Investigation of best practice for use of detector dogs in emergency prevention and response biosecurity surveillance programs.

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Contents

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Executive Summary

In many countries dogs are effectively used to detect different biological and non-biological substances including prohibited items of quarantine significance, illegal drugs, land mines and explosives. The use of detector dogs in Victorian biosecurity emergency response programs could provide a highly sensitive detection tool for locating plant pests[1], which are difficult to detect by humans and conventional methods. This method has the potential to improve prevention capability and border biosecurity, improve rapid and targeted responses for these pests, reduce costs, and enhance on-farm productivity and market access opportunities.

From November 2015 to March 2016 seven detector dog programs were visited and/or personnel surveyed to determine a best practice model for use of detector dogs in emergency prevention and response biosecurity surveillance programs, the results of which could be employed in Victoria's biosecurity emergency response programs.

A survey sheet was developed to collect standardised data on a number of different detector dog programs (see Attachment 1). Research questions related to target odours, daily work, breeding, training, quality assurance and coordination and administration of the program. A literature research was also completed to determine the benefits of detector dogs for use in emergencies.

A literature review found detection dog programs are most successful when targets are not readily visible due to a dog's incredible sense of smell. This means dogs could be beneficial for emergency response programs where target visibility is poor; for example, hazardous chemicals, fire accelerants, human health diseases, plant pests, animal diseases, and some invasive plants and animals.

Other benefits of using detector dogs for emergency response are: they are faster and more accurate than most other surveillance methods; they are cost effective; and reduce the number of humans on the ground or amount of time humans are exposed to high risk hazards or unstable environments e.g. location of humans in natural disasters.

Results from the survey showed while there is no single national standard for detector dog programs and there is some variance in the types of programs being delivered, there were a lot of similarities with the key elements of programs in detector dog breeding, training and program quality assurance, which could be used to frame a best practice model for Victoria.

Importantly, in a lot of cases, the success of programs is due to their flexibility, adaption to change and constant evaluation of the dogs' and handler's proficiency, elements which need to be factored into the model. The respondents' knowledge, skill and passion for the programs they were delivering were also highly evident in the answers provided and explained why all have had significant success.

Overall, the key findings from the research for detector dogs in biosecurity emergencies found that a best practice model in Victoria would have elements that take into account:

- the United States Department of Agriculture proof of concept project as a future model is worth considering for utilising detector dogs in biosecurity surveillance programs

[1] Plant pest means any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (FAO 2007)

- the use of external contractors as the best option as detector dog programs require a long term investment of at least seven years to be cost effective
- how capability can be built with external contractors by undertaking proof of concept trials for pests of quarantine significance already found in Victoria
- the development of synthetic detector dog training aids that would increase Victoria's preparedness for high risk biosecurity threats that are not already found in Australia/Victoria
- how accurate synthetic training aids would enable detector dogs to be effectively used in the final stages (proof of freedom) of an eradication program.

1.0 Aim

The aim of this project has been to investigate the characteristics and features of best practice for the use of detector dogs in emergency prevention and response biosecurity surveillance programs.

2.0 Introduction

The detection of surveillance targets at low levels or those that are not readily visible is one of the biggest challenges in any biosecurity surveillance and eradication program. Surveillance and delimitation techniques, such as active searching by humans, aerial surveillance and trapping, are not 100% effective.

Even with several techniques used in combination, results can be variable and dependent on many other factors including environmental conditions, habitat, seasonality and level of experience and attention of the human operator. Traditional surveillance techniques can also be hugely expensive, time consuming and labour intensive. Electronic noses have become an emerging technology since the 1980's. They are engineered to mimic the olfactory system and eliminate operator fatigue. However, none designed to date have been able to match the canine's capabilities.

While dogs and humans use all five senses, humans rely heavily on sight whereas dogs on smell. This is why dogs are great at odour detection. It is widely written that dogs have 100-300 million olfactory cells (depending on breed). In comparison, humans have around five million.

Detector dogs have an excellent ability to discriminate specific odours and are capable of smelling at concentrations as low as one part per trillion. What humans and dogs smell are very different. Dogs identify individual compounds whereas humans smell a mixture of odours. For example humans smell lasagne, whereas dogs can process all the individual compounds - mince, tomato paste, rosemary etc. Dogs are also able to exclude surrounding or competing odours. Therefore, dogs can narrow down a particular odour, no matter how potent the competing odours are around them.

It is widely accepted that well-trained dogs are the most portable and versatile tools in use today for odour detection. Humans have used dogs for detection since the late 19th century, initially for police work and search and rescue missions.

Dogs are used predominantly in law enforcement, firearms, explosives, currency, drugs and fire accelerant detection. In NSW, there are two dogs trained on fire accelerant detection. In the United States, Canada and United Kingdom accelerant detection dogs are in regular use in fire investigations. Hogsten (2013)[2] notes there are more than 200 accelerant detection canines in the United States.

In recent times, there has been a significant increase in the successful use of canines for conservation purposes – particularly for locating endangered species around the world, e.g., koalas, gorillas and killer whales. Likewise, in Australia, canines have been successful in detecting invasive pests and weeds including foxes, red-eared slider turtles, feral cats and hawkweed.

[2] Hogsten W.A (2013) Trust your dog, a Study of the Efficacy of Accelerant Detection Canines. Emmitsburg, MD: National Fire Academy – available online at http://usfa.kohalibrary.com/app/work/176033

Another emerging area for detector dogs is the medical field. Medical alert assistance dogs have been trained to support individuals who live with dangerous health conditions. Predominantly this has been for diabetes and epilepsy. Proof of concept trials are being undertaken to have dogs detect cancer and to identify people with malaria parasites[3].

For biosecurity the most prominent and long-standing detector dog programs are the Department of Agriculture and Water Resources program at airports and mail centres; and the Red imported fire ant (RIFA) eradication program in Queensland.

Dogs have been trained to detect the following in biosecurity programs:

- organochlorine contamination in soil 99% success rate (Queensland Biosecurity)
- fire ants at 100% proficiency (Queensland Biosecurity)
- electric ant (single foraging ants) rather than nests
- invasive species of turtle including detection of whole eggs, egg shell pieces, egg yolk and urine (Queensland Biosecurity)
- American foulbrood in beehives with a 100% success rate (Rural Industries Research and Development Corporation and Queensland Biosecurity)

Proof of concept biosecurity detector dog programs that have not been ongoing include:

- Screwworm parasites in livestock with a 99.7% success rate
- Asian citrus psyllid (potential to transmit the fatal citrus greening)
- European house borer in structural timber (Department of Agriculture and Food, Western Australia)

The use of dogs has an additional benefit of raising the public profile and awareness of emergencies in Victoria. For example, NSW uses its canines to raise the profile of fire prevention. Similarly, the dogs used in airports have significantly raised the profile of the importance of quarantine. Building relationships with community and industry increases the likelihood of cooperation during prevention and surveillance activities.

Figure 1: Image taken from ABC News online story

[3] Medical Detection Dogs available online at https://www.medicaldetectiondogs.org.uk/contact-us/

3.0 Method for determining a best practice model

The primary method of this research has been to observe detector dog programs in different parts of the world, and to explore other organisations that use detector dogs to be in a position to determine the elements of a best practice model. A literature search was also conducted to complete the work.

Four biosecurity programs were reviewed:

- NSW/Victoria Hawkweed program
- Biosecurity Queensland – red imported fire ant program
- United States Department of Agriculture – citrus greening (huangbongling) program
- Department of Agriculture and Water Resources airport/mailroom detector dog program.

Other detector dog programs reviewed:

- Australian Border Force
- Australian Federal Police
- Fire and Rescue New South Wales

A survey sheet was developed to collect standardised data from the detector dog programs (see Attachment 1). Research questions related to target odours, daily work, breeding, training, quality assurance, and coordination and administration of the program.

