



Royal Commission on the Pike River Coal Mine Tragedy

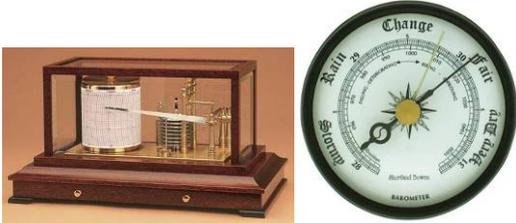
Te Komihana a te Karauna mō te Parekura Ana Waro o te Awa o Pike

Expanded Glossary – 14 June 2011

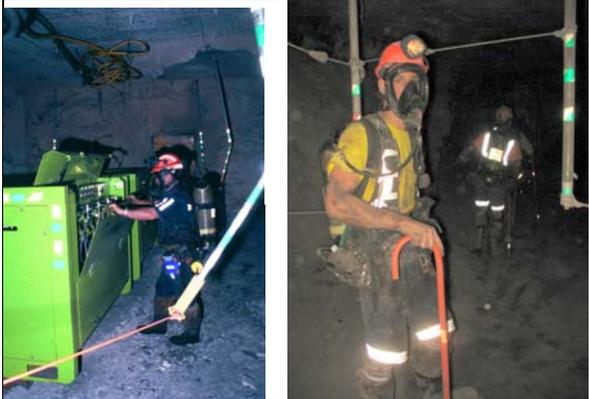
Term	Common definition	Notes	Example Picture or Diagram / Use of common term
Absorption Isotherm	A theoretical measure of the potential gas that could be contained within a coal inferred to be in its natural state.	An absorption isotherm is derived to forcibly charging a desorbed coal sample with gas under pressure and temperature conditions considered likely to replicate the maximum possible gas bearing capacity of the coal in its natural state. The absorbed gas content is typically twice that or more the gas content of the coal measured by desorption methods.	
After damp	Noxious mixture of Mine Gases resulting from a coal mine explosion.	<p>Afterdamp could be associated with a mine fire however it is more commonly associated with the mixture of mine gases resulting from an explosion.</p> <p>It could consist of water vapour, carbon monoxide, carbon dioxide, nitrogen, low levels of oxygen, water vapour, hydrogen, ethane, ethylene, acetylene, and other miscellaneous distillation products.</p> <p>The mixture of gases will vary, depending on the fuel source (eg. If it is predominantly methane, or predominantly coal dust, or a ratio in between).</p> <p>In general the atmosphere is irrespirable to due to the lack of oxygen and is often toxic due to the carbon monoxide.</p>	<p>Noxious. Adjective.</p> <p>harmful, poisonous, or very unpleasant: <i>they were overcome by the noxious fumes</i></p>
Air short circuiting	When all or part of the airflow does not complete the planned ventilation circuit because it finds an alternative route.	Intake air enters the mine from surface via shafts, ventilation raises or portals. The air is distributed through the mine via internal raises, tunnels, and roadway. Ventilation flows are controlled by regulators, ventilation control devices, and ventilation fans.	<p><i>"Fresh air did not arrive at the working place because it was short-circuiting into the main return. A set of double-doors had been left open".</i></p> <p><i>"The quantity of air at the face was low, because most of it had short-circuited at joins in the ventilation ducting. There were no rubbers on the joins".</i></p>

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		<p>Ventilation inefficiencies occur when not all of the planned ventilation arrives at the places it was intended for, for example, the working places.</p> <p>This can be caused by leakage including short-circuiting (eg. doors left open or ventilation ducting without rubbers).</p> <p>It is noted that some leakage or re-direction of airflow is planned or anticipated eg. to remove gases from a goafed area, or to maintain cut-throughs free of methane layering or heat where transformers are located.</p>	<p><i>Air was short circuiting through a damaged ventilation control device (eg. stopping).</i></p> <p><i>“Air was short circuiting past the double doors. The rubbers were damaged”.</i></p>
Airflow	Movement of air through underground roadways.	<p>Air is generally considered breathable and will sustain life. Ventilation however may contain contaminants that are detrimental to health and safety.</p> <p>Normal fresh dry air is respirable, and consists of approximately 20.93% O₂, 78.09% N₂, 0.03% CO₂ and other inerts including argon 0.93%.</p> <p>NZ Regulations states that Meaning of fresh air (1) A reference in these regulations to fresh air means that the air—</p> <ul style="list-style-type: none"> (a) contains not less than 19% by volume of oxygen; and (b) contains not more than 1 ppm of aldehydes (as formaldehyde); and (c) shows a concentration of respirable quartz dust of not more than 0.2 milligrams per cubic metre on a long-term exposure; and (d) shows a concentration of respirable coal dust of not more than 3 milligrams per cubic metre on a long-term exposure; and (e) contains the following gases at the lowest practicable level and at no more than the following levels: <p>Time-weighted average exposure (ppm)..as per schedule</p>	<p><i>“The airflow direction was from 4 to 5 cut through”.</i></p>

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Alimak	Alimak Hek AB is a Swedish-based manufacturer of specialised elevators for developing a shaft, raise or steep incline. An Alimak was used to develop the lower half of the main ventilation shaft at Pike River Mine.	<p>In underground mining a raise (or rise) refers to a vertical or inclined excavation that leads from one level, or drift, to another. A raise may also extend to surface. One method of excavating a raise is by the Alimak system of mining.</p> <p>At Pike River Mine, the Alimak raise connected the coal seam workings with the circular ventilation shaft. It is noted that the Alimak raise forms a part of the main ventilation shaft, which consists of a lower rectangular-section being the Alimak section, and an upper circular-section).</p>	
Anemometer	Instrument for measuring the air velocity within roadways.	<p>The most common instrument is a vane anemometer which consists of a windmill arrangement of vanes.</p> <p>A long handle is used to extend the reach.</p>	<p><i>"He took the velocity reading with a vane anemometer."</i></p>  <p>Kestrel type Analogue/Dial type</p>
Ascensional ventilation	Movement of air or gases to a higher point (uphill).	<p>Ascensional air could refer to return air in a mine being warmer than intake air in a mine, therefore of lower density and thus this air will rise.</p> <p>Definition of Ascent 1a : the act of rising or mounting upward : climb b : an upward slope or rising grade : acclivity c : the degree of elevation : inclination, gradient.</p>	
Auxiliary fan	Smaller fan used to ventilate dead-end roadways underground. Used in conjunction with ducting to force or extract air to the end	The flow-through or primary ventilation system provides the <i>main ventilation circuit</i> for the mine. Air enters the mine due to either natural ventilation or from the mechanical action of the main ventilation fan(s). Air enters from surface via shafts, ventilation	<p><i>Mains ventilation was supplied by a fan installed at the bottom of the shaft. An exhausting auxiliary fan was used to ventilate a blind heading in the production area. That auxiliary fan directed fresh air to the working place via 80 metres of fibreglass ventilation ducting of 620mm</i></p>

