or through the shutdown of the ignition or oxygen supply. (Solid Energy Media Release)

Waikato Coalfields Museum Resources

Books
100 Years of Mining (Edwards, H)
Coalmining (Statham, I.C.F)
Introduction to Mining (Stoces, B)

Objects, Archives, Photographs
Photographs: Underground Miners 1996.114.1; 1996.116.1
Underground mining Tools 2010.132.65
Opencast Mining Machiners 1996.106.1; 203.606.115

Audio/Visual
DVD: Early Coal Mining Methods
DVD: Work and the Challenges of Miners

Early Mining Safety Issues

A common source of accidents early in the mining industry centered on the use of mine shafts for transportation. Shafts were used to transfer both miners and heavy wagons of coal between the underground mining area to ground level.

Whilst mining underground, the ceiling of the mining tunnel was supported by vertical poles and horizontal beams. This created a supporting structure which was regularly positioned every 4-5ft (1.2-1.5 metres). Explosive charges were used to free the next section of the coal seam after. Due to the flammable nature of loose coal and coal dust great care had to be taken during the process of extraction. Carbide lamps used by miners to illuminate their work site were another safety risk. These gradually evolved into safety lamps providing a safer light source for miners. (Early Coal Mining Methods DVD)

Mining companies invested money into areas of production rather than providing safety devices for workers. As a result, it often was not until an accident or injury and the consequent Commission of Inquiry, that mining companies acted to improve the safety of the workplace. It was realised early on that the lack of accessibility to the mines could potentially become a safety issue for those working underground. In 1907, Judge Denniston and two assessors held a court of inquiry to consider the necessity of a second shaft for access to the Ralph's mine. "Mr Coutts, mining inspector, said that if anything went wrong with the workings under the river the workers would have a poor chance of escape." The Taupiri Coal Company, which owned the mine, contended that the pillars were quite strong enough and the shaft would cost an "unrealistic" £7,000 whilst the Assistant Mining Inspector estimated the cost at £2,000 . (Bush Advocate. vol XIX Issue 819, 13 Sep 1907 5). A Mines Inspector's report of 1909 announced the construction of a connection to the Taupiri West shaft "as it will provide an outlet on the western side of the Waikato River for use in case of emergency." (A.J.H.R. 1909 Vol II C-D 8). It was also noted that due to the distance to be driven and the uneven surface of the coal seam, it was likely to take two years to construct. (A.J.H.R. 1909 Vol II C-D 9).

Waikato Coalfields Museum Resources

Books
Commision of Inquiry Reports
Annual reports to the House of Representatives (from Mining Companies)
Appendices to the Journal of the House of Representatives

Objects, Archives, Photographs
Miner's carbide lamps
Miner's safety lamps
Mine disaster displays

Mining Accidents

Looking back, it is surprising how infrequently major incidents occured in the mining industry, particularly with the limited number of regulations and safety devices in use. Ventilation was originally provided only through the access shaft and by closing off unused portions of the mine. This directed airflow through the mine to dissipate the gases. Naked flame lighting was commonly used by miners. Canaries were used to detect flammable gases but there was very little other protection for miners, particularly from falling debris. Over time, there were several incidents involving fatalities in the Huntly coalfields. These led to significant improvements in workplace safety for workers. It took the occurrence of these dreadful events for significant safety advances to be made in the mining industry.

Carbide Lamp
(2010.98.1)

Light Sources Used in Underground Mining (Internationally)

Type	Source	Time Period
Spout lamps	Wick immersed in oil	1850 - 1920
Flame safety lamps	Wick immersed in oil, napthalene, or gasoline	1796 - present (1)
Carbide lamps	Calcium carbide and water	1910 - 20 (2)
Arc lamps	Carbon electrodes and electric current	1878 - present
Personal Lamps	Incandescent, fluorescent lamp - personal	1920 - 55
Cap lamps	Incandescent, fluorescent lamp - cap	1925 - present
Face lighting	Incandescent, fluorescent high - pressure sodium lamps	1975 - present

(1) Currently used to check for methane at the working face
(2) Still used in some developing countries and some 1 or 2 person mines

(United States Department of the Interior)

Miners in New Zealand initially used spout lamps that consisted of wicks immersed in oil. This changed as the mining industry was forced to respond to multiple fatal incidences clearly triggered by unsafe workplace environments and practices.

Safety Lamp
(2010.103.1)

The Dip Disaster: 23 December 1890

The Dip Disaster was a significant early New Zealand mining calamity. It resulted in the deaths of four miners and one rescuer. The miners had been working on tender for the mining company that was securing the main roof supports for a shaft being driven from Lake Hakanoa towards Rayners Road. The mine was being extended due to a fault halting the progress of the original mine. During the process the support, anchored in soft ground, gave way trapping the men in the shaft. This led to a domino effect in which six wooden roof supports and the clay above them collapsed. (Waikato Times 25 Dec 1890) Two to three months later mining in that shaft was discontinued. (Danford 11) This was the first multiple fatality attributable to mining in the Huntly coalfields.

