



Review of fire management capacity, risk, and opportunities

Central West Forestry Hub

14 April 2022

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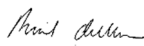
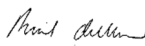
14/133 Castlereagh Street

Sydney, NSW, 2000, Australia

T 0428 643 115 | E paul.demar@ghd.com | **ghd.com**

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Author	Paul de Mar
Project Manager	Mick George
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Executive Summary

The Central West New South Wales Forestry Hub (the Hub) was established in 2020 and has received funding under the National Forest Industry Plan which has the overarching objectives of “better returns to business, more investment, more jobs and greater economic prosperity for Australia” and to “improve the productivity and efficiency of Australia’s forestry sector and support each region and its economy.” One of the priority projects identified by the Hub is to carry out a whole-of-industry review of bushfire fighting capacity and management across the Hub area in response to industry concerns about the bushfire risk and exposure of the plantation estate in the Hub region.

To better understand the current approach to, and capacity of, bushfire management and the overall plantation fire protection within the Hub region, a review of bushfire fighting capacity and management was commissioned with a view to identifying opportunities for making potential improvements of fire preparedness, capacity and management in the region. The review has been undertaken by GHD’s Natural Resources and Agriculture Group, led and facilitated by bushfire consultants Paul de Mar and Mick George who have broad plantation fire management experience.

The key outputs from this review and report cover:

1. The current plantation fire management capacity in the Hub.
2. Identification of opportunities to reduce the risk of plantation loss due to fire.

Plantation fire-loss risk in the Central West

Section 3 of this report addresses historical plantation fire-loss occurrence and the nature and distribution of existing/future plantation fire risk in the Hub, and also the key factors which drive the risk.

The review highlights that plantation fire-loss risk is highly variable both spatially within the Hub, and temporally depending on inter-annual/seasonal conditions. While bushfires can occur within the Hub every year, the highest likelihood of major losses occurs in high fire risk years such as during drought-affected years, or years with prolific cured grass cover, when major fires can develop and cover large areas during adverse fire weather. Plantation fire risk is not uniform across the Central West, with substantial variation in risk driven by a range of factors including the extent and continuity of forest cover in plantation areas, elevation, plantation topography/aspect, degree of accessibility into adjacent native forest areas, and priority given to early, aggressive containment response. The highest consequence fire-loss scenarios occur where large plantation agglomerations are concentrated, providing the potential for a single uncontrollable fire to cover large areas of plantation in one or more runs during adverse fire weather.

Historically, the largest single pine plantation fire loss event to occur in the Hub area is the ‘Canobolas Fire’ of 28 January 1985 (which burnt 2,349 ha of pine plantation). Only one other Central West plantation fire loss event has exceeded 1,000 ha, that being the Glenwood fire in 1982. Plantation fire loss events in the 100 to 1,000 ha size class are more common, with more than 6 such events occurring since 1980 (four of these in the last ten years). However, while fire losses to-date in the Hub have been relatively low in comparison with areas such as the south-west slopes (Tumut/Tumbarumba), the Southern Tablelands (Bombala) and other inter-state locations (including A.C.T., Victoria, SA and Queensland), the potential exists for significantly larger scale fire-loss events to occur within the Hub. As recent major fire-loss events over the past 15 years on the south-west slopes have served to highlight, a past history of relatively low losses is not a reliable indicator of continued low losses into the future.

A credible worst-case scenario in the Hub entailing plantation losses potentially exceeding 15,000 ha could involve a fire starting near Black Springs under severe NNW fire weather and making a sustained 6+ hour run to the SSE through the Shooters Hill/Vulcan/Gurnang plantation areas. More likely high-consequence scenarios with losses potentially exceeding 5,000 ha could arise from fires running up out of rugged forested landscapes along the Abercrombie River valley under adverse westerly or south-westerly winds. Depending on fire ignition location, fires emerging from the Abercrombie River valley area could potentially impact plantations in a range areas including Mt David, Jeremy/Burruga, Isabella, Gurnang and Shooters Hill localities.

Potentially, two or more large fire events could occur within a 5-to-10-year period. Depending upon the scale of fire events and the interval between them, reduced wood flow impacts could be compounded and/or extended, and

potentially result in significant restrictions in log supply to processors with serious financial impacts for plantation industry businesses and broader economic impacts for local communities.

Timber plantations are one of many rural economic asset classes identified/mapped as at-risk assets in Bush Fire Risk Management Plans (BFRMP) prepared by local Bush Fire Management Committees (BFMC). In the Central West, the vast majority of plantations are rated as 'Very High' risk with some having an 'Extreme' risk rating, typically based on a 'Major' consequence rating. While plantation fire risk is most acute for growers, it is recognised that inter-dependencies extend from growers to different industry segments including contractors (harvest and haul; silviculture; site preparation/roading/ earthmoving) and processors.

Fire response capability in the Central West

Section 4 of this report documents the firefighting capabilities resident within the Hub area, with a particular focus on resource capabilities available for initial attack and overnight first shift (extended attack) operations as these are the phases most critical to minimising the potential for uncontrollable high-consequence fires to develop.

Forestry Corporation of NSW (FCNSW) has the largest forest industry fire management capability in the Hub and FCNSW local capability is part of a much larger integrated fire management capability applied to its broader estate dispersed across NSW. Hume Forests (HF) and Plantation Pine Products (PPP) also have fire response capabilities that can work cooperatively with larger responders such as FCNSW and RFS. Forest processors and contractors also operate and maintain equipment that can be utilised in extended attack or multi-shift firefighting operations, however this is limited and not the primary focus of contractors.

FCNSW crews have specialised training and experience of how fuels and fire behaviour varies in different age classes/silvicultural treatments of pine plantation, and operational knowledge of where fires can best be contained in the plantation under different conditions. The key driver of FCNSW's approach to fire preparedness and response is the long-established mantra that for pine plantation fire loss minimisation, it is vital to detect fires as early after ignition as possible, and initiate an aggressive, multi-mode response (initial attack waterbombing helicopter supporting rapid response ground crews operating a combination of earthmoving machinery and tankers), mobilised as rapidly as possible to contain the developing fire to the smallest possible area before the fire develops to proportions beyond the capacity of the initial attack resources to control. The worse the fire weather conditions are, the less time there is before a fire can develop to uncontrollable proportions.

The multi-mode initial attack response is key – immediate response aerial waterbombing of the fire in its incipient phase serves to contain the size of the developing fire (as well as providing valuable location intelligence to ground crews), while the ground resources rapidly deploy to the scene with a combination of an initial attack bulldozer working in tandem with tankers to contain and knock-down developing flame fronts. Experience has shown that a multi-mode attack is far superior to tankers alone in a plantation setting. Plantation industry crews typically have extensive experience working different types of forestry/earthmoving machinery in different age classes and stand densities of plantation, and engaging in direct attack hose operations from tankers to minimise the potential for fire growth and escalation. This direct plantation industry firefighting knowledge, skill and experience is not commonly resident in non-forestry sector fire brigades. Private growers have a high reliance on RFS for fire response, noting that an RFS initial response is more commonly a single-mode attack with tankers, with additional modes of attack (aerial waterbombing and earthmoving machinery) more likely to be brought in (if available, and in the case of aircraft only while daylight remains) later in the extended attack phase and typically requiring specialist RFS aviation or plant supervision resources which also need to be sourced and mobilised.

The RFS is the lead emergency service for fire response in rural parts of NSW and has an important role to play in plantation fire protection in the Central West. The vast majority of heavy duty fire tanker resources locally available in the Central West are operated by NSW RFS. Volunteer rural fire brigades are established throughout rural areas, with higher densities of brigades occurring in more productive rural landscapes with higher numbers of rural landowners and where rural villages and towns are located. The Hub area is well-served by volunteer brigades, with some 109 RFS brigades (collectively operating approximately 200 medium and large fire tankers) distributed throughout the Lithgow, Oberon, Bathurst, Blayney, Cabonne and Orange City LGAs in which the Hub plantations are principally situated. Plantation growers which do not possess any fire response capability are highly reliant on RFS for fire response. Those growers which do operate their own fire response, including FCNSW, have varying degrees of reliance on RFS for responding to fires at which they need assistance for successful containment. For fires which develop beyond initial attack scenarios and progress into extended attack and multi-shift operations, reliance on RFS capability rises substantially, noting that indirect containment strategies involving backburning and burning-out operations can potentially require large numbers of RFS appliances to implement.

While numerically, there is a substantial RFS resource capability distributed through rural areas in the Central West, it is prudent to acknowledge that the primary motivation, training and experience of the RFS volunteers who respond to bushfires is the protection of human life, rural communities and settlements, critical infrastructure, and local rural enterprises. RFS resourcing of rapid initial attack operations applies a different methodology to FCNSW, being principally tanker-based, noting that RFS covers the whole rural landscape, and its response capability is not tailored specifically to the forestry sector. A key focus of RFS training, and historically the bulk of brigade firefighting experience is across the agricultural landscape (dryland grazing and cropping lands and to a lesser extent horticultural crop lands), and protecting local farming communities and settlements from fires emanating from areas retaining native vegetation or grasslands. Rural brigades are well equipped for, and experienced at, response to grass and crop fires across the agricultural landscape, and at protecting built assets in such landscapes.

The ability of RFS brigades to protect human life and rural assets is made considerably easier by good property-level bushfire planning and preparedness by individual, self-reliant property owners, many of which manage to protect their livestock, farm infrastructure and residence without ever requiring assistance from RFS. Indeed, good preparedness and self-reliance by individual rural and urban property owners is strongly encouraged by RFS, and promoted through the many community awareness, education and engagement activities undertaken by it. This principle applies equally to plantations – those which are well designed, with good access maintained in good condition, and with local plantation managers able to provide local knowledge have better prospects for successful fire response by RFS than plantations which are in difficult to defend locations, have access challenges, and where no fire plan is in place and/or where locally available plantation managers with local plantation property knowledge are lacking.

Those brigades with extensive tracts of timbered land in their brigade area may also have considerable experience responding to fires in native forests and woodlands. However, fire response in pine plantations is not a key area of training for RFS brigades and many brigades have little (if any) experience operating in plantations. Further, the dense plantation structure in early to mid-rotation stands, and low branch retention habit (both of which are often associated with a propensity for crown fire onset/fire behaviour escalation) can be unfamiliar and a cause of significant discomfort for many brigades. Thus it can be the case that private plantation growers which have a high reliance on volunteer brigades for response to fires may unknowingly be placing their plantation protection reliance in a firefighting capability which is not specifically trained for nor experienced in plantation firefighting.

Investments in fire protection are risk management decisions which ultimately hinge upon the risk appetite of each business. As recent major fire events in other parts of NSW have highlighted, growers are not the only segment of the plantation industry with exposure to fire risk. Large high-consequence fire events, or chronic recurrent losses, can also significantly impact other segments of the industry, and potentially plantation industry-dependent communities more generally.

Plantation fire loss risk optimisation

Section 5 of this report identifies and discusses the key requirements for optimising protection of plantations from bushfires. The key requirements include:

- Plantation design and set-up conducive to fire protection – providing a well-designed plantation layout with a well-maintained internal and boundary road access road/track network, and close local access to water, to facilitate efficient and safe firefighting operations. Implementation of hazard reduction in retained and adjacent native forest areas also makes an important contribution to good plantation set-up and ongoing risk reduction.
- Early fire detection capability - to facilitate early response while fires are still in their early growth stage;
- Early multi-mode initial attack (direct and close parallel attack) – to maximise suppression effectiveness in keeping small fires small and preventing fire escalation to uncontrollable proportions;
- Early request and mobilisation of back-up resources for extended attack – to provide timely and prudent up-scaling of resourcing levels for fires likely to exceed the capabilities of initial attack resources to control;
- Night firefighting operations capability – to take full advantage of cooler, milder conditions at night to get containment strategies implemented before the next onset of adverse fire weather;
- Multi-shift operations under the control of an Incident Management Team (IMT) – to develop well planned and resourced strategies utilising local knowledge and plantation fire containment experience, with access to Regional and State response resources to bring major fires under control and limit plantation loss and damage potential.

Opportunities for improvement

Acknowledging that all segments of the plantation forestry industry have exposure to major fire-loss risk, and that improvement of existing capabilities and enhancement of collaborative arrangements may be more pragmatic and realistic than upscaling of firefighting resources across the Hub, GHD has identified (in Section 6) a range of opportunities for improvement of plantation fire protection across the Hub. In summary, these opportunities include:

- **Good plantation design and maintenance measures**
 - Main plantation access roads designed and maintained to facilitate articulated truck access and egress for plant and heavy appliances
 - Provision of fire road network density conducive to facilitating rapid and close fire response
 - Perimeter break strengthening in areas directly abutting native forest to facilitate expeditious backburning from the plantation edge for protection against fires approaching through native forest
 - Hazard reduction in native vegetation in-holdings and areas adjacent to plantations
- **Risk awareness sharing and preparedness coordination**
 - A formalised annual pre-fire season meeting of the Hub members (and including local fire authorities), potentially facilitated by the Hub, focussed on sharing the latest and most detailed seasonal outlook information, and to discuss fire preparedness measures and coordination arrangements
- **Fire detection capability enhancement**
 - Convening of a “Future of Fire Detection Forum” with invited speakers to deliver the most up-to-date information on fire detection technology development, not limited to visual detection systems, but also covering private grower (and contractor) access to web-based technologies for monitoring of lightning strikes and remotely-sensed hotspots
 - Incorporation of fire detection vantage points (and maintenance requirements for these) in plantation fire protection plans
- **Response capability improvement – a range of opportunities (see Section 6) for improvement covering:**
 - Rapid initial attack capabilities;
 - Extended attack capabilities;
 - Multi-shift operations under an established Incident Management Team
- **Plantation industry coordination and cooperation enhancement measures including:**
 - establishment of a formalised local plantation industry group focussed on fire protection;
 - development of a plantation fire digital information sharing protocol to facilitate updating of digital map layers prior to each fire season;
 - broadening industry availability of access to FCNSW annual plantation firefighting training camps
- **Improved plantation industry collaboration with NSW RFS, with measures including:**
 - Periodically conducting targeted engagement activities with RFS aimed at broadening and increasing awareness of the scale of the Hub plantation industry and its importance to the local economy, the nature of collaborative efforts made by the sector to protect the resource, and the key risks to the resource and the importance of RFS capability and decision making to industry
 - Consideration by major plantation industry members to introduce programs to actively encourage and incentivise employees to join local volunteer rural fire brigades

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1. Introduction

The Australian Government has developed the policy “*GROWING A BETTER AUSTRALIA, A billion trees for jobs and growth*” to help create the setting to significantly increase new plantation forestry plantings to deliver confidence to our forestry-dependent communities, that they may have a bright future. A key strategy in pursuing the expansion of existing plantation forests and establishment of new plantations is the creation of a series of industry hubs to address regional issues in the forestry sector. The Central West New South Wales Forestry Hub (the Hub), area shown in Figure 1, was established in 2020 and has received funding under the National Forest Industry Plan (the Plan) which has the overarching objectives of “better returns to business, more investment, more jobs and greater economic prosperity for Australia” and “improve the productivity and efficiency of Australia’s forestry sector and support each region and its economy.”

The key objectives of the Hub are:

- Analysing the constraints that affect the productivity and efficiency of the forestry sector.
- Pinpointing opportunities for future investment in infrastructure and technology, and areas for potential expansion by forest industries.

The Hub has engaged The Fifth Estate (the Hub Manager) to manage projects that will meet its objectives and undertook a survey of local stakeholders to establish a set of key objectives and specific tasks requiring the input of contractors, consultants and service providers. The Hub Manager developed a work plan to manage these specific tasks. One of the priority projects identified by the Hub is to carry out a whole-of-industry review of bushfire fighting capacity and management across the Hub area.

1.1 Background

A stakeholder consultation process undertaken with Hub members prior to the Hub determining its work plan, raised concerns about the bushfire risk and exposure of the plantation estate in the Hub region. The devastation caused by the 2019/20 summer bush fires in the Tumut/Tumbarumba region would, if replicated in the Central West, have a serious impact on the industry within the Hub and could threaten its viability.

Some stakeholders suggested that the prevention, detection, suppression and management of the bushfire risk may be inadequate and/or more resources need to be committed to managing the bushfire risk. There was particular concern that the local NSW Rural Fire Service (RFS) brigades have limited training and experience in managing forest and plantation fires.

The Hub needs to better understand the current approach to and capacity of bushfire management and the overall plantation fire management strategy within the Hub region. The Hub sought proposals to carry out a review of bushfire fighting capacity and management and provide an accompanying report for the use of industry stakeholders. Following a tender process, GHD was selected to undertake the review, which is to include identification of opportunities for making potential improvements of fire preparedness, capacity and management in the region.

The key outputs from this review and report cover:

1. The current plantation fire management capacity.
2. Identification of opportunities to reduce the risk of plantation loss due to fire.

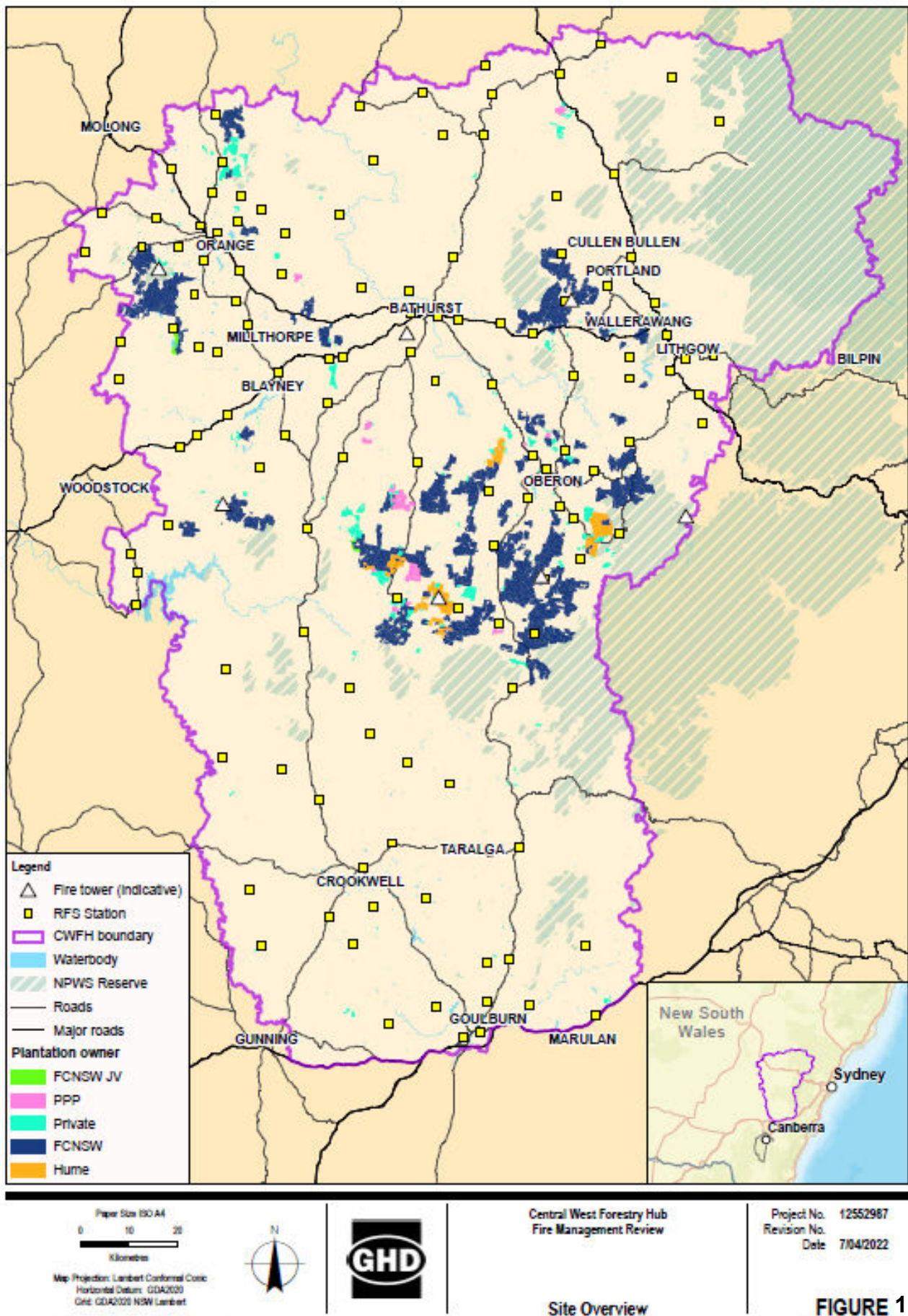


Figure 1 Central West Forestry Hub Overview Map

1.2 Scope and limitations

The review and associated report covers the following:

- A description of the capacity for plantation fire preparedness, detection, suppression and management within the Hub, covering but not limited to:
 - Human resources
 - Equipment
 - Infrastructure
 - Training
 - Geographic location of resources
 - Command and control
 - Cross tenure and multi tenure issues
 - Protection of the private plantation estate (specifically covering roads, access and water in private plantations)
- The roles of the various bushfire management authorities and their integration.
 - RFS
 - Forestry Corporation NSW (FCNSW)
 - NSW National Parks and Wildlife Service (NPWS)
- Plantation Industry Brigade concepts, potential benefits and issues
- The effects of plantation age, design and management on plantation fire risk
- Plantation risk levels in relation to the risk of serious fire impact on industry within the Hub.
- Relative plantation value and salvage potential
- Identification of any limitations to the current plantation fire protection capacity.
- Lessons learnt from previous plantation fires within the Hub or particularly relevant plantation fires outside the Hub
- Description of any new technologies and their suitability for implementation within the Hub area and recent developments
- Opportunities for potential improvements in capacity to minimise the risk of and loss from plantation fires.
- Specific implications for the Hub from the Royal Commission into National Natural Disaster Arrangements (Commonwealth of Australia, 2020).
- A review of relevant legislation, regulation and codes as they apply to private plantations in the Hub area, including suggestions to improve fire risk management in private plantations.

1.3 Assumptions

All information on firefighting capacities, appliances, levels of training has been provided by stakeholders and relied upon in the preparation of this study.

2. Review methodology

In undertaking the review, GHD undertook the following project methodology.

Project inception

GHD convened an inception meeting with the Hub project team. The inception meeting was conducted by on-line conference in place of the planned in-person workshop due to travel restrictions imposed by COVID. The purpose of the inception meeting was to confirm project methodology, project management and administrative arrangements, project timelines and work activity schedules, and deliverables.

Online survey and desktop review

In consultation with the Hub, GHD designed and conduct an on-line survey which was distributed to the Hub stakeholders to gain information on what resources, equipment, capabilities, infrastructure and capacities exist across plantation owners and managers (across tenures) within the Hub.

GHD reviewed documents provided by the Hub Manager/stakeholders and additional documents sourced by GHD to:

- a. Gain a sound appreciation of the capacity for plantation fire preparedness, detection, suppression and management within the Hub
- b. Review information and findings from fire events within plantations both within and external to the Hub for analysis of bushfire risk management planning and response concepts of potential merit for the Hub
- c. Consider where the most serious risks of high industry-impact fires in the Hub region have the greatest potential to occur
- d. Consider the salvage volumes potentially associated with different fire sizes/locations
- e. Examining how recommendations and findings from the Royal Commission and other relevant enquiries may potentially affect the plantation fire protection approach and technical capabilities for the Hub

GHD captured the key insights and findings gained from the desktop review stage in the form of a PowerPoint document which was utilised in subsequent project stages, and in particular the internal stakeholder consultation activities.

Consultative meetings with Hub growers and processors

Due to COVID restrictions, in consultation with the Hub, GHD devised a stakeholder consultation process comprised of two online workshops, a shortened visit program limited by the COVID restrictions, and phone consultations with those not able to participate in the in-person consultation activities. The presentations for the workshops are provided as Attachment A and B for workshop 1 and 2 respectively.

Workshop 1 (Attachment A)

A facilitated workshop designed and prepared by GHD in consultation with Hub Manager, covering:

- How fire risk is dispersed across the Hub Region
- Weather-related fire risk drivers
- Previous Central West plantation fire events as an indicator of important elements for risk reduction
- Lessons from major plantation fires in other Regions
- Implications Royal Commission into National Natural Disaster Arrangements (Commonwealth of Australia, 2020) and NSW Bushfire Inquiry (Owens and O'Kane, 2020).

Workshop 2 (Attachment B)

A facilitated workshop designed and prepared by GHD in consultation with Hub Manager, covering:

- Potential consequences of a large fire event
- Results of the Hub fire protection capability survey

- Fire protection system necessities and opportunities
- Capability limitations
- Collaborative organization
- Forest Industry Brigades – pros and cons

The subject areas covered in the two on-line workshops were designed to cover the key range of matters specified in the project scope of works.

Stakeholder meetings and phone consultations

In December 2021, GHD undertook a series of consultative activities, including meetings with FCNSW and Plantation Pine Products (PPP), and telephone consultations with Hume Forests and RFS (which for operational reasons became unavailable for the planned meetings).

The focus of the consultative activities was:

- Preparedness arrangements in the Hub – weekday, weekend, elevated fire danger – what resources are typically ready to respond? Arrangements for duty roster information sharing?
- Detection – what fire detection systems are being operated across the Hub and how is detection information shared between stakeholders? What emerging detection technologies are stakeholders investigating or trialling?
- Current response capabilities in the Hub – what fire scenarios can the Hub capability deal with and what scenarios would be beyond Hub capabilities requiring outside assistance? The consultation with RFS was directed to understanding their response capacity within the Hub area, and their general approach and operating protocols for responding to fires in plantations and incident scale-up for major incidents.
- Information sharing regarding response to reported lightning strikes, smoke, fires.
- Requests for assistance process (between plantation industry stakeholders; and to RFS and others).
- Local industry perceptions of strengths and opportunities for improvement.

Draft Report preparation

On completion of the workshops and consultative activities, GHD prepared a draft report covering:

- Plantation fire protection capability identification in the Hub. Noting that plantation fire risk and response resourcing varies significantly across the Hub, GHD has divided the Hub into five zones for the purpose of identifying plantation protection capability.
- Analysis of the current approach to how fire protection capabilities are responded to fire incidents, with consideration of strengths and opportunities for improvement
- Within each of the Hub response zones, identification of fire scenarios of concern which generate the greatest risk of a high-consequence plantation fire loss event
- Summary of 'industry brigade' concepts
- Options analysis for capability improvement options.

The draft report was provided to the Hub Manager for information prior to a second stakeholder workshop to present, discuss, and explore the feasibility of potential options.

Draft report consideration consultative workshop

A consultative workshop (online) was held to present the draft findings of the Hub fire protection capacity review, and to identify preliminary observation and canvass options for improvement opportunities.

Review report completion and presentation to the Hub Committee

Having considered all the comments and feedback following draft report consultative workshop, GHD updated the draft review report and an interactive findings presentation and facilitated discussion with the Hub Committee. Comments and feedback received from the Hub Committee were taken into consideration in GHD's final revision and report finalisation.

3. Plantation fire loss risk overview

Bushfires are an inherent feature of the Central West NSW landscape, as they are across the ranges and tableland areas throughout NSW. For example, in Oberon LGA, of the 3,660 km² Council area, 3,262 km² (89%) is classified by the RFS as bushfire prone.

3.1 Risk variability

Bushfires occur every year, and in high fire risk years such as during drought-affected years, or years with prolific cured grass cover, major fires can occur during adverse fire weather. However, plantation fire risk is not uniform across the Central West, with substantial variation in risk driven by a range of factors including the extent and continuity of forest cover in plantation areas, elevation, plantation topography/aspect, degree of accessibility into adjacent native forest areas, and priority given to early, aggressive containment response.

Plantation areas adjoining or near large expanses of native forest (particularly to the north or west) where fires can be difficult to access and contain while small, typically have a higher inherent fire loss risk than plantation areas situated in more open agricultural landscape areas with good access and where rural brigade resources are highly practiced at fire control across agricultural lands.

In the Central West, many pine plantations have the relative advantage of occupying high elevation areas (with a high proportion of the plantation estates occupying elevations above 1,000 metres and noting that east of Oberon a high proportion of plantations are at elevations in the 1,100 to 1,300 metre range). Relative to lower elevations these areas are cooler, forests are slower to dry out and grasses cure later, such that adverse fire season conditions are typically in place for a shorter timeframe than lower elevation areas.

Incipient fires in their early development phase spread faster up rising terrain and on drier northerly and westerly aspects. Fires developing in such areas typically have a higher likelihood of defeating initial control efforts than fires starting in more favourable landscape positions. Plantations in adverse fire-path locations with rising terrain and dry aspects can have higher fire risk than those in more favourable landscape positions.

Many large-scale plantation fire-loss events are prevented by early, aggressive, multi-mode (rapid aerial response in conjunction with early response with ground crews and earthmoving machinery), close-quarters response action to contain incipient fires to minimal area. However, particularly in drought-affected years, fires which are not contained early to small areas can attain a perimeter size and complexity vulnerable to rapid expansion and escalation upon the onset of adverse weather, posing serious threats to plantations potentially many kilometres away but within credible fire-paths. Forest/woodland areas where access for early aggressive control is challenging, or which are a lower priority for control relative to other areas, can give rise to increased risk in fire-paths leading from such locations.

3.2 Central West forest industries risk

Bushfires are a seasonal natural hazard in Central West NSW. It is the potential for bushfires to adversely impact life, property, business/livelihoods/economy and the environment that generates *bushfire risk*. The bushfire risk to human life is generally well appreciated and is the subject of comprehensive, coordinated (inter-agency) fire prevention, planning, community education, and response efforts aimed at preventing loss of life and injury. These efforts are coordinated in rural areas by the RFS. The RFS also have a strong focus on mitigating property loss from bushfires, with a strong focus on protecting human settlements (e.g. villages, towns, and urban interface areas around/within cities), key public safety and economic/business infrastructure, and rural assets including farm infrastructure, crops, livestock, pastures and timber plantations. Timber plantations are one of many rural economic asset classes identified/mapped as at-risk assets in Bush Fire Risk Management Plans (BFRMP) prepared by local Bush Fire Management Committees (BFMC). It is common practice for plantation asset/area risk ratings to be assigned in BFRMPs prepared by BFMCs.

In the Central West, while the level of bushfire risk assigned to timber plantations varies, the vast majority are rated as 'Very High' risk; mostly based on 'Likely' likelihood in combination with 'Major' consequence ratings. Some FCNSW plantations have an 'Extreme' risk rating due to being given an 'Almost Certain' likelihood rating and/or a 'Catastrophic' consequence rating. Private pine plantations are typically assigned either 'Extreme' or

'Very High' risk ratings, typically based on a 'Major' consequence rating in combination with either an 'Almost Certain' or 'Likely' likelihood rating.

In practice, differences in plantation asset/area risk ratings assigned in BFRMPs make little, if any, material difference to levels of fire protection provided to plantations or to how RFS respond to fires in or near plantations. For private plantations, risk treatments are typically the maintenance of boundary breaks and internal access trails (responsibility of the plantation owner/manager), while FCNSW plantations will have a wider range of risk treatments specified.

At a collective timber plantation industry level across the Hub area, it is well-appreciated that bushfire is a significant risk to the industry. Historically, the large-scale loss events experienced in other major plantation locations such as the NSW south-west slopes and Bombala plantation areas (or some other major Australian plantation areas) have not been experienced in the Hub area, yet. The largest single pine plantation fire loss event to occur in Hub area to date is the 'Canobolas Fire' of 28 January 1985 (which burnt 2,349 ha of FCNSW pine), however the potential exists for larger fire loss events to occur. A 10,000+ hectare pine fire loss/damage event is a highly credible scenario, and even a single fire event of 15,000+ hectares is a possible 'worst-case' category scenario. Additionally, there is the possibility of multiple, compounding major-loss events over a one or two-decade period.

GHD notes that up until 2006, pine plantation fire loss event history on the south-west slopes (Tumut / Tumbarumba) of NSW was very low, and substantially lower than in the Hub area. Three significant fire events over a 15-year period (the 2006 Billo Road fire [9,526 ha]; the 2014 Minnimbah fire [~2,400 ha]; and the 2019/20 Dunns Road/Green Valley fires [~40,000 ha]) have seen historical losses on the south-west slopes surpass and greatly exceed historical losses in the Hub region. As can be seen from the recent south-west slopes fire loss history, a relatively low fire loss history to a point in time, is not a reliable indicator that existing fire protection capability and organisation are effective for the prevailing risk or that the low loss history will continue. It is entirely credible, and even likely in the context of climate change, that fire losses in the Hub area will increase above historical levels.

