HAZELWOOD MINE FIRE INQUIRY

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Submissions Hazelwood Mine Fire Inquiry
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☑ Origin and circumstances of fire Measures by Hazelwood Coal Mine to prevent fire Application and administration of regulatory regimes Other (please state)	Response to fire by: Hazelwood Coal Mine Emergency Services Environmental Agencies Public Health Officials Other Government Agencies	

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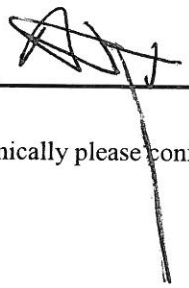
Signature 

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Date 24/4/2014

Submission to

Hazelwood Mine Fire Inquiry

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Director – Andy Tegart
April 2014

Contents

The following submission is made to the inquiry as a Company with an interest in fire mitigation in the Power Industry and some of whose employees and families live in the local community that are impacted by such events. The submission represents our limited perspective and we hope that some suggestions maybe worthy of the inquiry consideration.

1.0 Introduction

A large rural fire was understood to have developed from two separate locations(then burnt around 2500 hectares) which invaded Morwell open cut on Sunday 9th February 2014 (part of Victoria 's critical electricity supply infrastructure), also threatened homes and properties in Morwell and spread into Australian Paper (a Major Hazard Facility). This fire had also threatened the south west worked out corner of Yallourn Open Cut. This fire occurred during Total Fire Ban day with hot, dry and windy weather conditions followed by a late change resulting in an extreme fire danger forecast for Gippsland. The Latrobe Valley Airfield weather station recorded its highest temperature for February on the 9th (41.2 ^{0}C). The very lengthy period (45 days) to suppress the fire produced very significant smoke into the local communities, displacing persons, impacting wellbeing and presenting risks to those vulnerable to smoke, as well as disrupting normal life and business activities.

This brief submission is limited to some historical data and prior research into rural fires and open cut fires in the Latrobe Valley. It focuses any opportunities to improve and promote rigorous and quantitative risk analysis and associated risk controls that may assist all stakeholders.

2.0 The Occurrence and Extent of Fire Risk to Latrobe Valley Open Cut Mines

2.1 Historical Context – Frequency of Occurrence

Due to its climate and vegetation, South Eastern Australia including Gippsland is particularly prone to the outbreak of rural fires. From an international perspective, we are one of the most fire prone areas in the world along with California and Southern France. Large area wide rural fires caused extensive damage occurred in Gippsland in 1851, 1926, 1939, 1944, 1962, 1983, 2003, 2006 and 2009.

Many of these started from human activity and some are result of lightning strikes into forested areas.

In Gippsland, one to two major rural fires can be expected each decade. Climate change is likely to increase the frequency, intensity and size of bushfires in the future (Wright and Jones). The recent 2014 report by the CSIRO and Bureau of Meteorology on the state of the climate advises that extreme fire weather has increased and the fire season lengthened since the 1970s. It is worthy to note that this report indicates statistically significant long term trends of increases in extreme fire weather in Gippsland.

Since the commencement of brown coal mining associated with Power Generation in 1921, twelve large rural fires have impacted these facilities from surrounding country side. Six of these have invaded open cuts and disputed coal production.

The Yallourn fires of 14th February 1944 ceased coal production for four days and seriously curtailed it for two weeks impacting electricity supply to the State of Victoria.

The resulting Stretton Royal Commission (Leonard E. B. Stretton, 1944) inquired into:

- The place of origin and the causes of the fires which commenced at Yallourn on the 14th day of February 1944
- The adequacy of the measures which had been taken to prevent damage
- The measures to be taken to protect the undertaking and township at Yallourn

Justice LB Stretton found "the protection of a small area of Gippsland which contains a state asset of a value of many millions of pounds is and end which needs no advocacy". Many of his comments on the human cause lighting of a fire without proper caution or authority, the close proximity of the former township, the landholdings adjoining the mine and outside the commission's territory, water supply and fire protection in the open cut could still be considered as having some resonance today.

Despite the huge changes in the Power Industry since this time including the establishment of the National Grid, Latrobe Valley Power Stations and associated Mines continue to represent an important part of critical infrastructure for ensuring the basic necessities of our electricity supply and their protection should remain a broad and shared community wide interest.

2.2 Development of a SECV Latrobe Valley Rural Fire Policy and Major Fire Scenarios

In October 1985, the State Electricity Commission of Victoria undertook a public consultation process to develop a policy for the "Protection of SECV Latrobe Valley Assets from the Rural Fire Threat". A very detailed public discussion paper was issued (some 500 copies circulated) and a total of 22 submissions was received including the Country Fire Authority, State Government agencies, local government bodies, a significant forest plantation owner (APM Forests) and various community groups and private individuals.

The SECV issues paper remains one of the most comprehensive overview of rural fire risk to Latrobe Valley open cut surface mines. This paper offers useful base line knowledge and lessons learnt on the rural fire threats and countermeasures.

The issues paper identified three major fire scenarios impacting Power Station and Mine production facilities. We propose these continue to remain valid today and are described as follows:

1. **A Fire of Distant Origin**: This scenario identifies the extensive area of forested lands arising at the foothills of the great divide which are North West and northerly of Yallourn, Morwell and Loy Yang Open Cuts and the potential of a large bushfire to develop and spread and impact under severe fire conditions. A recent example of such a potential event is the Great Divide Complex South Fire in 2006/2007 which burnt around 1.1 Million hectares over 69 days (Smith, 2007). This fire occurred during extreme drought conditions and posed a threat as it moved easterly and potentially south east under north westerly winds to Latrobe Valley open cuts, water catchments and essential electricity transmission lines.

2. **A Fire of Regional Origin:** This scenario identifies that the Open Cuts and Power Generation facilities are located in rural lands in the Valley floor close to townships and in a mixture of grassland, pine plantation and remnant native vegetation. It notes that transport corridors of road and rail occur in close proximity to such operations and a range of ignitions sources are probable. In this case a grass fire or similar develops under unfavourable or extreme fire weather conditions and cannot be suppressed. The resulting fire then directly impinges on Open Cut assets from the North West or under a South West wind change (SECV, 1985). This closely describes the circumstances in 2009 of the tragic Churchill Black Saturday Fire which spread to the south boundary of Loy Yang Power. In addition the Driffield fire of 9th February 1983, which burnt from Newborough South West towards Driffield then swung back into the Yallourn Open Cut under the influence of a South Westerly change.

3. **A Fire within the Open Cut:** Open Cut brown coal mining exposes extensive coal seams to the environment. This low rank raw coal has a high moisture content (50 – 70 %) and will show some variation in physical and chemical composition due to coal type mined (lithotype). The weathered surface produces fine coal particles/dust that will dry and has extremely large surface to volume areas due to its porous structure (up to 300 m^2 per gram) enhancing combustibility (SEC, 1981). Mining operations can produce ignition sources that can result in a fire on the coal surface. A large number of fire prevention measures are undertaken in all Open Cuts to mitigate such risks. A recent example of a large Open Cut fire consistent with this scenario occurred in Morwell Open Cut during October 2006. Interestingly no fires in the Open Cuts have escaped to damage surrounding communities. Similarly the large Morwell Open Cut fire in 1977 started from a small fire in a dry coal area under strong West to North Westerly winds.