Those killed in the disaster were:

John Casby (miner)
Alexander Harris (miner)
Samuel Hyndman (miner/rescuer: died of his injuries some months later)
James Smith (miner)
John Tracey (miner)

Waikato Coalfields Museum Resources

Books, Articles
"The Dip Disaster." Chatter – A Community Newspaper (Danford, J.)
"Fatal Accident – Ralph's New Mine, Huntly" in Waikato Times
"The Mine Accident – The Inquest" in Waikato Times
Annual reports to the House of Representatives (from Mining Inspector) Vol. A-C

Ralph Mine Disaster: 12 September 1914

The Ralph Mine Disaster killed 43 men and left 19 survivors. A group of miners had been ordered into old workings to retreive timber for recycling. Firedamp (mainly methane) was ignited by the naked flame on miner John Martin's headlamp. The fatalities were caused either by the initial explosion or the fire that followed as the flame ignited the gas and coal dust in the mine and its walls. A further 19 men survived by escaping through the unused tunnels to the Taupiri West Mine. Sections of the mine were closed off by brattice (sheets consisting of sacking hung from the roof supports), in order to try to create air flow and dissipate gases as they amassed. (Edwards 29)

In Ralph's at that time as deputies were the only miners supplied with safety lamps. John Martin apparently went ahead of the group while Deputy Smith, who should have been leading the way and testing for flammable gas, brought up the rear. It is thought that Martin walked into a thick pocket of firedamp (methane) and as he did so, his light went out. When he relit the lamp, the firedamp ignited and created a cloud of coal slack, which exploded into a fireball that rose 100 feet above the pithead. The cage that usually transported the miners underground shot up from the shaft like a bullet becoming lodged in the poppet head seventy feet above the ground.

Main Street site of the Ralph Mine Disaster with cage lodged in poppet head. (2004.61.1)

The Human Cost of the Ralph Mine Disaster

Miners who lost their lives in the Ralph Mine Disaster					
First Name	**Last Name**	**Age**	**First Name**	**Last Name**	**Age**
William	Allen	18	William	Kelly	36
Thomas	Baker	37	Daniel	Lyons	62
William	Blenkinsop	37	Charles	Maloney	21
Thomas	Berry	29	John	Martin	29
John	Bowler	23	William Jnr	Mayland	18
William Snr	Broklebank	52	Theophilus	Molesworth	29
Hutchinson	Burt	19	Robert	Munsey	63
William	Burt	28	David	Paterson	36
William	Burton	27	William	Patterson	44
Thomas	Casson	22	Henry	Peckham	45
James	Darby	57	Hugh	Ransome	39
John	Dixon	-	John	Robinson	28
William	Gowans	43	William	Roper	36
John	Greener	48	Arthur	Ruston	28
William	Hinchco	37	John	Skellern	36
James	Holden	58	William	Slavin	18
Fawcett	Hopper	31	William	Smith	62
Alexander	Izatt	17	John	Steele	40
Henry	Jackson	24	Fred	Taylor	29
John	Jackson	26	Jacob	Thompson	18
Samuel	Jackson	54	John	Whorskey	36
John	Jones	49			

Three members of the Jackson family died as a result of the Ralph Mine explosion. The father, Samuel (54) and his son, Henry (24), died on the day of the explosion. His other son, John (26), died three days after. At the time of the explosion, John was wearing the fob watch shown to the right.

John Jackson's shattered fob watch (1980.368.1-6)

Miners who Survived the Ralph Mine Disaster			
First Name	**Last Name**	**First Name**	**Last Name**
William Jnr	Brocklebank	Glen	Mottram
Joseph	Brownlie	Joseph	O'Brien
Thomas	Earby	Alfred	Peckham
Arthur	Farrar	James	Richards
Daniel	Fletcher	Joseph	Ritchie
Bernard	Healey	Albert	Stewart
Thomas	Hughes	John	Tallon
Patrick	McGill	John	Wilkie
Alexander	McIntosh	James	Young
William	Mitchell		

The human cost of the disaster extended to those families of the men killed. The National Provident Fund Act (1910) allowed "for the support of dependent children by providing for the payment, on the death of a contributor, of a weekly allowance as long as any child is under the age of 14 and contributions have been made for five years." (Loeb,S.) However, it was not so positive for many of those children left behind after their fathers perished in the Ralph Mine disaster as a number of miners' families as they were caught out by the prerequisite five years of contributions to the National Provident Fund Act.

"Sir Thomas Wilford, who represented all the deceased relatives took the case collectively and didn't take into account the number of children some of the deceased had. My mother got 5/- a month and 5/- a week for my sister and myself. A welfare woman used to come and check on how the families were managing." (Interview with Mrs Pascoe (nee Brocklebank) in Edwards, 14)

The following case study demonstrates how the children of two of these families had quite different experiences as a result of the Ralph Mine Disaster.

Skellern Family

Ruth, Thelma and Elsie Skellern, whose mother Euphemia had died previously in childbirth, were raised by their grandfather Richard Skellen. Following the death of her mother and twin sister, baby Mavis was adopted by neighbour Mavis Greenacre.