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	of the road.	<p>raises or portals and is distributed throughout the mine via internal ventilation roadways, tunnels, raises and shafts.</p> <p>Ventilation flows are controlled by regulators, permanently installed ventilation fans, and ventilation control devices including stoppings, overcasts, and brattice.</p> <p>Auxiliary ventilation systems take air from the flow-through system and directs it to mine workings. Auxiliary ventilation systems include temporarily mounted ventilation fans, venturi's and disposable fabric (eg. Brattice), or ventilation ducting.</p>	<p><i>diameter.</i></p>  <p>Picture of an auxiliary fan in an underground mine.</p>
Barometric pressure	Atmosphere pressure as indicated by a barometer.	<p>Atmospheric pressure at any particular point is equivalent to the weight of the atmospheric vertically above the point and it is consequently lower at high-lying places than at low lying places. For most practical purposes it is convenient to remember that the atmospheric pressure at sea level is about 100 kilopascals and that it decreases by 1KPa for every 90 metres above sea level.</p>	 <p>Typical Barograph Typical Barometer</p>
Bleeder heading	<p>A roadway that is a part of the ventilation system used to manage methane accumulations in a goaf. Return roadway on the downwind side of an extraction area that is not directly connected by a roadway to the intake (fresh air) side. Used to draw seam gas away from the extraction area – carries the contaminated air.</p>	<p>Bleeder headings form a part of a strategy to keep methane from accumulating in the goaf (or gob) and away from active workings.</p> <p>The method relies on the placement of ventilation regulators to create pressure drops sufficient to ventilate the goaf and sweep away gases that might otherwise spill over into active workings, during (for example) large barometric changes which might otherwise result in uncontrolled release of gas into active mining areas.</p>	<p><i>“Bleeder roads were established to assist in managing methane at the mine. They contained high levels of methane”.</i></p>

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Booster fan	Fan located underground within the main ventilation circuit to increase airflow. The fan is installed so that all air passes through the fan.	Booster fans increase ventilation pressure to overcome resistance. The idea is to force adequate amounts of air to distant workings. They are used predominantly in areas that are difficult or uneconomic to ventilate with main surface fans alone.	 <p data-bbox="1444 550 1892 574">Picture of underground booster fans</p>
Bore Hole/Drill hole	Drillhole created by drilling to gather geology information or gas drainage. Can be done from the surface or underground.		
Brattice Fire Resistant Anti Static (FRAS)	Impervious plastic/fabric cloth used in the construction of ventilation control devices, eg stoppings, curtains etc.		 <p data-bbox="1444 1165 2060 1189">Brattice wing being used to “scoop” air into a stub</p>

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CABA system	Compressed Air Breathing Apparatus – Same system used by fire fighters. A CABA system may include a fix compressed air supply where units can be refilled while being used or a back pack system similar to scuba diving.	Provides cool air with limited breathing resistance compared to a self contained self rescuer.	
Caving / roof fall	Process where the roof is undermined and fails to the extent that the roof collapses.	In mining, the term <i>roof fall</i> is used to refer to a range of collapses, ranging from the fall of a single flake of shale or coal to collapses that prevent access through the roadway or form sink holes that reach to the surface. Note that roof falls in mining are not all accidental or unplanned. In longwall mining and retreat mining for example, miners systematically remove all support from under large areas of the mine roof, allowing it to settle just beyond the work area. The goal in such mining methods is not to prevent roof fall and the ensuing surface subsidence but to control it.	<p><i>“The Cross Mountain Mine disaster was a coal mine explosion that occurred on December 9, 1911 near the community of Briceville, Tennessee, in the southeastern United States. In spite of a well-organized rescue effort led by the newly-created Bureau of Mines, 84 miners died as a result of the explosion. The likely cause of the explosion was the ignition of dust and gas released by a roof fall”.</i></p>
Coal Measures	Coal measures comprise strata containing coal seams deposited in the same geological period.		
Coal Rank	Coal Rank varies from peat, lignite, sub bituminous, bituminous and anthracitic coals.	The Brunner Coal at Pike River is a high volatile bituminous coal.	
CO/CO ₂ Ratio	Ratio of carbon monoxide to carbon dioxide concentration used to assist the assessment of spontaneous combustion. A high proportion of CO is indicative that spontaneous combustion	Note- The ratio is indicative only. It needs to be established and validated at each mine. CO ₂ as a seam gas for example, will distort these ratios.	

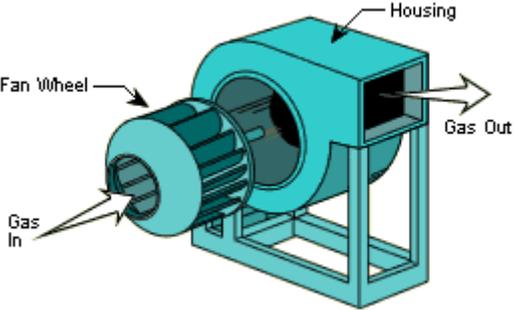
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	<p>is occurring. Typical Ratio are</p> <ul style="list-style-type: none"> • <0.02: normal; • <0.05: temperature of coal <60°C; • <0.10: temperature of coal <80°C; • <0.15: temperature of coal <100°C. 		
Control Room	<p>Surface location (operations centre) performing the centralised function of monitoring, operating and controlling the mine. This involves items such as data recording, controlling pump and conveyor systems, monitoring the mine atmosphere and responding to alarms. The control room acts as central communication point as is typically manned when personnel are underground.</p>	<p>Note- Control Room versus communication centre. May be different things.</p>	<p><i>“A control room was established at the mine. A function of the control room operator was to acknowledge alarms that are activated when gas alarm levels were exceeded”.</i></p>  <p>Example</p>
Continuous Miner (or Miner) (CM)	<p>Purpose built machine (track mounted, electrically driven) for developing roadways and extracting coal. Capable of loading the cut material into the coal transport system (e.g. flume, shuttle car, conveyor).</p>	<p>Notes- ABM20: A type of continuous miner, manufactured by Voest-Alpine, that allows simultaneous coal cutting and roof support. It is capable of loading the cut material into the coal transport system (e.g. flume, shuttle car, conveyor).</p>	<p><i>“The continuous-miner developed the roadway in coal. The machine was also capable of excavating soft rock, however this would result in damage and higher maintenance costs”.</i></p>

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			 <p data-bbox="1444 464 1836 491">Picture of an ABM20 (example)</p>
Conveyor	Fixed equipment used for transporting stone or coal.	Belt conveyor (system) consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward.	<i>Coal was loaded onto the conveyor belt. When the coal was very wet, a lot of material would fall off the conveyor belt”.</i>
Crosscuts or cut-through	Underground roadways developed at regular intervals to join one or more main roads.	<p data-bbox="741 756 1393 815">A roadway driven at an angle to the main roadways. Commonly used to inter-connect main roadways.</p> <p data-bbox="741 852 1393 979">This is the mine opening at an angle to the main heading direction. It is the roadway which joins one roadway to another; they are numbered in sequence going inbye along the length of the development.</p>	<p data-bbox="1444 756 2145 847"><i>“Supplies were mainly stored in cut-throughs. That prevented them from being hit by machines travelling on the main road”.</i></p> <p data-bbox="1444 884 2114 943"><i>“The transport rules required pedestrians to retire to a cut-through, when they saw a machine approaching.”</i></p> <p data-bbox="1444 979 2114 1038">A and B headings were joined at 9 and 10 cut through (c/t)</p>
Cutter head pin	Mechanical protection device on the continuous miner that will shear if sufficient force is applied to the cutting head of the machine.		
Desorbed gas	Desorbed gas is that gas directly measured from a coal sample, normally based on a coal core cut during surface or in-seam drilling.	Note. There are two principal methods of measuring desorbed gas. The quick crush method and the conventional method described in the UN and US standards. While the quick crush method gives an indication as to total gas content expressed as cubic	