The second scenario is a very similar to the recent fire of the 9th February 2014. This fire grew and accelerated to a high intensity fire from a human associated cause on a "blow up" day which exceeded the capability of fire suppression forces attending and develops into a major, high intensity grassland fire which is blown from the south west by a gusty wind change. Spot fire behaviour occurs associated with roadway native forest vegetation and recent plantations which result in short distance firebrands distributed downwind (Barber, 1983).

Such conditions can potentially occur every fire season and are a constant threat during severe fire seasons. Fire patterns of scenarios one and two are illustrated clearly in a previous SECV fire history map of the Latrobe Valley. To assist the inquiry a copy is provided.

After broad consultation and review of the public and fire authorities feedback the SECV published a final Rural Fire Protection policy in late 1986.

2.3 Fire Risk in Morwell Open Cut

Geoscience Australia describes the likelihood of bushfire hazard in terms of the probability of a fire arriving at a point in the landscape. For a bushfire invading Morwell Open Cut this is from fires originating externally.

Open Cut fire risks represented a learning experience as the combustion and explosive properties of brown coal fields were understood over a long history. Ignition sources and the occurrence of fires in the open are fundamental to the developing a risk assessment.

Overall fire incidents in the open where recorded across all SECV Latrobe Valley production operations. This data is represented in figure 1 below and indicates that for all three Open Cuts and the associated works areas the average annual number of the incidence of fires in the open (1985 – 1993) was 412. The highest frequency of such fires occurred during the five (5) months of November to March (243). This is generally longer than the declared fire danger period. However, fires were reported across every month of the year (SECV, 1990).

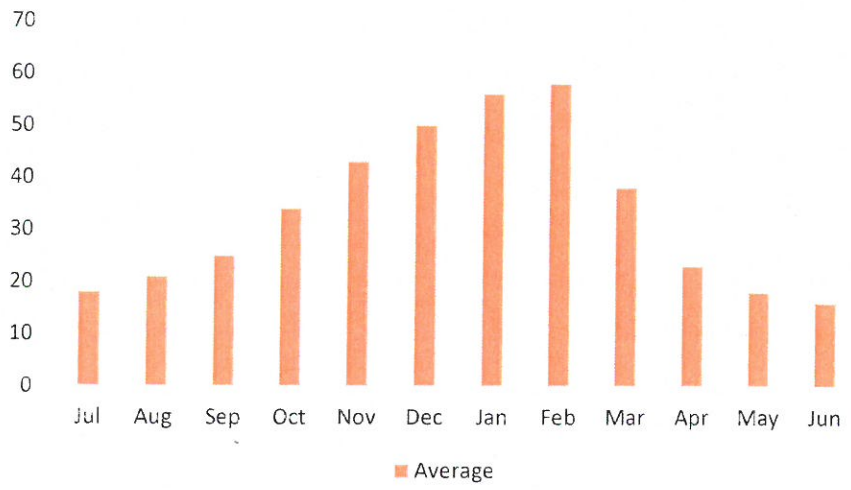


Figure 1 - Number of fires in the open across Latrobe Valley work areas

Interestingly, Morwell Open Cut has historically recorded the highest number of fires – some 2.5 to 3.2 times higher than Yallourn Open Cut and up to 4 to 10 times higher than Loy Yang Open Cut.

A detailed Fire Risk analysis was completed by the SECV Research and Development Department in 1990. This report analysed five years of fire reports from 1984 to 1989. The report analysis indicated that for similar lengths of conveyors in Morwell and Yallourn Open Cuts more fires occurred at conveyors in Morwell Open Cut. The highest risk and temporal distribution of ignitions at occurred during the summer months of January and February. From 1984/85 to 1988/89, Morwell Open Cut recorded 1450 fires compared to 423 for the same period at Yallourn Open Cut (a copy of this report is provided for evaluation).

Figure 2 shows the clear and consistent difference of the number of fire occurrences between the two mines. It also illustrates the seasonal changes in fire ignitions and their peak occurrence during the fire season. Figure 3 and Figure 4 illustrate the occurrence of large Mine fires in the Morwell Open Cut Mine and the difficulty of fire suppression of glowing combustion of steep brown coal batters.

It is important to recognise that most ignitions within open cuts are rapidly extinguished.

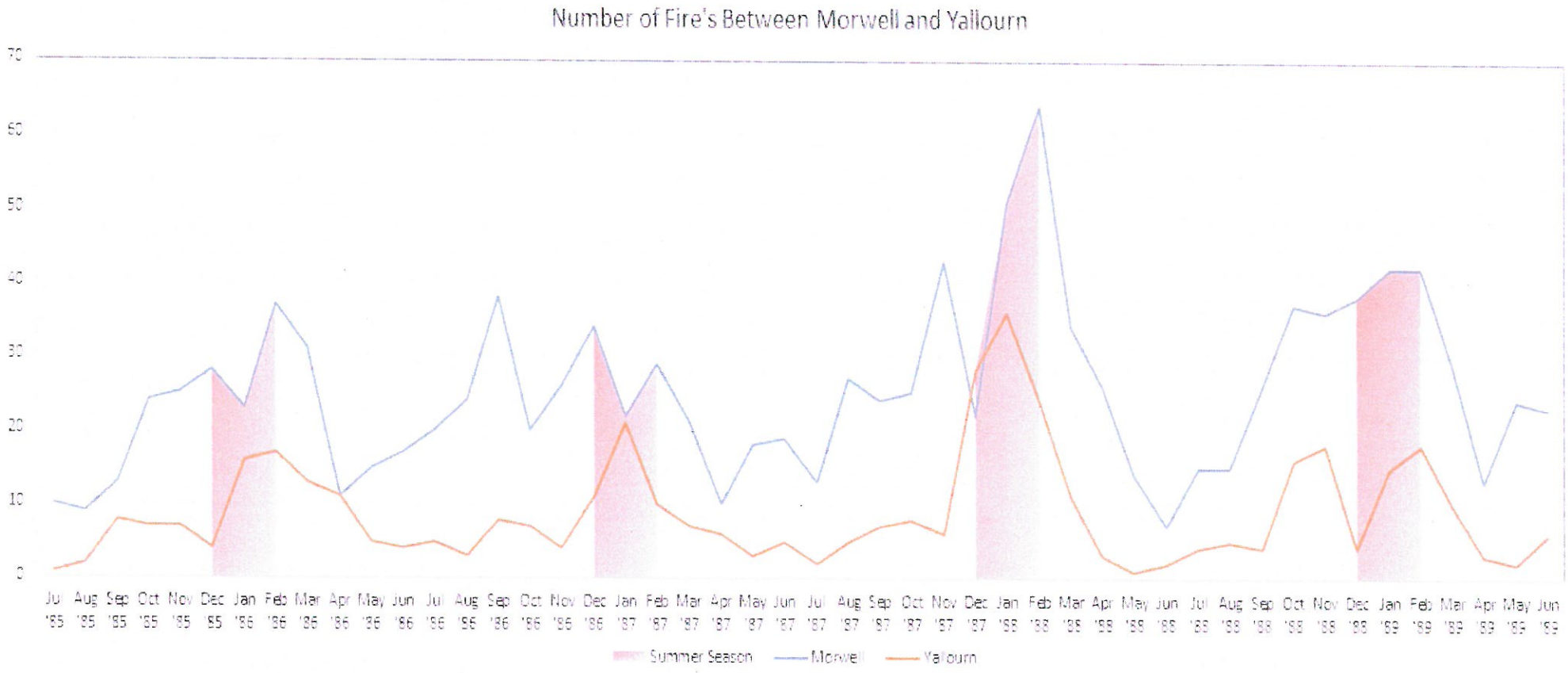


Figure 2 - Morwell and Yallourn Open Cut Mine fire events 1985-1989.

