Susceptible species	EPBC Act status	State/territory
Epacris virgata	E	Tas.
Leucopogon gnaphaloides	E	WA
Leucopogon marginatus	E	WA
Leucopogon obtectus	E	WA
Sphenotom drummondii	E	WA
FABACEAE		
Daviesia bursarioides	E	WA
Daviesia euphorbioides	E	WA
Daviesia glossosema	CE	WA
Daviesia megacalyx	E	WA
Daviesia microcarpa	E	WA
Daviesia pseudaphylla	E	WA
Daviesia speciosa	E	WA
Gastrolobium papilio	E	WA
LAMIACEAE		
Prostanthera eurybioides	E	SA
Prostanthera marifolia	CE	NSW
MYRTACEAE		
Darwinia collina	E	WA
Darwinia meeboldii	V	WA
Darwinia oxylepis	E	WA
Darwinia squarrosa	V	WA
Eucalyptus imlayensis	E	NSW/ACT
Verticordia carinata	V	WA
Verticordia densiflora var. *pedunculata*	E	WA
PROTEACEAE		
Adenanthos dobagii	E	WA
Adenanthos ellipticus	V	WA
Adenanthos eyrei	E	WA
Adenanthos pungens subsp. *effusus*	E	WA
Adenanthos pungens subsp. *pungens*	V	WA
Adenanthos velutinus	E	WA
Banksia anatona	CE	WA
Banksia aurantia	CE	WA

Susceptible species	EPBC Act status	State/territory
Banksia brownii	E	WA
Banksia cuneata	E	WA
Banksia goodii	V	WA
Banksia mimica	E	WA
Banksia montana	E	WA
Banksia nivea subsp. *uliginosa*	E	WA
Banksia oligantha	E	WA
Banksia serratuloides subsp. *perissa*	CE	WA
Banksia squarrosa subsp. *argillacea*	V	WA
Banksia verticillata	V	WA
Conospermum hookeri	V	Tas.
Conospermum undulatum	V	WA
Grevillea batrachoides	E	WA
Grevillea calliantha	E	WA
Grevillea christinae	E	WA
Grevillea elongata	E	WA
Grevillea flexuosa	V	WA
Grevillea infundibularis	E	WA
Grevillea involucrata	E	WA
Grevillea maccutcheonii	E	WA
Grevillea maxwellii	E	WA
Grevillea murex	E	WA
Grevillea scapigera	E	WA
Grevillea williamsonii	E	Vic.
Hakea megalosperma	V	WA
Isopogon uncinatus	E	WA
Lambertia echinata subsp. *echinata*	E	WA
Lambertia echinata subsp. *occidentalis*	E	WA
Lambertia fairallii	E	WA
Lambertia orbifolia	E	WA (2subsp WA)
Lomatia tasmanca	CE	Tas.
Persoonia micranthera	E	WA
Petrophile latericola	E	WA

Susceptible species	EPBC Act status	State/territory
RHAMNACEAE		
Pomaderris halmaturina subsp. *halmaturina*	V	SA
RUTACEAE		
Asterolasia phebalioides	V	SA, Vic.
Boronia revoluta	E	WA
Correa calycina	V	SA
Leionema ralstonii	V	NSW/ACT
Phebalium daviesii	CE	Tas.
THYMELAEACEAE		
Pimelea pagophila	V	Vic.
TREMANDRACEAE		
Tetratheca gunnii	CE	Tas.
WINTERACEAE		
Tasmannia purpurascens	V	NSW/ACT
XANTHORRHOEACAE		
Xanthorrhoea arenaria	V	Tas
Xanthorrhoea bracteata	E	Tas.

Appendix B

Threatened ecological communities listed under the EPBC Act that may be impacted by *Phytophthora cinnamomi*

Threatened ecological communities listed under the EPBC Act can be found at:

http://www.environment.gov.au/biodiversity/threatened/communities.html

This list was compiled on the basis of threatened ecological communities occurring within the climatic zone in which conditions for *P. cinnamomi* are favourable. The list was refined in consultation with state agencies.

EPBC Act status: CE=critically endangered; E=endangered; V= vulnerable

Ecological communities listed under the EPBC Act	EPBC Act status	State/territory
Arnhem Plateau sandstone shrubland complex	E	NT
Blue Gum high forest of the Sydney Basin Bioregion	CE	NSW
Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Queensland	E	Qld
Claypans of the Swan Coastal Plain	CE	WA
Corymbia calophylla - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain	E	WA
Corymbia calophylla - *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain	E	WA
Cumberland Plain shale woodlands and shale-gravel transition forest	CE	NSW
Eastern Stirling Range montane heath and thicket	E	WA
Eastern Suburbs Banksia scrub of the Sydney Region	E	NSW
Gippsland Red Gum (*Eucalyptus tereticornis* subsp. *mediana*) grassy woodland and associated native grassland	CE	Vic.
Grassy Eucalypt woodland of the Victorian Volcanic Plain	CE	Vic.
Lowland grassy woodland in the South East Corner Bioregion	CE	NSW/ACT/Vic.
Lowland rainforest of subtropical Australia	CE	Qld/NSW

Ecological communities listed under the EPBC Act	EPBC Act status	State/territory
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	E	WA
New England Peppermint (*Eucalyptus nova-anglica*) grassy woodlands	CE	Qld/NSW
Peppermint Box (*Eucalyptus odorata*) grassy woodland of South Australia	CE	SA
Scott River ironstone association	E	WA
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	E	WA
Shale/sandstone transition forest	E	NSW
Shrublands and woodlands of the eastern Swan Coastal Plain	E	WA
Shrublands on southern Swan Coastal Plain ironstones	E	WA
Silurian limestone Pomaderris shrubland of the South East Corner and Australian Alps Bioregions	E	Vic.
Swamp Tea-tree (*Melaleuca irbyana*) forest of south-east Queensland	CE	Qld
Swamps of the Fleurieu Peninsula	CE	SA
Temperate highland peat swamps on sandstone	E	NSW/Vic.
Turpentine-Ironbark Forest in the Sydney Basin Bioregion	CE	NSW
Weeping Myall-Coobah-Scrub Wilga shrubland of the Hunter Valley	CE	NSW
Western Sydney dry rainforest and moist woodland on shale	CE	NSW
White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland	CE	Qld/ NSW/ Vic.

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BIO317.0114

Attachment H to Proposed Approval Decision Brief Lord Howe Island Rodent Eradication Project, NSW (EPBC 2016/7703)
Proposed Approval Decision ERT Review

A search of the Department's Environmental Reporting Tool (ERT) on 13 July 2017 identified an additional six listed threatened species and ten migratory species that were not identified in an ERT search on 20 June 2016 (the same co-ordinates were used in the two ERT searches), within a parallelogram that encompasses all the islands of the Lord Howe Island Group (except for Balls Pyramid) and within a buffer of 2 km from the parallelogram. These species were not considered at the time of the controlled action decision on 17 September 2014.

Listed threatened species

The following threatened species (although previously listed under the EPBC Act) were not identified by the ERT at the time the controlled action decision was made, and therefore were not considered during the assessment process:

- Red Knot (*Calidris canutus*) - endangered
- Curlew Sandpiper (*Calidris ferruginea*) – Critically endangered
- Herald Petrel (*Pterodrama heraldica*) - Critically endangered
- Pacific Albatross (*Thalassarche bulleri platei*) – Vulnerable
- Sei Whale (*Balaenoptera borealis*) – Vulnerable
- Fin Whale (*Balaenoptera physalus) - Vulnerable*

These species were identified in the SPRAT search of 13 July 2017 because their distributions were updated in SPRAT subsequent to the controlled action decision for this project. The Department recently assessed the potential impacts of the proposed action on the above species and concluded that it was highly unlikely that they would be significantly impacted by the proposal.

The following is a summary of this assessment

<u>Red Knot (*Calidris canutus*) – endangered</u>
This species is a rare, regular visitor to LHI (13 records between 1990 and 2004). According to *Australian Field Ornithology, Volume 21 Supplement 2004* LHIG is not on the regular migration path of the species from Siberia to New Zealand via Australia, nor does it need to stop on LHI on a regular basis.

According to SPRAT, the global population of the Red Knot is estimated at 1 090 000. The population in the East Asian Australasian Flyway is estimated at 110 000. Populations by country (in the non-breeding period) are: Australia, 135 000 and New Zealand, 68 000.

The Department concluded that the proposed action is unlikely to have a significant impacts on this species because only a few individuals are likely to visit the LHIG annually, it does not breed in Australia, nor do the few stragglers that reach LHI do so during the proposed baiting period.

Curlew Sandpiper (*Calidris ferruginea*) – Critically endangered
The Curlew Sandpiper is distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. The Curlew Sandpiper breeds in Siberia and migrates to Australia for the non-breeding period, arriving in Australia between August and November, and departing between March and mid-April.

Individuals of this species recorded on LHI are from populations that occur throughout coastal Australia. The Department concluded that it is unlikely that the proposed action will have a significant impact on the Curlew Sandpiper because it is a rare/accidental visitor to LHI (recorded on 10 occasions since 1902).

Herald Petrel (*Pterodrama heraldica*) - Critically endangered
The Herald Petrel is a marine, pelagic species of tropical and subtropical waters. Published sightings of the Herald Petrel off eastern Australia occur from the edge of the continental shelf, 30-36 km offshore. LHI is over 500 km east of the mainland.

The species nests on tropical and subtropical islands, atolls, cays and rocky islets and was recorded near LHI on 28 April 2012. SPRAT indicates that there are less than 10 breeding pairs in Australia or fewer than 50 mature individuals. According to SPRAT, the global population size has not been quantified, but the population is believed to be greater than 10 000 mature individuals.

The Department is aware of a single record of this species from LHI and concluded that it is unlikely that the proposed action will have a significant impact on the Herald Petrel.

Pacific Albatross (*Thalassarche bulleri platei*) – Vulnerable
According to SPRAT, the Pacific Albatross is a non-breeding visitor to Australian waters. Foraging birds are mostly limited to the Pacific Ocean and the Tasman Sea, although birds sometimes reach the east coast of the Australian mainland.

The species breeds in New Zealand. Most birds seem to disperse outside Australasian seas during the non-breeding season. Away from the breeding grounds, they tend to range across the South Pacific Ocean north of the Antarctic Convergence, from south-east Australia to west South America. In Australia, the species occurs over inshore, offshore and pelagic waters and off the coast of south-east Tasmania.

This species is unlikely to be significantly impacted by the proposed action as it forages over the open sea, breeds in New Zealand and is unlikely to consume rodent bait pellets or any organisms that had consumed Brodifacoum pellets.

Sei Whale (*Balaenoptera borealis*) – Vulnerable
According to SPRAT, Sei whales have been infrequently recorded in Australian waters. This species is unlikely to be present, or present in small numbers, in the vicinity of the LHIG.

At sexual maturity, Sei whales can reach lengths of 17.7 m in males and 21 m in females. Sei whales feed on planktonic crustacea, in particular copepods and amphipods.

The Department concluded that there is no credible pathway by which this species could have sufficient exposure to sufficient bait to result in illness or death to any individuals. Sei whales are therefore unlikely to be significantly impacted by the proposed action.

Fin Whale (*Balaenoptera physalus) - Vulnerable*
The Fin whale is the second-largest whale species, after the blue whale (*Balaenoptera musculus*). Adult whales range between 20 and 27 m long and weigh more than 70 tonnes.

Fin whales feed intensively in high latitudes and may also feed to some extent, depending upon prey availability and locality, in lower latitudes. Fin whales feed on planktonic crustacea, some fish and cephalopods (crustaceans). This species is unlikely to be present or present in small numbers in the vicinity of the LHIG.

The Department concluded that there is no credible pathway by which this species could have sufficient exposure to sufficient bait to result in illness or death to any individuals. Fin whales are therefore unlikely to be significantly impacted by the proposed action.

Listed migratory species

The following migratory species although listed prior to 20 June 2016 (when the original ERT search was conducted) appeared in the ERT search for the first time on 13 July 2017 because their distributions were updated in SPRAT in March 2017.

- Curlew Sandpiper *(Calidris ferruginea)*
- Common Sandpiper (*Actitis hypoleucos*)
- Sharp-tailed Sandpiper (*Calidris acuminata)*
- Red Knot (*Calidris canutus*)
- Pectoral Sandpiper *(Calidris melanotos)*
- Sei Whale (*Balaenoptera borealis*)
- Fin Whale (*Balaenoptera physalus)*
- Common Noddy *(Anous stolidus)*
- Lesser Frigate Bird *(Fregata ariel)*
- Greater Frigate Bird *(Fregata minor)*

The Department recently assessed the potential impacts of the proposed action on the above species and concluded that it was highly unlikely that they would be significantly impacted by the proposal.

The following is a summary of this assessment.

Curlew Sandpiper (*Calidris ferruginea*)
The Curlew Sandpiper is distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. The Curlew Sandpiper breeds in Siberia and migrates to Australia for the non-breeding period, arriving in Australia between August and November, and departing between March and mid-April.

Individuals of this species recorded on LHI are from populations that occur throughout coastal Australia. The Department concluded that it is unlikely that the proposed action will have a significant impact on the Curlew Sandpiper because it is a rare/accidental visitor to LHI (recorded on 10 occasions since 1902).

Common Sandpiper (*Actitis hypoleucos*)
According to SPRAT, the total population of the Common Sandpiper is in the order of 2 455 000–4 030 000 individuals. The East Asian-Australasian Flyway population is estimated to be 190 000, whilst individuals within Australia during the non-breeding period are estimated to be approximately 3000.

The Common Sandpiper breeds in Eurasia and moves south for the boreal winter, with most of the western breeding populations wintering in Africa, and eastern breeding populations wintering in south Asia to Melanesia and Australia.

There are no records of this species in *Australian Field Ornithology, Volume 21 Supplement 2004* which is a detailed review of LHI bird records. The Department concluded that it is unlikely that the proposed action will have a significant impact on the Curlew Sandpiper because it is an accidental visitor to LHI.

Sharp-tailed Sandpiper (*Calidris acuminata)*
According to *Australian Field Ornithology, Volume 21 Supplement 2004* the Sharp-tailed Sandpiper is a rare regular visitor to LHI. LHI is not one of the 39 important international sites identified in SPRAT for this species. The Department concluded that it is unlikely that the proposed action will have a significant impact on this species because it is a rare visitor to LHI in small numbers.

Red Knot (*Calidris canutus*)
This species is a rare, regular visitor to LHI (13 records between 1990 and 2004). According to *Australian Field Ornithology, Volume 21 Supplement 2004* LHIG is not on the regular migration path of the species from Siberia to New Zealand via Australia, nor does it need to stop on LHI on a regular basis.

According to SPRAT, the global population of the Red Knot is estimated at 1 090 000. The population in the East Asian Australasian Flyway is estimated at 110 000. Populations by country (in the non-breeding period) are: Australia, 135 000 and New Zealand, 68 000.

The Department concluded that the proposed action is unlikely to have a significant impacts on this species because only a few individuals are likely to visit the LHIG annually, it does not breed in Australia, nor do the few stragglers that reach LHI do so during the proposed baiting period.

Pectoral Sandpiper *(Calidris melanotos)*
This species has been recorded on LHI on four occasions over a 28 year period (five birds in total). The Department concluded that it is unlikely that the proposed action will have a significant impact on this species because it is a rare visitor to LHI in small numbers.

Sei Whale (*Balaenoptera borealis*)
According to SPRAT, Sei whales have been infrequently recorded in Australian waters. This species is unlikely to be present, or present in small numbers, in the vicinity of the LHIG.

At sexual maturity, Sei whales can reach lengths of 17.7 m in males and 21 m in females. Sei whales feed on planktonic crustacea, in particular copepods and amphipods.

The Department concluded that there is no credible pathway by which this species could have sufficient exposure to sufficient bait to result in illness or death to any individuals. Sei whales are therefore unlikely to be significantly impacted by the proposed action.

Fin Whale (*Balaenoptera physalus)*
The Fin whale is the second-largest whale species, after the blue whale (*Balaenoptera musculus*). Adult whales range between 20 and 27 m long and weigh more than 70 tonnes.

Fin whales feed intensively in high latitudes and may also feed to some extent, depending upon prey availability and locality, in lower latitudes. Fin whales feed on planktonic crustacea, some fish and cephalopods (crustaceans). This species is unlikely to be present or present in small numbers in the vicinity of the LHIG.

The Department concluded that there is no credible pathway by which this species could have sufficient exposure to sufficient bait to result in illness or death to any individuals. Fin whales are therefore unlikely to be significantly impacted by the proposed action.

Common Noddy *(Anous stolidus)*
This species breeds in the LHIG. In 1996, the total Australian population of the Common Noddy was estimated to be between 174 480 and 214 130 breeding pairs. A 2012 IUCN assessment of the species' conservation status noted that the global population size was estimated between 180 000 and 1.1 million individuals; no estimated proportion of the population residing in Australia is available and according to *Australian Field Ornithology, Volume 21 Supplement 2004* in the early 1970s there were approximately 1000 breeding pairs on LHI. It is likely it has become more abundant since cats were eliminated on LHI.

This species is unlikely to be impacted by the proposed rodent eradication project because it is present on LHI between September and May outside the proposed baiting period.

Lesser Frigate Bird *(Fregata ariel)*
The Lesser Frigate Bird is a vagrant to LHI. There have been a number of unconfirmed sightings and one positive record since 1887. The Australian population is estimated to be between 18 862 and 19 631 breeding pairs.

This species is unlikely to be impacted by the proposed rodent eradication project because it has only been positively recorded on one occasion in the vicinity of LHI.

Greater Frigate Bird *(Fregata minor)*

According to SPRAT, the total Australian population of this species is estimated to be approximately 1600 breeding pairs. The only record of a Greater Frigate bird in the vicinity of LHI, that the Department has been able to locate, was a sighting over Roach Island in March 2007 referred to in a Friends of LHI newsletter (Issue 20 Autumn 2007).

This species is unlikely to be impacted by the proposed rodent eradication project because it has only been recorded on one occasion in the vicinity of LHI.

s22

From: s22
Sent: Wednesday, 19 July, 2017 11:12 AM
To: s22
Cc: Environment Protection; Species Policy
Subject: RE: EPBC 2016/7703 Rodent Eradication on Lord Howe Island currency check [SEC=UNOFFICIAL]

Hi s22

On behalf of the Protected Species and Communities Branch, I provide the following advice relating to the statutory documents for threatened species identified by ESD in the email below:

- The Minister has agreed to uplist the Lord Howe Woodhen (*Hypotaenidia sylvestris*) but the instrument to give effect to this uplisting required amendment and has not been signed yet. We are seeking the Minister's signature on the amended instrument by 9 August. While the uplisting is a subsequent listing event under s158A of the EPBC Act and not relevant to approval decisions on 2016/7703, an approved Conservation Advice for the species will come into force on the day that the uplisting takes effect. That Conservation Advice should be included in the decision brief if the proposed or final decision are made after the Conservation Advice is in force. Please let me know if you would like a copy of the advice.

- Protected Species and Communities Branch are not anticipating any changes to the documents relating to the other threatened species identified by ESD in the email below in the coming six weeks.

Please note that PSCB has not re-checked whether the correct documents are present or that the citation information is correct. I did notice that you have included a state recovery plan for *Placostylus bivaricosus* which has not been adopted under the EPBC Act and is not therefore a relevant document for the purpose of section 139 of the Act.

s22

s22
Director, Species Information and Policy Section
Protected Species and Communities Branch, Wildlife, Heritage and Marine Division, Department of the Environment and Energy
Ph: s22 M: s22

From: s22
Sent: Thursday, 13 July 2017 4:52 PM
To: Species Policy <SpeciesPolicy@environment.gov.au>
Cc: s22
Subject: FW: Species listing quality check request [SEC=UNOFFICIAL]

Hi

Can you please have an urgent look at the below information and advise if there are any decisions likely to be made regarding any of the other documents referenced below that might impact the proposed decision. The assessment officer has asked that advice be provided by 17 July 2017 for the delegate's decision on 19 July 2017.

Regards

s22 | Assessment Officer | Queensland Assessments and Sea Dumping
Environment Standards Division | Department of the Environment and Energy
s22 | s22

Listed threatened species and communities (s18 & s18A)

The Department considers that the action will have, or is likely to have, a significant impact on the following listed threatened species and endangered communities:

- Lord Howe Woodhen (*Hypotaenidia sylvestris*) (Vulnerable) I note that the recent EPBC Species Update (12 July 2017) states that the Minister has agreed to uplist this species. Is the up listing of the species imminent??
- Lord Howe Island Currawongs (*Strepera graculina crissali*) (Vulnerable)
- Magnificent Helicarionid Land Snail (*Gudeoconcha sophiae magnifica)* (Critically endangered)
- Masters' Charopid Land Snail (*Mystivagor mastersi)* (Critically endangered)
- Mount Lidgbird Charopid Land Snail (*Pseudocharopa ledgbirdi)* (Critically endangered)
- Whitelegge's Land Snail *(Pseudocharopa whiteleggei)* (Critically endangered)
- Lord Howe Flax Snail (Lord Howe Placostylus) *(Placostylus bivaricosus)* (Endangered).

Conservation advice

The approved conservation advices relevant to this proposed action are:

- Threatened Species Scientific Committee (2008). *Approved Conservation Advice for Gudeoconcha sophiae magnifica ms (a snail)*. Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/82015-conservation-advice.pdf.
- Threatened Species Scientific Committee (2008). *Approved Conservation Advice for Mystivagor mastersi (Masters' Charopid Land Snail)*. Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/81247-conservation-advice.pdf.
- Threatened Species Scientific Committee (2008). *Approved Conservation Advice for Pseudocharopa lidgbirdi (Mount Lidgbird Charopid Snail)*. Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species /pubs/85279-conservation-advice.pdf.
- Threatened Species Scientific Committee (2008). *Approved Conservation Advice for Pseudocharopa whiteleggei.* Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity /threatened/species/pubs/81249-conservation-advice.pdf.

There are no approved conservation advice for the LHI Woodhen, LHI Currawong or LH Flax Snail.

Recovery Plans

The Recovery Plans identified as relevant to this action are:

- Department of Environment and Climate Change, NSW (2007). *Lord Howe Island Biodiversity Management Plan*. NSW Department of Environment and Climate Change, Sydney. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/lord-howe/index.html.

- NSW National Parks & Wildlife Service (2002). *Approved Recovery Plan for the Lord Howe Woodhen* (Gallirallus sylvestris), NSW National Parks & Wildlife Service, NSW. Available from: http://www.environment.gov.au/resource/national-recovery-plan-lord-howe-woodhen-gallirallus-sylvestris.

- NSW National Parks & Wildlife Service (2001). *Lord Howe Placostylus Placostylus bivaricosus Recovery Plan,* New South Wales National Parks and Wildlife Service, Hurstville, NSW. Available from: http://www.environment.nsw.gov.au/resources/nature/approvedPlacostylusRP.pdf.

Threat Abatement Plans

The Threat Abatement Plans identified as relevant to this action are:

- Department of the Environment (2014). *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi.* Commonwealth of Australia, Canberra. http://www.environment.gov.au/biodiversity/threatened/publications/threat-abatement-plan-disease-natural-ecosystems-caused-phytophthora-cinnamomi

- Department of the Environment (2015). *Threat abatement plan for predation by feral cats.* Commonwealth of Australia, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats.

- Department of the Environment, Water, Heritage and the Arts (2008). *Threat Abatement Plan for competition and land degradation by unmanaged goats.* Commonwealth of Australia, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-unmanaged-goats.

- Department of the Environment, Water, Heritage and the Arts (2009). *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares,* Commonwealth of Australia, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/reduce-impacts-exotic-rodents-biodiversity-australian-offshore.

- Department of the Environment and Energy (2017). *Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa)* Commonwealth of Australia, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/feral-pig-2017. s22 : I have added the Pigs TAP because it is listed in the SPRAT profile for snails. Please disregard if there are no pigs on Lord Howe Is.

The Northern NSW Assessment Section notes that whilst the *Phytophthora cinnamomi* TAP is not mentioned in SPIRE as relevant to any of the EPBC listed species of concern in this assessment, it has been recorded from one lease in the southern part of the settlement area and could potentially spread to the remainder of LHI on footwear or vehicles. This root-rot pathogen is known to affect a range of plant species on mainland Australia and it is listed as a key threatening process under the EPBC Act.

The Northern NSW Assessment Section also notes that feral cats and goats have been eliminated on LHI.

From: s22 [redacted]
Sent: Thursday, 13 July 2017 12:18 PM
To: s22 [redacted]
Cc: s22 [redacted]
Subject: RE: Species listing quality check request [SEC=UNOFFICIAL]

s22 [redacted]

FYI

I just noticed in the ERT print out today for 2016/7703 that the LH Woodhen scientific name has recently changed to *Hypotaenidia sylvestris* from *Gallirallus sylvestris.*

s22 [redacted]

From s22 [redacted]
Sent: Thursday, 13 July, 2017 11:59 AM
To: s22 [redacted] Species Policy <SpeciesPolicy@environment.gov.au>
Cc: s22 [redacted]
Subject: RE: Species listing quality check request [SEC=UNOFFICIAL]

s22 [redacted]

I plan to check the below WHaM listing request this afternoon but thought I would send it to you now so you have a bit more time to check for any upcoming changes. The request asks for a response by 17 July 2017. I will resend you this email once I have completed the quality check.

Regards
s22 [redacted] | Assessment Officer | Queensland Assessments and Sea Dumping
Environment Standards Division | Department of the Environment and Energy
[redacted] au

BEFORE PRINTING THIS E-MAIL
please consider the environment

From: s22 [redacted]
Sent: Thursday, 13 July 2017 10:52 AM
To: s22 [redacted]
Cc: s22 [redacted]
Subject: FW: Species listing quality check request [SEC=UNOFFICIAL]

s22 [redacted]

Any chance you could do this QA check? I've received another one from NSW this morning and s22 [redacted] is not here today.

s22 [redacted] – when you send the request to the QA Officer can you make sure the environment.protection inbox is cc in your request.

Thanks.
s22 [redacted]

From: s22 [redacted] <
Sent: Thursday, 13 July 2017 10:43 AM
To: s22 [redacted] au>; [redacted] .au>; [redacted] e, [redacted] .au>
Cc: s22 [redacted] au>; [redacted] au>
Subject: Species listing quality check request [SEC=UNOFFICIAL]

Hi s22 [redacted] , [redacted] a, [redacted] w

Regarding EPBC 2016/7703 Rodent Eradication on Lord Howe Island I have drafted a request to s22 [redacted] that requires quality checking. s22 [redacted] r is away. Is anyone able to look at this master piece?

Regards

s22 [redacted]

s22 [redacted]

The proposed approval decision for the (EPBC 2016/7703) is likely to be signed by the delegate, prior to 19 July 2017. Could you please provide advice as to whether or not there are any new, revised or imminent conservation advices, recovery plans or threat abatement plans that may be relevant to this project?

I have included below a list of the species which are likely to be significantly impacted by the project and the CAs, RPs and TAPs that have been considered in the decision.

The last check of SPRAT for new or revised conservation advices, recovery plans or threat abatement plans was done on 13 July 2017.

Please let me know if you require any further information.

Are you able to provide this advice by 17 July 2017?

Listed threatened species and communities (s18 & s18A)

The Department considers that the action will have, or is likely to have, a significant impact on the following listed threatened species and endangered communities:

- Lord Howe Woodhens (*Gallirallus sylvestris*) (Vulnerable)
- Lord Howe Island Currawongs (*Strepera graculina crissali*) (Vulnerable)
- Magnificent Helicarionid Land Snail (*Gudeoconcha sophiae)* (Critically endangered)
- Masters' Charopid Land Snail (*Mystivagor mastersi magnifica)* (Critically endangered)
- Mount Lidgbird Charopid Land Snail (*Pseudocharopa ledgbirdi)* (Critically endangered)
- Whitelegge's Land Snail *(Pseudocharopa whiteleggei)*
- Lord Howe Flax Snail (Lord Howe Placostylus) *(Placostylus bivaricosus)* (Endangered).

Conservation advice

The approved conservation advices relevant to this proposed action are:

- Threatened Species Scientific Committee (TSSC) (2008). *Commonwealth Conservation Advice on Gudeoconcha sophiae magnifica*. Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/82015-conservation-advice.pdf. In effect under the EPBC Act from 08-Jan-2009.

- Threatened Species Scientific Committee (2008). *Commonwealth Conservation Advice on Mystivagor mastersi*. Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/81247-conservation-advice.pdf. In effect under the EPBC Act from 08-Jan-2009.

- Threatened Species Scientific Committee (TSSC) (2008). *Commonwealth Conservation Advice on Pseudocharopa lidgbirdi = Pseudocharopa ledgbirdi.* Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species /pubs/85279-conservation-advice.pdf. In effect under the EPBC Act from 08-Jan-2009.

- Threatened Species Scientific Committee (2008). *Commonwealth Conservation Advice on Pseudocharopa whiteleggei.* Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity /threatened/species/pubs/81249-conservation-advice.pdf. In effect under the EPBC Act from 08-Jan-2009.

There are no approved conservation advice for the LHI Woodhen, LHI Currawong or LH Flax Snail.

Recovery Plans

The Recovery Plans identified as relevant to this action are:

- NSW Department of Environment and Climate Change (NSW DECC) (2007). *Lord Howe Island Biodiversity Management Plan*. Sydney, NSW: NSW Department of Environment and Climate Change. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/lord-howe/index.html. In effect under the EPBC Act from 25-May-2008.

- NSW National Parks & Wildlife Service (2002). *Recovery Plan for the Lord Howe Woodhen* (Gallirallus sylvestris) - *2002*. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/lord-howe-wood-hen/index.html. In effect under the EPBC Act from 13-Oct-2003. as *Gallirallus sylvestris.*

- *Lord Howe Placostylus Placostylus bivaricosus (Gaskoin, 1855) Recovery Plan* (New South Wales National Parks and Wildlife Service (NSW NPWS), 2001b).

Threat Abatement Plans

The Threat Abatement Plans identified as relevant to this action are:

- Department of the Environment (2014). *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi.* Commonwealth of Australia, Canberra. http://www.environment.gov.au/biodiversity/threatened/publications/threat-abatement-plan-disease-natural-ecosystems-caused-phytophthora-cinnamomi

- Department of the Environment (2015). *Threat abatement plan for predation by feral cats*. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats. In effect under the EPBC Act from 23-Jul-2015.

- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). *Threat Abatement Plan for competition and land degradation by unmanaged goats.* Canberra: DEWHA. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/goats08.html. In effect under the EPBC Act from 01-Oct-2008.

- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009). *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares 2009*. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/exotic-rodents.html. In effect under the EPBC Act from 04-Jul-2009.

  The Northern NSW Assessment Section notes that whilst the *Phytophthora cinnamomi* TAP is not mentioned in SPIRE as relevant to any of the EPBC listed species of concern in this assessment, it has been recorded from one lease in the southern part of the settlement area and could potentially spread to the remainder of LHI on footwear or vehicles. This root-rot pathogen is known to affect a range of plant species on mainland Australia and it is listed as a key threatening process under the EPBC Act.

  The Northern NSW Assessment Section also notes that feral cats and goats have been eliminated on LHI.

Thanks

s22 [redacted]

3.8.17

FOI 190702
Document 19

This Conservation Advice was approved by the Minister on: 19 December 2008

A statement for the purposes of approved conservation advice
(s266B of the *Environment Protection and Biodiversity Conservation Act 1999*)

Approved Conservation Advice for *Pseudocharopa whiteleggei* (Whitelegge's Land Snail)

This Conservation Advice has been developed based on the best available information at the time this conservation advice was approved.

Whitelegge's Land Snail has a loosely coiled shell of few whorls which is 13 to 16 mm in diameter and 6 mm in height. The shell is relatively flat with has a depressed spire and a unicolour appearance of dark red-brown.

This species is listed as critically endangered under criterion 2, as its geographic distribution is precarious for the survival of the species and is very restricted.

This species is restricted to Mount Gower on Lord Howe Island (Northern Rivers Natural Resource Management Region).

The key threat to Whitelegge's Land Snail is predation by introduced rats and introduced birds and ants.

Research Priorities

Research priorities that would inform future regional actions include:

- Research into the biology and ecology of the species
- Investigate the impacts of rodent eradication methods on non-target species and other environmental impacts.

The following are actions that can be carried out to stop the decline or support the recovery of the species.

Priority Actions

Implement the draft Biodiversity Management Plan of Lord Howe Island, which includes the following actions.

Invasive Weeds

- Implement management actions identified in the draft Biodiversity Management Plan of Lord Howe Island.

Animal Predation or Competition

- Implement actions and tasks identified in the draft Biodiversity Management Plan of Lord Howe Island for the control and eradication of rats on Lord Howe Island.

Conservation Information

- Raise awareness of the species within the local community.

Establishing Additional Populations

- Investigate and if appropriate, undertake a captive breeding program that could potentially lead to the establishment of additional populations of the species in the wild.

This list does not necessarily encompass all actions that may be of benefit to this species, but highlights those that are considered to be of highest priority at the time of listing.

This Conservation Advice was approved by the Minister on: 19 December 2008

A statement for the purposes of approved conservation advice
(s266B of the *Environment Protection and Biodiversity Conservation Act 1999*)

Approved Conservation Advice for *Pseudocharopa lidgbirdi* (Mount Lidgbird Charopid Snail)

This Conservation Advice has been developed based on the best available information at the time this conservation advice was approved.

Following a name change, *Pseudocharopa lidgbirdi* (Mount Lidgbird Charopid Snail) is listed under the EPBC Act as *Pseudocharopa ledgbirdi* as at 12 July 2014.