The data was collected either when observing the program over a number of days; or due to time and cost constraints some of the surveys were completed via telephone or respondents answered the survey and emailed in their answers.

There were a number of changes to the initial list of programs to be visited. This was due to unavailability of key personnel. The USA program was assessed rather than the New Zealand program, as it was more in line with detection of plant pests in the field.

4.0 Results

Overall, although there was no single national standard for detector dog programs and there was variance in the types of programs being delivered, there were a lot of similarities between the key elements of programs in detector dog breeding and training and program quality assurance (see Attachment 1). The similarities are most probably due to the small size of the industry and a number of the respondents having worked across different detector dog programs within Australia.

In a lot of cases, success is due to the programs being flexible and adaptive to change. The respondent's knowledge, skill and passion for the programs they were delivering were highly evident in the answers provided and explained why all have had significant success.

Because dogs and humans have different ways of communicating, programs in either their early stages of development or with the introduction of new dogs, require instructors and handlers who are willing to trial and error the design of the program. It also requires the instructors and handlers

to have good problem solving skills, be creative and have significant experience and knowledge of dog behaviour to get the best out of the dogs.

The features of a best practice model for the use of detector dogs in emergency prevention and response biosecurity surveillance programs were decided in most part by the following characteristics.

4.1 Program coordination

The capability required for an effective detector dog program was similar across all programs. This included training instructors, team leaders/supervisors to oversee multiple teams, boarding attendants, dog handlers and canines.

There were three main types of program coordination models:

- all of the capability was contained within the organisation
- team leaders/supervisor, dog handlers within the organisation and all other resources were provided by an external contractor
- all of the capability was provided by an external contractor, but intellectual property for surveillance design were provided by the organisation.

Of the programs observed, 55 per cent were run internally by an Australian government agency. All of these programs have been running for at least 10 years. Attributes of in-house capability included the ability to be flexible and adaptable to change, have better corporate knowledge of the business, have greater control and can maintain standards, in particular with training.

4.2 Detector dog attributes

One hundred per cent of the respondents believe the hunt-prey drive is the primary attribute of a detector dog. Prey drive is an inherited characteristic, not learned. Therefore, the breed of the dog is an important aspect. Dogs with hunt-prey drive are highly motivated and driven to find the source target they are trained for detecting despite competing distractions and odours.

Other ideal attributes include independence, courage to confidently enter different environments, high-stamina and an outgoing nature. This is because most of the programs are highly dynamic and the dogs work in diverse environments so they need to readily adapt. Independence is important because they require dogs that do not rely on their handlers to direct them to search for the scent. All respondents noted dogs needed to be kept physically fit to undertake the work they did and this formed a significant component of their daily schedule.

For the respondents who predominantly use dogs to survey large areas of field (agriculture), the size and durability of the dog is also important due to the harsh environment they work in.

Seventy per cent of the respondents use the hunt prey Labrador bred dogs (rather than Labradors bred for show), of which most are sourced from the Australian Border Force (ABF) breeding program. In Australia, Labradors are preferred because they are predictable, particularly when they came from the ABF. Labradors are also preferred in programs that interact with the public, as they are perceived as being friendly in comparison to other breeds such as German shepherds.

Around 220 Labrador puppies are bred per year at the ABF. Foster carers rear the puppies. The foster carers bring the puppies back to ABF at 3, 6, 9 and 12 months for the ABF staff to assess whether they have the key attributes for an effective detector dog. Of the 200 plus dogs, the ABF choose a selection for their internal program based on key attributes described above. Other government departments can purchase the other puppies. State and national police agencies, Department of Agriculture and Water Resources, Biosecurity Queensland and NSW Fire and Rescue all purchase dogs from the ABF.

Some of the programs use specialised breeders to source dogs, or as a top up option if dogs are not available through the ABF.

In the USDA program, the Belgian Malinois is sourced from specialised breeders in Europe. These dogs are picked for their stamina, large noses (which increase the sensory area inside the snout), strength and durability to work over large hectares of agriculture land.

Spaniels are used in the hawkweed program and through research also appear to be a popular choice in other detector dog programs worldwide.

One hundred per cent of the applicants who answered the question noted that while you can look to dog pounds or shelters to source dogs, it is a high risk because the history of the dog is unknown and they generally have issues due to mishandling, lack of socialisation when young and past fearful experiences.

4.3 Dog/handler teams

The dog handler is an integral part of a detector dog team. This feature is important because of the relationship that forms between the handler and the dog. Dogs will have a change in behaviour or subtle cues when they detect a target odour, which the handler needs to recognise. It is vital the handler is tuned into their dog's cues and behaviours when they hit the scent cone of a target odour because it can be as individual as a tail twitch to a whole body freeze.

Handlers can utilise more than one dog. This is particularly useful in the field as 100% of respondents noted dogs are only worked in short bursts varying from 15 – 40 mins and then rested as their effectiveness of smell is reduced when they are panting and fatigued. Back up dogs, which are rested, allow the operational work to continue. This is particularly important for work where significant hectares need to be surveyed. In the USDA program, 10 ha a day can be covered using 10 dogs amongst five handlers. Dogs in this program are worked in 40-minute blocks.

Based on operational needs, sometimes handlers have two dogs that are trained in different source targets.

All but one of the respondents noted that one of the main drawbacks of handlers with multiple dogs is handlers will generally favour one particular dog. This means the other dog/s are not worked and trained to the standard of the favoured dog.

The number of dogs and handlers per team is predominantly determined by the amount of funds that are allocated to the program. Particularly in government environments, it was noted that it could be difficult to maintain capability of detector dogs because funding is allocated annually.

However, for retention and change over, detector dog programs need to be planned three years in advance.

Handling of dogs in the field also varies with the type of work they are doing and there is no preferred or best way. Dogs are used on and off lead in various programs depending on field based surveillance requirements or their work environment (e.g. airport, mailrooms).

Dogs are generally preferred to be handled on lead, in sites where safety is an issue i.e. warehouses, by the side of roads, or where the dogs largely interact with the public e.g. airports. One of the main drawbacks of the lead is that dogs can be more inhibited and influenced by the handler's unconscious cues and anxiety/mood.

Dogs are mostly used off lead to prevent the influence of the handler. However, in the field, handlers can lose site of the dog and miss the dog's indication upon detection of a target odour.

4.4 Training

The amount of time taken to formally train dogs and handlers varies from six weeks to four months. Most respondents said it takes up to two years for the dog and handler to be fully operational and self-sufficient in their work. The ABF have a 12-month probation period.

One hundred percent of training programs are designed in-house. All programs have researched and reviewed similar programs, taken components of the best programs that are relevant to them and then adapted the training to suit their operational needs.

While all respondents have specialised in-house training, the concepts of delivery for dogs and handlers have similarities across all the programs. This is due to most of the respondents doing significant research of similar programs in Australia and overseas e.g. the ABF did a worldwide review of detector dog programs and modelled their program on US Customs.

Training of the dog can commence from as young as five days (basic socialisation/environment) and up to 16 months to begin imprinting of the target odour. The main elements of training were all similar. All respondents focus on socialisation first and expose the dogs to different environments as they progress in age.

Handler training includes but is not limited to safety, dog health, canine first aid, basic handling skills, behaviour modification, search and obedience commands, grooming, training programs, training aids and searching.

Two of the programs noted it is important for the handlers to have technical experience in the identification and handling of the target odour/s. Handlers of the fire accelerant detector dogs must be professional firefighters as they understand the risks and hazards associated within fire scenes. Fire fighters also know burn patterns and the effects of fire on various scenes, which assist in performing search patterns of accelerants (Hogsten, 2013[4]).