Figure 3 - - Morwell Open Cut Mine fire in 2006

Figure 4 - Morwell Open Cut fire in 1977

Brown coal ignition is an exothermic chemical reaction involving oxidation and operates with a different mix of heat transfer mechanisms to grass and forest fuels. It is worth recognising that some complexity exists here as although fires do behave accordingly to certain physical laws these are imperfectly known. Brown Coal seams are largely burning through smouldering combustion resulting from conduction of heat in coal seams. This is glowing rather than flaming combustion.

The surface coal dust is normally the source of ignition and the vector for spread. Once ignited wind is the driving factor and will spread burning coal particles widely up and over batters. Burning coal particles can also be spread by convection of updrafts / turbulence (fire or heat) carrying burning particles from low levels of mine forward and upward.

Brown coal's rate of thermal degradation and combustion are influenced by three primary properties:

- Moisture content (vitally affects the combustion rate)
- Surface area to volume ratio (influences much a fuel particle intercepts heat transfer)
- Particle density (low density fuels will ignite more readily because of low thermal conductivity and heat retains at the surface of the fuel particle)

The increased combustibility or fire incidence of Morwell brown coal compared to the other Open Cuts may be explained by its coal properties (SECV, 1982), refer to Table 1.

	Morwell	Yallourn	Loy Yang
***Coal Properties**			
Moisture (%)	60.1	65.5	62.5
Porosity (%)	40.9	35.8	40
Apparent Density (g cm^{-3})	0.84	0.938	1.12

*Table 1 - Coal Properties (*Weighted averaged coal samples)*

It is important to note that considerable variability occurs in physical and chemical properties within each coalfield. Table 1 is a representation of the average bulk coal samples taken from each Open Cut.

Research indicates that coals with lower moisture content and bulk densities are more prone to combustion. Morwell coal has lower moisture content and a lower bulk density that Yallourn and Loy Yang coals (SECV, 1982). This data is also very consistent with research data on the minimum surface temperature required to ignite coal particles. A SECV research paper into ignition of coal particles on hot metal surfaces found ignition temperature trends of Morwell coal particles (6.35mm) at 270 ^{0}C (lowest observed minimum ignition temperature 249 ^{0}C),

Yallourn coal particles (6.35mm) at 285 ^{0}C (lowest observed minimum ignition temperature 271 ^{0}C) and Loy Yang Coal particles (6.35 mm) at 295 ^{0}C (lowest minimum observed ignition temperature 292 ^{0}C) (SEC, 1978).

Exposed surfaces in Morwell Open Cut bulk coal are estimated to weather to a slightly smaller particle size than Yallourn or Loy Yang. This coal dust/loose coal detritus dries and can be readily ignited. Brown coal fires are usually a combination of smouldering combustion and the spread of burning coal particles driven by wind along the surface of the exposed coal seams (SECV, 1989).

It may be reasonable from prior research to consider that you may expect that because of the marginally lower moisture content and slightly higher combustibility of Morwell coal that coal faces in the open cut may require additional spraying to reduce the risk of fire than is carried out at Yallourn or Loy Yang.

2.4 Spatial Vulnerability and Risk

The rural fire risk to the Open Cuts is also highly dependent on the exposure of assets and coal as a direct function of their considerable size. Each mine is dynamic and growing resulting in an increasing perimeter and potential exposed coal area that is vulnerable to ignition from firebrand attack or direct flame contact or other ignition sources. The Stretton Inquiry found that the 1944 fire in the mine "was caused by airborne burning material from the bushfire igniting the coal dust in the workings ". To illustrate this scale for this inquiry – Hazelwood Power Station and Morwell open Cut occupy an area of 3554 hectares with the mine size around 800 hectares to a depth around 100 metres and 15.5 kilometres of perimeter. The nearby Yallourn Open Cut, its power station and lands total some 5,500 hectares (Energy Australia, 2013).

Figure 5 the Landsat 5 Thematic false colour satellite photo shows the geographic associations of the exposure of open cuts; proximity to the communities and the type of vegetated landscape immediately around them. This spatial relationship is highlighted by the colour differences in the image of the three open cuts and associated Power Stations (green) and their close proximity to townships (pink) and nearby vegetation including plantations and the forested foothills of the Great Dividing Range to the North is blue.

Incoll (1986) proposes that the fire risk to Morwell Open Cut from external rural fires (as largely validated by local fire history) is most probably:

- the western and south western aspects exposed to high intensity rural fires occurring in the Latrobe Valley (scenario 2)
- to a much lesser extent the eastern and southern aspects where lesser intensity rural fires entry which were beyond the capability of suppression forces

Much earlier, a fire protection review of Morwell Open Cut in 1964 had considered the most dangerous fire winds came from the North, North West or West and as a result recommended that key trunk conveyors and vital outlets to Hazelwood Power station are on the vulnerable east and south sides of the open cut and need fire protection.

Figure 5 - Thematic false colour satellite photo taken in 1987

The dynamic nature of the Open Cuts and their increasing extension into the landscape is shown some 24 years later in the later satellite image (figure 6). If you compare and contrast the two images it demonstrates the concurrent expansion of urban areas and surface mines in this landscape. Perhaps of interest to future fire scenario's is the expansion of forested areas directly north of Yallourn Open Cut.

This also illustrates the priority to encourage a regional co-ordinated and integrated approach with all stakeholders to land use and fire prevention planning with such a significant concentration of critical infrastructure in Power generation facilities (Coal, Gas) and nearby communities and transport routes.

Figure 6 - Thematic false colour satellite photo taken in 2011

The Open Cut Mines reflect the different age technology and mining infrastructure with the associated Power Stations along with the installed fire protection equipment that reflected with the known technology at that time. This can be illustrated with Open Cut Dredgers (16) that first came into service in 1955 and the last commenced service in 1992. They vary significantly in type and capacity.

In added overlay to these risk factors, Open Cut mining has continued to expand and amend mining practices. For example, Yallourn Open Cut using dozer push/feeder breaker system to replace aging bucket wheel dredgers.

3.0 Mitigation and Management Strategies for Protecting Open Cut Mines

3.1 Historical Context

There are three main ways of modifying the fire risks of rural fires to Open Cuts (SECV, 1981).