While plantation fire risk is most acute for growers, it is recognised that inter-dependencies extend from growers to different industry segments including contractors (harvest and haul; silviculture; site preparation/roading/earthmoving) and processors. While even relatively small-scale bushfires can have major impacts for an individual grower (for farm-scale growers, a single bushfire could destroy their entire investment), large scale fires, depending on the scale of plantation loss/damage in relation to local industry requirements for log supply, have the potential to extend adverse impacts beyond growers to contractors and processors, which can in turn impact growers.

3.3 Potential industry impacts of large-scale fire events

Large, high industry-impact scale plantation fire loss events have largely been prevented to-date in the Hub area, with the worst-case impacts to-date affecting the Mount Canobolas area in the 1980s. Two fires, the 1982 Glenwood fire which burned through approximately 1,300 ha of pine plantation, and subsequently the 1985 Canobolas fire which impacted 2,439 ha of pine plantation, resulted in compounding impacts for local log supply from the Orange/Mount Canobolas area.

Since the 1980's, the largest single-event pine plantation fire loss was the 2006 Mount David fire which burned through 721 ha of pine plantation. Other locally significant fires have impacted less than 500 hectares, mostly from fires in the 2013/14 and 2019/20 fire seasons when severe rainfall deficiencies were in place.

The most threatening and high-potential plantation fire season to affect the Hub area occurred during the 2019/20 "Black Summer" bushfire season. Conditions leading into the 2019/20 fire season were extremely dry. Based on long-term rainfall data for Bathurst, rainfall over the key months of April to December was just 179.8 mm, the second lowest on record after 1982. Average monthly Forest Fire Danger Index (FFDI) for the three months of November 2019 to January 2020 greatly exceeded long term monthly averages, indicating that fire weather was substantially worse than average across that period. Across the November - January period, there were 32 days when FFDI reached Red Level (FFDI>30) across the Hub area (average for the period is 6 days), with a peak FFDI of 78 (Extreme) recorded at Pennsylvania Tower on 12 November 2019.

FCNSW records for the 2019/20 fire season indicate they attended 19 fires on State Forest (13 in pine plantation and 6 in adjacent native forest) as well as a further 17 fires burning on adjacent land tenures. Major fire threats emanated from the major Green Wattle Creek and Gaspers Mountain fire complexes which necessitated extensive

backburns to protect plantations in the east of the Hub area. Multi-shift inter-agency firefighting campaigns were mounted to protect plantation in the Jenolan/Mt Trickett and Gurnang plantation areas. Fires with high impact potential also broke out in the Arkstone, Isabella and Sunny Corner areas which were successfully contained preventing much more extensive damage. FCNSW plantation damage within the Hub area amounted to approximately 465 ha (0.7% of FCNSW plantation in the Hub area).

A bushfire which ignited on and spread from private property in early December 2019 in the Upper Turon/Palmers Oaky area was not contained and was able to spread north through rugged forested terrain across the Turon River and subsequently to burn through approximately 400 ha of private plantations in the Ilford-Running Stream area.

Despite the severity of the fire season, plantation losses were restricted to less than 1% of the total plantation area.

Insights as to the potential effects of large, high industry-impact scale fire events can be gleaned from such fires in other plantation areas outside the Hub area, as provided below.

3.3.1 2002/03 fire impacts on ACT plantations

Prior to 2003, the then Australian Capital Territory (ACT) Forests had approximately 16,500 ha planted to pine and were also running programs to encourage private landowners to invest in pine plantations. At the time there were four local mills/processors with a high degree of reliance on the ACT pine resource. A fire in 2001 destroyed 510 hectares of pine (3% of the ACT pine resource) – this loss was on a scale that was able to be managed without significant impact on ongoing timber supply and industry viability. In 2003 high-impact fires burned out of the Brindabella ranges through the ACT's major plantation areas, leaving only around 5,000 ha of pine plantations in the north east of the ACT. The consequences were catastrophic for the ACT plantation industry. Three of the four mills/processors closed, triggered by the collapse of wood supply. Private landowners who had been encouraged to plant pine lost their local market. The ACT plantation forest products industry effectively collapsed, and the ACT Government elected not to replant the bulk of burnt areas to pine.

3.3.2 2019/20 fire impacts on Tumut/Tumbarumba plantations

The 2019/20 fire losses saw 30,000 ha (around one third) of the FCNSW estate, plus around 10,000 ha of the private pine estate, plus around 3,000 of pine in northern Victoria which was part of the wood supply area for the Tumut/Tumbarumba processing industry burnt. These losses occurred in the context of prior large-scale losses from the 2006 Billo Road fire (9,500ha) and to a lesser extent the 2014 Minnimbah fire – regional log supply was already very tight in the aftermath of those fires;

The impacts are very substantial. After salvage operations conclude, over the next 15 years and potentially beyond, FCNSW will be able to provide around half the annual level of supply it provided before the major fires, and wood supply from private sources is likely to be similarly affected:

- this will commensurately reduce harvesting contractor requirements for FCNSW and from private growers;
- the impacts on haulage contractors are not quite as severe being partially offset by haulage over longer distances which will continue for the foreseeable future;
- Site preparation contractors for replanting are experiencing a temporary increase, which will be followed by a sharp decline

Supply substitution options from Bombala and northern Victorian plantation resources are negligible due to substantial fire impacts in those areas. Major mills are operating well below capacity, and production expansion prospects have been extinguished for the foreseeable future. As a result, one mill has had to reduce from 2 shifts to one. The other major mill is bringing in timber from as far away as Walcha in the north, and Adelaide Hills to the south, incurring the extra transport costs that entails. Visy is also sourcing resource over much wider transport distances

FCNSW profitability has been negated, noting their replanting program for the fire-impacted area is likely to take another 7 years. More general flow-on effects can be expected to impact the regional economy. Forest and Wood Products Australia found the ratio for the level of indirect employment southwest slopes around Tumut and Tumbarumba from the forest industry is 1.8 (Schirmer et al 2017).

3.3.3 2019/20 fire impacts on Bombala plantations

Bombala has also been subject to severe forest industry shocks from the 2019/20 fires. In the Bombala wood supply area there is approximately 47,000 ha of softwood plantation estate. The 2019/20 bushfires burnt approximately 10,000 hectares, resulting in major impacts for forest industries. The sole softwood sawn timber processor at Bombala (Dongwha Australia) is vulnerable to supply shocks, as are local residues-based industries which have dependency on it. Early projections by Margules Groome (2020) are that once salvage operations have concluded (by 2025), total sawlog supply will fall to only about 60% of the original pre-fire woodflows up until 2046 when the woodflows start to pick up again. This future supply shortfall prospect at Bombala is generating major business adjustment decisions for Dongwha, which will have to determine what is the most cost-effective option to adjust their processing to address the pending shortfall.

3.3.4 Potential consequence of large-scale plantation fire events

From the post-major fire consequences experienced recently in other NSW forestry hub areas (SE NSW Hub and Murray Region Hub), it can be reliably inferred that large scale fire events in the Central West Hub Region would be likely to have substantial adverse impacts on all segments of the plantation forest industry in the Central West. Forest and Wood Products Australia found the ratio for the level of indirect employment southwest slopes around the Hub region from the forest industry is 1:4 (Schirmer et al 2018).

3.3.4.1 Potential fire loss scenarios

While historically, plantation fires in the Hub area have not exceeded 2,500 ha, significantly larger scale fires are possible, particularly in parts of the region with large, near-contiguous plantation areas. Fires entering or starting near the western or northern boundaries of large plantation agglomerations (as listed below) and spreading under several hours of adverse fire weather conditions, have the potential to approach or exceed 5,000 hectares in the following localities:

- Mount Canobolas area;
- Sunny Corner/Kirkconnell area;
- Mount David/Trunkey Creek area;
- Burraga/Jeremy/Isabella area;
- Black Springs/Vulcan/Shooters Hill/Gurnang area;
- Hampton/Duckmaloi/Jenolan area;

In the Black Springs/Vulcan/Shooters Hill/Gurnang, Mount David, and Sunny Corner/Kirkconnell areas plantation where large plantation agglomerations are located, loss events exceeding 10,000 ha are credible scenarios when conditions conducive to sustained uncontrollable fire spread prevail.

A credible worst probable loss scenario could conceivably involve a fire starting near Black Springs under severe NNW fire weather and making a sustained 6+ hour run to the SSE through the Shooters Hill/Vulcan/Gurnang plantation areas (potentially, the scenario could be further exacerbated by a W to SW wind change following the main fire run). Under such a worst-case scenario, a 15,000+ hectare plantation burned area scenario is credible.

3.3.4.2 Potential large fire-loss event consequences

It is beyond the scope of this project to model the probable economic consequences of different fire scenarios. However, the potential consequences can be characterised as follows:

10,000+ hectare scenario

- Major financial impact on the grower(s) incurring the loss, particularly for self-insured and/or uninsured growers;
- Short-term adverse impacts for processors flowing from necessity to take fire-salvage logs during a 12-to-24-month period after the fire (i.e. a change in the product mix and ability to process 'charred' timber);
- Significant longer-term impacts for processors flowing from forward log supply volume reductions associated with burnt age-class impacts on annual wood flow, potentially persisting for up to a decade;

- Short-term increase in harvest/haulage work volume during salvage period, followed by a potentially sharp decline in work volume for up to around 5 years once salvage operations are completed and annual log supply shortfalls impact annual wood flow;
- Possibly constrained supply of plantation pine seedling supply for replanting programs, noting that existing nursery production capacity is already elevated to near-maximum levels to supply replanting programs following the unprecedented impact 2019/20 fires.

5,000+ hectare scenario

- Significant financial impact on the grower(s) incurring the loss, particularly for self-insured and/or uninsured growers;
- Short-term adverse impacts for processors flowing from necessity to take fire-salvage logs during a 12-to-18-month period after the fire;
- Potentially moderate medium-term impacts for processors flowing from forward log supply volume reductions associated with burnt age-classes;
- Short-term increase in harvest/haulage work volume during salvage period, followed by a short-term decline in work volume once salvage operations are completed and annual log supply shortfall impacts wood flow volume;
- Possibly constrained supply of plantation pine seedling supply for replanting programs, noting that existing nursery production capacity is already elevated to near-maximum levels to supply replanting programs following the unprecedented impact 2019/20 fires.

Compounding multiple event scenario

Potentially, two or more large fire events could occur within a 5-to-10-year period. Depending upon the interval between events, reduced wood flow impacts could be compounded and/or extended, and potentially result in significant sawlog supply to processors with serious financial impacts.

Potential industry investment impacts

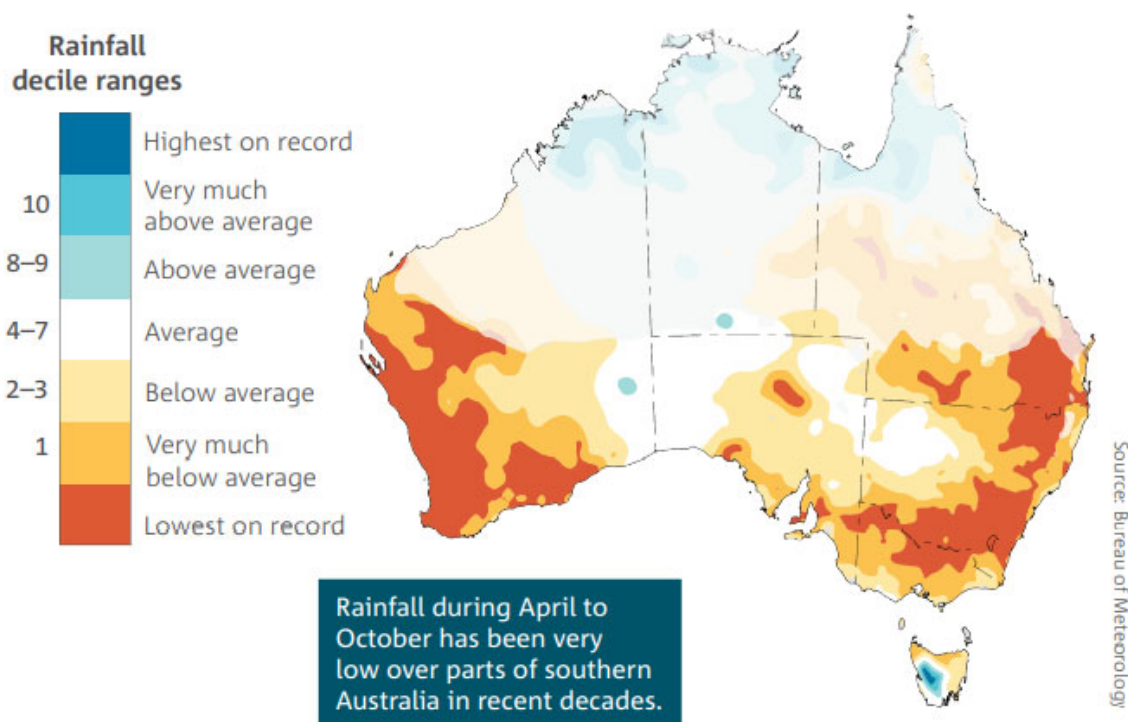
Large scale fire-loss events, particularly compounding multiple events, can erode investment confidence and negatively impact plantation fire insurance premiums and availability. This has the potential to reduce re-investment in second rotations, particularly by smaller growers, and potentially to deter private sector investment in plantation expansion. This, in combination with reduced wood flow following large fire events, can potentially stall or postpone mill capacity expansion plans.

3.3.5 Likelihood

The range of variables influencing large plantation fire event likelihood make it highly problematic to quantify event likelihood. Past fire loss event frequency is not a reliable indicator of future loss events, due to changes over time in factors affecting event likelihood:

- Climate change – In its *State of the Climate Report* (CSIRO and BoM, 2020), and in evidence presented to the Natural Disasters Royal Commission, the Bureau of Meteorology has identified the following trends in historical fire weather patterns are affecting NSW, all of which contribute to an increasing trend in bushfire risk:
 - Longer fire seasons arriving earlier in spring, most notably accompanied by more extreme heatwaves (including in spring);
 - Lower rainfall during the cooler months (Figure 1);
 - Hotter drought periods;
 - Increase in the frequency of days with dangerous fire conditions;
 - Increase in average fire danger levels over the bushfire season; and
 - Evidence for more favourable environments for fire generated thunderstorms (associated with high impact bushfire events).

- Human-caused fire incidence – the Central West is an increasingly popular outdoor recreation destination for people from Greater Sydney and large regional cities/centres in the region – this brings increased risk of accidental/careless fire ignition in the landscape.
- Rural population dynamics – land use and farm ownership in the Central West has been changing, with a generally decreasing trend in land used for primary production and permanent on-farm residents, and a corresponding increase absentee landowners and ‘hobby farming’ land use.



April to October rainfall deciles for the last 20 years (2000–19). A decile map shows where rainfall is above average, average or below average for the recent period, in comparison with the entire rainfall record from 1900. Areas across northern and central Australia that receive less than 40 per cent of their annual rainfall during April to October are faded.

Figure 2 Cool season rainfall deciles 2000-19

Recurrent small-scale plantation fire losses already occur (decadal losses in the 1,000 to 3,000 ha range; or annualised losses of around 0.25% of local resource). This is a low loss rate with which local industry has been able to continue growth. Such scale losses have an ‘almost certain’ likelihood, but at industry level a minor impact (noting for an individual grower they can have a more significant impact). The likelihood of losses increasing beyond historical losses is not quantifiable, however with increasing trends in several factors influencing high consequence fire likelihood, as discussed above, an increasing trend in losses is considered likely, noting such trends are already evident in other parts of NSW.

3.4 Risk factors required for high consequence scenarios

High consequence plantation fires are typically associated with the confluence of key risk factors:

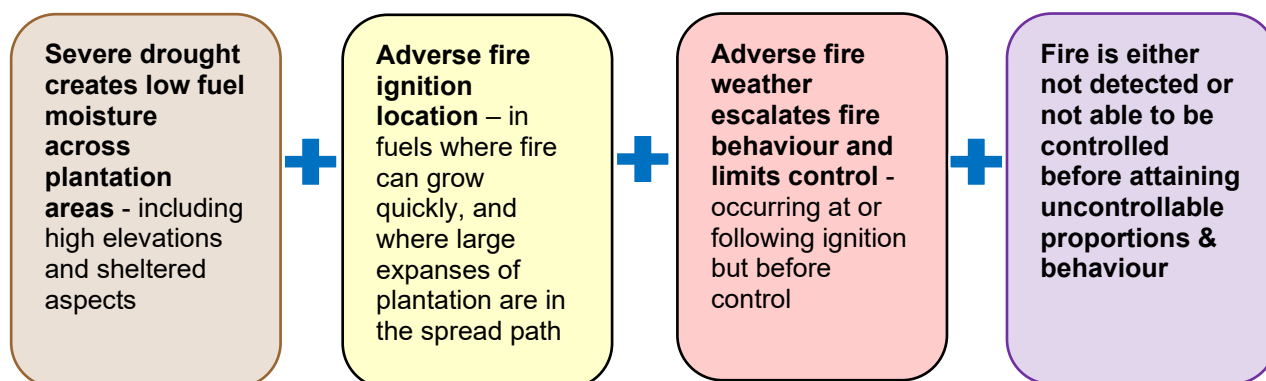


Figure 3 Risk factors for high consequence plantation fires

These risk factors are expanded upon below:

- Degree of plantation/forest fuel dryness and grass curing in adjacent areas
 - Drought years significantly increase fire risk in plantations because they increase the proportion of plantation areas prone to supporting high intensity fire, and reduce the extent of areas favourable for fire control (such as normally moist gullies and green grassy areas), and make control and mop-up much more difficult
 - The degree of grass curing between plantations also significantly influences risk, with high curing enabling inter-plantation spread and low curing providing improved control options between plantation areas
 - Fuel dryness and grass curing risk factors vary between years depending on the degree of rainfall deficiencies, and within a season largely through bringing forward the onset and lengthening the duration of fire danger periods
- Large expanses of contiguous plantation/forest feasible to be burnt within a credible fire path
 - large contiguous plantation areas typically have a higher consequence potential than dispersed smaller plantations where there are good opportunities for fire control in low fuel areas between plantations
 - This risk factor is one of the less dynamic risk factors – it is effectively constant through a fire season, and only has minor degrees of change from year to year (harvesting patterns can create temporary discontinuities in recently harvested areas within large estates)
- The weather during the period the fire ignites and spreads
 - the higher the Fire Danger Index (FDI), the higher the risk because fire becomes increasingly difficult to control, and burnt area during fire-runs increases proportionally with increasing rate of spread;
 - In High + FDI conditions typical of summer afternoon conditions, fully established fires¹ spreading in plantation are very difficult to control – headfire intensity is beyond controllable limits (>3,000 kW/m), short distance spotting breaches plantation roads and trails, and intermittent or sustained crowning can occur (and is almost guaranteed in pre-first thinning age classes, even at High FDI) – successful control is generally limited to Very High or less FDI in areas of reduced fire behaviour

¹ A 'fully established fire' refers to one which has attained its full potential rate of spread and behaviour – in forests and plantations this typically occurs where the head fire is around 100+ metres wide

such as the heel and flanks, and areas where fire is spreading downhill or in reduced/modified fuel areas.

- These limits of control thresholds associated with fully established fires make it vitally important to achieve control while fires are still only in their early development stage, while fire spread rates and intensity are still well below their full potential. While grassfires can reach their full potential rate of spread relatively quickly (typically within around 20 minutes - and potentially significantly quicker - in summer afternoon conditions with winds of around 25 km/h), plantation fires are substantially slower to develop. Under high to very high fire dangers a forest or plantation fire developing from a point ignition may have reached only one third of its potential rate of spread an hour after ignition (provided it remains spreading as a surface fire). In many cases a forest or plantation fire starting in the early afternoon only reaches its potential rate of spread late in the day (Cheney, 1988)².
- Weather risk factors are highly dynamic – while FDI typically follows a diurnal trend with maxima reached during the mid-afternoon and minima before sunrise, particular synoptic patterns can result in atypical weather, including the potential for sustained adverse overnight weather conducive to extreme plantation fire behaviour during the night.
- Fire ignition location
 - Fires starting in adverse locations (upwind of plantation and/or with a long downwind run through plantation) are higher risk start locations than downwind locations
 - The accessibility of fire start locations is another location factor – adverse upwind areas from plantations which have limited access for control, and potentially may be considered by responders as lower priority ‘back country’ response areas can be high risk ignition zones from a plantation perspective.
- Areas where fires are not detected early, and/or are not able to be controlled before they reach uncontrollable proportions
 - While traditional manned fire lookout towers and tower mounted cameras provide a means of early detection during periods of good visibility, they are not operational/effective at night, and are of limited effectiveness during restricted visibility from smoke or dust, and tower networks in mountainous topography often have blind areas – some fires starting at night during drought conditions, and potentially on uphill terrain, can become high risk propositions before they are found;
 - In drought conditions, following afternoon or evening summer lightning storms (those with negligible or no rain) every effort needs to be made to locate lightning ignitions as soon as possible (during the evening or at first light) to minimise fire growth opportunity;
 - Rapid initial attack (IA), at High or greater FDI, preferably within 20 to 30 minutes, and at worst within 60 minutes is advisable – an IA involving direct attack with hoses, and where direct attack is not possible, close parallel attack using one or more dozers as required, to minimise area burnt and contain the fire to the smallest possible area. Due to the potential for direct attack to require sustained hose attack for knockdown of the head and flanks on an actively spreading fire, a heavy tanker will almost always be required to ensure adequate water. Where parallel attack is required, a small dozer is invaluable particularly where fire is spreading up-slope (and essential where blackberries impede access). Initial attacks with one or two light units only have significant limitations - they may be sufficient on fires which have not yet spread significantly from their ignition source (and there are no direct access impediments), however it is highly likely to be insufficient for fires actively spreading in the plantation.
 - In the Central West, local RFS brigades can provide valuable assistance in plantation firefighting. However, it should not be assumed that RFS units will be available for every fire, or experienced and amenable to close-quarters forestry plantation firefighting techniques. RFS units are well

² Note these indicative initial fire growth rates are for fires developing from point ignitions in the understorey of mature forests and tall, late rotation plantations with a clear gap between surface litter fuels and the canopy base where – much quicker fire development can occur at fires developing in young, pre-thinned radiata pine age classes which have negligible separation between surface layer and crown-base fuels and can rapidly escalate fire behaviour into intermittent or sustained crown fires which have full exposure to above canopy winds

equipped and experienced at fighting grassfires. In forests they often undertake indirect attack (backburning and burning out) from existing trails and roads. Direct attack away from roads/trails within plantation, and/or close parallel attack work with earthmoving machinery are typically not their options of choice or comfort in initial attack, with indirect firefighting tactics typically the preferred option. Indirect options typically involve burning out from compartment boundaries, or further-out fall-back lines if there is a low probability of success working from compartment boundaries. FCNSW works closely with RFS brigades, and respects these tactical preferences, and thus maintains self-reliance for direct and close parallel attack plantation firefighting capability. Private plantation owners/managers who may have a higher reliance on RFS for fire response also need to acknowledge and consider these preferences.

- In drought conditions, fire in difficult country upwind of plantations, if left to burn overnight due to lack of night firefighting capability, can become high risk propositions with limited control options, which when adverse weather arrives can develop into serious plantation threats.

3.5 Plantation distribution and loss scenarios

In this section, fire scenarios which could potentially result in large-scale, high industry impact scenarios are characterised. These are focussed on areas with major plantation agglomerations. These are not the only areas where significant plantation losses can occur.

3.5.1 North West response area

Mount Canobolas area

Plantations on and surrounding Mount Canobolas are the major plantation agglomeration (approximately 10,000 hectares) in the Cabonne/Orange City Local Government Areas (LGAs). The adjoining Glenwood and Canobolas State Forest plantation groups dominate the plantation holdings in the locality, with private plantations contributing less than 2 percent of total plantation area in the Mount Canobolas area.

Potentially the most fire-exposed plantation area is the Glenwood plantation situated on the north-western slopes of Mt Canobolas, and exposed to rising topography/NW aspect in combination with exposure to dangerous fire weather conditions prevailing from the NW. Plantations on the southern and eastern slopes of Mt Canobolas have a higher degree of natural topographic protection than those to the north and west, being on more sheltered aspects, and downhill runs relative to the direction of adverse prevailing fire weather. Fires coming from the north-west over the Mt Canobolas ridge have prospects for control on sheltered downhill areas, the principal exception being if the approaching fire develops into a pyrocumulous fire and initiates mass down-wind spotting as it crosses the ridgeline.

Mount Canobolas Fire Tower, staffed and maintained by FCNSW, facilitates visual fire detection in clear visibility conditions.

FCNSW positions standby fire response crews and equipment at its Canobolas response base which can rapidly respond to lightning strikes or fires in Glenwood or Canobolas plantation or neighbouring areas. Typically, a response crew is 6 personnel with 1 heavy tanker, 1 slip-on, and a fast-response D3 dozer deployable from a 4WD tip truck.

Due to its proximity to the major regional centre of Orange and surrounding high-productivity agricultural areas, RFS resourcing around the Mt Canobolas area is strong. In the Orange /Cabonne/Blayney/Cowra local government areas there are more than 75 RFS brigades. The closest RFS brigades to the plantations in the Mt Canobolas area are:

- Springside
- Canobolas
- Nashdale
- Lidster
- Cargo

- Panura-Burnt Yards
- Tallwood

Additional surrounding district resources can be dispatched from surrounding RFS brigade areas including North West Orange, Orange-Molong Rd, Borenore, Cheesemans Creek, Gamboola, Cudal, Bowan Park, Lockwood, Moorbel, Chaucer, Walli/Islands, Mandurama and Carcoar, with Fire and Rescue NSW brigades stationed in Orange.

Mullion Range area

Plantations in the Mullion Range area are the second largest agglomeration (approximately 5,000 ha) in the Cabonne LGA, dominated by FCNSW plantations in the north, and privately owned plantations in the south. Fires approaching from the Kerrs Creek or Belgravia localities in adverse conditions could constitute a serious fire threat. Plantations adjoin rugged forested terrain to the east in the Mullion Range, with overnight easterlies a potential source of fire threat during drought-affected seasons if fires to the east are not contained early.

FCNSW positions standby fire response crews and equipment at its Canobolas response base, approximately 35 km away (~30-minute response time). In Mullion Range plantations, RFS brigade units may arrive at the fire scene before FCNSW initial attack resources.

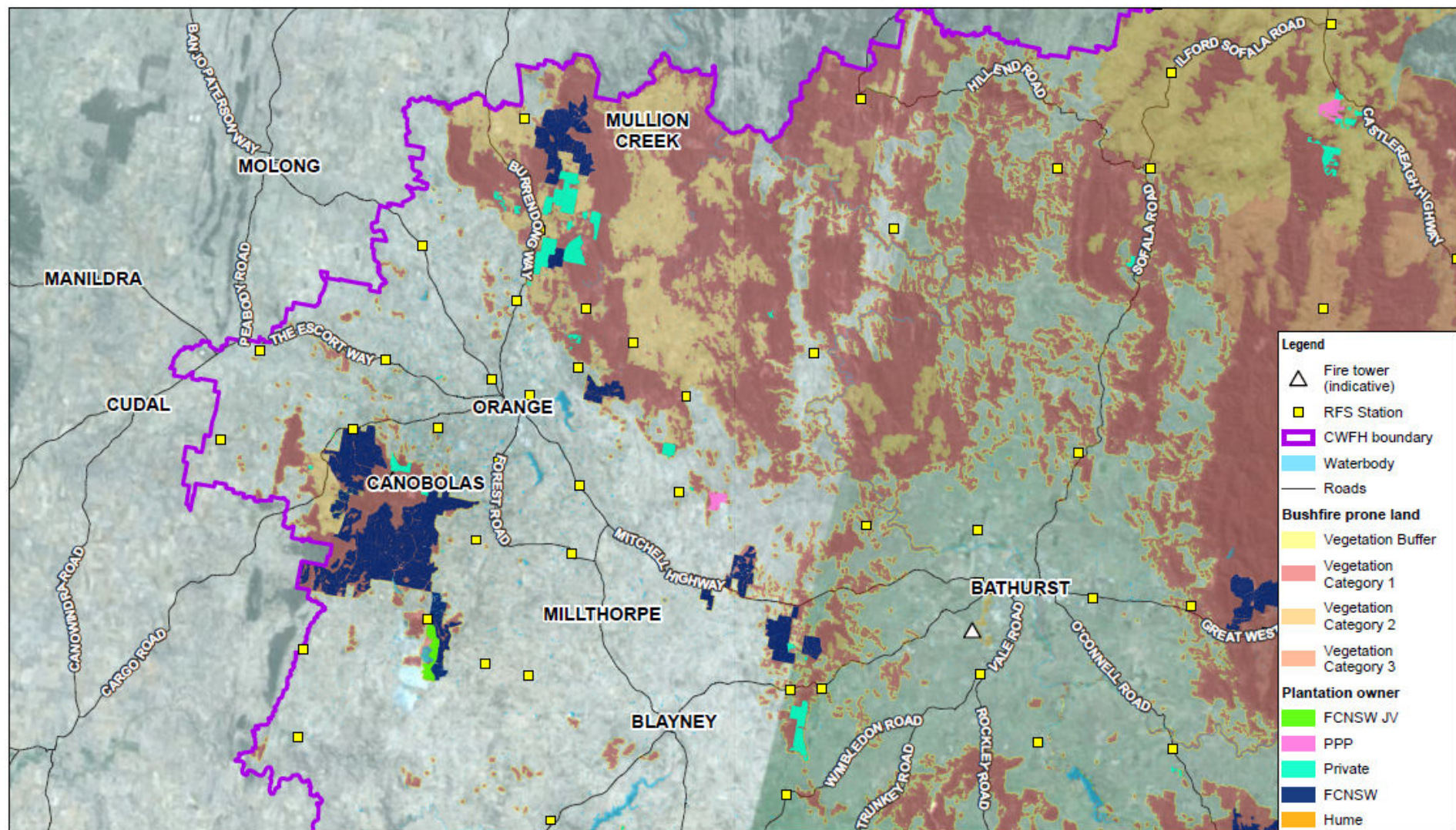
Due to its proximity to the major regional centre of Orange and surrounding high-productivity agricultural areas, RFS resourcing around the Mullion Range area is strong. In the Orange /Cabonne/Blayney/Cowra local government areas there are more than 75 RFS brigades. The closest RFS brigades to the plantations in the Mullion Range area are:

- Mullion Creek
- Euchareena
- Clifton Grove-Ophir
- March
- The Ponds

Additional surrounding district resources can be dispatched from surrounding RFS brigade areas, particularly those around Orange and Mount Canobolas.

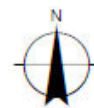
Other plantation areas in the NW

In addition to the major plantation agglomerations at Mount Canobolas and Mullion Range, smaller plantation areas are also located at Kinross, Emu Swamp, Macquarie Woods and Vittoria localities. These plantations lie between Orange and Bathurst.



Paper Size ISO A4
0 3 6 9 12
Kilometres

Map Projection: Lambert Conformal Conic
Horizontal Datum: GDA2020
Grid: GDA2020 NSW Lambert



Central West Forestry Hub
Fire Management Review

Project No. 12552987
Revision No.
Date 7/04/2022

North west response area

FIGURE 4

Figure 4 North west response area

3.5.2 North-East response area

Sunny Corner and Lidsdale Plantations

The major plantation group in the north-eastHub area is Sunny Corner plantation area where there are more than 12,500 hectares of pine (more than 95% of which is managed by FCNSW). Plantations in Sunny Corner State Forest abut large landscape areas of native forest in Winburndale Nature Reserve and Sunny Corner SF, which have the potential to support the run of a large uncontrollable bushfire toward the plantations in adverse fire weather conditions. Accordingly, early detection and control of any lightning strikes and/or incipient fires (while they are still small and controllable) in the plantation or in adjacent forested land as far as 20 km to the north or west of the plantations is prudent. The sandstone landforms which underlie the surrounding forests is deeply dissected by remote creeks and deep gullies making access difficult into many areas.

A large bushfire entering the plantation area from Winburndale Nature Reserve and/or Sunny Corner State Forest would have the potential to burn a high proportion of the plantations if adverse fire weather supported a sustained fire run through the plantations. Plantations straddle the Great Western Highway which high potential to be cut during a major fire incident.

Lidsdale plantation is well separated from Sunny Corner, between Lithgow and Mount Lambie.

Sunny Corner Fire Tower, staffed and maintained by FCNSW, facilitates visual fire detection.

FCNSW positions standby fire response crews and equipment at its Sunny Corner response base.

Because of Sunny Corner's location between the large population centres of Bathurst and Lithgow and proximity to the Great Western Highway, RFS is typically able to mount a rapid well-resourced response. RFS brigades at Portland, Sunny Corner/Meadow Flat, Dark Corner, Yetholme and Raglan are less than 20 km from Sunny Corner plantation group with rapid access provided by the Great Western Highway.