John and Euphemia Skellern
(2010.164.7)

Ruth, Elsie and Thelma Skellern
(2010.164.8)

Patterson Family

The Patterson children were not as 'lucky' as the Skellerns. William at 14 was regarded as an adult and able to fend for himself. Eileen (3), Bridget (5), Lil (6) and Kathleen (8) spent an unhappy childhood in an Auckland orphanage. At 11 years of age Maria was considered capable of housework and escaped her sisters' fate in the orphanage.

Funeral Venue for the Ralph Mine Disaster
The community hall built by the miners was known as the Miners' Hall and was the preferred venue for the funerals. Unfortunately, the hall was not big enough for the number of deceased. As a result, recovered bodies were taken to the King's Hall for the coroner and subsequently the funerals were held in this same hall, built by the Ralph family in the main street of Huntly. This was definately not popular with many in the community.

"In the early 1900s the miners had decided they had wanted a hall in their community. The Ralph family had committed to projects in the past but refused on this request. The miners went ahead and built the hall. When the hall was nearly half finished Sarah Ralph had a hall built in the main street. This became known as the 'scab hall' and miners never set foot inside it, but after the accident it was the only building big enough to take all the 43 bodies." (Edwards 15)

The First Funeral for the Ralph Mine Disaster (1997.47.1)

Ralph Mine Disaster Royal Commission of Inquiry
The Royal Commission of Inquiry into the Ralph Mine Disaster convened on 1 October 1914, to investigate the cause of the disaster and recommend any changes to the mining industry to prevent a reoccurence of a similar event.

The Commission came up with a number of critical points of evidence and recommendations for the industry. It found that the explosion was caused by inadequate ventilation and inspection of the mine. The testing for flammable gases during the operation of the mine was deemed insufficient. The mine manager did not take enough care of the mine workers as the worked out areas of the mine had were not sealed off. The door leading into the area where the explosion occurred was not only unlocked, it was not even provided with a lock. This meant it was harder to exclude access to areas which should have been restricted. Naked flames were in use for repeated ignitions, causing minor explosions. None of the workers held a current Mines Department Gas License. On the day of the disaster, inspections had not been carried out to check for gas in the area of operation.

King's Hall: Funeral Venue for the Victims of the Ralph Mine Disaster (2004.365.1)

The recommendations outlined by the Commission of Inquiry Report led to legislation requiring the use of safety lamps in all mines.

Waikato Coalfields Museum Resources

Books
The Ralph Mine Disaster (Waikato Coalfields Museum Booklet)
Official Inquiry Report 1914 into the Ralph Mining Disaster
National Appendicies to the Journal of the NZ House of Representatives for Statistics on Mining data

Objects, Archives, Photographs
Fob watch belonging to John Jackson (miner) - this stopped at the exact time of the explosion (1980.368.1-6)
Breathing apparatus used by miners at the time of the Ralph Mining Disaster (2005.149.3)
Skellern Family Tree (Family History Files)
Memorial Service Programme *14th September 1974*
Memorial Service Programme *19th April 2009*
Memorial card for the funeral of Thomas Casson
Photographs:
Funeral processions of the victims of the Ralph Mining Disaster *(Accession no. 1997.47.1)*
Skellern Children (2010.164.8)
Ralph Mine (2004.61.1)
Bodies being carried to the King's Hall for the first funeral (2004.63.1)
Bodies being carried from the Taupiri West Mine
The Rescuers (2004.62.1)

Glen Afton Mine Disaster: 24 September 1939

The Glen Afton Mine Disaster was caused by an accumulation of carbon monoxide gas from a small fire caused by a short circuit. The fire was thought to have been extinguished. It was located at a fault between two sections of a coal seam and ignited sometime on the Saturday morning prior to the weekend shutdown. Miners placed mud between the seams in an attempt to extinguish the fire. Unknown to them, the fire continued to smoulder, causing the release of carbon monoxide gas.

Floral Tributes following the Glen Afton Disaster (2004.59.1)

Extraction fans had been turned off for the weekend and this led to a buildup of carbon monoxide in the mine. Later a fault was noted at the Huntly Power Station and traced to the line supplying electrical current to the Glen Afton Collieries. Management at Glen Afton were advised of this. Men searched for the source of the problem on Saturday afternoon and when they were unable to locate it decided to return the following morning.

On Sunday Christopher Blackburn, mine manager, and a group including engineers, electricians and mine deputies returned to the mine. When Blackburn discovered that the two deputies and two electricians were trapped in the mine, he sent an urgent message for the extractor fans to be started. He then led a party of four other men into the mine, followed by two others who were sent to a different part of the mine.

Following this, four other men had entered the mine. Subsequently, several others ventured in, until those on the surface realised something was wrong. Whilst some of the men were lucky and managed to get out, eleven men died. As a result of the order to turn the fan on gas was forced through the mine hastening the death of the rescuers. (Edwards 26)

Victims of the Glen Afton Mining Disaster 23 September 1939		
First Name	**Last Name**	**Position**
William	Bell	Electrician
Christopher	Blackburn	Mine Manager
William	Brown	Miner
James	Clark	Miner
Walter	Cole	Deputy
George	Hunter	Miner
Richard	Ireland	Miner
John	Marshall	Miner
William	Peden	Miner
Raymond	Turley	Electrician
William	Wilcox	Deputy

George Hunter

George Hunter was a shiftman at the Glen Afton Collieries. He was killed in the disaster and was survived by his wife, Margaret, and their two young children Helen and George junior.

