New Zealand Partnerships for International Development Fund Activity: Building resilience to biosecurity threats from invasive ants throughout the Pacific

Environmental and Social Impact Assessment (ESIA) for Output 5 (Early Detection Rapid response plan for potential incursion of little fire ant and / or red imported fire ant in Tarawa, Kiribati)



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Key Terms and Acronyms

Usage of terminology for invasive species sometimes varies depending on context. The terms below are defined in the specific context of the Pacific, and where appropriate the terminology is identical to the SPC and SPREP Guidelines for Invasive Species Management in the Pacific.

Key terms

**containment**: Keeping an invasive species within a defined area.

**control**: Reducing the population of an invasive species.

**EC50**: median effective concentration. This may be reported for sub-lethal or ambiguously lethal effects and is used in tests involving species such as aquatic invertebrates where death may be difficult to determine.

**effective management**: Achieving operational success (e.g. reducing the pest to defined levels) and desired outcomes (reduced impact and recovery of impacted values) of invasive species management.

**environmental threat:** invasive ants pose an environmental threat when they are present in sufficient numbers to have measureable and quantifiable ecological effects.

**impact(s)**: A routinely used term in invasion ecology and management that refers to the negative effects of an invasive species on resident native organisms (biodiversity), agriculture, economy, health or lifestyle.

**incursion**: A single arrival event of an invasive species in a new environment. Typically an incursion is identified at the time of arrival (or first detection), and an incursion response plan developed.

**incursion response plan**: Effectively an emergency response plan to deal with a newly detected incursion of an invasive species. Incursion response plans include a number of steps including: 1) initial detection and response; 2) delimiting survey and; 3) draft management plan, including a surveillance plan, a plan for treatment and eradication (if possible), a communications strategy, specifications for movement controls, monitoring progress, a budget, and an organisational plan

**half-life**: the half-life is the time required for half of the compound to break down in the environment. Thus, 1 half-life = 50% remaining, 2 half-lives = 25% remaining, 3 half-lives = 12% remaining, 4 half-lives = 6% remaining, 5 half-lives = 3% remaining. Some chemicals metabolise or degrade into other chemicals of toxicological significance, and half-lives can vary widely depending on environmental factors.

**infestation**: a single discrete area where the invasive species is localised. An incursion consists of one or more infestations.

**introduced species**: Plants, animals and other organisms taken beyond their natural range by people, deliberately or unintentionally.

**invasive ants** **/ invasive ant species:** An exotic or non-native ant species that become destructive to the environment or human interests in one or more ecological or environmental contexts. Not all invasive ants have major negative effects, and for many species the effects are density-dependent (i.e. effects only occur or are perceived by humans as negative when a threshold of abundance is reached). These are **outbreaking** species. **Threat ant species** are those invasive ant species known to have significant impacts in multiple ecological or environmental contexts and / or are prone to outbreaks. **Emerging threat ant species** are those that have recently been identified as having, or having potential to result in significant impacts. In the context of this Activity, this also refers to exotic or non-native ant species that may be considered a threat for the first time, for which there are no existing processes for biosecurity or management.

**invasive species**: Introduced species that become destructive to the environment or human interests; can also include some native species that proliferate and become destructive following environmental changes caused by human activities.

**LC50**: Lethal concentration in a single exposure that causes death in 50% of animals tested.

**LD50**: Lethal dose in a single exposure that causes death in 50% of animals tested.

**LOEL**: Lowest observed effect level. Relating to a pesticide, the lowest level at which effects are observed.

**management**: Reducing or eliminating the impacts of established invasive species, by eradication, containment, exclusion, or population reduction by physical, chemical or biological control. Note that although the title of the SPC and SPREP Guidelines for Invasive Species Management in the Pacific refers to management, in this latter context biosecurity is included as part of management.

**monitoring**: Programmes to detect change, e.g. in the distribution of invasive species, the success of management projects etc.

**monogyne:** a monogyne ant colony only has one queen.

**NOEL**: No observed effect level. Relating to a pesticide, the level below which no effects are observed.

**polygyne:** a polygyne ant colony has multiple queens.

**RfD**: Reference Dose, or in this case, the estimated amount of hydramethylnon or pyriproxyfen ingested per day, *for the rest of their life* without any appreciable risk of adverse health effects.

**treatment**: application of pesticide or other means of control at a single point in time.

Acronyms

**BACIPS**: Before After Control Impact Paired Series – a methodology for assessing the differences between treatments and controls in experiments in ecological studies, environmental remediation or perturbation activities. The BACIPS approach involves surveying sites before and after treatment, in both control (untreated) and impact (treated) sites. Control and impact sites are paired and a series of surveys are undertaken before and after treatment.

**EDNRE**: Department of Economic Development, Natural Resources and Environment, Tokelau

**EIA**: Environmental Impact Assessment

**ESIA**: Environmental and Social Impact Assessment

**IPM**: Integrated Pest Manangement

**MELAD**: Ministry of Environment, Land & Agricultural Development, Kiribati which encompasses **ALD** (Agriculture and Livestock Division), **ECD** (Environment and Conservation Division)

**MFAT:** Ministry of Foreign Affairs and Trade

**MLPID**: Ministry for Line and Phoenix Islands Development, Kiribati

**NBSAP**: National Biodiversity Strategies and Action Plan

**NISSAP**: National Invasive Species Strategy and Action Plan

**PAPP**: Pacific Ant Prevention Programme

**PIAT**: Pacific Invasive Ant Toolkit

**PIPA:** Phoenix islands Protected Area (Kiribati)

**SPC**: Secretariat of the Pacific Commission

**SPREP**: Secretariat of the Pacific Regional Environment Programme

**WHO**: World Health Organisation

Contents

[Executive Summary 5](#_Toc514051626)