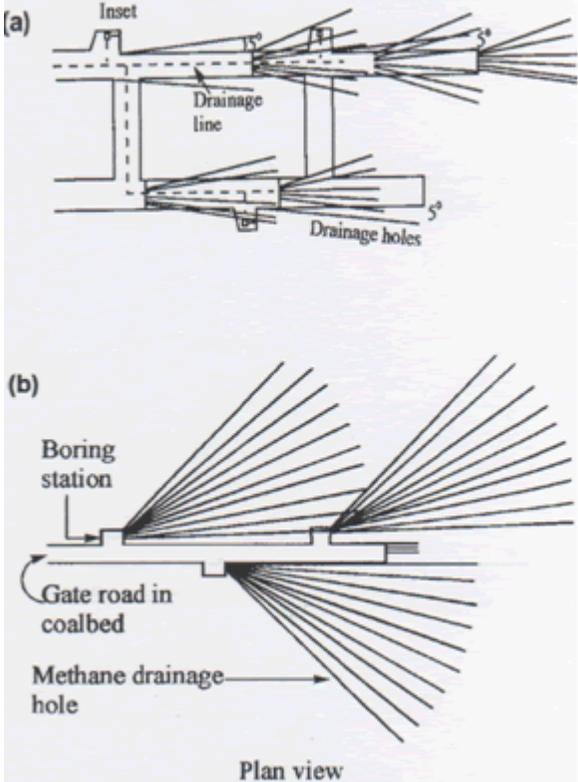
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		metres of gas per tonne of coal, valuable gas reservoir and desorption rate information is not obtained by this method.	
Descensional Ventilation	Movement of air to a lower point (downhill).		
Dedicated bore holes	Drillhole with a single use/purpose.		
Designated air reading station	Marked location underground with known cross sectional area where air velocity measurements are taken.	This enables air quantity calculations to be done.	<i>“Ventilation measurements were taken at a designated air reading station. The location was identified by a reflective sign on the rib”.</i>
Down-dip	Located down the slope of dipping strata e.g. coal seam.	<p>May not be a coal seam but can occur in any stratified rock mass. Dip or down dip only applies in stratified or foliated strata. Stone drive lacks stratification thus term does not apply.</p> <p>Dip <i>Pertaining to a position parallel to or in the direction of the dip of a stratum or bed.</i></p> <p>Dip Slope <i>Where the ground surface parallels the strata dip.</i></p> <p>Antonym Located up the slope of a dipping plane or surface. In an up-dipping (not flat-lying) surface.</p>	<i>“I saw him hosing down. I knew I was down-dip of him, because I could see the water flowing towards me”.</i>
Drift/drive/tunnel/Adit	<p>Roadway driven in stone</p> <p>Alternative definition(s)</p> <p><i>A tunnel or drive is an underground passageway, completely enclosed except for openings for egress, commonly at each end.</i></p> <p><i>A drift is an inclined access from the surface to the coal</i></p>	<p>Adits are driven into the side of a hill or mountain, and are often used when an ore body is located inside the mountain but above the adjacent valley floor or coastal plain. In cases where the mineral vein outcrops at the surface, the adit may follow the lode or vein until it is worked out, in this case the adit is rarely straight. The use of adits for the extraction of ore is generally called drift mining.</p> <p>.</p>	<p>New Zealand Legislation</p> <p>Meaning of tunnel <i>(1) In these regulations, tunnel—</i> <i>(a) means a place where a person works,—</i> <i>(i) with ground cover overhead, for the purpose of making an excavation intended to be greater than 15 metres long; or</i> <i>(ii) with or without ground cover overhead, for the purpose of making a shaft intended to be greater than 4.5 metres deep; and</i></p>

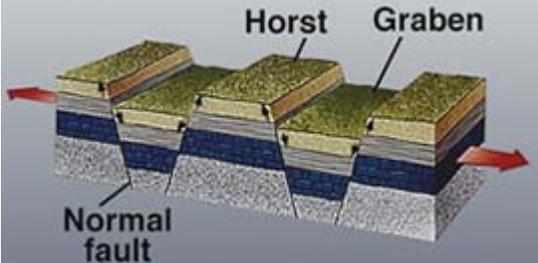
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	<p><i>seam or from coal seam to another coal seam.</i></p> <p>Adit describes the entrance or start of a tunnel or roadway driven into the side of a hill or mountain to access the coal seam or ore body.</p>		<p><i>(b) includes activities, buildings, headworks, or plant associated with the development or completion of the excavation or shaft.</i></p> <p><i>(2) In these regulations, tunnel does not include a tunnel, as defined in subclause (1),—</i></p> <p><i>(a) within a coal mine; or</i></p> <p><i>(b) within a metalliferous mine; I(c) made in the course of—</i></p> <p><i>(i) the building of a bridge or the approaches to a bridge; or</i></p> <p><i>(ii) the preparation of a foundation for a building.</i></p>
Drill	Equipment for developing boreholes/drillholes.		
Drill Stub	Generally a small extension roadway (2-5m) off main roadway to allow drilling equipment to be set-up to avoid blocking the main roadway.		<p><i>“The B heading stub was 8 metres long. Brattice was extended into the stub to direct air to the drill site”.</i></p>
Driving to the rise	Excavating a roadway up hill.	Rise (raise) and driving already explained.	
Explosion doors	Protection device in the form of hinged doors/covers on the ducting leading to the main fan that are forced open by the pressure generated by an explosion. This is done to provide some protection to the fan from the force of the blast.	<p>Notes</p> <p>The purpose of these devices is to allow mains ventilation to be re-established in an efficient manner following an over pressure event.</p>	 <p>Coal Mine Explosion Doors</p>

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Explosive limits	Concentration of gas in air which will ignite.	EG, methane 5-15% 5% lower explosive limit 15% upper explosive limit	
FAB – Fresh air Base/emergency refuge	Location underground where a known fresh air source is available, this may have an air source that is independent of the main ventilation air. An emergency refuge will generally have a supply of self contained breathing apparatus or refill station if using a CABA system. This was a roadway stub developed off the main access road within Pike River.	Fresh air base is defined by mines rescue as; <i>A designated safe location either on the surface or underground that is the departure point for active teams. Underground locations to have a positive supply of fresh air.</i>	
Fan and its components	CENTRIFUGAL or AXIAL FAN Housing – Contains the internals Fan Internals – Impellor &	Suggest breaking these terms down into individual components, not fan-and-its-components. A centrifugal fan (also blower , or squirrel-cage fan , as it looks like a hamster wheel) is a mechanical	