George Hunter with his wife Margaret and children: Helen and Georgie (Family History Files)

A letter from Margaret to George's family, written nearly a month after the disaster, provides a poignant insight to the situation in which the family found themselves. Margaret was clearly upset when writing, "I have to try and hide my sorrow. Every time she (Helen) sees me crying, she nearly goes into hysterics. We've had an awful job with Georgie, I've had to leave him with neighbours once or twice, he doesn't like me out of his sight. We go to bed at seven each night I can't sit up." Margaret continued "the fans [at Glen Afton Collieries] are suppose (sic) to work 2hrs before any man goes in the mine and they weren't on, so there will be some trouble about it. [This] tragedy will go down in history.".

At 10:15am on the Sunday, Mr Thomas, an underviewer from the mine had requested George Hunter's assistance. Prior to leaving for work, George could see smoke coming from the mine and he said, "Don't worry it will be another fire. I get double pay for today's work and I will see you later."

This was the last time Margaret Hunter, Helen and wee Georgie saw George alive, after having earlier shared breakfast in bed together. When Margaret delivered George's food at 3:30pm she saw ambulances and cars at the entrance to the mine and, in her letter, describes a feeling of unease she later interpreted as a premonition of the disaster. Margaret waited with members of the families of the other missing miners until 8 o'clock that night. Eleven bodies were removed from the mine, one of whom was George Hunter.

George Hunter's grave in Ngaruawahia Cemetery (Family History Files)

George's death in the disaster also brought financial and emotional difficulties for Margaret, and their children. Their circumstances were further complicated because George had not made a will. This meant the affairs of his estate were handled by the Public Trust. There was a compensatory company grant of £1,000 following the disaster. With a paltry pension of

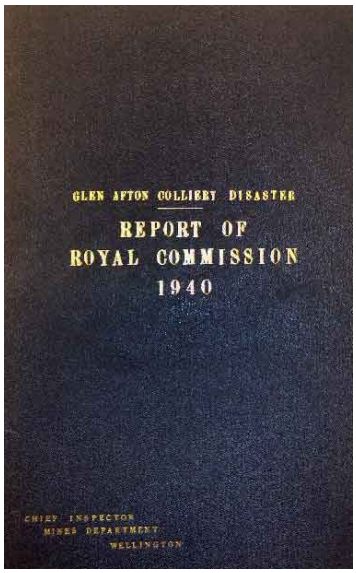
£1/15/0 Margaret and the children found it difficult to survive. With the help of financial assistance from her in-laws Margaret returned to Scotland with the children. Some nine months later Margaret was forced to return to Auckland as the monies held in trust for the children were administered in New Zealand. Margaret eventually remarried.

For many years, George and Margaret's extended families lost touch with each other. Recently through independent emailed inquiries to the Waikato Coalfields Museum website, staff have been able to put later generations of these families in touch once more. As all family members are now living the the United Kingdom it proves the value of the museum's archive of Family History files.

Royal Commission of Inquiry

The Royal Commission of Inquiry opened on 27 November 1939. It reported a number of failings and recommendations to be implemented in the mining industry nationwide, to prevent this sort of disaster happening again. The inquiry found that the fire was caused by a short circuit. It was found that the management of the mine was substandard and that the deputy's recording of potential hazards and abnormal circumstances was lax. These shortfalls were minor issues in themselves, however, when combined with other lapses and errors, led to disproportionately tragic consequences. (Edwards)

This disaster resulted in the establishment of a Mines Rescue Unit for the Waikato Mining Region.



Commission of Inquiry Report (2004.3.1)

Glen Afton Community

At the time of operation, the mines were a place of community. Glen Afton quickly became a model township, based around the mine. Everything had to be designed and built from scratch. Not only did the miners depend on each other with their lives inside the mines for safety, they also spent a large part of their time outside the mines together.

The Glen Afton community boasted a series of facilities which were financed through county council and ratepayers association projects. These facilities included: shops, bowling greens, rugby league grounds, railway station, Post Office, community hall (for dances, meetings and Sunday movies), hotel and well-known pottery.

Peckett Locomotive at Glen Afton Collieries 1955 (2010.176.1)

Waikato Coalfields Museum Resources

Books
Commision of Inquiry Reports
Annual reports to the House of Representatives (from Mining Companies)
Appendicies to the Journal of the House of Representatives

Objects, Archives, Photographs
Miner's carbide lamps 2010.98.1
Miner's battery powered safety lamps 2010.1031
Hand-held methane gas tester
Permanent Mine Disaster exhibition in Coal Hall

Audio/Visual
DVD Coal – Fueling the Future Part 3: Work and the challenges of Miners (10 min)
DVD Early Coal Mining Methods (12 min)

Explosion at the Huntly West Mine: 20 September 1992

Huntly West Mine opened in 1975 as an underground mine. It was established particularly to support the Huntly Power Station and specific conveyor systems can still be seen by drivers on back roads, wandering across paddocks between the site of the mine and the Power Station. Following a fire, which started on 20 September 1992 and raged for four days in the Huntly West Mine, there was a massive explosion which was heard several kilometers away. Workers had all been evacuated before the explosion but eight men were above ground on the site at the time of the explosion. None were injured in the blast. (Waikato Times 24 September 1992) Subsequently the mine was flooded extensively and this resulted d in the loss of expensive mining equipment which became submerged and unsalvagable.