[Policy, legal and administrative framework 6](#_Toc514051627)

[Environmental Impact Assessment requirements in Kiribati 6](#_Toc514051628)

[Other relevant documents in Kiribati 6](#_Toc514051629)

[New Zealand MFAT requirements 6](#_Toc514051630)

[Description of the Activity 7](#_Toc514051631)

[Materials, equipment and resources 7](#_Toc514051632)

[Pesticide description and hazard information: Synergy Pro® ant bait 8](#_Toc514051633)

[Details of operational processes 12](#_Toc514051634)

[Safe storage, handling and operations 12](#_Toc514051635)

[Disposal 13](#_Toc514051636)

[Description of the Environment 14](#_Toc514051637)

[Spatial boundaries of treatment activity 14](#_Toc514051638)

[Temporal boundaries of treatment activity 15](#_Toc514051639)

[Impacts and mitigation measures 15](#_Toc514051640)

[Issues remaining to be resolved 16](#_Toc514051641)

[Analysis of alternatives 16](#_Toc514051642)

[Site-specific environmental measures 16](#_Toc514051643)

[Biological controls 16](#_Toc514051644)

[Pesticide options 16](#_Toc514051645)

[Impact management plan 18](#_Toc514051646)

[Mitigation of risk 18](#_Toc514051647)

[Monitoring program 18](#_Toc514051648)

[Monitoring methodology 18](#_Toc514051649)

[Communication, complaints and reporting plan 19](#_Toc514051650)

# Executive Summary

In December 2013 the New Zealand Ministry of Foreign Affairs and Trade Partnerships for International Development Fund approved a Concept Note on “Building resilience to biosecurity threats from invasive ants throughout the Pacific” to proceed to the Activity Design stage. The Activity involves strengthening biosecurity and invasive ant management capacity in Kiribati. As part of the Activity Design MFAT requires that an ESIA be conducted regarding the use of pesticide. As there is no regional framework, this ESIA follows the MFAT guidelines.

A new initiative as part of the project involves Early Detection Rapid Response (EDRR) preparedness. This means the *possible* eventual use of pesticide in Kiribati to enable rapid containment and control of little fire ant and / or red imported fire ant should an incursion of either of these occur. The *predicted* incursion response area covers approximately 6 hectares centred on an industrial area. *It should be noted that the pesticides will not be used if there is no incursion.*

This ESIA specifically covers the potential treatment activity of due to EDRR, which involves pesticide use and disruptions to everyday activities (potential negative impacts), resulting in a reduction in ant abundance and distribution, and a consequent reduction in environmental and social effects should an incursion occur (positive impacts).

The proposed pesticide is manufactured by Sumitomo Chemical Australia Pty Ltd., New South Wales, Australia, and is branded Synergy Pro® ant bait (formerly branded as 0.5 HP Ant Bait). The active ingredients are hydramethylnon, which is a moderately hazardous pesticide, and classified as a WHO Class II chemical, with some environmental risks. The concentration of hydramethylnon in the bait is 3.65 g/kg. Pyriproxyfen, the other active ingredient, is classified as a WHO Class U chemical. The concentration of pyriproxyfen in the bait is 2.5 g/kg. According to information provided by the Australian supplier, the low concentration of both hydramethylnon and pyriproxifen in Synergy Pro® and the low application rate make this product non-hazardous by Australian work-safe standards and not classified as a dangerous good according to the Australian Dangerous Goods Code (2007). While the product appears to involve minimal risk to humans and other mammals, they pose considerable risks for fish and invertebrates, which require management. The product has been used effectively in Australia and Hawaii with no known residual effects.

The ESIA was carried out in 2018 and included detailed site inspection, identifying ecological characteristics and native species observations. No social impact assessment consultation was undertaken due to time constraints.

Overall the ecological effects of Synergy Pro® and potential for human harm appear to be outweighed by the negative ecological and social effects that an incursion of little fire ant and / or red imported fire ant would have.

To mitigate social impacts the following provisions exist: 1) no effect on human health is anticipated; 2) the pesticide is not to be deployed as a spray; 3) any nests inside homes and occupied buildings will not be treated; 4) non-target impacts (particularly on fish) would be managed to minimise the risk to the environment; 5) people would be given full information prior to and during treatment to advise of where the treatment was occurring; 6) the area to be treated is not used for food-harvesting or for community events, and; 7) potential for disruption to daily life during the treatment operations.

From an ecological perspective the main taxa likely to be affected by possible pesticide use include those groups that scavenge and are attracted to sugar, oil and protein products, including many ant species, cockroaches, crabs and potentially migrant shore birds. However, the Impact Management Plan addresses how these non-target effects would be minimised.

Overall any deleterious effects of the potential pesticide treatment on non-target species and human environments would be limited spatially and temporally, and appear to be outweighed by the support of the community for the mitigation of the effects an incursion of the extremely harmful and disruptive little fire ant and / or red imported fire ant would have.

# Policy, legal and administrative framework

## Environmental Impact Assessment requirements in Kiribati

In Kiribati environmental impact assessment is covered by the Environment Act 1999, which requires specific intervention for development for industrial or commercial purposes (Part III), as well as pollution (Part IV). The EIA requirement for the use of pesticides in Kiribati is not explicitly outlined on the legislation. For example, the proposed Activity does not conform to the definitions of development (Part III), and the legislation for pollution (Part IV) does not require environmental impact assessment. The requirements for environmental impact statements for development (Part III, 20) have a number of detailed and extensive stipulations that clearly apply to projects of much larger scope than the proposed Activity. Therefore this Environment Act 1999 does not appear to apply in this situation. However, this appears to be ambiguity in the legislation rather than a lack of provision for EIA for pesticide use. In fact, all activities involving pesticides must obtain permits, which require an environmental impact assessment. The ESIA outlined in this document is acceptable for permit processes.