The Mount Lidgbird Charopid Snail has a small (8 mm in diameter and 6 mm in height), loosely coiled shell of few whorls and an elevated apex. It has a dull-grey colouration, flame-marked with brown.

This species is listed as critically endangered under criterion 2, as its geographic distribution is precarious for the survival of the species and is very restricted.

This species is restricted to Mount Gower on Lord Howe Island (Northern Rivers Natural Resource Management Region).

The key threat to the Mount Lidgbird Charopid Snail is predation by introduced rats and introduced birds and ants.

Research Priorities

Research priorities that would inform future regional actions include:

- Research into the biology and ecology of the species
- Monitor populations in existing locations and assess the efficiency of management.
- Investigate and monitor the impacts of rodent eradication methods on non-target species and other environmental impacts.

The following are actions that can be carried out to stop the decline or support the recovery of the species.

Priority Actions

Implement the draft Biodiversity Management Plan of Lord Howe Island, which includes the following actions.

Animal Predation or Competition

- o Implement actions and tasks identified in the draft Biodiversity Management Plan of Lord Howe Island for the control and eradication of rats, ants and where appropriate other exotic predators on Lord Howe Island.
- o Increase quarantine and surveillance measures in relation to potential introduced threats.

Establishing Additional Populations

- o Establish and continue with existing captive breeding programs, that could potentially lead to the establishment of additional populations of the species in the wild.

Invasive Weeds

- o Implement management actions identified in the draft Biodiversity Management Plan of Lord Howe Island.

Conservation Information

- o Raise awareness of the species within the local community.

This Conservation Advice was approved by the Minister on: 19 December 2008

This list does not necessarily encompass all actions that may be of benefit to this species, but highlights those that are considered to be of highest priority at the time of listing.

This Conservation Advice was approved by the Minister on: 19 December 2008

A statement for the purposes of approved conservation advice
(s266B of the *Environment Protection and Biodiversity Conservation Act 1999*)

Approved Conservation Advice for *Mystivagor mastersi* (Masters' Charopid Land Snail)

This Conservation Advice has been developed based on the best available information at the time this conservation advice was approved.

Masters' Charopid Land Snail has a small shell (6.5 mm in diameter and 4.5 mm in height) of three whorls and a dull yellowish brown colouration flamed with brown.

This species is listed as critically endangered under criterion 2, as its geographic distribution is precarious for the survival of the species and is very restricted.

While the species has been recorded across Lord Howe Island, evidence now suggests that the species is restricted the southern part of the island, on Mount Lidgbird and Mount Gower (Northern Rivers Natural Resource Management Region).

The key threat to Masters' Charopid Land Snail is predation by introduced rats.

Research Priorities

Research priorities that would inform future regional actions include:

- Research into the biology and ecology of the species
- Monitor populations in existing locations and assess efficiency of management.
- Investigate and monitor the impacts of rodent eradication methods on non-target species and other environmental impacts.

The following are actions that can be carried out to stop the decline or support the recovery of the species.

Priority Actions

Implement the draft Biodiversity Management Plan of Lord Howe Island, which includes the following actions.

Animal Predation or Competition

- Implement actions and tasks identified in the draft Biodiversity Management Plan of Lord Howe Island for the control and eradication of rats, ants and where appropriate other exotic predators on Lord Howe Island.
- Increase quarantine and surveillance measures in relation to potential introduced threats.

Establishing Additional Populations

- Establish and continue with existing captive breeding programs, that could potentially lead to the establishment of additional populations of the species in the wild.

Invasive Weeds

- Implement management actions identified in the draft Biodiversity Management Plan of Lord Howe Island.

Conservation Information

- Raise awareness of the species within the local community.

This list does not necessarily encompass all actions that may be of benefit to this species, but highlights those that are considered to be of highest priority at the time of listing.

This Conservation Advice was approved by the Minister on: 19 December 2008

A statement for the purposes of approved conservation advice
(s266B of the *Environment Protection and Biodiversity Conservation Act 1999*)

Approved Conservation Advice for *Gudeoconcha sophiae magnifica* ms (a snail)

This Conservation Advice has been developed based on the best available information at the time this conservation advice was approved.

Gudeoconcha sophiae magnifica ms (a snail) has a thin, bronze shell with a depressed spire, sculptured with fine ripple marks. Its dimensions are 35 mm in diameter and 20 mm high (Hyman 2005).

This subspecies is listed as critically endangered under criterion 2, as its geographic distribution is precarious for the survival of the subspecies and is very restricted.

This subspecies is restricted to Mount Gower on Lord Howe Island (Northern Rivers Natural Resource Management Region).

The key threat to the *Gudeoconcha sophiae magnifica* ms (a snail) is predation by introduced rats and introduced birds and ants.

Research Priorities

Research priorities that would inform future regional actions include:

- Research into the biology and ecology of the subspecies
- Investigate the impacts of rodent eradication methods on non-target subspecies and other environmental impacts.

The following are actions that can be carried out to stop the decline or support the recovery of the subspecies.

Priority Actions

Implement the draft Biodiversity Management Plan of Lord Howe Island, which includes the following actions.

Invasive Weeds

- Implement management actions identified in the draft Biodiversity Management Plan of Lord Howe Island.

Animal Predation or Competition

- Implement actions and tasks identified in the draft Biodiversity Management Plan of Lord Howe Island for the control and eradication of rats on Lord Howe Island.

Conservation Information

- Raise awareness of the subspecies within the local community.

Establishing Additional Populations

- Investigate and if appropriate, undertake a captive breeding program that could potentially lead to the establishment of additional populations of the subspecies in the wild.

This list does not necessarily encompass all actions that may be of benefit to this subspecies, but highlights those that are considered to be of highest priority at the time of listing.

Australian Government
Department of the Environment

Referral of proposed action

What is a referral?

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) provides for the protection of the environment, especially matters of national environmental significance (NES). Under the EPBC Act, a person must not take an action that has, will have, or is likely to have a significant impact on any of the matters of NES without approval from the Australian Government Environment Minister or the Minister's delegate. (Further references to 'the Minister' in this form include references to the Minister's delegate.) To obtain approval from the Environment Minister, a proposed action should be referred. The purpose of a referral is to obtain a decision on whether your proposed action will need formal assessment and approval under the EPBC Act.

Your referral will be the principal basis for the Minister's decision as to whether approval is necessary and, if so, the type of assessment that will be undertaken. These decisions are made within 20 business days, provided sufficient information is provided in the referral.

Who can make a referral?

Referrals may be made by or on behalf of a person proposing to take an action, the Commonwealth or a Commonwealth agency, a state or territory government, or agency, provided that the relevant government or agency has administrative responsibilities relating to the action.

When do I need to make a referral?

A referral must be made for actions that are likely to have a significant impact on the following matters protected by Part 3 of the EPBC Act:

- World Heritage properties (sections 12 and 15A)
- National Heritage places (sections 15B and 15C)
- Wetlands of international importance (sections 16 and 17B)
- Listed threatened species and communities (sections 18 and 18A)
- Listed migratory species (sections 20 and 20A)
- Protection of the environment from nuclear actions (sections 21 and 22A)
- Commonwealth marine environment (sections 23 and 24A)
- Great Barrier Reef Marine Park (sections 24B and 24C)
- A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)
- The environment, if the action involves Commonwealth land (sections 26 and 27A), including:
    - actions that are likely to have a significant impact on the environment of Commonwealth land (even if taken outside Commonwealth land);
    - actions taken on Commonwealth land that may have a significant impact on the environment generally;
- The environment, if the action is taken by the Commonwealth (section 28)
- Commonwealth Heritage places outside the Australian jurisdiction (sections 27B and 27C)

You may still make a referral if you believe your action is not going to have a significant impact, or if you are unsure. This will provide a greater level of certainty that Commonwealth assessment requirements have been met.

To help you decide whether or not your proposed action requires approval (and therefore, if you should make a referral), the following guidance is available from the Department's website:

- the Policy Statement titled Significant Impact Guidelines 1.1 – Matters of National Environmental Significance. Additional sectoral guidelines are also available.
- the Policy Statement titled Significant Impact Guidelines 1.2 - Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies.
- the Policy Statement titled Significant Impact Guidelines: Coal seam gas and large coal mining developments—Impacts on water resources.
- the interactive map tool (enter a location to obtain a report on what matters of NES may occur in that location).

Can I refer part of a larger action?

In certain circumstances, **the Minister may not accept a referral for an action that is a component of a larger action and may request the person proposing to take the action to refer the larger action for consideration under the EPBC Act (Section 74A, EPBC Act).** If you wish to make a referral for a staged or component referral, read 'Fact Sheet 6 Staged Developments/Split Referrals' and contact the Referrals Gateway (1800 803 772).

Do I need a permit?

Some activities may also require a permit under other sections of the EPBC Act or another law of the Commonwealth. Information is available on the Department's web site.

Is your action in the Great Barrier Reef Marine Park?

If your action is in the Great Barrier Reef Marine Park it may require permission under the *Great Barrier Reef Marine Park Act 1975* (GBRMP Act). If a permission is required, referral of the action under the EPBC Act is deemed to be an application under the GBRMP Act (see section 37AB, GBRMP Act). This referral will be forwarded to the Great Barrier Reef Marine Park Authority (the Authority) for the Authority to commence its permit processes as required under the Great Barrier Reef Marine Park Regulations 1983. If a permission is not required under the GBRMP Act, no approval under the EPBC Act is required (see section 43, EPBC Act). The Authority can provide advice on relevant permission requirements applying to activities in the Marine Park.

The Authority is responsible for assessing applications for permissions under the GBRMP Act, GBRMP Regulations and Zoning Plan. Where assessment and approval is also required under the EPBC Act, a single integrated assessment for the purposes of both Acts will apply in most cases. Further information on environmental approval requirements applying to actions in the Great Barrier Reef Marine Park is available from http://www.gbrmpa.gov.au/ or by contacting GBRMPA's Environmental Assessment and Management Section on (07) 4750 0700.

The Authority may require a permit application assessment fee to be paid in relation to the assessment of applications for permissions required under the GBRMP Act, even if the permission is made as a referral under the EPBC Act. Further information on this is available from the Authority:

Great Barrier Reef Marine Park Authority

2-68 Flinders Street PO Box 1379
Townsville QLD 4810
AUSTRALIA

Phone: + 61 7 4750 0700
Fax: + 61 7 4772 6093

www.gbrmpa.gov.au

What information do I need to provide?

Completing all parts of this form will ensure that you submit the required information and will also assist the Department to process your referral efficiently. If a section of the referral document is not applicable to your proposal enter N/A.

You can complete your referral by entering your information into this Word file.

Instructions

Instructions are provided in blue text throughout the form.

Attachments/supporting information

The referral form should contain sufficient information to provide an adequate basis for a decision on the likely impacts of the proposed action. You should also provide supporting documentation, such as environmental reports or surveys, as attachments.

Coloured maps, figures or photographs to help explain the project and its location should also be submitted with your referral. Aerial photographs, in particular, can provide a useful perspective and context. Figures should be good quality as they may be scanned and viewed electronically as black and white documents. Maps should be of a scale that clearly shows the location of the proposed action and any environmental aspects of interest.

Please ensure any attachments are below three megabytes (3mb) as they will be published on the Department's website for public comment. To minimise file size, enclose maps and figures as separate files if necessary. If unsure, contact the Referrals Gateway (email address below) for advice. Attachments larger than three megabytes (3mb) may delay processing of your referral.

Note: the Minister may decide not to publish information that the Minister is satisfied is commercial-in-confidence.

How do I pay for my referral?

From 1 October 2014 the Australian Government commenced cost recovery arrangements for environmental assessments and some strategic assessments under the EPBC Act. If an action is referred on or after 1 October 2014, then cost recovery will apply to both the referral and any assessment activities undertaken. Further information regarding cost recovery can be found on the Department's website at: http://www.environment.gov.au/epbc/publications/cost-recovery-cris

Payment of the referral fee can be made using one of the following methods:

- **EFT Payments can be made to:**

  BSB: 092-009
  Bank Account No. 115859
  Amount: $7352
  Account Name: Department of the Environment.
  Bank: Reserve Bank of Australia
  Bank Address: 20-22 London Circuit Canberra ACT 2601
  Description: The reference number provided (see note below)

- **Cheque** - Payable to "Department of the Environment". Include the reference number provided (see note below), and if posted, address:

  The Referrals Gateway
  Environment Assessment Branch
  Department of the Environment
  GPO Box 787
  Canberra ACT 2601

- **Credit Card**

  Please contact the Collector of Public Money (CPM) directly (call (02) 6274 2930 or 6274 20260 and provide the reference number (see note below).

Note: in order to receive a reference number, submit your referral and the Referrals Gateway will email you the reference number.

How do I submit a referral?

Referrals may be submitted by mail or email.

Mail to:

Referrals Gateway
Environment Assessment Branch
Department of Environment
GPO Box 787
CANBERRA ACT 2601

- If submitting via mail, electronic copies of documentation (on CD/DVD or by email) are required.

Email to: epbc.referrals@environment.gov.au

- Clearly mark the email as a 'Referral under the EPBC Act'.
- Attach the referral as a Microsoft Word file and, if possible, a PDF file.
- **Follow up with a mailed hardcopy including copies of any attachments or supporting reports.**

What happens next?

Following receipt of a valid referral (containing all required information) you will be advised of the next steps in the process, and the referral and attachments will be published on the Department's web site for public comment.

The Department will write to you within 20 business days to advise you of the outcome of your referral and whether or not formal assessment and approval under the EPBC Act is required. There are a number of possible decisions regarding your referral:

The proposed action is NOT LIKELY to have a significant impact and does NOT NEED approval

No further consideration is required under the environmental assessment provisions of the EPBC Act and the action can proceed (subject to any other Commonwealth, state or local government requirements).

The proposed action is NOT LIKELY to have a significant impact IF undertaken in a particular manner

The action can proceed if undertaken in a particular manner (subject to any other Commonwealth, state or local government requirements). The particular manner in which you must carry out the action will be identified as part of the final decision. You must report your compliance with the particular manner to the Department.

The proposed action is LIKELY to have a significant impact and does NEED approval

If the action is likely to have a significant impact a decision will be made that it is a *controlled action*. The particular matters upon which the action may have a significant impact (such as World Heritage values or threatened species) are known as the *controlling provisions*.

The controlled action is subject to a public assessment process before a final decision can be made about whether to approve it. The assessment approach will usually be decided at the same time as the controlled action decision. (Further information about the levels of assessment and basis for deciding the approach are available on the Department's web site.)

The proposed action would have UNACCEPTABLE impacts and CANNOT proceed

The Minister may decide, on the basis of the information in the referral, that a referred action would have clearly unacceptable impacts on a protected matter and cannot proceed.

Compliance audits

If a decision is made to approve a project, the Department may audit it at any time to ensure that it is completed in accordance with the approval decision or the information provided in the referral. If the project changes, such that the likelihood of significant impacts could vary, you should write to the Department to advise of the changes. If your project is in the Great Barrier Reef Marine Park and a decision is made to approve it, the Authority may also audit it. (See "*Is your action in the Great Barrier Reef Marine Park,*" p.2, for more details).

For more information

- call the Department of the Environment Community Information Unit on 1800 803 772 or
- visit the web site http://www.environment.gov.au/epbc

All the information you need to make a referral, including documents referenced in this form, can be accessed from the above web site.

Referral of proposed action

Project title: **Lord Howe Island Rodent Eradication Project**

1 Summary of proposed action

NOTE: You must also attach a map/plan(s) and associated geographic information system (GIS) vector (shapefile) dataset showing the location and approximate boundaries of the area in which the project is to occur. Maps in A4 size are preferred. You must also attach a map(s)/plan(s) showing the location and boundaries of the project area in respect to any features identified in 3.1 & 3.2, as well as the extent of any freehold, leasehold or other tenure identified in 3.3(i).

1.1 **Short description**

Use 2 or 3 sentences to uniquely identify the proposed action and its location.

The Lord Howe Island Board (LHIB) is proposing to undertake the Lord Howe Island Rodent Eradication Project (LHI REP). The project aims to eradicate introduced rodents: the Ship Rat (*Rattus rattus*) and the House Mouse (*Mus musculus*) from Lord Howe Island (LHI) and its associated islands and rocky islets (excluding Balls Pyramid), hereafter referred to as the Lord Howe Island Group (LHIG). Rodents are currently having significant impacts on World Heritage values including impacts to a range of EPBC listed species. The eradication of rodents will also present an opportunity to simultaneously eradicate the introduced Masked Owl

The one-off eradication proposes to distribute a cereal-based bait pellet (Pestoff 20R) containing 0.02g/kg (20 parts per million) of the toxin, Brodifacoum across the LHIG (excluding Balls Pyramid). Methods of distribution will be dispersal from helicopters using an under-slung bait spreader bucket in the uninhabited parts of the island (most of the LHIG) and by a combination of hand broadcasting and the placement of bait in trays and bait stations in the settlement area. In the outdoor areas of the settlement, baits will be dispersed by hand and/or placed into bait stations. In dwellings (e.g. in ceiling spaces or floor spaces) bait trays and bait stations will be used. Bait stations will also be used around pens for any remaining livestock (e.g. the remaining dairy herd, goat or horse containment areas).

Given the size and rugged terrain of the LHIG, the exclusive use of baits stations is not feasible for the eradication.

The operation is targeted for winter of 2017 (June to August) however, to allow operational flexibility and to account for unforeseen delays, approval is sought for at least a three year period, June 2017 to December 2019.

1.2 **Latitude and longitude**

Latitude and longitude details are used to accurately map the boundary of the proposed action. If these coordinates are inaccurate or insufficient it may delay the processing of your referral.

	Latitude			Longitude		
location point	degrees	minutes	seconds	degrees	minutes	seconds
1	-31	28	53	159	4	23
2	-31	31	31	159	0	38
3	-31	36	18	159	4	8
4	-31	33	47	159	8	3

The Interactive Mapping Tool may provide assistance in determining the coordinates for your project area.

If the area is less than 5 hectares, provide the location as a single pair of latitude and longitude references. If the area is greater than 5 hectares, provide bounding location points.

There should be no more than 50 sets of bounding location coordinate points per proposal area.

Bounding location coordinate points should be provided sequentially in either a clockwise or anticlockwise direction.

If the proposed action is linear (e.g. a road or pipeline), provide coordinates for each turning point.

Also attach the associated GIS-compliant file that delineates the proposed referral area. If the area is less than 5 hectares, please provide the location as a point layer. If greater than 5 hectares, please provide a polygon layer. If the proposed action is linear (e.g. a road or pipeline) please provide a polyline layer (refer to GIS data supply guidelines at Attachment A).

Do not use AMG coordinates.

1.3 **Locality and property description**

Provide a brief physical description of the property on which the proposed action will take place and the project location (e.g. proximity to major towns, or for off-shore projects, shortest distance to mainland).

Lord Howe Island (LHI) is located 780 kilometres north-east of Sydney (See Map Attachment 1.1). It covers 1455 ha, is 12 km long, 1.0–2.8 km wide and formed in the shape of a crescent, with a coral reef enclosing a lagoon on the western side Figure 1. Mount Gower (875 m), Mount Lidgbird (777 m) and Intermediate Hill (250 m) form the southern two-thirds of the island; the northern end of the island is fringed by sea cliffs of about 200 m in height (See Attachment 1.1 and Figure 1 below). A settlement of approximately 350 inhabitants is located in the northern section of LHI and covers about 15% of the island. Approximately 75% of LHI plus all outlying islands, islets and rocks are protected under the Permanent Park Preserve (PPP), which has similar status to that of a national park. The LHIG has been placed on the Register of the National Estate and was listed as a World Heritage Area in 1982 (see Attachment 1.2) It is also located within the Lord Howe Island Marine Park (NSW) out to 3 nautical miles (under NSW jurisdiction) (see Attachment 1.3) and the new Lord Howe Commonwealth Marine Reserve (under Commonwealth authority), a further area of 110 000 km^2 (see Attachment 1.4).

Figure 1. **Lord Howe Island as seen from the north (DECC, 2007).**

A summary of key climate statistics during the proposed operational period is shown below (BOM, 2016)

Key Climate Statistics	Jun	Jul	Aug	Sep
Mean maximum temperature (°C)	19.9	18.9	19.0	20.0
Mean minimum temperature (°C)	14.9	13.9	13.5	14.5
Mean rainfall (mm)	171.2	144.0	108.8	114.0
Mean number of days of rain ≥ 1 mm	17.2	17.8	15.0	11.9
Mean 9am relative humidity (%)	66	67	65	68
Mean 9am wind speed (km/h)	21.9	21.8	21.5	21.0
Mean 3pm relative humidity (%)	66	66	64	68
Mean 3pm wind speed (km/h)	22.5	23.9	23.0	22.4

1.4	**Size of the development footprint or work area (hectares)**	The 2 dimensional area of LHI is 1,455 ha. The 3 D dimensional area when considering the rugged topography is approximately 2,100 ha.
1.5	**Street address of the site**	Lord Howe Island NSW 2898

1.6 **Lot description**

Describe the lot numbers and title description, if known.

The Proposed REP will occur over the entire LHIG, excluding Balls Pyramid. The LHIG consists of the following lease types:

- The Permanent Park Preserve
- Crown Land
- Permissive Occupancy
- Perpetual Leases
- Special Leases

Lease Boundaries are shown on Attachment 1.5.

1.7 **Local Government Area and Council contact (if known)**

If the project is subject to local government planning approval, provide the name of the relevant council contact officer.

The LHIG is part of the State of New South Wales and, for legal purposes, is regarded as an unincorporated area administered by the Lord Howe Island Board (Board), a statutory authority established under the provisions of the *Lord Howe Island Act, 1953* (the Act). The Board is directly responsible to the NSW Minister for the Environment and comprises four Islanders elected by the local community and three members appointed by the Minister. It is charged with the care, control and management of the Island's natural values and the affairs and trade of the Island. It is also responsible for the care, improvement and welfare of the Island and residents.

The Board carries out all local government functions on behalf of approximately 350 Island residents. It controls all land tenure on the Island and administers all residential and other leases in accordance with the Act. The Board manages the Island PPP and the protection and conservation of the Island's fauna and flora.

The proponent of this referral is the Board; the appropriate contact person is Andrew Walsh, Rodent Eradication Project Manager, Lord Howe Island Board, P.O. Box 5, LHI, 2898. Telephone 02 6563 2066.

The Board also undertakes the role of the relevant Local Government Authority and Consent Authority under the NSW *Environment Planning and Assessment Act, 1979*. Relevant Contact is Dave Kelly, Manager Environment and Community Development P.O. Box 5, LHI, 2898. Telephone 02 6563 2066.

1.8 **Time frame**

Specify the time frame in which the action will be taken including the estimated start date of construction/operation.

The REP is targeted for winter of 2017 (June to August) however, to allow for operational flexibility and to account for unforeseen delays, approval is sought for at least a three year period, June 2017 to December 2019.

1.9	**Alternatives to proposed action** Were any feasible alternatives to taking the proposed action (including not taking the action) considered but are not proposed?		No
		X	Yes, you must also complete section 2.2
1.10	**Alternative time frames etc** Does the proposed action include alternative time frames, locations or activities?		No
		X	Yes, you must also complete Section 2.3. For each alternative, location, time frame, or activity identified, you must also complete details in Sections 1.2-1.9, 2.4-2.7 and 3.3 (where relevant).
1.11	**State assessment** Is the action subject to a state or territory environmental impact assessment?		No
		X	Yes, you must also complete Section 2.5
1.12	**Component of larger action** Is the proposed action a component of a larger action?	X	No
			Yes, you must also complete Section 2.7
1.13	**Related actions/proposals** Is the proposed action related to other actions or proposals in the region (if known)?		No
		X	Yes, provide details: A previous related referral (EPBC 2013/6847) - *Pilot Study for captive management of LHI Woodhen and LHI Currawong* was declared "not a Controlled Action" in June 2013. The pilot study showed that woodhens and currawongs could be held in large numbers for prolonged periods with no observable impact. All 20 woodhens and 10 currawongs were successfully released at their individual capture sites and monitored.

			(Taronga Conservation Society Australia, 2014)
1.14	**Australian Government funding** Has the person proposing to take the action received any Australian Government grant funding to undertake this project?		No
		X	Yes, provide details: The LHI REP has received significant funding ($9M) in 2012 for planning and implementation from the: • Federal Government's former Caring for Our Country Program (now National Landcare program) $4,500,000 • NSW Environment Trust $4,542,442
1.15	**Great Barrier Reef Marine Park** Is the proposed action inside the Great Barrier Reef Marine Park?	X	No
			Yes, you must also complete Section 3.1 (h), 3.2 (e)

2 Detailed description of proposed action

NOTE: It is important that the description is complete and includes all components and activities associated with the action. If certain related components are not intended to be included within the scope of the referral, this should be clearly explained in section 2.7.

2.1 Description of proposed action

This should be a detailed description outlining all activities and aspects of the proposed action and should reference figures and/or attachments, as appropriate.

Introduced rats and mice are currently having a significant impact on the World Heritage, biodiversity, community and economic values of LHI. Rodents are implicated in the extinction of at least five endemic birds and at least 13 invertebrates on LHI. They are also a recognised threat to at least 13 other bird species, 2 reptiles, 51 plant species, 12 vegetation communities and numerous threatened invertebrates on the island (DECC, 2007). Predation by exotic rats on Australian offshore islands is listed a Key Threatening Process under the *EPBC* Act (DEWHA, 2009). EPBC listed species currently impacted by rodents on the LHIG are shown below in Table 1. Further impacts of rodents on the LHIG are described in detail in section 2.2 below.

Table 1: EPBC Listed Species Currently Impacted by Rodents on the LHIG (from DECC, 2007 and Carlile *et al*, 2016)

CE = *Critically Endangered, E = Endangered,* V = *Vulnerable*, Mi= Migratory, Ma = Marine

	Common name	Scientific Name	Endemic	EPBC Act	Impacted by rodents
Birds	Black-winged petrel	*Pterodroma nigripennis*	-	Ma	Yes
	Flesh-footed Shearwater	*Ardenna carneipes*	-	Mi, Ma	Yes
	Grey ternlet	*Procelsterna cerulea*	-	Ma	Yes
	Kermadec petrel	*Pterodroma neglecta*	-	V	Yes
	Little shearwater	*Puffinus assimilis*	-	Ma	Yes
	Lord Howe woodhen	*Gallirallus sylvestris*	En	V	Yes
	Masked booby	*Sula dactylatra*	-	Mi, Ma	Yes
	Providence petrel	*Pterodroma solandri*	-	Mi, Ma	Yes
	Wedge-tailed shearwater	*Puffinus assimilis*	-	Mi, Ma	Yes
	White-bellied storm petrel	*Fregetta grallaria*	-	V	Yes
Reptiles	Lord Howe Island gecko	*Christinus guentheri*	-	V	Yes
	Lord Howe Island skink	*Oligosoma lichenigera*	-	V	Yes
Invertebrates	Lord Howe Island phasmid	*Dryococelus australis*	En	CE	Yes
	Lord Howe placostylus	*Placostylus bivaricosus*	En	E	Yes
	Whitelegge's land snail	*Pseudocharopa whiteleggei*	En	CE	Yes
	Masters' charopid land snail	*Mystivagor mastersi*	En	CE	Yes
	Mt Lidgbird charopid land snail	*Pseudocharopa lidgbirdi*	En	CE	Yes
	Magnificent Helicarionid land snail	*Gudeoconcha sophiae magnifica*	En	CE	Yes
Plants	Little mountain palm	*Lepidorrhachis mooreana*	En	CE	Yes
	Phillip Island Wheat Grass	*Elymus multiflorus var. kingianus*	-	CE	Yes

Rodents also impact community amenity though hygiene issues and spoiling of food stuffs. Rodents predate on the seeds and seedlings of the economically important Kentia Palm disrupting natural regeneration processes.

The LHI REP is a proposal to eradicate introduced rodents from the LHIG using cereal baits laced with the anticoagulant Brodifacoum at a concentration of 20 parts per million. Methods of bait delivery will be dispersal from helicopters in the uninhabited areas, and a combination of hand broadcasting, bait stations and bait trays in the settled area.

It is planned that the eradication will take place in winter, no earlier than 2017.

Eradication (rather than ongoing control) is expected to provide the following benefits:

- Significant biodiversity improvement including threatened species recovery and reintroduction
- Removal of ongoing poison in the environment and associated control costs. It also removes the risk of rodent resistance to poisons
- Long term positive impacts for tourism through protection and enhancement of World Heritage values and improved visitor experience
- Increased productivity for the Kentia Palm industry
- Elimination of current health and amenity impacts from rodents.

The following operational elements of the proposed REP are described below.

- Captive management of at risk species
- Bait application methods
- Fate of the bait and toxin in the environment, product storage and disposal and spill response
- Environmental monitoring
- Elimination of survivors
- Rodent detection monitoring
- Masked owl eradication
- Improved Biosecurity
- Ongoing biodiversity benefits monitoring

Captive Management

The LHI Woodhen (*Gallirallus sylvestris*) and LHI Currawong (*Strepera graculina crissali*), both of which are listed as Vulnerable under the EPBC Act, are at risk of being poisoned, the former from eating baits and poisoned rodents, the latter from preying on poisoned rodents during the rodent eradication.

In order to protect these two bird species, it is proposed that concurrently with the rodent baiting, a large proportion of the population of the woodhens and currawongs will be taken into captivity. The period of captivity will start from approximately two months before baiting commences until baits and rodent carcasses have broken down (or for a total period of up to nine months). The time that baits are available is estimated to be 100 days although the rate of bait breakdown will be monitored to ensure birds are not released at a time which may put them at risk. Up to approximately 85% of the island's woodhen population will be taken into captivity. For the currawong, the proportion will be about 50-60%.

Details of the Captive Management program are found in Section 4 with supporting documents attached to this referral (in Attachment 2).

The captive management facilities will be constructed by modifying existing facilities at the Nursery. If required, expansion may occur on previously cleared land at the nursery Site (See Attachment 1.6).

Bait Application

Baiting Protocol

The bait will be distributed at a nominal dose rate of 20 kg (12kg + 8kg) of bait (or 0.4 g of poison) per hectare. At this rate, a maximum of 42 tonnes of bait (containing 840 g of Brodifacoum) will be required to cover the total island group surface area of 2,100 ha.

Area to be baited

Rats and mice occur throughout LHI, including the settlement. LHI is the only island in the LHIG that is known to contain rodents. However, ship rats are able to swim over 500 m and both rats and mice are difficult to detect at low densities. It is therefore possible that either species may occur on offshore islands and islets close to the main island or may invade those islands prior to the implementation of the operation. To minimise the risks of operational failure, the main island and all nearby islands and islets, other than Balls Pyramid and its associated islets, will be baited. The 23 km distance between Balls Pyramid and the main island renders the chances of invasion by rodents very low.

Number of bait drops

The proposal is for aerial and hand baiting to be carried out twice, the applications separated by about 14 -21 days (depending on the weather) although the number of applications in and around dwellings may be more as it is dependent on the rate of removal by rodents of distributed baits. This will maximise the exposure of rodents to the bait. The proposed application rate for the first bait drop is 12 kg of bait per hectare, and 8 kg per hectare for the second drop. These application rates relate to the actual surface area of the islands. Most rodents will be killed by bait from the first bait drop. However, it is beneficial to carry out a second bait drop to eliminate the likelihood of any gaps in the distribution of baits, ensure bait is available long enough to ensure that all individuals receive a lethal dose and to target:

- individuals that may have been denied access to bait distributed in the first application (by more dominant individuals that will now be dead), and
- any surviving young that have recently emerged from the nest.

The operation is programmed to take place in winter 2017 (June-August), when the availability of natural food for rodents is low, rodent breeding is greatly reduced or absent and the rodent populations are likely to be at their seasonal lowest. This is also a period when most non-target seabirds are absent from the LHIG. Bait drops will be timed to avoid periods of predicted heavy rainfall (as this may prematurely dissolve the bait) and cannot take place in more than light winds or in the presence of low cloud. Therefore weather will influence the actual timing of the two bait drops. Weather forecasts of rainfall and wind speeds will be obtained from the Bureau of Meteorology station on LHI from June onwards. A forecast of less than 15 knots and four fine days (three fine nights) without significant rainfall (less than 6 mm daily) is preferred for each drop.

Given the possibly limited operational window, approval is sought for at least a three year period to account for unforeseen delays beyond winter 2017.

Aerial baiting

Aerial baiting will be conducted throughout the LHI PPP and other areas of the main island excluding the settlement area and identified buffer zones. In all areas baited aerially, 10 mm baits (approximately 2g each) will be broadcast at a density of 12 kg/ha (one bait every two square metres) for the first drop and 8kg/ha for the second drop.

The bait will be dispersed using a purpose built spreader bucket (see Figure 2) slung below a helicopter. A rotating disc throws the bait 360^{o} consistently to 35 m (note outlier pellets may be thrown to 45 m), enabling a swathe of up to 70 m to be baited in a single pass.

Overlapping (50%) each swathe will ensure that there are no gaps in the distribution of baits (see Figure 3). Application rates out of the bucket are calculated to account for the 50% overlap (i.e. for the first drop 6kg/ha on each swathe with 50% overlap will be applied to achieve a 12kg/ha application rate on the ground). Each bait drop will take approximately two days to complete dependant on weather.

Figure 2: Custom built spreader bucket being prepared on LHI.