Additional brigades from the Bathurst Regional and Lithgow City LGA's can be responded as required, with those at Marrangaroo, Wallerawang, Tarana, Rydal, O'Connell and Bathurst potentially within 30 km.

Other plantation areas in the NE

In addition to the major plantation agglomerations at Sunny Corner and Lidsdale, smaller plantation areas are also located at Eusdale, Lyell Dam, and Ilford/Running Stream although the latter were burnt-out in the 2019/20 bushfires. Although relatively small scale, this was a big loss in a regional context and some plantation growers lost all of their resource. Future small-scale fires could occur at these locations, noting that Ilford/Running Stream area plantations are exposed to the potential for fires to burn out of forested ranges on private lands in surrounding areas.

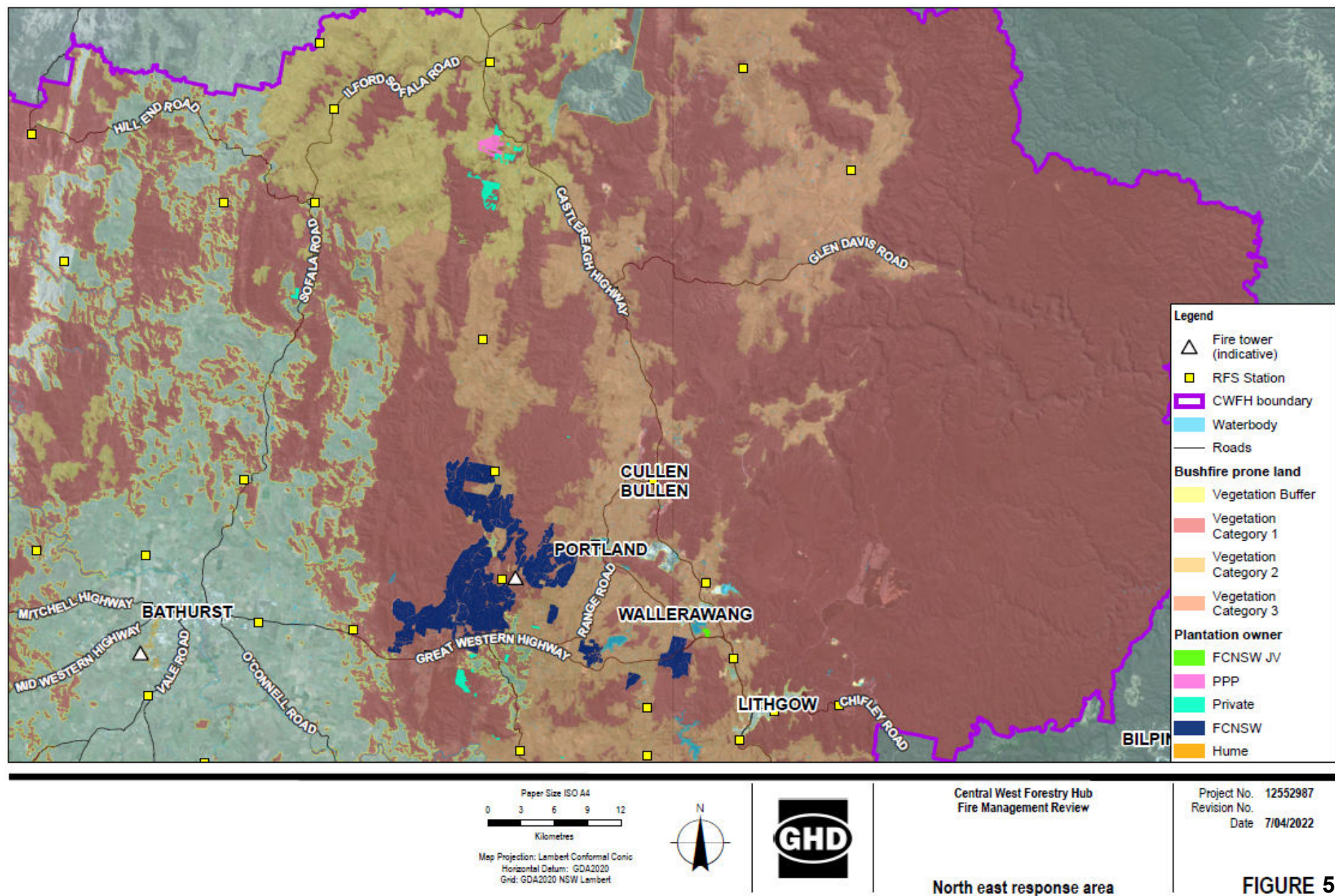


Figure 5 North east response area

3.5.3 Central-east response area

Plantations in the Oberon LGA and southern boundary area of Lithgow City

The central-east Hub response area is at the core of the Hub and covers the Oberon LGA and adjoining plantations in Lithgow City and Bathurst Regional LGAs. More than 60% of plantations in the Hub are in the Oberon LGA, taking advantage of proximity to processors.

Major plantation groups in the zone include the following plantation areas/localities:

- Vulcan/Black Springs/Shooters Hill
- Gurnang
- Jenolan/Edith
- Hampton/Million Acres
- Blenheim/Homers Hill
- Lowes Mount
- Essington
- Dog Rocks
- Triangle Flat
- Mt David
- Burraga/Jeremy
- Isabella/Arkstone

Due to plantation agglomeration, many of the above plantation areas have the potential to support large plantation fires in adverse fire seasonal and weather conditions. Further, it is possible in highly adverse conditions that bushfire could spread between two or more areas. In the central-east Hub area it is conceivable that a single fire impacting more than 15,000 hectares is a credible scenario if a fire was to start upwind of major plantation groups such as Vulcan and Gurnang and make a sustained run for 6 or more hours during adverse fire weather conditions. Plantation fire losses in the 5,000+ ha range are also credible in adverse fire weather in the Mount David and Isabella areas, noting that such plantation losses are historically unprecedented within the Hub (noting however they have occurred in other plantation areas in NSW).

South of the substantial plantation agglomerations in the Gurnang, Isabella/Arkstone, Burraga/Jeremy, and Mount David area lies the Abercrombie River which cuts deep through a rugged, mostly timbered landscape with mostly poor access and high difficulty for fire control. Abercrombie National Park occupies much of the area, extending further west toward large tracts of private timbered hills west of Burraga. These rugged landscape areas rising from the Abercrombie River, connected with timbered hills extending north into plantations areas in the Jeremy and Isabella areas, are potential source areas for fires to threaten large areas of plantations under south-westerlies, with the most exposed plantations being in the Mount David, Jeremy and Gurnang localities. Areas of native forest immediately west of plantation in the Mount David area are also a potential fire threat area.

Plantations in the east, from around Hampton down to Gurnang, adjoin the vast Kanangra-Boyd National Park. While the most adverse fire weather from the west and north west will push fires away from plantations deeper into the National Park, during drought years, very dry fuels in combination with fresh late afternoon and evening easterlies can generate serious fire risk from the east.

Elsewhere through the plantation estates throughout the Oberon LGA, grass fire threats to plantations can arise from adjacent lands, noting that areas of retained native vegetation cover near plantations typically make fire control more difficult, as well as threats from fires starting in plantations.

FCNSW positions standby fire response crews and equipment at its Black Springs response base centrally located within Oberon LGA for access to the surrounding plantation areas. Hume Forests local resources operate from Oberon which is centrally located to their major plantation areas in Jenolan, Isabella, Mt David and Essington. All PPP fire response crews and appliances are also based in Oberon, with contractors' crews and gear located at operations sites.

Owing to its proximity to the major plantation industry hub of Oberon and surrounding high-productivity agricultural areas around the plantation areas, RFS resourcing around within the central-east Hub area is strong. In the Oberon local government area there are 17 RFS brigades, nine of which have Category 1 (heavy) tanker capability. RFS brigades in the Oberon LGA with heavy tanker capability include:

- Black Springs
- Burraga
- Gurnang
- Hazelgrove
- Jenolan Caves
- Jerrong/Paling Yards
- Native Dog
- Norway
- Oberon HQ

Plantations in the southern part of Lithgow City LGA are in RFS brigade areas covered by Lowther/Hampton, and Hartley brigades which also have Category 1 tanker capability.

Plantations near the western boundary of Oberon LGA are close to RFS brigades in Bathurst Regional LGA, including Trunkey Creek and Rockley which have Category 1 tanker capability.

FCNSW fire lookout towers are at Shooters Hill and Burraga.

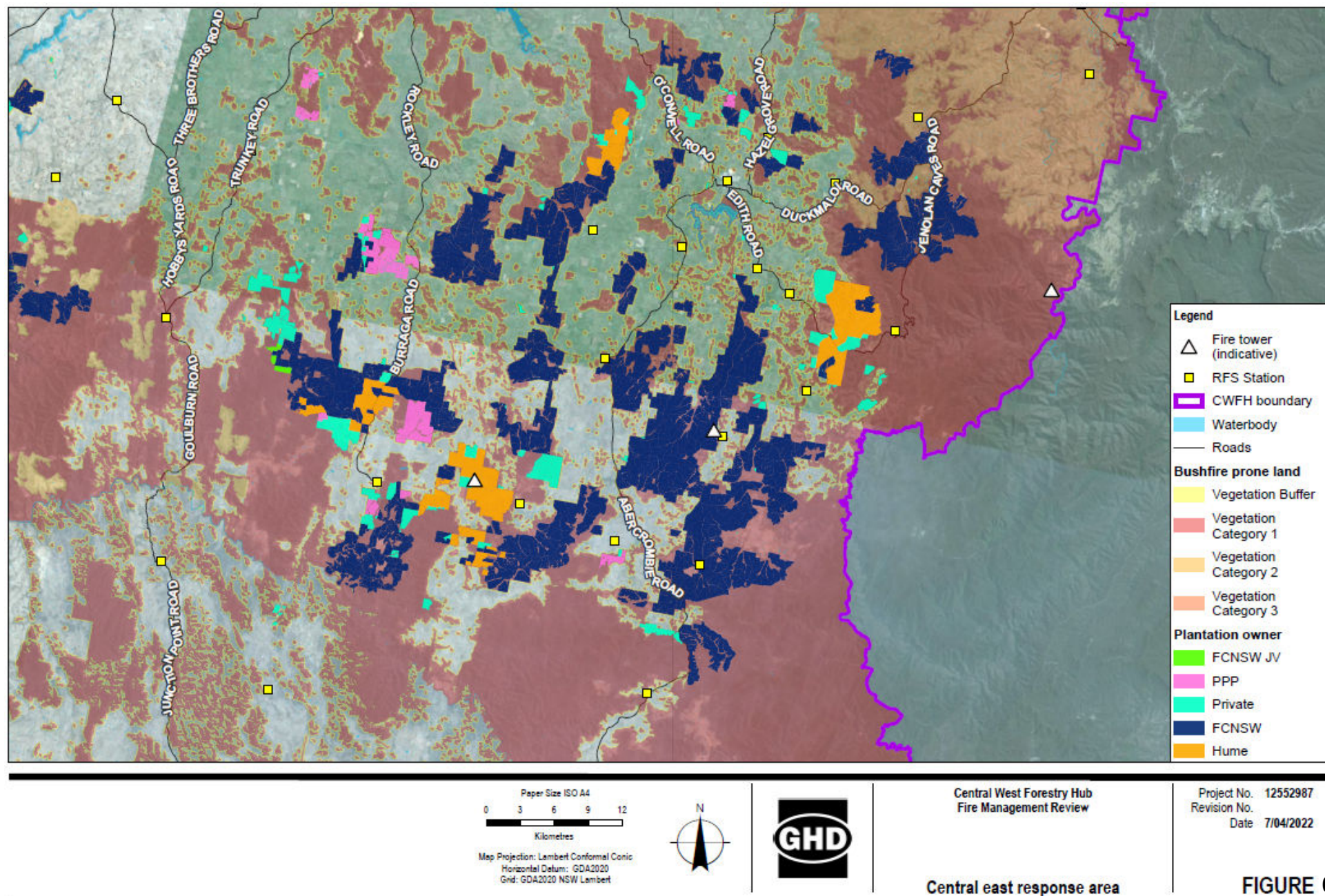


Figure 6 Central east response area

3.5.4 South West response area

Pennsylvania/Roseberg/Neville area

Plantations in the Hub south west response area are dominated by FCNSW plantations in Pennsylvania and Roseberg State Forests, with smaller plantations in the Neville and Mount Macquarie areas comprised of both FCNSW and private holdings.

Plantations in these plantation areas are within the response zone of FCNSW Canobolas response base, noting such response has a road travel distance of around 100 km and a response time in the 60-to-90-minute range.

Plantations in the Roseberg and Pennsylvania areas have exposure to bushfire risk from extensive tracts of surrounding native forest in rugged terrain. Rocky Bridge Creek and Piesleys Creek deeply dissect the native forested landscape in the immediate vicinity of these plantations.

Pennsylvania Fire Tower, staffed and maintained by FCNSW, facilitates visual fire detection.

Except during red fire preparedness level days (Max forecast FFDI ≥ 30) it is not usual for FCNSW to position standby fire response crews within the south-west Hub area – response to fires in this area is typically deployed from FCNSW Canobolas response base more than 60 km away by road.

RFS resourcing in the area is from within Blayney, Cowra, and Bathurst Regional LGAs. The closest RFS brigades to the plantations in the SW response zone area are:

- Trunkey
- Neville
- Barry/Hobbys Gap
- Mundurama
- Lyndhurst/Blayney

Additional surrounding district resources can be dispatched from surrounding RFS brigades in the Blayney, Cowra and Bathurst Regional LGAs can be mobilised by RFS as required.

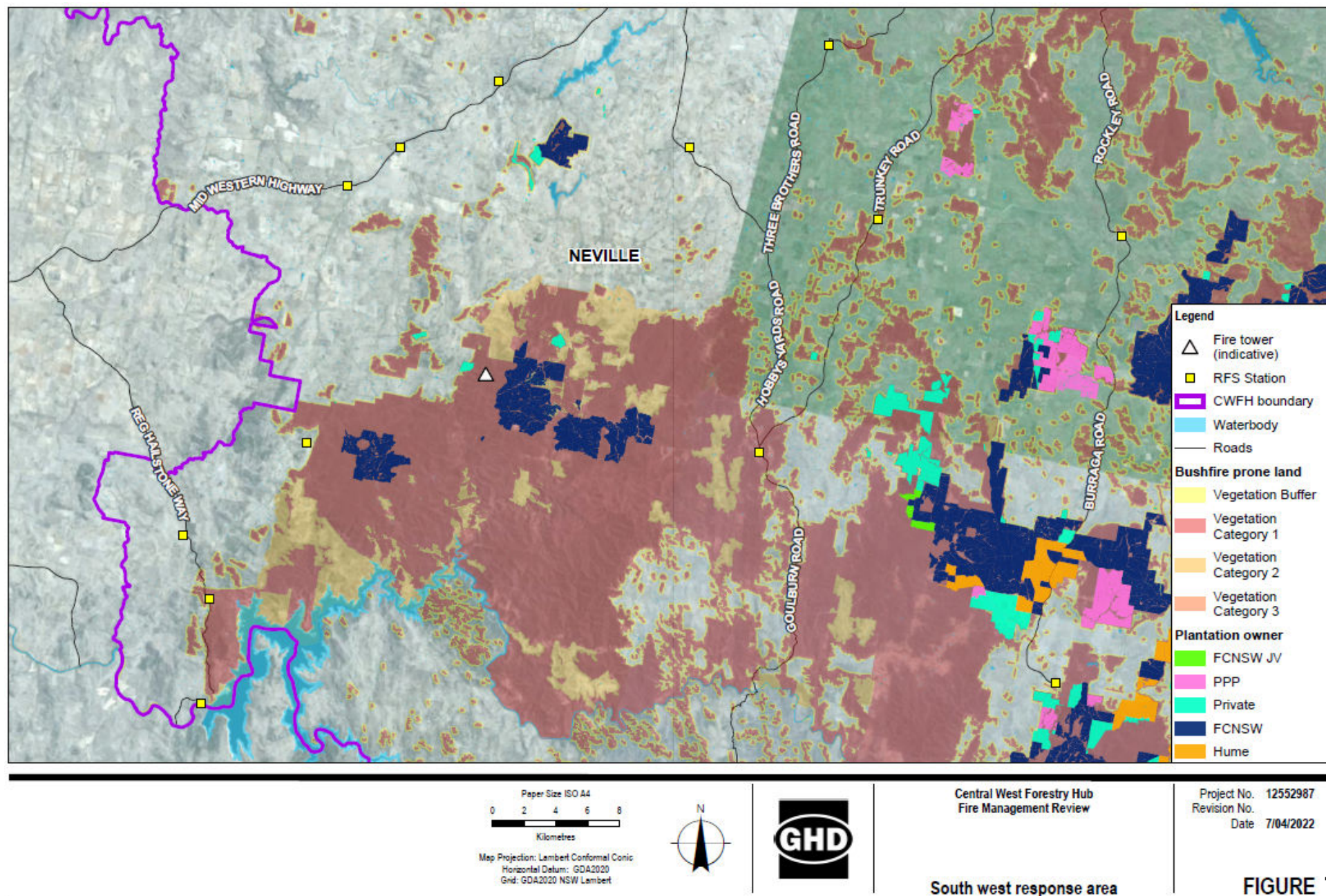


Figure 7 South west response area

3.5.5 South response area

Plantations in the Upper Lachlan and northern Goulburn Mulwaree LGAs

A relatively small, highly dispersed plantation estate comprised of small-scale private plantations is dispersed across the Upper Lachlan Shire area, extending into the northern part of Goulburn Mulwaree LGA (near Marulan). Plantations in the southern part of the Hub area are relatively remote from the major processing centres at Oberon, Burruga and Bathurst, and are outside FCNSW response zones. Privately owned plantations in the Hub south response area are reliant on RFS for fire response.

Due to the relative scarcity of pine plantations in the area, RFS brigades in the area are unlikely to be accustomed to pine plantation fire response.

Due to the relatively small scale of plantation, single event fire losses are likely to be small.

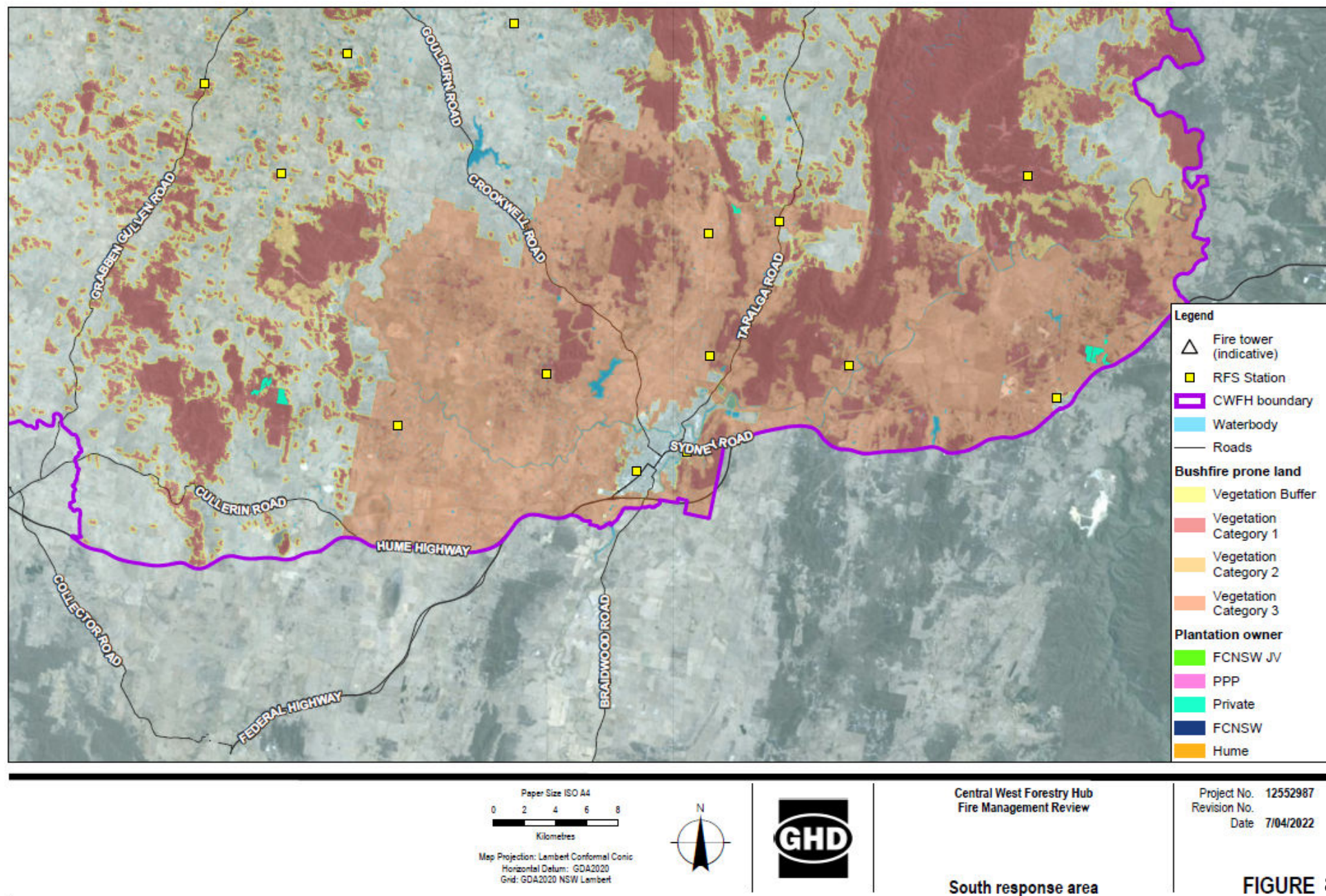


Figure 8 South response area

4. Fire response capability across the Central West Forestry Hub

Fire response capability can be challenging to categorise and quantify as there are many different dimensions to 'capability'. There are different appliance/equipment types, potentially fitted out for different fire response applications. Some crews will have different training, skills and experience compared to other crews, and there are numerous different roles and command and control levels within fire operations. Some crew capabilities may be 'part time', in that they are normally assigned to doing some non-fire response type role/work but are available to be directed to fire response as required – others may be primarily available and on immediate standby for fire response. Some resources may be available in field locations where plantations are located to facilitate rapid response, whereas others may be at regional centres or even outside the Hub area and thus are a 'back up' resource but not a rapid first response resource. Some may only be available for certain response activities, but not for others and some may have conditional availability subject to being prioritised onto other tasks. Accordingly, considering fire response capability is not as simple as quantifying types of appliances and equipment, and numbers of 'firefighters'.

Accordingly, in this section, some context and characterisation of different elements of fire capability is necessary.

4.1 Forest industry specific capabilities

Within major plantation hubs such as the Hub, typically there are forest industry employees/contractors who spend the bulk of their working time undertaking works in a plantation forest industry specific context.

4.1.1 Plantation growers/managers

Unlike in some other inter-state forestry hubs, the Central West Forestry Hub is dominated by one major grower (FCNSW - a NSW Government owned corporation) owning/managing around 74,600 hectares of net plantation area (~ 80% of the total pine plantation resource in the hub), with two private commercial growers with around 8,800 hectares under their ownership/management, and then a range of small-scale plantation owners of widely dispersed plantation holdings which individually constitute only a very small fraction of the overall pine resource. This contrasts strongly with some other areas such as the Green Triangle on the Victoria/South Australia border where there are four major pine plantation owner/growers (one with more than 80,000ha, one with more than 40,000 ha and two with more than 20,000 ha) where all are privately owned, plus additional large estates of blue gum plantations – thus there are more, and bigger players directly engaged to a significant degree in plantation fire protection.

Forestry Corporation of NSW

The major plantation grower in the Hub is FCNSW, which in addition to managing plantation in the Hub also manages substantial plantation assets in other parts of NSW (including the South West Slopes, Southern Tablelands, Southern Highlands, and Northern Tablelands), as well as managing approximately 2 million hectares of native forest for which it also has fire management responsibilities. Thus FCNSW fire management capability in the Hub is part of a much larger integrated fire management capability applied to its broader estate dispersed across NSW.

FCNSW local bushfire management capability in the Hub is organised and segmented as follows.

Table 1. FCNSW Local Bushfire management capabilities

Segment	Functions	Resources
1. Detection	a. Fire lookout tower network with dedicated lookouts (5), with manning times determined according to fire danger ratings	i. 5 primary fire lookout detection towers (Sunny Corner; Shooters Hill; Burruga, Pennsylvania, and Canobolas) with radio connection

Segment	Functions	Resources
	b. FCNSW Duty officer monitoring RFS lightning strike detection system and satellite-borne infra-red detection systems c. Supplementary ground and/or aerial detection patrols mobilised when lightning or severe conditions trigger activation	i. to central office seasonally staffed by dedicated lookouts ii. Additional high vantage points for viewing during detection patrols iii. Access to RFS ICON/lightning detection system and public access to sentinel hotspot detection systems iv. Ground crews dispatchable to undertake ground patrols to investigate lightning strike report and other fire reports v. Exclusive use FCNSW contract helicopter to undertake aerial detection flights as tasked
2. Rapid Initial Attack crew response upon initial fire reports	a. Standard-field based fire crews (3x6) on immediate standby at Canobolas, Sunny Corner and Black Springs) to respond in appliances & D3 to smoke or fire reports b. 1 x Duty Officer + 2 support personnel providing command and control of crews c. At FDI 30+ up to 3 additional fire crews in tankers deployed to additional field locations (e.g. Mt David, Pennsylvania, Mullion, Jenolan or Lidsdale) and D8 on float with operator on standby at Bathurst	i. At each of Canobolas, Sunny Corner, and Black Springs depots, a 6-person crew each with heavy tanker, slip-on and tipper with D3 initial attack dozer ready for immediate response to fire as directed by FCNSW Duty Officer ii. Additional tanker crews (3) on 30+ FDI days iii. Exclusive use FCNSW contract waterbombing helicopter at Bathurst iv. FCNSW Duty Officer in office able to request/dispatch back-up resources
3. First shift back-up/extended attack resources	a. During work hours, additional office and field staff undertaking business as usual forestry work which can be diverted to back-up initial attack crews for extended fire response	i. Up to 15 slip-ons and 7 tankers (additional to initial attack crew resources) available for crewing and dispatch as required ii. Call-when needed contractor machinery and bulk water pumpers
4. Surge operations for fires extending into multi-shift operations - out-of-area resources for deployment (next day) as needed from other FCNSW regions for	a. Organised on as required basis and coordinated centrally according to FCNSW whole organisation priorities	i. Resources are trained/qualified FCNSW crews in FCNSW appliances
5. FCNSW command and control resources for integration as part of RFS-led Incident	a. Local and out-of-area staff trained in IMT planning, operations and deputy IC roles which can contribute to IMT and	i. Normally locally available foresters with local knowledge, but sometimes out-of-area staff with

Segment	Functions	Resources
Management Teams (IMT)	provide plantation protection strategy advice as part of IMT	local knowledge from previous employment in the region
Notes: - FCNSW Rapid Initial Attack crews are made up of 10 seasonal staff (contracted) and permanent local employees with strong local plantation and geographical knowledge. This provides each crew with sound local knowledge of FCNSW plantation features, trail networks and other location intelligence. - FCNSW crews have specialised training and experience of how fuels and fire behaviour varies in different age classes/silvicultural treatments of pine plantation, operational knowledge of where fires can best be contained in the plantation under different conditions, and typically extensive experience using different types of forestry/earthmoving machinery in plantations to create new containment lines and in direct and close-parallel fire suppression operations to achieve minimal area burnt. This direct plantation industry knowledge, skill and experience is not commonly resident in non-forestry sector fire brigades. - FCNSW crews operate using mobile-connected Tablet PCs with FCNSW Map App system which provides highly detailed and current plantation information such as age class distribution, silvicultural treatment, road and trail networks, water point locations, contours, lightning locations and other fire data, and other important operational information for fire control tactical decision making.		

Hume Forests

A privately owned plantation grower in the Hub with plantation holdings mostly concentrated in Jenolan, Isabella and Mt David and Essington locations in the central-east the Hub area. Hume Forests has more extensive plantation assets on the South-West-Slopes, and in Victoria, and thus its fire response capability is necessarily split between the SWS and the Hub areas.

Table 2 Hume Forests Bushfire management capabilities

Segment	Functions	Resources
1. Detection	a. Agreement with FCNSW for fire detection service	i. FCNSW fire detection system
2. Rapid Initial Attack crew response upon initial fire reports	a. Two field-based fire crews (2x2) based in Oberon with 2 slip-on units to respond to smoke or fire reports in conjunction with any available FCNSW and/or RFS resources responding	i. 2 x crewed slip-on units capable of direct attack on small incipient fires and supporting larger RFS/FCNSW units in more resource-intensive fire containment operations ii. Command and control staff operating from Tumut, but can deploy to the Hub as required for extended attack operations
3. First shift back-up/extended attack resources	a. Call when needed contract earthmoving resources	i. Locally available contractors who provide services to Hume Forests for forestry operations
4. Surge operations for fires extending into multi-shift operations	a. Out-of-area resources for deployment (next day) as needed from Tumut for surge operations. Organised on as required basis	i. Resources are trained/qualified fire crews in HF appliances

Pine Plantations Products (PPP)

A privately owned plantation grower in the Hub with plantation holdings mostly concentrated in Mt David and Triangle Flat and some other smaller outlying locations in the central-east the Hub area. PPP fire response capability is based at Oberon.

Table 3 PPP Bushfire management capabilities

Segment	Functions	Resources
1. Detection	a. No role-specific detection systems	i. NA – but nearest FCNSW tower to Mt David and Triangle Flat is Burruga
2. Rapid Initial Attack crew response upon initial fire reports	b. Two field-based fire crews (2x3) based in Oberon with 1 tanker and 1 slip-on unit to respond to smoke or fire reports in conjunction with any available FCNSW and/or RFS resources responding. Policy to release RFS volunteers working in mill if there is a fire event for them to attend with local brigades as well.	i. 2 units capable of direct attack on small incipient fires and supporting larger RFS/FCNSW units in more resource-intensive fire containment operations ii. Command and control staff operating from Oberon
3. First shift back-up/extended attack resources	b. 2 Dozers, excavator and transporter available + Call when needed contract earthmoving resources. Bell helicopter that could also be made available for aerial observation.	ii. Locally available forestry operations contractors

Other private pine assets

Pine growers other than FCNSW, Hume and PPP are reliant on RFS for fire response (see Section 4.4).

4.2 Plantation Forestry Operations Contractors

Various types of contractors provide services the plantation forestry sector. Principally these include silvicultural contractors, harvest and haul contractors, site preparation contractors and potentially also plantation road/trail maintenance contractors. These contractors operate machinery such as bulldozers, skidders and other plant which can be useful in firefighting provided that such items are fitted out for forestry firefighting (or can be so fitted out quickly in the field) and have appropriate insurance covering fire work. Bulldozers with operators with experience working in plantations including creating new control lines through young plantations can be a high value resource during fire response operations.

Plantation forestry contractors are typically worked under the direct supervision of experienced forestry fire operations personnel who are familiar with the capabilities and limitations of different machines and understand their potential application in plantation stands with different age classes/silvicultural treatments (e.g. thinned or unthinned).

Limited responses were received via the capability survey undertaken for the Hub, with only one haulage and harvest contractor indicating they had firefighting appliances available. Two medium tankers (1,000 – 3,000 litre capacity) and 6 light/slip on units (<1,000 litres) were identified through the survey.

4.3 Primary processors

Primary processors include businesses which receive harvested logs from plantations process them into a range of primary products including sawn timber, engineered wood products, wood fibre and particle based composite products, treated timber products and woodchips. It is not usual in Australia for processors to be directly involved in firefighting except for vertically integrated companies which undertake both growing and processing business activity.

It can be the case that employees of processors are volunteer members of local rural fire brigades and thus contribute to fire response through the volunteer RFS brigade system.

Highland Pine Products was the only primary processor (excluding PPP who are included as a plantation owner) to respond, indicating they do not own/lease fire suppression equipment to operate locally within the.

4.4 NSW Rural Fire Service

The RFS is the lead emergency service for fire response in rural parts of NSW. Volunteer rural fire brigades are established throughout rural areas, with higher densities of brigades occurring in more productive rural landscapes with higher numbers of rural landowners and where rural villages and towns are located. The Hub area is well-served by volunteer brigades, with some 109 RFS brigades distributed throughout the Lithgow, Oberon, Bathurst, Blayney; Cabonne and Orange City LGAs in which the Hub plantations are principally situated.