1. **Ensuring Comprehensive Fire Protection Measures Within Open Cuts To Reduce Their Vulnerability.** Fires in brown coal Open Cuts are difficult and complex. The level of Open Cut fire protection has been determined by the detailed specifications in SECV Latrobe Valley Open Cuts Fire Protection Policy. The policy was introduced in 1981 and prompted by the Morwell Open Cut fire in 1977. It was a major step in standardising an approach to Open Cut protection. It was revised in 1984 and last updated by the SECV in 1991.

   The fire suppression aspect of the policy requires an extensive reticulated water supply and spray system for both dust control and fire prevention and containment of all Open Cut faces.

   The major assets in the Open Cuts are the dredgers and conveyors, both of which have fixed fire suppression deluge systems installed and all vehicles entering the coal face are required to have modified exhaust systems to minimise the potential threat from this ignition source.

   Others controls apply to works in the mines and mine management monitors the conditions in each Open Cut and is able to declare an "Open Cut fire alert" when warranted. The alert imposes severe restrictions on Open Cut activities. Fire protection activities and response has largely been the function of each mine fire service.

   These fire protection arrangements have reflected learning from previous Fire Investigations i.e. water spray coverage requirements increased from 19% of uncovered coal in working levels 1944 to 40% in 1962 to 50% in 1984. A very detailed investigation report into fire protection of the Morwell Open Cut Fire on the 4-7th of November 1977 also provides insight to the development of many protection strategies still operating today (i.e. use of mobile cranes and Elevated platform vehicles with water monitors, open cut signposting, location of stand pipes to name a few) (Vines, 1977).

   All Open Cuts normally require all employees to be aware of fire policy and procedures and can fight a fire when necessary.

In regard to fire protection in worked out batters as occurred in the February 2014 Morwell Open Cut fire – in brief the SECV open cut fire protection policy required that as a minimum worked out batters are to be protected as follows;

- all benches are clay covered
- fire break zones extending down the full length of the batter(reducing fuel continuity)
- alternatively fixed fire spray breaks maybe used

Vines indicated that fire suppression activities appeared to be a long term requirement on worked out coal batters. He also indicated that experience in Morwell Open Cut from where previous fires had penetrated deep into crack patterns or where cracks had opened up significantly "hot spots" tended to occur and self-propagate inside the coal face (Vines, 2007).

In an early review of fire protection fire (including Vines) for Morwell Open Cut in 1964 it had been recommended that wherever possible worked out batters should be covered with overburden and at least during summer months this covering be kept up to working faces so to increase protection and reduce demands on the water supply.

This report also recommended that permanent batters too steep for covering by clay should have water protection where possible.

Basic fire mitigation strategy is to reduce any fuel sources (particularly if plentiful and continuous as in the Open Cut exposed brown coal faces). The long term economic strategy would be the successful progressive rehabilitation and reduction of exposed coal in worked out batters and unused areas.

The potential application of new technology, improved policy and processes should be an important factor in maintaining the competitiveness of these operations and offer to improve fire protection for both the business and community.

2. **Managing the Surrounding Landscape so to Minimise the Risk of Damage to Life and Assets.** The SECV produced an annual bushfire mitigation plan for Latrobe Valley assets. Each mine operator now produces a detailed Bushfire Mitigation Plan.

   Key objectives could be expected to include reducing the probability of a rural fire starting, slowing its spread and limiting its intensity so that it might be controlled.

   This also involves the applying suitable land use controls and building controls in regard to fire protection and adequate separation of the Open Cut mine and rural/urban residential interface or surrounding land uses. For instance it is unclear whether any landholder tree plantations or vegetation within

VicRoads lands near to Morwell Open Cut and the Princes Highway (South of the highway and to the North West of the Open Cut) may have contributed to increased fire risk from spotting and ability / capability to suppress fires in these vegetation types.

Fire prevention works along nearby roadsides, adjacent rural lands and plantations all play a crucial role to fire spreading into Open Cuts.
One example of a large fire developing from a roadside ignition (car engine fire) was the McGauran's fire in 2002 which rapidly burnt 662 ha of Softwood and Hardwood Plantation on the south side of the Princess Highway between Morwell and Traralgon. The initial grass fire transitioned into a plantation crown fire and travelled under westerly winds towards Traralgon. If winds had altered to a North Westerly direction this fire would have spotted and travelled towards Loy Yang Mine (Overview of Fire in Victorian Plantations, 2014).

The Open Cut fire protection policy specifically nominates the need for "the effective limitation and management of forested, wooded or grassed areas external to the open cut to inhibit the progress and effect of an external fire ". This is extensively described in Section 1.4 External Protection in regard to firebreaks, grassed areas and timbered areas. For example, timbered areas were generally restricted from being within one kilometre of the Open Cut boundaries and are to be shown not to represent a significant fire hazard when within 5 kilometres.

3. **Reducing the Frequency of Ignition Sources.** This is an essential and broader community responsibility as many significant rural fires impacting the Open Cuts have started from human causes.

   In many ways this is a central and root cause to the external rural fire risks to these facilities. In particular, causes from deliberately lit bushfires have been well described in the 2009 Victorian Royal Commission reports and elsewhere. Bushfire arson has long been considered an intractable, complex and costly crime. It would seem logical to obtain greater State Government financial support for the Gippsland Arson Prevention Program to enhance prevention and education measures.

   Further investigation and analytical work on ignition sources within Open Cut operations may assist mitigation measures to limit scenario 3 (see major fire scenarios)

   It may be of interest that the SECV "Protection of SECV Latrobe Valley Assets from the Rural Fire Threat" in 1985 identified that more than 70% of the 115 rural fires requiring suppression action in the Yallourn/Morwell area each year were related to human activity and represented a huge opportunity to limit the fire problem.

Despite very large efforts by all fire agencies and enforcement authorities over time this remains an area worthy of relentless effort by all community stakeholders.

3.2 Risk Modification

The outworking of the SECV Rural Fire Protection Policy resulted in fuel management for asset protection including:

- The construction of an extensive strategic firebreak network predominately along roadsides. This was co-ordinated with other adjoining major firebreak systems. These consisted of around 180 kilometres of mineral earth (prepared by rotary hoeing and ploughing) varying in width from 10 to 30 metres, slashed grass and greenbelt firebreaks. Firebreak width was based on published research on width necessary to stop grassfires at certain intensities (Wilson, 1988).

  This research indicated that the probability of a firebreak being breached by a head on approach of a grass fire increases with increasing fire line intensity and the presence of trees (within 20 metres of the fire break) and decreases with increasing firebreak width.

  Firebreaks remain a valuable tool to fire prevention, directly slow or halt a fire – especially a fire which originates beside a road, Firebreaks also provide a line to back burn from or greater access for fire suppression activities.

- Fuel reduction burning of any forested areas adjoining works area was programmed to limit accumulation of litter (fine) fuel levels (i.e. West and North West of Yallourn) in conjunction with fire agencies. The aim of such hazard reduction programmes was to maintain fuel loads below the level critical for crown fire formation. The importance of strategic hazard reduction to reduce heavy fuels cannot be over emphasised.