### Other relevant documents in Kiribati

The following documents that have relevance to this Activity have also been reviewed:

* Kiribati Development Plan 2012-2015
* Line Islands Invasive Species Action Plan (NISSAP) 2016
* National Biodiversity Strategies and Action Plan (NBSAP) 2016-2020

## New Zealand MFAT requirements

The environmental and social impact assessment requirements for this project under New Zealand MFAT Environment and Social Impacts Operational Policy (ESI-OP) differ from those required by Kiribati. Compared to Kiribati, the MFAT requirements are similar for development, but the proposed Activity has no specific mention for environmental impact assessment under the Kiribati Environment Act 2011. As there is no regional framework, this ESIA follows the MFAT guidelines.

Appraisal of the Concept Note defined the proposed Activity “Building resilience to biosecurity threats from invasive ants throughout the Pacific” as meeting the criteria for MFAT Environmental and Social Impacts Guideline Category A or P(A) Activities, with ESIA reporting requiring the required to cover environmental and social impacts. The format of this report follows that suggested in the MFAT guideline.

In assessing the potential risks for pesticide use, MFAT refer to relevant in-country and regional guidelines (such as the Guidelines for Invasive Species Management in the Pacific) and the guidelines from other donors such as the World Bank Operational Policy on Pest Management (OP4.09).

# Description of the Activity

The Activity “Building resilience to biosecurity threats from invasive ants throughout the Pacific” is a proposed Partnerships for International Development Fund Activity of the New Zealand Aid Programme. The five partners involved are Pacific Biosecurity (New Zealand lead), PII, SPREP, SPC, MELAD. The project goal is to enhance resilience to the biosecurity threat of invasive ants.

A new initiative as part of the project involves implementation of Early Detection Rapid Response (EDRR) preparedness. This means provision for the *possible* use of pesticide in Kiribati to enable rapid containment and control of little fire ant and / or red imported fire ant should an incursion of either of these species occur at Betio. The likely incursion response area covers approximately 6 hectares at the port. It should be noted that the pesticides will not be used if there is no incursion. And it is also hoped that a smaller area would be treated if the incursion(s) were detected early. Regular surveillance is critical to early detection.

The ESIA outlined in this report covers rapid response to the little fire ant or red imported fire ant should an incursion of either or both of these species occur. The likely area of incursion is approximately 6 hectares in the port area in Betio (Figure 2).

Rapid response includes the following activities:

1. Develop adaptive management plan covering Communication, Delimiting, Containment (including movement controls), Surveillance, Treatment, Monitoring
2. Communication with affected stakeholders
3. Implement containment measures
4. Surveillance and Delimiting
5. Movement controls (in line with enforcement powers outlined in by the Kiribati Biosecurity Act 2011)
6. Implement treatment measures should an incursion occur
7. Treatment: pesticide control– two rounds of control 3 months apart
8. Monitoring before and after control rounds

This ESIA specifically covers the potential treatment activities, which involves possible pesticide use and disruptions to everyday activities (potential negative impacts), resulting in a reduction in ant abundance and distribution, and a consequent reduction in environmental and social effects should an incursion occur (positive impacts).

## Materials, equipment and resources

In Kiribati the chief materials, equipment and resources include 72 kg Synergy Pro® ant bait, with pyriproxyfen at a concentration of 2.5 g/kg and hydramethylnon in a concentration of 3.65 g/kg in a proprietary bait matrix that is attractive to ants, equipment to disperse the bait (manual “Scott” spreaders), (motorised blowers), fuel (400 litres unleaded 91 octane petrol) for the motorised blowers, and safety equipment. Secure storage facilities are required to ensure the ant bait, equipment and fuel is safely contained.

All equipment will be sourced in New Zealand. Synergy Pro® bait will be manufactured by Sumitomo Chemical Australia Pty Ltd. in Australia, and shipped to Tarawa via Brisbane, Australia (by sea). Work on Tarawa will be undertaken by Pacific Biosecurity staff with the assistance of MELAD staff.

### Pesticide description and hazard information: Synergy Pro® ant bait

Synergy Pro® has two active ingredients, hydramethylnon and pyriproxyfen. Hydramethylnon is a moderately hazardous pesticide, and classified as a WHO Class II chemical, with a number of environmental risks. Pyriproxyfen is unlikely to present acute hazard in normal use, and classified as a WHO Class U chemical. The technical information available[[1]](#footnote-2) on which the following assessments are based, relates to hydramethylnon and pyriproxyfen in their undiluted forms. The concentration of hydramethylnon in the bait is 3.65 g/kg. The concentration of pyriproxyfen in the bait is 2.5 g/kg. According to information provided by the Australian supplier, the low concentration of both hydramethylnon and pyriproxifen in Synergy Pro® and the low application rate make this product non-hazardous by Australian work-safe standards and it is not classified as a dangerous good according to the Australian Dangerous Goods Code (2007).

#### Chronic effects on humans

The RfD (Reference Dose) of hydramethylnon is 0.01 mg/kg of body weight. For a 50 kg human this is equivalent to 0.5 mg per day. Given that the hydramethylnon concentration in Synergy Pro® bait is 3.65 g/kg, a 50 kg human would need to ingest 0.14 g of the bait per day for life to generate possible chronic effects. Clearly doses are lower and risks are higher for small children (who are also more likely to pick up baits from the ground and eat them). For a 15 kg child, the RfD would be 0.04 g of bait. However, reference materials note that no data is available on what chronic effects might be, and it appears none have been reported – even among pest management contractors. In addition there are no recommended or regulatory occupational exposure limits for hydramethylnon in the US. Hydramethylnon is reported to be a possible carcinogen in chronic doses due to lung adenomas and carcinomas in mice. However, it is considered that there is inadequate or no evidence that it may cause cancer in humans. Ingestion rates of 5.05 mg/kg per day in rats (i.e. equivalent to ~69 g of Synergy Pro® bait for a 50 kg adult per day for life) have been associated with reduced reproductive performance in males, and lower pregnancy rates and reduced gestation weight gain for females.