In the Hub area, most brigades have either a 4WD Category 1 heavy tanker (or a 2WD Cat 3) typically with 3,000 to 4,000 litre water capacity, or a 4WD Category 2 medium tanker (or a 2WD Cat 4) typically with 1,600 to 3,000 litre capacity, and/or a light tanker ((Category 7 or 8) with an 800 to 1,600 litre capacity and potentially 4WD Striker Unit (Category 9) with less than 800 litre capacity. In the Hub area it is common for local brigades to have either a heavy or medium tanker, and a light tanker, and potentially also a striker unit. Whilst most brigades have 2 appliances, some of the larger brigades may have 3 appliances and even 4 appliances. In general, RFS brigades are trained for, and experienced at, grass and bush firefighting, town, village and property protection, with training made available also in structure and vehicle fires.

Unlike Victoria, South Australia and Queensland (where formerly State-owned plantation resources have been privatised), RFS does not have 'forest industry brigades' (FIBs). Thus RFS do not have specialised forest industry brigade training with modules specifically focussed on pine and other timber plantation fire behaviour and firefighting techniques. RFS brigades train for and undertake firefighting in native forests, which in the Hub area are predominantly woodlands and open dry forest types. However, the structural characteristics of pre-thinned pine plantations can be very different to the surrounding native forest areas, with unthinned plantations having much denser stand structure, retained branches from ground to crown, highly impeded visibility into the stand, and different fuel and fire behaviour characteristics. All these factors can cause brigades which are comfortable operating in grassland, woodland and open forest settings, to have varying levels of discomfort undertaking direct or close parallel firefighting operations in dense pine plantations. Thus, indirect firefighting operations (backburns) for fire containment from major access roads (rather than closer strategies along narrower more closed-in fire trails) or the plantation edge, can understandably, often be the preferred tactic of choice for brigades responding to fires in plantation. Where plantation forestry crews with experienced plantation fire leadership are on scene to work in close collaboration with RFS crews, closer-in strategies to minimise plantation area burnt are more likely to be agreeable.

During high tempo fire season periods, RFS brigade availability may be stretched, especially where large fires require multi-shift operations and when resource-intensive township and urban interface protection operations potentially draw large numbers of RFS resources. Whilst the Hub area has a strong RFS presence, large fires within, or at the periphery, of the Hub area can draw down a significant proportion of local RFS appliances and crews (including those brigades closest to plantations), and when such fires are campaign fires which draw resources over many days or weeks, capacity back in home brigade areas is diminished accordingly. During such times, local capability for initial and extended attack to local fires, including plantation fires, can be significantly constrained, noting that an extended attack involving indirect containment methods on a single compartment

plantation fire can require upwards of 10 tankers to implement successfully. Such numbers may not be locally available when campaign fires are drawing down resources. If such an extended attack plantation operation is attempted with a sub-strength response, the risk of fire escape into additional compartments is increased. Local RFS priorities can change quickly as fireground conditions change and new fire threats emerge. For these reasons, back-country fires and some fires near plantations away from population centres may be a lower priority for resourcing than fires where life and property are more immediately at risk. These operational demands on the RFS need to be factored into bushfire risk assessments for plantation assets.

In addition to local volunteer brigade resources, RFS has several other important capabilities (among others) available to manage and support fire operations where plantations are under threat or being impacted:

- Incident Management Teams – IMTs are established for all fires requiring coordinated multi-agency fire operations, typically operating from local RFS Fire Control Centres (or other suitably equipped centres). These IMTs prepare and implement fire incident action plans for the fire incident and have access through State Operations to out-of-area resources (aerial and ground) for scaling-up response operations as required.
- Communications network – RFS Units have radio and digital communications capabilities (including mobile repeater units and communications vehicles) facilitating fireground communications, and other agencies have systems for communicating with RFS.
- Aerial fire intelligence gathering capabilities including infra-red line-scanning aircraft and dedicated reconnaissance aircraft
- Aerial firefighting capability – RFS has at its disposal a fleet of owned, contracted and call-when-needed firefighting aircraft (rotary wing and fixed wing waterbombers) which can be requested by IMTs and are made available on a prioritised basis.
- Machinery (with operators or dry) for containment line construction and parallel attack, and supervisory personnel for heavy plant operations;
- Mobile bulk water supply capability (pumpers) for minimising water replenishment turnaround time.
- Strike Teams and out-of-area resources to supplement local resources.
- Logistical support infrastructure and support teams for supporting sustained multi-shift operations
- Lightning detection

4.5 Other fire and emergency services

In addition to the RFS, other fire authorities (recognised under the *Rural Fires Act 1997*) include National Parks and Wildlife Service (NPWS) (see section 4.5.1); Fire & Rescue NSW (FRNSW) (see section 4.5.2), and FCNSW (previously outlined at section 4.1). FRNSW may respond in collaborative assistance to RFS in rural areas. NPWS-managed lands abut plantations in parts of the Hub. NPWS fire crew attendance in rapid initial attack is most likely to occur where a reported fire may potentially be on or close to NPWS-managed land, but attendance may also occur on neighbouring land.

NSW Police and the NSW State Emergency Service may also undertake emergency management roles on non-firefighting roles (e.g. road closure and traffic control point management; evacuation management; and generally maintaining public safety).

4.5.1 NSW National Parks and Wildlife Service

National Parks and Wildlife Service are a major land manager in and adjoining the Central West Forestry Hub area. NPWS-managed land which adjoin plantation areas or have connectivity with forests which adjoin plantations in the Central West Forestry Hub include:

- Blue Mountains NP
- Kanangra-Boyd NP
- Mount Davies NR
- Mount Canobolas SCA

- Jenolan KCR
- Abercrombie River NP
- Abercrombie KCR
- Wiarborough NR
- Bubalahla NR
- Nuggetty SCA
- Razorback NR
- Copperhannia NR
- Barton NR
- Mullion Range SCR
- Winburndale NR
- Turon NP
- Marrangaroo NP
- Eusdale NR
- Wambool NR

The NPWS-managed estate is managed for the protection and conservation of biodiversity and natural values, and cultural heritage values. Many parks and reserves occupy rugged terrain, often dissected by deep gorges, rivers, other drainage features, steep terrain and exposed rock outcrops. Such features can make ground access for fire response very challenging and difficult. The NPWS estate is widely dispersed with many parks and reserves located significant road travel distances/times from local NPWS offices such as Bathurst, Oberon and Blackheath. Additionally, immediately east of the Central West Forestry Hub area, fires starting in Blue Mountains and Kanangra-Boyd NPs can occur in locations of high potential threat to bushfire-vulnerable communities in the vicinity of the Great Western Highway and Bells Line of Road. During drought years in particular, multiple ignitions can occur, and it can be the case that large campaign fires are already burning and drawing resources such that a triaged response is necessitated for new fires.

In the context of these substantial challenges for fire response, NPWS operates a locally dispatched, centrally coordinated cooperative response with other fire authorities. Noting the access challenges typically associated with the NPWS estate, NPWS places an emphasis on aerial response, including the deployment of Rapid Aerial Response Teams (RART) for response to fires on NPWS estate in areas where ground access is limited. RART response entails the insertion by helicopter of ground crews with hand tools into remote areas not otherwise accessible by road. By necessity, fire scenarios suitable for RART response are typically limited to incipient fires before they have had a chance to develop and spread, such as recent lightning strike fire detections and small fires naturally constrained by landscape features such as rocky outcrop areas or slowly developing in sheltered locations. RART dispatch bases within or near the Central West Forestry Hub area are located at Blackheath, Orange, Rylstone and Mudgee. NPWS air wing 'Park Air' operates 5 helicopters which enable dispatch of the RART teams. Additionally, contract waterbombing helicopters are also engaged as needed to support fire response operations in national parks and reserves.

NPWS fire crew attendance in rapid initial attack is most likely to occur where a reported fire may potentially be on or close to NPWS-managed land, but attendance may also occur on neighbouring land. NPWS ground-based fire crews operate using mostly light 4WD striker units suited to accessing remote areas via 4WD fire trail networks. While NPWS initial attack fire response is principally to fires on NPWS estate, NPWS crews also work cooperatively with other NSW fire authorities including NSW Rural Fire Service and Forestry Corporation of NSW, particularly in extended and multi-shift operations which often involve backburns. NPWS appliances are fitted with radio communications facilitating fireground communications for both on and off-estate response. NPWS fire response to fires threatening plantations includes planning and coordinating backburns, particularly those involving NPWS estate to contain fires within national parks and reserves.

4.5.2 Fire And Rescue NSW

FRNSW may respond in collaborative assistance to RFS in rural areas. FRNSW fire stations in the central west include Bathurst, Blayney, Canowindra, Kandos, Kelso, Molong, Oberon and Orange. FRNSW fire appliances are principally designed for urban response operations, however FRNSW Class 1 Tankers are multi-purpose and capable of off-road bushfire operations.

4.5.3 Other Emergency Management Agencies

NSW Police and the NSW State Emergency Service may also undertake emergency management roles on non-firefighting roles (e.g. road closure and traffic control point management; evacuation management; and generally maintaining public safety).

5. Plantation fire loss risk optimisation

When surface fuels (pine needle litter beds) and/or grass fuels in pine plantations are cured and dry, an ignition source can start a self-sustaining fire in the plantation. When winds are light and/or if relative humidity is high, initial fire development and rate of spread (ROS) can be relatively slow, and fire behaviour can be relatively mild. However, with increasing wind speed, air temperature, and falling humidity, initial ROS and growth potential increases, and fire behaviour becomes more vigorous. When a fire path is uphill and/or fuels are exceptionally dry such as during severe drought), as a headfire develops, spreads and becomes progressively broader, fire behaviour thresholds can be reached whereby the head fire is not controllable using direct attack methods from the ground or air, even in less windy conditions. The effectiveness of direct attack methods of fire suppression using tankers and bulldozers declines markedly once fireline intensity reaches around 2,000 kW/m, with 3,000 kW/m being an upper limit of direct attack success. Such fireline intensity can readily be attained in a pine plantation at FDIs from High and up once a head fire is well established (> 100m wide).

While a fire is still small and in its early development stage, its ROS and intensity can be well below its full potential ROS and intensity in all weather conditions. There is a variable-length window of opportunity when ROS and behaviour are below their potential when the fire may remain within controllable parameters – the more adverse the fuel and weather conditions, the shorter that window of opportunity will be.

Once a headfire has become fully established (head width > 100 metres wide) and is spreading at more than around 250 metres per hour, head fire behaviour will likely render any attempt at direct attack unsuccessful, and prospects of controlling the fire within a single compartment boundary will diminish greatly. Further, low crown height in young plantations, or contiguous vertical fuel structure in unpruned, unthinned age classes can lead to crown fire development and further spread escalation even in moderate fire danger conditions. Interplay between the wind-field and fire behaviour can cause surges and lulls in fire behaviour which can be problematic for firefighters when surges occur. Once away and running in windy conditions, the headfire will be uncontrollable until it runs out into open or low/green or discontinuous fuel areas or moves on to down sloping terrain, or weather conditions moderate.

Accordingly, the long-established mantra for pine plantation fire loss minimisation is to detect fires as early after ignition as possible, and dispatch suppression resources to the fire as rapidly as possible to contain the developing fire to the smallest possible area before the fire develops to proportions beyond the capacity of the initial attack resources to control. The worse the fire weather conditions are, the less time there is before a fire can develop to uncontrollable proportions, so fire crews will have less time in which to affect a successful response.

Fire response capability which can get to a fire during its early development phase has a much greater value than resources brought in after the fire has developed to uncontrollable proportions and is off and running. The priority focus in plantation fire protection is preventing uncontrollable fires from developing, providing a much higher return than resourcing mobilised later to deal with stemming damage from high consequence fires which can potentially burn out many thousands of hectares in a single multi-hour run during adverse fire weather conditions.

5.1 Rapid Initial Attack practice and resourcing

As previously discussed, rapid initial attack is a critical strategy in preventing recently ignited fires in plantations (and many other vegetation types) from developing into uncontrollable fires. In the Hub, and in other plantation areas, FCNSW has, over many decades, tried and tested different operating tactics for initial attack in pine plantations. No single set of tactics will work in every set of conditions – in some cases initial attack resourcing may easily suppress a fire and could potentially have been achieved with less resources, but in other circumstances the deployed resources will be insufficient, and the fire can develop into a scenario requiring indirect attack and containment from compartment boundary trails and entailing a major escalation in the resourcing and timeframes required to bring the fire under control.

Over many decades, FCNSW has found that an initial attack crew comprised of one heavy tanker (3,000 to 4,000 litre capacity), one striker unit (~400 litre water capacity) and a small D3 (75kW) size dozer which can be quickly mobilised to fire scenes on a medium rigid tipper truck, all operated with a crew of 6 firefighters (one of which is the tanker driver and one the dozer operator) is the minimal prudent initial attack crew combination for their circumstances. Optimally, this initial attack crew capability is supported by an initial attack waterbombing helicopter (Squirrel, Jetranger or similar), however it is assumed a helicopter will not be available at all initial attack fires.

For fires found to be spreading in typical plantation surface and near-surface fuels, the inclusion of a D3 dozer in initial attack crew provides a vital means of quickly establishing mineral earth breaks near the fire edge such that the flanks, and very often also the head, are much more easily able to be knocked down with water from the tanker as flames collapse due to the discontinuity in fuel created by the dozer lines. This enables the tanker and striker unit to directly attack fires successfully with much larger perimeters than they would otherwise be able to do without the assistance of the initial attack dozer operations. Where blackberries are prevalent, the D3 dozer is also essential for providing fire crew access to the fire edge.

Local RFS brigade tankers or back-up FCNSW tankers arriving on scene provides more water and manpower for direct attack to bring the fire under control and extinguish it to mop-up and patrol stage. During multiple lightning strike scenarios, the initial attack resources can be split allowing more than one fire to be attacked simultaneously while back-up resources are mobilised. Some fires may be successfully attacked with less resources than outlined above, however, with less resources the range of scenarios likely to defeat initial attack efforts (and potentially develop into a high consequence fire) expands. Initial attack crewing tactics is a risk management decision.

The above FCNSW approach to initial attack in plantation has a significant point of difference with a typical RFS response – the latter rarely if ever will dispatch a dozer as part of an initial attack. FCNSW considers that the early deployment of one or more bulldozers (D3 initial attack dozer followed by additional larger machines if required for extended attack) substantially improves the suppression effectiveness of tankers, conserves their water use extending their time on the fireline (before needing to refill – critical given often limited water supplies and travel distance to refill), and greatly improves the success probability of mop-up and containment consolidation after initial fire knockdown in direct attack. Evidence from decades of plantation firefighting experience is that plantation fire initial attack is made significantly harder for tanker crews where initial attack dozers are not available, with initial attack success probability reduced accordingly.

Where the response to a report of fire in a plantation or adjacent forest is comprised of only tankers and strikers, the only available mineral earth breaks are typically compartment boundary trails and access road/fire trails. Where a fire is still relatively small (e.g. less than 0.1 hectares - such as a fire 20 metres wide by 50 metres long) and not spreading quickly, a tanker response alone may have reasonable prospects of success provided the head is accessible from the road the tanker is operating from. However, where the headfire is beyond an accessible distance from the road or is spreading at a rate beyond the capacity of hose teams to keep pace with, then falling back to indirect containment strategies from compartment boundaries is necessitated, which will typically require many more large tanker crews for lighting and containment, very often extending into a major, inter-agency overnight operation, with greatly increased mop-up and patrol difficulty.

5.2 Key lessons learnt from historical plantation fire events

It is beyond the scope of this project to examine after action reviews of historical fire events in the Hub and further afield, however, there are some key themes from plantation fire protection experience which can provide a useful framework for considering potential future improvements in the Hub. These key themes are outlined in sections 5.2.1 to 5.2.6.

5.2.1 Early fire detection

Due to the time-critical nature of being able to mount a successful suppression response to a plantation fire (or fire threatening a plantation) before any such fire can reach uncontrollable proportions, early detection of fires is vital. With increasing time between fire ignition and detection, the more time a fire will have to grow towards size and intensity thresholds beyond the capability of initial attack resources to bring it under control. When adverse fire weather conditions prevail, every minute counts as the time from ignition to uncontrollable parameters can be short, potentially under 30 minutes in severe fire weather conditions. However, the vast majority of fire ignitions in plantations occur under much milder weather conditions, noting that some lightning ignitions occur at night when weather conditions are typically much more favourable (lower temperatures and higher humidity's).

Some of Australia's largest loss plantation fires were not detected until the day following ignition, by which time direct attack methods were not tenable. This includes the two largest plantation loss fires ever to occur in NSW – the 2006 Billo Road Fire, and the 2019 Dunns Road Fire. Both fires burnt overnight undetected in drought conditions, and by the time they were found and reported, fire extent and behaviour were well beyond controllable

thresholds. On the other hand, where fires are detected early after ignition, there is a high rate of success in effecting control, including during adverse fire seasons. However, some fires starting on wind-exposed aspects in locations where fire development is aided by rising topography, even early detection and rapid response may not facilitate successful initial attack (e.g. 2014 Minnimbah fire). For fires ignited by lightning at night when lookout towers cannot provide detection, if fires cannot be located overnight using targeted ground patrols, then aerial reconnaissance at first light may still provide sufficient time to affect a successful initial attack response.

Manned fire lookout towers are a traditional and mostly effective detection method, and historically, experienced lookout operators using high quality binoculars have often out-performed automated camera systems in detecting the first signs of smoke rising from a recent fire ignition. However, manned lookouts also have drawbacks, including that typically they are not manned and operational for the full duration of daylight hours, they do not work in darkness, visibility range from towers can be compromised by smoke drift from fires or dust storms or haze, and some parts of the landscape maybe obscured from view by topography and/or be beyond reliable early detection range of a tower. Depending on the risk appetite of the plantation owner, plantations which are remote from, or not well-served by existing lookout tower networks may need to take additional measures for fire detection (additional to relying on towers alone) particularly after local dry lightning storms.

In addition to existing fire lookout networks operated by NSW fire authorities, the following early fire detection options are available to growers to consider:

- Tower-mounted fire detection cameras with telemetry for reporting via mobile networks – several commercial options are available, with varying performance and cost (FCNSW is currently trialling new camera technology in Hampton SF. Hume Forests is also trialling new camera technology on the south-west-slopes);
- Lightning strike detection –RFS operates a lightning strike location display system via their Incident Command Online (ICON) system which can be accessed by RFS staff and volunteers and is accessed by other NSW fire authorities including FCNSW. The ICON lightning strike display system operated by RFS takes lightning detection data from a commercial lightning detection service provider, filters (cloud to ground strikes only selected) and processes it and displays it electronically on a map interface which can be viewed on a computer screen or Tablet PC. The displayed information differentiates between positive and negative lightning polarity and the timing the lightning occurred is displayed in time bands. Map zoom functionality allows a user to zoom in to property scales to locate ground strikes in relation to other mapped features such as roads, creeks, contours etc. FCNSW Duty Officers monitor the system and use 'screengrabs' of selected lightning strike locations to task patrols to investigate recorded strikes of interest to FCNSW. Access to and use of such a system may also be useful to commercial and smaller private growers for lightning strike fire early detection.
- Fire hotspot detection – Satellite-borne infra-red and multi-spectral sensors can detect active fire hotspots on the land surface. Fire hotspot detection is subject to fire size and heat energy output thresholds, and detection only occurs at times when a satellite with suitable sensors is passing over the subject area. One freely available service available over the internet is the Digital Earth Australia (DEA) Hotspots website (Digital Earth Australia Hotspots (ga.gov.au) - formerly Sentinel Hotspots). Hotspots detected by MODIS sensors (aboard NASA's Terra and Aqua satellites), and VIIRS sensors (aboard the Suomi NPP and NOAA-20 satellites) are displayed in time bands on a zoomable and customisable map screen interface. While these sensors may not detect small initiating fires, they may can detect some fires which have resulted from lightning during the night, which have not yet been detected by other sources. DEA Hotspots is freely and openly available to anyone with internet access. FCNSW has been working with a new satellite data service provider (Ororatech) to develop improved hotspot detection capability. The Ororatech system accesses infrared and multispectral data from a wider range of satellites than the DEA Hotspots and has also commenced a program of launching its own additional 'cube satellites' to increase the frequency of satellite passes at times when current passes are infrequent.
- Ground patrols – When fire intelligence such as mapping of lightning strikes, satellite hotspot data, smoke sightings or reports of lightning in a locality where plantation is located, any resulting fire needs to be located before suppression action can be commenced. Often such intelligence is received during daylight hours, but sometimes it is received after dark. Fire protection planning which identifies suitable high vantage points in the local landscape which provide good views into plantation areas can be highly valuable when ground patrols are dispatched to find and locate a potential fire report. At night, while smoke may not be visible, light emitted by a fire may be visible from some vantage points. In the absence

of such planning, ground patrols without strong local knowledge of the plantation may find it very challenging to locate a fire.

- Aerial patrols - When dry lightning storms have impacted plantation areas and lightning data confirms local lightning activity, early morning aerial fire detection flights can be a useful way of obtaining early detection of fires. Small quantities of smoke settled in a locality can indicate the potential presence of a smouldering fire which may later become more vigorous and start to spread as conditions warm up and winds strengthen – ground patrols can be directed to such areas to locate smouldering fires before they resume spread.

5.2.2 Early multi-mode initial attack

Facilitated by early fire detection, early initial attack mobilisation provides the best prospects of containing a fire before it can attain proportions and fire behaviour untenable for direct attack methods. A multi-mode attack will typically provide the highest probability of initial attack success. Depending on the fire's location, an initial attack waterbombing helicopter may be able to reach the fire before ground crews can get there by road and commence waterbombing operations to knock down the head fire and retard growth of the fire while ground resources are enroute. As outlined at section 5.1, ground initial attack operations with a combination of an initial attack bulldozer with heavy tankers and striker units is optimal. Bulldozer deployment is particularly valuable if the fire is not conveniently located near a road/trail, and/or if blackberries infestations impede access to the fire.

Initial attack of plantation fires by Fire and Emergency Services

The Hub plantations are in rural areas where the RFS has primary jurisdiction for fire response. FRNSW Class 1 multi-purpose tankers from towns where they have stations (e.g. Lithgow, Oberon, Bathurst, Kelso, Orange, Blayney) may also be responded in support of RFS, noting that many other FRNSW appliances are designed principally for urban operations.

It is very rare for RFS to deploy waterbombing aircraft for initial attack (immediately upon initial receipt of a fire report) except in areas where a Section 44 (S44) Emergency fire is already declared or a pre-emptive S44 has been declared with locally based waterbombing aircraft available to the IMT. The more typical practice is for aerial waterbombing assistance to be requested by RFS ground crews once they have arrived at the fire and made an initial appreciation of its size, behaviour, growth potential and assets potentially at-risk. Within RFS, requests for aerial waterbombers and other aviation assets require approval at State Operations level and thus internal RFS request and approval processes must be completed before an aircraft is dispatched. An emerging exception to this is a Pre-Determined Dispatch trial that RFS is currently trialling, but this is limited to Single Engine Air Tankers - SEATs (fixed wing agricultural aircraft) based in a limited number of regional locations, with only Cowra being within the Hub area. SEATs have the disadvantage (relative to helicopters) that they must return to their base to refill, whereas a helicopter can access water sources in the near vicinity of the fire. Accordingly, it is not historical or current practice for RFS to dispatch waterbombing helicopters (or fixed wing waterbombers) as part of initial attack on plantations fires in the Hub area.

RFS maintains internal processes and capability for engaging earthmoving machinery for fire operations. However, it is not historical or current RFS practice to deploy earthmoving machinery to fires as part of an initial attack response. Like the process used for aircraft, such resources need to go through a request process after any initial request from ground resources at the scene of a fire.

Accordingly, rapid initial attack response by RFS to a report of fire in or near plantation can normally be expected to be a combination of locally available ground resources comprised of different size tankers (heavy, medium or light) and potentially also striker units.

Initial attack of plantation fires by Forestry Corporation of NSW

Within the Hub area, during the bushfire danger period, FCNSW engages, on an exclusive-use contract, one waterbombing helicopter which is based in the region, based in Orange or Bathurst, unless released during low-risk conditions for use by FCNSW elsewhere. This waterbombing helicopter is principally available for initial attack waterbombing operations on any fire that FCNSW deems may potentially threaten their plantations and can also be used for fire detection and reconnaissance as required by FCNSW. This helicopter will be at increasing degrees of readiness for response according to the level of fire danger and/or potential for lightning activity. FCNSW will normally have at least one other exclusive-use contract helicopter engaged (at Tumut), and potentially additional aircraft if fire risk conditions dictate. When operational demands dictate, FCNSW may engage an

additional helicopter in the Hub region to cover their needs for current active fire operations as well as continuing to maintain aerial initial attack capability for response to new fires.

FCNSW will normally prioritise use of their waterbombing helicopter to fires on or threatening their plantation estate. If there are no immediate or potential threats to FCNSW plantations, FCNSW may deploy their helicopter to assist fires threatening other plantations in the Hub if requested, subject to immediate return if it becomes needed for FCNSW operations.

During periods with predictions for lightning activity, and periods following lightning activity, there is a high likelihood that FCNSW initial attack helicopter will be either actively engaged on active response or at immediate readiness to respond to anticipated reports of threats to FCNSW plantation estate, and thus only available for use on other plantation estates if FCNSW assesses the threats to its own estate are manageable. As typically FCNSW will normally only have one waterbombing helicopter available to it within the Hub, it will only be able to conduct initial attack on one fire at a time. During lightning activity scenarios, FCNSW may have multiple fire threats to deal with and will operate a triage process whereby the initial attack helicopter responds to the highest-risk fire threat, and the other fires can only be responded to initially with ground resources.

FCNSW initial attack ground response to fires will typically involve deployment of a small initial attack bulldozer (D3). These are stationed at FCNSW field response bases. Where the initial report of a fire indicates the fire has significant potential to get beyond initial attack capability, additional larger bulldozers are likely to be dispatched by FCNSW Duty Officer (typically D6 to D8 size machines), however noting the requirements for loading such machines onto a floats for mobilisation to the fire, and unloading in the plantation, these are more of an extended attack resource. Where a fire is reported to be burning across grassland toward a plantation, an FCNSW grader may be mobilised for control line construction as part of the back-up response, noting in grass a grader can construct mineral earth breaks at a much faster rate than a bulldozer.

FCNSW initial attack will typically also comprise a heavy tanker and a striker unit, with back-up resources sourced and dispatched after the initial attack mobilisation.

Accordingly, an FCNSW initial attack response will typically be a multi-mode response, using a waterbombing helicopter where available, D3 bulldozer, heavy tanker and striker unit, with back-up resources mobilised as required at the earliest opportunity. All FCNSW fires are also reported to RFS, who will typically also respond with tankers which work collaboratively with FCNSW initial attack crews in effecting a successful response.

Initial attack of plantation fires by private plantation owners

Within the Hub area, second tier plantation growers include Hume Forests (HF) and Plantation Pine Products (PPP [Borg]). Initial attack resources are limited to up to two crews in striker units for HF and one heavy tanker and one striker unit for PPP. Key roles of these units are to locate the exact location of any fires reported to be on or near their respective estates, and to work closely with responding RFS appliances and/or FCNSW appliances, providing local plantation knowledge to the attending crews and supporting efforts to contain and control the fire. The HF and PPP initial attack resources will typically also identify what earthmoving machinery may be of use for fire control operations so that arrangements can be made with contractors or call-when-needed suppliers to mobilise required resources to the fire.

5.2.3 Early request and mobilisation of back-up resources for extended attack

When it first becomes apparent that initial attack resources are unlikely to successfully contain a fire without additional resources, typically, an IMT is not yet established, and the call for what additional resources are required will come from on-scene responders. The nature of any back-up resource requests, made early, regarding what is required to affect a successful containment plan, can be crucial, particularly if the fire is relatively distant from where back-up resources are located. To make good calls about what resources are required typically needs those making the call to rapidly develop a viable incident action plan based on good local knowledge about the plantation (such things as age class distribution, local topography, road and fire trail network, presence or otherwise of such things as blackberry infestations, optimal locations for unloading of earthmoving machinery, and if machinery is to be used, where can it best be used to link roads or areas of lower fuel hazard where the fire might be contained). If the first responders do not have first-hand local knowledge in the plantation and are not experienced at using earthmoving machinery for fire containment in different age classes of plantation, then it is more probable than not that indirect attack methods will be resorted to, potentially from the main access and/or

boundaries. As late afternoon operations extend into night operations, good first-hand local plantation knowledge at the scene becomes even more critical.

Accordingly, if initial attack crews do not include experienced, supervisory-level personnel with first-hand local knowledge of the plantation or are not experienced or comfortable undertaking direct and-or close-up parallel attack with machinery, then potentially larger multi-compartment scale operations are likely to result, involving strategic backburns which must await an IMT to be established to provide approval. Extended attack strategies which place a high reliance on aircraft are unlikely to succeed on multi-hectare plantation fires, particularly for fires starting in the late afternoon, because by the time aircraft are approved and mobilised to the fire, daylength is likely to be running out, and the ratio of fire size to effective water drop area is unlikely to be anywhere near as favourable as it is for initial attack operations.

5.2.4 Multi-shift operations under the control of an Incident Management Team (IMT)

Whilst a very high proportion of plantation fires are contained either during initial attack or extended attack operations, those fires which can't be contained (typically those subject to adverse weather/wind during the first shift) can quickly become multi-compartment fires requiring substantial resourcing, multi-shift operations, often with high potential to cause extensive plantation loss if further adverse fire weather occurs. In NSW, plantation fires which progress to being multi-shift scenarios will typically have an IMT established by RFS to plan and control fire response operations.

It can be expected that a high proportion of IMT positions will be filled by RFS personnel who have been trained in the Incident Control System and particular roles within the system. Understandably, many RFS personnel have a low level of familiarity with pine plantations and may be unfamiliar with nuances such as the effects different age classes and silvicultural treatments have on fire behaviour and opportunity to effect pine fire containment under different weather conditions. IMT personnel are even more unlikely to have local in-plantation knowledge of different age classes, silvicultural treatments and locational information relevant to control options in the plantation. Accordingly, plantation growers seeking to gain influence in the containment strategies planned for fires in their plantation need to be willing to rapidly mobilise and place a Liaison Officer within the IMT, to provide relevant local knowledge and provide inputs regarding strategy preference during development of the Incident Action Plan. PPP and HF have both indicated a willingness and capability to do this. Where no such input is provided, strategies which potentially involve backburns within, or into the plantation from the boundary may be devised where no alternative strategies for closer containment have been put to the IMT.

Similarly, where uncontained fires are burning in landscape areas which subsequently could threaten plantations, growers seeking to gain influence in the containment strategies to keep fire out of their plantation need to be willing to place a Liaison Officer within the IMT.

Where FCNSW plantations are threatened or involved in a fire, FCNSW will typically be involved in such IMT's, potentially not limited to providing a Liaison Officer, but in key IMT functional positions. FCNSW will have specific knowledge about their own plantation estate but may not have local knowledge of other private growers' estates. In the circumstance that a combination of FCNSW and private plantation estate is under threat, it will often still be prudent for private growers to maintain liaison with IMTs to provide local knowledge and input about their plantation into Incident Action Plans.

5.2.5 Night firefighting operations

As generally (not always), weather conditions at night are more favourable for fire control operations than during the afternoon due to milder fire behaviour, there can be valuable opportunities for fire containment operations executed during the night. Such operations require equipment, particularly earthmoving machinery, to have lights fitted to enable safe operations. Accordingly, growers can maximise the potential for night operations by requiring their contractors to have machinery either fitted with lights or for lights able to be quickly fitted by plant operators so they can be used in night firefighting operations. Further, ensuring that contractors have insurance covering fire response operations is also important otherwise machinery may not be able to be utilised.

5.2.6 Plantation design and set-up

Plantation design and set-up can facilitate how amenable or otherwise fire responders will be to pursuing fire containment strategies within the plantation. Plantations which have the following features are more likely to provide sufficient comfort to fire responders to pursue in-plantation containment activities:

- fire roads/trails designed, built and maintained to relevant standards in the *Plantations and Reafforestation (Code) Regulation 2001* (the Code);
- main plantation access roads are maintained in a condition suitable for articulated truck access (facilitating floating in of earthmoving machinery) with safe lines of sight maintained on curves (potentially using pruning rather than clearing), and through-road or loop road access provided to facilitate truck ingress and egress from the plantation;
- plantation roads, fire roads/trails, link roads/trails and water point locations have signage consistent with the requirements of the Code for ease of navigation by brigades;
- The availability of suitable cleared locations within large plantation groups suitable for use as anchor points for containment operations;
- Where perimeter roads abut native forest in locations where backburning would be technically difficult, provision of wider than standard fire roads (wider than the minimum specifications required under the Code), or applying pruning and thinning treatments in such areas adjacent to native forest areas to facilitate safer and more expeditious backburning for plantation protection;
- Fuel reduction treatments in significant native vegetation inholdings within the plantation;
- Treatment of blackberry infestations along main plantation access roads and fire roads with high strategic value for defensive backburns in the event of fire threats;
- Plantation familiarisation tours facilitated by plantation owners with local brigades;
- Plantation owners and/or contractors are members of local brigades.