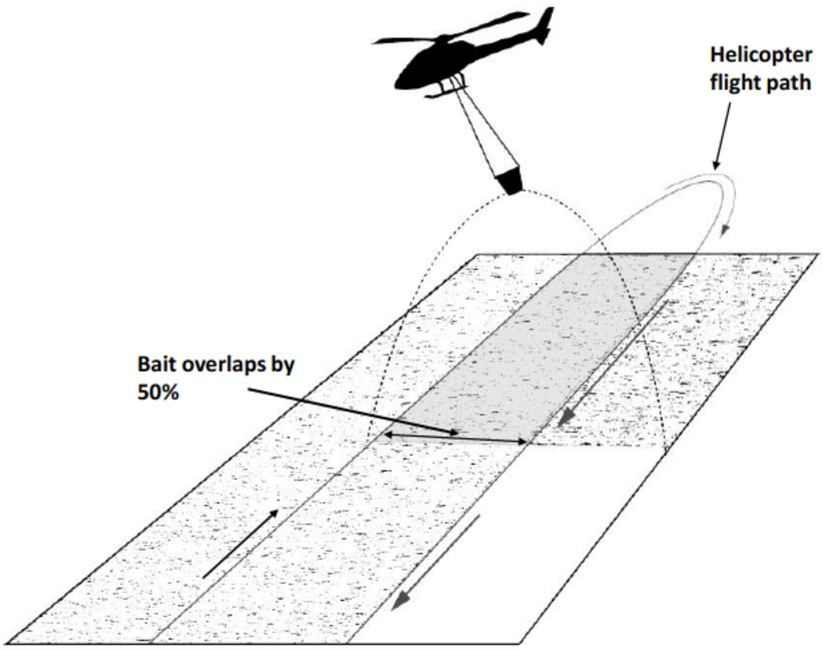

Figure 3: Aerial Application Method

In order to achieve the required baiting density on the cliffs and steep slopes (particularly around Mt Gower and Mt Lidgbird) several horizontal flight lines will be flown at approximately 50m vertical spacing along these areas to ensure adequate bait coverage. Baiting around the coast line will occur above the mean high water mark to minimise bait entry into the marine environment. A deflector arm can be attached to the spreader bucket to restrict the arc of the swathe to 180^{o} and will be used particularly when baiting the edge of buffer zones and to minimise bait entry into the marine environment when baiting coastal areas including cliffs. The dose rate, bait direction and swathe width can all be controlled within set limits and will be adjusted as required for specific requirements for different types of flight lines (inland, coastal or buffer zone). Other aerial dispersal options include the idling or turning off of the spinning motor on the spreader bucket which will result in bait trickling vertically below the helicopter for narrow areas if required. The combination of techniques will enable all terrains on the LHIG to be effectively baited. The exact methodology of distributing bait aerially on LHI will be finalised in consultation with the helicopter contractors.

Buffer zones for aerial application to individual properties will be agreed with the relevant occupiers and in accordance with relevant regulations and considering outliers from the bait swath. The LHIB has committed that this would be no closer than 30m to dwellings, by agreement or if agreement to the contrary is not reached, then the buffer zone will be 150 m. In these buffer zones bait will be applied by hand, or in bait stations. This will be covered in a Property Management Plan for each property. 30m buffer zones will also be established around containment areas for the dairy herd.

GPS will be used to guide the helicopter along a set of pre-determined flight lines designed to ensure that all areas are adequately baited. Computer-generated plots of the actual path flown will be inspected at predetermined times during and at the completion of the flight to confirm that this has been done. Any identified gaps will be treated. Flight-path height will be set at an altitude that ensures effective and safe baiting. It will be determined in discussion with the baiting operator, and take into account topography, weather conditions, aircraft safety and the need to avoid significant disturbance to roosting birds.

This baiting methodology is similar to (and is based on) established techniques for other island pest eradications undertaken worldwide. In Australia this technique has been used on islands such as Montague (2007) and Broughton (2009) islands in New South Wales and Hermite Island (1996) in Western Australia. It was also used on World Heritage listed Macquarie Island in Tasmania over autumn and winter 2011.

The aerial baiting technique has been trialled on LHI with non toxic bait and a custom built spreader bucket (LHIB, 2007). The trials have shown aerial baiting to be an effective technique that could be utilised in an operation on Lord Howe Island. The trial report is included in Attachment 6. The trial provided an opportunity to establish the correct flight configuration: air speed and settings to produce the required flow rate to achieve the on ground density of bait during operations. Methodologies for loading procedures, and determination of bait usage on flight runs were developed for use in future baiting operations.

Further detailed calibration of the equipment with non toxic baits (i.e. helicopter, spreader bucket, GPS equipment etc) will be undertaken immediately prior to the operation as part of and operational readiness check overseen by an international eradication expert most likely from the New Zealand Department of Conservation's Island Eradication Advisory Group.

Hand broadcasting of bait

Hand broadcasting of bait will be conducted concurrently with aerial baiting. It will be undertaken throughout the settlement area where agreed by residents under individual Property Management Plans and in buffer and exclusion zones (i.e. the lagoon foreshore and Ned's Beach). In the settlement area, either 10mm (2g each) or 5.5 mm Pestoff baits (0.6 g each) will be hand-broadcast at a density of 12 kg/ha (one bait every two square metres for the 10mm pellet or one bait every half square metre for the 5.5mm pellet on average) for the first application of bait and at 8kg/ha for the second application.

Provisional areas to be hand-baited are subject to completion of individual Property Management Plans.

Trained personnel will move through such areas and apply bait at the designated rate. All personnel will carry a GPS unit capable of continuously tracking their path. Computer-generated plots of their paths will be used to check baiting coverage. The aim will be to distribute baits in garden beds and other areas of vegetation around dwellings, rather than broadcast on lawns. These details will be contained in the individual property management plans which will be established between property occupiers and the LHIB.

It is essential that all hand-broadcast bait be out in the open so it is subject to degradation by weathering. No bait will be hand-broadcast directly in or under buildings where it will not be subject to weathering.

Bait stations

Commercially available or specifically designed bait stations will be used where aerial or hand broadcasting cannot be undertaken. Bait stations will also be placed within all areas containing livestock (i.e. dairy herd, horses and goats). The bait stations used in livestock areas will be designed specifically to be able to withstand interference and trampling by stock. Where practicable, and with the agreement of householders, small amounts of bait in open containers ('bait trays') similar to commercial products currently available, will be placed within buildings including kitchens, pantries, pet food storage areas etc. Where possible, bait trays will also be put in accessible roof spaces and under-floor cavities.

Note: there is a potential for currently registered Brodifacoum products to be used in accordance with label conditions by residents in some dwellings. This will be considered on a case by case basis assessing higher palatability of pellets vs. higher dosage, quality control and resident acceptability.

All bait trays and bait stations will be monitored regularly and bait replenished as necessary for approximately 100 days after the second baiting (this could be longer if surviving rats or mice are detected). Bait uptake will provide an indication of rodent activity, along with other detection techniques such as detector dogs, chewblocks and tracking tunnels. Bait in these locations will not be exposed to weathering, and so any remaining bait will be removed once project staff are confident all rodents have been eradicated from the island.

When using bait stations or trays it is important that they are set close enough together that individual rats and mice encounter at least one station during their nightly movements. Rats are wide-ranging and can be eradicated using a grid spacing of 25 m -50 m. Mice, however, are not as wide-ranging, and require a grid spacing as close as 10 m.

It is expected that the combination of hand broadcasting and setting and arming of bait stations will take approximately 5 days each application (coinciding with the aerial application) dependant on results of the property management plan process and actual staff numbers.

Product storage

At the manufacturing plant in New Zealand, the bait will be packaged into 25kg bags and loaded in approximately 1 tonne weatherproof bait pods for transport by ship to mainland Australia. After customs and quarantine clearance in Australia, the bait will be barged to LHI. On arrival on LHI, bait will continue to be stored in the weatherproof bait pods in a secured premise most likely at the LHI Airport.

Product Disposal

A limited amount of contingency bait will be purchased with the order in case of physical damage including weathering or bait loss so it is anticipated that there will be bait remaining at the end of the operation.

Unused Pestoff 20R is likely to be retained in case it is needed for follow up or incursion response. It may also be transported back to the mainland for sale to other similar projects or for disposal at an appropriately licensed facility. Unusable spillage will be collected and transported to the mainland for disposal. Emptied Pestoff bags may be disposed off in a similar manner as discarded bait pellets or they may be incinerated on LHI in accordance with all legal requirements.

Rodent and non target carcasses will be collected wherever possible by ground staff during and immediately after the operation, particularly in the settlement area, however due to the large size of the island and rugged and inaccessible terrain this will not be possible across most of the island. It is proposed that carcasses collected will be buried, incinerated on island or transported back to the mainland for disposal at an appropriately licensed facility.

Accidental Release

In the event of a spill, the area will be isolated and all practicable steps taken to manage any harmful effects of the spillage including preventing baits from, as far as practical, entering streams or waterways. Spilled baits will be collected and put into secure containers. Fine material will be swept up and placed into bags for disposal as above.

<u>Fate of the Bait and Toxin in the Environment</u>

The Pestoff 20R bait pellets are made from compressed finely ground cereal, and are designed to break down following absorption of moisture from soil or precipitation. Baits swell, crack and then crumble over time and the rate of pellet breakdown is influenced by temperature, rainfall and invertebrate activity.

The Pestoff 20R pellets will disintegrate very rapidly, when immersed in water, with the actual rate dependant on turbulence, flow, wave and current action.

Brodifacoum itself is highly insoluble in water (World Health Organisation 1995). It is slightly soluble in water at pH 9.2 or above but solubility reduces exponentially with decreasing pH. It has an estimated solubility of <10 parts per million in fresh water at pH 7 and 20^{O}C (U.S. EPA 1998). For comparison, table salt has a solubility of 1,200,000 mg/L under similar conditions.

Note: Solubility is the determining factor for the pesticide pathway beyond the bait in soil or water. For insoluble pesticides, fate in water (and therefore plants) is insignificant because negligible amounts of poison are dissolved.

During a laboratory study the stability of radio-labelled Brodifacoum in sterile buffered water showed that the half-life of Brodifacoum at pH 7 and 9 was much longer than 30 days. A precise calculation of the half-life was not possible because the degradation seen after one day did not continue (World Health Organisation 1995).

In laboratory studies using radioactive-labelled Brodifacoum, less than 2% of Brodifacoum added to any of four soil types tested, leached more than 2 cm (WHO, 1995) suggesting it is effectively immobile.

Brodifacoum in water will settle and bind to sediments and break down slowly. This is discussed in the soil and sediments sections below.

Fate in the Air

Brodifacoum is a solid and does not readily volatise or enter the atmosphere (Toxikos, 2010).

The baits are small, solid and specifically designed for aerial application and to minimise dust. Torr and Agnew (2007) found approximately 130 - 150 g fine material (<2mm size) in a 25 kg bag of Pestoff 20R bait as delivered. They also determined the amount of fines produced by mechanical abrasion during aerial dispersion from a number of different style hoppers to be approximately 50 – 330g per bag. Therefore the maximum amount of fine particles (<2mm) from aerial application is assumed to be 150g as delivered in bags plus 330g produced during dispersion = 480 g (rounded up to 500 g). This equates to approximately 2% of the total bait content.

At the LHI REP proposed application rate of 12 kg/ha bait (first drop) and concentration of 20 mg/kg Brodifacoum (20 ppm) this equates to 240 mg/ha of Brodifacoum. If 2% of this 240 g/ha is fines (<2mm) this equates to 4.8 mg/ha (4.8 g/10000m^2) Brodifacoum dust. At a drop height of 50m this equates to 0.0000096 mg/m^3 or 0.0000096 ug/L Brodifacoum dust in the air column. Fine Particles in the air column are expected to settle on the ground reasonably quickly.

The occupational exposure limit applied to protect workers from the effects of Brodifacoum during manufacture of rodent bait is 0.002 ug/L or (2 µg/m^3) (Syngenta 2006 cited in Toxikos 2010). Thus the maximum estimate of Brodifacoum in inhalable particulates in air during aerial broadcasting is many orders of magnitudes lower than the concentration used to protect workers so is therefore considered to present negligible risk to the environment.

Fate in Soil

The Pestoff 20R bait pellets are made from compressed cereal, and are designed to break down following absorption of moisture from soil or rain. Baits swell, crack and then crumble over time and the rate of pellet breakdown is influenced by temperature, rainfall and invertebrate activity. Mould and fungi can appear rapidly as breakdown proceeds; once this has happened baits are less likely to be eaten by non-target species.

Baits not exposed to weathering remain toxic for a long period and any bait not exposed to weathering (i.e. in bait stations or in dwellings) will be collected approximately 100 days after the second treatment.

A condition index for assessing bait breakdown has been developed (Craddock, 2004). The index uses a 1-6 scale, based on the following conditions and illustrated in Figure 4:

- Condition 1: Fresh Pellets/Pellets not discernable from fresh bait.
- Condition 2: Soft pellets. <50% of pellet matrix is or has been soft or moist. Bait is still recognisable as a distinct cylindrical pellet; however cylinder may have lost its smooth sides. <50% of bait may have mould. Bait has lost little or no volume.
- Condition 3: Mushy Pellet. >50% of bait matrix is or has been soft or moist. <50% of pellet has lost its distinct cylindrical shape. >50% of bait may have mould. Bait may have lost some volume.
- Condition 4: Pile of Mush. 100% of bait matrix is or has been soft or moist. Pellet has lost distinct cylindrical shape and resembles a pile of mush with some of the grain particles in the bait matrix showing distinct separation from the main pile. >50% of bait may have mould. Bait has lost some volume.
- Condition 5: Disintegrating Pile of Mush: 100% of bait matrix is or has been soft or moist. Pellet has completely lost distinct cylindrical shape and resembles a pile of mush with >50% of the grain particles in the bait matrix showing distinct separation from each other and the main pile. >50% of bait may have mould. Bait has definitely lost a significant amount of volume.
- Condition 6: Bait Gone: Bait is gone or is recognisable as only a few separated particles of grain or wax flakes.

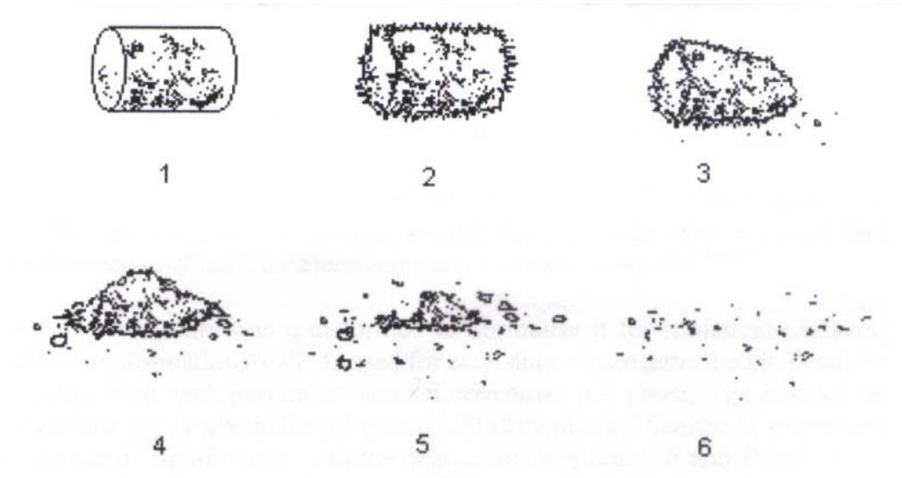

Figure 4: Illustration of typical bait condition (reproduced from Craddock, 2004)

Craddock (2004) monitored bait breakdown of 10mm pellets in a variety of habitats at Tawharanui Regional Park, north of Auckland in winter of 2003 as shown in Figure 5 below. All pellets had reached condition index score of 5.5 to 6 by 120 days.

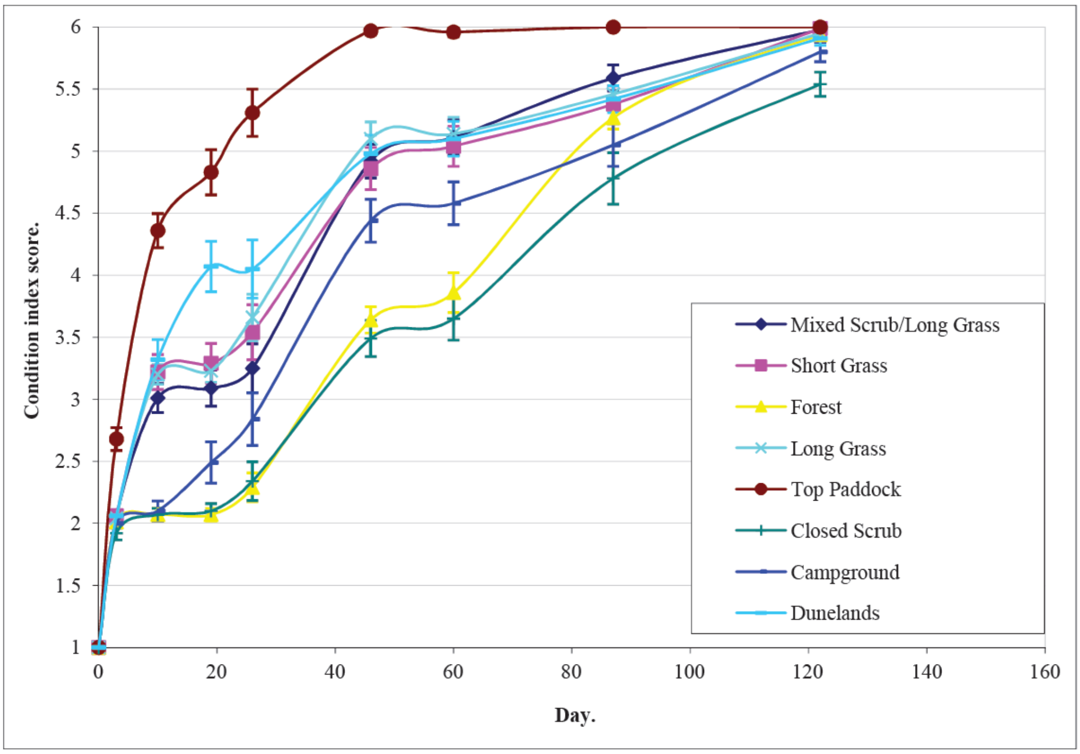

Figure 5. Bait Breakdown times of 10mm pellets (sourced from Craddock 2004)

A non toxic bait trial using Pestoff 20R conducted on Lord Howe Island in August of 2007 examined bait breakdown and longevities in the environment (LHIB, 2007). Baits were covered with 6 mm wire mesh to prevent access by rodents or non-target species to trial baits. Cages containing 5.5 mm and 10 mm baits were placed at three locations: an open site with zero canopy cover, a medium cover site with a broken canopy and a full canopy cover site to monitor bait longevity. 100 baits were placed in each cage and samples removed at approximately weekly intervals and photographed to assess the status of the baits. Bait condition was assessed according to the Craddock (2004) condition scale described above. Results showed that both 5.5 mm and 10mm baits in all three habitats were in advanced stages of decomposition (at least Condition 4) after 55 days and 164.2 mm of rainfall. Further monitoring showed that all baits had completely disappeared after approximately 100 days.

Results of similar breakdown studies of Pestoff 20R in the environment on other temperate islands in NZ are shown below (Broome *et al*, 2016):

- Trials on Great Mercury island in NZ found that bait at 10 out of 12 bait sites monitored were completely broken down in five weeks. Baits monitored on sand dunes lasted 3 months;
- Bait monitored at Rangitoto and Motutapu Islands had disappeared completely from pasture in less than 1 month, from coastal broadleaf forest within two months and on bare lava field in ten months post baiting ;
- Baits on the Ipipiri Islands in the Bay of Islands were in the final stages of breakdown when monitored from pasture 28 days, from sand 91 days, from manuka scrub 147 days and from bare rock 203 days post baiting.

A New Zealand withholding period trial for sheep (Day, 2004), found Pestoff 20R baits degraded rapidly after placement in pasture and were severely degraded or completely gone by Day 60. Baits continued to contain some Brodifacoum for as long as they were present in the pasture, but all baits had completely disappeared by Day 90.

Although the cereal pellet disintegrates and disappears within 100 days or so, the poison takes longer to break down. Environmental factors such as temperature, rainfall, leaf litter, and presence or types of micro-organisms will determine breakdown times.

Manner of use of Brodifacoum baits and physical and chemical properties of Brodifacoum suggests little accumulation of Brodifacoum in soil, with concentrations of Brodifacoum in soil predicted to be negligible/low and occurring only sporadically according to bait treatment timings. Brodifacoum is strongly bound to soil particles, and radio-labelled Brodifacoum was found to be effectively immobile (i.e. not leached) in four soil types (World Health Organisation 1995). It is broken down by soil micro-organisms to its base components, carbon dioxide and water, the half-life being 12-25 weeks (Soil Degradation for 50% of the compound (DT_{50}) – typical 84 days: Field – 157 days; Shirer 1992).

Soil residue monitoring has been undertaken from various trials and eradication operations following the use of cereal-based Brodifacoum baits particularly in New Zealand. Soil residues have rarely been found in random sampling but have been detected from soil taken from near or under disintegrating baits. Operational monitoring reported to date suggests soil residues have fallen below detectable levels after two to six months. Results from field testing or monitoring of similar projects are shown below.

During the Little Barrier Island operation in 2004, soil samples were collected from directly under decaying Pestoff® 20R baits or where they had lain. Samples were taken 56 and 153 days after the aerial bait drop. Those in grassland areas had Brodifacoum residues of 0.2 μg/g (micrograms of poison per gram of soil) after 56 days, and 0.03 μg/g on day 153. In forested areas the figures were 0.9 μg/g on day 56 and 0.07 μg/g on day 153. These data indicate a rapid decline in Brodifacoum content in soil, with around a 90% reduction in poison levels between days 56 and 153 (Fisher *et al*, 2011).

Brodifacoum soil residues were also tested in a baiting trial conducted at Tawharanui Regional Park, Auckland. Soil samples were collected from directly beneath disintegrating baits at 56, 84, 112 and 153 days after first exposure to the elements. These samples produced residues of between 0.02 and 0.2 μg/g, with all positive samples occurring within the first 84 days; that is, no Brodifacoum was detectable in the soil immediately below baits after 84 days. The residues remained below the method detection limit (<MDL) from 110 days after the pellets were placed on the ground (Craddock, 2004).

Soil was sampled after aerial application of 10mm Pestoff 20R baits containing 20ppm Brodifacoum to the Ipipiri Islands in the Bay of Islands in June 2009. This project applied two applications of bait 20 days apart to give a combined total average application rate of 26kg/ha. Samples were taken within 20cm of baits in three habitat types (pasture, bare rock, manuka forest). Soil samples taken 28 days following aerial application of baits contained Brodifacoum residues of 0.0016 mg/kg. Samples taken 58 days post baiting contained Brodifacoum residues of 0.002 mg/kg. Soil samples taken near baits laid in manuka scrub contained (very low) residues up to 147 days after baiting (Vestena & Walker 2010).

Analysis of bait and soil samples from Kapiti Island following an aerial application (14 kg/ha), showed only 10–30% of original levels of Brodifacoum in samples taken 3 months after the operation (Empson in Brown *et al.* 2006).

No residues of Brodifacoum were detected in soil samples taken from Lady Alice Island before, and then 2, 12, 34 and 210 days after an aerial poisoning operation using Talon□20P cereal pellets at 12 kg/ha on 27 October 1994 (Ogilvie *et al*. 1997).

Morgan and Wright (1996a) reported no Brodifacoum residues were detected in eight topsoil samples taken one month following the aerial application of Talon□20P cereal pellets at 15 kg/ha on Red Mercury and Coppermine islands in October 1992.

An accidental release of 700kg of Pestoff 20R bait into a 30ha freshwater lake in Fiordland was monitored for a month. No residual Brodifacoum was detected in samples of sediment (n=16) (Fisher *et al*. 2012).

The manner of use of Brodifacoum baits and physical and chemical properties of Brodifacoum suggests little accumulation of Brodifacoum in soil. Concentrations of Brodifacoum in soil are predicted to be negligible/low and occurring only sporadically according to bait treatment timings. Brodifacoum would not be expected to leach in soil and no mobile degradation products are produced. Brodifacoum strongly binds to soil particles and is slowly broken down by microbial activity with a half-life of 12-25 weeks (Shirer 1992).

The low-moderate application rate of Brodifacoum for the LHI REP (0.4g / ha) and one off eradication means that any soil contamination and bioaccumulation would be of a sufficiently low magnitude as to not present a significant risk.

Breakdown of baits and Brodifacoum levels in soil will be monitored after the LHI REP.
Bait breakdown will be monitored at established monitoring and random sites using the Craddock Condition Index described above at approximately 30 day intervals until complete disintegration.

Post operational soil samples will be collected to monitor residues of Brodifacoum in the soil. Representative samples will be collected from directly below some toxic bait and at control sites away from bait pellets. Soil samples will be collected approximately 30 days after bait disintegration and approximately every two months (if required, dependant on results). All tests will be conducted at a NATA accredited analytical laboratory.

Fate in Fresh Water

The Pestoff 20R pellets will disintegrate very rapidly when immersed in water, dependant on turbulence, flow, wave and current action. The presence and type of sediment layers in a waterway will also affect the degradation of Brodifacoum in aquatic environments as will temperature, pH, volume, or presence or types of micro-organisms.

Brodifacoum is practically insoluble in water (WHO 1995), and leaching from soil into water is unlikely to occur. Erosion of soil might lead to Brodifacoum entering water bodies, where it is likely to be strongly bound to organic material and settle out in sediments (Eason & Wickstrom 2001). Brodifacoum degrades slowly in natural waterways. Where baits have been sown directly into waterways during other baiting operations worldwide, Brodifacoum residues have rarely been detected in water samples.

Due to the low solubility of Brodifacoum, detection of residues in fresh water after aerial and hand distribution of Pestoff 20R baits is extremely rare, despite at least 324 samples analysed over 11 operations (Broome *et al*, 2016).

The only residues of Brodifacoum which have been detected in water bodies following pest control operations in New Zealand come from a single sample of stream water collected 24 hours after bait application and within 20cm of baits in the stream bed. This sample measured 0.083ppm and was one of 12 samples taken within a week of aerial application of 10mm Pestoff 20R baits containing 20ppm Brodifacoum to the Ipipiri Islands in the Bay of Islands in June 2009. Three of the four stream water samples taken within 24 hours of bait application had no measurable residues (MDL 0.02ppb) (Vestena & Walker 2010). 25 Samples of drinking water taken from 13 tanks (covered or disconnected from roofs during the operation) and one bore over a two month period showed no Brodifacoum residues (MDL 0.02ppb) (Vestena & Walker 2010).

Pestoff 20R baits containing 20ppm Brodifacoum were applied in three aerial applications on Rangitoto and Motutapu Islands during the winter of 2009. In total about 38 kg/ha was applied to the islands over the three drops. Roof water collection systems were disconnected before baits were applied and roofs cleared of any baits afterwards. Four drinking water samples were taken about two months following the last bait application and tested for Brodifacoum residues. None were found (MDL 0.00002 mg/l) (Fisher *et al*. 2011).

During the 2004 Hauturu rat eradication, 8 water samples were taken directly downstream from Pestoff 20R baits lying in stream beds within 24 hours of the aerial drop. Brodifacoum was not detected in any of the samples taken (Griffiths, 2004). Samples tested from bore water on the island did not detect any Brodifacoum.

Two fenced 'cells' on Maungatautari (35ha and 65ha) each received two bait drops of Pestoff 20R Brodifacoum cereal bait in September and October 2004. 15kg/ha was applied on the first drop and 8kg/ha in the second. The area (c.8ha) immediately around the inside of both cell fences was hand spread. A total 217 stream water samples were taken from 4 streams flowing out of the poison area. In each stream, samples were taken at the fence boundary and again 800 metres downstream. Time intervals post each drop for taking samples were 1hr, 2hrs, 3hrs, 6hrs, 9hrs, 12 hrs, 24hrs, 48hrs, 72hrs, 2 weeks, 3 months. No sample analysed detected Brodifacoum. The minimum detection level for these samples was 0.00002 mg/l (Fisher *et al* 2011.).

None of the seven water samples taken after bait application contained detectable residues of Brodifacoum (MDL 0.07ug/l) during the 2011 Macquarie island Eradication Project (Broome *et al*, 2016).

An accidental release of a box containing 700kg of Pestoff 20R bait by a helicopter flying over a 30ha freshwater lake in Fiordland was monitored for a month. No residual Brodifacoum was detected in samples of lake water (n=27) (Fisher *et al*. 2012).

In an isolated case, testing of liver and gut contents from two eels found dead in a Southland (NZ) waterway (Tomoporakau Creek, Branxholme) in May 2012, measured 0.095 ppm Brodifacoum in the gut contents of one eel (noting that other anticoagulants were not tested for). This suggests that the eel had recently ingested food containing Brodifacoum, probably through scavenging the carcass of a poisoned possum. There was a bait station approximately 100 metres from the location where a possum and eels (n=13) were found dead in the water (Fisher, 2013).

Laboratory studies using radioactive-labelled isotopes have shown that it is effectively immobile (i.e. not leached) in the soil (WHO 1995). It is strongly bound to soil particles; therefore contamination of ground water is not expected to occur.

Drinking water on LHI is primarily sourced from rain water tanks in the settlement area on LHI. Aerial application of baits will not occur in the settlement area and buffer zones from roofs and rainwater tanks will be established through individual Property Management Plans. There are a small number of bores on the island and covering of bores will also be discussed with individual owners. A small number of ephemeral streams are found on LHI. It is anticipated that a small amount of pellets may fall into these streams as part of the aerial distribution where they will sink and disintegrate rapidly. The Brodifacoum from these pellets will settle and bind strongly to sediments. The low-moderate application rate of Brodifacoum (0.4 g/ ha) for the LHI REP and one off eradication means that any environmental contamination would be of a sufficiently low magnitude as to not present a significant risk.

Random sampling will be conducted on water bodies on the island to monitor Brodifacoum levels after the bait drop. Water samples will be collected within 2 days of each bait drop and approximately weekly (if required, dependant on results). All tests will be conducted at a NATA accredited analytical laboratory. As a precaution tourists and residents will be advised not to drink from streams until laboratory testing confirms absence of detectable Brodifacoum. Supplementary water for people climbing Mount Gower will be provided during the eradication. Testing of resident's water tanks will be undertaken if requested on a case by case basis.

Fate in the Marine Environment

Bait will not be intentionally applied to the marine environment however when Brodifacoum pellets are applied aerially to islands in attempts to eradicate rodents, all terrestrial habitats which may harbour rodents must receive bait. In achieving this it is often the case that a small quantity of bait enters the marine environment near the shore. On LHI it will be impossible to collect these baits.

Howald *et al.* (2005) investigated how much bait entered the water when applied aerially to steep cliffs. The bait was applied with a spreader bucket and deflector arm at the rate of 15 kg/ha. SCUBA divers were used to count bait pellets on the sea floor and to observe the behaviour of marine organisms that encountered the baits. Boat- and island-based observers reported that no bait was directly spread into the ocean but a small amount of bait was seen to enter the water as a result of bouncing off the cliff faces (ibid). The divers counted a mean of 72 baits (range: 69-75) over 500 metres, at a 1-4 m depth on the ocean floor. No fish or other animals were observed feeding on the baits. This would equate to less than 0.5% of baits out of the approximate 15,000 baits applied over that area. On Gough Island, Cuthbert *et al* (2014), found that compared with adjacent flat areas, the vegetated cliff areas of the island retained an average 66-76% of pellets.

Empson and Miskelly (1999) investigated the fate of pellet baits, which fell into the sea as part of the Kapiti Island rat eradication. Non-toxic baits were dropped into the sea about 30m offshore to a depth of 10m and monitored by a diver. The bait disintegrated within 15 minutes. On the assumption that accidental discharges were likely to occur only in the coastal fringe, Empson and Miskelly (1999) concluded that it was unlikely that baits would withstand wave action and remain intact for more than a few minutes.

During the LHI REP it is expected that similar rapid disintegration of pellets will occur where pellets fall into the open ocean exposed parts of the coastline. With less wave action in the lagoon, pellet breakdown may take slightly longer in this environment. Bait entry into the lagoon will be minimised by hand baiting along the lagoon foreshore and through the use of the deflector arm on the spreader bucket.

Monitoring undertaken for similar projects has shown that of a total of 38 seawater samples analysed following three operations, none of the samples showed detectable Brodifacoum (Broome *et al*, 2016).
None of 12 seawater samples taken (within 20 cm of where baits had fallen) during the Ipipiri rodent eradication project in 2009 showed measurable residues of Brodifacoum (MDL 0.02ppb)(Vestena & Walker 2010).

None of 18 seawater samples taken from near Rat Island in Alaska following aerial application of baits showed measurable residues of Brodifacoum (MDL 0.02ppb) (Buckelew *et al*. 2009).

Sampling of the marine environment following application of Brodifacoum cereal baits at 15 kg/ha on Anacapa Island in California during 2001 and 2002 found no detectable residues in 8 seawater samples taken following baiting (Howald *et al* 2010). Four of these samples were taken within 24 hours of baiting and the remainder 1 month after.

In 2001 a truck crashed into the sea at Kaikoura spilling 18 tonne of Pestoff 20R (20 mg/kg Brodifacoum) cereal pellets into the water. Measurable concentrations of Brodifacoum were detected in seawater samples from the immediate location of the spill within 36 hours but after 9 days the concentrations were below the level of detection (0.02 µg/L). (Primus *et al* (2005).

The low-moderate application rate of Brodifacoum (0.4 g/ ha) for the LHI REP, low solubility, high dilution factor in the marine environment and one off eradication mean that any sea water contamination would be of a sufficiently low magnitude as to not present a significant risk.