Offices at Huntly West Mine after the explosion. (2005.196.17)

A report into the explosion by the Chief Coal Mine Inspector concluded that a delay in reporting the discovery of smoke in the mine was a significant contributing factor in the explosion.

Whilst no miners were injured, the explosion resulted in nearly 100 workers eventually being laid off from CoalCorp's Huntly mines. (Waikato Times 20 September 1993), bringing significant socio-economic problems for the miners and families involved.

The Role of Unions

The first miners' union in the Waikato region was the Waikato Miners' Union founded in 1889 by miners from the Ralph mines. However, it was relatively shortlived, being disbanded shortly after the Dip Disaster on 23 December 1890 (see page 18).

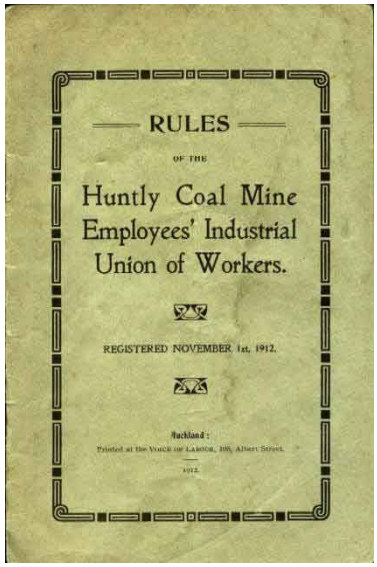
Originally access to the mines was by the use of a rope and pulley network. When exiting the mine with a full bucket of coal, the miner held onto the rope with his other hand. This

method of access caused injury to miners and resulted in reduced productivity for the mining companies and owners. The union was formed in response to a requirement from the mining companies that miners undergo a medical examination at their own expense.

The Coal Mines Amendment Act 1901 allowed for workmen, at their own cost, to appoint any two persons outside the mining industry to inspect the mine at least once a month. (Nelson Evening Mail, vol XXXV, Issue 192, 23 Aug 1901 2). These inspections were to check for the level of cleanliness, the presence of dust and for the safety of the roof supports. The rigour of these autonomous safety checks were obviously dependent on the knowledge and experience of the person selected to carry out the checks. There was no objective standard of safety to provide a benchmark against which the environment of each mining workplace could be accurately measured.

During the Second World War the government took control of mining operations nationally. In the Waikato region labour and materials were made available during this period for the construction of housing in Rotowaro and Glen Afton (New Zealand Herald, Oct 31 1942). This was a huge morale booster for the miners. It was noted by the New Zealand Herald on 2 November 1942 that "production had gone up and the men are working splendidly and ... the goodwill of the parties concerned had never been better in the whole history of the Waikato minefields."

It was not, however, until the Coal Mines Act 1979 that regular medical examination of miners, increased mechanisation of the mining process and increased control of the dust in the working environment became regulated. This brought New Zealand into line with overseas standards. (New Zealand Herald, 1980).


RULES
OF THE
Huntly Coal Mine Employees' Industrial Union of Workers.
REGISTERED NOVEMBER 1st, 1912.
Auckland:

Huntly Coal Mine Employees Industrial Union of Workers (2004.444.1)

Rehabilitation of Working Environments

On the west side of Huntly, Weavers Opencast Mine opened in 1956 and was subsequently mined both as an underground and opencast facility. It left a huge pit when it closed in 1993. Planned rehabilitation led to this area becoming a deep water lake with jetties, boat ramps and diving platforms. "We tend to look at Weavers as a bit of a model, because there's a social aspect to it and there's also an environmental and ecological aspect. Now ecology wise, we've planted about 30,000 native and exotic trees around there and created wetlands in association with it." (Cook 193) Subsequently this area has been renamed Puketirini.

Weavers Opencast Mine, now a deep water lake. (2004.324.1)

In 2000 the New Zealand School of Commercial Diver Training opened with all underwater exercises taking place at Puketirini in Huntly (New Zealand School of Commercial Diver Training). The school has a long-term lease with the Waikato District Council. (Puketirini Management Plan 2010) The dive school is industry-oriented and it attracts students from New Zealand, Australia and other countries. The attraction of Puketirini as a site for the school is the depth of the lake and the quality of the water which indicate its value as a unique diving location despite, or perhaps because of, its industrial history.