The Hawkweed trainer also believes it is desirable for the handler to identify hawkweed. Due to the plant being similar in appearance to many other plant species in the field, it is important that the

[4] Hogsten W.A (2013) Trust your dog, a Study of the Efficacy of Accelerant Detection Canines. Emmitsburg, MD: National Fire Academy – available online at http://usfa.kohalibrary.com/app/work/176033

handler can quickly reward the dog when it detects the target odour. Uncertainty or errors in the identification of the plant could cause the canine to produce false positive indications.

4.5 Canine reward systems

Play and food are the two types of reward systems used by respondents. Play reward is generally preferred for dogs that have lots of energy. Play driven dogs are not as motivated by food and would likely stop working after becoming satiated. However, these dogs will never stop working if the handler plays with them.

One hundred per cent of respondents use positive reinforcement to correct behaviour and 90 per cent use the play reward method for motivating the canines to work/search. This correlates with the type of dog chosen as play reward is generally utilised for canines that have prey drive, which means they are motivated to chase a ball or a stick. Ninety per cent of the programs use balls and tug toys as a reward for detection. These are successful because they are portable, less messy than food and inexpensive.

Corrective actions are part of the training programs; however the corrective action is to change an undesired behaviour, which is then followed by a positive reward for the corrected action.

One program uses food as a reward. A canine with an excellent food drive can work all day for the love of the food reward. The downside to using food rewards is that it is messy and a more expensive option than play rewards.

4.6 Indications for detection

Indications for detection vary based on the type of work and sometimes the dog breed. Canines may be trained to respond either passively or actively, depending on the use of the dog and its nature. Passive alert is where they don't bark or scratch e.g. they might freeze with their nose pointed in the direction of the target. This is important for sites that cannot be disturbed e.g. finding human remains. Fire and Rescue NSW dogs have also been trained to sit and stare, as it is important they do not disrupt the area they are working.

Passive cues however can be a drawback in the field. If the dogs are out of sight, the handler can miss the cue the dog has detected an odour.

Active alerts can be barking, scratching/digging at the object/odour and circling.

4.7 Imprinting process

Once imprinting of the target odour commences, the odour is introduced at large quantities and gradually reduced to the minimum standard that would be found in the particular setting/environment. Imprinting begins in a controlled environment and then moves out into the field once the dog is competent. The field environment is varied in complexity (in a controlled manner), in line with the proficiency of the dog in detecting the target odour.

When the canine detects the target odour, it is immediately given its preferred reward. The process is repeated a lot for it is an extremely important period of the dog's training. The time required to imprint varies according to how odorous the target is and how the dog progresses. Once the trainer and canine are proficient with the exercise of alerting to the odour, distractors are introduced. The

distractors are items that would typically be found in the environment they work in e.g. for red imported fire ants soil and grass.

If multiple odours are to be detected then the process is repeated for each odour.

4.8 Number of target odours

The number of target odours dogs are imprinted on varies from one to six (Attachment 1). Six seemed to be the maximum. Most respondents believe the fewer targets the better due to the significant amount of training and maintenance that needs to be undertaken equally for all scents to ensure the dog does not favour one over the other.

For the detection of plant pests (especially those that are inside another material e.g. European house borer inside wood), most of the trainers suggest one target odour due to the significant amount of components that exists within the plant pest or plant material that is being targeted; plus the added competing material and environmental odours. There can be hundreds of individual components that make up a plant pest and plant material. For example, the odour from a red imported fire ant will include their physical makeup, the food they eat, faeces and colony, components associated with their lifecycle.

4.9 Storage of target odours

Storage of samples is also important and all efforts are used to ensure the odours are kept as pure and fresh as possible. All efforts are also taken to ensure target odours are not contaminated during storage, handling or transport of odours for training sessions

Storage ranges from double bagging, airtight containers and air conditioning within the storage site to remove smells.

4.10 Working life of the detector dog

One hundred percent of respondents did not stipulate a set age to retire a working dog. The age a dog retires depends on the drive of the dog and its physicality. Retirement age ranged from 7 -10 years. It was noted by a number of respondents that dogs needed to be worked for seven years to be cost effective. Some programs do a formal assessment annually, although most noted they are checking regularly through the exercise programs and health checks.

4.11 Program quality assurance

One hundred percent of respondents re-certify annually. All respondents except for the Hawkweed and fire ant programs handle program quality assurance in house. For Hawkweed, an independent assessment is undertaken by Conservation New Zealand; and for red imported fire ant, a detector dog instructor who is contracted by the department assesses the handler and dogs. Instructors are responsible for assessing the canines and handlers.

Although there is an official certification process annually, all respondents noted dogs are exercised from two times a week to daily with a variety of target odours, distractors and venues.

Exercising is of particular importance if dogs are not finding all of their targets often in their operational work and to ensure the proficiency of the dog in the detection of odour/s. It is also

important for motivation of the dog. The target odour can be embedded in training for the handler to instil positive reinforcement of the target odour/s and maintain the drive of the canines.

Dogs undergo basic tests for odour recognition and proficiency. The purpose of the odour recognition test is for the canine to demonstrate the ability to recognise the target odour and the handler's ability to interpret the canine's change in behaviour upon detection. The purpose of the second test is for the canine to demonstrate proficiency in an operational environment. At AFP dog and handlers also complete an agility test. The test is undertaken to assess the bonding of the dog and handler team.

Most of the programs capture the proficiency of the dog through video or handler logbooks.

4.12 Summary

The main benefit of using detector dogs for emergency responses is that they offer a rapid detection method. Even with advancements in technology and electronic sensors, canines remain the most reliable real time detectors due to their mobility in large search areas and aptitude for locating a target odour (UTS website[5]).

This is important for emergencies when you need to find the hazard or cause of the hazard quickly. Dogs can also cover large areas much quicker than humans, have proven to be more accurate when the hazard is not readily seen, are cost effective and reduce the number of humans on the ground or amount of time humans are exposed to hazards in high risk scenarios e.g. unstable environments, hazardous substances.

Detector dogs are also a useful surveillance tool for emergency response, particularly for hazards that are not readily seen e.g. hazardous chemicals, fire accelerants, plant pests, animal diseases and human health diseases.

Dogs have been successfully used in other states of Australia and overseas to detect biosecurity threats. In Victoria, the use of detector dogs has been limited to research and the trial work being undertaken with a contractor to use dogs to detect hawkweed in Victoria and NSW.

The research has shown there are limitations to using detector dogs in biosecurity emergencies. This is because dogs cannot be used in the immediate stages as it takes up to 12 weeks to imprint a dog in a new odour; however this can be significantly less for dogs that are already familiar with the process. Unlike other programs where the target odours vary little e.g. fire accelerants, there is a huge variability in biosecurity hazards. For plant biosecurity, there are over 400 plant pest threats to Victoria. Use of dogs may also be limited in the final stages of a biosecurity response program as the pure source target odour would not be available for maintenance and training. Generally at least two years of surveillance is required to prove the plant pest is absent.

The USDA is doing further work to synthetically replicate plant pests. If successful, this technology would increase the benefits of detector dogs for use in the final stages of a response and dogs could also be used for prevention programs for early detection of exotic plant pests.

[5] UTS (2013) *Death, decomposition and detector dogs.* Available online at: https://www.uts.edu.au/about/faculty-science/what-we-do/uts-science-focus/forensics/death-decomposition-and-detector-dogs

Until such technology is available, the use of contractors seems the best approach for biosecurity emergency response programs. Capability could be built with contractors if detector dogs were used for biosecurity threats, which are already present in Victoria. Service providers would build capability and knowledge of biosecurity field surveillance programs. This would be useful for biosecurity emergencies as these specialist contractors could be used for biosecurity emergency eradication programs, which are funded long term.

5.0 Discussion

This research set out to investigate what is a best practice model for the use of detector dogs in emergency prevention and response biosecurity surveillance programs, in particular for biosecurity incidents that are discussed below.