Additionally significant mitigation through the use of the deflector arm on the spreader buckets, hand baiting within the Lagoon foreshore area and only baiting above the high water mark will minimise bait entry into the water. No seawater samples will be analysed for Brodifacoum after the LHI REP.

It is reasonable to expect that breakdown in marine sediments, would occur similar to soil. Operational monitoring of marine sediment samples taken after application of baits in the 2009 Ipipiri eradication project found that one of 12 samples had detectable residues (MDL 0.001ppm). This sample was taken 24hours after bait application. All samples were taken from within 20cm of baits.

The low-moderate application rate of Brodifacoum (0.4 g/ ha) for the LHI REP, high dilution factor in the marine environment, and one off eradication mean that any contamination of marine sediment would be of a sufficiently low magnitude as to not present a significant risk.

Additionally significant mitigation through the use of deflector buckets, hand baiting within the Lagoon foreshore area and baiting only above the high water mark will minimise bait entry into the water. No marine sediment will be analysed for Brodifacoum after the LHI REP.

Fate in Plants

Brodifacoum is strongly bound to soil particles and practically insoluble in water, therefore it is not likely to be transported through soils and into plant tissues.

Sampling of grasses (Poaceae) collected 6 months following application of Brodifacoum cereal baits at 15 kg/ha on Anacapa Island in California during 2001 and 2002 found no detectable residues in the six samples tested (Howald *et al* 2010).

A literature search failed to find published or verified unpublished data regarding plant uptake or persistence.

Bioaccumulation

Brodifacoum has been shown to bio-accumulate in mammals, birds, invertebrates and fish following repeated sub-lethal exposures. The low-moderate application rate of Brodifacoum for the LHI REP (0.4g / ha) and one off eradication means that any bioaccumulation would be of a sufficiently low magnitude as to not present a significant risk. Bioaccumulation potential in invertebrates and fish / aquatic organisms is discussed below.

Bioaccumulation in Terrestrial Invertebrates

Brodifacoum is not expected to have significant effects on invertebrates as they have different blood clotting systems to mammals and birds. Trials and operational monitoring conducted during rodent eradications in NZ so far have shown few invertebrate species are at risk of primary poisoning, and deleterious effects on arthropod, annelid, and mollusc populations have been rarely detected (Booth et al. 2001; Booth et al. 2003; Craddock

2003; Brooke et al. 2011; Bowie & Ross 2006). Several studies have demonstrated significant increases in invertebrates numbers following rodent eradication (Booth et al 2001, Green 2002, and Green et al 2011).

Observations of baits in the field during non toxic bait trials conducted on LHI in 2007 showed invertebrate damage occurred within a day of the bait drop. Several species of invertebrates were scanned externally with UV light to determine if they had ingested bait. Slugs and one snail (not Placostylus) fluoresced brightly indicating bait uptake, whilst ants, cockroaches, termites and millipedes did not show any fluorescence even though ants and cockroaches were observed feeding directly on bait (LHIB, 2007).

Similarly bioaccumulation in terrestrial invertebrates has shown to be in low concentrations and short lived in similar eradication operations. Invertebrates appear to metabolise or excrete residues rapidly at first but may retain trace amounts for several weeks.

When large-headed tree weta (*Hemideina crassidens*) were dosed with 15 µg/g Brodifacoum (equivalent to consumption of a 6g Talon® 20P pellet), Brodifacoum persisted in the weta for a maximum of four days (Morgan et al. 1996). Booth et al. (2001) dosed tree weta at 10ug/g to evaluate the persistence of Brodifacoum over time. Four days after dosing, Brodifacoum residues had declined to below the limit of detection (0.02ug/g).

Brooke et al (2013) studied the persistence of Brodifacoum in cockroaches and woodlice. In the first experiment cockroaches captured on Henderson Island were allowed to feed on Pestoff 20R pellets containing 20ppm for 4 days. Brodifacoum residues declined quickly in the first 24 hours followed by a gradual decline for the remaining 11 days of the experiment. By day 12 mean concentrations were 0.061ug/g. One cockroach collected in a control group before the treatment group were fed baits had a detectable Brodifacoum residue (below MLOQ) presumed to be from exposure to bait laid on the island 2 months previously. In a second experiment using cockroaches and woodlice, samples were tested for up to 42 days after access to Brodifacoum pellets (Pestoff 20R) was removed. Again depletion of Brodifacoum residues was rapid in the first two weeks followed by a long period of slow decline. Seven of 10 animals tested on day 35 contained measurable residues. By day 42 seven of 10 animals contained residues at a mean level of 0.02ug/g (Brooke et al 2013). This level is 1000 times less than the concentration of baits they fed on.

Craddock (2003a) fed captive locusts (*Locusta migratoria*) Pestoff possum baits containing 0.02 g/kg Brodifacoum and tested them for residue at 1,2,3,4,5,10 and 15 day intervals. The test group exposed for 72 hours were observed eating bait but only 2 of the 7 samples had detectable residues of Brodifacoum 3 to 4 days after dosing. Another test group exposed for 144 hours had no detectable residues. A bio-tracer experiment found the dye became undetectable 7 days after dosing. Craddock concluded that on average 48 hours of exposure gives a concentration of 0.41ug/g which drops below the detection limit of 0.06 µg/g after 3 days.

Craddock (2003) sampled live invertebrates captured around bait stations using cereal pellets containing 20ppm Brodifacoum. He found weta, cockroaches and beetles up to 10m from a bait station contaminated with Brodifacoum residues. The highest residue levels (up to 7.47 ug/g) were closer to the bait stations and soon after they were filled with bait. After toxic bait had been removed from bait stations, residue levels in invertebrates took in excess of 4 weeks to return to background levels. Trace levels of Brodifacoum were still detectable up to 10 weeks after bait had been removed.

On Red Mercury Island, invertebrates were collected after the aerial application of Brodifacoum baits, and were analysed for Brodifacoum residue. No such residue was found in 99% of the sample (Morgan *et al.* 1996). On Lady Alice Island, tree-weta and cockroaches were collected in the days and weeks after aerial baiting and tested for Brodifacoum; none was detected. A cave-weta and beetles found on the baits were also tested. No Brodifacoum was detected in the beetles, but was found in this weta (Ogilvie *et al*. 1997). Similar testing was done after the aerial application of Brodifacoum on Coppermine Island. In this instance no residues were found in the weta or beetles, or in the ants and weevils that were found on the baits, but residues were found in cockroaches (G.R.G. Wright cited in Booth *et al.* 2001). Non-target insects and millipedes in the Seychelles Islands consumed Brodifacoum bait with no apparent adverse effects.

Significant bioaccumulation in terrestrial invertebrates is not expected with the proposed LHI REP given the one off nature of the eradication, the relatively low dose and short timeframe in which bait will be available. Conversely the eradication will permanently remove the use of rodenticides including Brodifacoum on the island from the current control program.

Bioaccumulation in Terrestrial Vertebrates

Laboratory studies and field monitoring have shown that Brodifacoum can bio accumulate in terrestrial vertebrates and is very persistent in the livers of most sub-lethally exposed animals, (up to nine months in some cases). However short-term sub-lethal exposure is not expected to have any significant adverse effects. Brodifacoum residues have been detected in tissues of animals during the monitoring of field distribution, but not always associated with mortality or evidence of haemorrhage. Non-target deaths have been documented in eradication programmes. However, most incidences have involved low numbers and the affected species have recovered quickly to pre-eradication population levels, or higher, once invasive rodent species has been removed (Broome *et al*, 2016).

Nine months after 15kg/ha Talon® 20P pellets were aerial sown on Red Mercury Island in 1992 six blackbirds were sampled. The livers of all six birds contained low levels of Brodifacoum (0.004 to 0.2 mg/kg) (Morgan et al. 1996)

After rat eradication on Langara Island (British Columbia) bald eagles (*Haliaeetus leucophalus*) were sampled for Brodifacoum residues and prothrombin time evaluation. Three out of the 20 eagles examined had been recently exposed to Brodifacoum, but none were suffering from clinical anticoagulation (Howald et al. 1999).

Native birds have been sampled on two occasions following the use of Brodifacoum during pest control operations in New Zealand. In 1995, four months after Brodifacoum was used in bait stations at Mapara Wildlife Management Reserve, King Country, 14 native birds (five tomtits, five whiteheads, one bellbird, one fantail, one Australasian harrier and one morepork) were sampled for Brodifacoum residues. Only the morepork contained residue. Four robins were sampled for Brodifacoum residues in Waipapa, Pureora Forest Park, two months after Brodifacoum was used in bait stations in 1997. None of the birds had Brodifacoum residues (Murphy et al. 1998).

One month after being exposed to Pestoff rodent blocks containing 0.02 g/kg Brodifacoum two plague (rainbow) skinks had liver residues of 0.005 and 0.01 µg/g (Wedding 2007).

Two Duvaucel's geckos (*Hoplodactylus duvauceli*) found in traps were tested for Brodifacoum residues. One of the geckos had 0.007 mg/kg residue in its liver. Brodifacoum had been used in the area in bait stations up until two years prior to the gecko being caught (Vertebrate Pest Record Database 11938 cited in Broome *et al*, 2016).

Mourning gecko (*Lepidodactylus lugubris*) and common house gecko (*Hemidactylus frenatus*) samples were collected live following aerial application of Bell Labs 25w bait on Palmyra Atoll. Although showing no clinical signs of poisoning, 14 of the 24 samples were found to contain Brodifacoum residues, indicating that they were exposed (Pitt et al. 2012).

Significant bioaccumulation in terrestrial vertebrates is not expected with the proposed LHI REP given the one off nature of the eradication, the relatively low dose and short timeframe in which bait will be available. Conversely the eradication will permanently remove the use of rodenticides including Brodifacoum on the island from the current control program.

Bio-accumulation in fish/aquatic organisms

Whilst Brodifacoum can bio-accumulate in fish and aquatic organisms from repeated exposure and may cause long term effects in the aquatic environment (Tomlin, 2009), there is limited evidence of marine vertebrates or invertebrates being adversely affected by Brodifacoum poisoning during rodent eradication projects.

Fish potentially killed by Brodifacoum poisoning have been observed on only a very few occasions and a few studies have found residues in live fish shortly after bait application. Where tissue samples have been separated, this contamination has been confined to livers. Further sampling of these sites indicate residues are not long lasting (Broome *et al*, 2016). Results from operational monitoring of similar projects are detailed below.

Following aerial application of baits on Ulva Island near Stewart Island (NZ) in 2011, fish were sampled 10 days after a final bait application (i.e. 43 days after first bait application). No residues were detected in the flesh of blue cod (*Parapercis colias*) (30 individuals combined into 6 samples), trumpeter (*Latris lineata*) (10 individuals combined into 2 samples), spotties (*Notolabrus celidotus*) (18 individuals combined into 4 samples), girdled wrasse (*Notolabrus cinctus*) (1 individual, 1 sample) (MDL 0.001ppm) (Masuda *et al* 2015). However 2 of 6 blue cod liver samples (30 individuals) taken at the same time were found to contain 0.026 and 0.092ppm. A further 20 blue cod (4 samples) were tested 1 month after final bait application (77 days after first bait application) and no residues were found in either flesh or liver (MDL 0.001ppm) (Masuda *et al* 2015). Four months after bait application 20 blue cod (4 samples) were again tested and none showed detectable residues in liver or flesh (Masuda *et al* 2015). In the same operation marine invertebrates were sampled 10 days after final bait application. 85 mussels (*Mytilus edulis*) were collected from 3 sites. These were batched to form 9 mussel samples. Three samples had residues ranging from 0.003ppm to 0.022ppm. Two of 8 limpet *(Cellana ornata*) samples (50 individuals) had detectable residues (0.002 & 0.016ppm). Both pipi samples (20 individuals), all 3 paua (*Haliotis iris*) (15 individuals), all 3 kina (*Evechinus chloroticus*) (15 individuals) samples and one cockle sample (7 individuals) had no detectable residues (MDL 0.001ppm). Five further mussel samples (50 individuals) were tested one month after final bait application and none were found to have detectable residues. However two of the 6 limpet samples (50 individuals) tested at this time had residues very close to the MDL of 0.001ppm. Further testing of limpets and mussels was done 4 months after final bait application (i.e. 176 days after first bait application) resulting in one of 6 mussel samples (50 individuals) with detectable residue (0.018ppm). All 6 limpet samples (50 individuals) had no detectable residues. Further testing of limpets and mussels was undertaken 8 months after the bait application. Four limpet and 4 mussel samples taken from 2 sites had no detectable residues (MDL 0.001ppm) (Masuda *et al* 2015).

Following aerial application of baits on Shakespeare Open Sanctuary north of Auckland a large marine monitoring programme was undertaken, collecting 206 samples of 33 marine taxa from 4 sites before and after baiting. Among these samples were 2 blue cod, 1 parore (*Girella tricuspidata*), 1 spotty, 1 triple fin (*Forsterygion varium*), 1 moki (*Latridopsis ciliaris*), and 1 snapper (*Chrysophrys auratus*) taken 1 or 8 days after bait application. No detectable residues were found in any of the fish samples (MDL 0.001ppm). Samples were also collected for Pacific oysters (n=7), crayfish (*Jasus edwardsii*) (n=2), cushion star (*Asterina spp.*) (n=2), shrimps (n=1), kina (n=2), cockles (*Austrovenus stutchburyi*) (n=2), whelks, crab and sea cucumber (*Stichopus spp*). One of the post bait application samples catseye (*Turbo smaragdus*) had detectable residues (0.006ppm). Interestingly one sample of catseye and one oyster sample taken before any bait was laid had low levels of Brodifacoum (0.009ppm & 0.002ppm respectively). However on re-testing the catseye sample remained below and the oyster sample equal to - the limit of detection (0.001ppm) (Maitland 2012).

Following the aerial application of baits (18 kg/ha over 2 applications) on Taranga (Hen) Island in Northland (NZ) in 2011, 4 samples each containing 3 crayfish were taken from near shore rocks. The selected sample collection sites were also adjacent to where two streams, draining the largest island catchments, entered the marine area. Two samples were collected 25 hours and two samples nine days after bait application. No residues were detected (MDL 0.0005ppm). During the same project 4 samples each containing 3 kina were similarly collected with no detectable residues (Broome *et al*, 2016).

Baits containing 20ppm Brodifacoum were applied in three aerial applications on Rangitoto and Motutapu Islands (NZ) during the winter of 2009. In total about 38 kg/ha was applied to the islands over the three drops. Five dolphins (*Delphinus spp*), a number of pilchards (*Sarditlops neopilchardus*) (tested as one sample) and nine little blue penguins found dead around the Hauraki Gulf at the time of the operation were also tested for residues. Only 3 of the penguins contained detectable residues of Brodifacoum but all of the birds necropsied showed no evidence of anticoagulant poisoning and starvation was considered the most likely cause of death (Fisher *et al*. 2011). Ten pipi and ten mussels collected three weeks following the final drop were tested for Brodifacoum residues. None were found (MDL 0.001 ppm) (Fisher *et al*. 2011).

A field trial was also conducted to examine the fate of Talon® 20P cereal pellets dropped into the sea at Kapiti Island (NZ) and any consumption by fish. Non-toxic baits disintegrated within 15 minutes and spotties, banded wrasse (*Notolabrus fucicola*) and triple fins were observed eating the bait. In subsequent aquarium trials blue cod, spotty and variable triple fin were fasted for 24 hours before being exposed to Brodifacoum cereal pellets for 1 hour. The fish were moved to a clean tank and held for 23-31 days, then killed and analysed. Six of 24 triple fins exposed to bait died although none were observed eating bait and no residue was detected in their livers. Of 30 spotties, six ate toxic bait and one died of Brodifacoum poisoning. Two other spotties which died were not observed eating bait but showed clinical signs of poisoning. It is thought the poison was absorbed through gills or skin. This is unlikely to happen in the sea given wave action and dilution (Empson & Miskelly 1999). There was no evidence of a population decline in spotties as a result of the aerial application of Talon® 7-20 at 9.0 kg/ha followed by 5.1 kg/ha on Kapiti Island, based on surveys conducted before and after the poison drops (Empson & Miskelly 1999).

In 2001 a truck crashed into the sea at Kaikoura (NZ) spilling 18 tonne of Pestoff 20R (20 mg/kg Brodifacoum) cereal pellets into the water. A butterfish (*Odax pullu*) sampled 9 days after the spill had Brodifacoum residues of 0.040ppm in the liver, and 0.020 in the gut, although muscle tissue was below the MLD (0.020ppm). Residues in a scorpion fish (*Scopaena sp*.), two herring (*Sprattus* spp.) and an unknown species of fish collected between day 14 and 16 were all <0.020ppm. Samples taken from two seals (*Arctocephalus forsteri*), two black backed gulls (*Larus dominicanus*) and a shag (*Phalacorcorax* spp.) found dead in the area following the spill contained no detectable Brodifacoum levels, and necropsies found no signs of anti-coagulant poisoning (Primus *et al*. 2005). Samples of mussels and paua taken from the immediate location retained measurable residues for up to 31 months. This result was probably confounded by the animals being re- exposed to Brodifacoum bait particles through wave action. Effects of the spill were only measurable within a 100m^2 area surrounding the crash site (Primus *et al*. 2005)

Two of 5 pipi (*Paphies australis*) samples taken within 72 hours of aerial application of baits containing 20ppm Brodifacoum to the Ipipiri Islands in the Bay of Islands (NZ) in 2009 were found to have low levels of Brodifacoum. Four mussel (*Perna canaliculus*) samples taken from the site at the same time were clear and nothing was detected in a further 4 pipi and 3 mussel samples taken at 1 and 2 months post bait application (MDL 0.001ppm). Samples in this study were deliberately taken from within 20cm of baits (Vestena & Walker 2010).

On tropical Palmyra Atoll non-toxic baits were dropped into four marine environments to observe the reactions of the marine species present. Baits placed on exposed tidal flats had no interest shown in them by the species present (fiddler crabs, bristle-thighed curlews and Pacific golden plover). In shallow (1m depth) water fish showed no interest in the first pellets entering the water. However on following occasions 3 species did eat baits. In moderate depth (3m) trials, 2 species took baits falling through the water and in deep (10m) water trials, 1 species was seen to mouth baits but consumption could not be confirmed. In total six of 20 species observed showed interest in the baits (Alifano & Wegmann 2010). In the same study crabs were held in captivity and fed Bell Labs 25W pellet baits containing Brodifacoum for 7 days followed by a natural diet. Crab excrement was collected daily and analysed for Brodifacoum content. Results indicated that Brodifacoum levels climbed over the first couple of days but then levelled out and fell to low levels within 3 days of the crabs moving off their bait diet to natural food. However traces (0.25ppm) could still be found 16 days after the pellet diet ended. Crabs did not appear to be affected by the toxin (Alifano & Wegmann 2010).

Nine of ten black spot sergeant fish (*Abudefduf sordidus*) collected live following aerial bait application of Bell Labs 25w bait on Palmyra Atoll were found to contain residues ranging from 0.05 to 0.315 ppm (whole fish). Two applications of bait (80kg/ha and 75kg/ha) were applied about 10 days apart. Fish samples were collected shortly after the second application. A number of mullet (*Liza vaigiensis* and *Moolgarda engeli*) and a single puffer fish were found dead after this application and were found to contain residues ranging from 0.058 to 1.16 ppm. Interestingly, over half the residue results from the dead mullet samples were within the range of residues found in the live sergeant fish (Pitt *et al*. 2012). All hermit crab samples collected soon after baiting contained residues with levels ranging from 0.134 to 1.58 ppm less than 5 days after baiting. By the 3rd sampling period (22-25 days post first bait application) one of 5 samples had no detectable residues, and by the 4th sampling period (6 weeks after the last baiting) only one sample had detectable residues (MLD<0.018). Aquatic fiddler crabs were also collected during this study and showed similar results (Pitt *et al*. 2015)

A range of fish species were tested for Brodifacoum contamination following the aerial application of baits (Bell Labs 25W) to Wake Atoll in the mid Pacific in 2012. Forty-two samples from six species collected from 7 sites around the island were tested. Five samples returned results above the MDL of 0.001 ug/g, ranging from 0.002 to 0.005 ppm. Because the fish (papio trevally and blacktail snapper) were tested whole, it is likely that the contamination measured was in the gut of the fish (R. Griffiths pers com. in Broome *et al*, 2016).

Sampling of the marine environment following application of Brodifacoum cereal baits at 15 kg/ha on Anacapa Island in California during 2001 and 2002 found no detectable residues in 26 tidepool sculpins (*Oligocottus maculosus*) which are small fish found in the intertidal zone (Howald *et al* 2010). Sampling found no detectable residues in marine invertebrate fauna collected 15, 30 and 90 days following bait application (Howald *et al* 2010). Included in these samples were 6 hermit crabs, 1 limpet, 22 mussels, 42 shore crab (*Pachygrapsus spp*) and 10 sea urchin.

Following aerial application of baits on Kaikoura Island near Great Barrier Island (NZ) in 2008 two samples were taken from a nearby mussel farm and tested for residues. None were found (MDL 0.001ppm) (VPRD 11421, 11422 cited in Broome *et al, 2016*).

Following aerial application of baits on Hauturu (Little Barrier) Island in the Hauraki Gulf (NZ) in 2004, two paua and two scallop (*Pecten novaezelandiae*) samples (each consisting of about 4 animals) were taken from near the island and tested for residues. None were found (MDL 0.001ppm) (Fisher *et al*. 2011).

Following the aerial application of baits on Motuihe Island in the Hauraki Gulf in 1997 two Pacific oyster (*Crassostrea gigas*) and 4 mussel samples were tested for residues. The oysters and 3 of 4 mussels had no residues detected (MDL 0.01ppm). One mussel sample had 0.02ppm Brodifacoum, perhaps because a toxic bait was deliberately dropped into the rock pool it was living in (Fisher *et al*. 2011).

The low-moderate application rate of Brodifacoum (0.4 g/ ha) for the LHI REP, high dilution factor in the marine environment, and one off eradication means that the risk of bioaccumulation in local marine species would be of a sufficiently low magnitude as to not present a significant risk. The amount of Brodifacoum assimilated into the marine environment will be an extremely small fraction of (many orders of magnitude lower) the concentrations known to be toxic to fish (Empson, 1996).

Additionally significant mitigation through the use of deflector buckets, handing baiting within the Lagoon foreshore area and baiting above the high water mark will minimise bait entry into the water.

Monitoring

An extensive monitoring program will be conducted during and after the REP. This includes

- Monitoring of weather in the lead up to and during the REP.

- Monitoring breakdown of baits after distribution. Bait breakdown will be monitored at random sites using the Craddock Condition Index described above at approximately 30 day intervals until complete disintegration.
- Soil monitoring after distribution. Post operational soil samples will be collected to monitor residues of Brodifacoum in the soil. Representative samples will be collected from directly below some toxic bait and at control sites away from bait pellets. Soil samples will be collected approximately 30 days after bait disintegration and approximately every two months (if required, dependant on results). All tests will be conducted at a NATA accredited analytical laboratory.
- Random sampling will be conducted on water bodies on the island to monitor Brodifacoum levels after the bait drop. Water samples will be collected within 2 days of each bait drop and approximately weekly 30 (if required, dependant on results). All tests will be conducted at a NATA accredited analytical laboratory. Rain water tanks will be sampled if requested by residents.
- Monitoring for ill and dead non target species. Ill individuals will be treated with Vitamin K where possible. Carcasses of rodents and non target species will be collected if found. No analysis of non target carcasses is proposed.
- Analysis of milk samples pre and post baiting.

Elimination of survivors

The settlement area and other selected areas of LHI will be monitored for the presence of rodents throughout the 100-day period of the baiting operation. Detection of surviving rodents will be evidenced by bait take from bait trays and bait stations, observations of droppings or rodent activity through the use of chew blocks and tracking tunnels. Residents will be asked to report any such evidence to the project team.

In addition, trained detector dogs and handlers will be deployed throughout the settlement area to find and locate any surviving rodents. In the unlikely event that rodents are detected, action will be taken to eliminate them. A Contingency Plan will be developed prior to the REP to guide selection of appropriate actions in the event that surviving rodents are detected. This could include targeted hand baiting or bait stations.

The proven efficacy of a well planned and implemented aerial operation along with the any realistic monitoring of the rugged areas being unfeasible means that no post operational monitoring for rodents will be undertaken away from the settlement in the period immediately after the operation.

Rodent Detection Monitoring

Monitoring of the rodent-free status of LHI following the eradication of rats and mice will be achieved by monitoring for rodent activity at bait stations, in tracking tunnels strategically placed at stratified locations across the island and with the use of rodent detector dogs. This will form part of the island's permanent rodent detection and prevention system initiated as an integral part of the island's Biosecurity program which will be upgraded in parallel with the REP.

Improved Biosecurity

To improve Biosecurity on the island more generally and to protect the rodent eradication investment, the LHIB is updating the Island's Biosecurity system concurrently with the proposed REP although upgrades will occur regardless of whether the REP goes ahead. In 2015 a consultant was engaged to update the LHI Biosecurity Strategy. Recommendations from the updated Strategy include:

- reducing risk at the Port Macquarie wharf
- increasing education and awareness for residents and visitors pre arrival to LHI
- Increasing inspection regime for all pathways
- pursuing legislative declaration of LHI as a Special Biosecurity Zone under the Biosecurity Act 2015
- increasing residents' awareness of biosecurity risks of plants, animals and diseases both before and after import
- being prepared to react quickly to new incursions through early detection and rapid response
- continuing with on ongoing management and eradication programs
- ensuring biosecurity is adequately resourced with realistic cost and resource estimates

Masked Owl Eradication

As a result of the proposed rodent eradication, there is also an opportunity to subsequently eradicate the Masked Owl, which was introduced to LHI (along with 5 other Australian and North American owl species) to controls rats in the 1920s and 1930s. The Masked Owl on LHI were until recently believed to be the Tasmanian race *(Tyto* *novaehollandiae castanops),* however genetic testing has found significant divergence of the LHI population with *T. n. castanops,* suggesting hybridisation with the Mainland race *(Tyto novaehollandiae novaehollandiae) (*Hogan *et al*, 2013). This hybridisation and loss of genetic integrity would exclude translocation of the LHI Masked Owl to Tasmania or NSW.

A recent study (Milledge, 2010) has shown that rodents currently provide the Masked Owl's main prey base on the Island, supplemented by occasional predation on other native birds. During the rodent eradication it is expected that most owls are likely to succumb to secondary Brodifacoum poisoning by ingestion of poisoned rodents. To avoid any remaining owls switching to a diet of solely native species in the absence of rodents, it is proposed to eradicate remaining owls via hunting or trapping before, during and after the baiting proposal.

A more detailed plan for the eradication of Masked Owls is attached to this referral (in Attachment 3).

Biodiversity Benefits Monitoring

A Biodiversity Benefits monitoring program associated with the rodent eradication project has been established to assess and document the biodiversity benefits of removing rats and mice from the World Heritage Lord Howe Island. The program provides a measure of the return on investment. It also allows an evaluation of status of species prior to and following the eradication so any impacts of the eradication of rodents on key non-target species can be tracked during their recovery. Over time, results from the various monitoring components could be integrated to identify and explore changes to ecosystem processes.

2.2 Alternatives to taking the proposed action

This should be a detailed description outlining any feasible alternatives to taking the proposed action (including not taking the action) that were considered but are not proposed (note, this is distinct from any proposed alternatives relating to location, time frames, or activities – see section 2.3).

A range of alternatives that have been considered are discussed below. These include:

- doing nothing
- continuing the current rodent control program
- eradication using a range of methods, toxins and baits.

Do Nothing Scenario - The Impact of House Mice and Ship Rats on the LHI Group

The devastating impacts of introduced rodents on offshore islands around the world are well documented. The presence of exotic rodents on islands is one of the greatest causes of species extinction in the world (Groombridge 1992). Ship rats alone are responsible for the severe decline or extinction of at least 60 vertebrate species (Towns *et al.* 2006), and currently endanger more than 70 species of seabird worldwide (Jones *et al.* 2008). They suppress plants and are associated with the declines or extinctions of flightless invertebrates, ground-dwelling reptiles, land birds and burrowing seabirds (Towns *et al.* 2006). Mice have also been shown to impact on plants, invertebrates and birds (Angel *et al.* 2009).

Rats and mice prey heavily on birds, bats, reptiles, snails, insects and other invertebrates. The ship rat is known to eat seeds and other plant material, fungi, invertebrates, small vertebrates and eggs (NSW Scientific Committee 2000 in DECC 2007). Rats prey on the eggs and chicks of land birds and seabirds, and can cause major declines in these species (Merton *et al.* 2002). Mice eat the eggs and chicks of small bird species such as storm-petrels, but are also capable of killing chicks of birds as large as albatrosses.

Rats and mice consume vast quantities of seeds, flowers, fruits, foliage, bark and seedlings. This severely reduces seedling recruitment which changes the characteristics of native vegetation communities (Rance 2001; Shaw *et al.* 2005; Brown *et al.* 2006; Athens 2009; Meyer & Butaud 2009; Traveset *et al.* 2009). The impact that rats have on the regeneration of plants on islands is often not fully appreciated. After rats were removed from the Chetwode Islands, New Zealand, there was a twenty-fold increase in seedling numbers and a seven-fold increase in the diversity of plant species (Brown 1997a).

One of the indirect impacts of rats on islands is the loss of nutrients. Rats kill seabirds and this leads to a reduction in the amount of nutrients available from guano, regurgitations and failed eggs. These losses can profoundly affect the health and condition of forest ecosystems (Holdaway *et al.* 2007), as has happened on Norfolk Island after the loss of the providence petrel (*Pterodroma solandri*).

Mice probably arrived on LHI by the 1860s. Rats arrived in 1918. Rats are implicated in the extinction of five endemic bird taxa (species or subspecies), at least 13 species of endemic invertebrates on LHI including two endemic land snails (Ponder, 1997) – *Epiglypta howinsulae* and a sub-species of *Placostylus bivaricosus* and 11 beetles. While many of these extinctions occurred within only a few years of rats arriving, the detrimental effect of rodents on the island's plants and animals is ongoing. They are also a recognised threat to at least 13 other bird species, 2 reptiles, 51 plant species, 12 vegetation communities, and three species of threatened invertebrates on LHI that are currently threatened because of the presence of exotic rats (DECC, 2007). Another four species of land snails have subsequently been added to this list.

Two seabirds – white-bellied storm-petrel (*Fregetta grallaria*) and Kermadec petrel (*Pterodroma neglecta*) – that once bred on the main island are now restricted to breeding on smaller, rat-free islands within the LHI Group. They were last recorded breeding on the main island by Roy Bell in 1913-1915, just prior to the introduction of rats. The Kermadec petrel nests above ground, where it is highly vulnerable to rat predation. The small size of storm-petrel adults, nestlings and eggs make them especially vulnerable to predation by rats.

The consumption of seeds and invertebrates by rats reduces the amount of food available to the island's seed-eating and insectivorous birds. This competition for food resources is likely to be reducing the abundance of remaining bird populations.

Rats prey heavily on reptiles and have severely reduced the abundance and distribution of the LHI skink (*Oligosoma lichenigera*) and LHI gecko (*Christinus guentheri*) on the main island (Cogger 1971). It is no coincidence that these species are more abundant on the rat-free outer islets (DECC 2007).

Rats are voracious predators of invertebrates. The loss of invertebrates on LHI is particularly significant because invertebrates play an important role in maintaining natural ecological functions, such as nutrient cycling, pollination, pest control and decomposition. Documented impacts to invertebrates include the loss of two endemic land snails (Ponder 1997) – *Epiglypta howinsulae* and a sub-species of *Placostylus bivaricosus* and 11 beetles. These beetles, that were present on LHI prior to the introduction of rats, have not been recorded since. This is despite significant effort including a systematic invertebrate survey by the Australian Museum between 2002 and 2004 (C. Reid unpublished data). Rats are also responsible for the local extirpation of Wood-feeding Cockroach *Panesthia lata* which now only occurs on offshore islands including the Admiralty Group. Rats are also widely believed to be responsible for the elimination of the endangered LHI Phasmid from the main island. The only remaining wild population of phasmid occurs on rat-free Balls Pyramid (Priddel *et al*. 2003).

Rats are believed to have caused the extinction of the bridal flower (*Solanum bauerianum*) and native cucumber (*Sicyos australis*) from LHI (DECC 2007). Rat predation on seeds and seedlings also severely reduces or stops recruitment of the little mountain palm *Lepidorrhachis mooreana*) and big mountain palm (*Hedyscepe canterburyana*) (Moore Jr 1966; Auld *et al.* 2010). It is thought that seed and seedling predation by rats is hindering the regeneration of the palm stand on Little Slope (Pickard 1982), and rodent eradication is considered critical for the long term conservation of both little and big mountain palms (Auld *et al.* 2010).

Rats consume the seeds of many other plant species including: blue plum (*Chionanthus quadristamineus*), green plum (*Atractocarpus stipularis*), pandanus (*Pandanus forsteri*) and tamana (*Elaeodendron curtipendulum*) (Harden personal observations). Rats damage the vegetative parts of a number of plant species, including all four species of palms on the island. Rats commonly chew through the rachis, completely detaching the frond from the tree (Pickard 1983; Harden personal observations). Rats damage the bark on the trunk and limbs of a number of tree species, including Sally wood (*Lagunaria patersonia*), tamana and island apple (*Dysoxylum pachyphyllum*). In severe cases this can result in the death of the tree (Harden personal observations). The impact on vegetation also indirectly affects invertebrates through habitat loss and birds through the removal of food sources.