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	<p>Blades Diffuser – Duct on outlet side Ducting – Connecting to Mine working Motor – Located next to the housing Control System & Electrics – Controls motors A mechanical device used to create the air current within the mine, drawing in fresh air and removing “contaminated or bad” air.</p>	<p>device for providing ventilation. It has a fan wheel composed of a number of fan blades or ribs, mounted around a hub. As shown in Figure 1, the hub turns on a drive shaft that passes through the fan housing. The ventilation or gas enters from the side of the fan wheel, turns 90 degrees and accelerates due to centrifugal force as it flows over the fan blades and exits the fan housing.</p>	 <p style="text-align: center;">Centrifugal fan</p>
<p>Fault</p>	<p>A fault is a planar discontinuity in a rockmass across which there has been significant displacement resulting from the action of tectonic forces. Energy release associated with rapid movement on faults is the cause of most earthquakes.</p>	<p>A fault line is the surface trace of a fault, the line of intersection between the fault plane and the Earth's surface.</p> <p>Faults do not usually consist of a single, clean fracture. The term fault zone usually refers to the zone of complex deformation associated with the fault plane.</p> <p>The two sides of a non-vertical fault are known as the <i>hanging wall</i> and <i>footwall</i>. By definition, the hanging wall occurs above the fault plane and the footwall all occurs below the fault.</p> <p>A normal fault is one in which the hanging wall moves downward, relative to the footwall.</p> <p>A reverse fault is the opposite of a normal fault—the hanging wall moves up relative to the footwall. Reverse faults indicate shortening of the crust.</p>	

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Flume	Open steel channel for transporting coal and water downstream of the mining areas.		
FRAS (Fire resistant Anti-Static) hoses	Hoses made from a conductive material that prevents static charge and prevents the propagation of a flame.	FRAS can also apply to conveyors and brattice.	
Gas content (of a coal)	All coals inherently contain gas which in New Zealand is typically methane with trace amounts of ethane and possibly propane.	Note, actual gas content varies depending on coal rank. High volatile bituminous coals typically contain high volumes of gas. Gas content expressed as cubic metres of gas per tonne of coal may also vary depending on other factors such as depth of burial, or structural disruptions.	

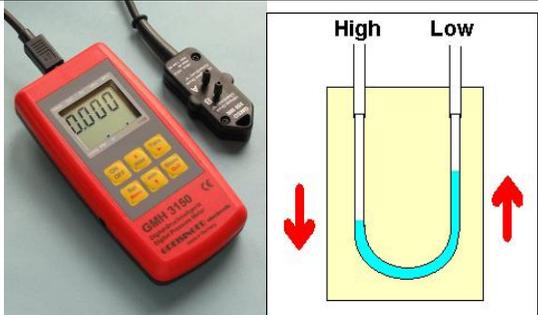
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Gas drainage pipes/ System	<p>Network of pipe work to reticulate the seam gas being emitted from the in-seam boreholes to a discharge point. The system may include valves, water traps to collect condensation in the pipeline and a flame arrestor at the discharge point to prevent ignition. A pump on the surface may be used to assist the gas to flow and reduce the required size of the pipework.</p> <p>Alternative definition</p> <p>The system of boreholes, pipes and other devices to capture gas from the coal seam and surrounding strata and reticulate it to a discharge point(s).</p>	<p>Gas drainage is a method of reducing the insitu gas content of the seam to within acceptable limits by drilling holes into the seam or surrounding strata ahead of mining.</p> <p>The gas drainage system is the pipeline and other installed infrastructure provided for the removal and collection of gas from the coal seam and surrounding strata to the surface of the mine.</p> <p>The benefits of gas drainage are:</p> <ul style="list-style-type: none"> Gas given off from the virgin coal is reduced so that gas percentage in intake airways and at working faces are kept within statutory limits and coal production rates are not governed by gas emission rates. This is achieved by degasification of coal prior to mining, i.e., pre-drainage Gas given off from the adjacent strata, mainly the lower coal seams after extracting an area of coal, is controlled so gas percentages in return airways are maintained below statutory limits. This is achieved by drainage from adjacent strata after mining, i.e., post drainage A reduction in the intensity of outbursts of coal and gas 	 <p style="text-align: center;">Underground Drainage:</p> <p>Underground drainage of gas can be carried out as pre drainage and post drainage. An example of local drainage ahead of the development headings is shown in the figures above. These holes are either drilled to both sample gas in advance of the developing coal face and to extract any residual gas ahead and adjacent to the proposed roadway.</p>
GC – Gas Chromatograph	Specialised gas analysis equipment used to measure an increased number of constituents of a Mine Gas sample.	Gas chromatography adds scope to the range, accuracy and reliability of the gases required to be measured, particularly when explosibility determinations are required or a spontaneous combustion is suspected.	
Goaf	That part of a mine from	Plural term is goaves	"The waste was left in the gob".

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	<p>which the mineral (eg coal) has been partially or wholly removed.</p> <p>Generally these areas are collapsed or partially collapsed and no longer suitable for access by people or equipment. Is also called the gob.</p>		<p><i>“Waste was left in the goaf, rather than bring it to the surface”.</i></p> <p><i>“It was too dangerous to enter the goaf, as the roof was not supported”.</i></p>
Graben	A downthrown block between two normal faults dipping towards each other is called a graben. An upthrown block between two normal faults dipping away from each other is called a horst.		
Graham's Ratio	<p>Ratio of the carbon monoxide produced to oxygen consumed and is directly proportional to the temperature of the coal or the extent of accelerated oxidation</p> <p>Typical European ratios are:</p> <ul style="list-style-type: none"> • <0.4: normal; • >0.4: possible early stages of spon com; • >1.0: spon com event almost certain; • >2.0: serious spon com event; • >3.0: active fire. 	Note- Trending the ratio may be more important than the absolute. Best calculated using gas data from a gas chromatograph.	
Grizzly	This is a term specific to Pike where the cables for the fan were take from underground		

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	up a wide borehole to the fans. The top of the hole has a grizzly, that is, a grating, to allow the cables to pass through, so it is a specific location and gas monitoring point rather than the normal mining term.		
Headings	Two or more roadways generally driven parallel to access different parts of the mine.		
Hydraulic mining / hydro monitor	Process of excavating stone or coal with the use of high pressure water and specialised equipment. This was the planned extraction process within Pike River. The hydromonitor is the high pressure water equipment.		 <p data-bbox="1630 1157 1960 1187">Example of a Hydro Miner</p>
In seam drainage	<p data-bbox="347 1193 705 1321">Removal of coal seam gas with the use of in-seam drill holes and possibly associated pipe work.</p> <p data-bbox="347 1359 705 1444"><i>Is a method of reducing the insitu gas content of the seam to within acceptable</i></p>	See gas drainage system	