Fuel management of asset zones around open cuts and facilities consisted of a mixture of techniques matching site requirements. These included:

- Slashing
- Grazing
- Pruning and mulching
- Grass harvesting (hay) for fodder conservation
- Ploughing, grading, bulldozing

Green cropping was successfully used at Loy Yang Mine (summer green high moisture crops).

All such works were to be completed prior to the commencement of the declared fire danger period and some similar arrangements appear within mine operator's bushfire mitigation plans.

3.3 Readiness

Historically the SECV undertook a series of readiness activities. These included;

- ***Fire Detection***

  Early detection and accurate location of outbreaks was achieved through a system of fixed lookouts, aerial patrol and ground observation.
  Integrated fire detection consisted of manning a fire tower at Morwell Work's area and one at Coach Road, Yallourn. These fire towers worked in co-operation with APM (now Hancock Plantations) tower manning times and DSE.

  On a day of high fire danger, aircraft detection supplemented fire tower detection and was arranged in co-operation with APM Forests Pty Ltd fire control room. Light aircraft were provided from the Latrobe Valley Aero club and airfield. An aircraft was automatically on standby for the SECV use on day of total fire ban.

  Fires generally have some scope to be detected and extinguished early and their subsequent impacts can be reduced. Fire danger ratings reflect the difficulty of control.

- ***Desk Top Drills – Testing Plans***

  An annual major exercise would occur for all open cuts and power stations exercising emergency planning operations. This regularly addressed area wide emergencies such as rural fires, open cut fires, earthquakes or similar.

  These included emergency service representatives to practice co-ordination arrangements, communication and information management. In addition, an annual senior management audit would inspect all open cuts and works areas for fire prevention and preparedness prior to the fire season.

  Many organisations undertake such activities as part of their Crisis Management Plans and schedule regular periodic drills that are mapped to address all major accident hazards and assist in developing capability.

  Drills and exercises range from simple communication to full operational exercises. They are normally conducted as follows:

  A. Full mobilisation of the organisations resources, state and federal support agencies and contact is made to any parent international level. Duration is usually between 6 to 48 hours.

B. Mobilisation of specific resources and local incident agencies with contact to state and federal agencies, but no mobilisation of resources. Usually 4 to 24 hours

C. Exercise is directed at a site /facility, to its immediate Incident centre and external affairs team for support such as media and welfare. It does not include any mobilisation of resources, other than the organisation's site directly involved. Contact is made with local and state agencies, but no mobilisation occurs. Usually 2 to 4 hours in duration.

D. A table top or discussion exercise conducted on site and involves incident response teams and may include contact with the Incident centre for limited support. Contact is made when required for the exercise, but is limited by design. Usually 1 to 2 hours in duration.

E. A communication exercise only involving the site/facility and contacts are limited to the site /facility. Usually 1 hour duration.

The current Australian Standard 3745 (Section 7) recommends all areas of a facility should participate in at least one emergency response exercise in each 12 month period. These types of activities assist all stakeholders, provide for continuous improvements and assist in demonstrating assurance.

- ***Fire Modelling***

The SECV engaged research in to spatial fire hazard mapping and fire spread predication. This included a Fire Hazard mapping project with the University of Melbourne (fire threat mapping using remote sensing and geographic information techniques) in 1991.

A fully operational fire modelling capability was built by CSIRO National Bushfire Research Unit and interfaced with the SECV Latrobe Valley Airshed Network (a dense network of five automatic meteorological stations in the Valley). This enabled real time weather and data acquisition and input from CSIRO Atmospheric Research of NOAA9 satellite AVHRR signals to produce digital maps of grassland curing. These were imputed into the fire model.

SECV Research and Development undertook a validation study on the model using three case study fires (Newborough 1978, Driffield 1983 and Firmins Lane 1983).

These geographic based fire modelling tools where developed to provide support to SECV policy to take aggressive and continued suppression likely to threaten SECV assets and determine levels of fire hazard.

Since this time, GIS has resulted in more accurate inventories of assets exposed and assessment of bushfire hazard throughout Australia.

The accuracy of fire spread and fire hazard models greatly improves with comprehensive and higher resolution data.

Significant developments have occurred in this field and offer opportunities to use such capability to better calculate fire risk and risk management to the Latrobe Valley. This may be available to industry with government support or facilitation. Developing modelling of brown coal fire spread should be considered to assist in both mitigation and suppression plans and strategies. Perhaps the most immediate opportunity exists with local government.

- ***Response***

  A major fire is simply a small fire on which initial attacked failed. Extinguishing all fires in their incipient stage remaining a critical objective to minimise fire loss consistent with crew safety.

  The difficulty of suppression for rural fires (forest and grass) is reflected by the daily forecasts of fire danger made by the Bureau of Meteorology during the fire season. This assists all stakeholders in determining suitable readiness of resources (i.e. adequate suppression force is available to the risk).

  Within open cuts, this is achieved by ensuring all Open Cut personnel can extinguish brown coal fires and sufficient firefighting resources exist to conduct initial attack to fires on surrounding lands until the arrival of external fire agencies. This is usually to cover this lapse time and accordingly minimise any fire growth. All Power Stations currently maintain separate site emergency service teams with a capability to conduct initial attack on grassfire /bushfires inside the works areas.

  Previous SECV arrangements also included responding firefighting resources to any fire occurrence in areas of mutual interest with adjoining landholders (DSE and APM Forests).

  Brown coal fires have normally been suppressed by the extensive application of water and may prove complex and time consuming. Wetting of the coal surface and its dust assists to extinguish the fire and prevent it from spreading. Deep seated smouldering combustion requires very large quantities of water as sufficient heat remains to dry out the surface and continue burning.

  The rate of spread in brown coal open cut mines is not well known or understood. The Morwell Open Cut fire in 1997 provides a glimpse when it was recorded to have initially spread under strong north to westerly winds at around 300 metres per hour. The equivalent weather conditions would have produced a higher forecast rate of spread in grassland fuels (GFDI) by a factor up to 10 times (3 to 4 kmph) and a factor of 1.5 for forest fuels (400-450 metres per hour). Much more research is needed here.

The final report of the review committee into the Morwell Open Cut Fire (November 1977) made 28 recommendations. These included an area emergency mobilisation plan, suitable back up reserves of equipment and training and mechanisms for more experienced mine personnel be trained to assume command and instruction of crews of inexperienced personnel. This supported the need to rapidly increase resources at a large or spreading Open Cut fire as these where manpower intensive activities. The demand for resources is a highlighted by allocation time line (figure 7) on the Morwell Open Cut 1977 fire. The principle aim to control the spreading edge, defend mining assets, and limit smouldering combustion penetration of coal seams.

The current Mutual Aid arrangements reported between the Power and mine operators may address the above and compliment mechanisms within the Victorian emergency Management Manual.

Such arrangements normally made between private organisations are designed to share resources and help one another for emergency preparedness, response and recovery. In particular they allow for a common pool of resources and minimise costs and avoid unnecessary duplication of materials and equipment. Such arrangements are recommended by US Electricity Supply Research Institute for area wide disasters.