A monitoring program has been established on LHI to assess and document the biodiversity benefits of removing rats and mice from the LHIG. The program provides a measure of the return on investment and allows an evaluation of current status of species so any impacts of the eradication of rodents on key non-target species can be tracked during their recovery. The most recent results (Carlile, 2015) show:

- seed and fruit losses to rats of all 16 plant species examined, comprising a mixture of plant families, life forms (trees, shrubs, vines) and habitats, with some experiencing very high losses
- recruitment failure as a result of rat predation on seeds and seedlings of the Critically Endangered Small Mountain Palm and associated loss of biotic process and interactions in the Critically Endangered Gnarled Mossy Cloud Forest (ibid)
- Low numbers of reptiles and birds and observed predation by rodents on eggs and suspected removal of nestlings in some species.

While the impacts of house mice on the LHI Group are difficult to positively confirm in the presence of rats and may not be as significant or as well understood as those of ship rats, they are likely to be similar to those demonstrated on other islands (see Newman 1994; Jones *et al.* 2003). For example, evidence on subantarctic Gough Island has identified mice as being responsible for increased mortality of several species of seabird nestlings (Cuthbert & Hilton 2004), including the Tristan albatross (*Diomedea dabbenena*). This albatross is a similar size to the masked booby (*Sula dactylatra*) which is the largest seabird breeding in the LHI Group. New Zealand studies have found that mice prey on reptiles and their eggs and can severely deplete populations (Towns & Broome 2003). Whilst the impacts of mice may be suppressed in the presence of rats (Angel *et al.* 2009), the potential negative impacts of house mice include:

- predation on seeds, competing with native seed-eating fauna for food resources
- severely reducing seedling recruitment which in turn changes vegetation communities
- predation of the eggs and chicks of small bird species, such as storm-petrels and the potential to attack large seabirds
- adverse effects on affected populations of the LHI skink and LHI gecko
- predation on invertebrate fauna which can cause the extinction of some species, as has occurred on Antipodes Island in New Zealand (Marris 2000)
- a detrimental effect on island nutrient recycling systems by reducing the abundance and diversity of soil invertebrates (Smith & Steenkamp 1990).

From the perspective of the human population, rats and mice are major domestic pests. They infest residences, destroy foodstuffs, vegetable gardens and contaminate homes with excrement. They are also a known health risk to humans as they harbour and transmit diseases and parasites.

From an economic perspective, rats cause considerable economic loss to the island's Kentia Palm *Howea forsteriana* industry with predation of seed as high as 30% (Parkes *et al*, 2004) severely reducing seed production (Pickard 1983; Billing 1999).

Tourism, the LHI Group's main industry, is based on the islands' unique biodiversity and World Heritage values. Evidence from LHI and other islands around the world (Towns *et al.* 2006) shows that the ongoing impacts of rodents on native fauna and flora erodes the biodiversity and World Heritage values, and therefore reduces the visitor experience offered by the island – the basis of its tourism industry.

In other locations the impact of invasive rodents on tourism has been acknowledged and is a primary consideration in decisions to eradicate rodents. In the Seychelles, which is a global biodiversity hotspot, the importance of rat eradication to tourism has been recognised (Nevill 2004). Tourism operators on privately owned islands funded eradications with the primary goal of facilitating the reintroduction of endangered bird species thus enhancing their existing tourism operations. Private tourist operators in the Seychelles have continued to embrace the eradication concept. This enthusiasm reflects the realisation that ecotourism is the fastest growing niche market in the tourism industry. Providing near pristine tropical island getaways allows the Seychelles to target the exclusive top-end tourist market.

A survey of island managers where rat eradications have been undertaken showed that ecotourism was the (or one of the) primary motivation(s) behind the activity. Resort owners noted that 'exclusive 5 star tourism and rats don't mix' (Nevill 2004). Tourism operators in the Seychelles promote the efforts made to rid their islands of rodents, and the benefits of doing so—the subsequent proliferation of fauna and flora and the opportunity to re-introduce species previously lost to predation. North, Frégate, Denis, and Bird islands all promote the conservation initiatives conducted on their islands, including reporting on eradications. Island restoration facilitated by rodent eradication has resulted in North Island winning numerous travel awards including nomination as the best travel location on earth.

On Ulva Island in New Zealand, an eradication of rodents was undertaken in 1996. The success of the eradication, and subsequent reintroduction of species lost from the island as a consequence of rat predation, has resulted in the island becoming a premier tourist location. Tourist numbers increased from around 10 000 to 30 000 per year in the decade after rat eradication. This boost in tourism resulting from ecosystem recovery sustains 17 new businesses (A. Roberts, Department of Conservation pers. comm.).

<u>Continuing the Current Control Program</u>

Since ship rats and house mice arrived on LHI, the Lord Howe community has invested considerable resources in trying to keep the populations of both species under control.

Control is quite distinct from eradication. It aims to keep the negative effects within acceptable limits, but its ongoing nature brings with it a constant financial burden. It also brings an increased potential for negative impacts caused by the ongoing presence of poison in the environment.

Since the 1920s numerous methods of control have been tried on LHI including a bounty on rat tails, hunting with dogs, introduction of owls and the use of various poisons including barium chloride, diphacinone, warfarin, and now Brodifacoum and coumatetryl. The prolonged use of warfarin has led to house mice becoming resistant to this poison.

The LHIB currently use an alternative poison to Brodifacoum (Coumatetryl in the product Racumin or Ratex) in a limited control program consisting of bait stations placed throughout the Island's Settlement Area and in some sections of the Permanent Park Preserve for conservation purposes (approximately 10% of the island). The LHIB also supplies Coumatetryl to residents on a pulse baiting schedule (approximately every 6 weeks) to control rats and mice and minimise the use of Brodifacoum in order to reduce the potential build-up of resistance to Brodifacoum. The current rodent control program uses approximately 3 tonnes of Coumatetryl-based bait annually at a cost of around $83,000 per year but neither the rat or mouse population is being reduced to a level that reduces landscape scale ecological impacts.

A range of anticoagulant toxicants including Brodifacoum baits (mostly wax blocks @ 50ppm) is currently used in the settlement area by residents to control rats and mice on their properties and inside dwellings. The LHIB has no control over this. The quantity of commercial rodenticide, (i.e. other than that provided by the Board) used by residents each year on the island is estimated at approximately 400 kg.

The present control baiting program does not adequately protect the island group's native flora and fauna. Widespread control is simply not practical given the large area and rugged terrain. There is also a significant risk that through ongoing control (and the continuous presence of poison baits) the island group's rodent populations will develop bait shyness or a resistance to current rodenticides. Mice have already developed a resistance to warfarin. The suite of second-generation anticoagulants, which includes Brodifacoum, is the only tool currently available for effectively eradicating rodents from islands. Resistance to these poisons, if it develops, will make eradication impossible and will greatly restrict control. Studies just concluded show that within benign laboratory conditions, rats succumb to the bait as expected while mice currently take approximately three weeks (Carlile unpublished data). Ongoing use of poison in the environment also presents a major risk to non-target species including humans, pets and livestock through continued exposure. As such, the effectiveness and long-term sustainability of the existing localised control programme, or an expanded programme, is highly questionable.

<u>The Case for Eradication</u>

The 'do nothing' scenario and continuation of the current control situation on LHI are both considered unacceptable, primarily because they fail to mitigate threats from rodents to threatened species and World Heritage values and will result in further species loss and degradation of values on the LHIG.

Eradication has become a powerful tool to prevent species extinctions and to restore damaged or degraded ecosystems (Towns & Broome 2003). The biodiversity benefits of removing rodents from islands are well recognised.

The eradication techniques proposed for LHI are neither novel nor experimental. They are the culmination of more than 20 years of development and implementation involving more than 300 successful eradications worldwide (Howald *et al.* 2007). Systematic techniques for eradicating rodents from islands were first developed in New Zealand in the 1980s (Moors 1985; Taylor & Thomas 1989; Taylor & Thomas 1993). Since then techniques have improved significantly, and eradications are now being attempted and achieved on increasingly larger and more complex islands, including those with human populations.

Aerial broadcasting of bait using helicopters has become the standard method used in eradications, particularly those on large islands (Towns & Broome 2003). This method has proven to be a more reliable and more cost-effective option than the previous ground based techniques. Depending on the nature of the area to be treated, aerial baiting has been combined with hand broadcasting of bait and the use of bait stations, particularly around areas of human habitation. The use of new tracking and mapping technologies such as global positioning systems and geographic information (computer mapping) systems has increased the efficacy of aerial-based eradication programmes (Lavoie *et al.* 2007).

The majority of successful eradications on large islands have used aerial baiting with Brodifacoum in cereal pellets. Rat eradications on islands over the period 1997- 2014 using this bait and method have been 98% successful (37 of 39 attempts) (DIISE 2015). Whilst attempts at eradicating mice from offshore islands using Brodifacoum have been less successful, with a 49% success rate internationally (MacKay *et al*. 2007), many of these failures can be attributed to inappropriate planning or implementation. The success rate for mouse eradications on NZ islands using Pestoff 20R with 20ppm Brodifacoum (the bait to be used on Lord Howe) aerially applied 1997- 2014 is 100% or 11 from 11 attempts (Broome *et al*, 2016).

The largest island successfully treated this way to date is 12,700ha Macquarie Island in 2011 which saw the successful eradication of ship rats, house mice and rabbits (*Oryctolagus cuniculus).* The island housed 70 people at them time.

Similar operations to that proposed for the LHI Group that have been completed include:

- Campbell Island (11 300 ha) in the New Zealand subantarctic, where Norway rats (*Rattus norvegicus*) were eradicated.
- seven species including ship rats and house mice from Rangitoto and Motutapu Islands, New Zealand (~4 000 ha) in 2009
- four species of rodents, including house mice and ship rats, from several islands in the Bay of Islands, New Zealand (605 ha) in 2009.

These operations offer opportunities to share information on techniques and planning. Not only are the target species similar, the eradication on Rangitoto and Motutapu Islands had a small number of residents and livestock and thousands of daily visitors. The Bay of Islands includes several permanent residents, a full-time tourism operation and numerous day visitors. Macquarie Island, about nine times the size of LHI, is to date the largest island from which house mice and ship rats have been eradicated, either individually or in combination.

After completing a Feasibility Study in 2001, the LHI Board has carefully considered and evaluated the eradication of rats and mice on the LHIG. Due to developments in eradication techniques during the past 20 years, particularly the refinement of aerial baiting methods, the eradication of both rats and mice on the LHI Group in a single operation is now feasible and achievable.

The many successful rodent eradication programmes undertaken on islands around the world have shown that the benefits to humans and native plants and animals are both significant and immediate. Benefits include (see review in Towns *et al.* 2006):

- significant increases of seeds and seedlings of numerous plant species on islands after the eradication of various rodent species
- rapid increases in the number of ground lizards (e.g. geckos, skinks) following removal of rats – including a 30-fold increase in one case
- dramatic increases in the numbers of breeding seabirds and fledging success
- rapid increases in forest birds and invertebrates.

Apart from the benefits to biodiversity, the proposed eradication operation is considered the most appropriate course of action for a range of social, health and financial reasons.

The anticipated benefits specifically relating to a rodent eradication programme on the LHIG include:

- recovery of a range of species an ecological communities directly at risk of extinction due to rodents such as the LHI Placostylus, Little Mountain Palm, Phillip Island Wheat Grass and Gnarled Mossy Cloud Forest
- a marked increase in birds, reptiles and insect density, diversity and distribution – this boost in diversity will increase food resources for predatory terrestrial vertebrates and potentially lead to population increases which will enrich the experience of both island residents and tourists
- increases in the abundance of plants, seeds and seedlings, thereby enhancing the process of forest regeneration
- removal of the economic and environmental burden of the ongoing control currently in place, eliminating the need for the ongoing use of rodent poisons in the environment and their associated long-term risks to native species, pets, livestock and people
- an increase in productivity in the island's kentia palm industry and returns to the local community
- the ability to return species (or closely related surrogates/ecological equivalents) that have long been absent due to the predation of rats and mice, such as the Island gerygone, grey fantail, Boobook Owl, LHI Woodroach and LHI phasmid
- elimination of significant health risks caused by rodents, including a range of viruses, bacteria, internal parasites (such as intestinal worms) and external parasites (such as fleas, mites and lice), many of which can spread disease to humans
- elimination of the inconvenience currently experienced by residents caused by spoiled foodstuffs and rodent excrement – currently, keeping rodents out of dwellings is an ongoing task for the island's residents.
- increased agricultural productivity
- increased tourism by marketing a rodent free World Heritage Area.

Recent advances in rodent eradication techniques and the size and complexity of islands now treated, mean that eradication is now technically feasible on LHI. LHI will be the first island with a significant resident community for which both mice and rats have been targeted for eradication although other similar projects are in the planning phase elsewhere in the world, including 17000 ha Floreana Island in the Galapagos. The presence of a significant human population, associated livestock and two endemic species/subspecies at risk from poisoning, add to the complexity of the task. Notwithstanding, the eradication techniques to be used on LHI are neither novel nor experimental; they are the culmination of more than 30 years of development and implementation involving more than 300 successful eradications worldwide.

Selection of Eradication Methodology

Systematic techniques for eradicating rodents from islands were first developed in New Zealand in the 1980s (Moors 1985; Taylor and Thomas 1989; Taylor and Thomas 1993). Since then techniques have improved, and rodents can now be eradicated from large, geographically and physically challenging and biologically complex islands. Eradication has become a powerful tool to prevent species extinctions and to restore damaged or degraded ecosystems (Towns and Broome 2003). A review of island eradications in 2007 found that rodents had been eradicated from 284 islands, and of 387 invasive rodent campaigns, 332 were reported as successful, 35 failed and 20 did not have a reported outcome (Howald *et al.* 2007). Failures most often occurred with mice, and the speculated causes of failure included technical issues (e.g., inadequate or insufficient bait deployment), failure to follow established protocols, observed or suspected non-target poisoning issues that halted the campaign, lack of funding and public support, and bait competition by terrestrial crabs.

Early attempts at eradicating rodents from islands mainly used traps and bait stations, but as the technology has improved aerial broadcasting of bait using helicopters has become the method of choice (Towns and Broome 2003). The use of new tracking and mapping technology such as Global Positioning Systems (GPS) and Geographic Information Systems (GIS) has increased the efficacy of aerial-based eradication programmes (Lavoie *et al*. 2007). The majority of successful eradications on large islands have used this methodology in combination with the rodenticide Brodifacoum in cereal pellets. The largest island successfully treated this way is Subantarctic Macquarie Island (13000 ha), where rabbits, ship rats and mice were successfully eradicated (Springer 2016).

Prior to 2007 there were 174 reported attempts to eradicate Ship Rats, with a success rate of 92%; and 37 attempts to eradicate mice, with a success rate of 81% (Howald *et al.* 2007). Another review of mouse eradication attempts (MacKay *et al.* 2007) calculated a lower success rate: 62% (28 successes from 47 attempts). Since these reviews were written there have been at least another ten successful operations to eradicate mice.

One of the problems with assessing failure rates for mice eradication attempts is that many operations were undertaken with the primary aim being to eradicate rats, without mice being specifically targeted. Examples include eradication operations on Patiti, Haulashore and Quail islands in New Zealand, where bait stations were used at spacing suitable for rats but larger than desirable for mice. Consequently, mice were not eradicated. These operations are often recorded as failures for mice, although the methodology used was not designed for mice. On the other hand an aerial baiting operation designed to target rabbits on Enderby Island had the unexpected benefit of also eradicating mice (Torr, 2002). On LHI, both rats and mice will be specifically targeted for eradication and the operational methodology planned accordingly.

The reasons for the higher failure rate of mice eradications are unclear, but in the two major reviews of global eradication attempts (Howald *et al.* 2007; MacKay *et al.* 2007) the authors speculate that inadequate bait density on the ground could be a significant factor. Mice typically have smaller home ranges than rats, and therefore they have a lower probability of being exposed to bait that is broadcast relatively sparsely. The solution for bait station operations is to use smaller spacing between stations, no larger than 10 m. Possible solutions for aerial operations are to increase the bait rate (kg/ha) or to use a smaller bait that, when broadcast at the same application rate (kg per ha), provides a greater number of pellets per unit area. However, mice were eradicated from Montague Island in NSW, where small (5.5 mm diameter) and large (10 mm diameter) baits were used on different parts of the island. This operation, undertaken to compare the efficacy of the two bait sizes, demonstrated that both sizes are capable of eradicating mice, provided that there are no gaps in the distribution of bait. On LHI, adequate bait dispersal will be achieved primarily by using aerial broadcasting of large bait pellets at a nominal density of at least one bait every two square metres. In the settlement area, where mice are likely to not range as far, small bait pellets will be hand broadcast at a nominal density of at least one bait every half square metre. Where bait stations are used, these will be set at approximately 10-m spacing.

On Lord Howe Island mice are already totally resistant to warfarin and trials indicate they may also be developing a resistance to Brodifacoum (Wheeler and Carlile, 2013; Carlile unpublished data). The suite of second-generation anticoagulants is the only tool currently available for effectively eradicating rodents from all but the smallest islands. Resistance to these poisons, if it develops, will make eradication impossible for the foreseeable future. Moreover, this could potentially result in a situation where there was no effective way to control rodents on the island, with catastrophic results for biodiversity, tourism and residents.

To minimise the risk of failure of the eradication it is vital to use tried-and-tested techniques that have proven repeatedly to be successful elsewhere. Use of published information, previous experience on other islands, on-site research, close collaboration with international experts, and peer-review will ensure that planning for the eradication of rodents on LHI is based on current best-practice techniques taking in to account the local situation.

A variety of techniques involving the use of traps and or toxicants have been used to eradicate rodents from islands. Most recent operations worldwide (and in New Zealand and Australia in particular) have used baits containing one of the second generation anticoagulants, principally Brodifacoum; although others such as floucoumafen and bromadiolone have also been used successfully. Diphacinone, a first-generation anticoagulant, has also been used.

The earliest eradications using toxicants utilised a network of bait stations, but this technique is very costly, time consuming and generally impractical for anything other than small islands (<100 ha) especially for mice. The exclusive use of Bait Stations on LHI is not possible given size and the rugged terrain. A far more cost-effective option is to spread bait aerially using a helicopter. Consequently, this approach has become the standard technique for most rodent eradications. Depending on the nature of the area to be baited, aerial baiting may need to be combined with hand broadcasting of bait or bait stations, particularly around areas of human habitation.

Hand broadcasting of bait and the use of bait stations are extremely resource intensive and hand broadcasting has a greater risk of gaps in coverage. Bait stations are problematic due to the density of stations required, especially for mice, and issues with interspecific and intraspecific competition, i.e. both mice and rats can be prevented from entering bait stations by dominant individuals of the same or other species, as well as quality of implementation. On LHI, rats may exclude mice from entering bait stations. This type of behaviour can put eradication operations at risk by violating a fundamental pre-requisite that all target animals are exposed to the poison. This means that in order to maximise cost-efficiency and minimise the risk of failure these methods tend to be used over the minimum area possible. The exclusive use of Bait Stations or traps on LHI is not possible given the size and rugged terrain.

A range of possible methods and mortality agents were considered for use in eradicating both rats and mice on LHI (Table 3). The only method capable of removing every rat and mouse on LHI is aerial distribution, in conjunction with minimal hand broadcast and bait stations where required, of highly palatable bait containing an effective toxicant. Brodifacoum is the preferred toxicant because it is has been well tested and proven successful in numerous rodent eradication projects throughout the world. An evaluation of potential rodenticides for aerial control of rodents (Eason and Ogilvie 2009) concluded that Brodifacoum was the best rodenticide for island eradications. The use of any other mortality agent would be largely experimental and pose unacceptable risks of failure. The *Island Eradication Advisory Group* for the Department of Conservation in New Zealand who are recognised as leaders in this field, is of the opinion that "*there is no other alternative rodenticide on the market anywhere in the world with which we would have the same level of confidence in using to eradicate Ship Rats and mice from an island such as Lord Howe*".

Selection of Toxicant - Mortality Agents Assessed as Unsuitable
A number of other rodenticides have been used for rodent eradications in the past. While effective at control measures, many are unsuitable for the eradication program planned for LHI due to a range of issues including safety concerns, rodent avoidance or incomplete product development.

Cholecalciferol
A form of vitamin D is an acute poison that to date has been used in at least three eradications, but all involved small islands and, in each case, baiting was supplemented with anticoagulants. Cholecalciferol is less toxic to birds than Brodifacoum, but it is highly toxic to mammals, and treatment of poisoning is difficult. More importantly, there is evidence that mice can detect the poison in baits and will avoid it. This bait avoidance, while not critical in a control operation, would place an eradication programme at risk of failure.

Sodium monofluoroacetate
Commonly known as 1080, is an acute poison which can be detected by some rodents especially mice and is prone to promoting bait shyness making it unsuitable for eradication. There is also no known antidote.

Zinc phosphide
Is an acute poison that is used to control plague mice in cereal crops. Although there is little risk of secondary poisoning, this compound is a broad spectrum poison that is more toxic to birds than it is to rodents. The high risk of direct poisoning of non-target species and the risk of bait avoidance precludes its use on LHI.

Other agents
Some research has been conducted into developing toxicants that are specific to rats and mice, but these have proven not to be technically feasible at this time. Even if a new rodent specific toxicant is developed it will take many years to test and trial it to ensure it is suitable for eradications and is suitable to be used on an island the size of Lord Howe.

Similarly, long-term research to develop a mouse-specific mortality agent has been largely abandoned both in Australia and overseas. Work over the past two decades focussed on the development of a virally-vectored immuno-contraceptive agent which would be transmitted between mice, rendering females sterile. To be effective, this type of mortality agent requires ready transmission between individuals, but researchers were unable to resolve the problem of attenuation of the virus when spreading among wild mice. This attenuation ultimately halts the spread of the virus among the population. While developing an eradication tool capable of killing 100% of individuals was never a goal of the research programme, even broad-scale control is now considered unlikely. This conclusion led to the programme being abandoned.

Another rodenticide (named ***Eradibait***®) works by physically blocking water absorption in the gut of rats and mice. It is a type of cellulose that coats the fine hairs (villi) in the lower gut, disrupting messages to the rodent's brain causing it to stop drinking. This leads to dehydration, blood thickening, kidney dysfunction, coma and eventual death. The bait contains no toxicant; consequently there are no secondary-poisoning issues. Unfortunately, while the product has been used for control on farms it has never been used in eradication. Recent research conducted in New Zealand indicates that the bait has low palatability to rodents, and they will only consume it when no other food source is available. This makes it unsuitable for use in eradication, where every animal must consume a lethal dose.

Para-aminopropiophenone
(PAPP) is currently being developed for the control of feral cats, foxes and wild dogs. The need to encapsulate the poison has added considerably to the task. Trials show that PAPP does not kill rodents. It is possible that an analogue of PAPP could be developed as a rodenticide sometime in the future (Eason *et al*. 2009), but its potential effects on non-targets and its suitability for eradication are all unknown.

Anticoagulants
Anticoagulants act by effectively blocking the vitamin-K cycle, resulting in an inability to produce essential blood-clotting factors. A range of anticoagulant rodenticides are available which could potentially be utilised in an eradication operation on the LHIG. Anticoagulants are classified as either first-generation or second-generation. First-generation anticoagulants such as warfarin, diphacinone, pindone and coumatetralyl are generally of low toxicity but require a high concentration and multiple feeds over several of days to be effective (Hone and Mulligan 1982). The need for rodents to ingest large quantities of the bait to obtain a lethal dose of the poison increases the risk of failure in eradication. Second-generation anticoagulants including Brodifacoum, bromadiolone and difethiolone are more toxic, require lower concentrations and only a single feed to kill rodents and are thus preferred for use in eradications. However they do present a greater non-target risk.

Sterilisation
The possibility of using a new rodent sterilisation technology called "Contrapest", developed by SenesTech Ltd was considered with the following issues identified:

- The product is not currently registered in any country. While SenesTech hope to have it registered in the USA next year it is likely to be some time before it is registered in Australia.
- The product, Contrapest, aims to *reduce* rat populations through sterilisation, by reducing fecundity but leaving some animals to defend territories i.e. ongoing **control not eradication**.
- It requires every female to be dosed with the product i.e. it needs to be regularly dispensed as there is no inherited or contagious transmission of the reduced fertility.
- The fertility control compounds (VCD and Triptolide) are not species-specific and could affect other mammals including humans.
- Currently the product is designed for rats although the developers state that it has the potential to be modified to target mice, along with other species, although dispensing the appropriate dosage is problematic at this stage.

The product is not suitable for the rodent eradication program on LHI as:

- The product is aimed at *reducing rat* numbers not eradicating them.
- The product needs to be ingested over a prolonged period (approx. 75 days) and all female rats would need to be exposed to the product. This would effectively mean that the product would need to be put out continually for the foreseeable future.
- While reducing rat numbers would have some benefits, only total eradication of rats and mice will give the anticipated ecological, social, economic and human health benefits.
- The product is currently dispensed by adding it to water. This is problematic for LHI as dispensers would need to be put over the whole island at approximately the same spacing as bait stations. The product needs to be consumed over many feeds as it affects the reproductive system slowly meaning that the bait would need to be made available in every territory for a prolonged period to affect even one generation of rats.
- Even if the product was used on the accessible areas and was able to reduce numbers, this would only be short term while the product was being dispensed. Also, rodents from the untreated areas would soon move in as resources, food and territory were freed up.
- The current product Contrapest is only for rats which would leave mice untreated.

- This product has been investigated for both the LHI program and by other rodent eradication organisations internationally and it is not currently considered a feasible option for rodent eradication in the foreseeable future.
- The currently planned technique using Brodifacoum is proven on over 300 islands while any use of Contrapest would be experimental, truly making LHI a guinea pig.

Selection of the Preferred Toxicant

A critical component in any eradication is the choice of toxicant. The toxicant selected for the eradication of rats and mice from the LHIG is Brodifacoum, a second-generation anticoagulant. Mice on LHI are known to be resistant to warfarin, so there is a risk that other first generation anticoagulants such as diphacinone may also be ineffective on mice. Second-generation anticoagulants were developed specifically for use in situations where rodents had developed resistance to first- generation anticoagulants.

The second-generation anticoagulants floucoumafen and bromadiolone have both been used in eradications, but (i) the relative lack of information on the environmental effects of these poisons, (ii) uncertainty about their efficacy in such operations, as they have only had limited use (iii) the fact that they offer no appreciable advantages over Brodifacoum and (iv) there has been limited trials and field work done on these toxicants mean that they are not suitable for this project.

Like all anticoagulants, Brodifacoum disrupts the formation of blood-clotting factors. Death through internal haemorrhaging typically takes 3–10 days (Torr 2002), with mice sometimes taking longer to die than rats (Fisher 2005) and recently on LHI, to be up to two weeks longer than rats (Carlile unpublished data).

Characteristics supporting the use of Brodifacoum in the operation on LHI include:

- Brodifacoum has proven to be successful in over 226 eradications including all 14 eradications on islands greater than 500 ha in size.
- Brodifacoum has proven to be successful in a variety of climatic conditions including those similar to LHI.
- Brodifacoum is highly toxic to both rats and mice in minute quantities, allowing a lethal dose to be consumed in a single feed, thus avoiding the consumption of sub-lethal doses and the associated risk of bait shyness/avoidance.
- Brodifacoum is a chronic toxicant i.e. its action is delayed meaning the rodent does not associate any illness with the bait it has consumed, thus avoiding the consumption of sub-lethal doses and the associated risk of bait shyness/avoidance.
- Both target species are highly susceptible to Brodifacoum, simplifying logistics and maximising cost-effectiveness.
- When contained in Pestoff® 20R bait formulation, Brodifacoum is highly palatable to both species, as confirmed by field trials on LHI.
- Brodifacoum is highly insoluble in water, and its propensity to bind to soil particles prevents its leaching into the substrate on which it is spread. Consequently, contamination of waterways and runoff into the marine environment are negligible, and it is less likely than other poisons to accumulate in either aquatic systems or plant material (Toxikos 2010); Ogilvie *et al*. 1997)
- The half-life of Brodifacoum in the soil is reasonably short: 12–25 weeks depending on soil type and conditions.
- The non-target effects of Brodifacoum are well understood enabling planning to mitigate or minimise any non-target impacts.
- Although toxic to livestock, pets and humans if consumed, an antidote is readily available.

All second-generation anticoagulants are more toxic than the first-generation anticoagulants; consequently they have a greater potential to kill non-target species that consume bait. Also, second-generation anticoagulants persist longer in the tissues of those vertebrate animals that ingest bait; the estimated half-life of Brodifacoum in rat tissue is estimated to be 150 to 200 days (Erickson and Urban 2004), therefore, there is a greater risk of secondary poisoning. Although generally not toxic to invertebrates, anticoagulants can be ingested by some invertebrates (Spurr and Drew 1999) which may then be eaten by non-target species. Thus, the use of second-generation anticoagulants poses more of a risk than does the use of first-generation anticoagulants, but actions, as discussed elsewhere in this application can be taken to effectively mitigate or limit these risks. Acute toxicity of Brodifacoum to rats and mice is shown below in Table 2. Assessment of suitability of other toxicants is considered in Table 3.

Table 2: ACUTE ORAL TOXICITY (LD50 Mg/Kg) OF BRODIFACOUM TO THE TARGET PESTS (from Broome *et al* 2016).

SPECIES	LD50 VALUE (mg kg -1)	REFERENCES
House mouse House mouse (caught from wild) House mouse (wild caught from Gough Island)	0.4 (95%CL 0.30 – 0.63) 0.52 0.44	Redfern *et al* (1976) O'Connor and Booth (2001) Cuthbert *et al*. (2011)
Ship rat *Male*	0.73	Dubock & Kaukeinen (1978)
Female	0.65	Dubock & Kaukeinen (1978)
Ship rat (caught from wild)	0.46	O'Connor and Booth (2001))

Table 3. Suitability of potential toxicants for the eradication of rats and mice

FGAC, first generation anticoagulant; SGAC, second generation anticoagulant; na, not applicable.

Mortality agent	Type	Palatability	Probability of killing all targeted individuals	Availability of manufactured formulations	Target specificity	Environmental persistence	Likelihood to induce aversion	Antidote available	Number of successful eradications
Cholecalciferol	Acute toxin	High	Low	High	High	Low	High	Yes	Low
Sodium monofluoroacetate	Acute toxin	High	Low	High	Low	Low	High	No	Low
Zinc phosphide	Acute toxin	High	Low	High	Low	Low	High	No	None
Rat-specific toxin	Acute toxin	Na	Low	Not available	High	Low	Low	na	None
Cellulose compound	Acute toxin	Low	Low	High	High	Low	High	na	None
PAPP	Acute toxin	Low	Low	Not available	?	?	?	Yes	None
Mouse-specific virus	Immuno-contraceptive	Na	Low	Not available	High	Low	Low	na	None
Diphacinone	FGAC	High	Low	High	Low	Low	Low	Yes	Low
Pindone	FGAC	High	Low	Low	Low	Low	Low	Yes	Low
Coumatetralyl	FGAC	High	Low	Low	Low	Low	Low	Yes	Low
Floucoumafen	SGAC	High	High	Low	Low	High	Low	Yes	Low
Bromadiolone	SGAC	High	High	Low	Low	High	Low	Yes	Low
Brodifacoum	SGAC	High	High	High	Low	High	Low	Yes	High

Selection of the Preferred Bait
The selected bait is Pestoff® 20R manufactured by Animal Control Products, Wanganui, New Zealand. In New Zealand, Pestoff® 20R is registered in New Zealand for aerial and hand broadcasting in operations to eradicate rodents from non-stocked off-shore islands as well as fenced enclosures (mainland islands). In Australia the Australian Pesticides and Veterinary Medicines Authority has previously approved the aerial dispersal of Pestoff® 20R on several islands in New South Wales (i.e. Montague Is), Western Australia (Hermite Is) and Tasmania (Macquarie Is). The Brodifacoum that the manufacturer of Pestoff 20R uses is currently registered for use in Australia under **Product No.: 56139**

Pestoff® 20R is a cereal-based pellet dyed emerald green to reduce its attractiveness to birds (Brown *et al.* 2006). Pestoff® 20R is produced to rigorous specifications so as to be hard enough to withstand being applied through a mechanical spreader with minimal fragmentation, and to have minimal dust residue. A trial using non-toxic bait pellets was undertaken on LHI during August 2007, and this confirmed that the baits were highly palatable to both rats and mice, and readily eaten by both species (LHIB, 2007) (in Attachment 6). Trials on LHI found that baits disintegrated completely after approximately 100 days although this is highly dependent upon precipitation and humidity.

Appreciating that it is written for the situation in New Zealand, the baiting operation will comply with the relevant conditions of the Code of Practice for Aerial and Hand Broadcast Application of Pestoff® Rodent Bait 20R for the Intended Eradication of Rodents from Specified Areas of New Zealand. (Animal Control Products, 2006). This document is designed to achieve

- The safe utilisation of Pestoff® Rodent Bait 20R to enhance the long term survival of threatened biota or for other ecological or commercial reasons that may develop in the future.
- The containment of Brodifacoum following aerial and / or hand broadcast application of PestOff® Rodent Bait 20R within the operational boundaries of any Specified Area.
- Brodifacoum residues in meat or food products sourced from livestock farmed on land either inside the operational area or adjoining any Specified Area as a result of the aerial and / or hand broadcast application of Pestoff® Rodent Bait 20R comply with the regulatory thresholds (see NZFSA website for these prescribed limits).
- The potential for any health risk to humans, arising as a result of the aerial or hand broadcast of Pestoff® Rodent Bait 20R, is eliminated.