The RfD (Reference Dose) of pyriproxyfen is 0.35 mg/kg of body weight. For a 50 kg human this is equivalent to 17.5 mg per day. As pyriproxyfen concentration in Synergy Pro® bait is 2.5 g/kg, a 50 kg human would need to ingest nearly 7 g of the bait per day for life to generate possible chronic effects. For a 15 kg child, the RfD would be 2 g of bait. However, reference materials note that no data is available on what chronic effects might be, and it appears none have been reported – even among pest management contractors. In addition there are no recommended or regulatory occupational exposure limits for pyriproxyfen in the US. Pyriproxyfen is not considered to be a carcinogen in chronic doses, and it has not been shown to cause mutations in mutagenicity screening tests designed to screen chemicals for carcinogenicity. Ingestion rates of 120 mg/kg per day in rats (i.e. equivalent to ~720 g of Synergy Pro® bait for a 15 kg child per day for life) have been associated with increased cholesterol and liver weights.

Chronic effects would occur only with continual exposure to either chemical over time and acute effects (due to the nature of pesticide use in the context of this Activity) are a higher risk.

#### Acute effects on humans

Technical grade (undiluted) hydramethylnon is considered low in toxicity when ingested with an acute oral LD50 of 1131-1300 mg/kg in rats. Although no data is available for human LD50, based on the rat data a 50 kg adult human would need to ingest ~15.5 kg of hydramethylnon containing Synergy Pro® granules in a single dose, and a 15 kg child would need to ingest ~4.6 kg of bait to cause death in a single exposure. Signs of acute toxicity reported for rats after ingesting near lethal doses of hydramethylnon include excessive salivation, decreased activity, anorexia, bloody nose, and difficulty with coordination and balance.

Technical grade (undiluted) pyriproxyfen has an even lower toxicity when consumed than hydramethylnon, with an LD50 of greater than 5000 mg/kg in rats, mice, and dogs. The LD50 for a human is not known, but based on the other mammal LD50s, a 50 kg person would need to consume more than 100 kg of Synergy Pro® in a single dose, and a 15 kg child would need to consume more than 30 kg of bait to cause death in a single exposure. Signs of acute toxicity reported for rats after ingesting near fatal doses of pyriproxyfen include diarrhea, unusual breathing, and loss of muscle control. Dogs fed near lethal doses of pyriproxyfen vomited occasionally.

There are no medical reports or occupational studies on the effects of acute toxicity caused by hydramethylnon or pyriproxyfen ingestion on humans, suggesting such cases are extremely rare or non-existent.

Hydramethylnon is considered very low in toxicity via inhalation. The proposed output does not involve spraying, but the Hydramethylnon Technical fact sheet reports very low toxicity by inhalation when inhaled by rats with a 4-hour LC50 of 2.9 mg/L. There are no reports of the effect of hydramethylnon inhalation in humans, probably because the risk of exposure to hydramethylnon via inhalation is expected to be minimal due to its physical-chemical properties (i.e. solid at room temperature) and the formulation (i.e. in baits and traps).

Pyriproxyfen is also considered to have very low toxicity when inhaled. The 4-hour LC50 when inhaled by rats was more than 3.48 mg/L, which is a very low toxicity. Some rats experienced salivation and urinary incontinence, and some mice had irregular respiration at doses of 1.3 mg/L after 4 hours. These symptoms disappeared within 1 hour of cessation of exposure. There are no reports of the effect of pyriproxyfen inhalation in humans.

#### Metabolism in soil

The half-life of hydramethylnon in aerobic soil is 375-391 days. Hydramethylnon binds tightly to soil particles, making it unavailable for microbial degradation. However, hydramethylnon is highly unstable to UV light (i.e. sunlight) and has a half-life of five days on the soil surface (though some studies have shown that in sunlight hydramethylnon has a half-life of 12 hours). Sunlight degrades hydramethylnon into two compounds, a epoxide and a ketone, but little more is known about these compounds. When ants bring the bait back to their nest and it is not immediately eaten, microbial degradation can occur. For example, one study found a white rot fungus (*Phanerochaete chrysosporium*) breaks down hydramethylnon with half-life of 14-25 days. Hydramethylnon is non-volatile, due to its low vapor pressure. As hydramethylnon binds tightly to soil particles and has low water solubility it is not very mobile in soil and is unlikely to leach into groundwater.

The half-life of pyriproxyfen is 12.4 days in aerobic soils, and 6-9 days if microbes are also present. Under aerobic conditions, naturally occurring soil organisms break down pyriproxyfen to form 4’-OH-Pyr and PYPAC.

Pyriproxyfen degrades on soil surfaces by ultraviolet radiation (i.e. sunlight) and has a half-life 3.5 – 16 days. The half life of pyriproxyfen degradates are longer than the parent compound with 4’-OH-Pyr having a half-life of 83 days and PYPAC a half-life of 33 days in aerobic soil. Pyriproxyfen has low mobility in soil and is not expected to leach into groundwater. After soil treatment, pyriproxyfen usually does not travel further than the upper twelve inches of soil, with the greatest concentration being in the upper six inches.

#### Metabolism in water

Hydramethylnon degrades rapidly in water when exposed to UV light. Under these conditions hydramethylnon has a half-life of less than an hour. Hydramethylnon has five photoproducts in water: TFP, TFPT, TFBA, N,N’-azo(5,5-dimethylperhydropyrimidin-2-one hydrazine, and TFCA. No further information on these degradates or their decomposition rates in water is known.