Effects of Mining on the Community

The mining of coal has provided many benefits for the people of the Huntly region. However, not all the effects over the years have been positive especially as the physical results of underground mining in Huntly have become apparent. "Underground mining has led to uneven subsidence that can cause damage to buildings and services." (Institute of Geological & Nuclear Science Ltd Aug 2002 1) Resulting subsidence in the residential areas led to uneven collapse of land and buildings resulting in the forced relocation of some residents. Horizontal voids, covering a wide area, have been left after coal has been extracted. This is because the coal seams are relatively flat-lying. Resulting ground subsidence can extend over the large area of underground workings. (ibid)

In 1974, State Coal Mines advised the Huntly Borough Council that there would be no more mining within the borough. By mid 1984 subsidence had begun to take place. In excess of 350 houses were later declared to be in an 'at risk area.' (Huntly Borough Council in the Huntly Subsidence Committee Newsletter 16 Nov 1985) During the 1980s a number of relocations took place to ensure the safety of residents. Residents were given the option of having their land purchased by State Coal Mines or of their homes being repaired at the expense of State Coal Mines.

In Burke Street the Electricity Department Hostel was closed due to subsidence of one metre under its foundations. It was built on a heavy concrete foundation on unstable land. With the underground mining at a depth of approximately 300 metres, damage was caused to the hostel. Cracks appeared in the walls and doors jammed. Water pooled around the building, which led to the development of swampy ground. This subsidence means green fields and cattle will always remain at the back of this hostel, although surrounded by housing.

Waikato Coalfields Museum Resources

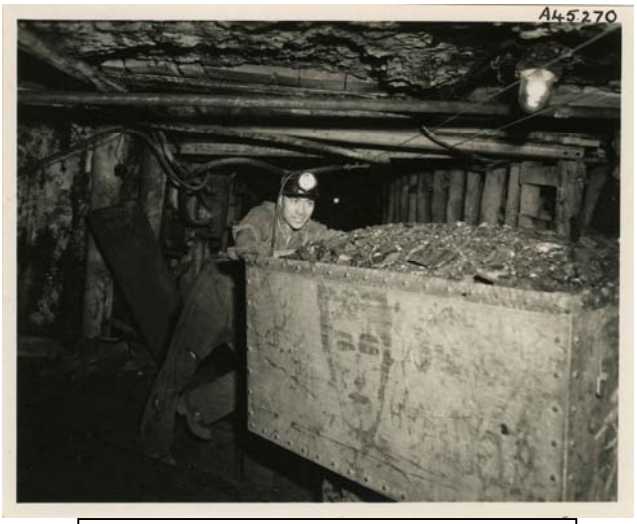
Books
"Mine Rehabilitation" - Coal NZ
Interim Report on the Subsidence of NZE Hostel, Burke Place, Huntly (2002.443.1)

Objects, Archives, Photographs
Archive on Huntly Subsidence

Rotowaro: the Town and the Mine

The word Rotowaro means "lake of coal". Rotowaro was a village built to harvest coal from its surroundings. The Rotowaro site hosted a number of mines following different coal seams. Drives from the Alison No 1 Mine (1939 –1974) went under the township and residents could, quite literally, feel the mining processes taking place beneath them. Given this, it should have been no surprise when eventually villagers were informed their town was to be destroyed in order to mine the coal upon which it stood.

In 1916 the Taupiri Mining Company purchased swampy land at Rotowaro to start a new mining venture and to build a workers' village. Over the years, various other blocks of land were acquired as the industry grew. Part of this purchase included the Maori Farm block that once belonged to King Koroki. The network of underground mines grew until miners were extracting coal from underneath their own houses In 1985 Mahon's Mine closed, ending a 69 year history of underground mining at Rotowaro.



Archie Katipo at Renown Mine, Rotowaro
(1996.122.1)

The mining system used in the Rotowaro mines was the Bord and Pillar method. This was relatively inefficient as it left 80% of the coal underground (Cook 2006). As a result, State Coal decided to opencast mine the coal underneath the township. Rotowaro residents were informed of their intention in 1979 and the destruction of a community slowly gathered momentum. Residents were given eight years to relocate from the village. Understandably many were angry and scared at the thought of compulsory relocation. They wrote letters of protest to articulate their resistance. Sadly, if somewhat predictably, these protests were largely disregarded (ibid) and the town had been abandoned by its residents by the end of the 1980s.

The life of the township of Rotowaro did not solely centre on the workings of the mine. A school had opened in 1924. There was a marching team, a football club, a bowling club, and a hall which hosted films, dances and indoor bowls. There were 100 houses, twelve of them privately owned. Many of the houses were eventually relocated to Huntly by residents. Other homes were flattened, evicted occupants forced to find alternative lodgings. Twenty-four Maori families received assistance from Maori Affairs to move to hapu-owned land at nearby settlements of Glen Afton and Pukemiro. A few others moved further afield to locations such as Palmerston North and Australia. (Cook 1984)

Rotowaro Miners
Photograph: David Cook
(2010.144.18)

In 1984 the Hamilton-based photographer David Cook was commissioned by the Waikato Museum to take a series of photographs to document the story of Rotowaro. This became a lengthy project that lasted until 2005. In 2006 Cook published his book Lake of Coal: The Disappearance of a Mining Township, a predominantly pictorial narrative of Rotowaro's destruction. The Waikato Coalfields Museum holds copies of many of the images used in this work.