The cereal seed used as the base in the bait manufacture is ground to flour, screened to 1.5 mm (smaller than cereal seed) and heated, thereby denaturing the proteins required for germination. There is, therefore, no risk posed by weed invasion by using this particular bait. The amount of poison (Brodifacoum) in each bait is 20 parts per million (0.002%), much less than that present in commercial Talon® (50 parts per million), a bait readily available to purchase and currently used by the residents on Lord Howe Island. Pestoff® Rodent Bait 20R pellet product breaks down more quickly than most commercial rodenticides which tend to contain waxes and other compounds aimed at extending bait life in the field. This would extend unacceptably, the period of non-target risk. The more rapid physical bait breakdown rate for Pestoff® Rodent Bait 20R and its lower toxicity provide an effective compromise between maintaining target animal efficacy and reducing non-target risk

Typically, 10-mm diameter bait is used for eradications targeting rats. The most appropriate size bait to target mice is less certain. In light of suggestions that some failed attempts at mouse eradication may have resulted from inadequate density of bait (pellets per unit area), both 10mm and 5mm diameter bait was tested for eradicating mice by applying each size to different sections of Montague Island for efficacy. On average, each 5.5-mm pellet weighs approximately 0.6 g, whereas each 10-mm pellet weighs approximately 2 g. Thus, for the same application rate (kg per ha), use of the smaller bait resulted in four times the number of pellets on the ground. This increased the encounter rate for mice, improving the chances that all individuals had access to bait. Brodifacoum is highly toxic to mice (LD_{50} is approximately 0.4 mg/kg), so each individual mouse need consume only a single 5.5-mm bait to ingest a lethal dose of poison. Results from the eradication of mice from Montague Island demonstrated that mice could be successfully eradicated using bait of either 10-mm or 5.5-mm diameter.

Given that the most difficult component of the eradication will be removing mice from the settlement where alternative foods may be more readily available, a high-encounter rate is preferable. On the other hand, the practical advantages of 10-mm baits over 5.5-mm baits are:

- They have been used through aerial sowing buckets in large quantities without problems.
- The pilot can see baits being spread which can be an advantage sowing up to exclusion zones or sensitive boundaries.
- It is much more feasible to retrieve the larger baits that may be accidentally over-sown into exclusion zones.
- In contrast 5.5 baits breakdown faster in the environment and are less easily seen than the 10mm bait which means that they are likely to pose a lower risk to children and pets i.e. it is harder for children and pets to locate them so this bait size will be used around the settlement.

In a non-toxic bait trial conducted on Lord Howe Island in 2007 to asses bait uptake, both small (5.5 mm) and large (10 mm) Pestoff® 20R baits were shown to be palatable to rats and mice (LHIB, 2007) (in Attachment 6). Consequently, large baits are recommended for aerial operations and small baits for hand broadcasting where it is critical to increase bait encounter rates for mice (LHIB 2007). It is believed that the benefits of using two bait sizes justify the added complexity of the operation.

As a precaution against ingestion by humans, most commercial rodenticides contain a compound known as Bitrex® which is extremely bitter and highly distasteful to humans. There are indications that this additive may cause bait aversion in some rodents and this may have contributed to the failure of several operations targeting mice and rats. Consequently, Bitrex® along with any other related additive will not be incorporated into baits used in the eradication on LHI.

The amount of Pestoff 20R bait rats and mice need to consume to result in death is shown below in Table 4.

Table 4: AMOUNT OF BAIT A TARGET PEST NEEDS TO INGEST TO RESULT IN DEATH BASED ON HIGHEST LD50 mg/kg.

SPECIES	LD50 (mg/kg)	AVERAGE WEIGHT FEMALE (g)	AMOUNT (grams) OF 0.02 g/kg BRODIFACOUM BAIT FOR LD50
House Mouse	0.52	20	0.5
Ship Rat	0.73	160	5.8

Efficacy Trials

An efficacy trial using Pestoff 20R undertaken on Lord Howe Island in 2013 indicated that the susceptibility of rats to Brodifacoum was in line with that for the species as a whole (Wheeler and Carlile, 2013) (see Attachment 6). That is, judging by the results of this trial, all the rats on LHI are susceptible to low levels of Brodifacoum and could consume a lethal dose in one day, but may require four or five meals to do so. The typical mouse on Lord Howe Island could consume a lethal dose in one day, requiring up to nine meals to do so. A second mouse toxicity trial undertaken in 2016 (unpublished data) showed that, while there is a wide range in the time until death following ingestion of Pestoff 20R, the poison will kill Lord Howe Island mice when the bait is provided in a manner that is consistent with field conditions. Efficacy is further considered by the Australian Pesticides and Veterinary Medicines Authority in their assessment of a Minor Use Permit application that has been lodged for the LHI REP.

2.3 Alternative locations, time frames or activities that form part of the referred action

If you have identified that the proposed action includes alternative time frames, locations or activities (in section 1.10) you must complete this section. Describe any alternatives related to the physical location of the action, time frames within which the action is to be taken and alternative methods or activities for undertaking the action. For each alternative location, time frame or activity identified, you must also complete (where relevant) the details in sections 1.2-1.9, 2.4-2.7, 3.3 and 4. Please note, if the action that you propose to take is determined to be a controlled action, any alternative locations, time frames or activities that are identified here may be subject to environmental assessment and a decision on whether to approve the alternative.

Alternative locations were not considered.

Alternative activities (eradication method, toxin choice and bait choice) considered but not chosen were described in the previous section.

The baiting is planned to occur in winter (June - August) of 2017 but may extend into September if there are problems such as unfavourable weather conditions. June- August is preferred because this is the time of the year when the rodents are at their most vulnerable due to the relatively low abundance of natural food. Many of the seabird species are also absent from the island at this time of years. This is also the low season for tourists on LHI. The operation will take place in a single year sometime between 2017 and 2019. Uncertainty remains concerning the year because there are a number of approvals that have not yet been obtained.

2.4 Context, planning framework and state/local government requirements

Explain the context in which the action is proposed, including any relevant planning framework at the state and/or local government level (e.g. within scope of a management plan, planning initiative or policy framework). Describe any Commonwealth or state legislation or policies under which approvals are required or will be considered against.

The proposed REP is supported by a range of international, national and state laws, policies and strategic planning documents that effectively provides strong evidence for both NSW and Commonwealth governments to support the eradication of exotic rodents from LHI. The eradication of rodents from LHI is recommended or supported by the following documents:

- Strategic Plan for the Lord Howe Island Group World Heritage Property (LHIB, 2010b).
- Biodiversity Management Plan for Lord Howe Island (DECC, 2007). This document serves as the Recovery Plan for many species.
- Lord Howe Island Permanent Park Preserve Plan of Management (LHIB, 2010a).
- Commonwealth Listing Advice on Predation by exotic rats on Australian offshore islands of less than 1000 km2 (100,000 ha) Threatened Species Scientific Committee (TSSC) (2006a)

- Threat Abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares (DEWHA, 2009)
- Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island (2000): a key threatening process listed under the NSW Threatened Species Conservation Act 1995.
- Recovery Plan for the Lord Howe Woodhen (*Gallirallus sylvestris*) (NSW NPWS, 2002)
- Recovery Plan for the Lord Howe Placostylus (NSW NPWS, 2001).
- Marine Bioregional Plan for the Temperate East Marine Region (DSEWPaC, 2012)

The eradication of rodents from LHI is consistent with the:

- Australian Pest Animal Strategy – A national strategy for the management of vertebrate pest animals in Australia. Natural Resource Management Ministerial Council (DEWR, 2007).
- Australia's Biodiversity Conservation Strategy 2010-2030 (NRMMC, 2010).

In addition to the EPBC Act referral, a number of other regulatory approvals and permits will need to be obtained prior to commencement of the operation including:

- A "Minor Use Permit" from the Australian Pesticides and Veterinary Medicine Authority (APVMA) for use of the toxin
- Civil Aviation Safety Authority approval for flight operations
- NSW Department of Planning and Environment approval under the *Environment Planning and Assessment Act* 1979 and associated approvals from various concurrence agencies including:
    - Part 4 Assessment for construction of the Captive Management facility
    - A Species Impact Statement and Threatened Species Licence under Section 91 of the NSW *Threatened Species Conservation Act* 1995
    - NSW Environmental Protection Agency - permissions to aerially bait within 150 m of dwellings and public places required under the NSW *Pesticides Act 1999*
    - NSW Dept of Primary Industries (Marine Parks and Fisheries) - assessment under Division 2 of the *Marine Estate Management Act 2014* and *Fisheries Act 1994*

2.5 Environmental impact assessments under Commonwealth, state or territory legislation

If you have identified that the proposed action will be or has been subject to a state or territory environmental impact statement (in section 1.11) you must complete this section. Describe any environmental assessment of the relevant impacts of the project that has been, is being, or will be carried out under state or territory legislation. Specify the type and nature of the assessment, the relevant legislation and the current status of any assessments or approvals. Where possible, provide contact details for the state/territory assessment contact officer.
Describe or summarise any public consultation undertaken, or to be undertaken, during the assessment. Attach copies of relevant assessment documentation and outcomes of public consultations (if available).

Australian Government

Approval from the Australian Pesticides and Veterinary Medicine Authority in the form of a "Minor Use Permit" for use of the toxin for the LHI REP is required under the *Agricultural and Veterinary Chemicals Code Act 1994.* As the active constituent (Brodifacoum) is registered for use in Australia by the APVMA and therefore has established regulatory standards, a Limited Level Environmental Assessment is applicable. The Limited Level Environmental Assessment considers fate in the environment (soil, air and water) environmental toxicology, bioaccumulation and potential impacts to all species present. The application also included a Work Health and Safety Module and a Safety and Efficacy Module that included impact to Human Health. The application for a Minor Use Permit was submitted in April 2016 and assessment is expected to take approximately nine months. Public Exhibition and Consultation is not required by the APVMA for a Minor Use Permit, however the LHIB has made the application package available to the LHI community post submission. Community feedback received over several years was addressed in the application package.

Primary contact is Karl Adamson, A/ Director Minor Use
karl.adamson@apvma.gov.au
P: +61 2 6210 4831 | F: +61 2 6210 4776 | M: +61 (0)4 2353 6049

NSW Government

Statutory environmental impact assessment will be undertaken as follows:

- Assessment under Part 4 of the NSW Environment Planning and Assessment Act 1979 for construction of the Captive Management facility. This will be assessed via a Development Application with a statutory public notification and comment period. The LHIB will be the consent authority. Note: A Species Impact Statement and Threatened Species License under Section 91 of the NSW Threatened Species Conservation Act 1995

- NSW Environmental Protection Agency - permissions to aerially bait within 150 m of dwellings and public places required under the NSW Pesticides Act 1999

- NSW Dept of Primary Industries (Marine Parks and Fisheries) - assessment under Division 2 of the NSW *Marine Estate Management Act 2014* and *Fisheries Act 1994*

In addition, given the broad public interest in the proposal, a non-statutory Environmental Assessment will be prepared and made publicly available. That document will assist the community to understand the overall purpose of the proposal, the range of approvals required (as above), and enable social and economic factors to be identified and considered.

Advice received from the NSW Office of Environment and Heritage is that the NSW Assessment Bilateral Agreement would not apply to the Part 4 Assessment

NSW Approvals primary contact is:
Dimitri Young, Senior Team Leader Planning, North East Region
Regional Operations Group
Office of Environment and Heritage
T: 02 6659 8272

Local Government
The Lord Howe Island Board has the status of a local government authority, and a consent authority under the Environmental Planning & Assessment Act 1979. The Development Application for the captive management facility will be assessed under the Lord Howe Island Local Environmental Plan 2010. These assessments will consider and address statutory requirements and will include a comprehensive assessment of the impacts, risks and proposed mitigation of the eradication program relevant to each agency's jurisdiction.

Relevant Contact is:
Dave Kelly, Manager Environment and Community Development
Lord Howe Island Board
P.O. Box 5, LHI, 2898. Telephone 02 6563 2066.

2.6 Public consultation (including with Indigenous stakeholders)

Your referral must include a description of any public consultation that has been, or is being, undertaken. Where Indigenous stakeholders are likely to be affected by your proposed action, your referral should describe any consultations undertaken with Indigenous stakeholders. Identify the relevant stakeholders and the status of consultations at the time of the referral. Where appropriate include copies of documents recording the outcomes of any consultations.

There are no indigenous stakeholders on LHI.

Island residents and the Board have been involved in the control of rodents (rats and mice) on Lord Howe Island since about 1920.

In 2001, the Board commissioned a feasibility study that looked at a long-term solution to the problem, through a program of total eradication. Between 2004 and 2007 the LHIB undertook further investigation and consultation, including looking at the benefits of eradication to the Kentia Palm industry, as well the benefits and risks to the natural environment. These studies led to a Draft Eradication Plan that was prepared in 2009 (LHIB, 2009). The 2009 Plan was sent for extensive expert and peer review by the following:

- the New Zealand Department of Conservation's Island Eradication Advisory Group
- Invasive Species Specialist Group of the Species Survival Commission of the World Conservation Union (IUCN)
- Worldwide Fund for Nature, Australia
- Birds Australia
- Landcare Research, New Zealand
- CSIRO
- Professor Tim Flannery.

The 2009 Eradication Plan was then put on public exhibition between 30 October and 27 November 2009. Numerous submissions on the plan were received. A final plan will be developed addressing comments and considering relevant approvals conditions.

This eradication program has subsequently received significant funding from the New South Wales Government's Environment Trust and the Australia Government's Caring for Our Country Program in 2012.

As part of proceeding with the implementation of the project, the eradication plan and a Human Health Risk Assessment (Toxikos, 2010) was presented to the community by the Board with the assistance of consultants "Make Stuff Happen", in 2013. The consultation on the draft plan identified strong views both for and against the removal of rodents, and in particular, the specific eradication program presented involving the use of Brodifacoum and aerial distribution.

In recognition of the differing views within the community, the Board decided in early 2014 to put the proposed eradication on hold, and to go back to the community and to discuss with the community what options are available.

Between July 2014 and February 2015, Elton Consulting undertook a series of community consultation visits to Lord Howe Island. They spoke on a one-on-one basis, through personal visits or open sessions at the public hall, to many Island residents, (many multiple times) concerning the issue of rodent control and potential eradication on the Island. They implemented an incremental approach to consultation to unpack the complexity of the community response to the previous rodent eradication process, and to identify what it would take for the community to actively engage in the evaluation of alternatives and options, with the aim to obtain community support or endorsement of any one particular approach.

A Community Working Group was established, based on residents who indicated a willingness to participate, along with an open call for nomination/ involvement, put out through a newsletter to community residents. In working towards a solution, the working group identified many issues (particularly regarding human health, potential impacts to business and tourism and potential impact to the environment) and considered a range of options. The option to "do nothing" was generally not considered an alternative, as there was broad agreement that rats and mice are a problem, and that Lord Howe Island would be better off with no rodents.

Two scenarios were therefore further investigated and discussed, these being:

1. Ongoing management through the existing baiting program, and the potential to expand this.
2. An eradication program as previously proposed or modified where possible to address Island residents' concerns.

It was agreed to develop and implement a community survey to test community support for these scenarios, whilst recognising that many of the community concerns with the proposed eradication could be addressed during the Planning and Approvals Phase. It was agreed that an additional independent Human Health Risk Assessment was needed and should also be progressed.

In May of 2015, an options paper (see Attachment 4.1) was disseminated to all people registered on the electoral roll for Lord Howe Island, together with an anonymous survey to allow the community to choose between:

- Option 1 - Retain and expand the current management program
- Option 2 - moving to the planning and approvals stage of an eradication program.

A total of 212 respondents (71% of the 299 people on the electoral roll) participated in the survey. 208 survey responses were received before the closing time. An overwhelming majority of respondents agreed (38%) or strongly agreed (53%) that the rodent problem on Lord Howe Island needs to be addressed. A small majority (52%) of all respondents expressed a preference for Option 2 whilst 48% of respondents expressed a preference for Option 1 - Retain and expand the current management program.

In line with the agreed Process for Resolution (Figure 6), the LHI Board responded to the majority view and on 19 May 2015 made the decision to proceed to the Planning and Approvals Phase. The final decision by the Board, along with the Funding Bodies, to proceed with the eradication or not will be informed by the technical, social and financial feasibility. This will include the status of approvals, level of community support and recommendations from and additional Independent Human Health Risk Assessment.

As an outcome of the consultation with the community, the Board developed and committed to an agreed process for resolution on the Project as shown below in Figure 6.

Process for Resolution

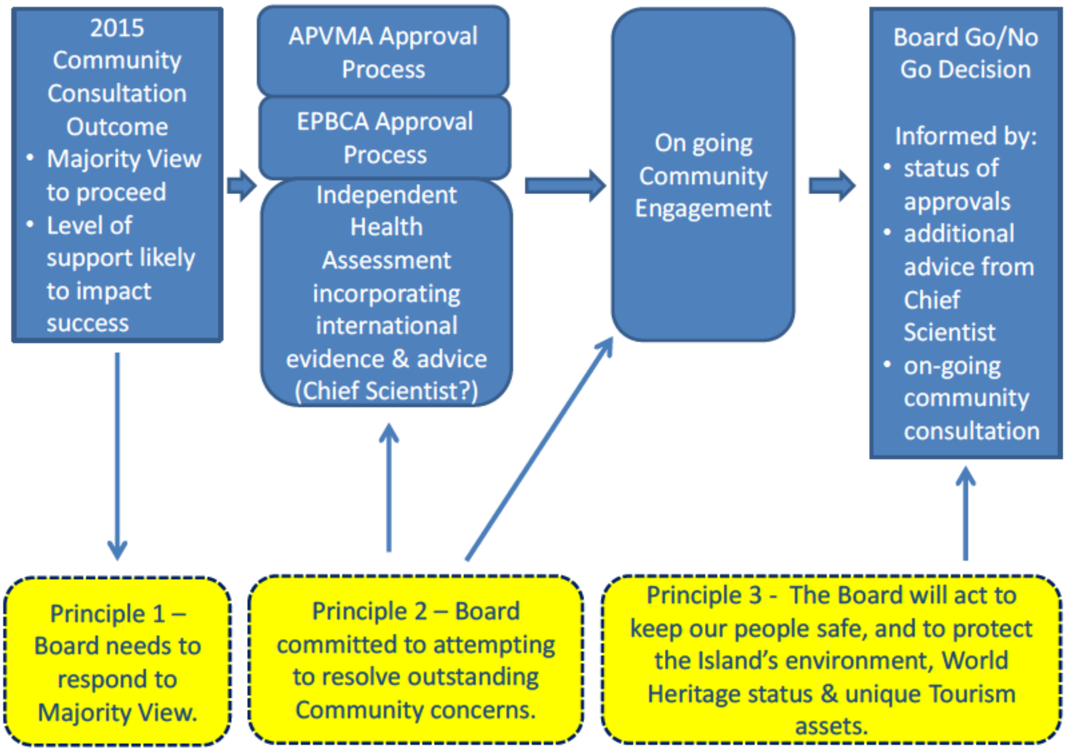

Figure 6: Agreed Process for Resolution

The Community Working Group has been re-activated and meets monthly to discuss project progress and community concerns. Minutes of the meetings are publicly available through the LHIB website. An updated Communication and Engagement Plan has been developed for the project and is attached to this submission (see Attachment 4.2).

The community will be notified of this referral through a newsletter to every householder, email to CWG representatives and a notice in the *Australian* newspaper. Draft copies of these are included in Attachment 4.

2.7 A staged development or component of a larger project

If you have identified that the proposed action is a component of a larger action (in section 1.12) you must complete this section. Provide information about the larger action and details of any interdependency between the stages/components and the larger action. You may also provide justification as to why you believe it is reasonable for the referred action to be considered separately from the larger proposal (e.g. the referred action is 'stand-alone' and viable in its own right, there are separate responsibilities for component actions or approvals have been split in a similar way at the state or local government levels).

N/A

3 Description of environment & likely impacts

3.1 Matters of national environmental significance

Describe the affected area and the likely impacts of the proposal, emphasising the relevant matters protected by the EPBC Act. Refer to relevant maps as appropriate. The interactive map tool can help determine whether matters of national environmental significance or other matters protected by the EPBC Act are likely to occur in your area of interest.

Your assessment of likely impacts should refer to the following resources (available from the Department's web site):

- specific values of individual World Heritage properties and National Heritage places and the ecological character of Ramsar wetlands;
- profiles of relevant species/communities (where available), that will assist in the identification of whether there is likely to be a significant impact on them if the proposal proceeds;
- *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*; and
- associated sectoral and species policy statements available on the web site, as relevant.

Your assessment of likely impacts should consider whether a bioregional plan is relevant to your proposal. The Minister has prepared four marine bioregional plans (MBP) in accordance with section 176. It is likely that the MBP's will be more commonly relevant where listed threatened species, listed migratory species or a Commonwealth marine area is considered.

Note that even if your proposal will not be taken in a World Heritage area, Ramsar wetland, Commonwealth marine area, the Great Barrier Reef Marine Park or on Commonwealth land, it could still impact upon these areas (for example, through downstream impacts). Consideration of likely impacts should include both direct and indirect impacts.

3.1 (a) World Heritage Properties

Description

The Lord Howe Island Group was inscribed on the World Heritage List in 1982. The Statement of Outstanding Universal Value (UNESCO, 2016) is presented below. The LHIG World Heritage property boundary is shown in Attachment 1.2.

"*Brief synthesis*

*The Lord Howe Island Group is an outstanding example of oceanic islands of volcanic origin containing a unique biota of plants and animals, as well as the world's most southerly true coral reef. It is an area of spectacular and scenic landscapes encapsulated within a small land area, and provides important breeding grounds for colonies of seabirds as well as significant natural habitat for the conservation of threatened species. Iconic species include endemics such as the flightless Lord Howe Woodhen (*Gallirallis sylvestris*), once regarded as one of the rarest birds in the world, and the Lord Howe Island Phasmid (*Dryococelus australis*), the world's largest stick insect that was feared extinct until its rediscovery on Balls Pyramid.*

About 75% of the terrestrial part of the property is managed as a Permanent Park Preserve, consisting of the northern and southern mountains of Lord Howe Island itself, plus the Admiralty Islands, Mutton Bird Islands, Balls Pyramid and surrounding islets. The property is located in the Tasman Sea, approximately 570 kilometres east of Port Macquarie. The entire property including the marine area and associated coral reefs covers 146,300 hectares, with the terrestrial area covering approximately 1,540 hectares.

***Criterion (vii):** The Lord Howe Island Group is grandiose in its topographic relief and has an exceptional diversity of spectacular and scenic landscapes within a small area, including sheer mountain slopes, a broad arc of hills enclosing the lagoon and Balls Pyramid rising abruptly from the ocean. It is considered to be an outstanding example of an island system developed from submarine volcanic activity and demonstrates the nearly complete stage in the destruction of a large shield volcano. Having the most southerly coral reef in the world, it demonstrates a rare example of a zone of transition between algal and coral reefs. Many species are at their ecological limits, endemism is high, and unique assemblages of temperate and tropical forms cohabit.*

*The islands support extensive colonies of nesting seabirds, making them significant over a wide oceanic region. They are the only major breeding locality for the Providence Petrel (*Pterodroma solandri*), and contain one of the world's largest breeding concentrations of Red-tailed Tropicbird (*Phaethon rubricauda*).*

Criterion (x): *The Lord Howe Island Group is an outstanding example of the development of a characteristic insular biota that has adapted to the island environment through speciation. A significant number of endemic species or subspecies of plants and animals have evolved in a very limited area. The diversity of landscapes and biota and the high number of threatened and endemic species make these islands an outstanding example of independent evolutionary processes.*

Lord Howe Island supports a number of endangered endemic species or subspecies of plants and animals, for example the Lord Howe Woodhen, which at time of inscription was considered one of the world's rarest birds. While sadly a number of endemic species disappeared with the arrival of people and their accompanying species, the Lord Howe Island Phasmid, the largest stick insect in the world, still exists on Balls Pyramid. The islands are an outstanding example of an oceanic island group with a diverse range of ecosystems and species that have been subject to human influences for a relatively limited period.

Integrity

The boundary of the property includes all areas that are essential for maintaining the ecosystems and beauty of the property. It includes all of the above water remains of the ancient shield volcano and surrounding reefs and a substantial proportion of the Lord Howe Island and Balls Pyramid seamounts. The island component of the property is largely Permanent Park Preserve (PPP) and the surrounding waters are Marine Parks. The land area not included in the PPP is managed to ensure that the property's values are maintained. The inscribed property would be strengthened by the inclusion of the entire Commonwealth Marine Park.

At time of inscription concern was raised with respect to a proposal to construct four telecommunications masts without thorough assessment by way of an Environmental Impact Statement. These were then built, although today no longer exist. Other potential threats to the integrity of the property include development pressures, introduced plants and animals and visitor / tourism pressures. Since inscription, a programme improving the conservation status of the Lord Howe Woodhen, and the successful eradication of feral pigs, cats and almost eradication of goats has contributed significantly to the enhancement of World Heritage values beyond their status at listing."

Nature and extent of likely impact

Address any impacts on the World Heritage values of any World Heritage property.

Criterion (vii)
No activities are proposed that could damage, degrade, alter or diminish World Heritage values associated with topographical relief, geological formation or scenic landscapes of the LHIG described in Criterion (vii).

No impacts are expected to transition zones for algal or coral reefs or the marine environment described in Criterion (vii). Further detail is provided in section 3.1 f). No impacts are expected to assemblages of temperate and tropical forms.

No impacts are expected to nesting seabirds or habitat described in Criterion (vii). Further detail is provided in section 3.1 d) and e). The proposal will remove a threat to nesting seabirds resulting in positive impacts and improving the World Heritage values.

Criterion (x)

The proposal is unlikely to impact on the number of endemic species, diversity of landscapes or biota described in Criterion (x). The proposal may have some potential impacts to individuals of endemic or threatened species (described in sections below) but this is unlikely to cause World Heritage values associated with endemism, threatened species or biota to be lost, damaged, degraded, notably altered or diminished. Any potential impacts will be localised and temporary.

It is highly likely that if the proposal proceeds and eradication of rodents is accomplished, this will contribute significantly to enhancement of World Heritage values, similar to what has occurred through the eradication of other invasive mammals and weed species on the property. The proposal may result in localised and temporary impacts to several endemic species but will remove a significant threat that if left unchecked would result in the continued degradation of the islands World Heritage values.

3.1 (b) National Heritage Places

Description

LHIG group is a National Heritage Place, listed on 21 May 2007 in recognition of its natural heritage significance in that it met four of the possible nine criteria as listed in the Commonwealth of Australia Gazette No. S 99, 21 May 2007, namely:

(a) the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history;
(b) the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;
(c) the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;
(e) the place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.

The Summary Statement of Significance and Official Values (Department of the Environment, 2016) are shown below.

"Summary Statement of Significance
The Lord Howe Island Group was inscribed on the World Heritage List for its outstanding natural universal values: as an example of superlative natural phenomena; and containing important and significant habitats for in situ conservation of biological diversity.

Located 700 kilometres north-east of Sydney and covering an area of 146 300 hectares, the Lord Howe Island Group comprises Lord Howe Island, Admiralty Islands, Mutton Bird Islands, Ball's Pyramid, and associated coral reefs and marine environments.
Nearly seven million years ago geologic movement of the Lord Howe Rise (an underwater plateau) gave birth to a large shield volcano on its western edge. Over time the sea eroded 90 per cent of the original volcano, leaving the islands that today comprise the Lord Howe Island Group.
Lord Howe Island has a spectacular landscape with the volcanic mountains of Mount Gower (875 m) and Mount Lidgbird (777 m) towering above the sea. The central low-lying area provides a marked contrast to the adjacent mountains and northern hills.
There are 241 different species of native plants, of which 105 are endemic to Lord Howe Island. Most of the island is dominated by rainforests and palm forest. Grasslands occur on the more exposed areas of Lord Howe Island and on the offshore islands. Most of the main island and all of the offshore islands are included in the Lord Howe Island Permanent Park Preserve.
The islands support extensive colonies of nesting seabirds and at least 168 bird species have been recorded either living at, or visiting, the islands. A number of these are rare or endangered.
The endangered woodhen is one of the world's rarest bird species. During this century the population of woodhens experienced a significant decline in numbers as a result of hunting by humans, habitat loss and disturbance by feral animals. Over the last few years a successful captive breeding program and other conservation measures have increased the numbers of these small flightless birds to around 220.
The islands are one of two known breeding areas for the providence petrel, a species that is also found nesting on Phillip Island, near Norfolk Island. They also contain probably the largest breeding concentration in the world of the red-tailed tropicbird, and the most southerly breeding colony of the masked booby.
The waters surrounding Lord Howe Island provide an unusual mixture of temperate and tropical organisms. The reef is the southern most coral reef in the world and provides a rare example of the transition between coral and algal reefs. A marine national park was declared by the State of New South Wales in 1999 to increase protection of the marine environment.
Europeans apparently discovered Lord Howe Island when the island was sighted in 1788 from the British colonial naval vessel HMS Supply, en route from Sydney to the penal colony on Norfolk Island. The first landing was made two months later on the return voyage to Sydney.
By the 1830s there was a small permanent settlement in the lowland area of the main island. The settlers made a living by hunting and fishing, and by growing vegetables, fruit and meat for trade with passing ships.
Pigs and goats, which were introduced to Lord Howe Island for food, later went wild and caused extensive vegetation and habitat changes, threatening populations of native species. Rats arrived on the island in 1918 from a wrecked ship, and have since been responsible for the extinction of five bird species. Over the last decade there have been intensive efforts to control these feral animals and the wild pigs have been successfully eradicated.
Lord Howe Island and its associated islands are under the care, control and management of the Lord Howe Island Board. When carrying out its functions, the Board is required to have particular regard to the World Heritage status of the area and to conserve those values for which the area was listed as a World Heritage property.

Official Values
Criterion A Events, Processes-
The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history;

This place is taken to meet this National Heritage criterion in accordance with subitem 1A(3) of Schedule 3 of the Environment and Heritage Legislation Amendment Act (No. 1) 2003, as the World Heritage Committee has determined that this place meets World Heritage criterion (x).

Criterion B Rarity
The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;

This place is taken to meet this National Heritage criterion in accordance with subitem 1A(3) of Schedule 3 of the Environment and Heritage Legislation Amendment Act (No. 1) 2003, as the World Heritage Committee has determined that this place meets World Heritage criterion (x).

Criterion C Research
the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;

This place is taken to meet this National Heritage criterion in accordance with subitem 1A (3) of Schedule 3 of the Environment and Heritage Legislation Amendment Act (No. 1) 2003, as the World Heritage Committee has determined that this place meets World Heritage criterion (x).

Criterion E Aesthetic characteristics
The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.

This place is taken to meet this National Heritage criterion in accordance with subitem 1A (3) of Schedule 3 of the Environment and Heritage Legislation Amendment Act (No. 1) 2003, as the World Heritage Committee has determined that this place meets World Heritage criterion (vii)."

Nature and extent of likely impact

Address any impacts on the National Heritage values of any National Heritage place.

The National Heritage values of the LHIG are intrinsically linked to the World Heritage values as evidence by the National Heritage criterion (A, B, C and E) referencing the World Heritage Criteria (vii) and (x). As the proposal is unlikely to cause World Heritage values to be lost, damaged, degraded, notably altered or diminished (see above section), it is also unlikely that National Heritage values will lost, damaged, degraded, notably altered or diminished. Any potential impacts will be localised and temporary.

It is highly likely that if the proposal proceeds and eradication of rodents is accomplished, this will contribute significantly to enhancement of World Heritage values and therefore National Heritage values.

3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

Description

Not applicable. There are no listed RAMSAR wetlands within the LHIG. The nearest RAMSAR wetland is the Elizabeth and Middleton Reefs Marine National Nature Reserve more than 150km to the north.

Nature and extent of likely impact

Address any impacts on the ecological character of any Ramsar wetlands.

No impacts are expected to any RAMSAR site.

3.1 (d) Listed threatened species and ecological communities

Description
There are no EPBC Listed Threatened Ecological Communities on the LHIG.

A Protected Matters Search (attached as Attachment 5) undertaken on 21/12/15 and combined with Island flora and fauna records has identified 23 birds, 1 fish, 1 shark, 4 marine mammals, 5 invertebrates, 5 marine reptiles, 2 land reptiles and 6 plant species listed as threatened under the EPBC Act, occurring or with the potential to occur in the project area. These are described in Table 5 below.

Table 5. EPBC Listed Threatened Species occurring or with the potential to occur on the LHIG
Data primarily from DECC (2007), Hutton (1991), McAllan *et al* (2004) and DoE (2016).
CE = *Critically Endangered, E = Endangered,* V = *Vulnerable*.

