Appendices

Ten Year Eradication Plan

National Red Imported Fire Ant Eradication Program

South East Queensland

2017–18 to 2026–27

Appendix 1
Background Information

1.1 History

The National Red Imported Fire Ant Eradication Program in South East Queensland (SEQ) (National Program) commenced in 2001 following the first discovery of red imported fire ants (fire ants) in Queensland.

Genetic analysis indicates that there have been seven separate incursions of fire ants in Australia. Four of these incursions have been eradicated (from Yarwun in 2010, the Port of Brisbane in 2012, a second Yarwun incursion in 2016 and Port Botany in 2016).

Eradication of incursions in the greater Brisbane and Ipswich areas, which are the subject of this National Program Ten Year Eradication Plan (Ten Year Plan), and new incursions at Brisbane Airport (2015) and Port of Brisbane (2016), are currently underway. The incursion at the Brisbane Airport and the second incursion at the Port of Brisbane are expected to be declared eradicated in 2017 and 2018 respectively if no new nests are found.

There have also been a number of post-quarantine detections in Queensland. Fire ants did not establish as a result of three post-quarantine detections at the Port of Brisbane (2004), Lytton (2009) and Roma (2011) as the infestations were detected and eradicated prior to establishment. The detection at Roma was on a shipment of goods bound for Western Australia.

A further eight quarantine intercepts have occurred at the Port of Brisbane (2009 and 2014), Darwin (2007), Melbourne (2006 and 2015), South Australia (2017 and 2009) and Western Australia (2011).

Since 2002, the National Program has undergone 14 external reviews in addition to a process of regular review by the then Tramp Ant Consultative Committee (TACC). These comprised six scientific reviews, three operational reviews, one efficiency audit, one financial audit and a movement control audit conducted by the Interstate Plant Health Regulation Working Group. There has also been a Senate Inquiry in 2004: *Turning back the tide – the invasive species challenge* (conducted by Environment, Communications, Information Technology and the Arts References Committee). All of these reviews showed the National Program to be scientifically sound, with eradication technically feasible and with an extremely favourable benefit-cost ratio.

Three scientific reviews have occurred since 2010:

- a whole of National Program review conducted in 2010 by a panel chaired by Professor Rick Roush of the University of Melbourne (Roush review)
- a Scientific Advisory Panel Review of molecular genetics in 2011
- a National Program Technical Review conducted in 2012 by an Independent Scientific Advisory Panel.

Immediately following the release of the Roush review report in January 2010, the National Program commenced planning to address science gaps and operational issues identified in the report, and recruited additional staff into the science area. Areas addressed included: assessing the efficacy of the National Program broadcast bait treatments; fire ant spread modelling; assessment of the value of passive surveillance (voluntary searching by the public) to the National Program; remote sensing surveillance diagnostics; refinement of the fire ant Habitat Model; and development of a Disturbance Model.

The most recent and most comprehensive independent review of the National Program, chaired by Mr Bill Magee, was completed in May 2016. The Independent Review report details a ‘compelling case for a strong and continued national approach to eradicate fire ants’, finding that eradication of fire ants remains technically feasible, and that the National Program has the necessary tools and skills to achieve this, provided there is sufficient funding to do so. The report contains 25 recommendations pertaining to all aspects of a future eradication National Program. All recommendations have been addressed in this Ten Year Plan, with the exception of an immediate increase in the National Program’s odour detection dog capability. This recommendation will be considered when the National Program enters into its first planned clearing phase.

1.2 Pest details

1.2.1 Classification

Ants are insects belonging to the order Hymenoptera and the family Formicidae. Worldwide, there are 17 subfamilies, about 400 genera and more than 15 000 described species and subspecies of ants (AntWiki 2017). Australia is currently known to have 12 subfamilies, 109 genera and 1561 described species and subspecies, and many more undescribed species (AntWiki 2017). A few of Australia's ant genera are unique and endemic to this country, and many are only shared with its closest neighbours. However, most of the species are endemic to Australia with only a minority occurring in both Australia and its neighbouring regions (Shattuck 1999).

The red imported fire ant (genus name *Solenopsis*; species name *invicta*) is exotic to Australia. There are six Australian *Solenopsis* species, which occur throughout the eastern and western coastal regions. One of these species has only been recorded in Queensland (Australian Faunal Directory 2016). In addition to S. *invicta*, a second exotic *Solenopsis* species (tropical fire ant, S. *geminata*) is present in northern Australia.

1.2.2 Distribution

Fire ants are native to the South American countries of Brazil, Paraguay, Uruguay and Argentina (Tschinkel 2006). Fire ants are a pest in the southern United States of America (USA) (Callcott & Collins 1996); Taiwan (Yang et al. 2009); mainland China (Zhang et al. 2007); Puerto Rico (Callcott & Collins 1996); Virgin Islands (Wetterer 2013); The Bahamas, Antigua, Trinidad, Turks and Caicos Islands (Davis et al. 2001); Mexico (Sanchez-Pena et al. 2005); Cayman Islands, Hong Kong and Malaysia (Global Invasive Species Database 2009); Australia (Vanderwoude & McCubbin 2002), and there are unconfirmed media reports of infestations in Japan, South Korea, Macau and the Philippines.

1.2.3 Life cycle/ecology

Like most insects, the fire ant life cycle consists of four distinct phases: egg, larva, pupa and adult. All the eggs in the colony are laid by the queen or queens. In fire ant colonies, queens are able to lay 600–800 eggs per day (Vargo & Fletcher 1986; Vinson & Greenberg 1986).

Adults in fire ant colonies are either worker ants or reproductive ants (alates). The workers are sterile females and vary in size (polymorphic) (Tschinkel 2006). Adult ants do not change size. Fire ant workers live for approximately two months (minor workers) to four months (major workers) depending on conditions (Tschinkel 2006).

Mature colonies produce a number of reproductive ants, which are winged males and females. These ants are cared for by workers until they leave the colony to begin their mating flights. The flights usually occur during the warmer summer months when environmental conditions such as temperature and humidity are suitable. However, mating flights can occur throughout the year (Markin et al. 1971; Tschinkel 1987).

Mating occurs on the wing some 100–300 m above ground (Markin et al. 1971; Tschinkel 1998). After mating, the male dies and the inseminated female sheds her wings and begins a new colony if an appropriate nest site is found.

New queens either dig a chamber or find a crevice in which to lay their eggs. Within the first 24 hours, the queen lays 10–20 eggs, which hatch after 6–10 days. The newly hatched larvae develop through four stages, or instars, over the next 12–14 days, before becoming pupae. After 9–16 days, the newly developed ants emerge.

Development from egg to ant takes approximately one month (Tschinkel 2006). During this time the queen continues to lay eggs, which are tended by the newly emerged workers called minims. Numbers build up quickly, and a year-old colony can have approximately 11 000 workers, rising to 240 000 workers after three years (Markin et al. 1973; Hung et al. 1977). Queens can live for over seven years (Tschinkel 1987) and insemination studies in the south-eastern USA have shown some queens had approximately seven million sperm in their spermathecae (Tschinkel 1987).

1.3 Risk assessment

1.3.1 Entry

The Commonwealth Department of Agriculture and Water Resources (DAWR) manages quarantine controls at the national border to minimise the risk of exotic pests and diseases entering Australia. Measures are in place to prevent the entry of fire ants.

Key measures to prevent the entry of fire ants into Australia include:

- implementation of national border protection measures by the DAWR to inspect items entering Australia for contamination by fire ants, and provision for the return, treatment or destruction should fire ants be detected
- implementation of national border protection measures by the DAWR to prevent or treat materials that could be infested by fire ants prior to their entry into Australia
- a national Threat Abatement Plan for dealing with tramp ants.

1.3.2 Establishment

Fire ants are one of a small subset of tramp ants that are classed as highly invasive. This is because these ants are not just restricted to urban areas (such as the Argentine ant, *Linepithema humile*), but also invade natural ecosystems, where they compete with and may displace native ants (Holway et al. 2002). Almost any environment may be suitable for fire ants provided there is a source of food, water and shelter for the colony. Fire ants have been found living in salt marshes, deserts (provided there is some water, e.g. irrigation) and buildings, inside water meter boxes, and in areas covered by snow in winter. They prefer open ground to shaded areas because they can use the sun to heat their mounds in winter.

In the warmer summer months, fire ant workers often shelter deep in the soil profile. They are not often found in forests under full shade. They prefer disturbed ground to undisturbed ground for ease of establishment of their colonies, and because ground disturbance often displaces other ants that may be competitors. Even inhospitable sites may contain pockets of suitable habitat for fire ants. A fire ant colony is highly migratory—the colony may move several times a year to find new food sources or in response to disturbance or inundation by water.

New queens are particularly vulnerable following mating, and only small percentages (thought to be less than 1%) survive to start a new colony (Markin et al. 1971).

Social forms – monogyne and polygyne

There are two social forms of fire ant colonies: colonies that contain a single queen (monogyne), or colonies that contain multiple queens (polygyne). These two forms have marked differences in their social and reproductive characteristics (Ross & Keller 1995). A monogyne nest will only support one reproductive queen (Vinson & Sorensen 1986). Workers from monogyne colonies are territorial and defend the area around their mound from other established ant colonies, as well as from other ant queens attempting to start new colonies nearby (Tschinkel 2006).

In polygyne nests in the USA, there may be up to a few hundred reproductive queens, which may be unrelated (Ross & Keller 1995). In native South America, polygyne nests tend to have fewer queens and there is higher relatedness between queens within a nest (Ross & Keller 1995). In Queensland, polygyne fire ant nests display characteristics of both the US and South American populations (Oakey 2009).

Ants from polygyne fire ant colonies are able to move from one mound to another without hostile reaction from other fire ant workers; they willingly adopt and support founding queens from other colonies (Tschinkel 2006). This type of colony is more stable and has a much greater mound density per unit area than monogyne colonies (Vargo & Porter 1989; Greenberg et al. 1992; Drees & Vinson 1993; Macom & Porter 1996). Drees & Vinson (1990) reported mound densities averaging 1635 per 10 000 m2 in a pasture infested with the polygyne form in Texas, whereas a monogyne-infested pasture in Maryland averaged 72 per 10 000 m2. The higher mound densities achieved by polygyne colonies increase their effect on the environment (Tschinkel 2006).

Colony founding

A single, newly mated fire ant queen can establish a colony that can develop into a nest with tens or hundreds of thousands of workers. Alternatively, a queen and a small number of workers from an existing nest are able to establish a new colony if the old one is disturbed, or part of the nest is accidentally transported to a new location (Markin et al. 1974; Vargo & Fletcher 1986; Obin et al. 1988; Vander Meer & Porter 2001). When a colony is polygyne, it can multiply by colony budding, in which a queen and a number of workers simply walk away from a parental nest and start a new colony some metres away (Vargo & Porter 1989).

Mounds

Fire ants build above-ground mounds, which are typically 30 cm tall and 60 cm in diameter when three years old (Markin et al. 1973), but have been measured at up to 90 cm tall (Green 1952). In Australia, they have been observed up to 40 cm or more in height. Soil type, availability of soil moisture and other factors affect the height, diameter and structure of mounds (Green et al. 1999). New colonies do not produce a conspicuous mound for several months after the new queen begins egg laying (Drees & Vinson 1993).

An unusual feature of the mound is that it tends to have no obvious entry or exit hole. Internally, the nest consists of many interconnecting galleries, which give it a honeycomb appearance. The ants enter and leave the mound via underground tunnels which radiate outwards from the nest. These tunnels can be 20 or 30 m long, winding through a colony's territory (Tschinkel 2006). Nests can be established under logs, rocks or other materials lying on the ground. These materials absorb heat from the sun in the same way that the fire ant mounds absorb heat, thus assisting thermoregulation of the colony (Tschinkel 2006). Fire ants appear to have an attraction to electricity, and nests have been found in buildings and equipment around electrical systems (Vinson & MacKay1990; MacKay et al. 1992).

Mature colonies of up to 500 000 workers have been recorded, although around 150 000 workers is more usual (Oi et al. 1994). Despite their large size and elaborately constructed subterranean nests, colonies will readily abandon an existing nest and relocate to a more desirable location at short notice. This characteristic is useful in environments where resources are not available at all times and at sites subject to periodic inundation or disturbance. It also serves an invasive pest ant well, as it allows an invading colony an opportunity to form a 'beachhead' in an undesirable niche without compromising its ability to move to a new location once a critical mass has been reached (Tschinkel 2006).

Diet

Fire ants have a non-specialised diet which allows them to take advantage of a wide range of habitats and food resources. The polymorphic structure of fire ant workers (meaning that workers vary in size) provides opportunity for the species to exploit a wide range of resources. For example, the larger major workers are able to overpower large insects such as grasshoppers and carry large seeds, while the minor workers can collect nectar from inside small flowers and collect small seeds and soil invertebrates (Vinson & Greenberg 1986; Vinson 1997).

1.3.3 Spread dispersal mechanisms

There are four mechanisms of dispersal that fire ants employ: nuptial flight, budding, rafting, and human-assisted spread.