5.1 The use of dogs as a detection tool in emergency response

Detector dogs are used in Australian emergency response programs for:

- Cadaver detection dogs (natural disasters) – NSW Police Force, Queensland Police Service.
- Living people search (natural disasters) State police programs, Search and Rescue Dogs Australia and Southern Cross Search Dogs.
- Fire Accelerant Dogs – NSW Search and Rescue.
- Biosecurity - fire ant/s, Queensland.

5.2 Benefit of dogs as a detection tool in emergency response

1. **Rapid detection method**

    - important in emergencies when you need to find the hazard or the cause of the hazard quickly
    - dogs can cover large areas much quicker than humans.

2. **Accurate detection method**

    For odours that cannot be readily seen, dogs have 85-100% success in comparison to humans who have 40% success. The following accuracy measures have been identified:

    - accelerant dogs for fire = 97% (NSW Fire and Rescue[6])
    - red imported fire ants = 100% (Queensland biosecurity)
    - citrus greening disease - huanglongbing (99.16% USDA).

3. **Cost effective**

    - can cover large areas rapidly
    - better accuracy
    - less people required to do the work
    - less people to train or resource.

[6] Fire and Rescue NSW *Accelerant Detection Canine Program* Available online at: http://www.fire.nsw.gov.au/page.php?id=169

4. **Reduces human exposure to hazards**

   The use of detector dogs will either reduce the number of humans on the ground or reduce the amount of time humans are exposed to the hazard, particularly in high risk scenarios such as:

   - unstable environments (natural disasters)
   - small confined spaces (hazardous chemicals)
   - hazardous atmosphere (fire)

Houser et al (2015)[7] states canines outperform human searchers in a lot of conservation surveillance programs; however, in some programs there was no difference between humans and dogs. The author concluded humans searchers use vision, while the advantage of detector dogs is their sense of smell. Therefore, the advantage of detection dogs may be reduced for highly visible targets and there may be little advantage in employing a dog detection team when targets are highly visible.

Emergencies that would benefit where the target visibility is poor would include:

- hazardous chemicals
- fire accelerants
- plant pests
- animal diseases
- human remains or live humans missing in natural disasters
- human health incidents where physical symptoms are not readily evident
- invasive plants (difficult to identify by site when not flowering)
- invasive animals.

5.3 Welfare of dogs in emergency response

Whilst it is noted in section 5.2. that detector dogs will reduce OH&S to humans because dogs are more resource effective than visual surveillance, the welfare of the dogs in emergency management situations also need to be considered. A special Pawprint edition on the New Zealand USAR Search Dog Association highlighted the role of the search and rescue dogs and their volunteer handlers in the 2011 Churchill, New Zealand earthquake.

The report highlighted the importance of the Massey University Emergency Response Team (VERT because of the long shift hours and both the dogs and handlers were tested to the limit with smoke, tight spaces, crane rides and noise. In an emergency, MU VERT is capable of performing veterinary and animal welfare
disaster analysis needs assessments (DANA), assessing the veterinary infrastructure, establishing veterinary field hospitals, animal decontamination/HazMat, providing care for search and rescue dogs (USAR and Police), identifying potential public health issues as well as technical animal rescue. The team can
deploy within 12-24 hours to a disaster area and are self-sufficient for 72 hours.

[7] Hauser C, Veltheim I, Crasse B and Guillera-Arroita G (2015) *Evaluation of a sniffer dog for detecting Hawkweeds* (Hieracium spp) on the Bogong High Plains. Report prepared for Department of Economic Development Jobs, Transport and Resources

The handlers realised that not only were the dogs critical in carrying out their job as trained search dogs, but in their down time they carried out a second equally important role – therapy and comfort for the USAR team.

5.4 Emergency plant pests

The benefit of detector dogs for emergency plant pests is evident in the red imported fire ant program and the proof of concept detector dog program for citrus greening disease (huanglongbing) in the USA. Huanglongbing is a serious bacterial disease of citrus thought to be caused by *Candidatus Liberibacacter asiaticus*. It has never been found in Australia and is classified as an emergency plant pest because of the devastating impacts it has on citrus production. Wherever this disease has been found, citrus production has been compromised with the loss of millions of trees.

The United States Department of Agriculture (USDA) has contracted the services of a detector dog agency, which has trained 20 dogs to identify huanglongbing. Huanglongbing has cost the US citrus industry $7.8 billion and 7,500 jobs since 2006.

In terms of visual surveillance by humans, huanglongbing is difficult to diagnose in the field because the symptoms can be confused with so many other common plant diseases, environmental factors such as water logging and mineral and nutrient deficiencies. This disease also has latent symptomatology, often for months or years. When it in this cryptic stage, it is sparsely distributed making sampling via PCR or other detection methods highly problematic and prone to false negative results. Because of this, humans would need to collect a significant number of samples for DNA analysis in order to confirm diagnosis.

The use of dogs has proven to be more successful than any of the other surveillance tools tested by the USDA. Statistical validation of the canines have determined them to be accurate 99.16% of the time, which is better than DNA sampling techniques which can require several hours or days to complete and are subject to lab-related and sampling errors. Even more, it has been found the canines are identifying diseased trees days and weeks before visual symptoms appear (Mittleman 2016[8]).

Figure 2: Bloomberg news[8]

[8] Mittelman M (2016) *Meet the canines sniffing out trouble in Florida's Orange Groves* Bloomberg news article. Available on line at http://www.bloomberg.com/news/articles/2016-03-03/meet-the-canines-sniffing-out-trouble-in-florida-s-orange-groves

The drawback of use of dogs for biosecurity emergencies is in the immediate stages due to it taking up to 12 weeks to train a dog on a new target odour. Access to pure odour for continual training in the final stages of a program may also limit the use of dogs. For example, for the "proof of area freedom" stage of a biosecurity emergency, the plant pest must be found to be absent from the area of operation for a minimum of one year.

The plant pest biosecurity programs looked at for this research work currently have the target odours present within their area of operations.

In the fire ant program, exercise and maintenance of the dog is done by infusing target materials (e.g. sticks and cloth) with an ant colony reared at the Biosecurity Queensland laboratory. Ant colonies are kept in secure facilities and the targets are placed in the ant colony for one week and then securely stored for use.

For the hawkweed and huanglongbing programs, live plant material is cut and used. Maintaining a pure target odour has been problematic for the huanglongbing program because once the plant material is cut, the integrity of the target odour is changed and therefore isn't the true smell. This had the potential to reduce the proficiency of the dog; however, it has now been rectified. Likewise there have been some issues with ant colonies reared in captivity for too long, whereby the odour is different to that in the field.

5.5 Fire accelerant dogs

Accelerant detection canines can smell accelerant in smaller concentrations than any portable scientific equipment currently available and can work easily in confined spaces. Accelerant detection canines reduce the time spent by investigators and fire crews in hazardous atmospheres and environments such as when a building is unstable or there is asbestos present. The process of discriminating between burned products of the fire scene and ignitable liquids is what sets the canines apart from the fire investigators (Hogsten, 2013)[9].

Accelerant detection canines and their handlers can cover large areas quickly to narrow down the area for frontline firefighters to undertake fire origin and cause analysis. Dogs are able to quickly and accurately establish or dismiss whether a liquid accelerant has been used or not. This has been evaluated and confirmed by a doctoral thesis research project and an honours thesis research project undertaken by forensic students with the University of Technology Sydney. Accelerant detection canines are 97 per cent accurate and have a high public profile as a communication tool to promote community fire safety messages.