When exposed to sunlight, pyriproxyfen has a half-life in water of 3.7 to 6.2 days. Pyriproxyfen is stable to hydrolysis (i.e. it does not degrade in water) at pH 5 - pH 9. In anerobic conditions pyriproxyfen breaks down much more slowly and has a half-life of 346.5 days. Pyriproxyfen degradates have an aquatic half-life of 16.5 hours for 4’-OH-Pyr and 8.2 days for PYPAC in aerobic conditions. Under anaerobic conditions the degradates break-down much more quickly than their parent compound and have a half-life of 4.8 days and 41.3 days for 4’-OH-Pyr and PYPAC, respectively. In highly polluted water, one study found pyriproxyfen strongly adsorbed onto organic matter and remained biologically active for up to two months after the initial application. Its persistence in water without organic matter decreases with increasing temperature and UV radiation exposure. Pyriproxyfen may volatize slightly from an aqueous solution.

#### Ecotoxicity

As Kiribati is home to no freshwater fish or invertebrates, this discussion relates only to marine life. When applied to water, hydramethylnon and pyriproxyfen vary in their toxicity and potential to bioaccumulate in aquatic invertebrates, depending on the species. The proposed Activity will not apply Synergy Pro® to water, nor use sprays, and a number of measures will be taken to avoid run-off (see Impacts and mitigation measures).

Hydramethylnon is moderately to highly toxic to freshwater fish (no studies have looked at hydramethylnon toxicity to marine fish, but it is likely similar), however, the half-life of hydramethylnon in water is less than one hour when exposed to light. The 96-hour LC50 is 0.16 mg/L for rainbow trout, 0.10 mg/L for channel catfish, and 1.70 mg/L for bluegill sunfish. Laboratory tests have shown hydramethylnon accumulation in fish with a bioconcentration factor of 1300X in whole fish, 780X in fillet, and 1900X in viscera. However, due to hydramethylnon’s low solubility, and very short half-life via photodegradation in water, fish are very unlikely to come into contact with this chemical and thus no bioaccumulation is expected to occur.

Pyriproxyfen is moderately to highly toxic to marine fish, however, in one study[[2]](#footnote-3) two species of fish exposed to pyriproxyfen-treated water showed no toxic effects at the highest dose. It is difficult to tell how toxic it is because it dissolves poorly in water and thus fish are unlikely to be directly exposed to it. The 96-hour LC50 is 0.0.270 mg/L for bluegill sunfish, 0.325 mg/L for rainbow trout, 0.450 mg/L for carp, 2.660 mg/L for killfish, and 0.102 mg/L for sheepshead minnows. Pyriproxyfen has a moderate risk of bioaccumulating in fish, as it binds to fat. Laboratory tests have shown pyriproxyfen accumulation in fish with a bioconcentration factor of about 400X for whole fish. However in these tests treated fish eliminated pyriproxfen quickly after being transferred to clean water, with a half-life of 12 hours. Thus, in areas with large volumes of water, such as the lagoon or ocean, together with the low concentration of pyriproxyfen in the ant bait, and the application method more likely to result in the toxin remaining on land, the likelihood of bioaccumulation in fish is minimal.

Hydramethylnon is moderately toxic to aquatic invertebrates. In daphnids (planktonic crustaceans), the 48-hour LC50 for hydramethylnon was measured at 1.14 µg/L. The U.S. Environmental Protection Agency did not consider it necessary to test the effect of hydramethylnon on an aquatic invertebrate lifecycle (chronic), due to hydramethylnon’s very low solubility in water, and it’s brief half-life there.

Pyriproxyfen is slightly to moderately toxic to marine invertebrates. In daphnids, the 48-hour EC50 for pyriproxyfen was 400 μg/L. A test found that when two species of daphnids lived in treated water, they produced less offspring. However, this effect was reversible. Another study found at field rates (6-28 g/ha, the proposed activity would use 5-10 g/ha) pyriproxyfen has no noticeable effect on mayfly, dragonfly, ostracods, cladocerans, copepods, and beetles[[3]](#footnote-4). In a test that treated aquarium water with pyriproxyfen at a concentration of 10 μg/L, no adverse effects were found on planktonic organisms[[4]](#footnote-5). The LC50 of the estuarine shrimp, *Leander tenuicornis*, was calculated to be 98 μg/L, which is 12 times the estimated field concentration[[5]](#footnote-6).The 96-hour LD50 of mysid shrimp, was calculated to be more than 92 μg/L. For oysters, an Oyster Shell Deposition test, a test that measures several health parameters including an oyster’s ability to rebuild its shell, found an 96-hour EC50 of more than 92 μg/L.

However, in the context of the proposed activity, the large volumes of water, the application method more likely to result in the toxin remaining on land, together with the very low solubility of hydramethylnon and pyriproxyfen and hydramethylnon’s rapid break-down in water, the likelihood of effects on marine invertebrates are minimal.

Hydramethylnon is selectively toxic to terrestrial invertebrates with chewing or sponging mouthparts, such as cockroaches, termites, crickets, and silverfish. It is highly toxic when ingested by insects, the LD50 value for the tobacco budworm (the larval stage of a moth) was 7 µg/g. It is relatively nontoxic to insects that are incapable of ingesting the compound (i.e. with other types of mouthparts) and when exposure is limited to cuticular contact. Hydramethylnon is practically nontoxic to honey bees, with an LD50 of 68.0 µg/bee.