6. Opportunities for improvement of plantation fire risk management in the Hub

In this section, in consultation with the Hub members, GHD has identified a range of opportunities for improvement of plantation fire protection across the Hub. In identifying these opportunities, it is prudent to highlight that in plantation forestry, every dollar spent on fire protection can erode business profitability in the short term. However, financial resources invested in fire protection also need to be viewed from a longer-term perspective as a form of 'insurance' which might only reap dividends occasionally, but potentially large dividends through prevention of a large-scale loss with potentially severe financial and other consequences. So whilst over-expenditure on fire protection can erode profitability, under-protection in fire protection can increase the risk of fire loss, including severe fire loss. One of the problems facing those who decide what is affordable in terms of fire protection, is that it is very difficult to quantify the value of fire losses prevented through the investment in fire protection, because such losses didn't happen, so they aren't measured. Accordingly, investments in fire protection are risk management decisions which ultimately hinge upon the risk appetite of each business. As recent major fire events in other parts of NSW have highlighted, growers are not the only segment of the plantation industry with exposure to fire risk – large high-consequence fire events, or chronic recurrent losses, can also significantly impact other segments of the industry, and potentially plantation industry-dependent communities more generally.

6.1 Plantation design and road network set-up

Plantations which are well designed and provide good access for fire crews can provide better opportunities for responding fire crews to effect control fires and limit damage in the plantation when unplanned fires occur.

In NSW, standards for 'fire roads' and tracks in plantations are established in the Code. These standards identify minimum road and track dimensions, grades, curve limits, crossing and road drainage requirements, passing bay provision, turnarounds and signage. The Code does not seek to mandate a range of plantation access network design matters which are left as risk management decisions for individual growers to decide.

Opportunity 1

The following plantation access road/track network design matters, which can have a bearing how constrained or otherwise fire responders may be when responding to fires in or threatening the plantation, may be prudent for consideration at the plantation design stage:

- **Main plantation access roads** - designed and maintained to facilitate articulated truck access and egress (not just medium rigid heavy tanker access) into the plantation can facilitate mobilisation of earthmoving machinery into the plantation for fire containment and suppression operations. Main access road widths, curve designs, grades and egress facilitation which exceed those specified for medium rigid tankers can improve accessibility for heavy plant delivery into the plantation.
- **Fire road network density** (noting there are no minimum requirements in the Code other than having an access road and a perimeter road). Best practice guidance for fire access network density (from SA/VIC Green Triangle Forest Owners Conference) is for road/track network density achieving an average compartment size generally not exceeding 40ha – this is aimed at facilitating the ability for responders to reach all parts of a plantation with hose lays not exceeding 200m. At the plantation design stage, road and trail network density is a fire risk management consideration, particularly where tanker-based operations without bulldozer assistance are the likely method of fire containment, and taking into consideration areas which may have a higher likelihood of fire ignition such as known high lightning impact areas and areas adjacent to high recreational use where the potential for accidental fires has an elevated likelihood.
- **Perimeter break areas directly abutting native forest** - some sections of perimeter breaks may have greater constraints for fire protection than others. To facilitate expeditious backburning from the plantation edge for protection against fires approaching through native forest, it may be prudent risk management to make perimeter breaks along higher-risk sections of the perimeter break wider than minimum requirements under the Code (or strengthened with planation edge pruning and thinning to make these sections easier for fire crews to work from).

6.2 Risk awareness sharing and preparedness

Plantation fire risk varies substantially from year to year, and spatially within the Hub area. Some Hub members may have better access to seasonal fire risk information than others, and some smaller scale individual growers may have a desire for improved appreciation of risk variability. Pre-fire season preparedness decisions can be improved by good access to knowledge and information about seasonal risk severity predictions. Similarly, within a fire season, typically there are several days each season when fire danger and therefore risk are heightened, and such days are often the ones with the greatest potential for large scale plantation fire loss events. A variety of forecast and prediction products are available which can provide useful insight into approaching fire danger and risk conditions. Some the Hub members may have greater capacity and access to information than others in monitoring forecast and predicted fire weather and other information relevant to the degree of upcoming fire danger and risk.

Sharing of fire risk awareness information among the Hub participants can assist by providing participants good information for informing their preparedness and readiness for fire response. A formalised process for forest/plantation industry groups to meet and share information about forecast/potential fire seasonal conditions and risk, fire preparedness in relation to the risk, and more generally, fire management issues of mutual interest. Such processes often only become formalised after a major loss event. One example of an area-specific, formalised cross industry group (including fire services) to consider such matters is the Forest Owners Conference in the Green Triangle (GTFOC) which formed after the Caroline Fire in 1979 and remains in place today. The GTFOC meets biennially, including during the lead-up to the fire season, to share information about fire risk and preparedness, promote well-coordinated fire prevention and risk management, pursue mutual support and cooperation between forest owners in the region, and develop and support mutually beneficial fire suppression arrangements for the Green Triangle (e.g. aerial detection and suppression). Plantation area in the Green Triangle is substantially greater (more than three times greater) than in the Hub and has a different ownership profile, nevertheless there is potentially mutual advantage in elements of the GTFOC model that may work for the Hub.

Opportunity 2

A formalised annual pre-fire season meeting of the Hub members (and including local fire authorities), potentially facilitated by the Hub, focussed on sharing the latest and most detailed seasonal outlook information (with email updates to follow as required), and to discuss fire preparedness measures may be an opportunity for the Hub to take fire management cooperation to a more formalised level.

Additionally, whilst industry-wide systems (daily) for restricting forest harvesting activity based on maximum forecast FDI are in place, much more detailed information regarding daily fire danger rise, peak timing and fall, and 4 to 7 day ahead projections of adverse fire weather, and onset of lightning activity are available for sharing to inform preparedness and readiness. A system of alerting all Hub members/registered plantation owners could be established, covering such things as:

- 'Red Flag' advanced warning of days when the maximum forecast FFDI is above a defined locally severe threshold (e.g. say FFDI 60) with link to relevant BoM forecast info;
- Maximum Level Readiness Day advanced warning of days when the maximum forecast FFDI is above a defined threshold (e.g. say FFDI 30) with link to relevant BoM forecast info;
- Advanced warning of days when Thunderstorm/Lightning activity is forecast, with link to relevant BoM forecast info;
- Days when visibility across parts of the Hub are forecast to be compromised below a threshold visibility distance (e.g. by smoke or dust)

6.3 Fire detection

As outlined in section 5.2.1, early fire detection is a critical and foundation element of capability to respond to fires while they are still controllable.

While traditional forms of fire detection such as FCNSW fire lookout tower network, and reports made by the public are mainstays of existing fire detection capacity in the Hub, supplemented on a risk-based basis with dedicated fire detection flights as determined prudent by fire services and growers, there are other fire and lightning detection

and monitoring technologies which have advanced significantly in recent years which continue to develop. These include improved tower-mounted camera technologies integrated with machine learning enabled image processing capability; lightning strike location technology already utilised by the RFS and FCNSW, and satellite-borne 'hotspot' detection capabilities (existing such as DEA Hotspots and developing such Ororatech system being trialled by FCNSW).

Opportunity 3
There is an opportunity for the Hub members to familiarise themselves with these existing and developing fire detection technologies so they can make informed decisions about which technologies they may wish to utilise and potentially support further. The Hub could convene and facilitate a “Future of Fire Detection Forum” with invited speakers to deliver the most up-to-date information on detection technology development. FCNSW has expressed willingness to present information regarding its technology development and trial work with Ororatech. Green Triangle Fire Alliance are currently trialling camera technology and could be approached to provide an update on their progress. FCNSW and HF are also trialling new generation fire detection camera systems. RFS could be invited to provide a presentation on recent projects they have been pursuing in the lightning and fire detection technology area, including accessibility of RFS lightning location system.
Opportunity 4
There is an opportunity for growers with fire risk management plans covering their estates to specifically consider the location of good vantage points looking over their plantation areas, for identification in their plans and ground patrol protocols, and inclusion in maintenance plans to ensure vantage points remain open and accessible.

6.4 Fire response capability

Sections 4.1 and 4.2 of this report identifies existing levels of fire response capability within the Hub area, and importantly also characterises how different agencies and companies within the Hub typically operate during fire response operations, in rapid initial attack, extended attack, and multi-shift operations.

All phases of fire response are important for preventing and mitigating plantation fire loss, with different points of emphasis and reasoning for each phase.

Rapid Initial Attack capability

Rapid initial attack capability is vitally important for minimising the numbers of plantation fires which develop and reach fire behaviour thresholds beyond the direct attack and close-in parallel attack methods typically attempted during initial attack, including fires outside plantations which are a potential threat to plantation.

FCNSW rapid initial attack operations are typically multi-mode operations utilising their initial attack waterbombing helicopter, a small bulldozer (D3) transportable on a medium rigid truck, a heavy tanker and a striker unit. FCNSW rapid initial attack crews are often supported by RFS brigade appliances also mobilised in initial attack, commonly a combination of one or more heavy or medium or light tanker, and typically also a striker unit. FCNSW and RFS are well-practiced at working together on firegrounds, both being recognised fire authorities operating under the coordinated firefighting arrangements in the *Rural Fires Act 1997*.

FCNSW initial attack crews are comprised to include an experienced crew leader with robust local knowledge of the plantations, and highly experienced in supervising multi-mode initial attacks in plantations.

RFS volunteer brigade coverage across the Hub is strong, particularly in areas where plantation assets are most concentrated such as around Oberon, Lithgow, Bathurst and Orange. Brigades are also established in more outlying parts of the Hub, but not to the same density as near the main plantation areas.

RFS resourcing of rapid initial attack operations applies a different methodology to FCNSW, noting that RFS covers the whole rural landscape, and its response capability is not tailored specifically to the forestry sector. RFS initial attack response is typically a tanker-based response, not normally including a bulldozer or other plant, and not normally using waterbombing helicopters in the initial response. Weight of response will vary depending on the operating circumstances and commitments at the time and can vary from a one or two appliance response to a

multi-brigade response with many appliances. Subject to the incident appreciation undertaken by RFS on-scene units, additional assistance may be requested, typically further tankers, but potentially also aerial waterbombing support and earthmoving machinery. It is uncommon for RFS to use small D3 size dozers deployable on medium rigid trucks – larger bulldozers requiring loading onto floats hauled using prime-movers are more typical, which can have significantly longer mobilisation timeframes than FCNSW initial attack D3 bulldozers.

GHD considers that D3 bulldozers and initial attack waterbombing helicopters add very substantial initial attack capability to rapid initial attack for plantation fires in the early development stage. These resources significantly enhance tanker operations, and each modal component complements the other providing highly desirable functionality. GHD considers that initial attack waterbombing helicopters and initial attack bulldozers are much more constrained in availability across the Hub area than fire tankers, of which RFS has a substantial fleet dispersed across brigades in the Hub. Accordingly, if there is any resource type which warrants consideration by the Hub members for increased availability, it is dedicated initial attack waterbombing helicopters and initial attack dozers with operators skilled in plantation operations.

Noting that around 20% of the plantation estate in the Hub is privately owned, the availability of experienced plantation fire operations supervisors with detailed knowledge of private plantation estate areas, able to work on-scene collaboratively with attending RFS brigades is also a vitally important element of initial attack capability. Where such capability is absent, brigades may lack the necessary plantation local knowledge to pursue direct attack operations within the plantation and may necessarily select more indirect containment options with greater potential consequence for plantation loss and damage.

Opportunity 5
Given the relative strong tanker-based rapid initial attack capability provided in the Hub area by NSW RFS, increased availability of scarcer high-value capabilities such as rapid response bulldozers (deployed using 4WD medium rigid trucks) and locally stationed initial attack waterbombing helicopters may be a wiser choice for increased response capability investment consideration by the Hub members. Such capability investments could potentially be made from any of the forestry industry segments.
Opportunity 6
For private plantations, there is an opportunity to consider and plan how experienced plantation fire response practitioners, with specific local knowledge of private plantation assets, can be engaged and mobilised as part of initial attack operations (particularly during conditions conducive to rapid fire development) to work collaboratively with local RFS brigades attending initial attack operations in plantations. This may include detailed information such as access, water points, assets and any suppression capabilities in property fire management plans.
Opportunity 7
Given that NSW does not have Forest Industry Brigades, provided with plantation-specific fuels, fire behaviour, and suppression tactics training, there is an opportunity for the Hub members to consider developing a plantation fire response training module (potentially based on Forest Industry Brigades (FIB) modules from interstate and FCNSW training programs) for offer through RFS to brigades which have plantations in their designated response areas. This would be based upon and extend the plantation fire management and response modules that FCNSW staff and seasonal firefighters undertake.

Extended attack capability

When direct attack methods fail or are untenable for rapid initial attack crews attending plantation fires, there is typically an immediate need to substantially upscale resourcing for extended attack operations potentially involving close-in parallel and indirect attack operations within the plantation utilising the plantation road network. Such operations are typically tanker-intensive as they usually involve burning-out operations and potentially also tactical or strategic back-burning operations. Large bulldozers are typically also of high value for reducing the extent of burning-out operations by creating new control lines to provide a smaller fire perimeter than can be achieved using existing plantation road and track networks. Such extended attack operations very often require continuation of

operations well into or through the night and therefore crews and machinery need to be suitably equipped for night operations, noting that inability to take advantage of night conditions can lead to lost opportunity necessitating higher risk multi-shift operations with associated cost-plus loss implications.

Opportunity 8
There is an opportunity for the Hub growers and their contractors to ensure that crews are suitably trained and equipped for, and machinery suitably fitted out for, night firefighting operations.
Opportunity 9
In planning contingency operations for the event that direct attack operations fail or are untenable, there is an opportunity during pre-season fire planning to consider how incident resources can be scaled up for extended attack operations, and what if any improvements may facilitate night operations.
Opportunity 10
As extended attack and night firefighting operations will typically be undertaken under the control of an establishing IMT, the Hub growers have an opportunity to consider how they can best provide input to IMT's to contribute to extended attack/overnight operations.

Multi-shift operations operating under an established IMT

Once a plantation fire event (or fire threat) has escalated to multi-shift operations under control of an IMT, there is significant potential for large scale plantation loss, as the fire has defeated initial attack, and has potentially developed beyond extended attack, and will likely be further exposed to daytime weather, potentially adverse fire weather depending on forecast conditions. Such circumstances are potentially very serious and necessitate input at strategic level to incident action planning undertaken by the IMT. FCNSW participates in Section 52 Bush Fire Operations Plan preparation involving pre-incident identification of personnel qualified and suitably experienced for IMT roles. Second tier and other private growers may not have the capability to fill IMT functional positions, but it is typically open to growers to nominate suitable personnel for a Liaison Officer role within the IMT.

Plantation defence against fire threats emanating from outside plantations can in some cases be foreseen one or more days ahead. When such threats are present, growers have a typically short opportunity to strengthen local capacity with out-of-area resources mobilised from outside the Hub.

Opportunity 11
There is an opportunity for the Hub growers, particularly second tier and smaller private growers, each fire season to consider and pre-plan how they might resource a Liaison Officer role in an IMT to ensure strategic input to multi-shift fire operations involving fires in or a potential threat to their plantation.
Opportunity 12
There is an opportunity for the Hub growers, particularly second tier and smaller private growers, to consider and pre-plan how they might rapidly mobilise out of area resources to assist with plantation defence operations involving their plantation.
Opportunity 13
There is an opportunity for contractors to register their plant such as bulldozers, excavators and graders on the RFS approved firefighting plant register. Registered plant will need to meet RFS minimum safety and fit-out requirements. The advantage of RFS registration is being able to have locally available plant engaged expeditiously by RFS for work on RFS-controlled fires, including plantation fires. This will serve to maximise the pool of locally available plant able to be promptly deployed onto fires in the Hub area. Plant operators also need to have appropriate fireground Personal Protective Equipment and Basic Wildfire Awareness qualification (available online through Fireground).

6.5 Plantation timber industry sector-wide coordination and collaboration

While plantation growers have the greatest exposure to plantation fire loss risk (and they bear the greatest burden for plantation fire risk control), such risk impacts more broadly across the plantation forest industry, particularly the risk implications of a major loss event.

Through the Hub, all segments of the local industry have shown proactive interest in improving sector-wide coordination and collaboration for fire risk management (such as through initiating this project) and have not waited for a large loss event in the Hub to initiate such action. Collaborative models the Hub can look to are most advanced in the Green Triangle Forestry Hub (SA/VIC). Meeting twice a year, company personnel with lead responsibility for fire risk management come together to share information about fire risk outlooks and preparedness, and to pursue collective, collaborative arrangements of benefit to all parties, such as for aerial fire detection and suppression. Over time, the GTFOC has developed agreed and documented guidelines for plantation design and road access, common operating protocols for fire prevention, risk-based work restriction and contractor fire training, standards for heap and windrow burning. GTFOC companies also implement a coordinated and collective approach to aspects of fire detection including resourcing protocols for aerial detection and initial attack aerial waterbombing. A copy of the GTFOC Plantation Fire Protection Guidelines is attached at Appendix 1 for information.

Collaborative entities such as the GTFOC, and the more recently initiated Green Triangle Fire Alliance, can add real value to local plantation fire protection through structuring and formalising collaborative effort, facilitating information flow between industry participants on fire risk escalation and preparedness, providing a forum for exchange of experiential knowledge which can assist smaller participants to improve their knowledge level and preparedness, and strengthen industry networks and trust across the local fire community which can reap dividends when fires subsequently occur.

Opportunity 14
Participants in the Hub may wish to consider establishment of a formalised plantation industry group focussed on fire protection, with a charter for risk and preparedness information sharing, strengthening agreed standards, operating protocols and improving collaborative arrangements.
Opportunity 15
Over the last ten years fireground navigation has been shifting away from hardcopy maps to digital map applications. It is vital that growers capture and share digital information about dynamic plantation features of importance for fire responders such as age classes, harvested areas, roads, water points, fuel reduced areas etc. The Hub growers have an opportunity to develop a plantation fire digital information sharing protocol to facilitate updating of digital map layers prior to each fire season.
Opportunity 16
FCNSW has the critical mass to conduct its own internal firefighter training, skill refresher and team training activities, which some other smaller owners may not. While FCNSW already opens positions (on a cost recovery basis) on its annual plantation firefighting training camps to other growers, there may be opportunities to broaden availability.

6.6 Collaboration with NSW Rural Fire Service

The RFS is a critical element of plantation fire protection capability in the Hub area. RFS provides the largest component of rural firefighters and fire appliances available to respond to fire threats in all plantation areas and adjacent agricultural lands and bushland. In NSW, the situation has not arisen to necessitate introduction of FIBs, as has occurred in some other jurisdictions where formerly State-owned plantation estates have been privatised. In jurisdictions with FIBs, specific training in plantation fuels, fire behaviour, and suppression techniques is incorporated in FIB training modules. Plantation-specific training is not incorporated in RFS brigade training. For

brigades whose brigade area incorporates significant areas of plantation, this may be an area for collaboration between the plantation forest industry and RFS.

As the plantation forestry industry keenly understands, plantations represent very high capital value assets which are the resource base for major industry which contribute most substantially to the regional economy in the Hub. RFS plays a key role in protecting the primary resource from fire for the entire industry. Some individuals in the plantation industry, on occasion, lament that the importance of pine plantations is not appreciated widely enough within RFS including among salaried personnel in key fire threat identification and response prioritisation decision making positions with the result that pasture or relatively low value property can sometimes be prioritised over very high value plantations. As a generalisation such sentiment is not entirely accurate as local Bush Fire Risk Management Plans clearly articulate the importance of the plantation industry in the Hub, and plantations typically attract Very High or Extreme risk ratings in such plans. FCNSW is a statutory member of Bush Fire Management Committees and works persistently to raise awareness in those committees about the very high values attached to plantations and their fundamental importance to the plantation forestry industry in the Hub. The imperative for maximising RFS awareness of the very high importance and value of plantation to local economies in the Hub falls to the plantation industry, not to RFS. Accordingly, RFS engagement activities aimed at continually improving and maintaining awareness about the economic importance of plantations and the imperatives for their protection from fire may be warranted to optimise fire protection priority afforded to plantations during fire operations.

Local rural fire brigade capacity increases when new members join, and participants coming from the plantation forestry industry can bring plantation knowledge and experience into individual brigades potentially benefitting the rural brigade. Thus there are significant potential benefits for forestry industry sector employers to actively encourage, and potentially provide incentives, for their employees to join local rural fire brigades. Employees who join brigades are also likely to gain non-financial rewards from being members of volunteer-based community organisations like RFS brigades.

Opportunity 17

There is an opportunity for the Hub members to conduct targeted engagement activities with RFS aimed at broadening and increasing awareness of the scale of the Hub plantation industry and its importance to the local economy, the nature of collaborative efforts made by the sector to protect the resource, and the key risks to the resource and the importance of RFS capability and decision making to industry. Annual bushfire awareness week may provide an opportunity for the Hub to host an annual RFS engagement activity, potentially targeted to local RFS leadership including Group Captains and salaried operations staff.

Opportunity 18

Major plantation industry members in the Hub have an opportunity to consider introducing programs to actively encourage and incentivise employees to join local volunteer rural fire brigades. Shared benefits would be likely to accrue to the RFS, plantation industry, individuals and local communities, whilst serving to increase local RFS capacity for fire response.

7. References

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Appendix 1 Plantation Fire Risk Forum 1 Powerpoint





Central West Forestry Hub

Firefighting Capability Project:

Forum 1 - Fire risk drivers



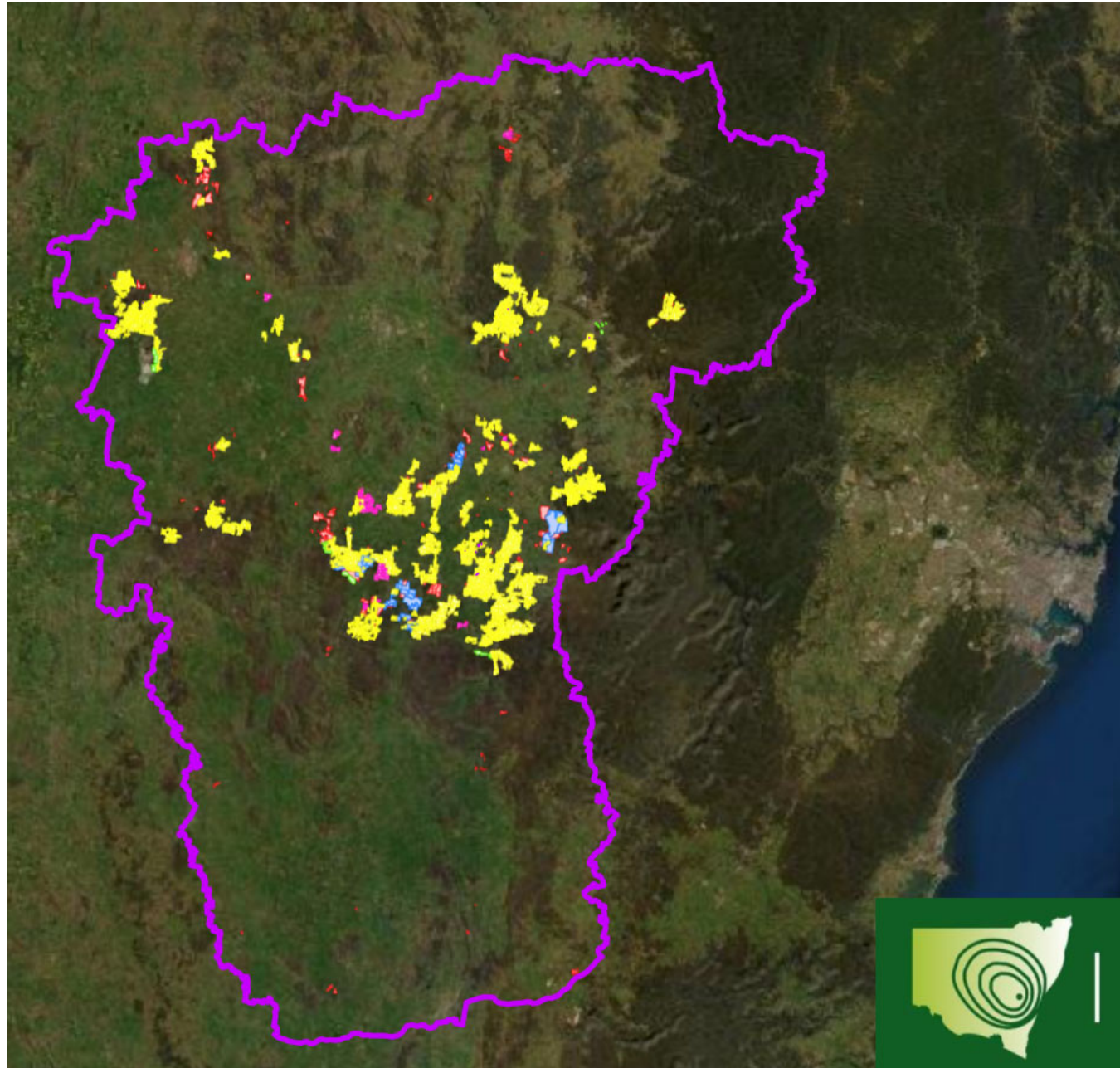
Paul de Mar, Mick George

CW Plantation Fire Risk Drivers Forum

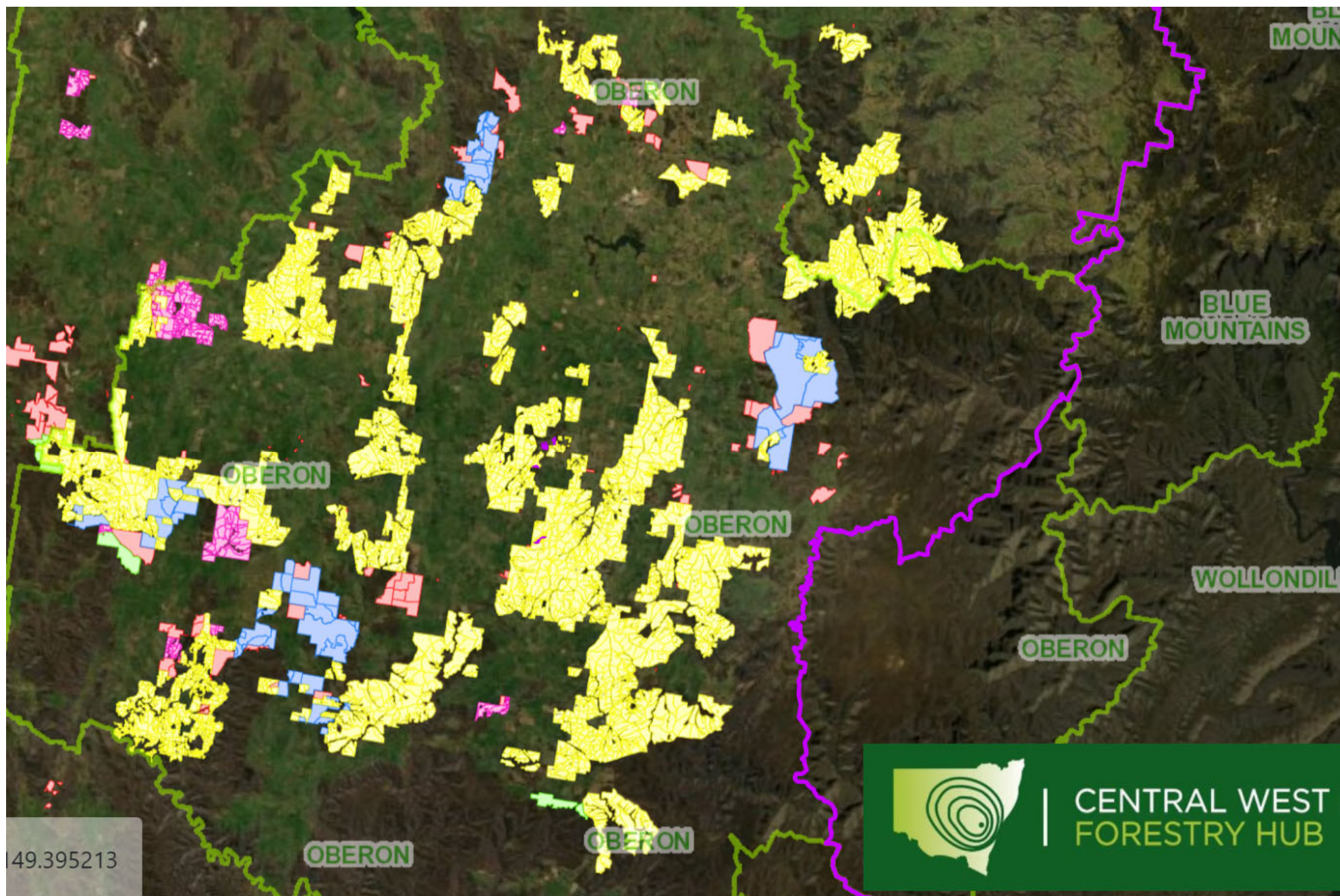
In this forum we will cover:

- Look at how fire risk is dispersed across CWFH Region
- Look at weather-related fire risk drivers
- What do previous CW plantation fire events show is important for risk reduction?
- What lessons are there to learn from major plantation fires in other Regions?
- Implications of 2019/20 fires Royal Commission and NSW Inquiry.