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	<i>limits by drilling holes into the seam or surrounding strata ahead of mining.</i>		
In seam drilling	Drilling of boreholes in and around the coal seam from an underground location.		
Inbye	The direction towards the coal face from any point of reference.		<i>"I walked inbye from the portal to pit bottom"</i>
Inclination (of strata)	To lie at an angle to the horizontal plane, as a rock stratum or seam.		
Inseam Drillers	Personnel who operate underground in-seam drilling equipment.		
Intake	U/G roadways that have uncontaminated/fresh air moving through them that has not yet passed a working place.	Predominantly containing fresh air as it has not passed a production area, and is therefore not a return airway. Not contaminated with gas or dust.	
Jones-Trickett Ratio;	Ratio using the concentrations of Mine Gases to help differentiate between gas or coal dust explosions. Typical ratios are: <ul style="list-style-type: none"> • <0.4: normal; • <0.5: methane fire possible; • <1.0: coal fire possible. 	Best calculated using gas data from a gas chromatograph.	
JORC Code	Code of practice from the Joint Ore Reserves Committee which sets minimum standards for public reporting in Australia and		

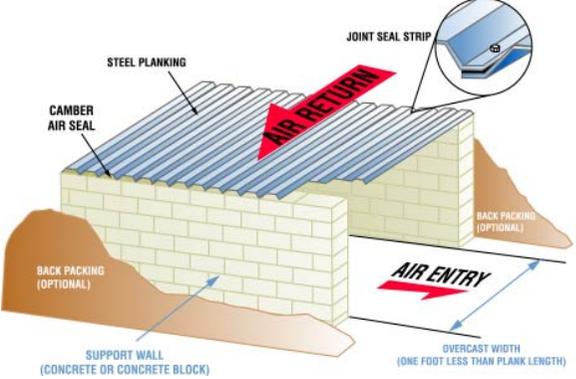
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	New Zealand of Exploration Results, Mineral Resources and Ore Reserves.		
LHD	Load Haul Dump machine – low profile front end loader.	<p>Front-end loaders (and other types of loaders) are a machinery used for loading materials into or onto another type of machinery. This is done by a bucket attached to hydraulically controlled arms, moved around by a rigid or articulated body on wheels. In mining they have multiple uses; for example they could be used for loading supplies, using man baskets, drilling platforms, loading materials onto conveyor belts and rolling and unrolling large cables.</p> <p>Loaders used in underground mining are referred to as 'boggers', 'muckers' or 'LHD's' (load haul dump) and are similar machines to front end loaders.</p>	
Liquid inclined manometer	Pressure measuring device using liquid columns in an inclined tube.		
Loader	Same as LHD, mucker, bogger.		
Maihak tube bundles or <i>Tube Bundle System</i>	Gas monitoring system that continually draws (vacuum based) air/gas samples through a network of plastic tubes placed around the mine to the surface for analysis. There is a delay from when the sample is taken to when it reaches the analyser. SICK Maihak GmbH is the leading	Maihak analysers in use at Pike River Mine. Tube bundle systems may still be used after a fire or explosion which would destroy telemetric systems located underground (see telemetric definition)	

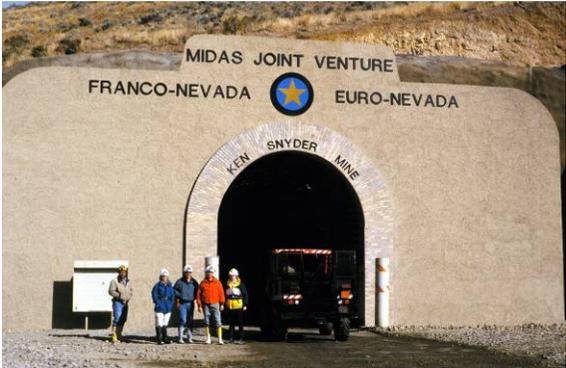
Term	Common definition	Notes	Example Picture or Diagram / Use of common term
	manufacturer of such systems.		
Main Fan(s) / Primary fan(s)	Largest fan(s) that draw or push all air through the mine.	The flow-through or primary ventilation system provides the <i>main ventilation circuit</i> for the mine. Air enters the mine due to either natural ventilation or from the mechanical action of the main ventilation fan(s).	<p><i>“When the main fans stop, it is necessary to stop all auxiliary fans. That will prevent recirculation”.</i></p> <p><i>“When the main fans stop, natural ventilation of 10 m³/s still ventilates the main drift”.</i></p>
Mains/ Section/ panels Mains Section Panel	<p>Group of roadways that provide long term people and equipment access and ventilation pathway to get to and from the mining areas (panels/sections).</p> <p>Also know as panel. Mining area connected to the mains roadways consisting of access roads and extraction areas with a separate ventilation circuit.</p> <p>Also know as section. Mining area connected to the mains roadways consisting of access roads and extractions areas with a separate ventilation circuit.</p>	The terms section and panel are interchangeable.	
Manometer	Instrument for measuring pressure differences.		
MCC – Motor	Set of electrical switch gear		

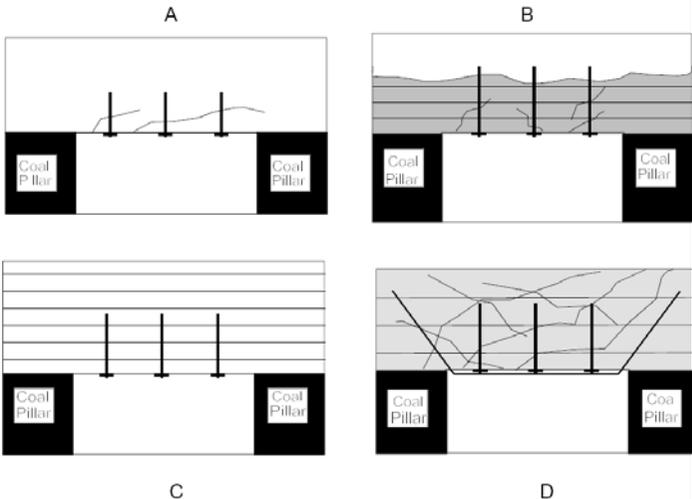
Term	Common definition	Notes	Example Picture or Diagram / Use of common term
Control Centre	for controlling electrical equipment. May be located on the surface or underground.		
Methane Outburst	The sudden ejection from the solid coal face into the mine workings of methane, carbon dioxide and generally including coal and rock.		
<p data-bbox="107 406 264 435">Mine Gases</p> <p data-bbox="107 470 235 566">Carbon Monoxide (CO)</p> <p data-bbox="107 1149 309 1177">Carbon Dioxide</p>	<p data-bbox="340 470 719 1114">A colourless, odourless gas, CO, formed by the incomplete combustion of carbon or a carbonaceous material (eg diesel machines, mine fire, spontaneous combustion of coal) Highly flammable (12.5 to 74%) & very toxic in low concentrations 25 PPM No Effect (TWA) 1000 PPM - Headache, nausea, and dizziness Vomit after 30 mins 1500 PPM – Possible collapse after 15 mins 3,000 PPM – Immediate physiological effects, unconsciousness after 5 mins.</p> <p data-bbox="340 1149 719 1437">0.03% of Air. Formed U/G by engine exhaust, oxidation of coal or fire. May be a coal seam gas Colourless but pungent odour 0.5% - Slight Increase in respiration (TWA) 2% - 50% Increase in respiration</p>		