Pyriproxyfen is also toxic to some terrestrial invertebrates. It produced severe deformities at the molt of a predatory bug, *Podisus maculiventris*, but had no effect on another predatory bug species, *Orius insidious*.In one test the larvae of a ladybird beetle species (*Rodolia cardinalis*) failed to develop into adults after being treated with pyriproxyfen3. Pyriproxyfen is practically non-toxic to earthworms, with an LC50 of 42,630 μg/L[[6]](#footnote-7). Pyriproxyfen is also practically non-toxic to bees, with a contact LC50 of more than 100 μg/bee. One study found that bumblebee colonies developed normally over five weeks after being feed a 20 ppm (20,000 μg/L) dose of pyriproxyfen and sugar solution for 24 hours[[7]](#footnote-8).

Other ant species will also be affected by Synergy Pro® treatment, but only if they are attracted to the bait matrix.

Hydramethylnon is slightly toxic, to practically non-toxic when ingested by birds, with an LD50 of greater than 2510 mg/kg in mallard ducks and 1828 mg/kg in bobwhite quail. Pyriproxyfen is also practically non-toxic to birds. Reports include an acute oral LD50 (a single dose test) of greater than 2000 mg/kg in mallard ducks and bobwhite quail.

The technical information does not mention effects on reptiles, however these species may be affected through loss of prey insects in Synergy Pro® treated areas.

#### Pesticide resistance

The supplier information for insecticide resistance of advises the product is both a Group 7C and 20A insecticide. It is possible that some biotypes or genotypes of insect species are resistant to Synergy Pro® and other Group 7C and / or 20A insecticides, due to naturally occurring genetic variability in any population. Resistance has not been reported in ants.

## Details of operational processes

Effective ant management requires that the ant queen(s) must be killed to kill the colony (colonies of little fire ants can have hundreds or thousands of queens; red imported fire ants may have one or many queens). Ant baits containing pesticides must be attractive to workers, so that the workers return the bait to the nest for the queen(s) to feed on, but the bait must be not so toxic that it kills the workers before the bait is returned to the nest. Ants are attracted to protein and sugar, however some combinations are more attractive to specific ant species than others. Synergy Pro® is unique as a granular bait in that it has two different types of granules, one sugar-based, the other protein/oil-based so it will remain attractive as feeding preferences change throughout the year. Synergy Pro® bait has been used for control trials of Argentine ant in Hawaii, and African big-headed ant control on Lord Howe Island.

Little fire ant and red imported fire ant colonies are made up of long-lived queens (~1 year for little fire ant, ~2-6 years for red imported fire ant), short-lived workers (~3 months), and short-lived males that die immediately after mating. Queens produce new workers year-round, and produce new queens and males during certain environmental conditions. Typically production of queens and males coincides with the onset of the wet season (when there are distinct wet and dry seasons). While the new queens are in pupal stage they do not eat, and while treatment at this stage will kill adult queens, the pupal queens will be unaffected and thus the colony will not be killed.

Thus, effective treatment must take into account the biology of the ant, and its relationship with environmental conditions, as well as an appropriate pesticide concentration and bait matrix for the target species. For these reasons treatment is best undertaken during the dry season, or at least during dry weather [[8]](#footnote-9),[[9]](#footnote-10),[[10]](#footnote-11). The second reason for undertaking treatment in dry weather is to minimise the risk of non-target effects through run-off into the marine environment due to more frequent rain in the wet season.

The number of treatments (within a season and throughout the management programme) depends on the objective of the operation. The objective of the proposed work is to eradicate little fire ant and / or red imported fire ant colonies before they become widespread, should an incursion occur. Thus, only two control treatments three months apart years are proposed, interspersed with and followed by of monitoring. Eradication is feasible on Betio.

### Safe storage, handling and operations

#### Manufacturer’s precautions for safe handling and storage

The proposed Activity will follow the manufacturer’s guidelines for safe handing, which are as follows: “Keep out of reach of children, unauthorized persons and animals. After handling and before eating, drinking or smoking wash hands, arms and face thoroughly with soap and water. Use only in well ventilated areas. Avoid contact with eyes. Eye contact can be avoided by wearing protective eyewear. Avoid contact with skin or clothing. Skin contact should be minimised by wearing protective clothing including gloves, long sleeved shirt, long pants and chemical resistant boots.” The Activity has budget provisions for gloves and face masks for all participants.

#### Manufacturer’s conditions for safe storage

The proposed Activity will follow the manufacturer’s guidelines for safe storage, which are as follows: “Store in the closed, original container in a dry, cool, well-ventilated area out of direct sunlight. Do not store near food, feedstuffs, fertilizer or seed.” Facilities are available in Betio for secure storage. However, temperature cannot be controlled in these facilities. Sumitomo Chemicals reports that in their experience with Synergy Pro® in hot climates, the product will remain use-able as long as it is stored covered and not exposed to the full heat of the sun. The worst effect of excess heat is that the external bait granules congeal and are unusable.

#### Distribution of bait around Betio commercial area

Should an incursion of little fire ant and / or red imported fire ant occur, baiting will be necessary. Approximately two days prior to when baiting operations are planned to commence a meeting will be held with businesses in the commercial area, and local residents who use the area. The details of the operation will be described and the expectations regarding the presence of bait around will be highlighted, for example, not touching any bait, ensuring children do not interfere with the bait. Signs will need to be erected informing of treatment activities and prohibited activities.

MELAD staff involved in the baiting operation will need to be given specific safety briefings and training in the baiting operation. In the coming months, participants will be advised of the safety requirements regarding protective clothing (gloves, close-toed shoes, long-sleeved shirts and trousers), and that protective items must not be washed in the lagoon or ocean.

Synergy Pro® ant bait will be stored in locked facilities in Betio until required. Baiting will only take place when the ground is dry and there is minimal chance of rain for at least 4 hours after cessation of baiting activities.