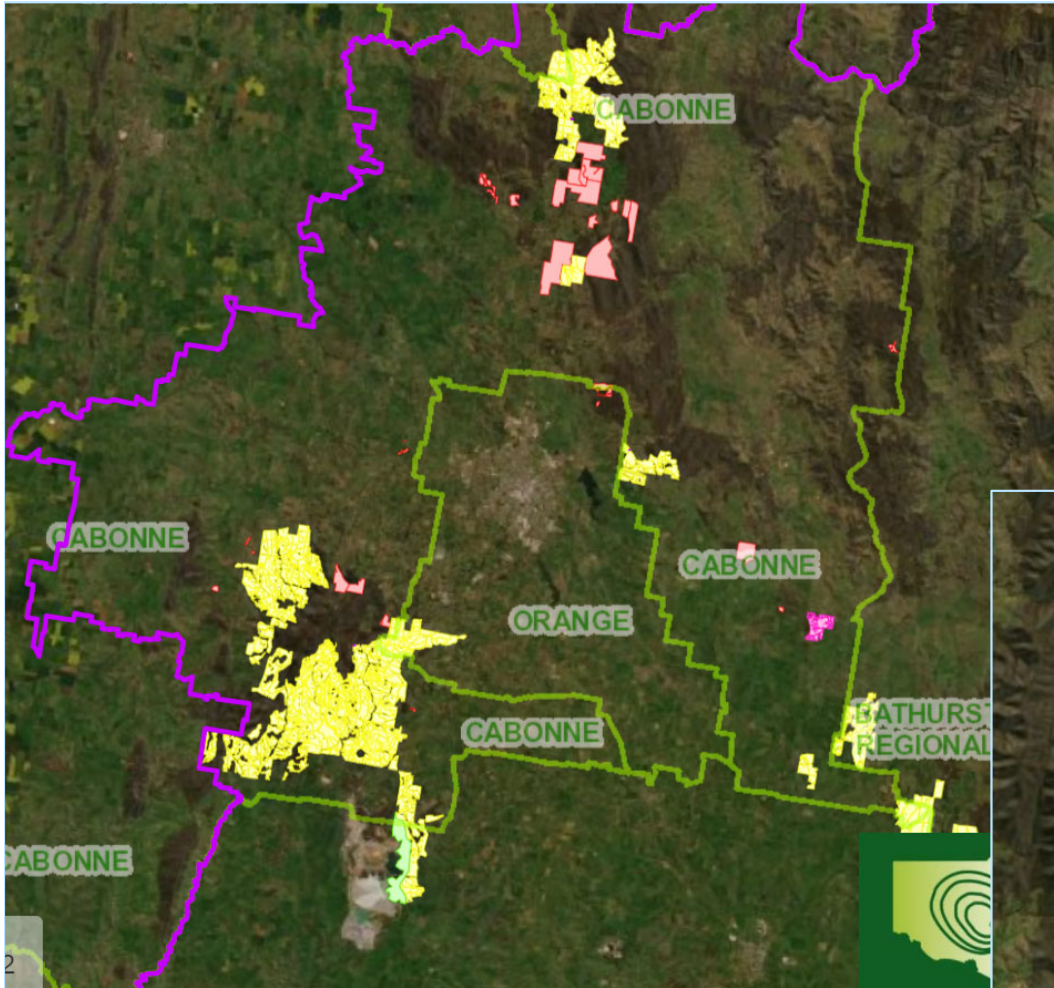
CWFH plantation distribution



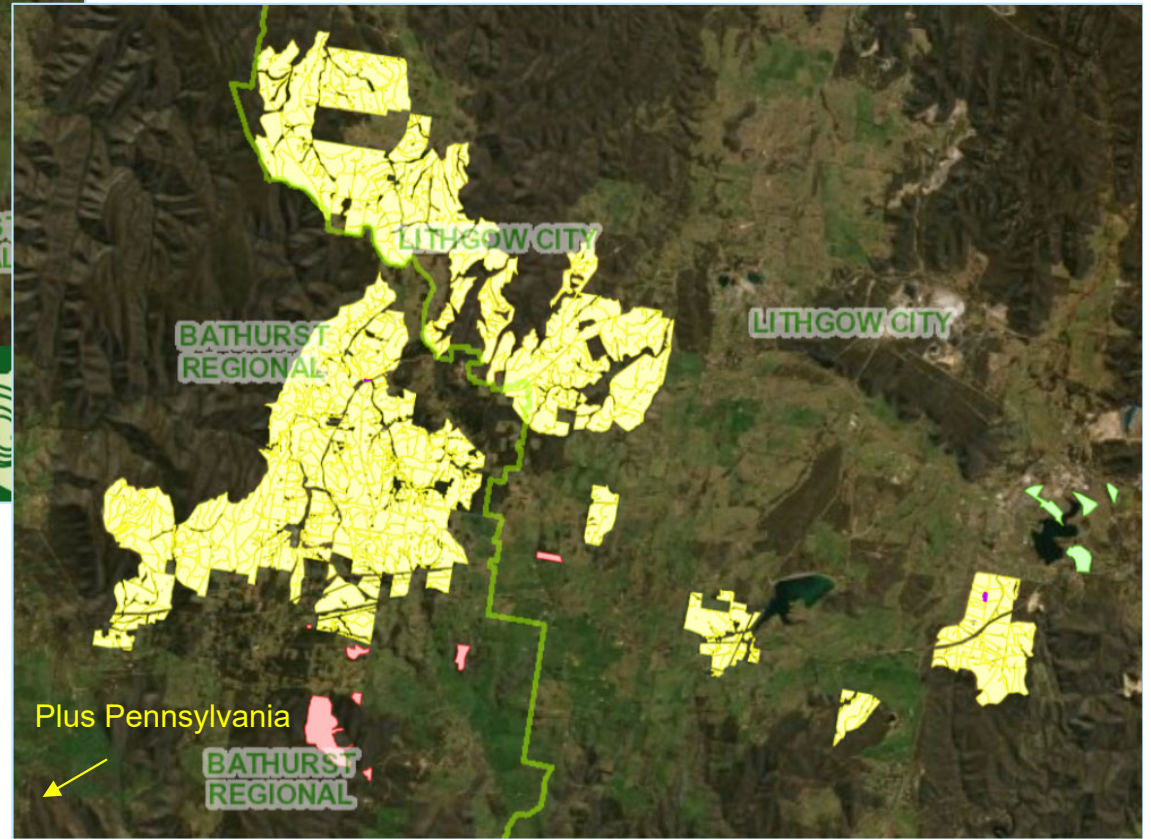
Oberon LGA - Largest exposure



Cabonne



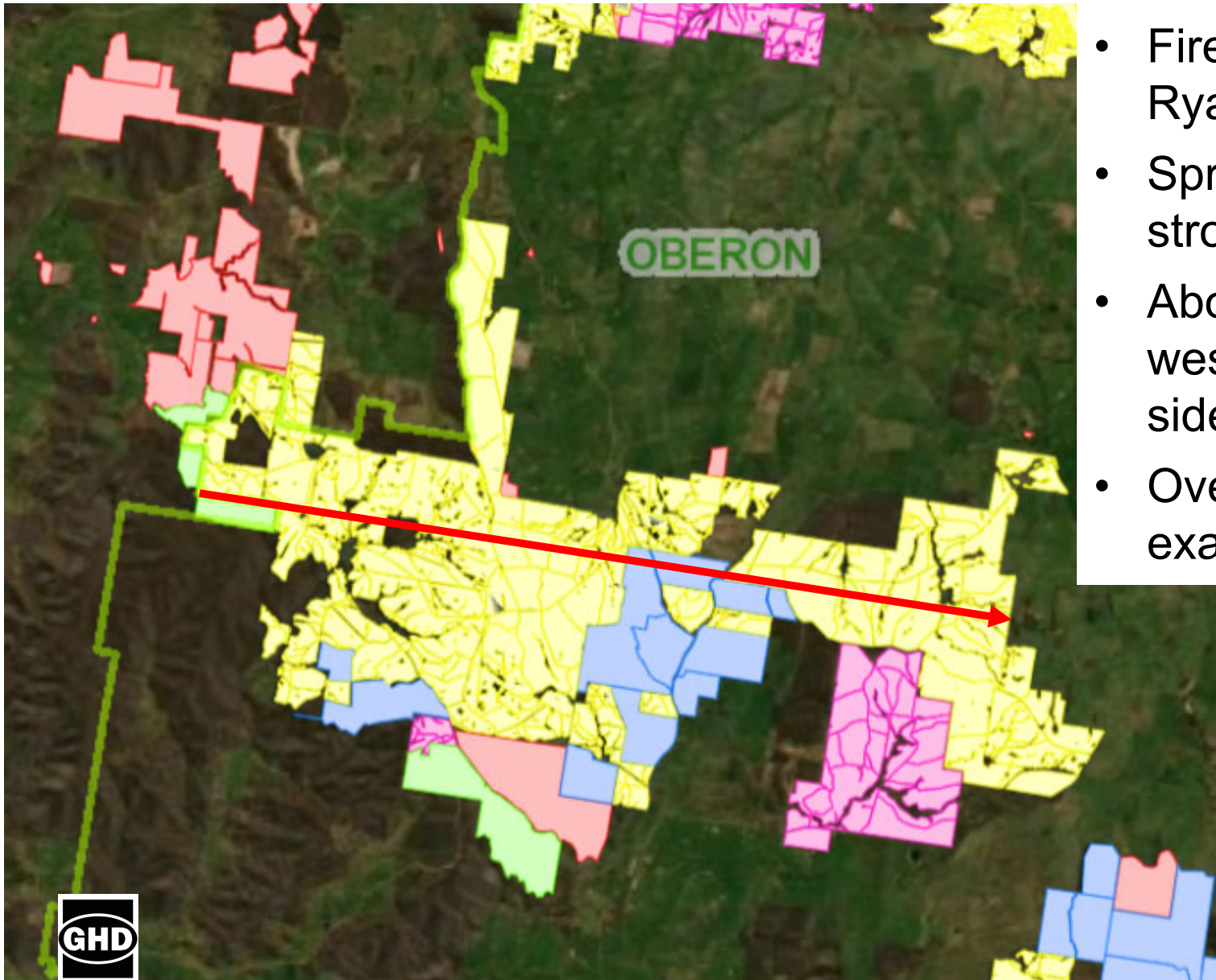
Bathurst Regional, Lithgow



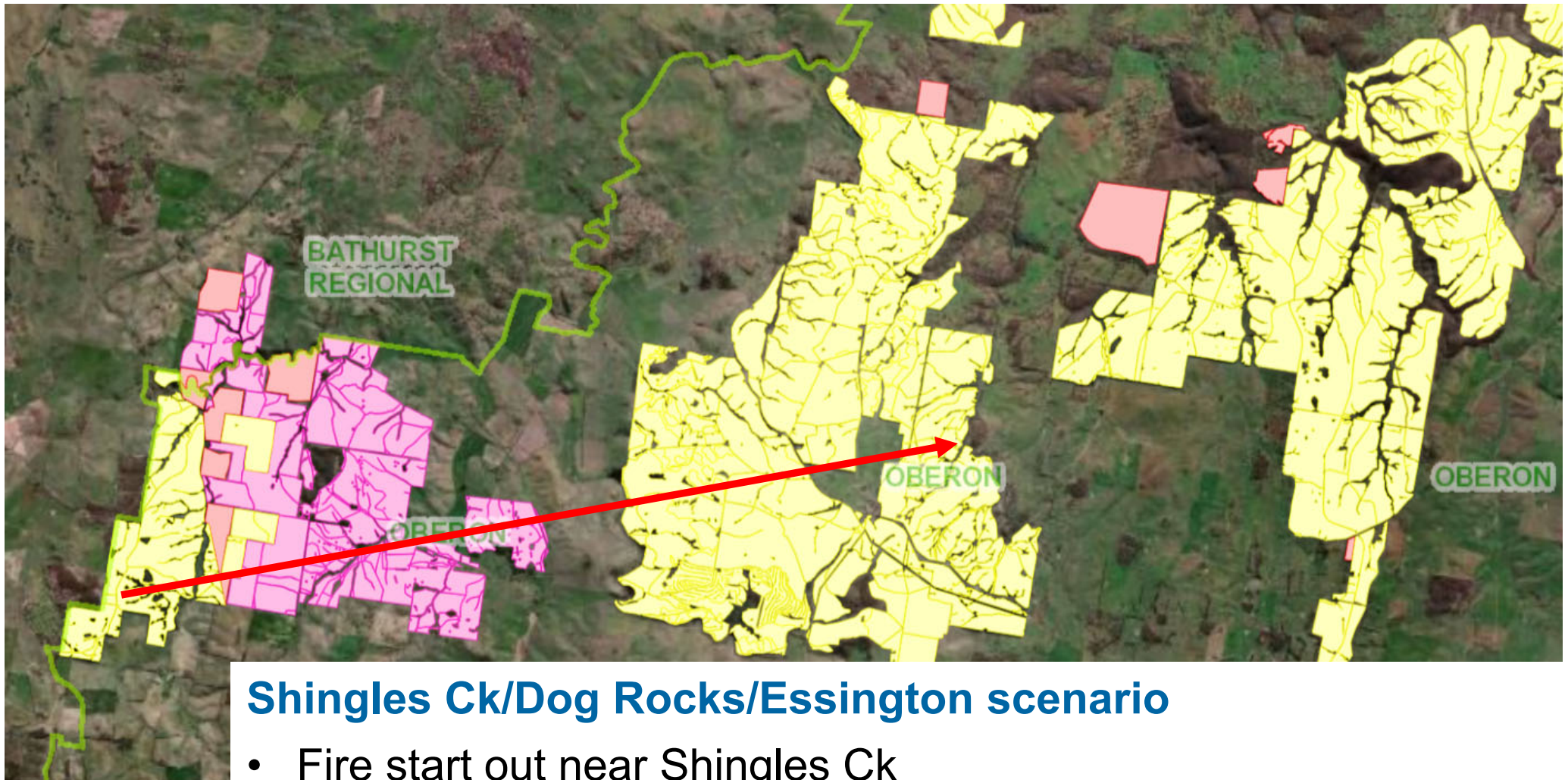
Large plantation fire loss scenarios

Mt David scenario

- Fire start out near Mt Ryan
- Spread east under strong westerly
- About 15 km from western to eastern side
- Overnight easterlies exacerbate losses



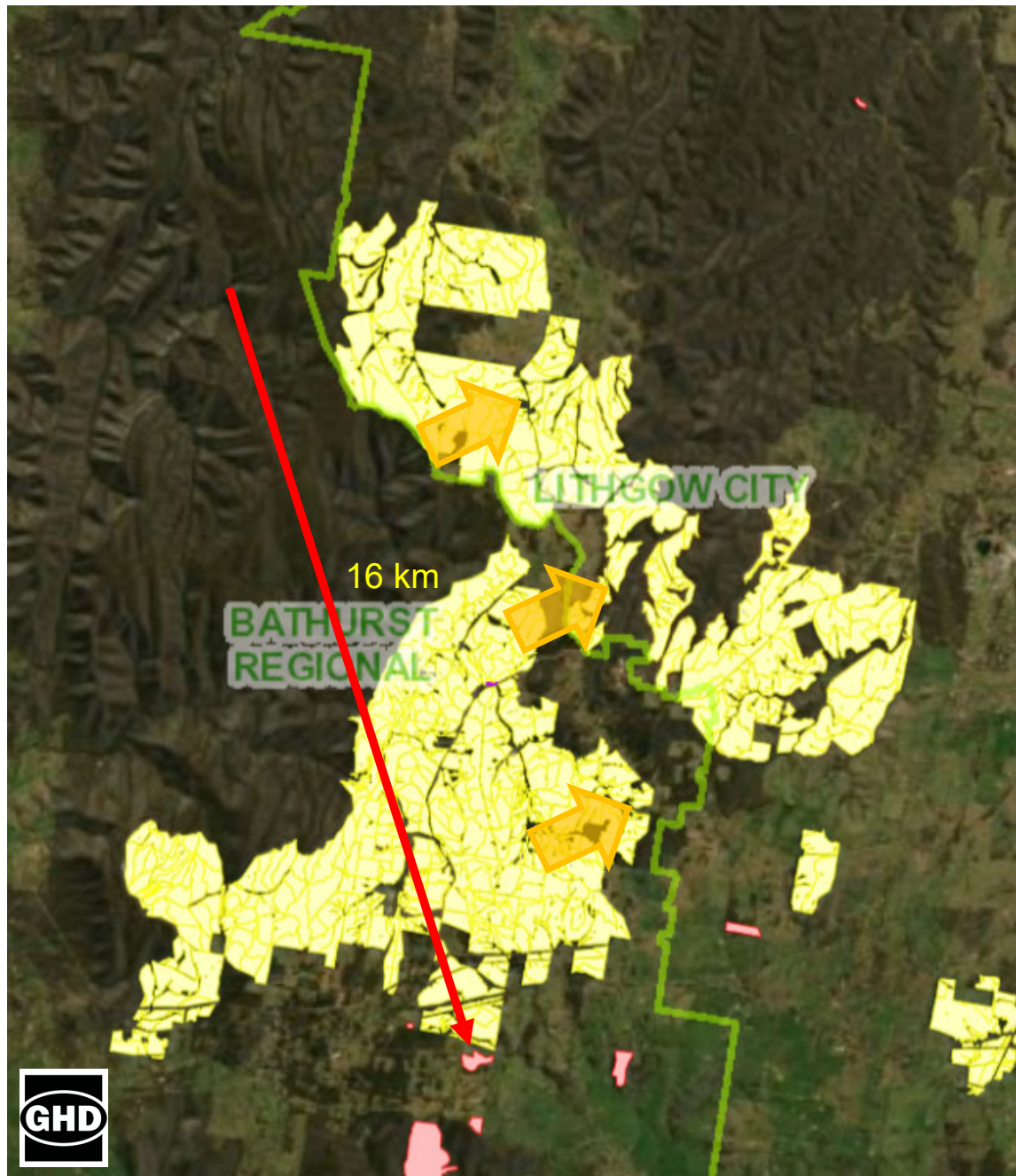
Large plantation fire loss scenarios



Shingles Ck/Dog Rocks/Essington scenario

- Fire start out near Shingles Ck
- Spread ENE under strong WSW'ly (short-range spotting across Burraga Rd/Campbell's R. then uphill into Dog Rocks)
- About 13 km from western to eastern side

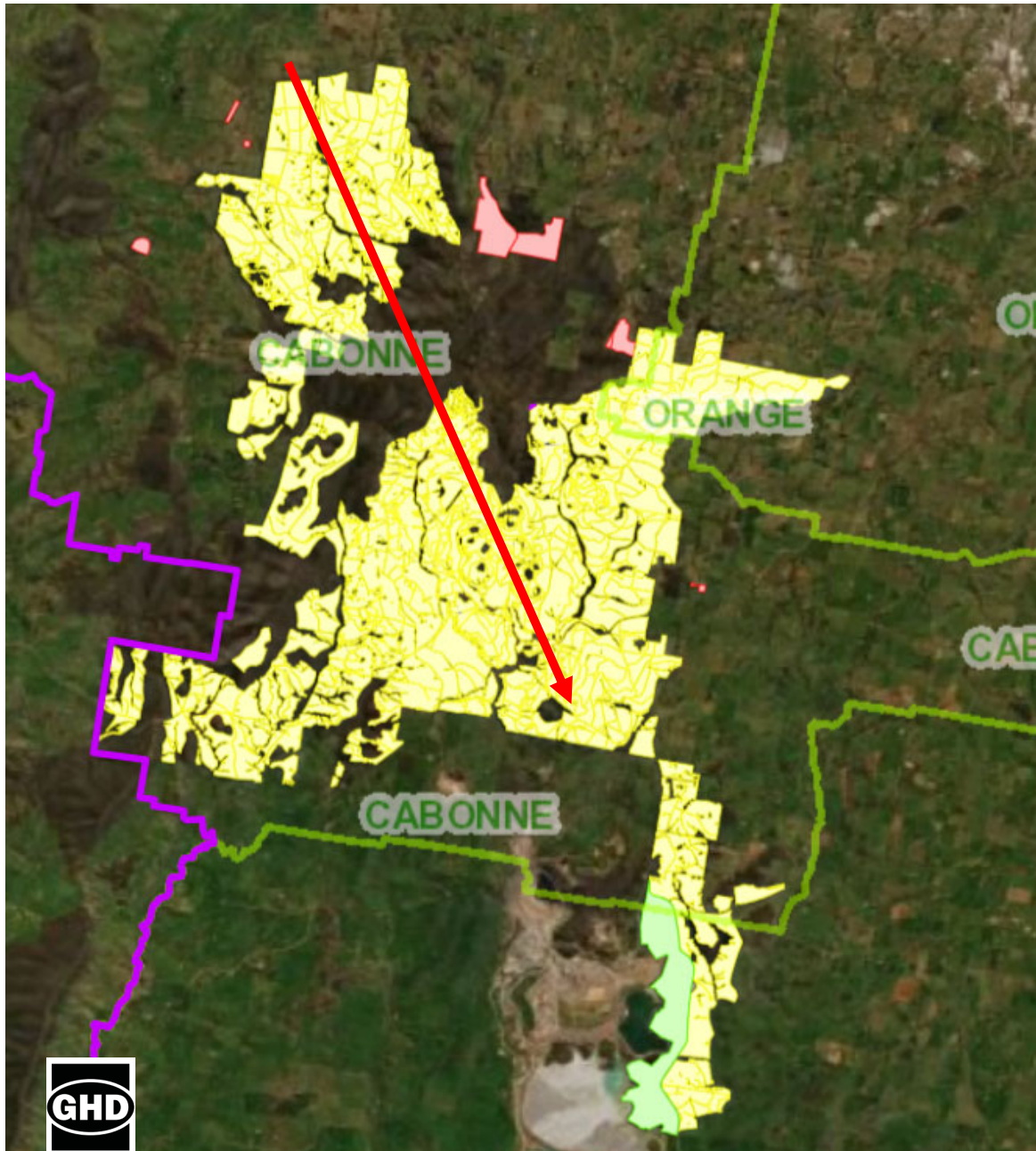
Large plantation fire loss scenarios



Sunny Corner scenario

- Fire starts in rugged country in Winburndale NR
- Large developed fire spots over Lagoon Ck
- Spread SSE through Sunny Corner plantation under strong NNW'ly
- SW change sends eastern flank through Sunny Corner plantation

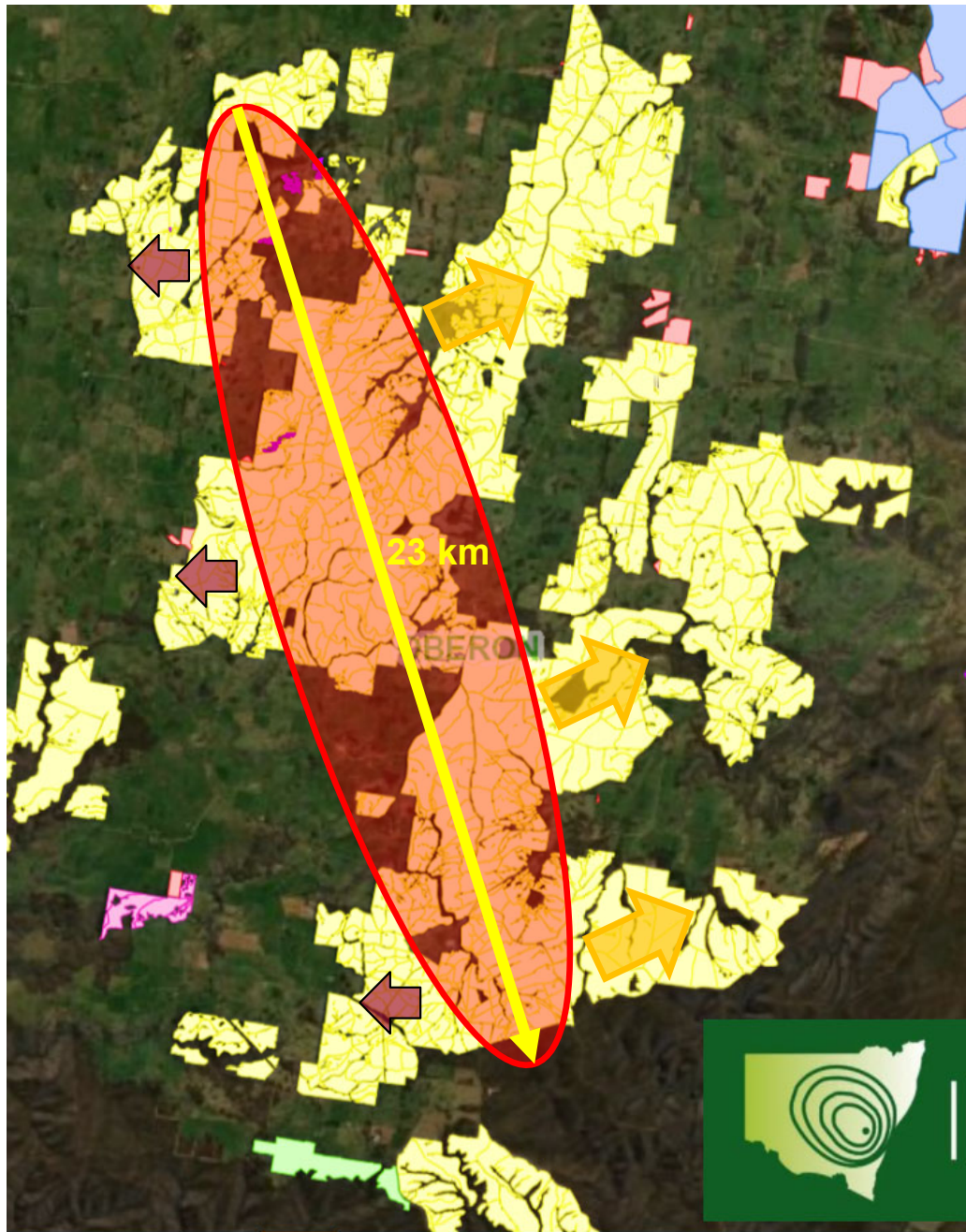
Large plantation fire loss scenarios



Glenwood/Canobolas scenario

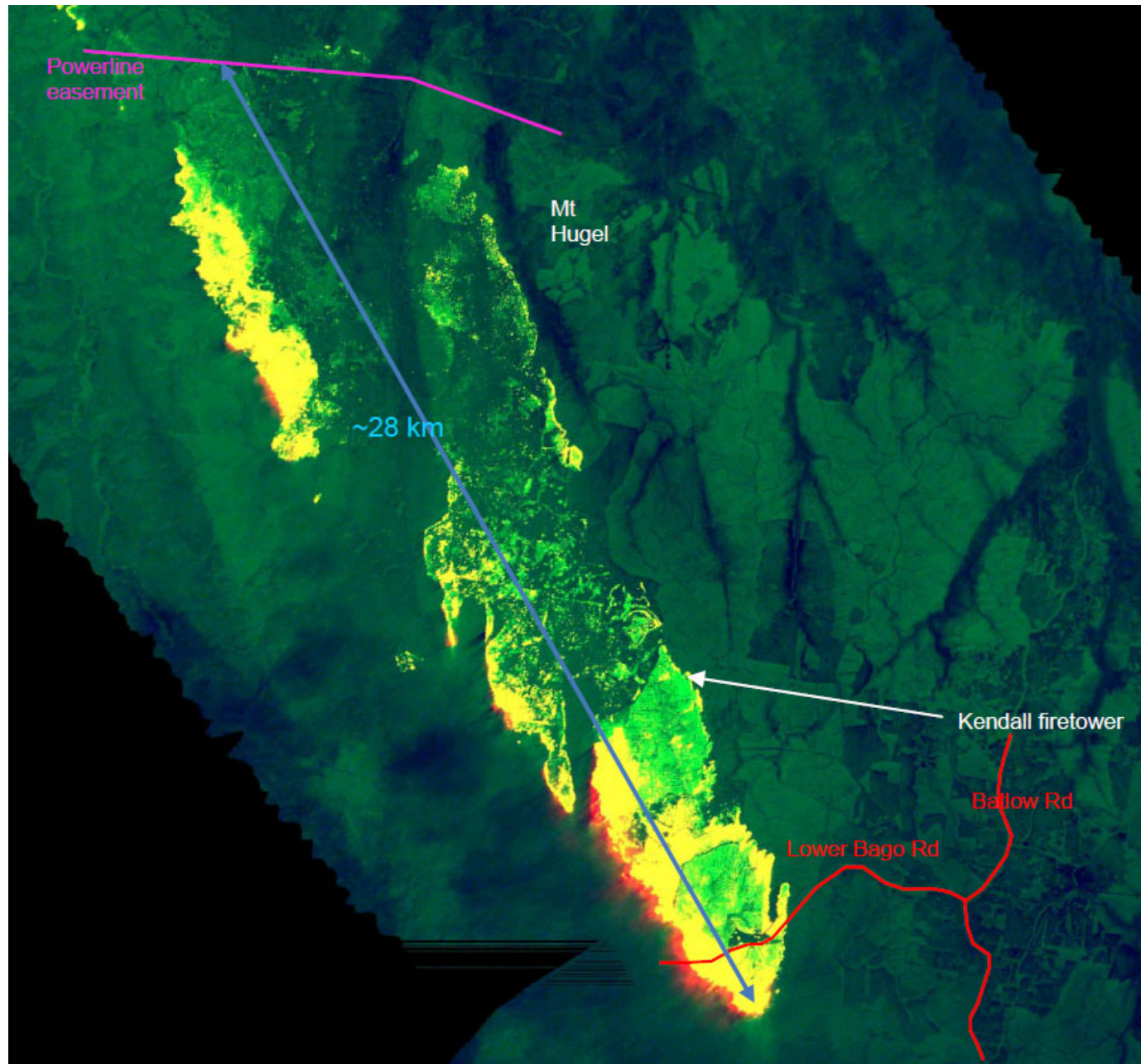
- Fire starts out near Cargo Rd and runs up NW aspect through Glenwood plantation fanned by strong NW winds
- Runs to the top of Mt Canobolas – convection column collapses creating mass spot fires across to the southern slopes and into Canobolas plantation

Worst-case plantation fire loss scenario



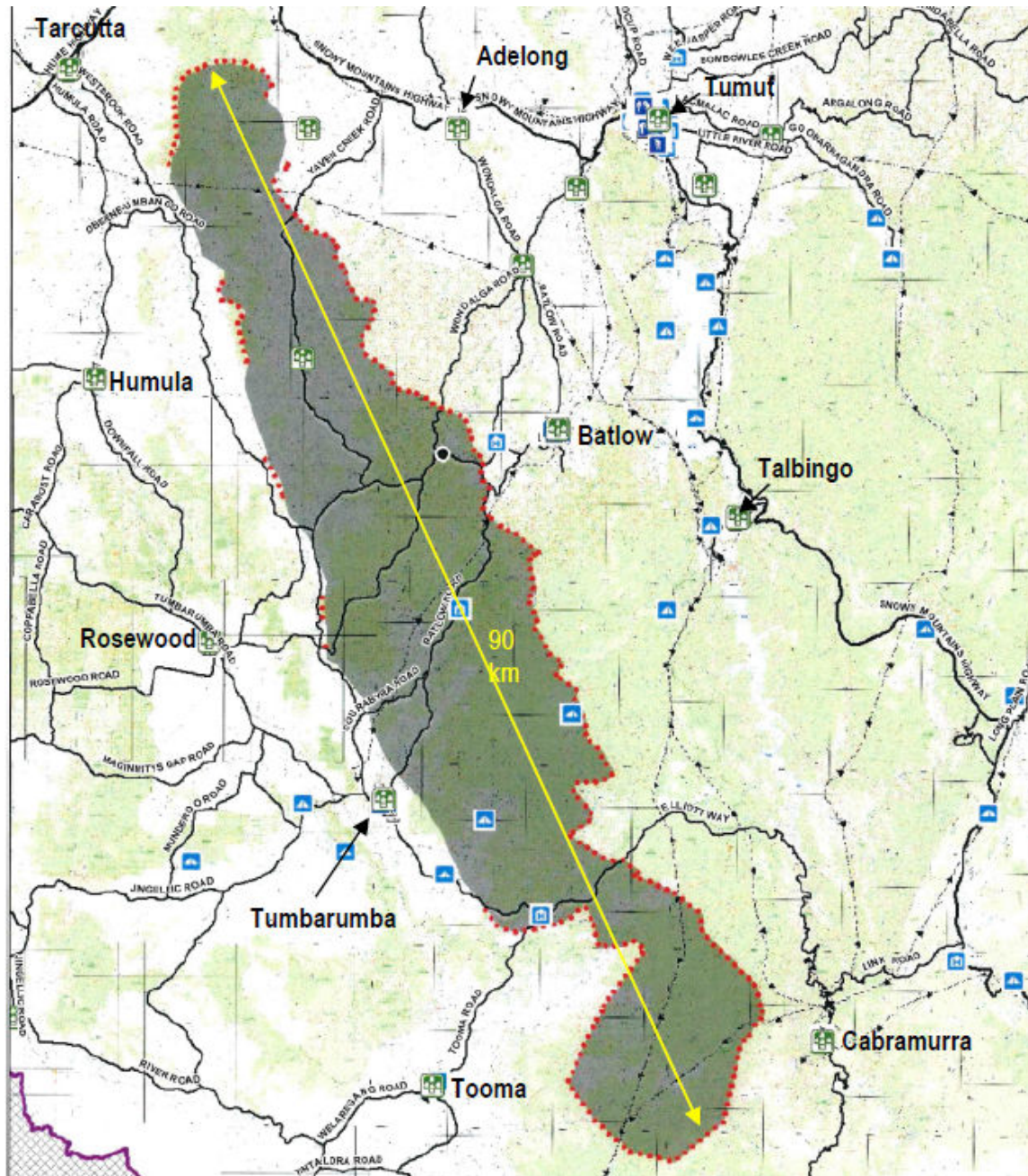
- Fire start near Black Springs
- Long (~23km) uncontrollable run under Severe+ NNW'ly
- Vigorous W or SW change
- Overnight E'ly putting pressure on W flank
- Could only happen in drought, with Severe + FDI, with 7+ hours SSE run time
- Unlikely but possible

Worst-case comparison to Dunns Rd Fire



- Dunn's Rd fire run from break-out at around 14:00 until RFS linescan at 00:55 (11 hour run)
- Rate of spread in pine ~ 3 km/h at night

Worst-case comparison to Dunns Rd Fire



- Dunn's Rd fire run continued through the night under Severe FDI
- SSE run length over about a 24 hr period was ~ 70+ km
- Very bad combination of drought, sustained Severe FDI including overnight, Yaven Ck Valley flume fire path, and increasing elevation on E flank.
- Enormous flanks at whim of weather – 4 days later Catastrophic FDI (hot westerlies)

First Discussion Point

Plantation estate distribution across CWFH and high industry impact fire potential:

- Concerns?
- Thoughts?
- Others?
- [Note: We will be summarising key info from CWFH historical plantation loss events next]

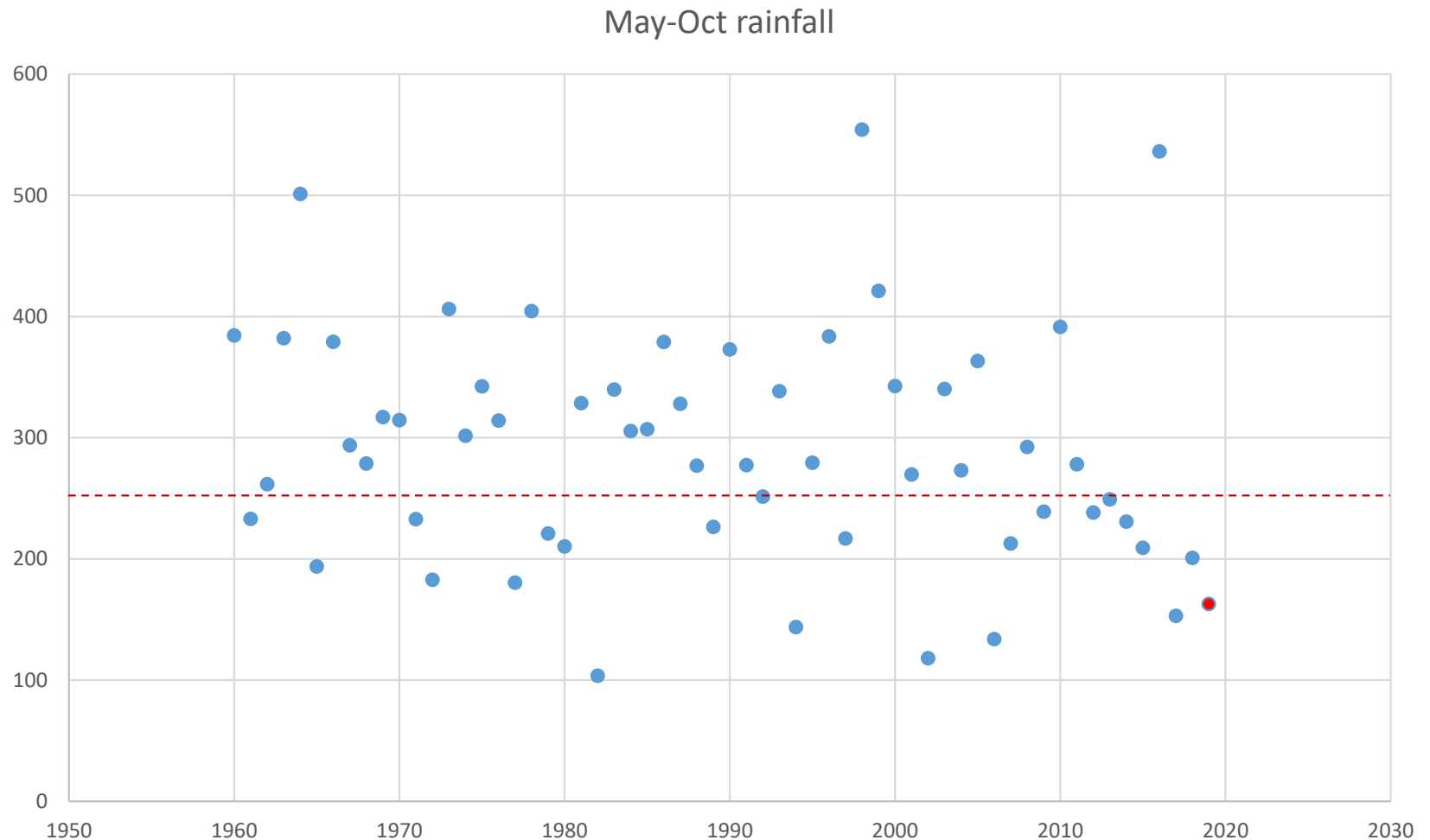
Will a high consequence fire happen?