Nuptial flights

As part of the reproduction cycle, the male and female alates fly and mate in the air. Once mated, the inseminated female will fly to a location where she will lay her eggs to begin a new colony. Both monogynes and polygynes employ this dispersal method, but it is predominantly used by monogynes (Vargo & Porter 1989). There have been reports in the literature suggesting that reproductive flights can result in fire ants travelling 12–16 km away from the parent nest. However, this is likely to be either wind-assisted, or dispersal over water—a case which would reduce the opportunity for reproductive success due to a serious depletion of stored resources (Tschinkel 2006).

Recent evidence from genetic analysis in Australia suggests that the majority of nuptial flight distances are approximately 500 m. Out of 108 direct parental relationships found between colonies, only three indicate dispersal greater that 3.7 km, with the greatest being 12 km (Oakey 2009). It is unknown if human-assisted or natural movement is the cause of these large dispersal distances. With the biology of the monogyne alates being larger in body size and wing development than their polygyne counterparts, monogyne fire ants are thought to be more likely to successfully mate and survive to establish a new colony through nuptial flights (Mescher et al. 2003).

Budding

Dispersal and colony founding by budding a new colony from the parent nest is much simpler and more reliable than nuptial flights, but can only occur in polygyne colonies. A queen will leave her maternal nest, taking with her a group of workers, and walk away for 1–50 m to establish a new nest. The new nest is capable of functioning independently. However, it has been found that there may be regular interchange of workers, food and brood between neighbouring polygyne nests (Bhatkar & Vinson 1987; Porter & Savignano 1990; Vargo & Porter 1989). Polygyne colonies have been found to use the budding process to re-establish colonies after disturbance and even after flooding.

Rafting

The fire ant natural range is the headwaters of the Paraguay River, which arises in one of the largest wetlands in the world. Every year during the rainy season, the waters of the Paraguay River flood an area of approximately 180 km2. Fire ants have adapted to this regular inundation; colonies are able to float on the water's surface (rafting) for weeks until land is once more available. It is interesting to note that areas of regular and continual flooding do not support large populations of fire ants (Tschinkel 2006). Rafting consists of bundling the queen and immatures inside a ball of worker ants, which is continuously rotating to allow workers access to surface air (Morrill 1974; Taber 2000), and floating on the water surface until contact with land is made.

Human-assisted spread

Fire ants may also spread through the movement of items they are associated with or housed within, such as soil, potting mix, plant equipment and other cargo (Tschinkel 2006; Vinson 1997). This is believed to be the method of introduction of fire ants into Australia through the Port of Brisbane. An example of this occurred in 2011, when a consignment of mining equipment originating in the USA was found to be infested by fire ants after being unpacked in Roma. Further evidence of successful colony spread through mechanical vectors was demonstrated after a fire ant nest was detected by tracing the movement of pot plants from an infested commercial premises to Doonan, 150 km away from Brisbane; another such movement occurred with a consignment of infested plants to Victoria (Vanderwoude & McCubbin 2002). The risk of successful colony spread through mechanical vectors is minimised through the declaration of Fire Ant Biosecurity Zones (zones), and the requirement for movement controls within these areas.

1.3.4 Potential impacts

Since they were accidentally introduced into the USA around the 1930s, fire ants have become a major pest in southern states. By 2017, they had spread to infest more than 148.5 million hectares of land across 15 states (USDA 2017). Unlike many insect pests that cause either economic, health or environmental impacts, fire ants have significant impacts in all of these areas (Vinson 1997).

Climate modelling conducted by the CSIRO for the National Program using CLIMEX has shown that fire ants have the potential to inhabit most of the major coastal areas of Australia, and extensive areas of the tropical north. Vast areas of the continent's natural environment, including world heritage areas and national parks, are prone to fire ant invasion (Sutherst & Maywald 2005).

Fire ants are a 'super pest', whose impacts, if unchecked, will surpass the combined effects of many of the pests that are regarded as Australia's worst invasive animals (Wylie & Janssen-May 2016). Three cost-benefit analyses have estimated the costs if fire ants became established at between A$8.5 and A$45 billion (Kompas & Che 2001; Antony et al. 2009; Hafi et al. 2014). The higher figure includes the estimated environmental impact.

a) Economic and infrastructure

While fire ants have so far been prevented from affecting Australia's business sectors in a significant way, they have had a major economic impact in the USA. A broad range of industries face additional costs to deal with fire ants, including animal industries (e.g. cattle, sheep, goats, pigs, equine, poultry, apiculture and pets), plant industries (e.g. broadacre crops, fruit and vegetables, hay and forestry, turf, nursery and landscaping, and apiculture), tourism, mining and development, and construction. Furthermore, fire ants have resulted in costs to public utilities and infrastructure such as airports, roads, and electrical and communications infrastructure.

If uncontrolled, Australia could expect similar impacts to those seen in the USA, where fire ants cause over US$7.43 billion in annual economic costs (Lard et al. 2006, extrapolated from data collected in 1999).

The greatest damage was to residential households with almost US$5.24 billion, electrical and communications infrastructure with almost US$910 million, and agriculture with over US$611 million (Lard et al. 2006, extrapolated from data collected in 1999).

Agriculture

While fire ants have been prevented from infesting Australia's significant agricultural areas, they have had a major impact on agriculture in the USA. Gutrich et al. (2007) undertook a study to estimate the potential economic costs to Hawaii in the event of the introduction and establishment of fire ants. The authors of the study concluded that the estimated impact on various economic sectors in Hawaii would be around US$211 million per year.

The Australian Bureau of Agricultural and Resource Economics (ABARES) (Hafi et al. 2014) estimates that losses to the Australian agricultural industries, if there were no National Program, would amount to between A$4.5 billion and A$13.6 billion over 70 years. Based on US impacts, it is estimated that the Australian cattle industry would be hardest hit if there were no National Program to eradicate fire ants. Hafi et al. (2015) estimate gross margins could be reduced by around 40% in beef cattle farms if fire ants were to establish across Australia.

Fire ants can affect agricultural practices by:

- **attacking livestock and chickens**—in Texas, two thirds of all veterinarians surveyed reported having treated animals for fire ant injury, of which 17.5% were cattle (Jetter et al. 2002; Riggs & Drees, 2003; Baar & Drees, 1994)
- **invading the food and water supplies of animals**—animals are unable to reach the food or water without being seriously stung, and this can lead to starvation and dehydration. Fire ants can cause problems on poultry farms by attacking chickens and foraging on broken eggs. Stings cause blemishes that can reduce the quality of poultry (Drees & Vinson 1993)
- **predating on newborn animals**, as fire ants are attracted to mucous areas and wounds (Drees & Vinson 1993)—this commonly occurs in south central Texas, as heavily grazed pastures support high populations of fire ants (Summerlin et al. 1984)
- **causing fatal damage to some plants by tunnelling through roots and stems and by girdling various parts of young ornamental plants** (Vinson 1997) and feeding on planted food crop seeds (Banks et al. 1991; Drees & Vinson 1993; Morrison et al. 1997)
- **eating the bark and cambium of young citrus trees** to obtain sap while chewing off new growth, and feeding on flowers and developing fruit (Banks et al. 1991; Jetter et al. 2002)
- **downgrading the quality of produce and assisting the spread of some diseases** (Vinson 1997; Vinson & Sorensen 1986)
- **invading bee hives** and feeding on developing bee larvae, occasionally destroying weak colonies (Drees & Vinson 1993)
- **increasing costs to farmers in time, costs of control and machinery and infrastructure repairs** due to mounds damaging harvester operations and irrigation systems in the USA (Drees & Vinson 1993)
- **reducing worker productivity**
- **hindering integrated pest management practices**, and feeding on important biological control agents
- **increasing the costs of compliance due to interstate and intrastate movement restriction controls**—in 2008, the Nursery & Garden Industry Australia reported that the Queensland nursery industry invests over A$18 million a year on fire ant compliance costs and the implementation of interstate and intrastate movement restriction protocols.

Infrastructure, telecommunications and electrical industries

Although fire ants typically nest outdoors in the ground, in high-density populations they bring soil into and make nests inside wall cavities, in electrical boxes such as air conditioners and traffic signal boxes, computers, and car electric systems (Vinson 1997). They also infest telephone junctions, airport landing lights (Lofgren 1986), electric pumps for oil and water wells, computers, and car electrical systems (Lofgren 1986). Foragers also occasionally cause short circuits in electrical wiring by chewing on insulation (Lofgren 1986; Slowik et al. 1997), and fires have been started after such incidents (Brenner et al. 1994). Fire ants have caused portions of roads to collapse (Lofgren 1986). They also chew through the silicone sealant which is used to regulate surface expansion on highways (Adams 1986).

If uncontrolled, fire ants would likely result in substantial damage to, or deterioration of, infrastructure used by a significant proportion of people over an extensive area of Australia. An extrapolation of data from the USA to Australia estimates costs to the electrical and telecommunications industries of over A$23.7 million (Wylie & Janssen-May 2016).

Tourism

Costs are also borne by tourism and related businesses. These include golf courses, swimming pool installers, ball parks, hotels and resort facilities. These businesses must treat their properties to ensure they are free from fire ants, as there may be liability issues if people or pets are hurt (Vinson 2013). Fire ants also infest coastal dunes and foreshores in the USA (Defeo et al. 2009). In Australia, activities such as picnicking and swimming may be affected at hotels, on infested beaches, and in national and local parks.

b) Health and social amenity

Fire ants will have a significant impact on Australian health and lifestyles. In the USA, severe impacts have been reported on human health, schools, and public amenities and sporting facilities, including public urban areas, cemeteries, golf courses, sports fields and auto racing tracks (Lard et al. 1999). If left uncontrolled in Australia, fire ants would likely result in substantial human health, lifestyle and social amenity impacts.

Human health

Fire ants can have significant impacts on human health because of their sting, which is similar to that of wasps and bees. However, unlike bees, fire ant workers can sting repeatedly.

Colony defence is a feature of fire ants (Nattrass & Vanderwoude 2001). When disturbed, workers rush out from the damaged colony and swarm over the mound surface and on to any humans or animals close by (Vinson & Sorensen 1986). They sting in synchrony, which is initiated by an alarm pheromone. Fire ants have the ability to sting repeatedly, and will continue to do so even when their venom supply has expired. Their venom is unique among Hymenoptera in that it is composed largely of alkaloids instead of acids (Lofgren 1986).

Symptoms of a fire ant sting include the rapid onset of flushing, general hives, swelling of the face, eyes or throat, chest pains, nausea, severe sweating, breathing difficulties and faintness. The usual response is the immediate development of localised welts on the skin, followed by pustules within 24 hours (Stafford 1996). There is a risk of secondary infection if the blisters or pustules at the sting sites are broken, causing severe complications to the original stings (Parrino et al. 1981; Lofgren 1986). Multiple stings give the sensation that the skin is on fire; hence, the common name fire ants (Tschinkel 2006).

In extreme cases, fire ant stings have been lethal to humans due to anaphylactic shock and lack of medical attention (Stafford 1996; Solley et al. 2002). It is believed that, in the USA, at least 100 people have died as a result of a sting or multiple stings from fire ants (Rhoades et al. 1989; Taber 2000). No deaths have occurred in Australia, but people have been hospitalised for treatment following fire ant stings (Solley et al. 2002).

In a US survey, 89% of people living in a fire ant infested area said they, or someone in their family, had been stung (Vinson 1997). In the USA, over 40 million people live in areas infested by fire ants. Annually, 14 million people are stung, and one-quarter of these are expected to develop some sensitivity to fire ant toxin (Lofgren et al. 1975). It is estimated that 1% of the 14 million people stung each year seek medical attention (Adams 1986; Taber 2000; Vinson 2013).

A survey of 1286 practitioners in South Carolina (USA) (population 4 million), where fire ants are well established, had similar results, estimating that annually over 33 000 people (94 per 10 000 population) seek medical consultation for fire ant stings, and, of these, 660 people (1.9 per 10 000 population) are treated for anaphylaxis (Caldwell et al. 1999). Direct extrapolation of this data to the Australian situation would suggest that about 140 000 consultations and 3000 anaphylactic reactions are to be expected each year by 2030 if fire ant eradication is not successful (Solley et al. 2002). Wylie & Janssen-May (2016) estimate the total medical costs borne by Australian households could be A$114 million based on the impacts realised in the USA.

Increasing pest density positively correlates with an increase in stings occurring indoors. Between 1991 and 2004 in the USA, 20 people were reportedly stung indoors, mostly in long-care facilities. Effects ranged from nightmares to death in seven adults 2006. Three involved hospitalised patients, and there were also a number of infants stung. One of the infants died and two suffered long-term morbidity. Six of the 20 sting victims died within one week of the attack. Seven of the 10 attacks reported in newspapers did not result in significant medical consequences, as compared with only two of the 10 attacks in previously published reports (Rupp & deShazo 2006). There have been many attacks in nursing homes which have resulted in litigation and settlements in excess of US$1 million (Oi 2008).

Similarly, in areas of mainland China where fire ants have infested, approximately one-third of the people have been stung by fire ants. Nearly 10% of people reacted with fever and dizziness and around 1% experienced some systemic allergic reaction (Xu et al. 2012).

The impact of fire ants is not restricted to people (Barr et al. 1994; Vinson 1997). Pets and domestic animals are also stung and injured, and may have allergic reactions to fire ant venom. Fire ant stings are a major reason for visits to veterinarians in fire ant infested parts of the USA (Barr et al. 1994). If fire ants were left unchecked, Australian outdoor dwelling pets and domestic animals would be adversely affected.