Wairua o te Whenua: Wairua o te Tangata

There had long been a larger ratio of Maori to Pakeha living within the Rotowaro township. With their traditional affinity to the land, the effect of this compulsory relocation on local Maori was significant and disturbing. In 1951 the population of Rotowaro had peaked at approximately 660, by 1981 this had fallen to 428 (Centre of Maori Studies and Research). In 1985 David Cook observed that there were only three non-Maori children attending Rotowaro primary school.

Josie Kingi and friends in Matai St, 1984
Photograph: David Cook
(2010:144.17)

The practicalities of the displacement of the township's Maori population (consisting of both Tainui and non-Tainui individuals) resulted in real cultural and spiritual trauma that was largely unaddressed by State Coal. Articulating a highly sensitive example of cultural and spiritual wounding, The Centre of Maori Studies and Research observed that "Non-Tainui residents lack these opportunities for tribal identity and integration but to replace them to some extent by a sense of belonging… For their burials they must take their dead back to their tribal areas or use civic facilities". As already suggested, Maori have been associated with the general area of Rotowaro for generations: to destroy the township and pollute the land ended their ability to continue their complex relationship with the whenua on which they and their children were living.

Boy on Horse Overlooking Maori Farm Mine
Photograph: David Cook (2010.144.16)

Waikato Carbonisation Limited

Waikato Carbonisation Ltd built the Rotowaro Carbonisation Plant in 1931 to process coal slack from the Rotowaro Coalfields. The carbonisation plant used the Lurgi Process under license from the copyright owners, Metalgellschaft of Frankfurt, Germany. Consequently, much of the remaining structures are examples of German design - industrial Art Deco. Although the main product of the Lurgi Process was solid fuel briquettes (carbonettes), by-products were tar, creosote and phenol. The building of the plant is seen as as symbolic of New Zealand's growing national attitude toward technology and movement away from England, given that the technology was sourced from Germany. Several of the establishing engineers still present at the beginning of World War II had to be deported.

The carbonisation plant, surrounded by piles of carbonettes, ready to be sold as household fuel. (2004.192.1)

At this time there were few policies governing the environment or regulating the use of ingredients for the creation of these products, resulting in the creation of dangerous by-products. During periods of over-production phenol would be released directly into the Awaroa Stream, which feeds into Lake Waahi.

The plant was once part of a larger industrial complex including several houses, a bunkhouse, and the locomotive and industrial workshops for the Rotowaro Mine.

During its time of operation, fires and explosions were a constant risk for those working at Waikato Carbonisation Limited. In 1974 a workman, James Wood, was killed in an explosion at the tar still in the plant. When the retort exploded in 1987 the plant was permanently closed. (G. Nicholson 2007)

After the closure, the remaining pollution was severe, requiring coordinated clean up efforts by national, regional and local government. Containment areas were created in the 1980s but these eventually proved ineffective and required urgent attention following discharge of pollutants into local waterways. With the passing of new legislation, resource consents were declined. After the company went into voluntary liquidation, the site was passed to the regional council (now Environment Waikato).

Waikato Carbonisation Limited (2010.151.1)

From 1991 to 1996, Environment Waikato cleaned the site with funding from the Ministry for the Environment. This was done through the incineration of approximately 11,000 cubic meters of stored waste at the Kinleth pulp and paper mill. The remaining 4,000 cubic meters of sludge was put into a treatment pond, where air and nutrients were added, with the aim of assisting in the breaking down of the contaminants. Phenol pollutant levels then dropped from 550 parts per million (ppm) to 10 ppm and hydrocarbon levels from 630 ppm to 19 ppm. The remaining sludge has been mixed with clay, spread over land and contoured away from waterways. The cost for this cleanup was approximately $900,000. (Environment Waikato ref 2)

The plant is the only building of its type in New Zealand and may be the only such structure surviving in the Southern Hemisphere. New Zealand Historic Places Trust has designated the site a heritage area and has allocated at least two of the surviving buildings a Category I status; meaning that they cannot be demolished or altered in any way. Nowadays, the plant is inaccessible from the road. It is in the midst of the Rotowaro opencast mining operations and access to the site is only possible at the discretion of Solid Energy. As part of the clean up operations, an earthen bund was placed around the site. This has flooded, leaving the buildings standing in a lake.

Due to the ongoing potential for remaining contaminants leaking into the Awaroa Stream, Environment Waikato made a successful application for financial support to the Ministry for the Environment's Contaminated Site's Remediation Fund. The initial indication is that this will amount to $1.3 million. (Environment Waikato ref 1)

Removing sludge from storage pond

(Environment Waikato)

Active treatment pond

Waikato Carbonisation Works in 2002 following vandalisim and theft of roofing iron and bricks.

Fire at Waikato Carbonisation Works 1974 (2004.58.7)

The site continues to provide a representative example of industrial practices prior to current safety and environmental requirements.