Species	EPBC Act Status	Type of Presence	Distribution, Abundance and Diet relevant to the LHI REP
Birds			
Australasian Bittern *Botaurus poiciloptilus*	E	Recorded Vagrant	Only one verified record for LHI (and that is from 1888) (McAllan *et al*. 2004). Has been recorded elsewhere feeding on freshwater crayfish, fish as well as frogs and tadpoles.
Black-browed Albatross *Thalassarche melanophris*	V	Recorded Vagrant/irregular visitor; seabird	Only three records of occurrence in the LHIG, and all were at sea (McAllan *et al*. 2004). This species feeds on fish and squid.
Bullers Albatross *Thalassarche bulleri*	V	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Feeds mainly on squid, supplemented by fish and krill
Campbell Albatross *Thalassarche melanophris impavida*	V	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Feeds on krill and fish, with some cephalopods, salps and jellyfish.
Chatham Albatross *Thalassarche eremita*	E	Recorded Vagrant/irregular visitor; seabird.	Known to forage over deep water in the area on probably eats fish and cephalopods.
Curlew Sandpiper *Calidris ferruginea*	CE	Recorded Vagrant/irregular visitor; seabird.	There have been 12 or so sightings of the Curlew Sandpiper on LHI from 1963 to 2002, although some may be multiple records of the same individual (McAllan *et al*. 2004). Most of the sightings were made over the spring to autumn period but one was noted in late August. Foraging on tidal flats, its diet is made up of worms, molluscs, crustaceans, insects, small fish and seeds. Forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds
Eastern Curlew *Numenius madagascariensis*	CE	Recorded Regular visitor; seabird	Records of the Eastern Curlew on LHI are for Autumn (March and April), Spring (September and November) and Summer. There is no indication that the species is on LHI in June-August. The Eastern Curlew is carnivorous, mainly eating crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects
Fairy Prion *Pachyptila turtur Subantarctica*	V	Recorded Vagrant/irregular visitor; seabird.	A single record of Fairy Prion exists for the LHIG. The individual was seen at sea in September of 2011. Fairy Prions usually eat mostly euphausiids and other small crustaceans, but also eat small quantities of fish and pteropods
Gould's Petrel	E	Recorded Vagrant;	Only two at-sea records and one beach-wash record for this species. Diet of the species as

Pterodroma leucoptera		seabird	a whole includes squid and fish.
Kermadec Petrel *Pterodroma neglecta neglecta*	V	Recorded Regular visitor; seabird	Breeds on Balls Pyramid from November to May (Hutton 1991), and may been seen flying around Mt. Gower during summer. The Kermadec Petrel (western) feeds on squid, fish, crustaceans and, during the breeding season, insects.
Lord Howe Island Currawong *Strepera graculina crissalis*	V	Recorded Endemic; land Bird	This bird is a sub-species of the mainland Pied Currawong, and is endemic to the LHIG. The entire population of the Lord Howe Island Currawong is restricted to LHI and the nearby islets (Mayr and Greenway 1962; Schodde and Mason 1999). The current population is 215 ± 11 birds (Carlile and Priddell, 2007) and appears to be stable as there is no empirical evidence of an historical decline (DEWHA 2009a). The Lord Howe Island Currawong is widespread on LHI, occurring in lowland, hill and mountain regions. It mainly inhabits tall rainforests and palm forests, especially besides creeks or in gullies, but it also occurs around human habitation, and forages amongst colonies of seabirds on offshore islets (DEWHA 2009a). It breeds in the forested hills of LHI, particularly in the south (Hutton 1991, McFarland 1994). Highest densities of nests are on the slopes of Mt Gower and in Erskine Valley (Garnett and Crowley 2000). Its breeding sites are located close to water in gullies (Garnett and Crowley 2000; Hindwood 1940; Hutton 1991). The currawong occurs singly, in pairs and family groups and, in the non-breeding season, in small flocks of up to 15 birds (DEWHA 2009a). It has been recorded breeding from October to December although breeding may commence in September (McAllan *et al*. 2004). During the breeding season breeding pairs and offspring probably occupy strongly-defended territories (Knight 1987). Data from a recent mark-recapture programme undertaken by the Office of Environment and Heritage suggests that not all currawongs are able to establish a breeding territory due to the lack of appropriate habitat (Carlile and Priddel 2007). In autumn and winter the species forms flocks and can be found in the settlement area (DEWHA 2009a). No information is available on the ages of sexual maturity or life expectancy, but it is probably capable of surviving to more than 20 years of age (Higgins *et al*. 2006). Breeding success appears to be relatively low; the only available, though limited, data suggests that less than 42% of nests produce fledglings (DEWHA 2009a). The Lord Howe Island Currawong is omnivorous; its diet consisting of fruits, seeds, snails, insects, the chicks of other bird species, and rodents (Garnett and Crowley 2000; Hull 1910; Hutton 1991; McFarland 1994).
Lord Howe Woodhen *Gallirallus sylvestris*	V	Recorded Endemic; land bird	The Lord Howe Woodhen is a flightless bird endemic to LHI. The population estimate in 1997 was 220-230 individuals and 71-74 breeding pairs (NPWS 2002). The population of woodhen has remained relatively static over the last ten years (DECC 2007), and may have reached carrying capacity at least in the lowlands, (NPWS 2002). 209 birds were recorded as part of the annual population survey conducted in 2015. The 2015 survey data is still being analysed to produce a total population estimate using the methodology in Harden (1999). It is expected that the population estimate will be approximately 240-300 individuals (unpublished data).

			Woodhens usually lay eggs from August until January (NPWS 2002) or February (Gillespie 1993) and continue raising young until April (NPWS 2002). However, the start and finish dates of breeding can vary between years and there are breeding records for much of the year (Miller and Mullette 1985). Pairs have multiple broods during the breeding season (Gillespie 1993). Juveniles can breed at nine months of age (Marchant and Higgins 1993) but juveniles that do not establish a territory by the breeding season immediately following their own hatching generally do not survive (Harden and Robertshaw 1988, 1989). About 60% of juveniles die in their first year (Harden and Robertshaw 1989) possibly due to limited high-quality habitat (NPWS 2002). Breeding success is greater in the settlement area than in the southern mountains (Marchant and Higgins 1993, Harden and Robertshaw 1988, 1989). The species is currently impacted by rodents on LHI. The woodhen occurs predominately in three vegetation types: 1) Megaphyllous Broad Sclerophyll Forest (mainly palms), which covers 19% of the island; 2) Gnarled Mossy-Forest, which covers 2% of the island; and 3) Gardens around houses. About 40 % of the population lives in the settlement area of the island (NPWS 2002). Over 80% of the woodhen's diet is comprised of earthworms (Miller and Mullette 1985). The bulk of the remaining 20% is made up of grubs, typically found in rotting logs. Snails, arthropods, seabird chicks, rodents, plant shoots, lichen and fungi are also eaten (NPWS 2002). Woodhen were observed eating non-toxic pellet baits during a trial conducted on LHI to gauge what species may eat the Pestoff 20R baits. Blue-coloured faeces have also been seen when handling some birds, indicating they had been consuming Brodifacoum wax blocks (Harden 2001). These blocks are widely dispersed around the settlement by residents. Further evidence of woodhens consuming Brodifacoum baits has come from its detection in the internal organs of several woodhens found dead along roadsides and recovery of ill birds that have been captured and treated with Vitamin K.
Northern Giant Petrel *Macronectes halli*	V	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). The Northern Giant-Petrel eats seal, whale, and penguin carrion, and seal placentae. It also eats substantial quantities of krill and other crustaceans, octopus, squid and fish. It will kill and eat immature *Albatross Diomedea*, and a variety of other seabirds, which are either consumed as carrion or captured at sea.
Northern Royal Albatross *Diomedea epomophora sanfordi*	E	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Feeds primarily on cephalopods, fish, crustaceans and salps.
Painted Snipe *Rostratula benghalensis*	E	Recorded Vagrant; seabird	There has only been one Painted Snipe recorded on LHI, and that was in February 1990. Feeds on vegetation, seeds, insects, worms and molluscs, crustaceans and other invertebrates.
Salvin's Albatross *Thalassarche cauta salvini*	V	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Eats squid and fish.
Shy Albatross *Thalassarche cauta cauta*	V	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). The main foods of the Shy Albatross are fish, squid, crustaceans and tunicates.

Southern Giant Petrel *Macronectes giganteus*	E	Recorded Vagrant; seabird	Only four confirmed records for LHI; all prior to 1965, three of which were beach-cast specimens. There are reports of sightings on Balls Pyramid between 1978-1980 (McAllan *et al.* 2004). The Southern Giant-Petrel is an opportunist scavenger and predator. In summer at least, it will scavenge primarily penguin carcasses, although it will also feed on seal and whale carrion. It catches and kills live birds. It is also recorded consuming octopus, squids, krill other crustaceans, kelp, fish, jellyfish, and rabbit.
Southern Royal Albatross *Diomedea epomophora epomophora*	V	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Feeds primarily on squid and fish.
Swift Parrot *Lathamus discolor*	E	Recorded Vagrant; landbird	One record only from LHI, and that is of a dead bird found in 1968. Feeds on nectar, mainly from eucalypts, but also eats psyllid insects and lerps, seeds and fruit.
Wandering or Snowy Albatross *Diomedea exulans (sensu lato)* Amsterdam Albatross *Diomedea amsterdamensis* Antipodean Albatross *Diomedea antipodensis* Tristan Albatross *Diomedea dabbenena* Gibson's Albatross *Diomedea antipodensis gibsoni*	V E E E V	Recorded Vagrant/irregular visitor; seabird. Subspecies not identified	Irregular visitor to the LHIG Group. Occasionally seen at sea during winter, autumn and spring. This species feeds on fish and squid.
White-bellied Storm-petrel *Fregetta grallaria gallaria*	V	Recorded Regular visitor; seabird	The White-bellied Storm-petrel is present on the LHIG from September to May. It feeds at sea on feeds on small crustaceans and squid, and visits its nesting burrows only during the night.
White-capped Albatross *Thalassarche cauta steadi*	V	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). The White-capped Albatross probably has a diet of inshore cephalopods (squid) and fish.
Fish			
Black rock Cod *Epinephelus daemelii*	V	Recorded	The Black Rock Cod is recorded from warm temperate and subtropical waters of the south western Pacific, including off south eastern Australia, Lord Howe Island, Norfolk Island, the Kermadec Islands and northern New Zealand. It is a large reef-dwelling grouper. Adult Black Rockcod are known to occur in caves, gutters and on rocky reefs from near shore environments to depths of at least 50 m (Heemstra and Randall 1993). Recently settled small juveniles are occasionally found in intertidal rock pools along the NSW coastline and larger juveniles are generally captured by anglers on rocky reefs in estuary systems. It is likely that they are epibenthic predators feeding on macroinvertebrates (mainly crustaceans) and fishes on or near the bottom.

Sharks			
Great White Shark *Carcharodon carcharias*	V	Recorded with the LHI Marine Park	Occasionally recorded in waters around the LHIG
Mammals			
Blue Whale *Balaenoptera musculus*	E	Species or habitat likely to occur	May transit waters around the LHIG
Southern Right Whale *Eubalaena australis*	E	Species or habitat likely to occur	May transit waters around the LHIG
Humpback Whale *Megaptera novaeangliae*	V	Recorded Vagrant/irregular visitor; Marine Mammal	May transit waters around the LHIG in early and late winter.
Sperm Whale Physeter macrocephalus	V	Recorded Vagrant/irregular visitor; Marine Mammal	May transit waters around the LHIG
Invertebrates			
Magnificent Helicarionid Land Snail *Gudeoconcha sophiae magnifica*	CE	Recorded	Very little is known about the biology and ecology of this endemic snail which is, or was, predominantly confined to Mount Gower and Mount Lidgbird. Evidence indicates that numbers may have declined over time. This species is so rare (only 29 specimens, most of which were dead, were collected from 1998 and 2002. No live animals were found despite extensive surveys conducted by the Australian Museum in 2001 and 2002. Rats are regarded as a significant threat to this snail (Beeton, 2008a) and are possibly driving this species towards extinction, if they have not done so already.
Masters' Charopid Land Snail *Mystivagor mastersi*	CE	Recorded	This snail, endemic to LHI, is only known from a few sites, including the summit of Mount Lidgbird, Mount Gower, Blinky Beach and Boat Harbour (Beeton 2008b). However, recent surveys suggest that the species is now confined to the summits of the two southern mountains. It is a relatively uncommon snail, with only 17 specimens being collected by the Australian Museum in 140 years. The population has probably declined, due initially to pigs and goats, then later to predation by the introduced rat (Beeton 2008b). The size of the current population is unknown.
Lord Howe Flax Snail, Lord Howe *Placostylus Placostylus bivaricosus*	E	Recorded	The Lord Howe Placostylus is a large land snail; the shell of a mature specimen can be up to 8 cm long. It is endemic to LHI with three sub-species recognised. *Placostylus bivaricosus bivaricosus* is the only sub-species of this snail known to be extant; other sub-species are either listed as extinct (*P.b. cuniculinsulae*) or have not been recorded in over 30 years (*P.b. etheridgei*). It has close relatives in New Zealand (*P. ambagiosus, P. bollonsi and P. hongii*). Other members of the genus occur in the Solomon Islands, Fiji and New Caledonia. The Lord Howe Placostylus was once abundant and widespread on the island, inhabiting the leaf litter of rainforest areas. The decline of the species was first noted in the 1940s.

			The Ship Rat identified as a major predator of the species and posing a significant threat to the Placostylus, (NPWS 2001).
Mount Lidgbird Charopid Land Snail *Pseudocharopa ledgbirdi*	CE	Recorded	This snail, endemic to LHI, is now thought to be confined to Mount Gower although its distribution, prior to 1945, also included Mount Lidgbird and Erskine's Valley (Beeton 2008c). From 1887 until 2002, 239 specimens have been collected for museums. However, the number of snails found has declined markedly since 1981, with only six specimens being recorded for the period 1981 to 2002 (none alive). Because the effort to find snails has increased since 1925, the decline in finds has been interpreted as reflecting a severe drop in the snail's population (Beeton 2008c). Additionally, no live specimens have been found since 1979 (Beeton 2008c). The decline in the snail's population is likely to be due to damage done to its environment by pigs and goats, then subsequently to predation by the introduced rat (Beeton 2008c). The size of the current population is unknown.
Whitelegge's Land Snail *Pseudocharopa whiteleggei*	CE	Recorded	Once found on both of the southern mountains, it now appears to be limited to Mount Gower (Beeton 2008d). In spite of increased survey effort, only two specimens have been found since 1971 compared to 32 before 1920. This suggests a significant decline in snail abundance. The key threat to this snail is predation by introduced rats (Beeton 2008d).
Reptiles			
Loggerhead Turtle *Caretta caretta*	E	Recorded Vagrant/irregular visitor; Marine Reptile	Occasionally recorded in waters around the LHIG as a visitor in the park during trans-Pacific migrations. Loggerheads are carnivorous, eating shellfish, crabs, sea urchins and jellyfish. No nesting recorded on the LHIG.
Green Turtle *Chelonia mydas*	V	Recorded Vagrant/irregular visitor; Marine Reptile	In the LHIG, Green turtles regularly occur from the sheltered habitats of the lagoon through to the offshore fringing reefs and deeper shelf waters of the park. Feeds predominantly on seagrass and algae. No nesting recorded on the LHIG.
Lord Howe Island Gecko *Christinus guentheri*	V	Recorded land reptile	Endemic to LHI and Norfolk Island. Once abundant on the main island until the mid-1930s, after which it declined dramatically, most likely due to predation by rats. Now rare on Lord Howe Island, more common on Blackburn and Roach Islands. Possibly present on other large offshore islets. This species feeds on beetles, spiders, moths, ants and other insects amongst the leaf litter.
Leatherback Turtle *Dermochelys coriacea*	E	Recorded Vagrant/irregular visitor; Marine Reptile	Has been sighted very occasionally in waters around the LHIG and is likely to migrate periodically through the park's waters; it has a carnivorous diet consisting of jellyfish and other soft-bodied invertebrates. No nesting recorded on the LHIG.
Hawksbill Turtle *Eretmochelys imbricata*	V	Recorded Vagrant/irregular visitor; Marine Reptile	Occasionally recorded in waters around the LHIG and is also observed relatively regularly in the lagoon. It feeds primarily on sponges but also consumes seagrasses, algae, soft corals and shellfish. No nesting recorded on the LHIG.
Flatback Turtle *Natator depressus*	V	Recorded Vagrant/irregular visitor; Marine Reptile	Rarely recorded in waters around the LHIG. No nesting recorded on the LHIG.
Lord Howe Island Skink *Oligosoma lichenigera*	V	Recorded land reptile	Rich metallic bronze or olive above with numerous small brown longitudinal flecks or streaks, to about 80mm in length. Endemic to the Lord Howe Island Group and

			Norfolk Island. Rare on Lord Howe Island, more common on offshore islets – Blackburn Island, Roach Island and Ball's Pyramid, possibly other large offshore Islets. They feed on beetles, spiders, moths, ants and other insects amongst the leaf litter.
Plants			
Calystegia affinis	CE	Recorded	A delicate thin-stemmed twiner with white to pale pinky-purple flowers. Rare and very localised and restricted in its range. This species is endemic to Lord Howe Island and Norfolk Island. On Lord Howe Island it is known from eight locations; one on a slope at Old Settlement, the others at various locations in the southern mountains. Seed and seedlings potentially browsed by rodents.
Phillip Island Wheat Grass *Elymus multiflorus* subsp. *kingianus*	CE	Recorded	A tufted perennial grass, 30–100 cm tall, with a low, spreading habit, known from the Norfolk Island group and LHI. On LHI the subspecies (about 50 individuals) is record from only 2 locations (in close proximity) occurring between exposed basalt-derived cliffs near the waters edge, with littoral rainforest upslope (Auld *et al*. 2011). Seeds presumed to be predated by rodents.
Geniostoma huttonii	E	Recorded	A rare scrambling shrub to 1m high. Mainly found on the remote ridges and sheltered habitats in the southern mountains. On Mt Lidgbird it occurs on the south east corner at about 500m altitude. On Mount Gower it occurs on the cliff which leads into Little Pocket and above the Get Up Place.
Little Mountain Palm , Moorei Palm *Lepidorrhachis mooreana*	CE	Recorded	A stout, dwarf palm with a trunk to 2m high endemic to LHI. Confined to higher elevations in the southern mountains, mainly above 750m altitude. Rats are known to predate heavily on the developing seeds, and also chew the stems of leaf fronds.
Rock Shield Fern *Polystichum moorei*	E	Recorded	A fern with distribution limited to the southern mountains, favouring sheltered cliff faces and overhangs. Also known from low elevation near Kings Beach and mouth of Erskine Creek.
Xylosma parvifolia	E	Recorded	Shrub to 2 m high. Restricted to the remote ridges in the southern mountains. Seed and seedlings potentially browsed by rodents.

Nature and extent of likely impact

Address any impacts on the members of any listened threatened species (except a conservation dependent species) or any threatened ecological community, or their habitat.

Potential Impact to Threatened Birds

Potential impacts to EPBC listed threatened birds from the proposed LHI REP include:

- Primary poisoning from consumption of bait pellets
- Secondary poisoning from consumption of poisoned rodents or invertebrates
- Disturbance as a result of helicopter activities
- Impacts as a result of handling and captive management during the captive management program

Any potential impacts will be localised and temporary.

Risks to non-target bird species during an eradication programme are a function of the species present on the island group and their behaviour, susceptibility of those species present to the poison, composition and delivery method of the bait and the probability of exposure to the poison either directly or indirectly.

Many of the records for EPBC listed threatened bird species on the LHIG refer to species that rarely visit the island group with 17 bird species only being recorded in the waters surrounding the island group. On island visits typically involve only a small number of individuals. And these are considered vagrants, rare or irregular visitors. Even if the proposed baiting constituted a real threat to these individuals, no viable local population of the species is likely to be placed at risk of risk by the proposed action. In most cases the low overall number of individuals involved, their diet or the small possibility that they will be in the vicinity during the baiting operation strongly suggest that these species will not be significantly harmed by the eradication. Assessment of risk to these species is detailed in the table below.

During 2007, a study using non-toxic baits (similar to those cereal pellets to be used in the proposed eradication operation) was conducted on LHI to examine bait uptake by non target species (LHIB, 2007) (in Attachment 6). These baits contained a fluorescent dye that glowed under ultraviolet light. The woodhen produced fluorescing faecal samples, indicating that they had consumed bait and was observed feeding directly on baits. Although currawongs did not consume baits they are vulnerable to secondary poisoning from feeding on dead or dying rodents that have taken baits. The study is included in this referral as part of Attachment 6.

To mitigate the threat posed by the baiting, a large proportion of the population of the endemic woodhen and currawong will be housed in aviaries during the baiting and for several months after baiting to ensure that Brodifacoum residues have diminished to a level that would no longer pose a threat to free-ranging woodhen or currawong. This is discussed in more detail below.

During the trial conducted on LHI, some ants, slugs, cockroaches and snails (not Placostylus) were observed feeding on baits (LHIB, 2007). For each of these groups only a small proportion of individuals had consumed bait; consequently it is unlikely that any of the birds on LHI will consume contaminated invertebrates exclusively to the point where there is a risk of secondary poisoning from insects.

The risk of collision with helicopter to the several seabird species that are present during the baiting will be reduced by taking advantage of the diurnal movements of seabirds away from the island. In this way sections of LHI will be baited when those birds are foraging at sea and away from their roosting (nesting) grounds. To reduce disturbance to those species that are present throughout the day, baiting height for the helicopters will be set at an altitude that does not unduly disturb roosting or nesting birds.

Table 6: Significant Impacts to EPBC Listed Threatened Birds

Species	EPBC Act Status	Significant Impact from the LHI REP
Australasian Bittern *Botaurus poiciloptilus*	E	No. Species unlikely to be present.
Black-browed Albatross *Thalassarche melanophris*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Bullers Albatross *Thalassarche bulleri*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Campbell Albatross *Thalassarche melanophris impavida*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Chatham Albatross *Thalassarche eremita*	E	No. Known to forage in the area but unlikely to have exposure to bait.
Curlew Sandpiper *Calidris ferruginea*	CE	No. May be small number present but unlikely to have significant exposure to bait.
Eastern Curlew *Numenius madagascariensis*	CE	No. Species unlikely to be present.
Fairy Prion *Pachyptila turtur Subantarctica*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Gould's Petrel *Pterodroma leucoptera*	E	No. Species unlikely to be present and unlikely to have exposure to bait.
Kermadec Petrel *Pterodroma neglecta*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Lord Howe Island Currawong *Strepera graculina crissalis*	V	Yes. With the proposed mitigation in place, it is considered possible that the REP will still have a significant impact on currawongs through disruption of a breeding cycle. See further detail below.
Lord Howe Woodhen *Gallirallus sylvestris*	V	No. With the proposed mitigation in place, it is considered unlikely that the REP will have a significant impact on woodhens. See further detail below.
Northern Giant Petrel *Macronectes halli*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Northern Royal Albatross *Diomedea epomophora sanfordi*	E	No. Species unlikely to be present and unlikely to have exposure to bait.
Painted Snipe *Rostratula benghalensis*	E	No. Species unlikely to be present.
Salvin's Albatross *Thalassarche cauta salvini*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Shy Albatross *Thalassarche cauta cauta*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Southern Giant Petrel *Macronectes giganteus*	E	No. Species unlikely to be present and unlikely to have exposure to bait.

Southern Royal Albatross *Diomedea epomophora epomophora*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
Swift Parrot *Lathamus discolor*	E	No. Species unlikely to be present and unlikely to have exposure to bait.
Wandering or Snowy Albatross *Diomedea exulans* (sensu lato) Amsterdam Albatross *Diomedea amsterdamensis* Antipodean Albatross *Diomedea antipodensis* Tristan Albatross *Diomedea dabbenena* Gibson's Albatross *Diomedea antipodensis gibsoni*	V E E E V	No. Species unlikely to be present and unlikely to have exposure to bait.
White-bellied Storm-petrel *Fregetta grallaria*	V	No. Species unlikely to be present and unlikely to have exposure to bait.
White-capped Albatross *Thalassarche cauta steadi*	V	No. Species unlikely to be present and unlikely to have exposure to bait.

Potential impact to Lord Howe Island Currawong *Strepera graculina crissalis*
The proposed rodent eradication poses a significant threat to currawongs. Currawongs are very unlikely to eat the baits deployed in the rodent eradication programme but there is a significant risk that some individuals will succumb to secondary Brodifacoum poisoning by eating poisoned rodents. To mitigate for this, as many individuals of the population as possible (approximately 50-60%) from across the island (to maintain genetic diversity) will be captured immediately prior to the baiting, and will remain in captivity until 30 days after last indications of rodent survival (likely September), after which the risk of secondary poisoning for currawongs is likely to be negligible (as by then poisoned rodents will no longer be a potential food source). Although approximately 90% of those rodents poisoned are likely to die in dens underground or amongst dense vegetative cover, it is possible that a number of those currawongs left at large during the eradication will consume baited rodents, thereby placing some of the current population at significant risk, however a mortality rate cannot be predicted.

The stability displayed in the present population size and the presence of non-breeding currawongs during the breeding season (a result of a lack of availability of unoccupied breeding territories), indicate that LHI is at carrying capacity for currawongs. If so, the potential death of a sizeable proportion of the at-large (i.e., non-captive) currawong population from poisoning due to the proposed rodent eradication does not, in itself, threaten the long-term viability of the population. It is expected that losses due to poisoning will be compensated by increased breeding success of the survivors, including those released from captivity. The removal of rats and mice may also lead to an increase in the carrying capacity of LHI and/or a rise in breeding success as there will be substantially more food available for currawongs (e.g., forest fruits, seeds, invertebrates, reptiles and small birds).

As stated above, approximately 50-60% of the currawong population will be placed into captivity during the eradication. Holding currawongs in captivity from approximately June until October may disrupt the birds' breeding season for one year. However, it is unlikely that all birds left in the wild will be poisoned by the operation and thus disruption would not affect the entire population, and given that currawongs are long-lived, such disruption is not expected to result in long-term harm to the population.

The captive facility will be located on LHI and will be managed by a highly experienced aviculturist most likely from Taronga Zoo. To ensure all husbandry protocols are correct, a trial involving 10 currawongs was conducted in 2013 (Taronga Conservation Society Australia, 2014) with all birds successfully released. One critical lesson learnt from this trial was how currawongs reacted to being confined with or near other currawongs during the breeding season. Further detail on the proposed captive management is provided in Section 4. The trial report is included in Attachment 2.

In the absence of mitigation, a significant impact to currawongs is likely to occur from the LHI REP. With the proposed mitigation in place, it is considered possible that the REP will still have a significant impact on currawongs through disruption of a breeding cycle, although it is unlikely that a long term population decrease will occur. Any potential impacts will be temporary. In the event that rodents are detected after the eradication attempt and contingency measures are considered, potential impacts to the captive managed population will be reassessed.

Potential impact to Lord Howe Woodhen *Gallirallus sylvestris*

This species is at risk of both primary and secondary poisoning. Woodhen have been recorded eating non-toxic Pestoff bait pellets (LHIB, 2007). They are also known to eat rodents that have been poisoned during the ground baiting that currently takes place around the Settlement and will also consume poisoned birds.

The protection of this species requires that it be taken into captivity during the eradication. Approximately 80 - 85% of the population will be captured prior to the baiting and will remain in captivity for the duration of the operation; that is, until the baits (and rodent carcasses) have disintegrated and pose no further risk. It is expected that individuals that are not captured may succumb to primary or secondary poisoning, however a mortality rate cannot be predicted. The captive population will include both adults and juveniles, and will be collected from across LHI to ensure that the deepest practical gene pool is maintained. It should be noted however that the gene pool experienced a severe bottle neck with the reduction in numbers prior to the captive breeding program in the 1980s. Birds originating from the remotest parts of LHI (e.g., the summit of Mt Gower) will be transported to, and back from, the holding facility by helicopter to minimise transport time and its associated stress on the birds. The captive facility will be located on LHI and will be managed by a highly experienced aviculturist most likely from Taronga Zoo. Woodhen have previously been successfully held in captivity (Gillespie, 1993) so information is already at-hand for captive management. A trial involving of 22 birds was conducted in 2013 to ensure all husbandry protocols are correct (Taronga Conservation Society Australia, 2014). The trial report is included in Attachment 2. At least one other captive colony will be established on the Australian mainland. These actions, namely the establishment of on-site and off-island captive facilities, are in accordance with recommendations made in the "Recovery Plan for the Lord Howe Woodhen *Gallirallus sylvestris*" (NPWS 2002) which calls for the development of a plan for the establishment of an on-island captive-breeding facility in the event of a substantial reduction in woodhen numbers; and the establishment of captive populations at sites other than LHI as insurance against a catastrophe affecting the wild population. Further detail on the proposed captive management is provided in Section 4.

Woodhens are to be held in captivity during most of the duration of one breeding season. Although the release of the birds is dependent on how long it takes the baits and carcasses to breakdown, it is likely that the woodhen will be released by December, a hundred or so days after the second aerial bait-drop. If so, then the birds will have up to two months of the current breeding season to lay eggs (Gillespie 1993). Body conditioning through diet manipulation, such as the provision of woodgrubs in the weeks leading up to release, may also be able to improve reproduction immediately post release (Gillespie, 1993). Woodhens have also been bred very successfully in captivity on LHI (in pair cages) and may therefore breed in captivity. The full or partial loss of one breeding season is unlikely to have a significant effect on the population particularly given the lifespan can be in excess of 15 years. Similarly, the death of many of those woodhen that are not taken into captivity is also unlikely to result in long-term harm to the overall population. Presently, about 60% of juveniles die in their first year (Harden and Robertshaw 1989) and this is more than likely a result of a lack of high-quality habitat (NPWS 2002) for them to occupy. The death of the adult birds that are not taken into captivity will provide vacant territories for many, otherwise doomed, juveniles that fledge in the years immediately following the rodent eradication.

In the absence of mitigation, a significant impact to woodhens is likely to occur from the LHI REP. However with the mitigation proposed in place, it is considered unlikely that either long term population decrease or major disruption to a breeding cycle will occur. Impacts are likely to be temporary. It is therefore considered unlikely that the REP will have a significant impact on woodhens. In the event that rodents are detected after the eradication attempt and contingency measures are considered, potential impacts to the captive managed population will be reassessed.

The eradication of rodents is likely to result in an increase in terrestrial invertebrates which will likely lead to population increases for woodhen. The density of LHI Woodroach on Blackburn Island suggests that following reintroduction of this species to the main island will present a significant increase in food availability for woodhen.

Potential Impacts to Threatened Marine Species (Fish, Sharks, Whales and Turtles)

Potential impacts to EPBC Listed threatened marine species are limited to accidental bait entry into the water (either through aerial distribution or a spill) leading to pollution of water, primary or secondary poisoning.

Pollution of marine water resulting in impacts to threatened marine species is considered extremely unlikely considering the minimal amount of bait likely to enter the water, the insolubility of Brodifacoum and the huge dilution factor.

Black Cod and Great White Sharks are unlikely to have sufficient exposure to the bait to have a significant impact at a population level.

There is no realistic pathway by which threatened marine mammals can be significantly exposed to rodenticide at the LHIG as a result of the proposed aerial baiting with Pestoff® 20R. The combination of Brodifacoum being practically insoluble in water, the infinitesimal amount of Brodifacoum that may land in the sea and the huge dilution factor preclude any significant effect upon marine mammals. Marine mammal species are also rare visitors to LHI waters, passing through on the annual migration and are therefore unlikely to encounter the bait.

It is very unlikely that Green Turtles *Chelonia mydas* could be exposed to rodenticides by consuming baits directly or prey items that have ingested rodenticides. Adult Green Turtles feed exclusively on various species of seagrass and seaweed. Plants have not been documented to take up and store anticoagulants, therefore no effect on adult Green Turtles is expected to occur from ingestion of rodenticide in their food.

Juvenile Green Turtles and the other four species of turtle (Flatback Turtle *Natator depressus*, Hawksbill Turtle *Eretmochelys imbricata*, Leatherback Turtle *Dermochelys coriacea* and Loggerhead Turtle *Caretta caretta*) that may be encountered in the marine park are carnivorous, and will eat soft corals, shellfish, crabs, sea urchins and jellyfish. However, it is unlikely that these turtles will encounter marine invertebrates that may have been contaminated with Brodifacoum as a result of aerial baiting the LHIG with Pestoff® 20R. Evidence against the existence of a significant dietary exposure pathway for invertebrates is outlined in section 3.1 f). No turtle nesting occurs on the LHIG.

In summary, the proposed baiting of LHI does not pose a threat to threatened marine life (Cetaceans, turtles, fish or sharks) because:

- The use of specialised equipment on the bait hopper will ensure minimal bait entry to the water. The amount of bait that may bounce off the cliffs to fall into the sea will be minimal (Howald *et al.* 2005; Samaniego-Herrera *et al.* 2009);
- The breakdown of baits that do land in the sea will be rapid (Empson and Miskelly 1999), therefore the opportunity for fish to take baits will be limited;
- Fish have shown a lack of interest in baits (Samaniego-Herrera *et al.* 2009, U.S. Fish and Wildlife Service and Hawai'i Department of Land and Natural Resources 2008), so it is unlikely that many fish will take baits;
- The possible death of those few fish that find and eat enough baits to prove fatal does not pose a threat at the population level;
- Baiting other islands using similar methods, although sometimes using significantly more bait, has not resulted in adverse effects on the marine environment as a whole.
- Potential impacts are likely to be very localised and temporary in nature.

Further details regarding potential impacts to the marine environment are provided in Section 3.1 f).

Table 7: Significant Impacts to EPBC Listed Threatened Marine Animals

Threatened Marine Animals	EPBC Act Status	Significant Impact from the LHI REP
Black rock Cod *Epinephelus daemelii*	V	No. Unlikely to have sufficient exposure to bait.
Great White Shark *Carcharodon carcharias*	V	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Blue Whale *Balaenoptera musculus*	E	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Southern Right Whale *Eubalaena australis*	E	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Humpback Whale *Megaptera novaeangliae*	V	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Sperm Whale Physeter macrocephalus	V	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Loggerhead Turtle *Caretta caretta*	E	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Green Turtle *Chelonia mydas*	V	No. Unlikely to have sufficient exposure to bait.
Leatherback Turtle *Dermochelys coriacea*	E	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Hawksbill Turtle *Eretmochelys imbricata*	V	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.
Flatback Turtle *Natator depressus*	V	No. Species unlikely to be present or present in small numbers. Unlikely to have sufficient exposure to bait.