One or two teams of 3-4 people, made up of Tarawa MELAD staff, will distribute the Synergy Pro® ant bait by broadcast spreading using “Scott” spreaders at a rate of 2-4 kg / hectare. Excessive baiting will be avoided to minimise residual bait in the field (i.e. unsuitable habitat areas such as roads will not be baited). The area treated will include the detection area of the ant, plus a buffer zone of 50 metres around the perimeter of the known infestation, except where this buffer zone impinges an area within 5 metres of the high tide zone. Motorised blowers will only be used in the area that contains many crushed cars and well outside the buffer zone.

### Disposal

All Synergy Pro® ant bait will be used. Leftover buckets, together with used gloves, masks and other safety equipment that cannot be safely cleaned, should be shipped back to New Zealand or Australia for disposal according to New Zealand laws and regulations and manufacturer instructions.

# Description of the Environment

**Figure 1:** Aerial view of Tarawa, showing the main settlements and the Port of Betio, the area of interest for the proposed Activity.

Tarawa atoll (Figure 1) is part of the Gilbert Islands group and the capital of Kiribati. It has air connections to Fiji, which operate weekly. Connections for cargo and passengers are by ship to Kiritimati, and the other islands in the Gilbert, Line and Phoenix groups, and internationally.

Half the country’s population, 50,000 people, live in South Tarawa. Betio is the largest village in Kiribati, with a population of almost 16,000 people. It contains the main commercial area, as well as one of two of the main ports of entry in Kiribati (the other is on Kiritimati).

## Spatial boundaries of treatment activity

**Figure 2:** Aerial view of Betio Port, Tarawa, Kiribati, outlined in red, showing the area of interest for the proposed Activity. Image sourced from Google Maps (<http://maps.google.com>).The area of interest for the proposed Activity is the port of Betio (Figure 2). This area covers approximately 6 ha, and mostly contains port and industrial activities, with some people living on the very edge of this area (Figure 3).

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**Figure 3:** Photo montage of typical areas that would be treated should an ant incursion occur in the port area of Betio, Tarawa atoll, Kiribati

## Temporal boundaries of treatment activity

Should an incursion occur, the proposed treatment activity on Betio will take place immediately (during the dry season or dry periods in the wet season, as Betio often experiences long periods of drought in the wet season) twice, with three months in between treatments. After treatment monitoring of ant distribution and abundance will occur and decisions made by MELAD on further treatment.

## Impacts and mitigation measures

The treatment activities on Betio will take no more than a few days each round. However, this might interfere with normal activities of the businesses in the area, which will need to be minimised. This was noted as an issue for consultation with the affected businesses. The management plan addresses communication with the affected stakeholders including discussion and signage.

Although Tarawa is home to 41 species of birds, including seabirds and migrant shore birds, the size and nature of the target area (around six hectares in an industrial area), makes it highly unlikely these non-target species would be affected should an incursion occur and treatment be necessary.

# Issues remaining to be resolved

If the Activity is approved, a permit for the Treatment will be required by ECD in Tarawa, using this ESIA as a basis for risk assessment.

Businesses in the affected areas will need to be contacted prior to treatment being undertaken.

# Analysis of alternatives

The option of not being prepared in case of an incursion of little fire ant and / or red imported fire ant… undertaking treatment has not been considered by Kiribati. Both ECD and ALD have expressed support for having an early detection rapid response plan for little fire ant and red imported fire ant in place in Tarawa. In order of preference integrated pest management should involve: 1) site-specific environmental measures; 2) biological control; 3) pesticide application. However, the most important measure is prevention, and a major focus of the broader Activity is on enhancing biosecurity and preparedness.

### Site-specific environmental measures

On Tarawa the potential infestation are is in a commercial area around the port. When the infestation is first discovered, site-specific environmental actions can include distributing sea-water onto the nests. This results in flushing out a large number of queen ants which are then killed, however limited resources (time, staffing, transport) and the effort required to undertake this method of control means this is unworkable for eradication. Movement controls are often difficult to enforce. As pesticide treatment is relatively quick and less labour intensive at this small scale, with relatively small risks to the environment, it seems highly prudent to use pesticide for a rapid incursion response.

### Biological controls

No biological control options are currently available for ants, and most ant species typically have no significant predators. However, the population crashes occasionally seen in yellow crazy ants and other ants suggests disease may be responsible (similar to colony collapse disorder in bees). Some work is being undertaken by various research groups on the potential of viruses, microsporidia and other parasites and pathogens as biological controls, but this work is complex and to date no effective option has been identified.

### Pesticide options

Preferred options for treatment products for ants are those whose effects on target and non-target species are well known. Synergy Pro® is commonly used in Australia against both little fire ant and red imported fire ant.

Hydramethylnon, usually in combination with an Insect Growth Regulator, such as pyriproxyfen or S-methoprene, is the most common active ingredient used when treating little fire ants and red imported fire ants. In the Galapagos, Charlotte Causton of the Charles Darwin Research Station eradicated little fire ants from Marchena Island using Amdro®, a hydramethylnon-based product. In Hawaii, Cas Vanderwoude has achieved several eradications of little fire ant using the products Probait® (hydramethylnon-based) and Tango® (S-methoprene-based) together. In one trial in Taiwan, Dr. Ji-Sen Hwang eradicated a small infestation of red imported fire ants using Esteem®, a pyriproxyfen-based product. And the Australian government uses Amdro®, Engage® (S-methoprene-based), and Distance® (pyriproxyfen-based) in their red imported fire ant control programme. However, all the above treatments, though effective, required treating the infestation every 6 weeks, sometimes for 1.5-2 years, adding significantly to the cost and effort of the work.

A number of treatments with different active ingredients have been or are used to treat little fire ant and red imported fire ant infestations. In the case of red imported fire ants, spray treatment has also been used (on individual nests only), but more often the active ingredient is combined with a bait matrix. In addition to hydramethylnon other candidate active ingredients for little fire ants and red imported fire ants ants include indoxacarb, fipronil, and metaflumizone. All have some non-target effects. Another IGR that has been used against little fire ants (Australia and Hawaii) and red imported fire ants (Australia) is S-methoprene.