Lifestyle and social amenity

Fire ants have the potential to seriously impact outdoor lifestyle. In the USA, people in fire ant infested areas have changed their habits to avoid exposure to the ants (Drees & Vinson 1993) by avoiding having picnics on their lawns, walking barefoot outside, sitting or lying on the ground, gardening, or even standing for too long in one spot.

In Australia, public areas such as parks and recreational areas may become unsafe for children (Department of Sustainability, Environment, Water, Population and Communities 2011).

Outdoor activities, such as gardening, increase the risk of stings. Although fire ants typically nest outdoors in the ground, they have been found inside dwellings and other structures. In the USA, fire ants have been discovered in wall cavities, under rugs, in electrical boxes, computers, cars, and even beds and wardrobes (Vinson 1997). As a result, fire ants can become a problem in homes, apartments, schools and businesses.

In the southern USA, infestation in schools, sporting fields, cemeteries, on golf courses and at auto racing tracks is common, requiring increased expenditure on treatment, repair, replacement and medical costs (Lard et al. 1999; Dorough 2006; Lard et al. 2006).

Fire ants also have the potential to reduce property values in areas where infestation occurs. In Australia, in the initial stages of the National Program, when infestations were high compared to today's relatively low infestation levels, there were reports of fire ants nesting in pot plants on verandas, and invading homes. There have been no reports of this occurring since the reduction in the density of the infestation.

c) Environment

Fire ants are considered by the International Union for Conservation of Nature (IUCN) to be one of the world's most invasive alien species, and have been listed as one of 100 worst invasive species in the world (Global Invasive Species Database 2016).

Fire ants would likely result in extensive impacts on:

- nationally important and ecologically valuable species
- nationally important and ecologically valuable places.

Impacts on nationally important and ecologically valuable species

The Tramp Ant Threat Abatement Plan lists 10 endangered, 15 vulnerable and 14 unlisted species recognised by the *Environment Protection and Biodiversity Conservation Act 1999* that may be adversely affected by fire ants (Commonwealth of Australia 2006).

In the USA, fire ants are an aggressive predator, reducing populations of many pest species. The animals at most risk include ground-dwelling animals and those that hatch from eggs in the soil. Species that are stung by fire ants may be killed outright, and those stung non-lethally may exhibit reduced weight gain or survival, loss of digits, obscured vision or blinding, and an inability for normal movement.

Fire ants also affect native vertebrate wildlife in the USA by consuming soft-shelled eggs, hatchlings, newborn and dependent young, and sometimes adults of certain species. Fire ants reduce biodiversity among invertebrates, reptiles, frogs, lizards, ground-nesting birds and small mammals (Wojcik et al. 2001). In the USA, fire ants have been found to negatively impact at least 14 bird species, 13 reptile species, one fish species and two small mammal species through predation, competition or stinging (Holway et al. 2002).

Fire ants are competitively dominant to most other invasive ant species, reducing native ant populations (McGlynn 1999) and displacing the Argentine ant in areas in the USA where the species have been introduced (Holway et al. 2002). Many other species of effective predatory ants are eliminated by fire ants, resulting in a simplified predator component of the ecosystem. Thus, any beneficial effects of fire ants are offset by a reduction in the diversity of important beneficial arthropods (Vinson 1997).

In the USA, ticks, chiggers, boll weevils, sugar cane borer and corn earworm populations have been reduced, and fire ants also prey on parasitised aphids, parasitic insect pupae, eggs of beneficial lacewings, and larvae and adults of many other beneficial insects that are important in reducing pest problems.

Serious negative impacts on Australian native ant species and native scincid lizards have already been observed in the early stages of the National Program (Nattrass & Vanderwoude 2001) in infested bushland in Brisbane's south-west. Environmental studies conducted in the infested area in Queensland have revealed that, since implementation of the National Program (and the significant reduction in the population of fire ants present), there has been a reversal in the decline of native ant species (NRIFAEP unpublished data 2002).

Fire ants will pose a substantial risk to Australia's fauna if they spread beyond their current Australian range and are not eradicated. If the worst-case scenario occurs, and their range increases to cover most of the continent as predicted, wide-ranging species declines in a variety of habitats is expected (Wylie & Janssen-May 2016). Although endangered species are of particular concern, many common Australian animal species have experienced range declines, and the additional pressure caused by fire ants may be sufficient to result in a new wave of local or country-wide extinctions (Moloney & Vanderwoude 2002).

Nationally important and ecologically valuable places

Without a National Program to eradicate fire ants, the species would likely have an extensive impact on the physical environment, Australian biodiversity, the structure of ecological communities, ecosystem functions, environmental amenity and ecosystem services.

Fire ants have the potential to impact Australian native fauna and flora, and as such were listed as a key threatening process on 2 April 2003 under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.

Fire ants have been shown to have a broad environmental impact in the USA, including damage to plants and plant communities, reduction in invertebrate fauna (food sources for other species), altered ecological balance (simplified ecosystems) and increased endangerment of species.

Being omnivorous, fire ants can exert not only a direct effect on the plants (feeding), but also secondary effects (e.g. predation on seeds and seedlings may alter the ratios and the distribution of plants available to develop, which can cause major changes in an ecosystem) (Vinson 1994).

Disturbing the assemblage of invertebrates and vertebrates in an area will ultimately affect plant assemblages. The farming by fire ants of aphids and scale insects will increase stress to plants (Vinson 1997; Vinson & Sorensen 1986). The removal of specific ant/plant pollinators and replacement with fire ants could adversely affect pollination and seed set. If fire ants intercept insect pollinators, some of which are very specific to some plant species (e.g. a range of native bees, flies and beetles), the plants' pollination service may be disrupted. Common species of plants may become rare or locally extinct if their symbiotic relationship with native pollinators is disrupted or their seed is removed and destroyed.

Worldwide, it is estimated that ants disperse 35% of all herbaceous plant seeds (Beattie 1985), and at least 70% of the carbohydrates used to support fire ant colony maintenance and growth are obtained directly or indirectly from plants (Shatters & Vander Meer 2000). Invertebrate herbivores may be important for regulating seed viability, plant architecture and competition among plants. The loss of decomposing species will affect soil nutrient levels that will ultimately affect the plant assemblages. The ability of ants to facilitate vegetation change is recognised worldwide (Levey & Byrne 1993), and extrapolated to an Australian context, fire ants will adversely affect Australian vegetation communities.

Appendix 2

Monash University modelling

The Independent Review panel considered that the value of the Monash University modelling was to estimate a quantum of funding required for the National Program to achieve eradication, and it recommended that the National Program develop the specific treatment and surveillance actions (what, where and when) to be implemented.

Due to the nature of modelling, many elements of the optimal strategy were simplified. Therefore the National Program believes it is more appropriate to implement eradication practices in line with the scientific standards required for an eradication program. For instance, the National Program would aim to treat heavily infested areas up to six times within as short a timeframe as possible to achieve a 99.994% confidence of treatment success, as opposed to implementing the variable treatment rates and timing that were modelled (and which achieved a 95% probability of eradication) (refer to **Appendix 3**).

The modelling also does not attempt to predict human-assisted spread of fire ants. Increased media (including social media and television advertising) will be undertaken to mitigate this risk.

The Monash University modelling did not provide any information on which areas may require some form of management action (i.e. treatment or surveillance). The modelling prioritised the treatment and surveillance of areas based on the estimated number of undetected fire ant colonies at each site ('most abundant' infestation). This means that the model did not allocate as many rounds of treatment and surveillance in isolated, less infested areas (usually in the outer areas of the operational area) compared with more heavily infested areas. National Program research into best practice standards indicates that eradication would be more efficient and practical to manage if eradication effort was focused around the outer western perimeter initially, moving progressively toward the eastern areas of the infestation. This would also provide more confidence to cost-share partners, as the operational area will constrict over the life of the program.

The modelling also assumes that the budgets for treatment and surveillance would be split evenly (i.e. 50:50) over the life of the program. However, consistent with eradication best practice, the National Program will aim to treat heavily in initial years to reduce the infestation rapidly, and then shift to higher levels of surveillance in the final years to ensure no fire ants remain.

The modelling assessed management actions, taking into account the time required for the development of remote sensing surveillance prior to its implementation. The optimal strategy allows for an initial two-year period whereby the latest remote sensing surveillance technologies and algorithm developments will be further investigated, and the existing remote sensing surveillance systems will be upgraded and tested to ensure successful their implementation in Phase 3 of the planned approach outlined in the Ten Year Plan.

There were also some eradication activities that were not modelled. These activities are outlined in the plan and are consistent with the recommendations made by the Independent Review panel. These activities include: communication and engagement; preventing human-assisted spread; science evaluation and improvement of diagnostic techniques and treatment processes; odour detection dog surveillance; and support services including planning, policy development, quality assurance, information and spatial systems, administration, finance, workplace health and safety, and human resource management. Processes to undertake post-treatment surveillance to determine treatment success and declare proof of freedom were also not modelled (and not included in the treatment and surveillance costing estimates recommended by the Independent Review panel).

Appendix 3

Responsive eradication activity

The approach for responsive eradication activities is outlined in Figure 3.

Figure 3: Overview of responsive activities

New infestation in area undergoing or which has already undergone treatment phase or beyond operational area boundary

- Broad delineation surveillance (based on situation) unless within planned treatment areas
- Diagnostics to confirm fire ant and genetic testing as required
- Communication and engagement tailored for new isolated or outlier infestation unless already part of existing campaign
- Treatment for outlier/isolated infestation unless already in planned treatment area
- Surveillance to confirm treatment success
- Monitoring of compliance with treatment GBO on any sites receiving responsive treatment
- Compliance and investigation activities where human assisted movement is potential cause of new infestation

New infestation detected in future treatment phase area

- Minimal delineation surveillance
- Diagnostic services to confirm fire ant (genetic testing on selected samples only)
- New messages communicated about approach to future areas
- Treatment as per protocol (TBD)
- No validation surveillance or monitoring of treatment GBO

Appendix 4
Technical feasibility

This appendix assesses the technical feasibility of the proposed response for eradication of fire ants in SEQ against the following criteria:

- capability to accurately diagnose or identify fire ants
- effectiveness of the control techniques
- level of confidence that all individual fire ants present can be destroyed by the recommended control techniques
- level of confidence that it is possible to remove fire ants at a faster rate than they can propagate until the population is reduced to a non-viable density
- confirmation that the recommended control techniques are publicly acceptable
- endemic pest or disease controls that may limit or prevent establishment
- legislative impediments to undertaking the Ten Year Eradication Plan
- the known area of infestation
- the likely distribution of the pest or disease and dispersal ability of the organism
- identification of the pathways for the entry into, and spread within, Australia of the pest or disease and level of confidence that further introductions are sufficiently low
- the level of confidence that the organism is detectable at very low densities (to help determine if eradication has been achieved), and that all sites affected by the outbreak have or can be found
- surveillance activities that are in place or could be put in place to confirm proof-of-freedom for sites possibly infested by the pest or disease.

4.1 Capability to accurately diagnose or identify fire ants

In comparison with Australian native Solenopsis species, Solenopsis invicta is easily distinguishable by its generally larger size, polymorphic workers, darker colour and the presence of a middle clypeal tooth.

Diagnosticians use microscopic laboratory diagnosis to positively identify fire ants. Field staff provide preliminary identification, and geneticists undertake genetic analysis to determine social form, population structure and intra-population analysis. A fire ant identification kit is also available which may be used by non-experts to positively identify fire ants in the field.

4.1.1 Field identification

Field officers make preliminary identifications in the field using the following characteristics:

- worker caste is polymorphic
- head and body are a coppery-brown colour, with a darker abdomen
- if visible, nests vary in shape and size, but can be up to 40 cm high dome-shaped mounds without any obvious entrance and exit holes. Foraging holes generally occur every 1–5 m along the underground tunnels.

Samples are then taken of ants with features consistent with the above characteristics and submitted for diagnostic testing.

4.1.2 Laboratory diagnosis

National Program scientific staff diagnose samples using visual examination of morphological diagnostic characteristics as outlined by specialised scientific web databases such as AntWeb and PaDIL.

The diagnostic characteristics of *Solenopsis invicta* are:

- worker caste is polymorphic and ranges in size from 2–6 mm
- head and body are a coppery-brown colour, with a darker abdomen
- propodeal spines are absent
- antennal scrobes are absent
- waist has two segments (petiole and post-petiole)
- antennae have 10 segments, with a two-segment club
- petiolar process is either reduced or absent
- mandibles have four teeth
- a single central seta visible on the lower edge of the clypeus
- anterior clypeal margin has a middle tooth between two lateral teeth.

All positive diagnoses are confirmed by a second member of the diagnostics team as part of the confirmation process.

National Program scientists then send confirmed positive samples for genetic analysis (if required). The National Program has made a large investment in progressing genetic analysis of fire ant populations in Queensland. There are two components to the current analysis: determination of social form (monogyne or polygyne) and fragment analysis using microsatellites to determine relatedness.

4.1.3 Determination of social form

Within the National Program, the social forms of fire ant samples are determined using genetic analysis of the Gp-9 alleles. Fire ant workers and queens from monogyne (single queen) colonies always have the genotype BB, whereas fire ant queens from polygyne (multiple queen) colonies have the genotype Bb, and polygyne workers can be either BB, Bb, or bb.