A large-scale plantation loss fire can happen IF:

- Severe drought conditions create low fuel moisture across plantation areas (including at high elevations and sheltered aspects); AND
- Fire starts in the wrong place, where it can initially spread rapidly, and from where it has a long fire path through extensive areas of plantation; AND
- Fire starts under, or in advance of, adverse fire weather; AND
- Fire is either not detected, or not able to be controlled, before it reaches uncontrollable proportions.

Plantation drought – how often?

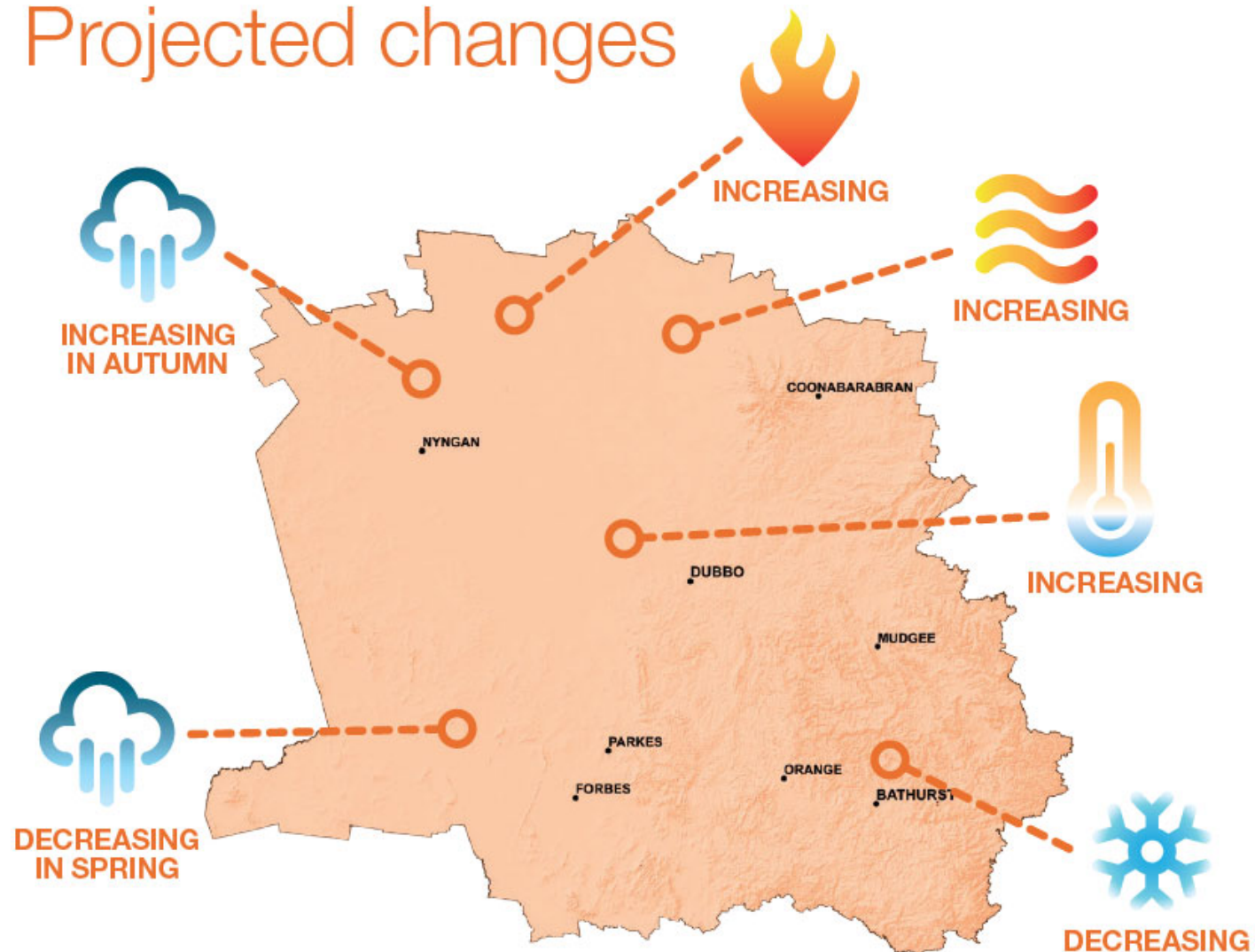
Bathurst Rainfall May - October:



Plantation drought – how often?

Future climate change projection:

Projected changes



Plantation drought – how often?

Projected change in Severe FFDI day occurrence:

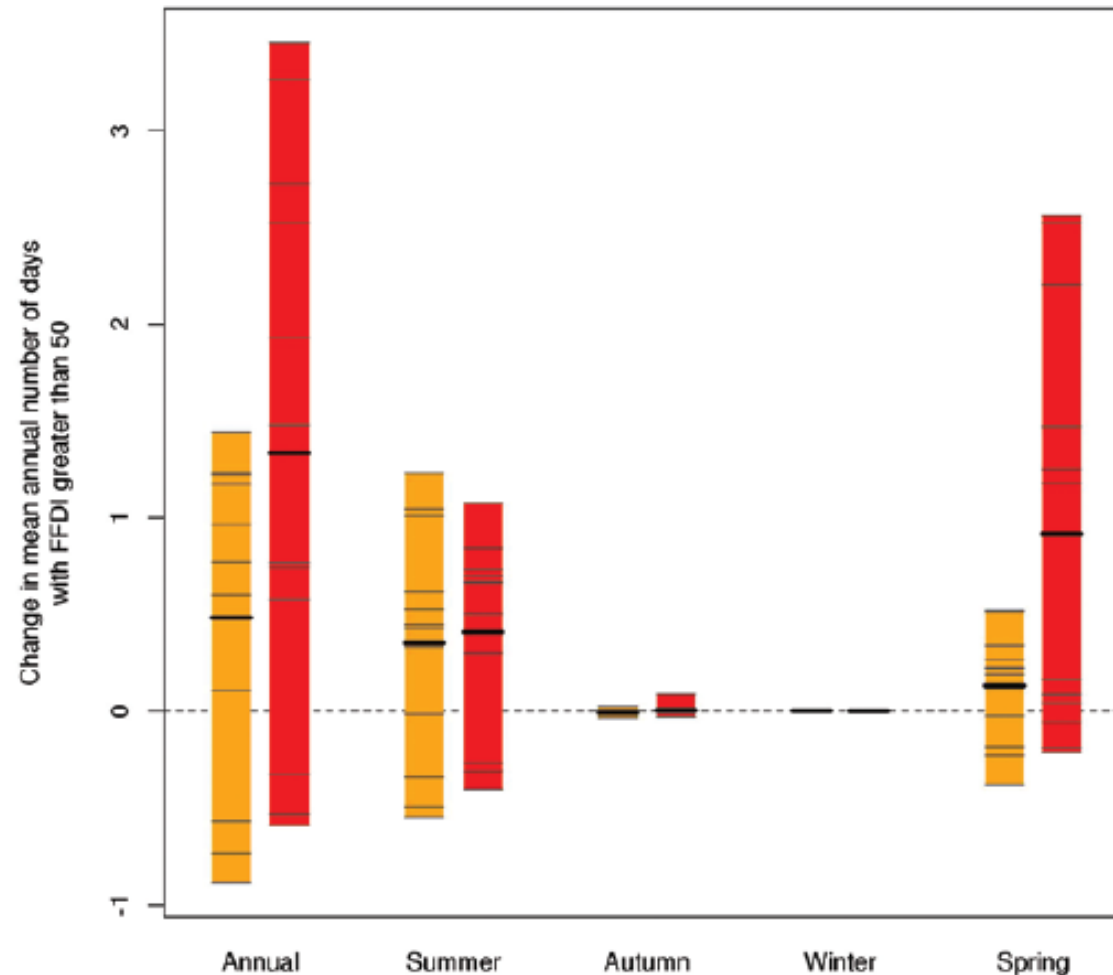


Figure 17: Projected changes in average annual number of days with a forest fire danger index (FFDI) greater than 50 for the Central West and Orana Region, annually and by season (2030 yellow; 2070 red).

NW Wind Severe FFDI day occurrence

Date/Time	Relative Humidity (%)	Temp (Deg C)	Wind Speed (km/h)	FFDI	Wind Direction (Degrees)
21/11/2019 11:00	14	29.9	11	27	337.5
21/11/2019 12:00	12	32.4	15	35	315
21/11/2019 13:00	8	34.4	15	43	337.5
21/11/2019 14:00	8	35.2	13	42	315
21/11/2019 15:00	7	35.5	22	54	360
21/11/2019 16:00	7	35.6	19	51	337.5
21/11/2019 17:00	7	34.9	22	53	337.5
21/11/2019 18:00	8	33.8	20	47	337.5
21/11/2019 19:00	9	31.6	19	41	360
21/11/2019 20:00	17	26.3	9	21	360
21/11/2019 21:00	21	24.8	13	19	360

Date/Time	Relative Humidity (%)	Temp (Deg C)	Wind Speed (km/h)	FFDI	Wind Direction (Degrees)
4/01/2020 9:00	30	32.1	28	25	360
4/01/2020 10:00	23	34.7	31	37	337.5
4/01/2020 11:00	20	36.1	28	40	337.5
4/01/2020 12:00	16	37.6	39	63	292.5
4/01/2020 13:00	15	38.7	35	62	315
4/01/2020 14:00	14	39.7	35	66	315
4/01/2020 15:00	13	40.3	28	59	292.5
4/01/2020 16:00	12	40.1	30	64	292.5
4/01/2020 17:00	13	40.1	20	49	292.5
4/01/2020 18:00	13	39.3	26	55	337.5
4/01/2020 19:00	13	37.8	19	44	337.5
4/01/2020 20:00	16	35.3	19	37	337.5
4/01/2020 21:00	20	31.2	11	23	360

Date/Time	Relative Humidity (%)	Temp (Deg C)	Wind Speed (km/h)	FFDI	Wind Direction (Degrees)
31/12/2019 10:00	13	32.3	35	53	337.5
31/12/2019 11:00	13	33.5	30	49	337.5
31/12/2019 12:00	12	34.8	35	60	315
31/12/2019 13:00	11	36.1	31	59	337.5
31/12/2019 14:00	10	36.3	28	58	315
31/12/2019 15:00	11	35.3	31	58	292.5
31/12/2019 16:00	11	36.1	30	58	315
31/12/2019 17:00	13	34.8	26	47	292.5
31/12/2019 18:00	14	33.5	22	40	315
31/12/2019 19:00	14	33.2	22	39	337.5
31/12/2019 20:00	16	31.7	15	30	360
31/12/2019 21:00	22	30.8	24	29	225

Date/Time	Relative Humidity (%)	Temp (Deg C)	Wind Speed (km/h)	FFDI	Wind Direction (Degrees)
21/12/2019 11:00	25	33.1	19	25	360
21/12/2019 12:00	13	38	30	58	292.5
21/12/2019 13:00	11	39	28	61	292.5
21/12/2019 14:00	10	40.4	33	74	270
21/12/2019 15:00	10	39.6	31	69	292.5
21/12/2019 16:00	8	40	28	70	292.5
21/12/2019 17:00	8	39.4	28	68	270
21/12/2019 18:00	9	38	24	57	270
21/12/2019 19:00	9	37.4	24	56	225
21/12/2019 20:00	18	35.1	33	47	225
21/12/2019 21:00	21	33	11	24	180

Bigger Longer NSW Picture

Last century (1900 -1999) the forested regions of NSW experienced 4 fire seasons with > 1,000,000 ha burnt: (does not include big western grassfire seasons)

- 1926/27 > 2,000,000 ha burnt
- 1957/58 > 2,000,000 ha burnt
- 1968/69 > 2,000,000 ha burnt
- 1979/80 > 1,000,000 ha burnt

In the first 20 years of the current century (2000 - 2020) the forested regions of NSW have already experienced 3 fire seasons with > 1,000,000 ha burnt:

- 2002/03 ~ 1,500,000 ha burnt
- 2012/13 ~ 1,400,000 ha burnt
- 2019/20 ~ 5,520,000 ha burnt

Significant CW plantation fires

Glenwood Fire 3 to 5 DEC 1982:

- Drought conditions
- Ignition by lightning early afternoon/lunchtime
- Not a particularly bad day – local FDI around 20 with westerly winds - Initial attack failed
- Head fire burnt mostly through 10 – 15 yo compts, steep topography with difficult trails (reached Canobolas summit)
- Contained with assistance of downslope topography and 20+ age class compartments
- Fire burnt 2,500ha – incl 971 FC pine & 320 ha priv pine

Significant CW plantation fires

Canobolas Fire 28 JAN1985:

- Heavy grass after wet winter then very dry spring/summer
- Ignition by farm electrical fault – started ~ 5km SW of plantations near Cannondale Creek
- After spreading through farmland and timbered ridges, a SW change sent the fire on a 9km run into the plantation
- 3 day firefight – RFS protecting homes; small fixed wing A/C used but not effective in pine
- Fire contained with assistance of downslope topography and older age classes
- Fire burnt 9,610ha – incl 2,439 FC pine

Significant CW plantation fires

Mt David Fire 19 DEC 2006:

- Severe drought season
- Accidental ignition by pruning contractor in eastern end of Mt David plantation (1km from eastern boundary)
- Initial spread east as a crown fire in unthinned unpruned 15+ plantation – no prospect of control
- At ~3PM easterly wind change sent fire west back into plantation, crowning through unthinned unpruned age classes
- Contained overnight in older age classes in easing conditions in private pine
- Fire burnt 857ha – incl 721 ha of pine (FC & Great Sthn)

Significant CW plantation fires

Dog Rocks 2 Fire 18-20 JAN 2014:

- Drought season
- Lightning ignition as part of a multi plantation ignition event
- Initial spread during 19 JAN up steep slopes east and north in plantation then PM easterlies spread fire west to Campbells River
- Initial containment overnight with dozers and tankers
- Early on 20 JAN westerly wind caused breach of eastern containment line – aircraft, dozers and ground crews brought fire under control by 21 JAN
- Other plantation fires burning concurrently (incl Redbank)
- Fire burnt ~400 ha pine over 2 days (PM FDI High reaching VH)

Significant CW plantation fires

Redbank Fire 18-21 JAN 2014:

- Drought season
- Lightning ignition - one of a multi plantation ignition event
- RFS units responding – fire burning through the night but mildly (Limited FC as attending multiple other fires)
- Fire escalated in plantation on 19 JAN PF - Olsen slip-ons (2) and dozer attending with some RFS
- 19/20 JAN joint PF Olsens/FC/RFS backburn in pine to contain + further work to contain western perimeter
- Fire burnt ~350? ha of pine (PM FDIs High reaching VH)

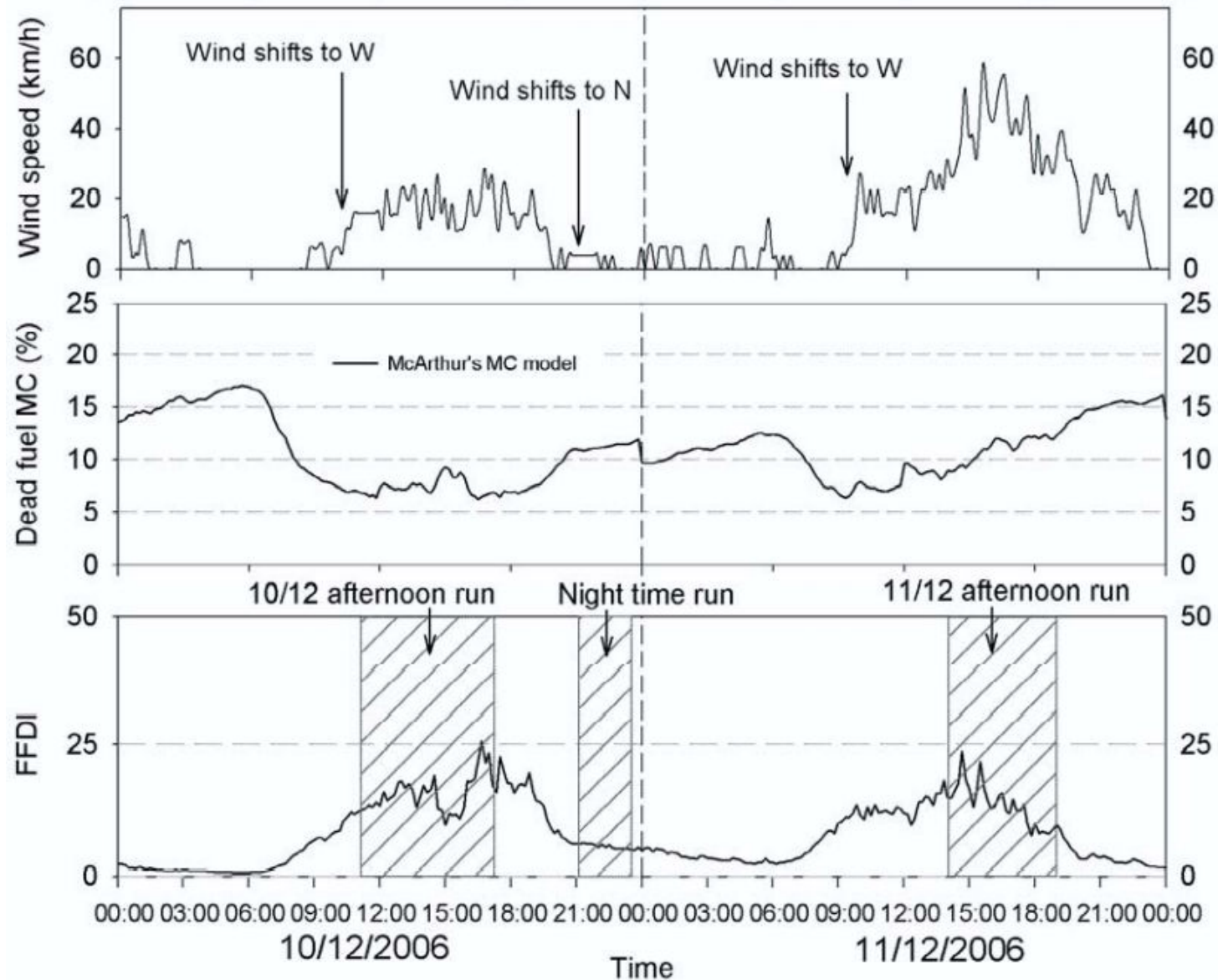
Significant NSW plantation fires

Billo Road Fire 9-14 DEC 2006:

- Severe Drought season
- Night-time car arson ignition (overnight 9/10DEC)
- Not detected until around 9AM – IA commenced 9:20
- Already about 6 ha burning in 10 & 14 yo pine with thick blackberries – head began torching and spotting and took off by 11AM
- Afternoon 10 DEC fire ran ~ 7km E thru various A/C (peak FDI 26 @ 4:40PM), then around 4 km S during the evening in light northerlies
- 11 DEC fire made a 9km run ENE from NE corner (WSW winds exceeding 40 km/h during afternoon)
- Further spread S and W on ensuing days until contained
- Fire burnt ~9,526 ha of pine (PM FDI reaching upper end of High)

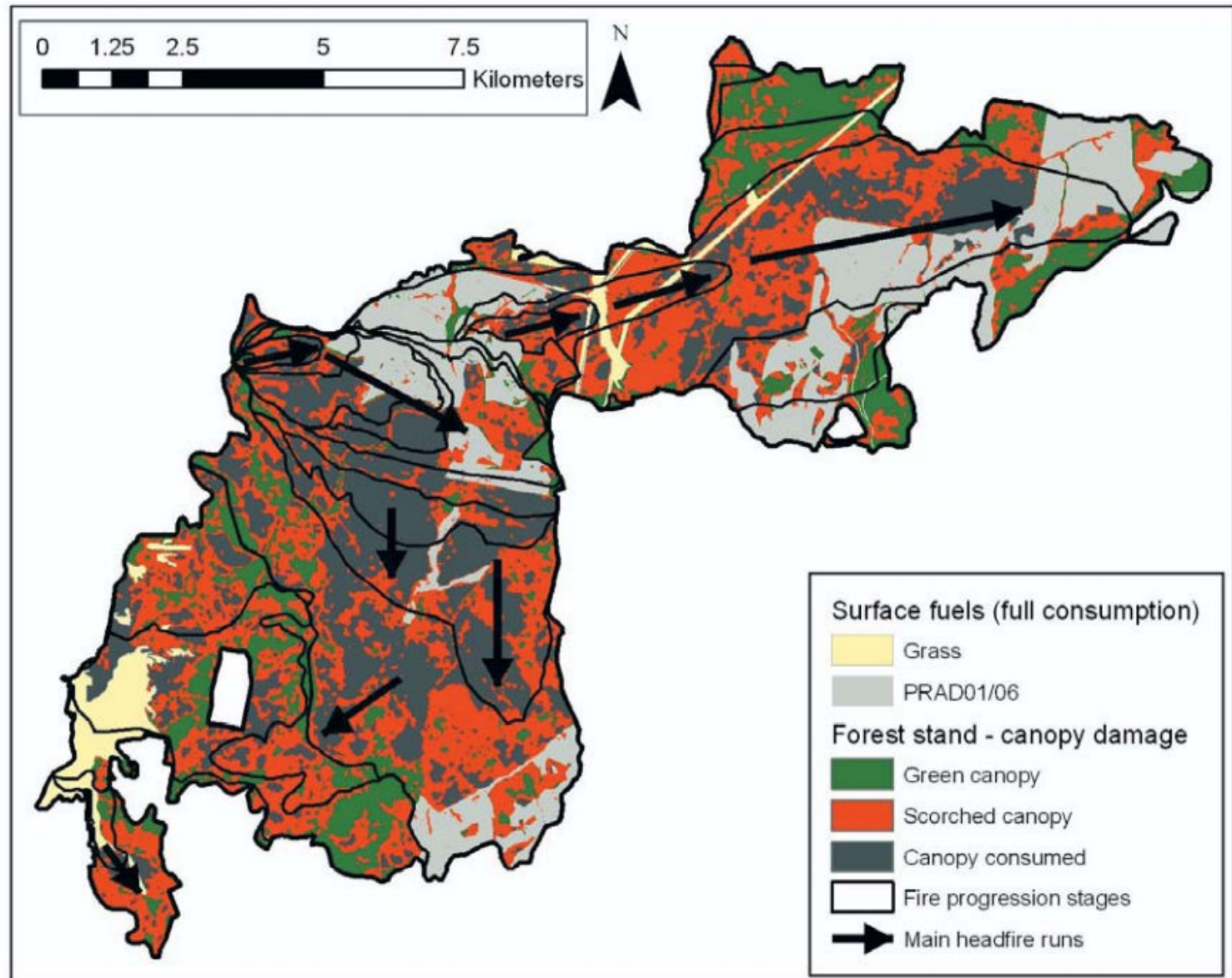
Significant NSW plantation fires

Billo Road Fire 9-14 DEC 2006:



Significant NSW plantation fires

Billo Road Fire 9-14 DEC 2006:



Other major fires?

- Canberra fires (2003) ~ 10,500 ha plantation – large fires burning out of the Brindabellas
- Bombala fires (1983 - 6, 500ha); (2019/20 >10,000 ha) big fire coming north from VIC
- Ash Wednesday (1983 ~21,000 ha in SA) – multiple uncontrollable fires burning into and through plantations
- VIC – significant plantation losses in 1983; 2002/03; 2009; 2019/20
- Other large pine plantation fire events in Northern NSW; QLD; WA; and TAS.

Plantation fire loss potential for CW?

Not our role to model maximum probable loss – leave that to the actuaries, however:

- Worst-to-date is ~ 2,500ha – Canobolas 1985
- A couple of events around the 1,000 ha mark
- Numerous events in the few 100 ha range
- It would be prudent to assume that a 5,000 ha event, or even a 10,000+ ha event could happen, but we need to do everything reasonably practicable to prevent such events.
- Keep in mind Tumut/Tumbarumba had very small scale losses up to 2006 – then Billo Rd (2006); Minnimbah (2014); Dunns Rd and Green Valley (2019/20)
- The key task is to consider the best collaborative approach to minimizing potential for large loss event fires to occur.

Second Discussion Point

Historical high-industry impact plantation loss fires:

- Concerns?
- Thoughts?
- Errors?
- [Note: We will be summarising key themes/learnings from CWFH historical plantation (and other plantation fire loss events next]

Themes from past fire events

1. Early detection is vital, especially during drought
 - Billo Rd and Dunns Rd fires both not found until the next day, by which time they were off and running
 - Fires that burn overnight undetected get a headstart – night detection capability would be a big advantage
 - Post-lightning patrol urgency during drought & reduced viz
2. Early, rapid, multi-mode attack (aerial, and ground with both tankers & bulldozers) to minimise fire growth and intensification is vital (prevent fires getting to multi-compartment size)
 - Most difficult in pre-first thinning age classes
 - Blackberry infestations also constrain direct attack (small dozer can be very handy for access in blackberry areas)
 - More rapid escalation on west and wind-exposed aspects
 - Multi-ignition events may require increased aerial resources
 - Response resource dispersal is a consideration

Themes from past fire events

3. Aggressive, direct and close parallel attack methods incorporating machinery are key to IA success
 - Local, within-plantation knowledge is very important for IA
 - Any backburning/burning-out necessitates rapid and substantial resourcing escalation
 - Overnight firefighting capability/skill is critical
4. Reliance on out-of-area resources has limitations
 - Often not realistic until next day, or more commonly second night (by which time it is a significant multi-shift event (not IA))
 - Typically lack local knowledge
 - More often used for assisting pre-planned defence of plantation (defensive backburns) from external fire threats
 - Out-of-area crews must have experienced plantation FF leaders

Themes from past fire events

5. Avoid low success-probability options

- Can be very difficult to contain fires running in unpruned pre-first thinning age-classes (highly prone to crowning, and line construction with dozers can be impractical involving excessive pushed over fuels) – better to attempt containment from thinned mature late rotation areas, or open recently harvested/planted areas, or open grass country/breaks.
- Topography dictates tactics – very difficult to contain sections where fire is burning uphill
- Timing – particularly important for backburns

6. Resourcing

- Resource-intensive strategies need sustained commitment to maintaining resourcing levels needed for implementation
- Overnight containment line security is important
- Large dozers can be gold but take time to mobilise to the fire – better to deploy early on just-in-case basis

Themes from past fire events

7. For fires that get big – strategic resourcing of IMT is vital
 - Ensure strategy/tactics and resourcing to minimise plantation losses.
 - IMT needs senior plantation industry representation to maximise influence in strategy development
 - IMT needs sustained access to highly-regarded plantation fire operations tactician to improve prospects of plantation defence strategy adoption
 - Timely and accurate Intel into IMT is vital
 - Important for field Divcomms to maintain regular comms with IMT to give confidence that strategies are working and still viable
8. Sometimes you get unlucky, and no matter what you do you are going to lose large areas of plantation – e.g. uncontrollable fires entering plantation from outside; fires starting on really bad days; fires that get going on adverse aspects getting beyond IA

Royal Commission/NSW Inquiry findings

Despite unprecedented plantation losses in 2019/20, not much in RC findings for CWFH and forest industry generally.

- RC was into 'Natural Disaster Arrangements' therefore not so much focussed on 'prevention' of events getting to 'disaster' scale, but arrangements for managing disaster-scale events
- Just one noteworthy inclusion of direct relevance to plantations (see next slide)

Royal Commission/NSW Inquiry findings

- 6.73 Fire and emergency services should ensure they utilise private emergency responders effectively and safely to respond to natural disasters. For example, in SA, Victoria and Queensland, private plantation firefighters may form ‘industry brigades’, which are identified as Country Fire Service (CFS), CFA or rural fire brigades respectively, and operate under that structure with the associated liability protections.¹⁰⁸ NSW does not have ‘industry brigades’, but Forestry Corporation NSW contracts private firefighters to supplement resources during the fire season. We heard that the approach in NSW leaves private firefighters without the necessary liability protections to effectively and safely assist in a response.¹⁰⁹
- 6.74 Fire and emergency services should ensure that private firefighters they directly engage or contract in a response have the same protections as paid and volunteer emergency responders.

¹⁰⁸ Mr Saunder, Forest Owners’ Conference, Transcript, 1535; CLQ.001.001.0622; SSA.632.001.0046.

¹⁰⁹ Mr Lazarus, Hume Forests Limited, Transcript, 1543–44.

NSW Inquiry findings

Despite unprecedented plantation losses in 2019/20, not much in NSW Inquiry findings/recommendations (76) for CWFH and forest industry generally.

Recommendation 4

That, in order to improve capability to detect ignitions and monitor accurately all fire edge intensity and progression automatically across the State in near real time, Government establish a spatial technology acceleration program to maximise the information available from the various remote sensing technologies currently in use and to plan for inclusion of new remote sensing systems that can sense precisely and rapidly through heavy smoke, cloud, fog and dust. This will require work within the State and with partners nationally and internationally.

Recommendation 46

That, in order to improve early fire suppression, the NSW RFS trial initial aerial dispatch in areas of high bush fire risk. The trial should identify the most appropriate and cost-effective mix of aircraft, and any associated infrastructure improvements that would be required.

Recommendation 49

That, in order to maximise the efficiency and effectiveness of heavy plant used in dry fire fighting techniques, the NSW RFS expand and introduce the following in respect to heavy plant:

- a) increase the number of trained Heavy Plant Supervisors and Managers to ensure an appropriate level of supervision in future significant fire seasons

Open discussion forum

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? Questions ?