Similar to huanglongbing, the process for obtaining laboratory confirmation takes time as they have a large number of samples of fire debris to analyse. A study by Wagner (1997)[10] of Connecticut's accelerant detection canines showed that:

- from the attendance at 184 fire scenes, the proficiency rate was 92 per cent, saving 1,472 man-hours and cut the number of samples submitted to the laboratory by 1000

[9] Hogsten W.A (2013) Trust your dog, a Study of the Efficacy of Accelerant Detection Canines. Emmitsburg, MD: National Fire Academy – available online at http://usfa.kohalibrary.com/app/work/176033

[10] Wagner E (1997) The use of canines in accelerant detection. Available online at: http://www.tcforensic.com.au/docs/uts/essay2.pdf

- it takes dogs on average 30 minutes to cover an average fire scene. In comparison it can take humans days to do the same job as the canines
- on average three samples are collected by canine teams to identify accelerant use, compared to 20 samples collected by humans.

6.0 Best practice for setting up and mobilising detector dogs for biosecurity emergencies

Through the observation of various programs, there is not one recognised Australian standard for detector dog training and quality assurance. All of the programs reviewed had their own specialised training and one of the seven programs used an external organisation to review the competency of the dogs.

Likewise, all of the quality assurance programs are tailored for the programs. Variability exists between the programs in the ongoing maintenance/exercising of the dogs.

It seems this specialisation is necessary due to the variability in detector dog programs. For example, how often the target odour is found in the operational environment, the personality of the dog and proficiency of the dog and handlers. Particularly for ongoing maintenance/exercising, handlers have to find novel and different ways to test the dog's proficiency on the target odours. This includes changing the environments the target odours are placed in, changing the threshold of the odour concentration, ensuring handlers do not impose their scent (i.e. use of gloves, pipettes), disturbing sites where the odour is not also to try and teach the dog to ignore handler and competing environmental odours.

Although the training is specialised, all programs have sought best practice in their programs by viewing similar type programs nationally or internationally.

In comparison to human surveillance programs, you would also assume the amount of quality checks that are part of all of the programs observed e.g. video footage, log books, regular exercising gives great assurance that the proficiency of the dogs and handlers is of a high standard.

6.1 Coordination of detector dog program

6.1.1 Contractors

For biosecurity, the best model observed would be to utilise external contractors. The model in which further investigation of its success should continue is the USDA program for huanglongbing. The same proof of concept program could be explored for plant pests that are already found in Victoria and are of significance to Victorian plant industries. The survey designs would be developed by Agriculture Victoria or sourced from the USDA program and this could be shared with detector dog service providers, which might want to specialise in providing a service to agriculture.

The use of contractors seems most useful for programs that have a short life. Detector dog programs require significant funding in terms of resources for operations, training and upkeep of the dogs. Investing in detector dogs programs requires a long-term approach because most respondents advised dogs are required to work for seven years to be cost effective.

A contractor approach therefore seems better as a typical biosecurity eradication program for plant pests generally runs for three to five years if eradication is successful.

In comparison to an in-house emergency program, such as fire accelerant, the hazard varies considerably for a biosecurity program. For example, there are over 400 plant pests of concern to Victoria and in the last year alone there have been six different plant pest emergency responses.

Use of contractors for biosecurity response is in line with the programs observed. All of the biosecurity detector dog programs (except the Department of Agriculture and Water Resources) were either run by contractors or some elements of the program utilised contractors. The Department of Agriculture and Water Resources program is different to the biosecurity plant pest programs and can therefore be successfully run in-house because the target odours (fruit, vegetables, meat etc.) are readily sourced and do not change considerably over time and pose no biosecurity risk to store and use for training.

Both the Hawkweed and fire ant programs have dog handlers within the combat agency. A contractor provides instructors, the canines and technical input. These models seem to have worked. To note the USDA and Hawkweed program are both still in "proof of concept" phase and therefore the use of contractors is beneficial if it does not go ahead long-term.

The drawback of using contractors for the biosecurity program is that dogs cannot be used immediately for emergency response as it can take up to 12 weeks to imprint a dog to a new target odour and to work out how to source, transport and store the target plant pest. While a three month delay would be detrimental to emergencies that have a short response life e.g. fire and natural disasters, this is not so for biosecurity response due to eradication programs running on average for at least three years e.g. fire ant is in its tenth year and hawkweed its fourth year.

Capability would be built with external contractors if detector dogs were used for quarantine plant pests, which are already present in Victoria. Service providers would build capability and knowledge of biosecurity programs. This would be useful for biosecurity agencies that may want to contract specialist service providers for biosecurity emergency eradication programs.

The other significant area that requires further research for biosecurity emergency response would be in the final years of the program. For plant pest programs, generally two years of zero detection are required to deem the program successful for reinstatement of market access.

Based on feedback that the dogs need to find the target odours on a regular basis to keep motivated, live plant material or insects would need to be kept. While in the first year or two of a response, it would be readily available, once eradication was successful, finding the target odour in the operational environment would drop considerably.

This would mean options would be required to keep plant pest material in a secure quarantine facility, or use "pre-cursors" or synthetic products (see below).

6.1.2 In-house programs

The benefits respondents see in an in-house program is that it is run by business objectives rather than profit; and significant corporate knowledge is built over time. For ABF, this is 40-50 years.

What was common with all of the in-house programs is they are on-going and the target odours do not vary significantly or are readily purchased for training and exercising e.g. fruit, meat and explosive materials. For emergency response programs, readily sourced material would be: accelerants for fire, hazardous chemicals, search and rescue of live humans.

On-going programs are of particular importance for in-house programs, as dogs are required to work seven years to be cost effective. The drawback of in-house capability is funding. Most of the

programs stated that the size of the program is dependent on the funding provided. It was evident in some programs that funding has been reduced over time, which therefore impacts on the number of dogs that can be trained. In addition, for some, funding is worked out on a financial year which makes it difficult to maintain future capacity of the dogs e.g. pending retirements, injuries.

For some programs dogs are utilised for community awareness programs. Respondents use either their current working dogs or retired dogs to participate in communication activities. For in-house emergency programs such as the NSW Fire and Rescue, dogs have been proven to be successful in raising community awareness in their downtime. All of the programs have used dogs to promote their programs in the media. Dogs are a popular media piece. For example, an article on the Hawkweed proof of concept program ran on ABC news online and the front page of the Wall Street Journal in the United States. On the weekend it was run, it was one of the top videos on the Wall Street journal site on the Saturday.

Image 1 – Detector dog for Hawkweed –ABC news article[11]

6.1.3 In-house program for biosecurity

In order for dogs to be kept in house for biosecurity emergency response, dogs would have to be utilised in other ways. Options would be to use detector dogs:

- for pest and diseases found in Victoria and which are of economic concern to Victorian industries e.g. phylloxera
- for other states requiring surveillance of the same plant pest
- as an early detection tool for biosecurity plant pests not yet found in Victoria
- to improve community awareness about biosecurity

6.1.4 Plant pests found in Victoria

In recent years, resources for biosecurity surveillance have considerably reduced. Surveillance is supported through funding provided by external providers. Those that benefit from the work for

[11] Sanders (2016) Sniffer dogs being used at Kosciuszko National Park to detect weeds. Available online at http://www.abc.net.au/news/2016-03-06/sniffer-dog-being-used-at-kosciuszko-national-park-too-detect-we/7224252

plant pests already found in Victoria now fund surveillance. For a plant pest like phylloxera, this would be industry.

It would therefore be beneficial to use the USDA model described earlier in which the government would develop the surveillance design and industry would buy the services through a contractor if it was beneficial to their business.

6.1.5 Early detection tool

The use of detector dogs as an early detection tool for biosecurity threats that are not yet established in Victoria or Australia was reviewed.

The benefits of using dogs for early detection would be dogs can work all year round if there were no biosecurity responses occurring and thereby maintain in-house capability.

Options to imprint dogs for biosecurity plant pests not in Victoria are:

- to imprint the canines where the plant pest is found (e.g. interstate or overseas)
- bring in the plant pest from overseas or interstate to secure quarantine facilities
- explore the use of pre-cursors (selected elements or odours associated with the plant pest)
- explore the use of synthetic replicates.