Since December 2007, genetics staff conduct this analysis using a High Resolution Melt (HRM) polymerase chain reaction (PCR) technique developed by Oakey (2009) (from the National Program). During 2007, the National Program validated this method against the standard restriction endonuclease analysis (REA) PCR described by Krieger & Ross (2002). It was necessary to develop this test as the DNA extracted from field samples was of inadequate quality to perform reliable analysis.

The National Program performs a 'bulk' DNA extraction using a pool of 5–10 fire ant workers from a colony. Pooling multiple ants, rather than single ants, from a colony eliminates falsely assigning the monogyne genotype to a polygyne colony (as the BB genotype exists in workers from both types of nests). The National Program performs DNA extraction using a commercial kit (QIAgen DNeasy Blood and Tissue kit) according to the manufacturer's instructions.

Knowledge of social form is useful to the National Program, as both forms have different dispersal characteristics and associated risk of spread, meaning that the operational response to the detection of a polygyne colony can be different to that for a monogyne colony. For instance, the detection of a polygyne colony may require more thorough tracing (and possibly require more intensive treatment methods to reduce the initial high density of colonies), but may not require the same extent of surveillance compared to the discovery of a monogyne colony, as the polygyne social form rarely develop from nuptial flights.

4.1.4 Determination of colony relatedness

Microsatellites are short tandem repeats found within the genes of eukaryotic organisms. These repeats are prone to higher levels of mutation and can be used in genetic analysis to determine kinship and levels of relatedness between individuals. The variable number of repeats can be detected using PCR. An individual's pattern of microsatellite lengths (alleles) at multiple microsatellite sites (loci) in nuclear DNA provides a microsatellite genotype for that individual.

The National Program conducts fragment analysis to determine the following:

- **population structure**—which aids in the determination of:
  - how many populations are present and how many separate incursions have occurred
  - the presence/absence of sub-structure within a population
  - whether a population is demonstrating genetic equilibria (population stability)
- **intra-population analysis**—which aids in the determination of:
  - estimating the number of founding queens
  - the relatedness between colonies
  - estimating the dispersal distances of newly detected colonies
  - whether newly identified colonies survived treatment or are a new infestation
  - estimating the number of undetected colonies.

Colony relatedness and population analysis are useful to the National Program as they provide crucial information about the number of times fire ants have established (number of separate incursions), and whether new detections are the result of treatment survival or the result of colony spread.

4.2 Effectiveness of the control techniques

The incidence of fire ant infestation is reduced through:

- the early detection of fire ant colonies
- the destruction of those colonies and the treatment of areas around the colonies (based on the limit of natural dispersal of the pest)
- the prevention of new colonies forming in areas outside of the limit of natural dispersal of the pest (as a result of human-assisted spread).

Since 2001, Australia has had measures in place to detect, control and contain fire ants in areas of Queensland where they are known to occur, and measures to eradicate fire ants from known infested areas.

Detection strategies used depend largely on abiotic and resource-related factors (e.g. targeting surveillance to suitable fire ant habitat in proximity to known infestations, and conducting detection surveys at times when treatment will be ineffective due to ant foraging behaviour). Control and containment measures include addressing the risk of human-assisted spread, and eradication measures include the use of chemical products to destroy infestations.

Experience gained in dealing with fire ants in the USA initially provided the basis for developing a course of action for control and eradication of fire ants in Australia. Subsequently, national oversight groups, including the TACC and, in the early days of the National Program, its technical reference group, the Scientific Advisory Panel, have been responsible for developing, analysing, endorsing or rejecting any proposed modification to the course of action based on experience of fire ants in Australia, and to reflect the changing situation and ensure eradication is achieved in the most efficient and effective way possible.

Going forward, a new national oversight group: the National Program (SEQ) Steering Committee and technical advisory groups (as required) will be responsible for strategic oversight and technical direction of the National Program.

4.2.1 Detection methods

The National Program employs a number of surveillance strategies for the detection of fire ants, dependent on abiotic factors that influence fire ant behaviour, infestations levels and available resources.

The Ten Year Plan details the surveillance methods to be implemented by the National Program.

4.2.2 Containment measures

The key control measure for containment of fire ants is the implementation of movement controls on infested areas and high-risk materials.

Queensland's *Biosecurity Act 2014* (the Act) provides the legislative framework for biosecurity measures designed to safeguard our economy from pests including fire ants. The Biosecurity Regulation 2016 (the Regulation) sets out how the Act is implemented and applied.

The Ten Year Plan details the containment measures to be implemented by the National Program.

4.2.3 Eradication measures

The National Program uses a number of chemical products that have been approved for use under the conditions of the relevant product label or permit. The following section details chemicals currently used in the National Program, as well as their destruction effect on the pest. These chemicals have been employed in the eradication of the Brisbane Airport (2015), Yarwun (2013), Yarwun (2006) and Port of Brisbane (2001) incursions.

It is proposed that the same chemicals will continue to be used to treat fire ants in SEQ.

a) Fipronil treatment and effect

The National Program currently uses fipronil in a liquid form to conduct direct nest injection (DNI), in a once only application. Fipronil is a slow-acting poison which is non-repellent and undetectable. It kills insects by both contact and ingestion as it disrupts normal nerve function, and works by blocking the GABA-gated chloride channels of neurons in the central nervous system. The GABA-receptor system is responsible for inhibition of normal neural activity (i.e. prevents excessive stimulation of the nerves). When the system's regular functions are blocked by fipronil, the result is neural excitation and the death of the insects.

b) Insect growth regulator treatment and effect

Currently, broadcast treatment baits are crushed corn impregnated with soybean oil and an insect growth regulator (IGR), either S-methoprene or pyriproxyfen. The use of an IGR interferes with the growth and development of ants, thereby breaking the reproductive life cycle, causing starvation of the colony.

Ant workers pick up the bait granules and take them back to the colony, where workers extract the toxic oil and feed the bait to both the queen and immature ants, preventing worker replacement through the degeneration of the queen's reproductive organs. The lack of worker replacement results in colony death as the existing worker ants age and die. In field trials conducted in the USA on methoprene (0.5% active ingredient), with one application, efficacy rates ranged between 66% and 98% (average 83% over several studies). The time taken to reach maximum efficacy ranged from 4–8 months (the 98% efficacy was achieved over eight months) (National Program unpublished data 2011). In field trials with one application of pyriproxyfen, efficacy rates ranged between 86.9% and 100% (average 95% over five studies). The time taken to reach maximum efficacy ranged from

2–9 months, but in a few studies, efficacy rates of 95–100% were achieved in 2–6 months. Pyriproxyfen is relatively stable in sunlight with a half-life of 3–16 days (National Program unpublished data 2011).

S-methoprene is permitted for use up to the edge of waterways, whereas pyriproxyfen cannot be applied within 8 m of water when using ground-based equipment. S-methoprene is used for the aerial baiting regime.

The National Program will continue to investigate existing and new treatment products (such as indoxacarb and water-resistant baits) as they become available, and liaise with the Australian Pesticides and Veterinary Medicines Authority (APVMA) in regard to approvals for these products.

4.2.4 Bait distribution methods

Bait in SEQ will be distributed either aerially, on foot, or using an all-terrain vehicle (ATV) or blower truck, with aerial baiting being the most efficient method of application. Manual application of bait on foot is the most labour intensive and expensive method of treatment, but it is the only option available for use in heavily built-up areas or other areas where it is not possible or practical to treat using mechanical methods. This method involves program staff carrying handheld and operated bait dispersal devices and systematically walking over the area surrounding the fire ant infestation. In heavily vegetated areas and steep terrain, a backpack blower unit may be substituted for, or work in combination with, hand-operated bait spreaders to ensure a more effective coverage of the area.

4.3 Level of confidence that all individual fire ants present can be removed/ destroyed by the recommended control techniques

Australian efficacy data proves that DNI is almost 100% effective in destroying a fire ant colony, and is not subject to foraging activity and associated temperature considerations (National Program unpublished data 2009).

Published data from the USA indicates that broadcast baiting has proven to be effective against fire ants (Drees et al. 1996), with reports indicating 80–95% control within 1–6 months (Barr 2000). A higher level of confidence in achieving eradication of a known infestation is achieved through the conduct of multiple rounds of treatment and combining the confidence obtained from each treatment.

This is represented by the formula:

$$C=1-(1-C1) \times (1-C2) \times (1-C3) \ldots (1-Cn)$$

Where C is the confidence provided after n treatments, and Cn is the confidence provided by each round of treatment.

Assuming the confidence provided by each round of treatment is constant, the confidence of success over multiple rounds of treatment may be represented by the following formula:

$$C=1-(1-tE)n$$

Where tE is the treatment efficacy, and n is the number of treatments conducted in the treatment area.

Assuming a treatment efficacy of 80% for each round of bait treatment, **Table 4** demonstrates that a confidence of success in destroying fire ant infestation in the treatment area after six rounds of treatment is 99.994%.

However, additional unquantifiable factors such as temperature, terrain and the effectiveness of delivery systems can impact on the confidence of eradication of a colony provided by an individual or series of treatments. The theory also assumes that each treatment is a ‘perfect’ treatment and is applied without error and as specified over the treatment area.

National Program experience has shown that polygyne infestations take longer to kill and more rounds of bait. A National Program trial (concluded April 2016) with Distance® bait at Ebenezer required five rounds of treatment before all colonies were destroyed. Analysis of early National Program data on 60 study sites showed that, using baits alone, all monogyne infestations (n=22) were eradicated in 15–18 months, but polygyne infestations (n=38) were not eradicated until 24–30 months (McNaught et al. 2014).

Polygyne colonies have multiple queens (up to several hundred have been recorded in the USA) and higher density of mounds. For IGRs to work effectively, the active chemical must be maintained within the colony at levels high enough to cause brood production to cease and for long enough to allow the colony to age and die. At high initial populations of fire ants, competition between colonies for available bait may result in insufficient quantities of chemical circulating within some colonies, allowing them to persist for longer than populations with lower densities. As well, there is a hierarchy of feeding of queens in polygyne colonies; dominant (alpha) queens are fed first and the other queens get the crumbs from the table. This means that not all queens receive the required dosage of the chemical at each round of treatment.

In order to destroy polygyne infestations faster, the National Program may use a combination of IGR baits and a toxicant or DNI to reduce the initial high density of colonies. However, the National Program will only apply this treatment regime to known polygyne infestations and is unable to implement this for incipient or undiscovered infestations.

Assuming a gross overestimate of the efficacy or accounting for imperfect treatment during each round of treatment, **Table 4** also demonstrates that to achieve an acceptable 99% confidence that fire ants have been destroyed in the area after six rounds of treatment, the efficacy provided by each round of treatment may be as low as 53.6%.

This is represented by the formula:

tE=1–(1–C)1/ n

Where tE is the treatment efficacy, n is the number of treatments conducted in the treatment area, and C is the desired confidence to be provided after n treatments.

Therefore:

tE=1–(1–0.99)1/ 6

tE= 53.58%

The National Program will continue to undertake treatment efficacy testing throughout the life of this ten-year plan to maintain confidence that treatment methods used are effective.

4.4 Level of confidence that it is possible to remove fire ants at a faster rate than they can propagate until the population is reduced to a non-viable density

DNI of known fire ant colonies is almost 100% effective in destroying the colony and broadcast baiting has proven to be effective against fire ants (refer to Section 3.2.3).

A treatment program using a combination of DNI and broadcast baiting was used to eradicate fire ants at Yarwun (2013), Yarwun (2006) and the Port of Brisbane (2001), with these areas being declared free of fire ants in 2016, 2010 and 2012, respectively. The same strategy is being implement for eradication of the South East Queensland and Brisbane Airport (2015) fire ant incursions.

Table 4: Confidence of treatment success over multiple rounds of treatment

Efficacy per round of treatment (%)	Confidence for treatment success (%)					
	1 round	2 rounds	3 rounds	4 rounds	5 rounds	6 rounds
10	10.000	19.000	27.100	34.390	40.951	46.856
20	20.000	36.000	48.800	59.040	67.232	73.786
30	30.000	51.000	65.700	75.990	83.193	88.235
40	40.000	64.000	78.400	87.040	92.224	95.334
50	50.000	75.000	87.500	93.750	96.875	98.438
55	55.000	79.750	90.888	95.899	98.155	99.170
60	60.000	84.000	93.600	97.440	98.976	99.590
70	70.000	91.000	97.300	99.190	99.757	99.927
75	75.000	93.750	98.438	99.609	99.902	99.976
80	**80.000**	**96.000**	**99.200**	**99.840**	**99.968**	**99.994**
90	90.000	99.000	99.900	99.990	99.999	100.000
100	100.000	100.000	100.000	100.000	100.000	100.000

4.5 Confirmation that the recommended control techniques are publicly acceptable

The National Program has operated since 2001, and operates with the full support of the community, as evidenced by the continual submission of ant samples by the public throughout the life of the National Program. The National Program has applied for and been granted approval for a number of chemical products to be used under the conditions of the relevant product label or permit. All chemicals are used in accordance with label specifications and permits as issued by the APVMA. The National Program will continue to monitor the availability of new chemicals for possible use in the enhanced program.

4.6 Endemic pest or disease controls that may limit or prevent establishment

No endemic pest or disease controls have been identified that may limit or prevent establishment.