Appendix 2 Plantation Fire Capability and Issues Forum 2 Powerpoint



Central West Forestry Hub

Firefighting Capability Project:
Forum 2 - Capability



Paul de Mar, Mick George

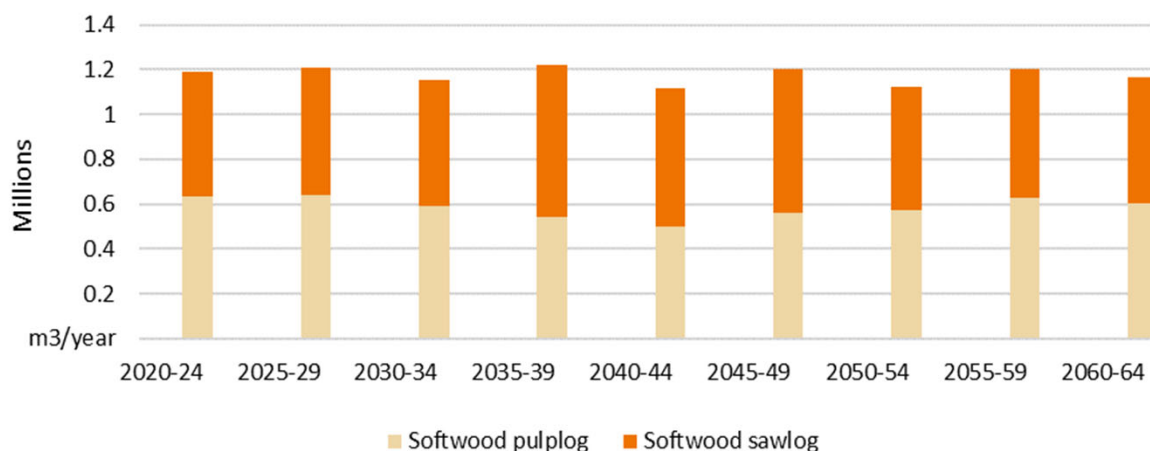
CW Plantation Fire Protection Capability

In this forum we will cover:

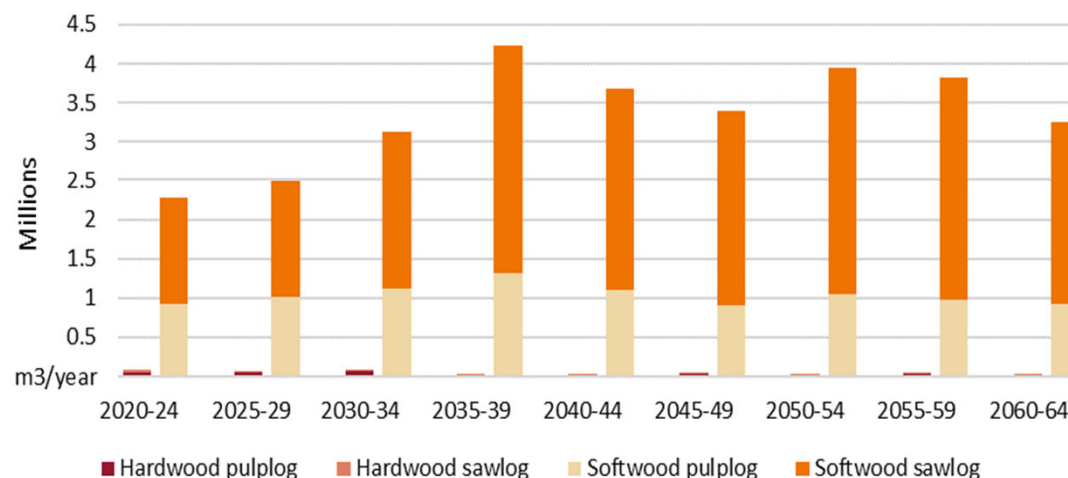
- Potential consequences of a large fire event
- Results of CWFH fire protection capability survey
- Fire protection system necessities and opportunities
- Capability limitations
- Collaborative organization
- Forest Industry Brigades – pros and cons

CW Plantation Fire Protection Capability

Potential consequences of a large fire event:

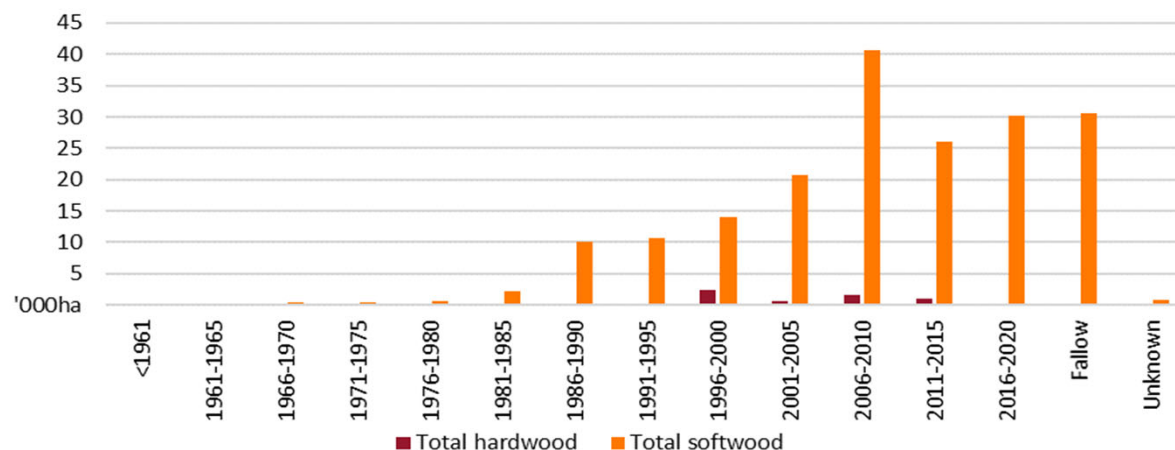


Murray Valley (36% of plantations damaged in fires)
- log availability forecast to decline by around a third 2020 - 2029 and recovering from 2035 (ABARES 2021)
- Decade of impact as a result of fires

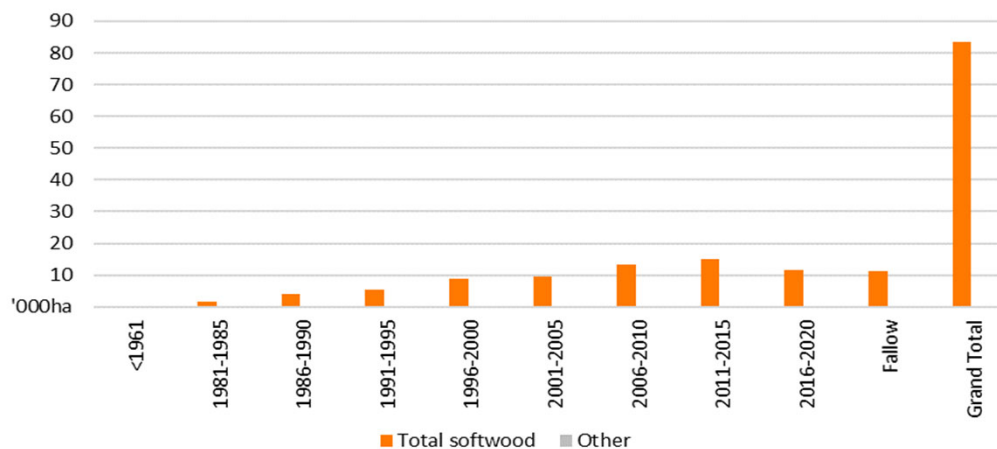


CW Plantation Fire Protection Capability

Potential consequences of a large fire event:



Central Tablelands age class by five-year period, showing significant replanting events in recent years, with a large fallow area still awaiting replanting (ABARES 2021)



CW Plantation Fire Protection Capability

Potential consequences of a large fire event:

Central Tablelands plantation average annual log availability by harvest period (ABARES 2021)

Planting period	2020-2024	2025-2029	2030-2034	2035-2039	2040-2044	2045-2049	2050-2054	2055-2059	2060-2064
Softwood	'000m ³ /year								
Softwood pulplog	633	643	591	545	502	557	571	625	604
Softwood sawlog	557	566	564	678	617	646	550	577	563

Murray Valley plantation average annual log availability by harvest period (ABARES 2021)

Planting period	2020-2024	2025-2029	2030-2034	2035-2039	2040-2044	2045-2049	2050-2054	2055-2059	2060-2064
Softwood pulplog	918	1 006	1 118	1 307	1 108	909	1 045	974	919
Softwood sawlog	1 355	1 481	2 008	2 927	2 572	2 481	2 894	2 840	2 339

CW Plantation Fire Protection Capability

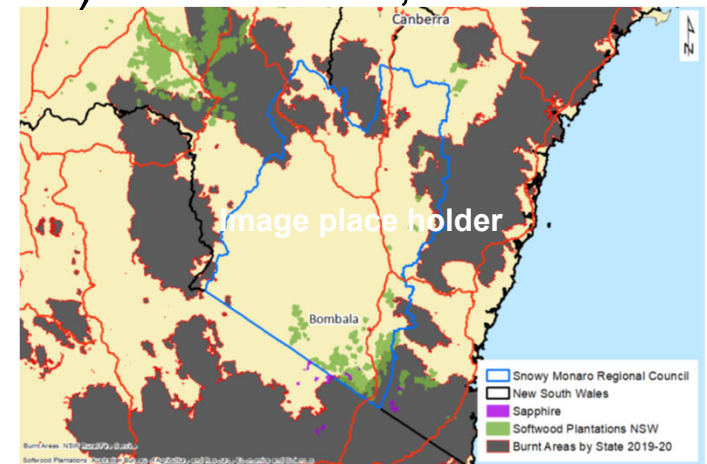
Potential consequences of a large fire event:

- The extent to which fire-affected trees can be harvested depends on the severity of the fires and the types of logs harvested
- Smaller window for the recovery of fire-affected pine trees (12 to 18 months) before deterioration and pest incursions render the timber uncommercial
- Softwood sawlogs less than 25 years old are generally not large enough for domestic sawmills (Oberon, Bathurst, Burruga)
- Supply of pulplogs exceed that which can be processed domestically in the short term (packaging, industrial paper and paperboard products that can have small charcoal content)
- Printing and writing paper uses - pulplogs generally cannot have any degree of fire damage
- Reliance on export markets dependant on ability of domestic processors to respond to peaks (salvage) and troughs (10 -20 year impacts) in resource availability

CW Plantation Fire Protection Capability

Potential consequences of a large fire event: Bombala experience

- Approx 10,000 ha impacted
- Replacement cost ~ \$40 million
- Opportunity cost (future log value) ~ \$100 – 120 million
- Replanting areas – increased from 2,000 ha to 12,000 ha
- Total sawlog supply increases first 5 years due to salvage, then ~ 60% of original wood flows until 2046
 - Post fire shortfall for processing (Dongwha) needs ~320,000 m3/annum 2035 – 2046
- Approx 25 years of impact
- 370 direct jobs, 450 indirect jobs in region



CW Plantation Fire Protection Capability

Results of CWFH fire protection capability survey:

- 4 plantation owners/growers; 1 processor; 1 harvest & haulage; 1 grower/processor/ harvest & haulage
- Area of plantation/cover – 83,783/87,201 ha
- Fire management plans in place for larger growers and harvest & haulage
- Road and Trail maintenance and boundary firebreak maintenance in place for all growers
- Initial firefighting response (ground-based) to reports of fire or smoke for all larger growers
- Forestry Corp undertake fire detection using manned lookout towers or camera systems; web-based applications such as lightning tracking systems or satellite hotspots (PPP also); ground patrols after lightning storms or reports of fire/smoke

CW Plantation Fire Protection Capability

Results of CWFH fire protection capability survey:

Appliances

	Cat 1 (4 crew)	Cat 7 (2 crew)	Cat 9 (2 crew)	Bulk water	Large dozer	Small dozer	Grader
FCNSW	9	2	26	2	6	4	3
Other	1	3	11	1	5	2	0
Total	10	5	37	3	11	6	3

Additional FCNSW resources not listed above

- 1 aerial waterbombing helicopter
- 24 non-firefighting vehicles with RFS capable comms (including 1 fire command vehicle)

CW Plantation Fire Protection Capability

Results of CWFH fire protection capability survey:

Qualified fire fighters

	Number available	CL qualified
FCNSW	81 (3 x 27)	23
Other	21	5
Total	102	28

- On any given day during fire season, only a proportion of the above resources are in the field, equipped and ready for fire response (FCNSW runs a 3 team roster)
- To fully crew all first response appliances available (10 x Cat 1, 5 x cat 7, 37 x Cat 9) would need 124 fire fighters per shift all available and active

CW Plantation Fire Protection Capability

Fire protection system necessities & opportunities:

Widely accepted and proven plantation fire protection practice is that early detection in conjunction with rapid Initial Attack response with sufficient resources to contain fire while small and prevent escalation to large uncontrollable proportions (if fires are not controlled when small they can become uncontrollable within plantation from High + FDI).

Key elements:

- Early detection
- Fast initial attack
- Back-up for consolidation and/or extended attack or external threat defence
- Multi-responder inter-operability

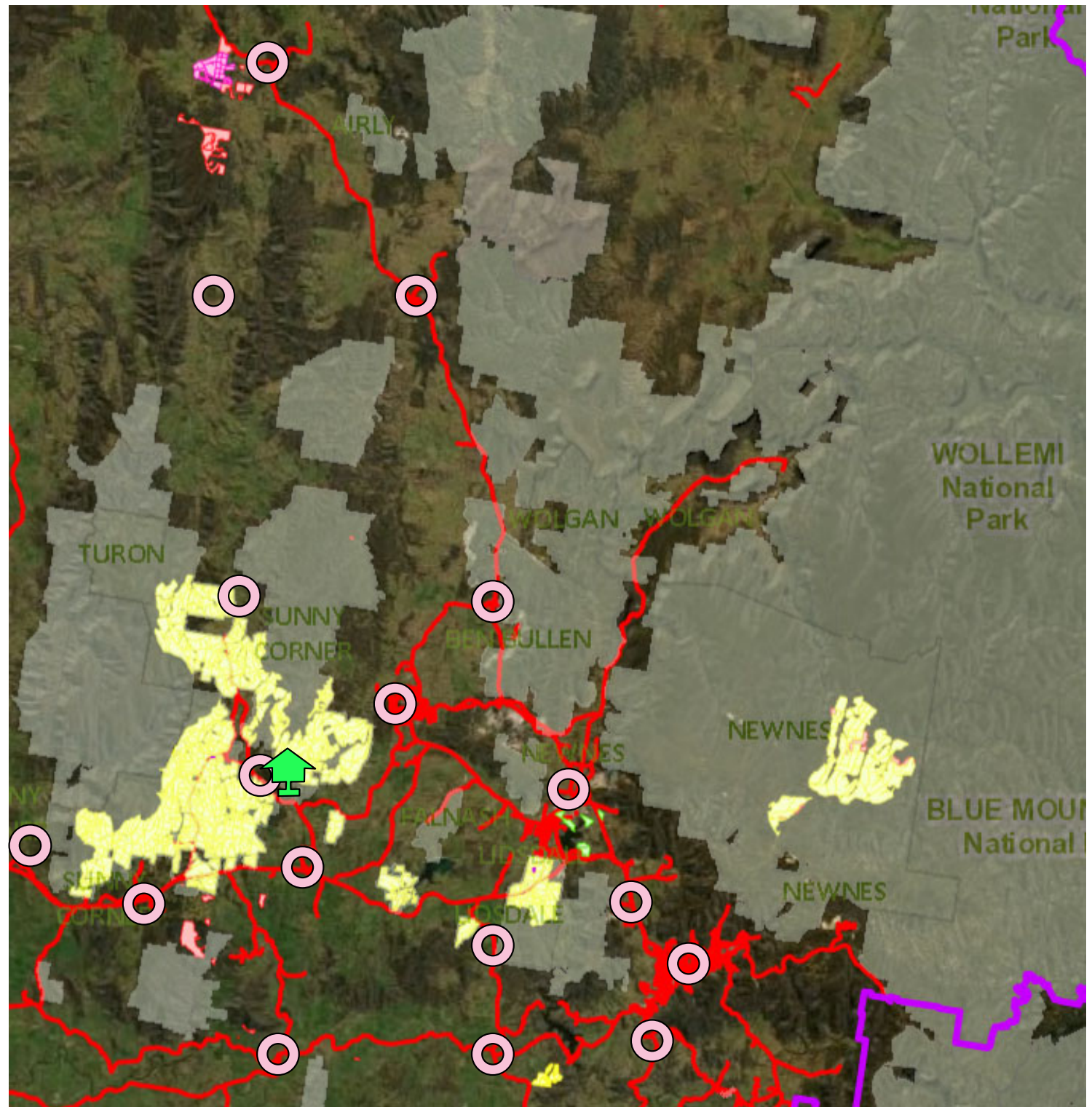
CW Plantation Fire Protection Capability

Fire protection system necessities & opportunities:

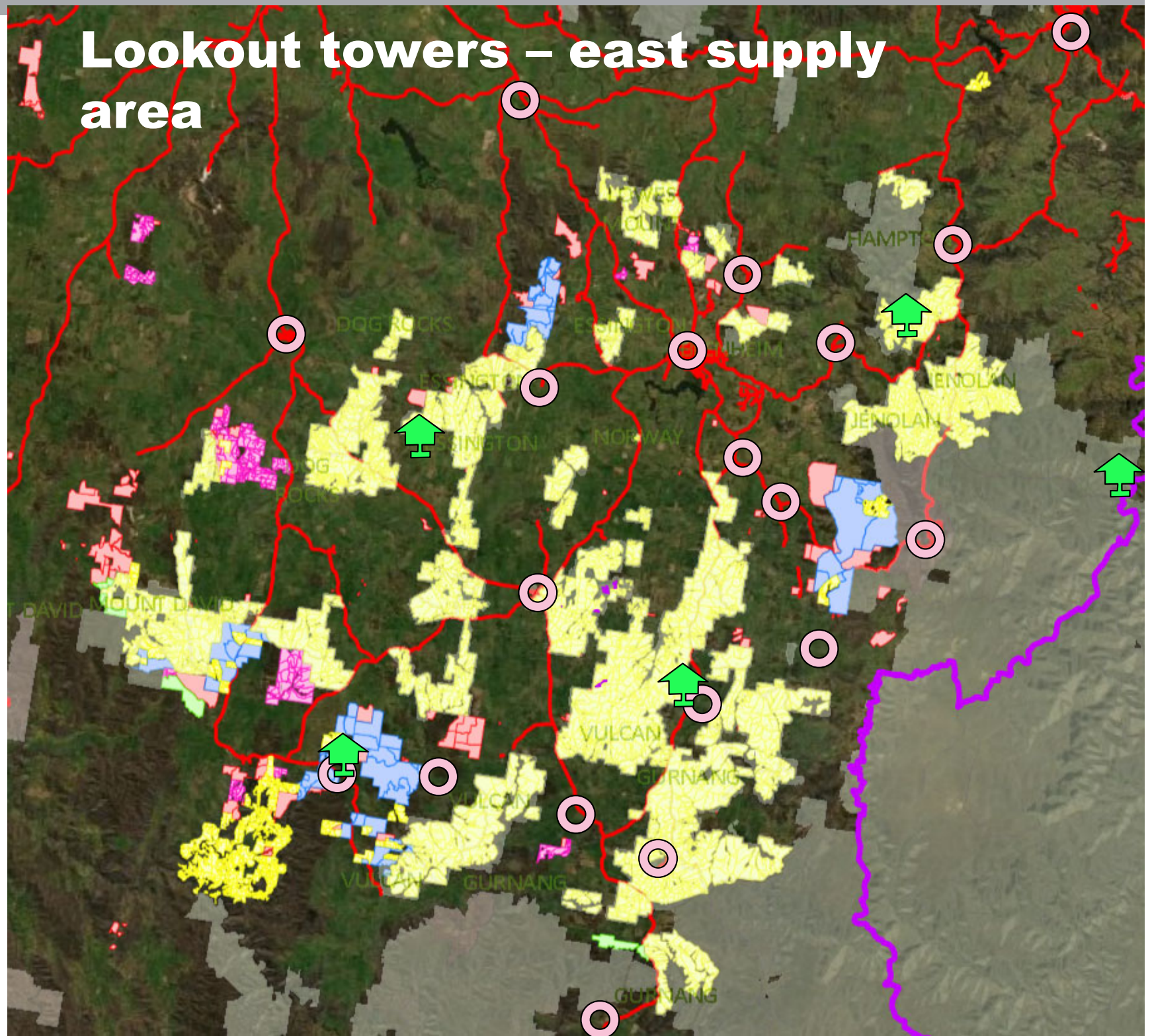
Early detection

- Lookout towers (maps indicate locations)
- Camera systems
- Lightning detection
- Aerial and ground patrols
- Hotspot detection
- Reports from public

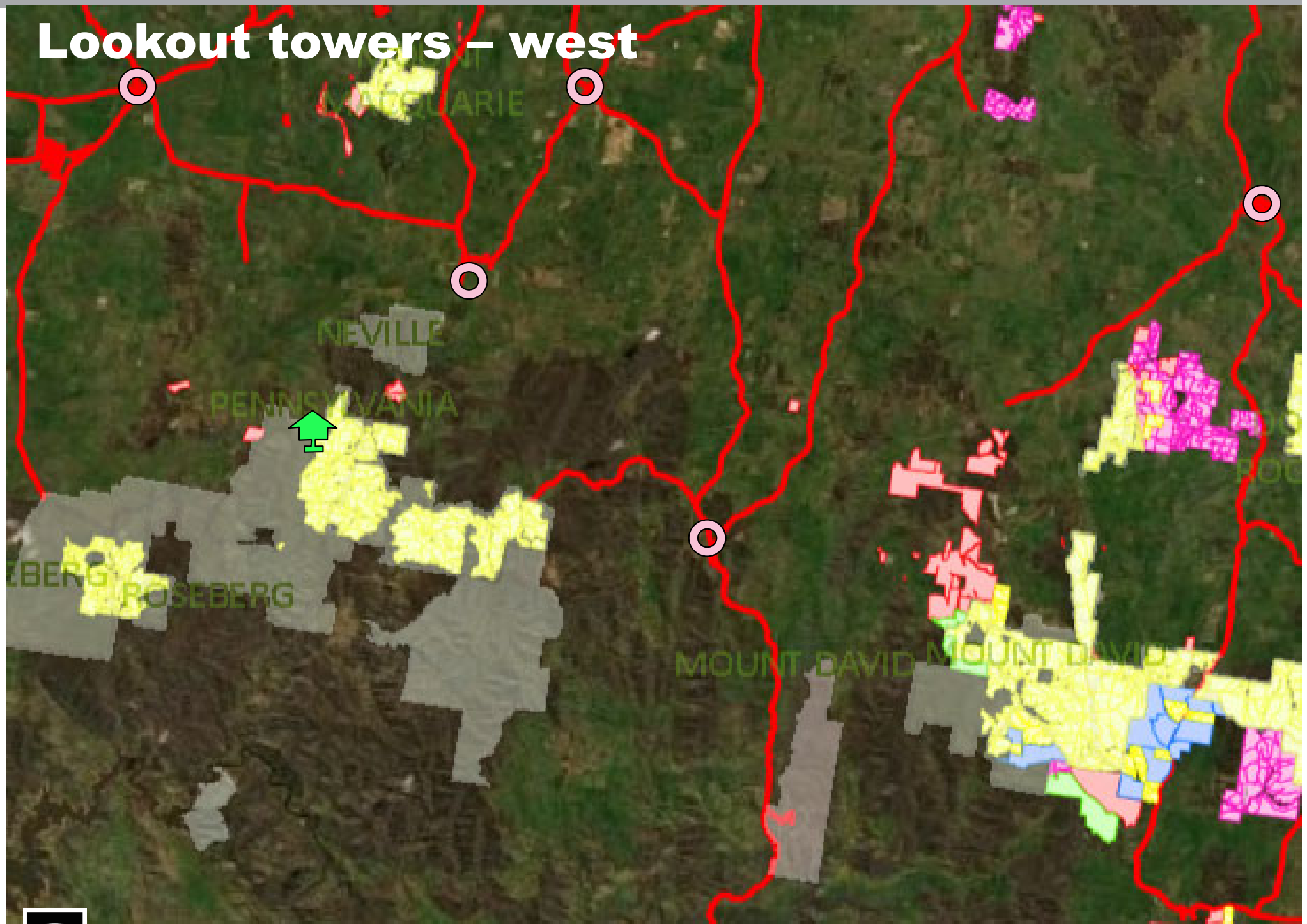
Lookout towers (CWFH north supply area)



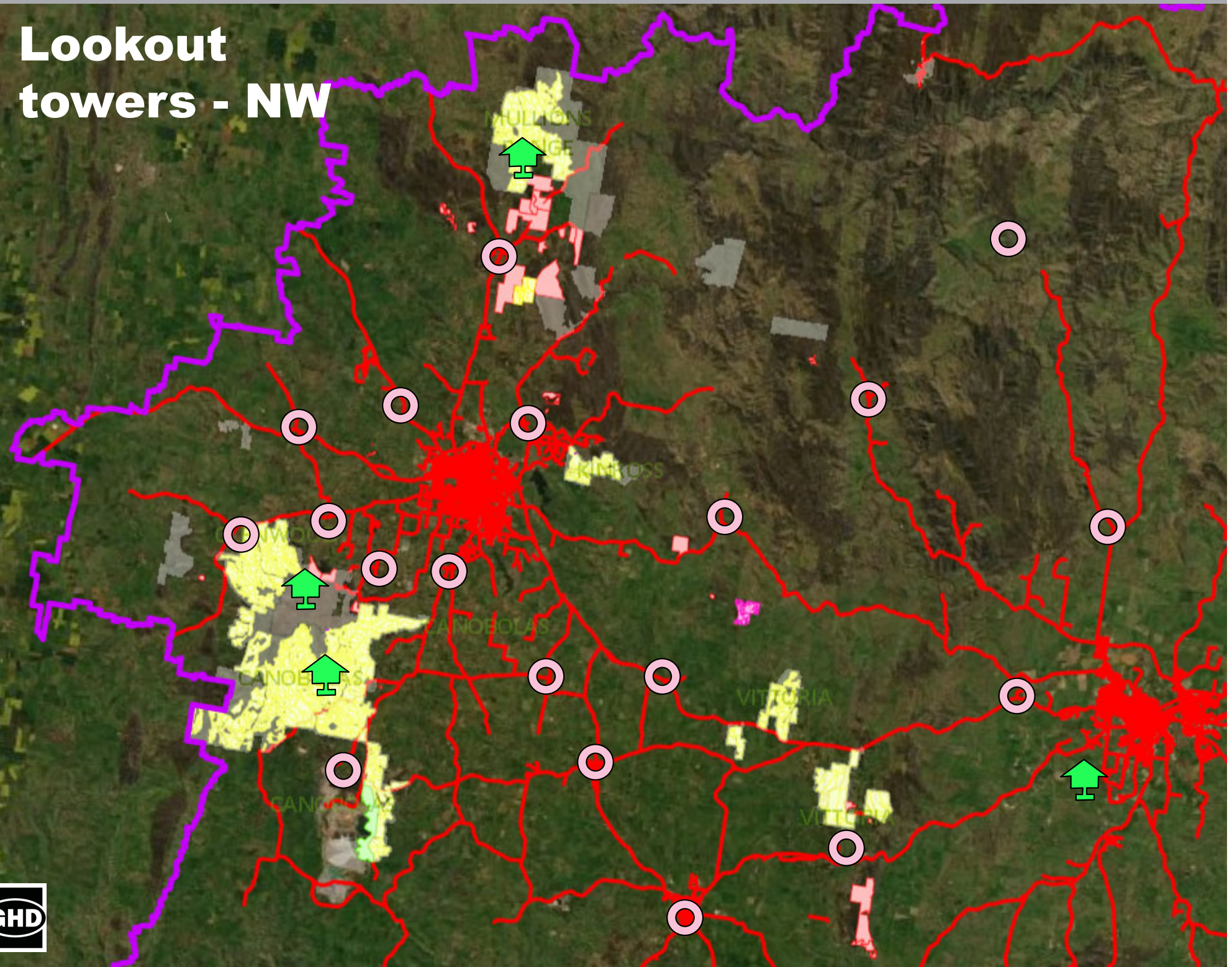
Lookout towers – east supply area



Lookout towers – west



Lookout towers - NW



CW Plantation Fire Protection Capability

Fire protection system necessities & opportunities:

Rapid response - timing

- During drought, if fires are not found until the next day, even in benign overnight/early morning conditions they can attain a size that becomes highly problematic to control once winds strengthen >20 km/h (or less particularly where uphill topography increases fire spread rate)
- On an average summer day (High range FDI) IA within 30 mins desirable; 60 mins likely to need parallel attack (dozers)
- Days of VH+ FDI, IA success prospects will depend on topographic location and plantation age class

CW Plantation Fire Protection Capability

Fire protection system necessities & opportunities:

Rapid response – weight of attack

- A single light unit may be able to deal with some early-stage lightning struck tree fires or low intensity surface fires < 0.5 ha in benign conditions, but fires beyond these proportions will typically require much more water and hence heavy tanker and small dozer support (if response time is >30 minutes, it is prudent to send multiple units including a heavy tanker)
- Plantation fires which get beyond direct attack typically require dozers for mineral earth line construction for containment
- Helicopter waterbombing can knockdown the headfire on small fires and retard fire development buying extra time for ground response – a distinct advantage during elevated fire danger
- Defending plantation against external fire threats is typically a significant scale multi-agency operation

CW Plantation Fire Protection Capability

Fire protection system necessities & opportunities:

Multi-responder inter-operability

- Radio and digital communications for operations
- Appliance/equipment compatibility
- Operational procedural alignment
- Trust and confidence in each others competence, experience and fireground safety approach
- Collaborative preparedness and response – mutual aid agreements; pre-emptive detection patrol and triage arrangements; potentially even combined standby roster arrangements

CW Plantation Fire Protection Capability

Fire protection system necessities & opportunities:

Limitations

- FCNSW - necessarily prioritise fires in their own plantations
 - Typically close-quarters minimal area approach to fire response, making use of machinery and heavy tankers with contract helicopter water bomber support
- RFS - farmlands, rural village/urban interface protection focus
 - will assist with plantations and remote NP fires but not their forte – tendency to prefer backburning from existing trails
- NPWS – very large urban interface risk exposure in Blue Mtns
 - reserves like Copperhannia, Abercrombie, Winburndale, Turon are relatively remote from NPWS main operating centres – these can have longer response time
 - Remote Area Crews available but limited

CW Plantation Fire Protection Capability

Collaboration models:

Green Triangle SA/VIC – Forest Owners Conference

Forest Owners Conference



Plantation Fire Protection Guidelines

FOREST OWNERS CONFERENCE

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CW Plantation Fire Protection Capability

Collaboration models:

Green Triangle SA/VIC – Forest Owners Conference

- Forest Owners meet at least annually to address fire protection issues
- Agreed Fire Protection Guidelines in place adopted and implemented by all FOC members – these guidelines address:
 - Common firebreak and fire trail standards including network density
 - Contractor equipment/fire prevention/safety standards and minimum fire training requirement
 - Forest work ban triggers
 - Windrow management and burning procedures
- Additionally, FOC has automatic dispatch arrangements, whereby individual company resources respond according to pre-planned arrangements in designated geographic areas

CW Plantation Fire Protection Capability

Collaboration models:

Green Triangle Fire Alliance

- The GTFIH has set up the GTFA, with a member-funded full-time GFTA Coordinator position to lead and coordinate collaboration and advocacy, undertake fire operational coordination functions across the hub; develop and promote improved cooperative arrangements, and manage agreed research and technology development projects.
- The coordinator function is particularly relevant in the GT noting the number of growers in GT, absence of a 'dominant' grower, and numbers of companies with substantial plantation estates
- Focus on resource sharing and efficiency

CW Plantation Fire Protection Capability

Forest Industry Brigades – models; pros & cons; alternatives

Features of VIC model

- Statutory requirements under CFA Act and Reg.
- Brought in at time of privatising of VIC publicly owned plantations in part to ensure a minimum level of plantation fire protection
- Applies across VIC plantation grower industry, not just ex-public plantation estates
- FIB eligible estates (>500ha) in a designated area required to have and maintain a Plantation Fire Management Plan
- < 500 ha – no FIB or appliances/equipment required
- 500 < > 10,000 ha - min 800 litre capacity (eg 2 slip ons)
- > 10,000 ha – min 2,500 litre capacity (e.g. 1 heavy tanker)
- CFA training, command and control, and procedures apply

Open discussion forum

&

? Questions ?