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
Hydrogen (H ₂)	3% - (STEL) 5% - 300% increase in respiration 10% - Intolerable Colourless tasteless and odourless. Highly flammable 4 to 74%). May be produces as product of spontaneous combustion		
Hydrogen Sulphate (H ₂ S)	Colourless gas with rotten egg odour. Flammable (4.3% to 45%). Detected by smell at 0.1ppm 10 PPM - TWA 15 PPM – STEL <100 PPM: irritation to eyes and respiratory tract		
Methane (CH ₄)	Coal seam gas Colourless tasteless and odourless Highly flammable (5.0 to 15%). Auto Ignition (that is, will burn) temperature 537°C		
Ethylene (C ₂ H ₄)	Spontaneous combustion indicator – detectable only with Gas Chromatograph. Presence in low quantities indicates temperature of 100-150°C		
PPM	Parts per Million	10,000 ppm = 1%	
STEL	Short-term exposure limit means the maximum average exposure (to the gas) measured over any 15-minute period in the working day. Measurements over the		

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
	STELs will require removal of personnel from the exposure area.		
<p>Monitoring non-restricted environment/non restricted environment qualification</p> <p>Restricted Zone</p>	<p>Defined by Mining Regulations (Underground) 1999.</p> <p>Restricted Zone means –</p> <ul style="list-style-type: none"> (a) all parts of a ventilation district in a gassy mine that are on the intake side and within 100 metres of – <ul style="list-style-type: none"> (i) the most inbye completed line of crosscuts; or (ii) a longwall or shortwall face; or (b) a part of a gassy mine in which flammable gas, whether or not normally present, is likely to occur in such quantity as to be 2% by volume or more in the general body of air in the gassy mine; or (c) a part of a gassy mine in which electrical equipment is located and that has not been shown to be free from flammable gas; or (d) all of the return side of a gassy mine <p>The Regulations stipulate additional equipment</p>		

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
	restrictions, record keeping and air management standards for restricted zones.		
Non Restricted Zone	Areas within a mine not classified as Restricted zone.		
Outbye	The direction away from the coal face from any point of reference.		<i>"I headed outbye from pit bottom to the surface via the drift".</i>
Overcast	A structure built in an underground roadway intersection to keep air paths separated. An air crossing between intake and return roadways.	Many types of constructions available.	 <p style="text-align: center;">Example.</p>
Oxidation	The reaction of coal with oxygen that produces heat and gas. The rate of oxidation is affected by the surface area of coal, coal type, temperature, and available oxygen.	<p>Process is not exclusive to coal.</p> <p>A freshly-cut apple turns brown, a bicycle fender becomes rusty and a copper penny turns green. What do all of these events have in common? They are all examples of a process called oxidation.</p> <p>Oxidation is defined as the interaction between oxygen molecules and all the different substances they may contact, from metal to living tissue.</p>	
Pit bottom	First area to be developed in the coal seam where underground services are established e.g. the area of initial mine development at the end of the stone access roadway within Pike River.		

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
Portal	Surface entry of a main roadway into the mine.		<p data-bbox="1451 148 2145 209"><i>"I hit the portal structure when driving out of the mine. A part of it collapsed and needed to be repaired"</i></p> 
Power Pack	Portable device for providing electrical or hydraulic power to equipment.		
Raise Bore	Method of developing a shaft where initially a pilot hole is drilled from the surface to an existing underground roadway. A drill head is attached underground and is pulled/rotated back to the surface to enlarge the hole.		<p data-bbox="1451 743 2145 836"><i>"The material produced from raise boring needed to be handled underground. It was stowed in a disused roadway".</i></p> 
Recirculation (ventilation)	When return, entrained or exhaust airflow including contaminants re-enters the incoming ventilation path.	This could include explosive gases.	
Rescue Station	Resourced mine specific mines rescue station with on call mine rescue personnel, such as that located in Dunollie.		

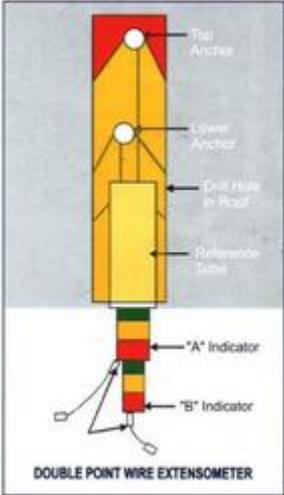
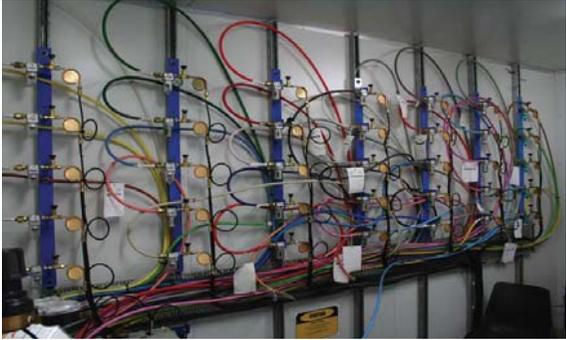
Term	Common definition	Notes	Example Picture or Diagram / Use of common term
Return	Any underground roadways that have “used contaminated” air moving through them towards the surface after it has passed a mining area.	Ventilation returning from the working face(s) or other mining area. Generally considered to be of lower quality as it has been contaminated with heat, dust, and gas liberated from mining areas.	
Roadheader	Purpose built machine for driving roadways in stone capable of loading the cut material into the stone/coal transport system (e.g. flume, shuttle car, LHD, conveyor).	<p>A roadheader, also called a boom-type roadheader, road header machine, road header or just header machine, is a piece of excavating equipment consisting of a boom-mounted cutting head, a loading device usually involving a conveyor, and a crawler travelling track to move the entire machine forward into the rock face.</p> <p>A road header can cut much harder stone or rock than a conventional continuous miner, as forces are concentrating through a smaller diameter rotating drum (head).</p>	
Roof bolt/roof bolting techniques/ cable bolts	Boreholes from 1 – 2.5 metres long are drilled upward in the roof and bolts if 25cm diameter to more are inserted into the holes and anchored at the top by a chemical resin or mechanical device. The bolt end produces below roof level and is used to support mesh and simple steel plates pulled tight up to the roof by a nut on the bolt head. The bolts are put up to a defined pattern. The purpose is to clamp together the several roof beds to form a composite beam with a strength considerably greater than the sum of the individual beds acting separately. Cable bolts are constructed like a wire rope and are used	The principle objective of roof bolting is to help the rock mass support itself.	<p>(1).</p>  <p>Figure 1. Roof bolt support mechanisms: (A) simple skin support, (B) suspension, (C) beam building, and (D) supplemental support in failing roof.</p>