Resource Allocation Timeline

Morwell Open Cut Friday 4th November 1977

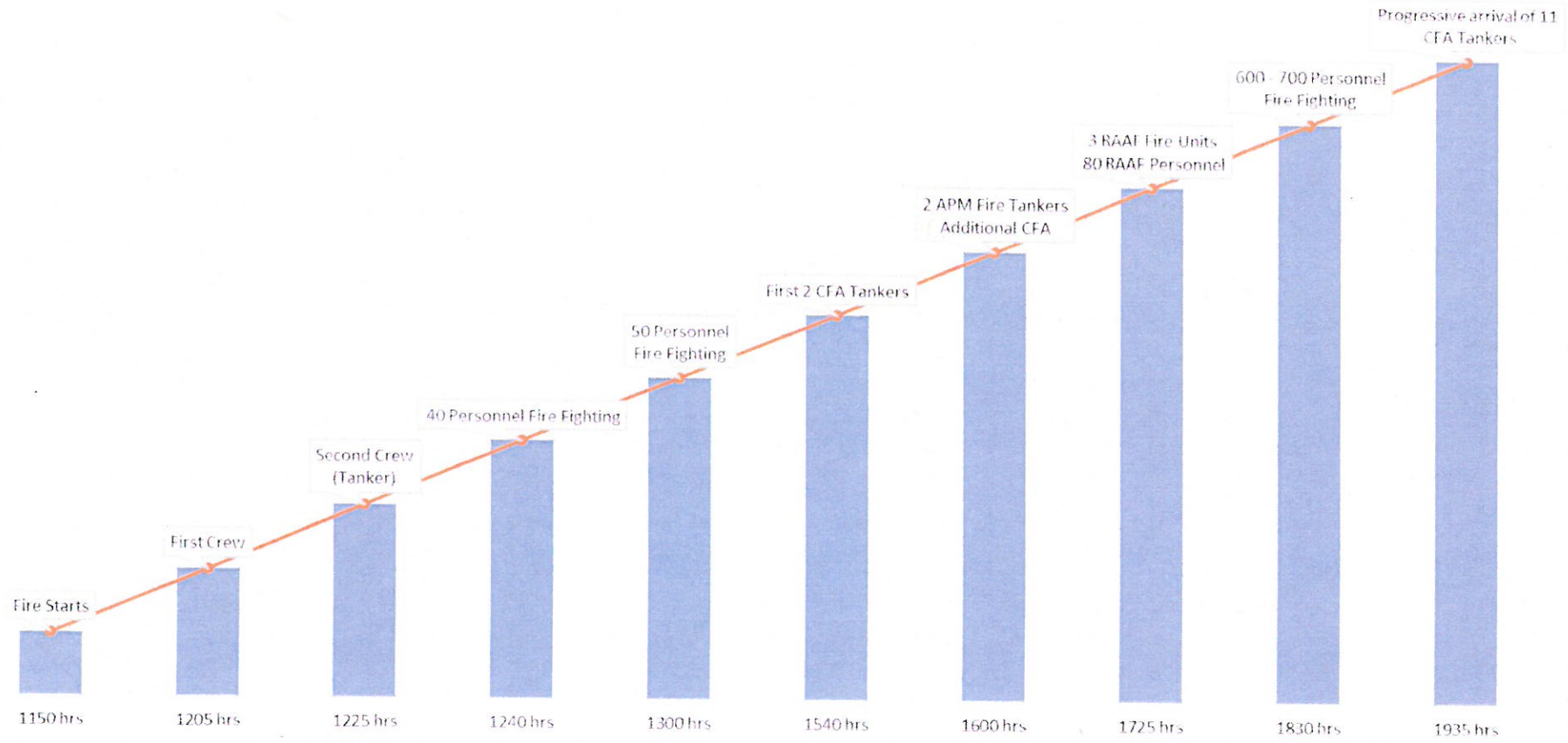


Figure 7 - Morwell Open Cut Fire

4.0 Possible Opportunities for Improvement

1. All relevant Research and lessons from fire incidents are captured and promulgated to assist mining operators, fire agencies and stakeholders to improve hazard identification, risk assessment and risk control. This could include ignition risk maps that Plucinski (2012) concludes can be used to identify the best locations for fuel treatments and optimise fire suppression resourcing levels. Such risk maps can also support bushfire arson prevention (Anderson 2010).

2. It may be possible for Power and Mine Operator current Bushfire Mitigation plans(assisting compliance to Electrical safety bushfire mitigation regulations 2003)to more closely integrate with the Latrobe City Municipal Prevention Plan (for example identify and list mine strategic firebreaks and their interface to municipal firebreaks, use common computerised fire hazard mapping tools), along with any other adjoining significant landholders (such as a Private Plantations Fire Prevention plans.) It may also prove beneficial to seek best practice of Bushfire Mitigation plans against other surface or coal mine operators (i.e. BHP Billiton, Rio Tinto or similar) through benchmarking. An example of other mine plans is the BHP Billiton Dendrobium Mine Bush Fire Management Plan.

   A more integrated, broader and collaborative approach should ensure intensive fire prevention measures directly around mines and adjoining areas that may offer further opportunity to reduce risks to open cuts and associated power plant.

3. Training and education in specific brown coal fire prevention and firefighting could be further developed and enhanced to match a range of competencies necessary for all current fire protection equipment and initial response techniques and be formalised into the national training curriculum.

   No specific and up to date competency units for brown coal fire control have been formally developed within the PUA streams, PMA streams or RII units. The training competency standard RIIER201A "Conduct fire team operations "applies to resources and infrastructure industries including coal mining and is used by other surface coal mine operators in NSW and Queensland. This competency package could be modified or customised to a brown coal surface mine environment.

   Training development will also need to address additional and broader training needs due to technological change and understanding of hazards (i.e. Carbon Monoxide, more extensive A Class foam use, fire prevention equipment, ground monitors, infra-red cameras, bulk water tankers etc.).

This may assist with the training and continuation training necessary to maintain suitable skills and competence in operators, contractors and other stakeholders. More broadly, AS 3745 (Section 6, Training) recommends general emergency control organisation skill retention training activity at intervals not greater than 6 months and first attack firefighting at intervals not greater than two years. This is similar to the Open Cut Fire Protection policy that recommends refresher training in fighting brown coal fires every three years.

4. There may be opportunities to improve emergency planning at Open Cuts to aid preparedness, response and business continuity by benchmarking such current arrangements to international standards such as the National Fire Protection Association Standard (120), Standard for Fire Prevention and Control of Coal Mines (2010). This standard includes surface mining operations.

   In addition, similar international standards such as the NFPA Standard 1600 Standard on Disaster/Emergency Management and Business Continuity programs along with ILO Safety and Health in Mines Convention 176, and it's guidance on emergency preparedness for surface mining and quarrying may also provide useful assistance if not already used.

   The Draft Code of Practice on Emergency Response at Australian Mines by SafeWork Australia provides further guidance to developing emergency plans and the underpinning risk management process supporting plan review and improvement.

   Such planning activity may also support the Victorian Critical Infrastructure model and its resilience improvement cycle.

   Unfortunately, the recent Morwell Open Cut fire produced significant smoke that impacted the local community over 45 days.