Of the four, the last two are the best options based on risk and cost. To date, there has not been significant research on pre-cursors and synthetic replicates for biosecurity plant pests.

At the time of the survey, the USDA had only just started research work to determine if synthetic options are viable for plant pests. Their research is focussed on plum pox, which is not yet found in the USA. This work will determine if plum pox can be authentically replicated as a synthetic product. The USDA research noted plant odours are incredibly complex. There are hundreds of chemical compounds in the odour and therefore to replicate it synthetically is very difficult.

Research on synthetic options is also being undertaken by UTS[12] for cadaver dogs. Cadaver detection dogs are specially trained scent detection canines used by the police to locate human remains. These canines can be deployed to locate missing persons, victims of homicides; and for emergencies, they can be deployed for mass disasters such as earthquake and tsunamis.

The NSW Police Force dog unit train their cadaver detection dogs on a combination of natural and artificial scent sources. Artificial scent sources are synthetically produced to represent the odour of decomposition given the difficulty associated with using real samples for training. These aids are the closest representations available; however it is still unknown whether the odours of these training aids chemically represent the odour of death and decay. This is important to ensure cadaver detection dogs are exposed to accurate representations of the odours they are tasked with locating (UTS website[13]).

Long-term goal of the UTS research is to try and provide a more accurate training aid that will enhance accuracy and response of the cadaver detector dogs. Findings from this research may be

[12] UTS (2013) *Death, decomposition and detector dogs.* Available online at: https://www.uts.edu.au/about/faculty-science/what-we-do/uts-science-focus/forensics/death-decomposition-and-detector-dogs

[13] UTS (2013) *Death, decomposition and detector dogs.* Available online at: https://www.uts.edu.au/about/faculty-science/what-we-do/uts-science-focus/forensics/death-decomposition-and-detector-dogs

beneficial for biosecurity programs looking for a similar outcome on synthetic detector dog training aids.

7.0 Conclusion

The use of detector dogs in Victorian biosecurity emergency response programs could provide a highly sensitive detection tool for locating plant pests, which are difficult to detect by humans and conventional methods. This method has the potential to improve prevention capability and border biosecurity, improve rapid and targeted responses for these pests, reduce costs, and enhance on-farm productivity and market access opportunities.

From November 2015 to March 2016 seven detector dog programs were visited and/or personnel surveyed to determine a best practice model for the use of detector dogs in emergency prevention and response biosecurity surveillance programs.

Overall, although there is no single national standard for detector dog programs and there is some variance in the types of programs being delivered, there were a lot of similarities with the key elements of programs in detector dog breeding and training and program quality assurance.

The investigation has shown that the United States Department of Agriculture proof of concept project for citrus greening is a best practice model for biosecurity to consider. This program utilises external contractors to undertake the work and the government agency is responsible for the survey design. This seems the best model for biosecurity because plant pest responses can be short term and the results show that detector dog programs require a long term investment of at least 7 years to be cost effective.

In order to build capability, proof of concept trials could be undertaken on plant pests that are already found in Victoria and are significant to plant industries. This would enable external dog detector contractors to build capability in training dogs for plant pest surveillance and the government agency to develop survey models for different plant pests.

In addition the USDA will also be important in the development of synthetically produced detection aids will also be integral to increasing the utilisation of detector dogs in areas such as early detection for high risk plant pests which are not found in Australia/Victoria and the beginning and final stages of an eradication program.

8.0 Attachment 1 – Research questions

Detector dog program	Steve Austin (private contractor)	DAWR	Aust Border Force	USDA	Fire and Rescue NSW	Qld Biosecurity/ Craig Murray	AFP
What odours are your dogs trained to detect?	Hawkweed, Conservation programs	Eggs, meat (excl fish), fresh fruit and veg, fresh plant material		Citrus greening; Citrus Canker	Petrol, kerosene, turpentine, mineral thinners, methylated spirits	Red imported fire ant (RIFA) electric ant, browsing ant	Cash, drugs, firearms, explosives
How many different target odours per dog?	Up to 6 odours	multiple	Up to 6 odours	One. Because there are so many different elements in plant pest	5	Two. RIFA	Around 6. Can do up to 9 or 10.
How are the dogs worked? Hours per day and/or area covered	6-7 hours; 20 mins on 15 mins off. Including grooming, transport, feed etc. 2 weeks off every 6 months	Cumulative total 5 hours per day	8-9 hours - short bursts. Varies based on search	Do 10 acres a day; 40 min blocks. 4 handlers/15 dogs	Unable to quantify	10-20 mins; 3 rounds	Short assignments. 10 mins with 30 mins rest
How do you maintain motivation in the dog if not readily detected?	Variable reward structure	Target rich environment. Training on a daily basis	Keep it interesting to dog by varying work. Training exercises set up to reward them while sharpening their skills	-	Constant training of black runs - trigger often placed after a number of blank runs to confirm the dog is working effectively and to game the dog	Maintenance work. Infused cotton cloths/sticks	1 in 6 times the dog is rewarded (average). This will vary with motivation of the dog. Do it in exercising if not accomplished in Ops
How do you determine number of dog/handler teams for your program	2 dogs per handler. Allow rotation and for unexpected injury	Workload divided by team capacity. Based on passenger and mailing screening	Funding	Based on no. acres dog can perform in 40 min blocks	Dollars. Only 3 funded positions	Funding	Funding
What variables affect their probability of detection?	Fear failure, lack direction, distractions, contaminants	Health, training, quality, drive, environmental factors	motivation handler, nature of goods/people, environment, extreme temps, time of the day, workspace they are in (engine of a ship)	Flagging/tired	Distance in travel, heat within the scene, duration the ignitable liquid was in the scene, how much water was used, distractions such as burnt food, dead bodies, odours similar to their target odours from burnt furnishings	Motivation, handler's mood, weather in part. Wind	Training, handler, wind

Breeding programs							
Where do you purchase dogs from?	Breeders and pounds	ABF breeding program	Internal breeding program - supply to Vic, NSW WA police, AFP DAWR corrections etc. Over 300 foster carers	Dogs bought from Europe;	ABF breeding program	ABF, shelters, breeders	ABF and testing some breeders
What ideal attributes do you look for?	High hunt drive, independence, recall, working line breed of hunting, non-obedient	High hunt drive, brave bold, outgoing, strong food drive, strong play/retrieve drive; Dogs need to be kept fit.	Hunt drive, Independence, Play drive, physically capable, height (size) due to search of passengers. Can't be small as would have to jump on passengers; Strong correlation between fit dog and work ethic	Large dogs, tough (harsh environment), stamina, long nose (sensory area inside the snout), youthful/enthusiasm	High hunt drive, independent, non-obedient, good temperament, high reward/play drive, limited fear (dark, heights, grates etc.)	High hunt drive; Independence	Hunt-prey drive, high drive/energy, independence, physically fit,
Do you choose specific breeds?	No preference. However, mainly have spaniels, border collies, labs.	Yes. Labradors only	Yes Labradors with hunt drive	Yes. Shepherds/ Belgian Malinois	Labradors	No. Lots of labs as ABF have best dogs. Also have cattle dogs	Labs due to use of ABF dogs- predictable, friendly for environments as they work in with people.
What age do you start training	Choose dogs at 8 weeks. Retrieve hunt, socialisation; 12 weeks crate and toilet trained.	-	12 months (prefer 14 months); check on them monthly from pups - health and stimulate play drive	6 months	16 months	As early as can	12-14 months
Have you accepted dog candidates offered by the public that are either full or mixed breed and not specifically bred for detection?	Can take mixed breeds but look at shape, size and drive	Previously but for a large program it is not cost effective	Until 1993. Moved away from it as couldn't source enough dogs	No. Best dogs are from Europe as they are specifically bred with hunt/drive capability	Have tried before and it wasn't successful; rare for pets to become work dogs	From shelters but rarely as history of the dog is unknown; They generally have issues	No. Don't know what you're getting. Not predictable
What is the expected working life of the dogs?	Until dogs no longer want to or physically incapable.	Minimum 7 years or 8 years	9-10 yrs. Up to dogs physical capability and want to do it	Use a contractor	Approx. 9-10years old. However depends on the drive, agility and potential risks for a dog that age	Depends on the dog; 9 year old labs in the program but they are monitored heavily	8-10 yrs. However no set date.