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
<p>Self-contained self-rescuer/self-rescuer/SCSR</p>	<p>in conjunction with roof bolts where roof conditions are poor and where longer length (4 – 11 metres) support is required.</p> <p>A temporary breathing system for use when the mine atmosphere becomes unbreathable. There are two possible systems: one with a simple filter (rarely used); the other, using potassium peroxide, reacts with exhaled CO₂ and produces sufficient oxygen for approximately 30 to 60 minutes of use. Intended to allow the user to move from current location to fresh air or other air source.</p> <p>Alternative definition</p> <p>Escape breathing apparatus shall be classified in accordance with the following types:</p> <ul style="list-style-type: none"> • Chemical Oxygen Self-Contained Self Rescuers (chemical oxygen apparatus) • Carbon monoxide filter self-rescuers • Compressed Air Self-Contained Breathing Apparatus (compressed air apparatus) • Compressed Oxygen Self-Contained Breathing Apparatus (compressed oxygen apparatus) 	<p>Body-worn</p> <p>Refers to a unit which has at any time been issued to be worn by a person. Units which are frequently transported on a vehicle are equivalent to body-worn units for the purposes of registration.</p> <p>Cached</p> <p>Refers to a unit which is stored underground, normally in a stationary signed posted and vibration-free location.</p>	 <p>The image on the left shows a person in a blue uniform wearing a yellow self-contained self-rescuer. The image on the right is a diagram titled "Breathing protection in just four steps!" with the following steps:</p> <ol style="list-style-type: none"> 1. Pull opener towards indicated direction 2. Sealing strip falls off by itself 3. Remove lid at the opener 4. Donning of unit: <ul style="list-style-type: none"> - adjust harness - pull plug from mouthpiece - put on mouthpiece/noseclip <p>Oxygen Self-Rescuer of the OXY K Family – Donning Procedure Dräger</p> <p>Example of self contained self rescuer</p>  <p>Example of box (Cache) for storing spare SCSR</p>

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
Shaft	Vertical access way between two points connecting the surface with the underground workings e.g. 100 metres long and 5 metres in diameter.	<p>NZ Legislation definition</p> <p>shaft means an opening in a mine having an inclination above the horizontal of 15° or more—</p> <p>(a) through which employees or materials are transported; or</p> <p>(b) that is used as a main intake or outlet for ventilation</p>	
Shaft bottom	Lowest point in the shaft.		
Shaft sinking	Process of excavating a shaft e.g. raise bore.		
SIMTARS	Safety and Mines Testing and Research Station (SIMTARS). Queensland Government organisation focusing on research, consulting, testing, certification and training services for the improvement of mining industry safety and health.		
Single inlet centrifugal fan	Type of Main Fan.		
Slimline Shaft	Small diameter shaft. This was located within the pit bottom area of Pike River.		
Smoke lines	A series of rope lines and small cones hung along underground roadways to assist in guiding people through the mine to a point of safety in the event of an emergency and low visibility.		

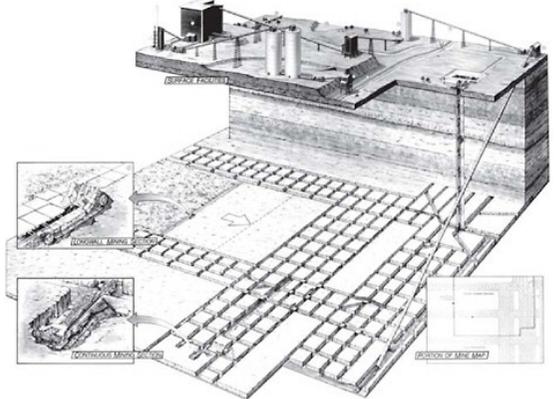
Term	Common definition	Notes	Example Picture or Diagram / Use of common term
SMV	Specialised Mining Vehicle – personnel carrier. Also known as drift runner.	Another common acronym is PJB.	 <p data-bbox="1487 389 2105 451">Example of a personnel carrier used in the mining industry</p>
Spontaneous combustion (also termed a heating when coal is involved)	Coals reacts with atmospheric oxygen even at ambient temperatures and this reaction creates heat. If the heat liberated during the process is allowed to accumulate, the rate of the above reaction increases exponentially and there is a further rise in temperature. When this temperature reaches the ignition temperature of coal, the coal starts to burn and the phenomena is described as spontaneous combustion.	<p data-bbox="741 458 1415 651">Spontaneous combustion is a process whereby certain materials can ignite as a result of internal heat which arises spontaneously due to reactions liberating heat faster than it can be lost to the environment. Examples of materials that are prone to spontaneous combustion are coal and hay.</p> <p data-bbox="741 683 1415 1002">Whenever coal is exposed to air, oxygen is adsorbed onto the surface. This oxidation is irreversible and exothermic producing a quantity of heat that is dependant on temperature. The rate of oxidation is proportional to the temperature, so that a higher temperature produces a faster oxidation rate. When the temperature reaches the ignition temperature of coal, the coal starts to burn. The spontaneous combustion of coal refers to this self-heating coal oxidation process.</p> <p data-bbox="741 1034 1415 1134">Some coal mines have never reported spontaneous combustion, however rule of thumb is that all coals will spontaneously combust given the right conditions.</p>	<p data-bbox="1442 458 2136 810">Factors affecting liability (or propensity) of coal to spontaneous combustion include Coal Quality (rank, pyrites, physical properties, moisture, petrographic composition, seam gas) Geological factors (seam thickness, overlying seams, faults and intrusions, seam depth, incubation period) Mining Factors (mining systems, entry design, pillar design, supports, barrier pillars, coal recovery, rate of retreat, sealed off extraction areas, ventilation pressures and flows, methane drainage, housekeeping, secondary extraction methods).</p> <p data-bbox="1442 842 2136 1198">Susceptibility testing – researchers have for many years been seeking an absolute index to measure the liability of coals to spontaneously combust. Because coal is a variable product composed of many different materials which have undergone numerous physical and chemical processes and the oxidation process is so complex such an index may never be established). A number of laboratory methods for ranking in order of spontaneous combustion liability have been published. Of these the R70 ranking is favoured by most Australian organisations.</p>
Stand pipes	3-6m pipe that is inserted and grouted into the start of an in-seam borehole to enable a valve or coupling to be installed. This enables the hole to be sealed or		

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
	connected to a gas drainage pipeline.		
Stone Drive	A drive put in through non coal-bearing rocks in order to access a coal seam. Stone drives may be either in stratified or non stratified rocks.	These may be either inclined or rise drives, declined drives or horizontal drives.	
Subsidence	The lowering of the ground surface as a result of undermining of the strata such as results from coal mining.		
Sump into the face	First cut by the CM or roadheader where the cutting head excavates into the solid coal		
Telemetric system	System where data (gas monitoring) is collected and analysed at an underground location and result relayed electronically to another point (control room) for evaluation. Compared with Maihak, system where gas is collected underground but analysed on the surface.	<p>Telemetry is a technology that allows remote measurement and reporting of information.</p> <p>In respect of an underground gas monitoring system, it is considered the real-time instantaneous and automatic gas monitoring system with a control module on the surface and intrinsically safe sensor heads strategically placed underground. In the event of a fire or explosion these sensors will be unlikely to survive.</p>	

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
Tell-tales	Device installed into the roof for measuring ground movement in the immediate/near roof strata.		 <p style="text-align: center;">DOUBLE POINT WIRE EXTENSOMETER</p>
Tube bundle	Bundle of tubes spread throughout underground workings to transport gas samples to the surface for Maihak (or other) analysis.	See Maihak tube bundles	 <p style="text-align: center;">Tube Bundle System</p>
Tunnel	Horizontal roadway primarily driven in rock that links the surface operations to the coal seam. An underground roadway could be used along with similar terms as: roadway, drift, heading		<p>Meaning of tunnel(1) In NZ Mining regulations, tunnel—</p> <p>(a) means a place where a person works,—</p> <p>(i) with ground cover overhead, for the purpose of making an excavation intended to be greater than 15 metres long; or</p> <p>(ii) with or without ground cover overhead, for the purpose of making a shaft intended to be greater than 4.5 metres deep; and</p> <p>(b) includes activities, buildings, headworks, or plant associated with the development or completion of the excavation or shaft.</p> <p>(2) In these regulations, tunnel does not include a</p>