   Current legislation is designed to protect employees, the community and the environment from the hazards associated with normal mining and industrial operations. However, in other major hazard facilities and their associated safety case recognise operations that can create hazards of a scale and type that are not necessarily covered under this existing legislation.

   Consequently there is a need for controls designed to eliminate the under lying and immediate causes of major accidents and limit their consequences.

   A key role in this approach includes the management of offsite risks arising from such incidents.

   It would appear logical to consider the suitability of brown coal surface mines and power stations to develop offsite emergency plans with local planning authorities and emergency agencies to cover the contingency incidents that may impact the surrounding community. Historical research may assist here as the Latrobe Valley Airshed study represents one of Australia's best long term studies into local

climate conditions (similar to the Sydney Basin studies) and air movements are well understood.

This includes the mixing of seas breezes around Morwell and influence of topography (Great Divide and Strzelecki Range) funnelling winds in an easterly or westerly direction.

In general smoke consists of a range of products of combustion that rise in plumes above the fire source. Smoke plumes disperse dependent on local meteorological conditions and atmospheric structure and are often complex and difficult to forecast (SECV, 1986).

The SECV Atmospheric Science section initially undertook an investigation of the influence of bushfires on air quality using the Latrobe Valley Airshed data. It concluded that methods where available to estimate particle emissions from fires, associated particle concentrations and visual range. It suggested that at ground level large fires result in large quantities of particles, some NO2 but negligible SO2 or ozone.

The Federal Government Bushfire inquiry in 2004 identified and nominated details on smoke exposure and risks. In particular the National Environment Protection measure of a maximum concentration of 50 micrograms per cubic metre for particles of 10 microns or less in diameter over a 24 hour period. It discussed the risks of asthma and other medical conditions and how smoke particle concentrations often exceed safe levels during major bushfires.

Much more detailed information arose the Bushfire CRC project on Air Toxics Exposure and Management including the provision of a field guide to smoke exposure (includes details on risks from CO, respirable particles, formaldehyde and acrolein and acetaldehyde) (Reisen, 2009).

The combustion of brown coal is a complex process of coal devolatilisation, ignition and combustion. The thermal decomposition of brown coal will be highly variable with temperature. Moisture in brown coal promotes partial combustion and enhances smoke formation. This incomplete combustion enables some distilled substances to condense without being burned and remained suspended as very small droplets of liquid or solid over the fire. Water vapour may often condense giving smoke a whitish appearance. In addition smoke contains the left over products of combustion – residual ash. Research found that some key final gas products of combustion from brown coal fires are typically tars, CO (20%), CO2 (9%), H2O (8%), C2H4 (3%) , CH4 (3%), and H2 (1%) and ash consisting of various inert minerals and inorganics. At temperatures around 1200 ^{0}C, 70% volatile products yield in the order of 40% gases, tars 30% and 30% residual char of the original dry mass (SECV, 1982).

RMIT Research (1989) reports coal ash chemistry for Morwell consisting of a mixture of minerals, FeS2, SiO2, AlO3, inorganics, Fe, Ca, Mg, Na, Cl, Organic S.

Further research into the general volumetric estimates from the potential amount of coal burnt and products of combustion including ash that was likely to have been released into smoke and plume behaviour would be valuable.

Any information that could assist offsite emergency response planning for this risk would be a valuable improvement for all stakeholders.

5.0 Conclusion

The business of mining inherently involves significant risk and this brief submission shows that historically Latrobe Valley Open Cut Mines include the risk of impact from rural fires.

Comprehensively assessing rural fire risks is critical to determining suitable priorities and fire mitigation measures and assists in the allocation of limited resources.

Perhaps the current safety case approach to major accident hazards may also provide a valuable guide with the concept of reducing the risk as low as reasonably practicable thus assisting the mine operator, the surrounding communities and other stakeholders.

Previous fire history gives quantitative evidence that Morwell Open Cut has been subject to both internal fire and external bushfire impacts and that this coalfield may likely have a higher level of combustibility than the adjoining fields. More broadly, the Latrobe Valley represents a dense concentration of critical infrastructure in close proximity to many communities vulnerable to bushfire risks. It is also reasonable to suggest that changing climatic conditions are increasing these risks.

Reducing community wide rural fire ignition sources (deliberate or otherwise) offers considerable scope to reduce this risk.

Improved off site emergency planning may help deal with any future smoke or similar impacts on the community from such facilities

This approach is considered consistent with the all hazards resilience approach of the Victorian Critical infrastructure model which focuses on identifying, assessing, managing and mitigating risks.

In the end, this requires all stakeholders and the community to contribute and share responsibility for managing rural and mine fire risk, preventing rural fires and ensuring vigilance in fire mitigation measures.

This submission is limited and we would encourage new data and collaborative research to support fire risk analysis and determine the best possible future direction in fire safety for all these facilities.

Finally, a former leading Loss Prevention Chemical Engineer Trevor Keltz stated" Problems of all sorts not just accidents, will recur less often if we publicise, discuss and record actions of the past, remind people of them from time to time, do not make changes unless we know why the procedure or equipment was introduced and ensure an organisation learns from it's past."

6.0 References

A Short Overview of Fire in Victorian Plantations, 2014. Available from: < http://hancockwatch.nfshost.com/docs/fire.htm>

Anderson J (2010) Research in Practice No 11: Bushfire Arson Prevention Handbook, Australian Institute of Criminology.

Australian Standard 3745 – 2010 Planning for emergencies in facilities

Barber J. R, Assistant Chief Officer, Country Fire Authority, 1983: Fire Prevention as an Essential Factor in Roadside Management

Beer,T 1991 Bushfire – Control Decision Support Systems, Environmental International Vol 17, pp 101 -110

Blake Julie E, 1990: Fire Threat Mapping Using Remote Sensing and Geographic Information Techniques

CSIRO, Bureau of Meteorology 2014, State of the Climate

CSIRO, Division of Forestry, 1994: Bushfire Spread Simulator SiroFire

Davidson Tim, Joynt R, 1991: Validation of the National Bushfire Model in the Latrobe Valley

Durie R.A, 1991: The Science of Victorian Brown Coal: Structure, Properties, and Consequences for Utilization

Durre Mark, Beer Tom, 1990: The National Bushfire Model User's Manual

Ellis S, Kanowski, Pwhelen R, 2004: National Inquiry of Bushfire Mitigation and Management, Commonwealth of Australia, Canberra

Energy Australia Yallourn, 2013: Bushfire Mitigation Plan

GDF Suez Hazelwood, 2013: Electricity Safety Bushfire Mitigation Plan

ILO C176 (1995): Safety and Health in Mines Convention

Incoll R, SECV 1986 Fire Prevention Considerations for the rehabilitation of the Morwell Open Cut and Overburden Dumps

Keltz, T (1993) Lessons from Disaster – How organisations have no memory and accidents recur I.Chem.E

Latrobe City, 2011: Municipal Fire Prevention Plan

Leonard E. B. Stretton: Report of the Royal Commission to Inquire into The Place of Origin and the cause of the Fires which commenced at Yallourn on the 14th day of February, 1944; The Adequacy of the Measures which had been taken to Prevent