4.7 Legislative impediments to implementing this Ten Year Plan

There are no legislative impediments to the implementation of this Ten Year Plan. Fire ants are a prescribed pest under the Queensland *Biosecurity Act 2014*.

4.8 Known area of infestation

At the time of submission of this Ten Year Plan, the current 'footprint' of this infestation, the area in which controls are applied on the movement of materials likely to harbour fire ants, is approximately 400 000 hectares, but the actual area infested is only a small fraction of that, and is very dispersed and generally low density.

4.9 Likely distribution of fire ants and dispersal ability of fire ants

CLIMEX and Climatch modelling of the potential distribution of fire ants indicates that there are few places in Australia where fire ants could not establish (refer to section 5.2 'Cost-sharing apportionments'). In arid regions, fire ants can colonise anywhere there is a source of water (e.g. surface, accessible groundwater or irrigation). Potential spread modelling was initially based on US climatic limitations such as a low cold tolerance (Buren et al. 1974), but fire ants have been seen to survive in areas with winter snow such as the east and west coasts of the USA, and could well reach Canada (Bennett 2016).

Scanlan et al. (2006) also modelled the spread of fire ant based on dispersion through the formation of new locations of infestations and spread within each location. The estimations of new locations were based mainly on natural spread, with some allowances for human-mediated spread. This modelling indicated that fire ants could spread to an area of 6 million km2 across Australia. While natural spread may take some time, it may occur sooner as a result of human-assisted spread.

If spread were to occur at the same rate as recorded in Texas in the USA (i.e. 48 km each year between 1957 and 1977 (Hung & Vinson 1978)), fire ants would now extend south almost to Sydney, north to Mackay and west of Charleville in Queensland (National Program unpublished data 2017). In China, spread has occurred at an estimated rate of 80 km per year (Lu et al. 2008).

Refer also to Section 1.3.4 'Potential impact'.

4.10 Identification of the pathways for the entry into and spread within Australia of fire ants and level of confidence that further introductions are low

Refer to Section 1.3 'Risk assessment': '1.3.1 Entry' and '1.3.2 Establishment.'

4.11 Level of confidence that fire ants are detectable at very low densities and that all sites affected by the outbreak have or can be found

The National Program employs a number of surveillance techniques for the detection of fire ants. The most appropriate method depends on infestation and treatment status, terrain type, infrastructure, available resources and cost efficiency. Most commonly, surveillance is undertaken on foot by a field team, but post-treatment validation processes may use odour detection dogs, in-ground lures and visual surveillance. Community engagement (passive surveillance) is also a very effective surveillance tool, generating valuable positive and negative sample data.

The National Program will invest in research and development to update the remote sensing surveillance technologies (RSS) used by the National Program in the past. Previously, RSS was used to undertake delimitation activities, but in the future it will be used as a tool to undertake broadscale surveillance, particularly following an optimal treatment regime, to provide confidence that no fire ants remain.

On-ground visual surveillance, odour detection dogs, RSS and passive surveillance will be employed in SEQ to determine that all infested sites have been found and that fire ants have been eradicated.

Visual surveillance

Members of the field team form a line with pre-set spacing, determined by difficulty of detection as a result of terrain or vegetation type, and move forward to conduct a survey sweep across the land parcel to be surveyed. The method will be repeated until all areas of the land parcel have been inspected.

It is estimated that visual surveillance has an 80% efficacy of detection. The ground/visual search detection rate of 80% is derived from trials conducted in Taiwan by staff of the Biosecurity Queensland Control Centre.

Refer to Section 3.2.2 a) of this Ten Year Plan: 'Visual surveillance by field teams'.

Odour detection dogs

National Program testing indicates that there is an 80–100% confidence level for odour detection dogs in detecting fire ant infestation if present.

Refer to Section 3.2.2 b) of this Ten Year Plan: 'Odour detection dog teams'.

Passive surveillance

Passive surveillance by the community is a useful tool to detect infestation within and outside known infested areas. The communication and engagement strategy and tools are detailed in Section 3.4.2 of this Ten Year Plan. The invasive and aggressive nature of fire ants support their detection through passive surveillance techniques in areas where there is human activity and fire ant awareness material or activity is provided.

Refer to Section 3.4 of this Ten Year Plan: 'Communication and engagement'.

Remote sensing surveillance

RSS involves using technology such as cameras mounted on a helicopter that can capture near infrared, colour and thermal images of possible fire ant mounds. These images were refined using algorithms developed by The University of Sydney and analysed by program staff, and suspected sites followed up by field staff. The National Program will investigate new technologies to undertake cost-effective broadscale surveillance. It is anticipated that new technologies will have a detection sensitivity of between 0.38 and 0.5.

Refer to Section 3.2.2 c) of this Ten Year Plan: 'Remote sensing surveillance'.

4.12 Surveillance activities that are in place or could be put in place to confirm proof of freedom for sites possibly infested by fire ants

A pest-free area is defined as ‘an area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained’ (FAO 1996).

In Australia, principles for the establishment of pest-free areas have been set to provide guidance to Commonwealth and state agencies in making formal decisions about the pest-free status of Australia, or parts of it, and to provide evidence to that effect. These guidelines are provided as a report commissioned by the Department of Agriculture, Fisheries and Forestry and Plant Health Australia, *Guidelines for the Establishment of Pest Free Areas for Australian Quarantine* (Jorgensen et al. 2003).

In cases where the spread of the pest has been clearly delineated and the infested area clearly has some form of natural or artificial boundaries that would in some way limit the spread of a pest (e.g. host availability, climate characteristics or regulated contisrol and containment measures that would limit the spread of the pest out of the area), national principles for the establishment of pest free-areas may be applied as the risk of reinfestation from outside the defined area has been addressed.

The pest-free surveillance protocol for this Ten Year Plan is outlined in **Section 5**.

a) *Estimating a minimum predicted apparent pest prevalence*

As part of the survey validation process, estimation must be made on the minimum predicted apparent prevalence of the pest within the survey area at the time of survey.

In this instance, a determination of minimum predicted prevalence at the time of each survey is based on a conservative but realistic consideration of the likely multiplication, spread and survival of the pest since the ‘pest prevalence start date’, which is the date after which the last treatment was applied.

A conservative approach was taken by assuming that the minimum number of colonies survived treatment (i.e. one colony).

Modelling work by Schmidt et al. (2010) provides a quantitative estimate of the increase in fire ant nests over time. The estimates are based on colony point data in SEQ provided by the National Program.

A minimum apparent pest prevalence (in nests) may be estimated at the time of each survey round.

b) *Estimating sensitivity of surveillance and overall test sensitivity*

Collaborative survey sensitivity trials conducted in Taiwan by the National Program provide some guidance for estimating surveillance sensitivity.

The trials consisted of multiple passes of surveillance of plots with low to high densities of fire ant mounds. The trials found that, for a fire ant colony where a nest structure is visible, and the area is inspected by National Program staff on foot undertaking an ‘emu parade’ inspection, an average of 82% survey sensitivity was achieved using the specified inspection method.
For large mounds (>30 cm) 100% were detected.

Based on these trials, the National Program assumes a conservative 80% sensitivity of surveillance for detecting a fire ant nest using the specified method. Suspicious samples collected during surveys are considered as ‘presumptive positives’ and are sent for laboratory diagnosis.

The final assessment of the presumptive positive sample taken as part of the field inspection is undertaken through the conduct of two independent diagnostic tests. The initial diagnostic identification is followed by an additional confirmatory analysis by a second diagnostician. This process also provides for independence by allowing the independent diagnostician to confirm the result by performing the same test. This provides for an extremely high diagnostic test specificity (the probability of a negative test result given that the sample is not fire ant).

However, multi-layer diagnostic tests can provide a potential for reduction in diagnostic test sensitivity (the probability of diagnosing a positive test result given that the pest is present) by providing more opportunities for test failure where a final determination is made based on the result at the final level diagnostic test (the test layer where the result comes up negative and the result is considered as negative and no further action is taken).

In this case, and in many cases where multiple independent tests are performed, the testing protocol incorporates a number of controls and the provision for the diagnostician to repeat the test where the test result is ambiguous or unexpected based on the results of previous tests. Further, samples generally include between one and 10 ants. The diagnostic process requires that each ant in the sample is diagnosed, further reducing the likelihood of a sample being fire ant and being dismissed as a negative sample.

The test sensitivity is the probability of detection of a red imported fire ant nest, taking account of the survey sensitivity and that provided by the diagnostic test. In this instance, the probability of detection through two statistically independent tests equals the product of the individual probabilities of detection of both tests. It is represented by the following equation:

Set = Ses x Sed

Where Set is the test sensitivity, Ses is the survey sensitivity, and Sed is the diagnostic test sensitivity.

No studies have been undertaken on the diagnostic test sensitivity. However, the National Program suggests a 99% diagnostic test sensitivity as a conservative estimate. The estimation of test sensitivity is provided in **Table 5**, which provides likely test sensitivities over a range of diagnostic test sensitivities and a range of survey sensitivities. Assuming a survey sensitivity of 80% and a diagnostic test sensitivity of 99%, an overall test sensitivity of 79.20% is achieved.

c) Validation surveillance strategy and determining the likelihood of success

Table 6 provides estimations for the likelihood of detecting pest infestation in an area should it be present. The table provides estimates of confidence of pest freedom over a range of test sensitivities after completion of each survey. Calculations are made against the estimated apparent pest prevalence at the time of each survey and highlight combinations where a confidence level of greater than 99% will be achieved.

In this example, the analysis demonstrates that the likelihood of pest freedom when at least eight nests are present after 12 months, and assuming a test sensitivity of 79.20%, is 99.999%.

As reported in *Guidelines for the Establishment of Pest Free Areas for Australian Quarantine* (Jorgensen et al. 2003), a higher level of confidence in confirming pest absence may be achieved through the conduct of multiple rounds of inspection within the survey population and combining the confidence obtained from each survey.

This is represented by the formula:

C=1−(1−C1) x (1−C2) x (1−C3) … (1−Cn)

Where C is the confidence provided after n surveys, and Cn is the confidence provided by each survey.

Table 5: Estimation of test sensitivity for diagnosing fire ant in an area

Sensitivity of survey	Sensitivity of diagnostic test						
	95.00%	96.00%	97.00%	98.00%	99.00%	99.50%	99.90%
65%	61.75%	62.40%	63.05%	63.70%	64.35%	64.68%	64.94%
70%	66.50%	67.20%	67.90%	68.60%	69.30%	69.65%	69.93%
75%	71.25%	72.00%	72.75%	73.50%	74.25%	74.63%	74.93%
80%	76.00%	76.80%	77.60%	78.40%	79.20%	79.60%	79.92%
85%	80.75%	81.60%	82.45%	83.30%	84.15%	84.58%	84.92%
90%	85.50%	86.40%	87.30%	88.20%	89.10%	89.55%	89.91%
95%	90.25%	91.20%	92.15%	93.10%	94.05%	94.53%	94.91%
99%	94.05%	95.04%	96.03%	97.02%	98.01%	98.51%	98.90%

By combining the confidence provided by each survey conducted within the survey area (C=1–*(1–0.99961)* x *(1– 0.999999999999977)*) at the estimated test sensitivity of 79.20% for detection by field staff on foot, it is estimated that the confidence of freedom from fire ant provided by the surveillance program is virtually absolute (100%) when the pest is present as one or more apparent colonies within the survey area.

Further, we can calculate the minimum test sensitivity required to achieve an acceptable 99% confidence of pest freedom by applying the formula:

Set =1–(1–C)^ n

Where Sed is the desired test sensitivity to be provided at each survey, n is the sum of apparent nests at each survey, and C is the desired confidence to be provided for all surveys.