Potential Impacts to Threatened Invertebrates

The only REP activity with the potential to impact on EPBC listed terrestrial invertebrates is distribution of the bait through primary poisoning (direct consumption). Any potential impacts are likely to be temporary in nature.

Brodifacoum is not expected to have significant effects on invertebrates as they have different blood clotting systems to mammals and birds. Introduced slugs and snails used as analogues for native snail species in experiments suggest NZ terrestrial molluscs are not susceptible to Brodifacoum poisoning (Broome *et al* 2016). Whilst most studies of molluscs indicate a lack of impact of Brodifacoum (Booth *et al.* 2003; Bowie & Ross 2006), a study conducted in Mauritius reported mortality in two snail species after reports of snails consuming toxic baits (Gerlach & Florens 2000). Trials done in NZ so far have failed to show any effect on invertebrates feeding on Brodifacoum baits (Booth *et al*. 2001; Booth *et al*. 2003; Craddock 2003; Bowie & Ross 2006).

Booth *et al*. (2003) carried out a laboratory evaluation of the toxicity of Brodifacoum to native snails, using introduced common garden snails as a model. In one experiment, common garden snails were exposed to soil contaminated with Brodifacoum at 0.02 to 2 mg ai/kg. In a second experiment, snails were exposed to contaminated soil (100 to 1000 mg ai/kg) and Talon® 20P pellets. No snail mortality was observed in either experiment. The authors concluded that primary poisoning of native *Powelliphanta* snails from cereal pellets containing Brodifacoum was unlikely.

Bowie and Ross (2006) allowed introduced slugs (*Deroceras* spp.) held in captivity, to feed freely for 40 days on Talon 50WB® wax baits containing 0.05 mg/kg Brodifacoum. No mortality was observed.

Gerlach & Florens (2000) reported 100% mortality of two Seychelles Islands snails (*Pachnodus silhouettanus* and *Achatina fulica*) after they consumed Brodifacoum baits. Lethal doses varied with snail size, with 15-20mm *P. silhouettanus* being killed by a dose of 0.01 to 0.2 mg/snail within 72 hours. This is equivalent to a *P. silhouettanus* eating between 0.5 and 10 g of 0.02 g/kg Brodifacoum bait. *A. fulica* were killed by a dose of 0.04 mg/kg in 72 hours (Booth *et al*. 2003). This is equivalent to a *A. fulica* eating approximately 0.2 g of 0.02 g/kg Brodifacoum bait.

Gerlach & Florens (2000) also reported observing *Pachystyla bicolor* eating baits and finding significant numbers of recently dead snails following a Brodifacoum operation to control rats in Mauritius.

In another experiment by Brooke *et al*. (2011) native snails were collected from the litter layer on Henderson Island in the Pitcairn group and held on the island in plastic boxes to which broken pieces of Pestoff 20R cereal pellets containing 20mg/kg Brodifacoum were added. A control group of snails in boxes were kept in similar conditions with no exposure to Brodifacoum. Each of seven species (Orobophana spp & Achatinellids spp) was tested this way for 10 days. After 10 days exposure a total of 3 snails from the treatment groups were found dead from a total of 57. In the control boxes a total of 4 snails were found dead from a total of 53 held. None of the dead snails were found to contain Brodifacoum residues.

During 2007, a study using non-toxic baits (similar to those cereal pellets to be used in the proposed eradication operation) was conducted on LHI to examine bait uptake by non target species (LHIB, 2007) (in Attachment 6). These baits contained a fluorescent dye that glowed under ultraviolet light. During the trial conducted on LHI, some ants, slugs, cockroaches and snails (not Placostylus) were observed feeding on baits (LHIB, 2007). For each of these groups only a small proportion of individuals had consumed bait.

Research was conducted in 2009 to assess the vulnerability of the endangered LH Placostylus to Brodifacoum baits (Wilkinson *et al.* unpubl. data) (in Attachment 6). When given a choice between their natural diet and bait pellets, Placostylus will feed preferentially on their natural diet, ignoring bait. When all other feed was denied to them, they fed exclusively on Brodifacoum baits, but no mortality occurred. These findings demonstrate that there is negligible risk posed to *Placostylus bivaricosus* by the proposed eradication operation. In the unlikely event of any incidental mortality occurring during the eradication, evidence from other eradications suggests that this will be more than offset by the benefits that accrue to invertebrate populations from the removal of predation pressure by rodents. In the absence of the eradication (or increased control) it is likely that the species will over time become extinct.

These findings suggest that the probability of a significant proportion of the *Placostylus bivaricosus* population consuming and dying from toxic baits in the wild is extremely unlikely.

The four species of critically endangered land snails on LHI: Masters' charopid land snail, Mount Lidgbird charopid land snail, Whitelegge's land snail and *Gudeoconcha sophiae magnifica* are highly threatened by rat predation and it is likely that if rats are not removed these species will become extinct; some may already be extinct. The extreme rarity of these species precludes any testing of their susceptibility to Brodifacoum, or capturing the species to safeguard them in captivity. Whilst it is possible that some individuals of these species may be at risk of poisoning, this possibility must be weighed up against the threats associated with not removing rodents including almost certainty that predation by rats will result in the extinction of these species. Therefore a significant impact to these species is not expected from the REP when compared to not proceeding with the eradication. Proceeding with eradication of rats is listed as a priority action in the Commonwealth Conservation Advices for these species.

In summary, significant impacts to threatened invertebrate species is considered unlikely.

Table 8: Significant Impacts to EPBC Listed Threatened Invertebrates

Terrestrial Invertebrates	**EPBC Act Status**	**Significant Impact from the LHI REP**
Magnificent Helicarionid Land Snail *Gudeoconcha sophiae magnifica*	CE	No
Masters' Charopid Land Snail *Mystivagor mastersi*	CE	No
Lord Howe Flax Snail, Lord Howe *Placostylus* *Placostylus bivaricosus*	E	No
Mount Lidgbird Charopid Land Snail *Pseudocharopa ledgbirdi*	CE	No
Whitelegge's Land Snail *Pseudocharopa whiteleggei*	CE	No

Potential Impacts to Threatened Terrestrial Reptiles

REP activities with the potential to impact on EPBC listed terrestrial reptiles (Lord Howe Island Skink and Lord Howe Island Gecko) include distribution of the bait through primary poisoning (direct consumption) and secondary poisoning (consumption of poisoned invertebrates). Any potential impacts are likely to be temporary in nature.

There is little published information on the interactions between reptiles and Brodifacoum worldwide, however reptiles are considered to be more tolerant than mammals and birds based on field observations and survival during experimental dosing (Hoare and Hare 2006).

In general, the risk of primary poisoning in reptiles appears to be minimal as reptiles do not appear to be interested in cereal pellets (Merton 1987). Merton did record Telfair's Skink (*Leiolopisma telfairi*) feeding on rain-softened pellet bait, and this apparently led to a number of deaths in this species. Despite these deaths the number of reptiles, including Telfair's Skink, on Round Island has markedly increased since the baiting (North *et al.* 1994). There was a 15 % mortality of the Caribbean gecko species *Sphaerodactylus macrolepis* when exposed to Talon-G (cereal pellets containing 0.02 g/kg Brodifacoum) during pen trials (Gaa 1986, cited in Garcia *et al*. 2002).

Gunther's Gecko *Phelsuma guentheri,* although present during the same baiting programme as Telfair's Skink, showed a lack of interest in pellets (Merton 1987). Reluctance to eat bait was also shown by the skink *Oligosoma maccanni* (which is a close relative of the LHI Skink). When lizards in the laboratory were offered cereal-based pellets as their sole source of food, only a relatively small amount of bait was consumed (Freeman *et al*. 1996). However, two species of New Zealand geckos have been observed consuming Brodifacoum baits (Christmas 1995; Hoare and Hare 2006).

The two LHI species are considered at risk of ingesting Brodifacoum if they feed on invertebrates that have themselves fed on Brodifacoum-laced baits. However the risk of secondary poisoning for these species is low because:

- baiting will take place in winter when reptiles may be either dormant, or relatively inactive. Therefore few if any reptiles will be feeding at the time when invertebrates may be carrying Brodifacoum; and
- the proportion of invertebrates that will have fed on Brodifacoum baits will be small so even if they are foraging at this time then most of the potential prey that they will encounter will not be poisoned (on Red Mercury Island for example, no Brodifacoum residue was found in 99% of the sample of invertebrates collected after the aerial application of Brodifacoum baits (Morgan *et al.* 1996);

It is possible that some Lord Howe Skinks and Lord Howe Geckos may be exposed to either primary or secondary poisoning. This could lead to some deaths, but the overall effect on the species will not be detrimental and a significant impact is considered unlikely. To the contrary, the world-wide trend for reptiles on islands that have been baited with Brodifacoum to eradicate introduced mammals such as rodents is to greatly increase in number following the removal of predation and competition (Towns 1991, 1994; North *et al*. 1994). This is evidenced on LHI, where the main population of the LHI skink occur at North Bay, which is currently extensively baited for rodents

Table 9: Significant Impacts to EPBC Listed Threatened Terrestrial Reptiles

Terrestrial Reptiles	**EPBC Act Status**	**Significant Impact from the LHI REP**
Lord Howe Island Gecko *Christinus guentheri*	V	No
Lord Howe Island Skink *Oligosoma lichenigera*	V	No

Potential Impacts to Threatened Terrestrial Plants

REP activities with the potential to impact on threatened plants are: works associated with building the captive management facility and bait distribution (through potential uptake of Brodifacoum by plants).

The captive management facility construction will predominantly occur through modification of existing structures and if needed, previously cleared land at the palm nursery within the lowland settlement area. No clearing of land is proposed.

Brodifacoum is not herbicidal, is highly insoluble (WHO, 1995) and binds strongly to soil particles, therefore it is not likely to be transported through soils and taken up by the roots of plants into plant tissues. There is no identified chemical process that would allow Brodifacoum to impact on plants. A literature search failed to find published or verified unpublished data regarding plant uptake or persistence. Sampling of grasses (Poaceae) collected 6 months following application of Brodifacoum cereal baits at 15 kg/ha on Anacapa Island in California during 2001 and 2002 found no detectable residues in the six samples tested (Howald *et al* 2010).

Therefore no impact to EPBC listed plants is expected. Conversely removal of rodents is expected to significantly benefit individual species (such as the Little Mountain Palm and Phillip Island Wheat Grass) and many vegetation communities through reduced predation on developing seeds, seedlings and stems of leaf fronds.

Table 10: Significant Impacts to EPBC Listed Threatened Plants

Plants	**EPBC Act Status**	**Significant Impact from the LHI REP**
Calystegia affinis	CE	No
Phillip Island Wheat Grass *Elymus multiflorus* subsp. *kingianus*	CE	No
Geniostoma huttonii	E	No
Little Mountain Palm , Moorei Palm *Lepidorrhachis mooreana*	CE	No
Rock Shield Fern *Polystichum moorei*	E	No
Xylosma parvifolia	E	No

3.1 (e) Listed migratory species

Description

A Protected Matters Search undertaken on 21/12/15 and combined with Island fauna records has identified 77 bird species listed as Migratory or Marine under the EPBC Act, occurring or with the potential to occur in the project area. These are described in the table below.

Table 11 EPBC Listed Migratory Species Occurring or With the Potential to Occur on the LHIG

Data primarily from DECC (2007), Hutton (1991), McAllan *et al* (2004) and DoE (2016).

Mi= *Migratory* species as listed in various international treaties to which the Australian Government is a signatory.
Ma = *Marine* Species listed under the EPBC Act.
C = *Critically Endangered*
E = *Endangered*.
V = *Vulnerable*.

Species	EPBC Act Status	Type of Presence	Distribution, Abundance and Diet relevant to the LHI REP
Migratory Marine Birds and Migratory Wetland Birds and Listed Marine Birds			
Bar-tailed Godwit *Limosa lapponica*	Mi, Ma	Regular visitor	The Godwit diet consists of crustaceans, molluscs, worms, insects and some plant material. They arrive on LHI from September (Hutton 1991). The Godwit is a summer migrant to LHI in small numbers (McAllan et al. 2004). Most depart from March. Some young non-breeding birds (typically five or less) over-winter on LHI.
Black-browed Albatross *Diomedea melanophris*	V, Mi, Ma	Vagrant	Only three records of occurrence in the LHIG, and all were at sea (McAllan et al. 2004). This species feeds on fish and squid.
Black-naped Tern *Sterna sumatrana*	Mi, Ma	Vagrant	Only one bird has been recorded on the LHIG (in April 1989) (McAllan et al. 2004).
Black-tailed Godwit *Limosa limosa*	Mi, Ma	Irregular visitor	The five records of this species seen on LHI are confined to the spring and summer months (McAllan et al. 2004).
Black-winged Petrel *Pterodroma nigripennis*	Ma	Regular visitor	It is absent from the LHIG from May to October (McAllan et al. 2004). Eradication of rodents will reduce predation during the nesting season and deliver positive impacts.
Brown Booby *Sula leucogaster*	Mi, Ma	Vagrant	Only four birds seen in the vicinity of the LHIG in the period 1971 to 2003 (McAllan et al. 2004. Eats fish.
Brown Noddy *Anous stolidus*	Mi, Ma	Regular visitor	Although present mainly from September to May, Brown Noddies have been seen on the LHIG in all months (NSWBA cited in McAllan et al. 2004). They leave nest early in the morning to surface-skim the sea for fish and small crustaceans (Hutton 1991). They return late in the day. Egg laying commences in October.

Buff-breasted Sandpiper *Tryngites subruficollis*	Mi, Ma	Vagrant	Only one record of this species seen on LHI (circa 1980) (McAllan *et al*. 2004).
Bullers Albatross *Thalassarche bulleri*	V, Mi	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Feeds mainly on squid, supplemented by fish and krill
Campbell Albatross *Thalassarche melanophris impavida*	V, Mi	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Feeds on krill and fish, with some cephalopods, salps and jellyfish.
Caspian Tern *Sterna caspia*	Mi, Ma	Irregular visitor	This tern may be in the area during winter (movements poorly known), although the only two birds seen on the LHIG were recorded in September through to November (McAllan et al. 2004). Mostly feed at sea on a diet consisting of fish. Some insects (taken in pastures) are consumed.
Cattle Egret *Ardea ibis*	Mi, Ma	Regular visitor	Eats invertebrates, lizards, frogs and fish. Prey items usually < 3 cm. Typically birds migrating between Australia and New Zealand stop over on LHI in May-June and October to December, although a small number may over-winter on LHI (Hutton 1991).
Chatham Albatross *Thalassarche eremita*	E, Mi, Ma	Vagrant/irregular visitor; seabird	Known to forage over deep water in the area on probably eats fish and cephalopods.
Common Greenshank *Tringa nebularia*	Mi, Ma	Vagrant/irregular visitor; wader	There have only been 13 sightings of this species on LHI between 1963 and 2003 (McAllan et al. 2004); all but one occurred in the months October to March. One record (of one individual) is from July 1992. Although their diet is mostly crustaceans, molluscs, insects, fish and frogs, they have been recorded eating rodents.
Common Sandpiper *Tringa hypoleucos*	Mi, Ma	Vagrant/irregular visitor; wader	There are nine positive records, mostly of one or two birds, from LHI covering the period 1959-2002, and from the months November to March.
Common Tern *Sterna hirundo*	Mi, Ma	Irregular visitor	The five birds found on the LHI (1915-1967) were all recorded as summer visitors (McAllan et al. 2004).
Curlew Sandpiper *Calidris ferruginea*	CE, Ma, Mi	Vagrant/irregular visitor; wader	There have been 12 or so sightings of the Curlew Sandpiper on LHI from 1963 to 2002, although some may be multiple records of the same individual (McAllan *et al.* 2004). Most of the sightings were made over the spring to autumn period but one was noted in late August. Foraging on tidal flats, its diet is made up of worms, molluscs, crustaceans, insects, small fish and seeds.
Double-banded Plover *Charadrius bicinctus*	Mi, Ma	Regular visitor	It feeds on insects caught on lawns, and on marine worms and crustaceans taken at low tide along beaches. A small number of these plovers (approximately 6) are seen on LHI between February and July (Hutton 1991).
Eastern Curlew *Numenius madagascariensis*	CE, Mi, Ma	Regular visitor	Records of the Eastern Curlew on LHI are for Autumn (March and April), Spring (September and November) and Summer. There is no indication that the species is on LHI in June-August. The Eastern Curlew is carnivorous, mainly eating crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects

Eastern Great Egret *Ardea modesta*	Mi, Ma	Irregular visitor	Eats invertebrates, lizards, frogs, fish and birds. Prey items usually < 15 cm. Only ten Great Egrets reported on LHI since the 1930s (McAllan *et al.* 2004).
Eastern Reef Egret *Egretta sacra*	Ma	Vagrant; land bird	Only one record from the LHIG (McAllan *et al.* 2004). Eats mainly fish, some crustaceans, molluscs, lizards, noddy chicks. Food items < 15 cm.
Flesh-footed Shearwater *Ardenna carneipes*	Mi, Ma	Regular visitor	This deep-sea fish-eater arrives at LHI in August and departs in May (McAllan *et al.* 2004).
Fork-tailed Swift *Apus pacificus*	Mi, Ma	Vagrant; land bird	An insectivorous bird only recorded on LHI in November 1971 (McAllan *et al.* 2004).
Glossy Ibis *Plegadis falcinellus*	Mi, Ma	Vagrant; land bird	Food is mostly aquatic invertebrates and insects, some fish, rice seed. Only one record for LHI.
Gould's Petrel *Pterodroma leucoptera*	E, Ma	Vagrant	Only two at-sea records and one beach-wash record for this species. Diet of the species as a whole includes squid and fish.
Great Knot *Calidris tenuirostris*	Mi, Ma	Vagrant	Only one bird recorded on the LHIG, and that was in November, 2002.
Greater Sand Plover *Charadrius leschenaultii*	Mi, Ma	Vagrant	The three records for this species, spanning 1914 to 2002, are confined to Spring and Summer.
Grey Plover *Pluvialis squatarola*	Mi, Ma	Vagrant	Low numbers of birds recorded (two from November 1959 and one from January 1971).
Grey-tailed Tattler *Heteroscelus brevipes*	Mi, Ma	Regular visitor	Tattlers feed on crustaceans and other invertebrates on mudflats. In over a hundred years of records for LHI, only three tattlers were seen in August and four in September; all other sightings (> 37) were reported in the months November to April.
Grey Ternlet *Procelsterna cerulea*	Ma	Resident	These ternlets are present on the LHIG all year round (Hutton 1991). Nesting takes place from late August, eggs are laid in September and October (McAllan et al. 2004) and chicks fledge in December/ January (Hutton 1991). Their food consists of small fish and crustaceans collected from the sea surface.
Latham's Snipe *Gallinago hardwickii*	Mi, Ma	Regular visitor	There are no reports of this species being on the LHIG in August; most records are for the period November to May but "several" were recorded in September 1963 (McAllan et al. 2004). From 1956 to 1989 there have been 13 sightings of about 40 birds. (McAllan et al. 2004).
Least or Lesser Frigatebird *Fregata ariel*	Mi, Ma	Vagrant	The only positive record of occurrence on the LHIG is from 1915. There are two possible sightings from the 1970s, but at least one of these was during cyclonic conditions (McAllan et al. 2004), possibly suggesting that the frigate had been blown to the area. Diet consists of fish.

Lesser Sand Plover *Charadrius mongolus*	Mi, Ma	Irregular visitor	Approximately 23 Lesser Sand Plovers have been recorded on LHI between 1977 and 2003 (McAllan et al. 2004). Of the 13 records, dates on which the birds were seen are given for 11, all of which are confined to October to April.
Little Curlew *Numenius minutus*	Mi, Ma	Irregular visitor	Only seven records of this species on LHI; and these are for the months from November to March.
Little Shearwater *Puffinus assimilis*	Ma	Regular visitor	Present on the LHIG February to October. Nests are in burrows. Most eggs are laid in July with the bulk of hatchings occurring in late August (Hutton 1991). The birds feed at sea, returning after sunset to feed their young. They depart before sunrise. Rodents are restricting the capacity of this species to recolonise the main island. The species is expected to benefit from the eradication.
Little Tern *Sternula albifrons*	Mi, Ma	Vagrant	The five individuals recorded on LHI from 1967 to 2003 were seen in the period October to March (McAllan et al. 2004). Also their diet consists of mainly fish (but also crustaceans, insects and molluscs) collected by diving into the sea or gleaning from its surface.
Long-tailed Jaeger *Stercorarius pomarinus*	Mi, Ma	Vagrant	Only two birds recorded for the LHIG; one in April 1975, the other in March 2002.
Marsh Sandpiper *Tringa stagnatilis*	Mi, Ma	Vagrant	Only four birds seen on LHI between 1977 and 1998 (McAllan et al. 2004).
Masked Booby *Sula dactylatra tasmani*	Mi, Ma	Resident	On LHI year round. Breeds from June to February with most egg laying occurring in December. LHI is the most southerly breeding colony of boobies in the world (McAllan et al. 2004). This sub-species breed only on the Lord Howe, Norfolk and Kermadec island groups (McAllan et al. 2004). The birds feed at sea.
Northern Giant Petrel *Macronectes halli*	V, Mi	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). The Northern Giant-Petrel eats seal, whale, and penguin carrion, and seal placentae. It also eats substantial quantities of krill and other crustaceans, octopus, squid and fish. It will kill and eat immature *Albatross Diomedea*, and a variety of other seabirds, which are either consumed as carrion or captured at sea.
Northern Royal Albatross *Diomedea epomophora sanfordi*	E, Mi	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Feeds primarily on cephalopods, fish, crustaceans and salps.
Oriental Cuckoo *Cuculus saturatus*	Mi, Ma	Vagrant	Recorded on LHI in December 1913 and between February and May 1915.
Oriental Plover *Charadrius veredus*	Mi, Ma	Vagrant	Recorded on LHI twice. Up to 53 birds were reported in September 1982 and one bird seen in November 2002 (McAllan et al. 2004).
Oriental Pratincole *Glareola maldivarum*	Mi, Ma	Vagrant	There are only two records (each for one bird) for this species on LHI (circa 1979 and 1987) (McAllan et al. 2004).

Pacific Golden Plover *Pluvialis fulva*	Mi, Ma	Regular visitor	They arrive on LHI in September and leave in April, although some, less than 10, over-winter. They feed on insects, molluscs, crustaceans and some plant material (Hutton 1991).
Painted Snipe *Rostratula benghalensis*	E, Mi	Vagrant	There has only been one Painted Snipe recorded on LHI, and that was in February 1990. Feeds on vegetation, seeds, insects, worms and molluscs, crustaceans and other invertebrates.
Pectoral Sandpiper *Calidris melanotos*	Mi, Ma	Vagrant	The first record of a Pectoral Sandpiper on LHI is from 1945 (McAllan et al. 2004). Another four have been recorded up to 2003. These five birds were present on LHI during Spring to Autumn. They are a summer migrant so will be on eggs in Siberia.
Providence Petrel *Pterodroma solandri*	Mi, Ma	Regular visitor	Found on LHI year-round (McAllan et al. 2004). The Providence Petrel feeds at sea. It is present in its breeding grounds (the two southern mountains) from March to November. In August, Providence Petrels will be tending young in the nest underground so breeding birds will not be in the area until late afternoon/evening. However, non-breeders will be present during the days until mid-August (Hutton 1991).
Rainbow Bee-eater *Merops ornatus*	Mi, Ma	Vagrant	One bird seen in August 1990.
Red Knot *Calidris canutus*	Mi, Ma	Rare regular visitor	Records of Red Knot occurrence on LHI suggest only a few birds (one to three) may be on the island in any one Spring and "it is evident that either the (Lord Howe Island) Group is not on the regular migration path (between Australia and New Zealand) of the species or the Red Knot rarely needs to stop during migration" (McAllan et al. 2004, page 42).
Red-footed Booby *Sula sula*	Mi, Ma	Vagrant	Only one individual has been recorded on the LHIG (in February 1974) (McAllan et al. 2004).
Red-necked Stint *Calidris ruficollis*	Mi, Ma	Rare regular visitor	Records suggest that low numbers of Red-necked Stints (one to three individuals) are likely to be present on LHI over Spring to Autumn (McAllan et al. 2004).
Red-tailed Tropicbird *Phaethon rubricauda*	Mi, Ma	Regular visitor	Summer-breeder; with about 500 to 1000 pairs being active. Only a few birds are present during the winter months (McAllan et al. 2004).
Ruddy Turnstone *Arenaria interpres*	Mi, Ma	Regular visitor	Begin to arrive on LHI in September and most have left by April. A few remain (10-20) to over winter (Hutton 1991). They eat crustaceans, molluscs and worms sheltering under organic debris such as seaweed (Hutton 1991). Main foraging habitat is exposed sea grass beds. Turnstones will also eat carrion.
Salvin's Albatross *Thalassarche cauta salvini*	V, Mi	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Eats squid and fish.
Sooty Tern *Onychoprion fuscata*	Ma		This species has been recorded on the LHIG in all months but it is most common from August to February (Hutton 1991). Sooty Terns only feed at sea.

Sharp-tailed Sandpiper *Calidris acuminata*	Mi, Ma	Regular visitor	Records suggest that low numbers of Sandpipers (one to four individuals) are likely to be present on LHI over Spring and Summer (McAllan *et al*. 2004).
Short-tailed Shearwater *Puffinus tenuirostris*	Mi, Ma	Vagrant	Apart from five beachcast specimens found on LHI, all sightings, about 100+ birds, have been recorded off Balls Pyramid or between this island and LHI (McAllan *et al*. 2004). All sightings at sea were made in September or October, while the beachcast birds were found in December or January. Feeds at sea on a diet of fish and squid.
Shy Albatross *Thalassarche cauta cauta*	V, Mi	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). The main foods of the Shy Albatross are fish, squid, crustaceans and tunicates.
Sooty Shearwater *Puffinus griseus*	Mi, Ma	Vagrant	Apart from a beachcast shearwater found in November 1964 and three seen off Balls Pyramid in October 1999, there are no other records of this species in the LHIG.
Southern Giant Petrel *Macronectes giganteus*	E, Mi, Ma	Vagrant	Only four confirmed records for LHI; all prior to 1965, three of which were beach-cast specimens. There are reports of sightings on Balls Pyramid between 1978-1980 (McAllan *et al*. 2004). The Southern Giant-Petrel is an opportunist scavenger and predator. In summer at least, it will scavenge primarily penguin carcasses, although it will also feed on seal and whale carrion. It catches and kills live birds. It is also recorded consuming octopus, squids, krill other crustaceans, kelp, fish, jellyfish, and rabbit.
Southern Royal Albatross *Diomedea epomophora epomophora*	V, Mi	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). Feeds primarily on squid and fish.
Swift Parrot *Lathamus discolor*	E, Ma	Vagrant	One record only from LHI and that is of a dead bird found in 1968. Feeds on nectar, mainly from eucalypts, but also eats psyllid insects and lerps, seeds and fruit.
Terek Sandpiper *Xenus cinereus*	Mi, Ma	Vagrant	Only five Terek Sandpipers seen on LHI from 1959 to 1991 (McAllan *et al*. 2004). The four records that have dates are for Spring and Summer.
Wandering or Snowy Albatross *Diomedea exulans* (sensu lato) Amsterdam Albatross *Diomedea amsterdamensis* Antipodean Albatross *Diomedea antipodensis* Tristan Albatross *Diomedea dabbenena* Gibson's Albatross *Diomedea antipodensis gibsoni*	V, Mi, Ma	Vagrant	Only five records of occurrence in the LHIG, sub species unknown. Three were at sea, several kilometres from LHI, one was seen from LHI and one was found washed up on Blinky Beach. This species feeds on fish and squid.
Wandering Tattler	Mi, Ma	Regular visitor	Records indicate that this bird may be present on LHI only over late Summer and Autumn.

Tringa incana			
Wedge-tailed Shearwater *Puffinus pacificus*	Mi, MA	Regular visitor	Small numbers arrive at breeding sites on LHI in late August, but the bulk of the population (10,000- 100,000 pairs) only arrives in mid to late September. Adults depart April, chicks leave in May. Feeds at sea in deep water. Birds return to the island and their burrows on or after dusk.
Westland Petrel *Procellaria westlandica*	Mi, Ma	Vagrant	Only one at-sea record for this species for the LHIG.
Whimbrel *Numenius phaeopus*	Mi, Ma	Regular visitor	This bird is a summer migrant to LHI in small numbers (McAllan et al. 2004). Some (typically only one or two birds) over-winter. Diet is mostly limited to worms, molluscs, crustaceans, insects, reptiles, tern chicks and seeds.
Whiskered Tern *Chlidonias leucoptera*	Mi, Ma	Vagrant	Several sightings in December 1999 were probably of the same bird. Apart from that December set of records, there have been no other sightings on the LHIG.
White-bellied Storm-petrel *Fregetta grallaria*	V, Ma	Regular visitor	The White-bellied Storm-petrel is present on the LHIG from September but mainly from December to May. It feeds at sea on feeds on small crustaceans and squid, and visits its nesting burrows only during the night. Breeding is currently restricted to offshore islets due to rodent predation.
White-capped Albatross *Thalassarche cauta steadi*	V, Mi	Rare visitor; seabird	Low numbers occasionally recorded at sea during winter around island but not recorded on Island, (Hutton pers comms, 2016). The White-capped Albatross probably has a diet of inshore cephalopods (squid) and fish.
White-tailed Tropicbird *Phaethon lepturus*	Mi, Ma	Vagrant	The seven records of this species, from 1890 to 2003, suggest that if this species was to visit the LHIG it would be sometime from February to May (McAllan *et al*. 2004). Diet consists of fish caught offshore.
White Tern *Gygis alba*	Ma	Regular visitor	On LHI the White Tern is generally present from October to May. Although recorded in all months, it is usually absent from the island group from June to September. About 60-100 pairs nest annually on LHI. Its diet consists of small fish and squid.
White-throated Needletail *Hirundapus caudacutus*	Mi, Ma	Irregular visitor	An insectivorous bird that may be present between September and April.
White-winged Black Tern *Chlidonias leucopterus*	Mi, Ma	Irregular visitor	The six sets of records, totalling 30 or so birds, cover the years 1915 to 2003 (McAllan *et al*. 2004). All sightings spanned November to February.
Wilson's Storm- petrel *Oceanites oceanicus*	Mi, Ma	Vagrant	Only one record; a bird seen near Balls Pyramid in March 2002 (McAllan *et al*. 2004).
Migratory Marine Species			
Antarctic Minke Whale *Balaenoptera bonaerensis*	Mi	Rare visitor	May transit waters around the LHIG
Brysdes Whale *Balaenoptera edeni*	Mi	Rare visitor	May transit waters around the LHIG
Blue Whale *Balaenoptera musculus*	E, Mi	Rare visitor	May transit waters around the LHIG
Pygmy right whale *Caperea margniata*	Mi	Rare visitor	May transit waters around the LHIG
Great White Shark *Carcharodon carcharias*	V, Mi	Recorded with the LHI Marine Park	Occasionally recorded in waters around the LHIG
Loggerhead Turtle	E, Mi	Recorded	Occasionally recorded in waters around the LHIG as a visitor in the park during trans-

Caretta caretta		Vagrant/irregular visitor; Marine Reptile	Pacific migrations. Loggerheads are carnivorous, eating shellfish, crabs, sea urchins and jellyfish. No nesting recorded on the LHIG.
Green Turtle *Chelonia mydas*	V, Mi	Recorded Vagrant/irregular visitor; Marine Reptile	In the LHIG, Green turtles regularly occur from the sheltered habitats of the lagoon through to the offshore fringing reefs and deeper shelf waters of the park. Feeds predominantly on seagrass and algae. No nesting recorded on the LHIG.
Leatherback Turtle *Dermochelys coriacea*	E, Mi	Recorded Vagrant/irregular visitor; Marine Reptile	Has been sighted very occasionally in waters around the LHIG and is likely to migrate periodically through the park's waters; it has a carnivorous diet consisting of jellyfish and other soft-bodied invertebrates. No nesting recorded on the LHIG.
Hawksbill Turtle *Eretmochelys imbricata*	V, Mi	Recorded Vagrant/irregular visitor; Marine Reptile	Occasionally recorded in waters around the LHIG and is also observed in the lagoon. It feeds primarily on sponges but also consumes seagrasses, algae, soft corals and shellfish. No nesting recorded on the LHIG.
Southern Right Whale *Eubalaena australis*	E, Mi	Rare visitor	May transit waters around the LHIG
Dusky Dolphin *Lagenorhynchus obscurus*	Mi	Rare visitor	May transit waters around the LHIG
Mackerel Shark *Lamna Nasus*	Mi	Rare visitor	Occasionally recorded in waters around the LHIG
Reef Manta Ray *Manta alfredi*	Mi	Rare visitor	Occasionally recorded in waters around the LHIG
Giant Manta ray *Manta birostris*	Mi	Rare visitor	Occasionally recorded in waters around the LHIG
Humpback Whale *Megaptera novaeangliae*	V, Mi	Recorded Vagrant/irregular visitor; Marine Mammal	Occasionally recorded in waters around the LHIG
Flatback Turtle *Natator depressus*	V, Mi	Recorded Vagrant/irregular visitor; Marine Reptile	Rarely recorded in waters around the LHIG. No nesting recorded on the LHIG.
Killer Whale *Orcinus Orca*	Mi	Rare visitor	May transit waters around the LHIG
Sperm Whale Physeter macrocephalus	V, Mi	Recorded Vagrant/irregular visitor; Marine Mammal	Occasionally recorded in waters around the LHIG