Damage; And The Measures to be taken to Protect the Undertaking and Township at Yallourn

Loy Yang B, 2013: Station Bushfire Mitigation Plan

Ma Shengping, Mill J.O , Herg.S , 1989 A thermal analysis study of the pyrolysis of Victorian Brown Coal. Journal of Thermal Anaylsis Vol 35, p 977 -988

M.H.Middelmann 2007 Natural Hazards in Australia, Identifying Risk Analysis requirements, Geoscience Australia

National Occupational Health and Safety Commission, October 2002 National Standard for the control of Major Hazards (NOHSC: 1014) and National code of practice for the control of major hazards (NOHSC:2016). AGPS

NFPA 120: Standard for fire prevention and control in coal mines

NFPA 1600: Standard on Disaster/Emergency Management and Business Continuity Programs

Reisen Fabienne, C. P. Meyer, 2009: Field Guide to Smoke Exposure Management

Ross Smith, Department of Sustainability and Environment, 2007: Key Issues Identified from Operational Reviews of Major Fire in Victoria 2006/07.

Safe Work Australia, March 2012 Guide for Major Hazard facilities: Safety case: Demonstrating the adequacy of safety management and control measures

Safe Work Australia, July 2011 Draft Code of Practice Emergency Response in Australian Mines.

Schmidt Donald L., 2007: Implementing NFPA 1600 National Preparedness Standard

State Electricity Commission of Victoria Research and Development Department, 1982: Devolatilisation of Victorian Brown Coal

State Electricity Commission of Victoria, 1985: Discussion Paper on Draft Policy for the Protection of SECV Assets from Rural Fire Threat

State Electricity Commission of Victoria Research and Development Department, 1986: Explosibility of Victorian Brown Coal Dusts

State Electricity Commission of Victoria, Research and Development, 1978: Ignition of Coal Particles on Hot Metal Surfaces

State Electricity Commission of Victoria, 1984: Latrobe Valley Open Cuts Fire Protection Policy

State Electricity Commission of Victoria Research and Development Department, 1985: LVAMN Cumulative Percentage Wind Frequency Distribution Tables and Wind Roses: September 1979 to February 1985

State Electricity Commission of Victoria Research and Development Department, 1990: Morwell Open Cut Fire Risk Analysis

State Electricity Commission of Victoria, Research and Development Department (1986): The Influence of Fires on Air Quality

State Electricity Commission, 1981: The Chemistry of Brown Coal

Victorian Government, December 2012 A roadmap for Victorian Critical Infrastructure Resilience

Victorian Government, December 2013, Critical Infrastructure Resilience Interim strategy

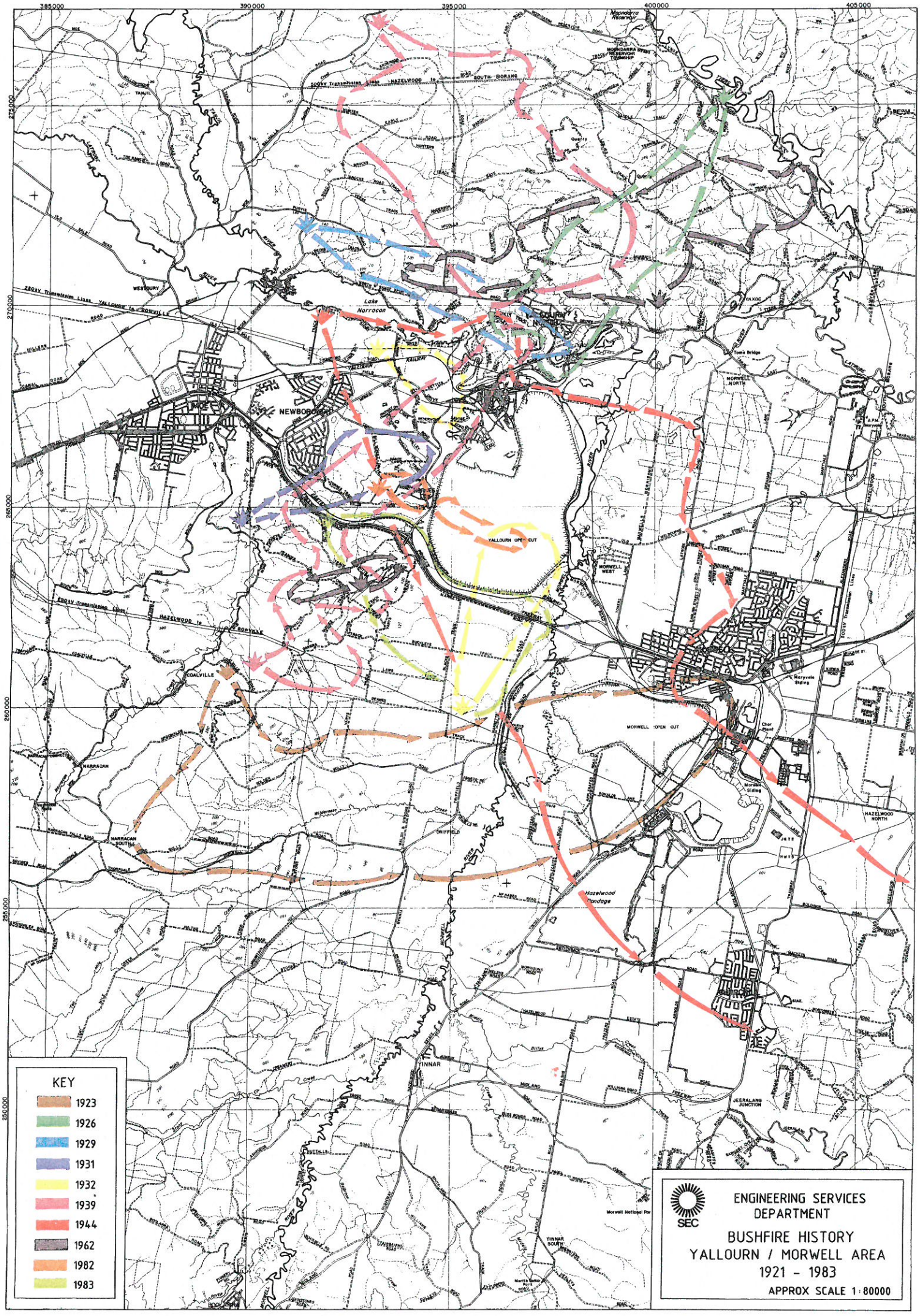
Vines J A, 1996: A History of Morwell Open Cut, Its Origins and Development to June 1995

Vines J A, Greenwood R M, Norris H V, 1977: Morwell Open Cut Fire 4, 5 & 6 November 1977 Final Report by Review Committee

Vines J A, Greenwood R M, Norris H V, Freshwater G, 1977: Morwell Open Cut Fire 4, 5 & 6 November 1977 Summary Report by Review Committee

Wilson A A, 1988: Width of a Fire Break that is Necessary to Stop Grass Fire. Canadian Journal of Forest Research

Wright W.J and Jones D.A: Climate prediction – a potential tool for effective fire resource management planning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