Therefore:

Sed=1–(1–0.99)^ 25

Sed=0.1682 or 16.82%

Table 6: Estimation of confidence of pest freedom where the pest was not diagnosed and likelihood of detecting infestation (%) in the survey area should infestation be present

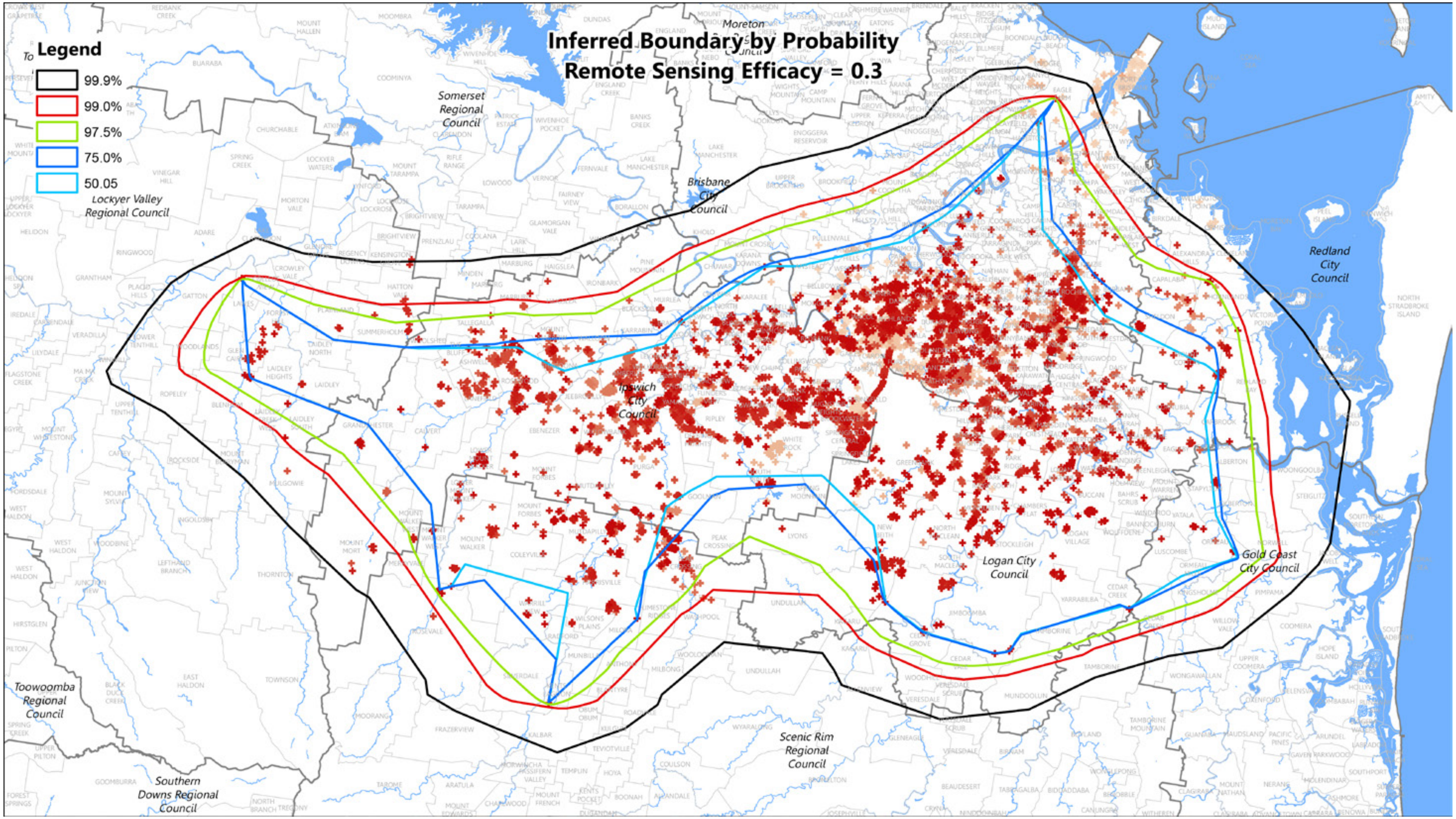
Likelihood of detecting infestation (%) in the survey area should infestation be present											
Test sensitivity (Se^{tt})	Number of visible mounds present within the survey area at the time of inspection										
	1	2	3	4	5	6	7	8[A]	9	10	20
10.000%	10.000	19.000	27.100	34.390	40.951	46.856	52.170	56.953	61.258	65.132	87.842
20.000%	20.000	36.000	48.800	59.040	67.232	73.786	79.028	83.223	86.578	89.263	98.847
30.000%	30.000	51.000	65.700	75.990	83.193	88.235	91.765	94.235	95.965	97.175	99.920
40.000%	40.000	64.000	78.400	87.040	92.224	95.334	97.201	98.320	98.992	99.395	99.996
43.780%	43.780	68.393	82.231	90.010	94.384	96.842	98.225	99.002	99.439	99.685	99.999
50.000%	50.000	75.000	87.500	93.750	96.875	98.438	99.219	99.609	99.805	99.902	100
60.000%	60.000	84.000	93.600	97.440	98.976	99.590	99.836	99.934	99.974	99.990	100
65.000%	65.000	87.750	95.713	98.499	99.475	99.816	99.936	99.977	99.992	99.997	100
70.000%	70.000	91.000	97.300	99.190	99.757	99.927	99.978	99.993	99.998	99.999	100
75.000%	75.000	93.750	98.438	99.609	99.902	99.976	99.994	99.998	100	100	100
79.200%	79.200	95.674	99.100	99.813	99.961	99.992	99.998	99.999	100	100	100
80.000%	80.000	96.000	99.200	99.840	99.968	99.994	99.999	100	100	100	100
90.000%	90.000	99.000	99.900	99.990	99.999	100	100	100	100	100	100
100.000%	100	100	100	100	100	100	100	100	100	100	100

A – Predicated minimum apparent pest prevalence after treatment assuming a 12 months period of dispersal and development.

Appendix 5

SEQ delimited area

Map 2: SEQ Delimited Area



Appendix 6

Basis for decisions on movement controls

6.1 Purpose

Risk-based decision-making is used to assess proposed risk mitigation measures for the movement of fire ant carriers. These decisions are based on a set of principles underpinned by scientific research.

The decision for issuing a biosecurity instrument permit to move fire ant carriers rests with the compliance inspector. The decision is based on the availability of practical risk mitigation options for businesses that would allow movement of the fire ant carrier with an acceptable level of risk that a viable fire ant colony will not be moved with the product.

There are three factors to be considered when making a decision: site risk factors, risk mitigation processes and destination risk factors.

This document will be the reference point when an inspector is performing a risk assessment. The decision on whether a movement request can be approved or not approved needs to be recorded on an information notice, which is provided to the business with or without a biosecurity instrument permit. The information notice outlines the information that has been taken into account and the reasons for the decision, and contains justifications that are based on the principles outlined in this document.

The table on the next page is a set of key principles used as a basis for decisions on movement controls.

6.2 Principles

Principle	Scientific reason	Scientific reference	Practical measures
A queen will not survive without workers, so if a queen is separated from her workers she will not survive.	The queen, once she starts egg-laying in earnest, cannot feed herself and is fed by workers. When a newly mated queen starts a nest, she draws on her stored energy reserves to lay a first clutch of eggs. These can number from 10–25 workers, so that would be the minimum for her survival.	Tschinkel, W.R. (2006). *The fire ants*. Belknap Press of Harvard University Press.	Need to apply some form of risk mitigation prior to movement of the carrier off site to disturb a fire ant colony. For high-risk carriers (such as hay), two types of risk mitigation within 24 hours would be considered necessary.
It takes approximately 28 days for a colony to establish, so any disturbance of the nest during this time is likely to result in the death of the new colony.	The claustral period (initial establishment of nest, first egg-laying, larval stage, pupal stage and first foraging by emerging adults) lasts from 3-4 weeks depending on temperature. It is this claustral period that has the most risk and highest fatality rates for fire ants—any disturbance causing separation of the queen from her workers during this time is likely to result in death of the new colony.	Tschinkel, W.R. (2006). *The fire ants*. Belknap Press of Harvard University Press.	Inadequate storage of the carrier for more than 28 days will require some form of risk mitigation (disturbance, chemical or heat) prior to movement off site.
a. Disturbance			
Fire ants will move away from sites if they are disturbed, so disturbing carriers that have been stockpiled should assist in ensuring that fire ants are not nesting in the item.	Brand et al. (1973) state that, with very few exceptions, when a nest is disturbed the reaction of the queen is to move as far as possible from the point of disturbance—they evade and hide.	Brand, J.M., Blum, M.S. and Ross, H.H. (1973). Biochemical evolution in fire ant venoms. *Insect Biochemistry* 3(9), 45-51.	Disturbance of carriers that have been stockpiled to disrupt a fire ant colony can be in the form of: • screening • shredding • turning • grinding • crushing or • chipping.

Principle	Scientific reason	Scientific reference	Practical measures
b. Heat			
Fire ants will move from environments where temperatures are greater than 40°C, so carriers that are heated to this temperature or greater are unlikely to harbour fire ants.	In a controlled environment experiment, fire ants became agitated and attempted to leave their surroundings when the temperature reached 38.3°C. At 46°C, the fire ants started to slow in movement, with death occurring at 51°C.	Bauer, J. (2014). *The effects of increasing temperature on Solenopsis invicta (Hymenoptera:Formicidae)*. Texas A&M University.	Heating to at least 40°C can disturb a fire ant colony.
c. Soil depth			
A fire ant colony in the ground is usually located within the top 1 metre of soil.	Markin et.al (1973) studied fire ant colonies and maturing mounds and found the spongelike internal structure typical of the interior of mounds extended down into the ground in the shape of an inverted cone. The apex of the inverted cone would be approximately 60 cm below the soil surface, with several large tunnels extending downwards an additional metre or more at the approximate level of the water table.	Markin, G.P., Dillier, J.H. and Collins, H.L. (1973). Growth and development of colonies of the red imported fire ant, *Solenopsis invicta*. *Annals of the Entomological Society of America* 66(4): 803-808.	By removing the top metre of soil from ground level, the soil below can be extracted for use, and must be moved off site as soon as possible. The remaining top metre of soil should be relocated away from the working area and will need to either stay on site, move to a waste facility (zone restrictions apply) or have a different form of risk mitigation applied for an approved movement.

Appendix 7
Indicative budget

7.1 Indicative budget breakdown

Indicative budget[1]		2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24	2024–25	2025–26	2026–27
Activity description	Detail	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget
Directorate	Management costs are constant and are not expected to increase. However, there will be an additional cost for the Steering Committee Chair.[2]	310,902	301,309	306,582	311,986	317,523	323,196	329,009	334,966	341,069	347,323
Operations—planned treatment and surveillance (excl. dogs)[3]	This incorporates costs for operational office-based and field staff wages, bait, aircraft hire (for aerial treatment), all-terrain vehicles, vehicles for field staff, fuel and remote sensing surveillance costs including cameras, manual analysis, aircraft and on-ground verification. Contract staff will be used where possible for additional treatment/surveillance.[4]	21,480,199	22,486,164	24,149,265	24,574,885	25,011,004	25,540,753	26,012,801	26,535,290	27,149,983	28,182,174
Operations—responsive treatment and surveillance (excl. dogs)[5]	This incorporates costs for operational office-based and field staff wages, bait, all-terrain vehicles, direct nest injection, vehicles for field staff and fuel. Contract staff will be used where possible for additional treatment/surveillance.[6]	2,911,396	2,580,443	3,018,658	3,071,861	3,126,376	3,182,235	3,239,473	3,298,123	3,358,220	3,419,799
Odour detection dog teams	Odour detection dog teams will increase slightly as the 10-year program shifts from a treatment to surveillance focus.	515,739	602,618	786,109	799,964	814,160	828,707	843,613	858,886	874,536	890,573
Preventing human-assisted spread/ compliance	As recommended by the panel, additional compliance and case management staff are required as this area is at full capacity, with each inspector covering approximately 50 suburbs each. Additional inspectors will contribute to the coordinated and focused approach in the Ten Year Plan.	1,013,477	1,352,028	1,375,691	1,399,936	1,424,781	1,346,649	1,316,036	1,288,329	1,289,941	890,573

1 This budget does not include the cost of undertaking proof of freedom activities following the completion of this Ten Year Plan.

2 Cost of Chair calculated from QLD Government rates for board chairs.

3 Cost of conducting treatment and surveillance in the field excluding dogs.

4 Some FTES may be sourced as contract staff. The exact split of contractors/FTEs will be determined during the ramp up stage.

5 Cost of conducting treatment and surveillance in the field excluding dogs.

6 Some FTES may be sourced as contract staff. The exact split of contractors/FTEs will be determined during the ramp up stage.

Indicative budget[1]		2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24	2024–25	2025–26	2026–27
Activity description	Detail	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget
Communication and engagement	As recommended by the Independent Review, enhanced budget includes market research for each stage (priority treatment area). Better use of communication technology including a new 'check your yard' app, online training, SMS/email communications to replace letters will be developed. Increased treatment would result in more public and industry engagement which will require additional staff. Mass communication channels (such as TV or radio) have also been included in budget.	1,482,394	1,738,322	1,788,398	1,819,917	1,852,215	1,885,309	1,919,219	1,953,966	1,989,570	2,026,053
Science and genetics	Genetics and science is currently at capacity and cost of maintenance and consumables for new next generation sequencer technology (as recommended by the panel) has increased the budget. Increased treatment and surveillance will increase the demand for scientific support with more samples being submitted. Science will also have enhanced capacity (1 position) to contribute to treatment efficacy testing and trials.	1,521,943	1,255,455	1,277,427	1,299,941	1,323,010	1,346,649	1,370,871	1,395,690	1,311,805	1,224,537
Information systems improvements	The spatial and information services budget will increase to provide additional systems support required for the larger National Program. The information system and hardware requires significant enhancement to fully support National Program activities, as detailed in the plan and recommended by the review panel.	1,043,826	772,588	0	0	0	0	0	0	0	0
Ramp up activities	A ramp up taskforce was established within the National Program in 2016–17 to commence the activities required. This includes increases to staffing, accommodation and supporting information systems.	1,114,522	0	0	0	0	0	0	0	0	0
Remote sensing surveillance research and development	Research and testing to upgrade the National Program's remote sensing surveillance technologies will be undertaken in the first two years of the program, as recommended by the review panel.	504,610	1,147,293	0	0	0	0	0	0	0	0

Indicative budget[1]		2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24	2024–25	2025–26	2026–27
Activity description	Detail	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget	Total budget
Policy and governance	The enhanced National Program will necessitate additional policy, legislation and reporting officers, including provision of the secretariat for the Steering Committee. A specialist consultant will undertake an investigation of alternative funding models in the first two years.	801,496	869,161	884,373	899,959	915,930	932,295	949,064	966,247	983,853	1,001,894
Planning and quality assurance	A dedicated planning group will monitor and analyse fire ant spread patterns and colony relatedness, and use expert knowledge on the biology of the ant and the effectiveness of treatment and surveillance methods as the basis for eradication planning. The planning unit will assess the risk of fire ants establishing in certain areas, based on preferred habitat and land use, to assess the required treatment, surveillance and other eradication activities to be undertaken in each area.	1,440,401	1,371,343	1,395,343	1,419,936	1,445,135	1,491,673	1,518,503	1,545,995	1,574,166	1,603,031
Administration, workplace health and safety, and human resources	Business support to the National Program will require increased capacity to provide WHS, Finance, HR, contract services and fleet management. Provision has also been made for the National Program to contribute to corporate costs.	2,590,716	2,877,889	3,026,519	3,079,860	3,134,517	3,190,522	3,247,909	3,306,712	3,366,965	3,428,705
Building maintenance and lease	There is an ongoing cost of building lease and maintenance. Site lease costs will go up significantly to cater for additional workforce, ideally supporting a move to a single site with potential to acquire satellite depots as required.	1,125,266	1,158,882	1,179,163	1,199,946	1,221,240	1,243,061	1,307,600	1,331,274	1,355,531	1,380,388
Independent financial and efficiency auditing and performance monitoring	Provision has been made for regular performance monitoring (modelling to show cost-share partners that eradication is being achieved) and independent financial (every two years) and efficiency (as required) auditing.	112,713	115,889	117,917	119,994	122,124	124,306	126,542	128,833	131,182	133,586
		$37,969,600	**$38,629,384**	**$39,305,445**	**$39,998,185**	**$40,708,015**	**$41,435,355**	**$42,180,640**	**$42,944,311**	**$43,726,821**	**$44,528,636**
Total budget							**$411,426,3947**				

7 The CPI adjustment is 2.46% per annum and was calculated based on the average inflation increase over the past 20 years.