No publicly available, peer-reviewed quantitative assessments have been made to compare the efficacy and risk profiles of Insect Growth Regulators, hydramethylnon-, indoxacarb-, fipronil- and other pesticide based ant baits on little fire ants or red imported fire ants in atoll environments.

Pesticide resistance has not been reported in any ant species including little fire ants and red imported fire ants. However, excessive use of pesticides is linked to resistance, and the proposed Activity minimises the exposure to pesticide with treatments only proposed annually.

The World Bank requirements for funding projects that require the use of pesticides stipulate that: “(a) They must have negligible adverse human health effects; (b) They must be shown to be effective against the target species; (c) They must have minimal effect on non-target species and the natural environment.  The methods, timing, and frequency of pesticide application are aimed to minimize damage to natural enemies.  Pesticides used in public health programs must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them; (d) their use must take into account the need to prevent the development of resistance in pests”. The proposed Treatment plan meets all of these requirements.

Weighing up the evidence (or lack there-of) the hydramethylnon and pyriproxyfen-based product is most appropriate for the proposed Activity as it has proven effective in Australia and its non-target effects are reasonably well-known. In addition, the lessons learned on Lord Howe Island are of particular relevance to the Pacific atoll environment due to a number of similar ecological characteristics e.g. the effects on coconut crabs, tropical environment, porous soils, and risks of pesticide entering the marine environment.

# Impact management plan

Should an incursion occur, and treatment be required, the risk components on Betio include the proximity to people’s homes and businesses and proximity to the ocean and lagoon.

## Mitigation of risk

Treatment risks to human health can be mitigated in the following ways:

* Communication of the baiting process approximately two days prior to baiting to home and business owners in the vicinity of the affected area in Betio and advice to supervise young children during the baiting period
* Placement of signs advising the community of baiting around the affected area (using images, clear symbols and local language), perimeter tape around the infestation in Betio, and perhaps a ‘night watchman’ to watch out for children in the evening
* Following the safety precautions for storage, handling and disposal recommended by the manufacturers and outlined in the operational processes. Ensuring all workers follow these precautions
* All safety equipment will be brought to site if there is not suitable equipment already at each location.
* Personal protective equipment will be provided to all of those involved, and a safe washing procedure for cleaning clothes after use will be identified
* Providing safety training to all workers
* Potential health effects will be advised to the community
* Surveys to identify any human health effects will be undertaken as part of monitoring. Although no effects have been reported for Synergy Pro®, this may be because the product has not been used in areas where people are present, or no monitoring has been reported. If it is suspected that health effects have occurred, treatment may be discontinued at the discretion of the community.

Mitigation of the risk of pesticide contamination of the ocean and lagoon (including marine life) includes:

* Using a granular bait matrix rather than spray application
* Undertaking management on days where the risk of rain in the 4-6 hours following baiting is highly unlikely
* Ensuring a buffer zone of 8 metres above the high tide level.

Managing the potential for pesticide resistance / bait shyness will include:

* Limiting treatment to once every three months.

Given that the area of potential incursion on Betio is in a degraded, developed terrestrial environment, non-target effects on natural food resources and natural enemies are highly unlikely.

## Monitoring program

The purpose of monitoring is to assess non-target impacts, which will provide useful information for management of little fire ants and / or red imported fire ants in other projects, and validate the success of the treatment in reducing ant abundance and distribution. This information will also enable assessment of the risk versus reward of continuing little fire ant and / or red imported fire ant treatment. Outcomes of monitoring

### Monitoring methodology

#### Ecological monitoring

On Betio, the nature of the site of the infestation makes monitoring for non-target effects via the use of transects un-workable. Instead monitoring will be via visual surveys of the entire area, and a corresponding uninfested area of the same size.

The ecological outcomes of monitoring will be assessed and reviewed immediately after monitoring has taken place, and reported back to the stakeholders by MELAD.

#### Social monitoring

In addition to monitoring non-target effects, surveys of the local community should be undertaken on Betio to attempt to detect possible effects on human health.

The ecological and social outcomes of monitoring will be assessed and reviewed immediately after monitoring has taken place, and reported back to the stakeholders (MELAD, local communities). If an incursion occurs and treatment is necessary, the treatment programme will be adapted and may be revised dependent on the results of monitoring. For example, if monitoring uncovers unforeseen negative impacts, further treatment may be discontinued. If monitoring reveals an absence of little fire ants and / or red imported fire ants treatment will be discontinued (however monitoring will continue).

## Communication, complaints and reporting plan

The Betio community around the treatment area will be consulted at the beginning of treatment, to confirm the schedule for management and identify any constraints to the schedule (i.e. other activities that would preclude treatment occurring), confirm work schedules.

Communities on Betio should be informed of their right to raise issues (complaints or conflicts) arising out of the treatment activities. Contact details should be provided on signage. All complaints or conflicts should be recorded (including details on gender, approximate age, and name of complainant). The intention is that any issue will be resolved between the parties where possible, and as soon as possible.

MELAD should report to the communities regarding the outcomes of treatment and monitoring.

**Table 2**: Roles and responsibilities of parties

|  |  |
| --- | --- |
| **Organisation and Role** | **Responsibilities** |
| MELAD  Activity Leader | Undertake treatment and monitoring on Betio, Ensure appropriate parties (business owners on Betio) are fully informed, Ensure all safety and mitigation measures are followed, Maintain professional practice, Report outcomes of monitoring as described, Comply with local law and cultural expectations, Ensure effective communication, Ensure that logistic requirements are met |
| Business owners on Betio | Support the Activity, Comply with the safety guidelines, Raise concerns with appropriate parties, Report concerns to PB |

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