Waikato Coalfields Museum Resources

Books
Lake of Coal: The Disappearance of a Mining Township (Cook, D., 2006)

Reports
Rotowaro Opencast Coalmine Technical Mine Report on Maori Cultural and Spiritual Values (Centre of Maori Studies and Research, 1986)

Objects, Archives, Photographs
2004.208.1 Photo in 1978 of the Carbonisation Plant
2004.204.1 Photo in 2004 of workers at the Carbonisation Plant
2004.222.1 Photo of new Carbonisation Plant in 1931
2004.58.1-9 Carbonisation Plant Fire 1974 in which James Wood died

Audio/Visual
DVD - Coal – Fueling the Future Part 1: Coal and the Environment
DVD - Coal – Fueling the Future Part 2 : Rotowaro The Closure of the Rotowaro Township and Interviews with Past Residents

Glossary

Anthracite	A hard, black, shiny coal, which is very high in fixed carbon and low in volatile matter, hydrogen and oxygen.
Biogas	Energy produced from the anaerobic digestion of sewage and industrial waste.
Biomass generation	Generation of electricity by the burning of trees and grass crops, forestry and urban.
Bituminous coal	A relatively soft dark brown to black coal, lower in fixed carbon than anthracite but higher in volatile matter, hydrogen and oxygen.
Brattice	Sacking erected in passageways of underground mines to direct air from main airway. Made from impermanent materials as the roof was progressively allowed to collapse as the coal face advanced.
Carbon dioxide	Gas produced through the burning of carbon products (including coal).
Carbon monoxide	Poisonous gas released in the mines following the use of explosive charges to release the coal from the coal face.
Carbonisation	The industrial process to reduce coal slack to carbonettes.
Carbonisation plant	An industrial plant designed to make profitable use of coal slack.
Char	The solid carbonaceous residue that results from incomplete combustion of organic matter.
Coal	A hard, black substance, mainly carbonised plant matter found in underground seams and used as a fuel.
Coal face	The actively mined area of a coal mine.
Coal seam	A layer of coal.
Coal tar	A thick, black, oily liquid, distilled from coal and used as a source of benzene.
Coking Coal (Coke)	The end product when coal is burned in the absence of oxygen, which reduces volatile gases, leaving almost pure carbon. This is used in industrial steel and aluminium manufacturing in a blast furnace.
Creosote	Wood preservative.
Drive and drift	Mining method involving vertical mine shaft and horizontal mining of coal.
Firedamp	An explosive mixture of gasses of which methane is the predominant part.
Fossil fuels	Coal, natural gas and fuels derived from crude oil (including petrol and diesel). They have been formed over long periods of time from ancient organic matter.
Geothermal	Electricity generation by naturally occurring steam.
Greenhouse gas	Gases that increase the temperature of the earth's surface. These include water vapour, tropospheric ozone, chlorofluorocarbons, carbon dioxide, carbon monoxide, methane and nitrous oxide.
Hydro electric	Electricity generation by water.
Lignite	A brownish-black, woody structured coal, lower in fixed carbon than either anthracite or bituminous coal, but higher in volatile matter and oxygen.
Longwall mining	Driving underground roads along a continuous block of coal before extracting the entire block on the return journey - accounts for about 50% of the world's production of coal.
Methane	A flammable gas created by decomposition of organic matter, which is released as the coal is mined.
Mine	An excavation in the earth for extracting coal or other minerals.
Mine roof	The layer of rock or mineral over an underground mine working.
Mine shaft	A passageway allowing access to a mine.
Natural gas	Consists mainly of methane occurring naturally in underground deposits. It may be associated or free gas.
Opencast mine	Mining by the removal of the surface layers, working the mine from above, rather than from the shafts of a mine.
Overburden	Layer of soil and useless rock on top of the coal being mined by the opencast method.
Oxygen	A colourless, tasteless, odourless, gaseous element, occurring naturally in most minerals and organic substances.
Peat	Vegetable matter decomposed in water and partly carbonised, a precursor to coal which then requires compression.
Pit-head	The entrance to a mine shaft.
Pit props	Timber supports used to hold up the roof of an underground mine tunnel
Slack	Very fine powder, a residue of mining.
Spragg	A piece of timber or iron between the spokes of a cart wheel to slow down coal cart.
Stopping	A wall erected across the entrance of a worked out or dangerous area, so that air cannot pass into the disused district.

Sub-bituminous	A glossy-black made of smaller particles coal that bituminous coal. It has a higher oxygen content than bituminous coal.
Subsidence	An area of ground that has sunk due to underground mining beneath.
Sulphur	A pale yellow, non-metallic element with a suffocating smell which occurs in coal.
Tailings	The waste products after mining.
Underground coal gasification	The burning of coal underground without mining and the collection of the gas to a turbine for the generation of electricity.
Underground mine	Mining by the removal of coal from an underground tunnel network.
Ventilation fans	Fans in the underground mining tunnels used to disperse poisonous gases released during the mining of coal.

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Waikato Coalfields Museum Booklets

Glen Afton Mine Disaster
Heritage Recipes
Huntly Brick: The Brickworks and the Buildings
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Huntly Street Names
The Ralph Mine Disaster

Museum DVD's and Audio Visual Resources

DVD: Early Coal Mining Methods
DVD: Coal Corp: Uses for Coal

Oral History Archives

Details of our ongoing Oral History Archive project are available on request.