7.2 Cost-sharing calculations for the Ten Year Plan

The following process was undertaken to determine cost-sharing calculations for this plan.

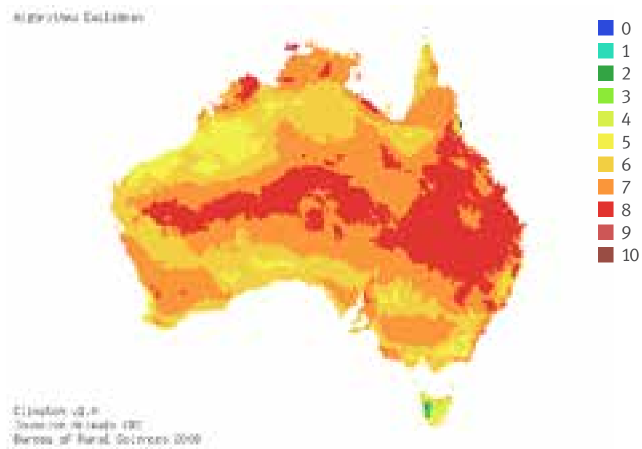
7.2.1 Processes and procedures for modelling the likely area of infestation of fire ants

A Climatch (ABARES 2008) analysis was undertaken to determine areas within Australia that would be suitable for fire ants by comparing climatic matches in Australia to that of fire ant distribution worldwide. The Climatch analysis was performed using latitude and longitude locations of fire ant records provided by Professor James K Wetterer from Florida Atlantic University (Wetterer 2013).

Data were obtained through ABARES, which contacted Professor Wetterer directly for the dataset. Additional data points were included in the dataset to represent all current fire ant incursions in Australia.

The 'worldclim data' dataset stations were used, with 644 source stations for climatic analysis. The Climatch analysis used 16 variables representing eight each for rainfall and temperature. The Climatch data indicate substantial areas of potential climatic suitability for fire ants in Australia (**Map 3**).

Map 3: Climatch map of potential distribution of red imported fire ants based on the 'worldclim data' dataset stations – 644 source stations, target area set to Australia Albers 20 km grid and match run with default settings (Euclidean algorithm)



For further analysis, classes were viewed as Climatch scores 0–4 (below threshold, or not suitable fire ant habitat) and Climatch 5–10 (above threshold, or suitable fire ant habitat) (**Map 4**).

Map 4: Climatch analysis indicating areas of potential distribution for red imported fire ants in Australia, split into two climate classes

Legend

- Climatch classes 5–10 (suitable)
- Climatch classes 0–4 (not suitable)

A report was generated from the Climatch map in multi-criteria analysis shell (MCAS-S) at a resolution of 1 cell = 1 km2 to determine the cell count for each Climatch class per state/territory (**Table 7**) (ABARES 2014).

Table 7: Total cell area generated from Climatch map in MCAS-S of potential distribution of red imported fire ants in Australia (output resolution layer of 1 cell = 1 km2 (NLUM06))

State/ territory	B: Total area (km^2)	C: Proportion area with Climatch classes 0–4 (km^2)	D: Proportion area with Climatch classes 5–10 (km^2)
NSW	797,798	5479	792,319
Vic	223,360	1200	222,160
Qld	1,716,069	2998	1,713,071
SA	977,346	0	977,346
WA	2,507,518	4367	2,503,151
Tas	62,287	29,084	33,203
NT	1,339,284	0	1,339,284
ACT	2358	121	2237
Total	**7,626,020**	**43,249**	**7,582,771**

7.2.2 Processes and procedures for calculating jurisdictional cost-sharing apportionments based on likely area of infestation of a terrestrial pest or disease

The cost-share apportionments were calculated in accordance with the cost-sharing formula as identified in the National Environmental Biosecurity Response Agreement.

Firstly, the potentially affected population of each state/territory and of Australia was calculated, where 1% of the jurisdiction's land area potentially affected equates to 1% of the jurisdiction's population (Table 8).

Table 8: Potentially affected populations based on potentially affected area.

	Total population	Percentage of affected area state/territory	Potentially affected population
NSW	7,704,300	99.31%	7,651,140
Vic	6,039,100	99.46%	6,006,489
Qld	4,827,000	99.83%	4,818,794
SA	1,706,500	100.00%	1,706,500
WA	2,613,700	99.83%	2,609,257
Tas	518,500	53.31%	276,412
NT	244,000	100.00%	244,000
ACT	395,200	94.87%	374,926
		Total potentially affected population of Australia	**23,687,518**

Note population data is the most recent available from the Australian Bureau of Statistics **http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0**

Secondly, cost-sharing apportionments were calculated in accordance with the cost-sharing formula as identified in 7.2 (d) of the National Environmental Biosecurity Response Agreement.

A State/Territory Party's share of the combined investment = the number of people in a potentially affected area in that jurisdiction the total number of people potentially affected in Australia

Appendix 8
In-kind support

The National Program receives in-kind support from industry, government and the public. Most of the support comes from SEQ, primarily from within and around the Fire Ant Biosecurity Zones (zones).

This support has been gained through the establishment of important alliances and partnerships since the National Program began in 2001. These were developed to ensure participation in surveillance, compliance with movement controls and support for other program activities.
The result of this support in collaboration with National Program activities has been that:

- 95.7% of people in SEQ are aware of fire ants (a level of brand awareness equivalent to that gained by high profile commercial companies, e.g. Coca Cola)
- high levels of reporting of suspected fire ant infestation
- containment of fire ants to SEQ
- increased efficiency in the delivery of National Program operations.

Examples of the in-kind support that has been provided to the National Program since 2001 are provided in **Table 9**.

Table 9: In-kind support

Support provided by	Surveillance	Containment	Publicity	Other
Volunteers	• organising surveillance activities		• delivering talks to schools, community and garden clubs at events and meetings in their local areas • promoting fire ants and the 'check your yard' message in local newspapers and news	• undertaking office duties
Queensland Department of Transport and Main Roads/ Queensland Rail	• surveillance during routine field work	• risk mitigation efforts • ensuring fire ants are not spread through construction and maintenance activities	• providing moveable 'visual message signage' (VMS) which is used by the program to display National Program messages	• facilitating treatment activities
Councils	• surveillance during routine field work	• risk mitigation efforts • ensuring fire ants are not spread through construction and maintenance activities • 37 council and privately owned waste facilities participate in awareness campaigns where staff provide movement control information to clients	• library in-store displays • events • online referrals on their websites to the fire ant web pages	
Energex	• fire ant e-learning package for staff, including an interactive surveillance activity and an assessment that is relevant to the daily activities undertaken by Energex staff	• ensuring fire ants are not spread through construction and maintenance activities		
Utilities	• surveillance during routine field work	• risk mitigation efforts • ensuring fire ants are not spread through construction and maintenance activities		

Support provided by	Surveillance	Containment	Publicity	Other
Australia Post			• 5500 detection notifications in the Lockyer, Peak Crossing and Harrisville	
Federal government	• surveillance during routine field work		• media releases • online referrals on their websites to the fire ant web pages	
Schools (more than 50)	• surveillance during routine field work		• displaying fire ant materials • hosting the 'Aka the Fire Ant Tracker' show	
Dial Before You Dig and Telstra			• advising clients requesting pipeline and underground cabling information within the Biosecurity Zone to contact the National Program	
Port of Brisbane	• for 12 years, a staff member was employed to conduct surveillance for fire ants across sites			
Other businesses and industry groups	• surveillance during routine field work	• risk mitigation efforts, e.g. companies may treat their restricted items at own expense in order to move soil products outside the zone • ensuring fire ants are not spread through construction and maintenance activities	• promotion through industry newsletters • distribution of information Turf Queensland 'Green Turf Book' promotion • display tear off collateral in the ant kill products aisle at no charge, e.g. Bunnings • shopping centre information stands • online referrals and messages on websites to the fire ant web pages (e.g. eBay is an example of an online organisation that promotes movement controls at no charge)	• staff training time

This in-kind support may be at risk if levies or fees were introduced as an alternative funding source for the National Program.

Appendix 9
Risk management plan

Table 10: Risk management plan

Risk management plan National Red Imported Fire Ant Eradication	
Objective 1 Reduce infestation until fire ants are no longer present in SEQ and ensure areas remain free from fire ants through the implementation of eradication measures as outlined in this Ten Year Plan.	**Objective 2** Prevent spread of fire ants to non-infested areas (using a combination of treatment, monitoring of compliance with movement restrictions pertaining to fire ant carriers, and public education/engagement).
Objective 3 Provide evidence to demonstrate freedom from fire ant infestation in the SEQ region following the process to declare proof of freedom described in **Section 5** of this Ten Year Plan.[8]	**Objective 4** Help prevent the establishment of new incursions of invasive ant species Australia-wide by building capability in, and provision of, invasive ant response and eradication expertise.

Purpose

The purpose of the risk management plan is to identify risks that may affect the achievement of the Ten Year Plan objectives, and to outline additional strategies and actions which will be implemented to reduce the risk to an acceptable level.

Levels of risk
Low
Medium
High
Extreme

8 Final proof of freedom will be declared two years following the last treatment of confirmed infestation. The Monash University modelling did not estimate the budget for the process to declare proof of freedom at the completion of the eradication program. Due to the difficulty in determining the exact timing of the last treatment, the final proof of freedom process may require further consideration, and additional budget, at the completion of this plan in 2026–27.

Risk description	Potential impact	Likelihood/ consequence	Proposed actions	Risk level after action
Risk 1: Community/legal				
Public and industry may become less motivated to act (e.g. to report, to prevent human-assisted spread) or may deliberately spread fire ants.	Reduction in public reports of suspected ants (reduction in passive surveillance) or long-distance movement of fire ants, which may compromise eradication objectives.	Possible/major	Market research to reassess best methods of encouraging public to search and report suspected fire ants in target areas and promotion of legislated requirements in regard to preventing spread of fire ants. Maintain profile and promote messages through media campaigns, community engagement projects, and collaboration with other agencies and levels of government, industries and communities. Increase number of inspectors undertaking suburb/business monitoring. The National Program also undertakes risk assessments for any businesses wishing to move a fire ant carrier that cannot comply with legislated requirements and is seeking a biosecurity instrument permit. Communication strategy to be implemented with high-risk industry stakeholders.	Unlikely/ moderate
Risk 2: Environmental				
Climatic disaster or event (e.g. flood, heavy rainfall, drought)	Significant outlying fire ant detection due to spread by flood. Reduced detections of fire ants during drought. Heavy rainfall may also prevent certain areas from receiving the required amount of treatment in a given period.	Rare/moderate	Contingency planning will be undertaken to ensure additional surveillance/treatment is undertaken following a significant climatic event.	Rare/minor
Risk 3: Environmental				
Environmental damage due to excess bait application	Unintended consequences to native species or ecosystems.	Unlikely/minor	Systems and processes in place and continual scientific testing and monitoring will occur to ensure that baits are distributed in accordance with approved APVMA specifications and that there are no impacts to native species or ecosystems.	Rare/minor