Do you conduct a formal assessment to determine end of working life?	Every 12 months check physical and how they are performing	Depends on circumstances. Regional supervisors recommend retirement based on performance and/or health issues. Sometimes seek external specialist advice or an independent performance assessment	Annual certification (quarterly assessments); record daily performance	Use a contractor	Constantly conduct assessment based on the above	Yes, monitor them regularly	Assessed annually. Determined by drive and physical state of the dog.
Do retired dogs go on to community engagement and for demonstration work?	N/a	No they are retired to a loving home	Combination of genetics and nurturing	Use a contractor	Once retired they are offered to a family with FRNSW as a pet. Owners sign a waiver to never use for demos, training etc.	Some are used for demonstration; others go to handlers or staff in biosecurity	Some dogs are used for community engagement activities.
If breeding specifically for detection capability, what is required during their development to get a good working dog?	Training begins at 5 days	Refer AFB breeding program		Use a contractor	Based on what ABF do as they generate excellent detection dogs	hunt/drive breed, strong build, work in all environments Adaptable; drive that is in synergy with the handler	Socialisation, getting them used to environments they work in. Conveyer belts, airports etc.
Do you do extensive environmental conditioning and socialisation to potential competing environmental distractions?		Refer AFB breeding program	Foster carers undertake. Dogs brought in quarterly to check on their progress	Use a contractor	Constantly, from terrain, heat, locations, distractions, time of days etc.	Yes because dogs work in such varied environments. If unable to meet standards then they are not selected.	Yes. As above
Training detector dog teams							
Who trains the handler and dogs?	Internal training course	Internal trainers	In house	Contractor handler and trainers	In house training developed from ABF and adapted to suit the needs of FRNSW.	External contractor who has developed in house training	AFB Instructors

Is it a course or method recognised nationally/ internationally?	Developed internally	In house training specific to department objectives	In house training specific to department objectives	In house training	ABF course	Contractor's training course. Based on training done overseas - Bob Tulford	In house training specific to department objectives. Reviewed and used knowledge from other programs e.g. ABF
It is an outside training provider or kept in house?	In house	In house		In house training;	In house	External contractor	In house
How long does it take to train a dog and handler unit?	6 week course	New handler and dogs trained separately; Dogs trained by instructor and specialist - 8 weeks; handlers 6 weeks	7 month course. 11-12 weeks basic training; 3-4 months in field; 12 month probation period	6-10 weeks	3-6 months but training never ends as you keep adapting to suit the environment and change in characteristics of the dog as they mature		3 months. 2 years for dog and handlers to be good
Do handlers handle/train more than one dog?	Yes	Yes; trainee handlers are allocated numerous experienced dogs throughout training	on a case by case basis Worked out on type of detection and work not as complex	Yes; all dogs are used by the handlers	One dog per handler. Train other dogs if the current one retires	Yes 2 - 3 dogs	Yes some do based on operational requirements. Usually dogs have different target odours
Pro's to handling more than one dog	Can get more work done as rotating the dogs	All pros	-	-	If simply training the dogs and not operational the benefit can be consistency in the training methodology generating greater output of the canine	Can get more work done as rotating the dogs	Back up contingency. Effective for handler's work role.
Con's handling more than one dog?	Can show bias to one dog; Handler not able to do more than one dog	nil	Can show bias to one dog. Don't treat training needs equally	-	If they have an operational canine and trying to train other dogs, or have more than one, then they can end up with a number of half trained dogs but not one well trained canine	Can show bias to one dog	Favour the better dog and therefore the other dog not worked enough in exercising

What methods are used to imprint the dogs?	Scent boards in controlled environment and then move to the field.	Initial training - food and tactile praise secondary; Repetitive progressive training to a small number target odours;	Positive assoc. repetition/reward. Incrementally in-bed it	Start in a nursery on 100m grid. 2 infected plants	Repetitive positive reinforcement on infused toy, then no toy but odour only toy introduced once found and placed in an indication position. This is all done in clean environment until canine able to locate odour and deemed imprinted. Its then started in a brief format in its operational environment (fire scenes)	Dolly infused with odour in field	Simple to hard environment. Large quantities to small quantities. Vary the way the odours are presented.
Is it done under controlled conditions or in the field?	Controlled to the field	Early stages in a controlled environment. And then to ops environment. Use numerous presentations to isolate target odour	Controlled environment and then move training off site to bring in variety of environments	Controlled environment. To then the field	-	-	Controlled environment to the field.
What is your method based on?	Internal methods	-	-	-	Based on national/international passive alert-active rewards but has been altered to suit NSW training and operational needs. E.g. once canine is accurate in its target odour and environment. They start negative reinforcements and train off similar odours with corrections for false indications. All corrections are verbal with no harm other than tug on harness and back in the car	-	-
Is it nationally/internationally recognised?	-	-	-	-	As above	-	-

What are benefits of your imprinting method?	-	Use a conditioned reinforcement marker (bridge) with food to establish scent recognition which is more accurate than dummy/play reward. Use experienced trainers to train novice dogs eliminates errors as often setbacks with novice dogs and handlers	Incremental increase in difficulty; finding balance not to go too far. Works quickly	-	Its worked very well in producing accurate canines	-	-
What is your preferred reinforcement method?	Positive reinforcement	-	-	-	Positive	-	Positive
Controlled environment to field	Yes	Yes; to prevent errors	-	-	Controlled then field. However walk canines through fire scenes but do no training until they know their target odours in clean environments.	Yes done in controlled environment first and then move to the field	Yes
Active or passive indication from the dog they have found scent?	Whatever works for the dog and environment they are in. Hawkweed puts nose on it and waits. This used as Cocker spaniel used and doesn't bark much	Both. Passive in first 3 months (airport); Then 1 month of training for active in the mail room. Multi-purposes capability depending on work environment	Active - towel	Sits/points nose out/ or tilts head	Play only. No food, even if they start to become food driven, it is trained out of them as there is food in every fire scene and they do not want the dogs to try or take it	Active	Passive "sit"
What is the preferred method	Active can damage the target Passive can be difficult to see dog has stopped in the field	Passive in airport due to safety issues close prox. To passengers Active (dig/scratch) in mail on moving belts where accuracy and speed is important	-	-	Sit and stare as close to the target odour	Active - scratching at the ground	Passive doesn't disturb the target. Good for environment. Where people are. In field if out of sight you don't know when they have responded.
How many target odours do you think a dog can be effectively trained in?	Up to 6 odours	The less the better	Work from simpler to more complex. Limit to 6	-	Five is the optimum for this role and accuracy of canines	One	Up to 10. But lots of work in upkeep and maintenance for them all equally