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
			tunnel, as defined in subclause (1),— (a) within a coal mine; or (b) within a metalliferous mine; or (c) made in the course of— (i) the building of a bridge or the approaches to a bridge; or (ii) the preparation of a foundation for a building.
TWA	<p>Time Weighted Average (Total exposure in day concentration x time)/8hours) The exposure is likely to relate to gas levels in this case.</p> <p><i>Alternate definition</i></p> <p><i>means the average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day working week.</i></p>	<p>'Exposure standard' means an airborne concentration of a particular substance in the worker's breathing zone, exposure to which, according to current knowledge, should not cause adverse health effects nor cause undue discomfort to nearly all workers. The exposure standard can be of three forms; time-weighted average (TWA), peak limitation, or short term exposure limit (STEL).</p> <p>'Exposure standard - peak' means a maximum or peak airborne concentration of a particular substance determined over the shortest analytically practicable period of time which does not exceed 15 minutes.</p> <p>'Exposure standard - short term exposure limit (STEL)' means a 15 minute TWA exposure which should not be exceeded at any time during a working day even if the eight-hour TWA average is within the TWA exposure standard. Exposures at the STEL should not be longer than 15 minutes and should not be repeated more than four times per day. There should be at least 60 minutes between successive exposures at the STEL.</p> <p>'Exposure standard - time-weighted average (TWA)' means the average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day working week.</p>	<p>Usual measurements</p> <p>ppm Parts of vapour or gas per million parts of contaminated air by volume</p> <p>mg/m3 Milligrams of substance per cubic metre of air at 25°C and one atmosphere pressure.</p>
Underground monitor pump	Pump that generates high pressure and high volume water that is used to excavate coal via the hydromonitor.		
Up-dip	Located up the slope of a	May not be a coal seam.	<i>"I was up-dip of him. As I was hosing down, the water</i>

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
	dipping coal seam.	<p>Dip</p> <p><i>Pertaining to a position parallel to or in the direction of the dip of a stratum or bed.</i></p>	<i>flowed toward him”.</i>
Upsidence	The upward rupture of the beds of incised streams as a result of a wider area of subsidence such as results from coal mining.	Not that as well as upward movement of the beds of incised streams, the walls of the incised streams may also move horizontally towards each other, “closure”.	
Ventilating pressure	Pressure required to overcome the resistance of air moving through the mine.	<p>Ventilation Pressure (Pa) Static pressure (bursting pressure) is the potential energy measured normal to the direction of flow</p> <p>Velocity pressure is the kinetic energy and is calculated</p> <p>$P = \rho v^2/2$</p> <p>v = velocity of the air (m/s) ρ = density of the air (kg/m³)</p> <p>Total pressure is the sum of the static and velocity pressures.</p>	<p>Elementary Laws of Airflow</p> <ul style="list-style-type: none"> • For air to flow from one point to another there must be a difference in pressure between the two points. • Air will always flow from a high pressure to a low pressure and will continue to flow as long as the pressure is maintained. • The greater the difference in pressure the greater the quantity of airflow. (P,Q) • Any resistance to pressure will reduce the quantity of airflow. • As the resistance between the two points increases the quantity of airflow decreases
Ventilation circuit	Pathway that air follows through the mine or section/panel of the mine.	<p>The main purposes of a coal mine ventilation system are to provide adequate quantities of fresh air to the miners in the workings to remove heat and to render harmless toxic, noxious, and explosive gases, and dusts and carry them out of the mine through dilution by fresh air.</p> <p>Qld 343 Ventilation system must provide for general body concentrations for particular contaminants and gases (1) The ventilation officer must ensure the mine’s ventilation system is designed, implemented and monitored to ensure the atmosphere in each part of the mine has a general body concentration that is—</p>	

Term	Common definition	Notes	Example Picture or Diagram / Use of common term
		<p>(a) for carbon dioxide or a contaminant mentioned in schedule 6, column 1—as low as reasonably achievable and within the limits to which a person may be exposed to the contaminant under section 359; or</p> <p>(b) for oxygen—at least 19%; or</p> <p>(c) for methane—not more than 2.5%.</p> <p>(2) The ventilation officer must ensure a record is kept of the results of monitoring for atmospheric contaminants in each place where a person is exposed to a contaminant.</p> <p>(3) This section does not apply to a part of the mine exempted under section 345.</p>	
Ventilation shaft	Vertical access with a primary purpose of passing air in or out of a mine.		

<p>Ventilation system</p>	<p>Roadways and equipment required to direct, control, push, pull air throughout the mine. This involves fans, ducting, artificial walls etc.</p> <p>Alternative definition</p> <p><i>Describes the arrangement of facilities (including fans and other ventilation control devices), and the distribution of air throughout the mine roadways and workings that provide for a sufficient volume of airflow to remove heat and to dilute and render harmless noxious, and flammable gases, and dust.</i></p>	<p>Flow-through ventilation is the main ventilation circuit for the mine. Air enters the mine from surface via a shaft, ventilation raise or adit. The air is distributed through the mine via internal ventilation raises and ramps, and flows are controlled by regulators and permanently mounted ventilation fans.</p> <p>An Auxiliary ventilation system takes air from the flow-through system and distributes it to the mine workings via temporarily mounted ventilation fans, venturi's and disposable fabric, or steel ducting.</p>	<p>NZ regulations Ventilation</p> <p>Every employer must take all practicable steps to ensure, in relation to every gassy mine, that—</p> <ul style="list-style-type: none"> (a) the percentage of flammable gas in the general body of air in the mine is not more than 1.25% by volume; and (b) a quantity of fresh air adequate to ensure that paragraph (a) is complied with is circulated— <ul style="list-style-type: none"> (i) before an employee enters the mine; and (ii) continuously whenever an employee is in the mine; and (c) the air at the commencement of the restricted zone in the intake airways is kept free from flammable gas; and (d) no air current passes through any stopping, or any unsealed, abandoned, or worked out area, before ventilating or passing through an active working place; and (e) the total number of employees ordinarily present in a ventilation district or ventilation circuit in the mine is kept to a minimum; and (f) a competent person measures, at least once in every week, the percentage of flammable gas in the main return and split returns; and (g) a competent person measures, at least once in every month, the quantity of air— <ul style="list-style-type: none"> (i) in the main current; and (ii) in every split; and (iii) at the beginning of the main return airway; and (iv) from each ventilating district; and (v) at any additional place identified by the employer as a hazard. <p>Qld Legislation</p> <p>344 Other things for which ventilation system must provide</p> <p>(1) The ventilation officer must ensure the mine's ventilation system provides for the following—</p> <ul style="list-style-type: none"> (a) minimising, within acceptable limits, the layering and accumulation of noxious and flammable gas in each place where controlled ventilation is required under paragraph (b);
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