Risk description	Potential impact	Likelihood/ consequence	Proposed actions	Risk level after action
Risk 4: Health/community				
A member of the public experiences anaphylactic reaction due to fire ant stings.	Reaction could result in hospitalisation or death. Potential political ramifications and loss of public confidence in the National Program.	Possible/ extreme	National Program aims to prevent significant human health impacts from being realised. Raise awareness of the risk of fire ants through media stories, community engagement projects, and through collaboration with other agencies and levels of government, industries and communities.	Rare/major
Risk 5: Planning and implementation				
National cost-sharing funding ceases or decreases due to withdrawal of national funding partner(s).	The National Program will be unable to eradicate in line with timeframes modelled.	Possible/ severe	A long-term funding commitment will mitigate this risk. The National Program will provide full and complete information to funding partners to ensure full understanding of the activities, progress and any issues impeding the success of the National Program. Enhanced governance arrangements which include monthly reporting through the Steering Committee.	Unlikely/ major
Risk 6: Planning and implementation				
Polygyne infestation	Polygyne infestations may take longer to destroy using IGR baiting methods solely, thereby compromising the ability of the National Program to achieve eradication objectives within timeframes and budget.	Possible/ moderate	On detection of a polygyne colony the National Program will implement more intensive treatment methods (e.g. a combination of IGR baits and a toxicant or direct nest injection to reduce the initial high density of colonies), undertake more thorough tracing, and monitor the site more closely to ensure it is completely destroyed. The National Program will investigate the risk that polygyne colonies present to eradication and assess potential enhancements to treatment, surveillance and tracing processes to mitigate the risks.	Possible/ minor

Risk description	Potential impact	Likelihood/ consequence	Proposed actions	Risk level after action
Risk 7: Planning and implementation				
Loss of key staff/expertise, high staff turnover, low morale or heavy workloads, including loss of experienced staff due to temporary nature of National Program. Difficulties in appointing new/replacement staff due to Queensland Government full-time equivalent cap.	Diminished capacity and capability of the National Program resulting in loss of productivity.	Likely/ moderate	The Ten Year Plan will provide more job certainty. With increased certainty, there will be increased opportunities for mentoring, training, career progression, and career succession planning. Skills/knowledge transfer between staff members (cross-training) will be encouraged and processes and procedures will be documented. Processes in place, via annual staff performance development planning, to address staff issues.	Unlikely/ minor
Risk 8: Planning and implementation				
Significant detection beyond the current operational area, which is related to the SEQ infestation (as confirmed through genetic analysis).	Size of infestation may mean eradication is no longer feasible within current resources. Significant detections may result in decreased community and cost-share partner confidence in the National Program.	Possible/ severe	Systems and processes in place to rapidly respond to outlying detections. Additional surveillance will be undertaken as a part of the Ten Year Plan. Communication strategy to be implemented with high-risk industry stakeholders such as mining companies.	Possible/ moderate
Risk 9: Planning and implementation				
Significant fire ant detection within operational area, which is beyond the capacity of the National Program to deal with.	Size of infestation may mean eradication is no longer feasible within current resources.	Unlikely/major	Large areas of prophylactic treatment will be undertaken (based on spread modelling).	Unlikely/ minor
Risk 10: Planning and implementation				
Surveillance: remote sensing surveillance project delay (beyond two years) or unable to achieve desired sensitivities at desired project cost. Surveillance procedures and protocols not implemented in accordance with target surveillance areas as per annual Work Plan.	Without a cost-effective, broadscale surveillance method, eradication may no longer be feasible within current resources.	Possible/major	Research and testing will ensure the effectiveness of the technology. Modelling was based on previous sensitivity and preliminary research indicates this might be improved.	Unlikely/ major

Risk description	Potential impact	Likelihood/ consequence	Proposed actions	Risk level after action
Risk 11: Planning and implementation				
Treatment: difficulties in securing adequate bait supplies. Major bait permits expire on various dates and will need to be reissued by APVMA. Inability to gain timely access to all properties where treatment is scheduled. Treatment procedures and protocols not implemented in accordance with target treatment areas as per annual Work Plan.	The National Program may be unable to eradicate in line with timeframes modelled.	Unlikely/ severe	Supplies will be ordered well in advance of when treatment is required. Existing supplier can source alternative products from overseas if local manufacture becomes unavailable. New procedures will be implemented in regard to entry using powers under the prevention and control biosecurity program. Quality assurance systems and processes will be implemented.	Unlikely/ moderate
Risk 12: Planning and implementation				
Modelling: optimal model projections (on which budget estimates are based) are generalised and may not accurately reflect future real-world situation. Modelling did not include proof of freedom.	The National Program's ability to eradicate fire ants within desired budget and timeframes may be compromised.	Possible/major	The Monash model will be periodically run (in-house) to provide guidance on the National Program's treatment and surveillance strategy, combining modelling insights with National Program and scientific expertise. Implementation will be closely monitored by the Steering Committee. Oversight will include regular review of mathematical modelling designed to monitor progress.	Unlikely/ major
Risk 13: Planning and implementation				
Full implementation of the Ten Year Plan does not commence on 1 July 2017 (due to ramp up delay) with the treatment season potentially being delayed.	The National Program may be unable to eradicate in line with timeframes modelled.	Likely/severe	The National Program to commence ramp up in 2017–18 (pending timely funding decision) using the Ten Year Plan budget.	Possible/ major

Risk description	Potential impact	Likelihood/ consequence	Proposed actions	Risk level after action
Risk 14: Planning and implementation				
IT systems fail to support increased scope and intensity of enhanced National Program, or changing priorities of the government as unable to keep up with demand.	Lack of workable supporting infrastructure will result in National Program inefficiencies which may compromise eradication objectives.	Almost certain/ major	A project business case and funding proposal will be drafted for the Queensland Information Communication and Technology Governance Board to redevelop the key application and database used by the National Program. Approval and implementation of this project is fundamental to ensuring the ongoing operational needs of the National Program. Information system performance will be continually reviewed, including data cleansing and validation, and upgrades recommended accordingly.	Unlikely/ major
Risk 15: Planning and implementation				
IT systems: loss of computer systems or corruption of data due to network loss, power failure, hardware crash, software corruption, theft or natural disaster. The local area network within the National Program is damaged or the wide area network connecting QDAF is damaged. Lack of functionality or data integrity due to data entry, programming, configuration errors, virus or incorrect business logic.	Lack of workable supporting infrastructure will result in National Program inefficiencies which may compromise eradication objectives.	Likely/ Moderate	Redevelop information system as per Risk 14. Quality assurance systems and processes, staff training, and user testing will be implemented. Virus protection software will continue to be installed on servers and local computers and regular backups applied. Access to systems is controlled by relevant authorisations. Continual review of performance and recommendation of upgrades, as appropriate. Ability to acquire a mobile network truck to facilitate wireless network functionality and move staff to other locations if network access is compromised.	Rare/Minor
Risk 16: Planning and implementation				
Information and knowledge management systems, policies, procedures and record systems fail to support increased scope and intensity of enhanced National Program, or changing priorities of the government.	Lack of adequate, workable systems will result in National Program inefficiencies, which will decrease productivity and potentially compromise eradication objectives.	Possible/ moderate	Ten Year Plan will contain a clearly defined scope and Work Plan. Resources will be allocated during ramp up to investigate operational systems and logistical efficiencies. Sufficient resources will be allocated for an annual review process of procedures, policy, and protocols to ensure clear and up-to-date documentation and coordinated information management. Quality assurance system will be established to monitor implementation. The National Program will have additional governance including oversight by the Steering Committee.	Unlikely/ minor

Appendix 10
Glossary

Table 11: Glossary

Term	Definition
Broadcast bait	Broadcast baiting uses insect growth regulator to destroy fire ant infestation.
Colony	A group of ants that are living together and depend on each other for reproduction and survival.
Community surveillance	Searching by the community, industry and other areas of government for fire ants. Also referred to as passive surveillance.
Compliance inspector	Means a person appointed as an inspector under the Queensland *Biosecurity Act 2014*.
Coordinated and focused eradication activity	Combination of activities undertaken at set times and duration in order to achieve fire ant eradication.
Delimited area	The boundary of the infestation as confirmed by Monash modelling of National Program delimitation activities undertaken 2012–2015, adjusted for infestation spread since delimitation was completed.
Delineation surveillance	Surveillance undertaken around new detections to confirm the extent of the infestation.
Direct nest injection	The injection of chemical directly into a nest or mound to destroy the nest.
Fire ants	Red imported fire ant or *Solenopsis invicta* (Buren 1972).
High-density infestation	Definition to be reviewed. In the past the definition has been infestation that is more than 10 mounds in a 500 m radius.
Independent Review	Most recent Independent Review of the National Program in SEQ undertaken during 2015 and 2016.
Infested areas	Areas which have had fire ants confirmed.
Local area freedom from fire ants	When fire ants are no longer found in an area following completion of coordinated and focused eradication activity.
Monogyne	Single queen colony.
Mound	A structure that ants use for survival or reproduction that is associated with one colony of ants.
National Red Imported Fire Ant Eradication Program – South East Queensland Steering Committee (Steering Committee)	The National Red Imported Fire Ant Eradication Program – South East Queensland Steering Committee provides strategic oversight of the 10-year National Program. The Steering Committee, accountable to the Agriculture Senior Officials Committee (AGSOC), will provide guidance and support to the National Program on all aspects of the National Program's delivery.
National Program	National Red Imported Fire Ant Eradication Program in South East Queensland.
Nest	A structure which ants form and use for reproduction and survival.
Operational area	Total area of known infestation confirmed by delimitation and adjusted for predicted infestation spread since completion of delimitation. The operational area will not remain static, possibly increasing initially as surveillance increases in Phase 1 and then decreasing as the areas with confirmed infestation reduce over the life of the National Program.
Outlying areas/Outlier	An outlier is a new detection found 5 km from the operational area boundary.
Pest	For the purposes of this response plan, 'pest' means red imported fire ant.
Pest-free verification process	Demonstration of proof of freedom from fire ants through structured surveys and other targeted methods.
Planned treatment area	Areas which are targeted for intensive or suppression treatment. Areas will be determined through a rigorous planning process based on the highest densities of confirmed fire ant sites, anticipated spread patterns and highest risk.

Term	Definition
Polygyne	Multi-queen colony.
Post-treatment surveillance	Surveillance undertaken following treatment to confirm or validate that all fire ants have been destroyed. This is also referred to as validation surveillance.
Priority area	Sub-areas within the operational area, which will receive coordinated and focused eradication activity, in accordance with a staged approach. The boundaries of each area are indicative only and will be updated as a part of the biennial review of the Ten Year Plan to be endorsed by the Steering Committee.
Progressive rolling strategy	Focused eradication activities in infested areas on the outer south-western and southern perimeter of the operational area, shifting eradication effort inwards to areas with persistent infestation.
Proof of freedom	Evidence of absence of fire ants, usually through structured surveillance and other methods.
Red imported fire ant	*Solenopsis invicta* (Buren 1972).
Regulation	Biosecurity Regulation 2016. The Biosecurity Regulation 2016 prescribes procedures that must be followed when moving or storing a fire ant carrier.
Remote sensing surveillance	Cameras mounted on helicopters which fly over broad areas to capture visible, near infrared and thermal images of possible fire ant mounds.
Risk-based eradication planning	The process of prioritising eradication activity in priority target areas based on the highest density and risk of fire ant spread.
Sentinel sites	Areas of land that will be used to monitor for the presence or absence of fire ants.
Staged approach	Coordinated and focused eradication activity in three phases, with each area to receive an optimal treatment regime of six treatments over two years during Phase 2.
Staged clearing of suburbs	Process for confirming targeted areas free from fire ants following the completion of treatment. The operational area will be progressively reduced as suburbs are cleared.
Suppression activities	The minimum required treatment and surveillance required to contain and suppress spread, in accordance with the National Program Treatment Protocol. I
Surveillance	An official process that collects and records data on pest occurrence or absence by survey, monitoring or other procedures.
Target area	An area within a priority area that will receive planned treatment.
Tramp ant	A diverse group of ant species originating from many regions that are readily moved across the world through a variety of transport pathways.
Treatment	The application of a chemical solution, or a substance impregnated with a chemical solution, for the purpose of destroying an infestation of red imported fire ants.
Treatment season	The warmer months when fire ants are more likely to forage—the season is approximately from September to May.
Work Plan	Detailed plan outlining the eradication activities that will be undertaken in the upcoming financial year.
Zone	Fire Ant Biosecurity Zones that have been established in areas of SEQ where fire ants have been detected, or where it is likely that fire ant infestation exists. Zone regulatory provisions restrict movement of fire ants and fire ant carriers to help prevent human-assisted spread.

Appendix 11
Acronyms

Table 12: Acronyms

Acronym	Titles
ABARE	Australian Bureau of Agricultural and Resource Economics
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
AGMIN	Agriculture Ministers' Forum
AGSOC	Agriculture Senior Officials Group
APVMA	Australian Pesticides and Veterinary Medicines Authority
ATV	All-terrain vehicle
BQCC	Biosecurity Queensland Control Centre
CRM	Client Relationship Management System
DAWR	Commonwealth Department of Agriculture and Water Resources
DNI	Direct nest injection
GBO	General Biosecurity Obligation
IGR	Insect growth regulator
NBC	National Biosecurity Committee
NMG	National Management Group
NEBRA	National Environmental Biosecurity Response Agreement
QDAF	Queensland Department of Agriculture and Fisheries
RSS	Remote sensing surveillance
SEQ	South East Queensland
SMS	Short message service
TACC	Tramp Ant Consultative Committee
USA	United States of America
USDA	United States Department of Agriculture
VMS	Variable message signage

Appendix 12
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