Effects of odour quantity on detection. Is there a difference in training at different quantities? If so, what and why?		Odour thresholds need to be continually challenged; but you cannot exceed to dogs current capability. Must gradually challenge	Big quantity and work down. Vary quantities so they don't get used to it	-	Dogs are trained on odour quantities and odour evaporation levels. Start at high levels and then decrease	Odour imprint through scent association protocol on higher levels at first then dropping down to more realistic and usable levels with a 21 day imprint process.	Is huge. Can't keep testing at same amount. Need to vary it otherwise the dog doesn't react if it's not at that amount they have always been trained in
Pre-cursors? Is it possible?	A lot of work still to prove	Start with high and reduce it. If go too low to early background factors can be an issue	-	Are presently experimenting with it. But very difficult to replicate	-	-	-
How do you keep the target odour as pure as possible?	Fresh leaf used. Double bag. Use tweezers to remove and gloves	Don't use pseudo. Do best to eliminate contamination from storage, transport or construction (background) factors	Vary the presentation; handlers take all precaution to not impose their scent;	-	Laboratory grade jars and fuel is evaporated by Science labs and universities. Are beginning to do their own evaporation processes.	Stored in freezer (triple bagged) no more than a month	Not an issue for their targets. More varying what it is stored or associated with.
Is there any odour you cannot get access to?	Not at the moment as the weed is still present in the field Will become a problem if eradicated	No.	No	Wanting to start plum pox which they don't have access to	No	No	No
Do you use pseudo methods for any odours?	As above	No	-	Exploring this issue now. More synthetic replicate	No need for pseudo	Yes as above	-
Where do you source the target odours from for training?	In field	Buy from the supermarket; dispose of it after use. Buy as fresh as possible. Only exception is shelf stable commodities e.g. seeds and dried meats	-	-	Service stations, hardware shops etc. Test dogs out on new fuel lines as they become available.	As above	-
How do you store them and keep them from taking on "storage" odours?	As above	-	Have them sit for hours when brought out of storage	-	Pelican brief cases in vehicles and large quantities in fuel cabinets	As above	Airtight containers. Air conditioned facilities to remove smells

Do your dog's work on or off lead? Pros and cons of your chosen method?	Off lead	Both. On lead airport (safety) off lead mail.	On lead. Can also work off lead. 6 foot of slack on lead	On lead	On lead. Off lead in a clothing search in a controlled/confined environment. Or if doing an assessment for lab or demo for the court to prove no handler influence	Off lead unless in a dangerous area (i.e. road sides at 80km) then on a long line	On leads. 3 sweeps of area. Becomes more specific each time
Pros of your chosen method	Independent, not influenced by the handler	Off lead as dogs less inhibited by lead/handler	For safety reasons. Easy to read signal of the dog.	-	For safety reasons.	-	Safety. Line of sight of the dog
Cons of your chosen method	-	-	Off lead issues as they aren't trained for obedience.	-	Influence of handlers	-	-
How do you manage the transfer of human odour onto target odour?	-	Use controls	-	-	Gloves, pipettes and walking throughout the scene, in training conduct the same walk entry patterns and actions whether setting a target or blank run. Never touch the target odour with bare hands	Try to vary the training. Walk around to sites other than where the target odours are placed so dog does not track them. Gloves. Use crowbar to disturb areas where control isn't placed	Variance
Does your training prepare dogs for harsh or different environments?	Yes dogs are trained for different environments. Lots of physical conditioning also to work in a field environment over large tracts of land	New environments. Don't pose a problem for bold and outgoing dogs. Should find it stimulating if you picked the right dog. Competing odours/distractors used in early stages of training. You must use these tools to instil scent discrimination which is different to scent association (a specific odour in an environment. as opposed to an odour in an environment)	Yes dogs are trained for different environments. Stimulates the dog		Yes		Simple to complex environments. Do obstacle course to test dog's motor skills and bonding to work with the handler.

When do you introduce the competing odours and environment?	-	-	-	-	When the dog has been deemed imprinted	-	-

Quality Assurance							
Is there a standard for maintaining QA of the dog?	Yes. Advocate for independent assessment. Certified by Conservation NZ. Video assessment	Yes. Scent discrimination test and field deployment -twice per year	Video review. Annual appraisal process - welfare dog, maintenance and deployment of dog	-	Yes constant testing down to minimum levels	Yes. Dogs are regularly by trainer and team handler; video footage	Yes annual assessments. Training every day with handler
Is there a standard for maintaining QA of the handler?	As above	As above	As above	-	Constant assessments as handler is blind to odour when training assessment by other FRNSW canine teams, labs or the court	Yes. Handlers are regularly monitored by the trainer and team leader	As above
How do you maintain efficacy of the dog?	Training, video assessment	Variety of performance measures (KPIs) in conjunction with QA process	regular training and review		Constant training and assessments, variety of training and environments in between operational jobs	Maintenance. 2-3 times per week at the moment due to competing time for use in the field	Exercising every day; physical training
Do you have the dogs anointed under your relevant legislation e.g. powers of entry?	N/a	Yes. An appointed officer can utilise animal under Act	No	-	Yes. NSW Fire Brigades Act and under a warrant when assisting the police	N/a	N/a
Coordination and administration							
Do you have an in-house program or contract dogs?	External trainer. Can train handler and dog and then provide advice on an ongoing basis	In house	In house. Looked at US customs model and based on world-wide review of programs.	Contract dogs and handlers	In house	Contract dogs. In house team leader and dog handlers	In house program. Training is coordinated nationally
Pros of in-house	-	know your business better than a contractor;	Self -driven and managed internally. Now 40-50 years of corporate knowledge	-	Can be flexible and adaptable to the changing times. In house staff have access to the fire scenes. The handlers are all professional fire fighters which is essential to understand the risks and hazards associated with training canines within fire scenes.	-	Control of the program. Maintain standards

Con's on in-house	-	Nil given	-	-	-	Funding. Worked on a yearly basis but need to think long term for maintaining capacity of the dogs	Funding. Worked on a yearly basis but need to think long term for maintaining capacity of the dogs
Pro's contracting dogs	A short term program and may not be ongoing - proof of concept. So therefore don't have to invest in dog and associated equipment	Nil given	-	Dollar. Department sets the design specs for surveillance. Not a cost imposed on the department as industry can contract services themselves. Works well with limited resources Beneficiary pays	-	-	-
Cons of contracting dogs	Ideal to have in-house handlers who have technical expertise in identification of the weed to ensure the dog is appropriately rewarded	contract can impose limitations on both parties caused by nature legally binding contracts	Private sector driven by profit there standards can drop; not sustainable long term;	-	-	-	-
What qualifications and experience do your handlers, senior handlers, trainers have?	In house training program	Nil given	ABF employed and trained.	-	Qualified fire fighters. No other experience as in house training provided	Training provided by contractor; In house training has been developed	In house training. Experience in other organisations ABF
What are OH&S risks of using dogs in the field?	Snakes, unstable work ground. No different to field workers	No more than any other tool	Conveyer belts; busy freight environments. Physical jumping/ conditioning of dogs	-	Same as risks to a fire fighter, not safe for them then not using a dog	Snakes, high density traffic, glass/needles; stinging ants	Same as for people. Conveyer belts, warehouses, forklifts etc.
What specialised facilities, equipment and vehicles do you require for the training/private boarding and transport of the dogs?	Fitted out vehicles etc.	Fitted out vehicles; training shed and kennels.	Custom built facility	-	Kennels (home and office area) vehicle, protective clothing, harness and leads, towels used for rewards, vet costs, boarding fees when handler on leave	Fitted out vehicles, ramps, kennels,	Infrastructure for training or location to train. Kennels, storage for scent

Do dogs reside with the handler?	Kennelled with the contractor. Who can double as the handler	Kennelled in depart. Or contracted facilities	No. Can control how dogs are maintained. Separation of dog/handler maintains stimulation of both	-	Live with handler whom is on call 24 hours 7 days a week	One handler keeps dog at home; other are in kennel	No
Do they have specific conditions like fenced run or can they be part of the family?	Kennels at the property	N/a	N/a.	-	Yes fenced or separated kennel run in their yards. They are part of the family, but are not pets, not allowed inside	Cons - never switch off for trainer; Pros - bonding of dog and the handler	N/a
Other	-	-	220 pups bred per year. Excess dogs are sold to government departments only	Researchers are developing different types of services for biosecurity purposes which can be packaged up for contractor to sell. E.g. Spread of pest; detection to confirm infection; detection to confirm property is free	-	Live plant material difficult to replicate. Once you cut it, it gives off a different smell	-