Section 4.1D Effects on the Environment

This section contains the registers which identify effects on the environment. The "environment" includes soil, water (surface water and groundwater), plants and animals. This assessment is only concerned with effects on **native animals**. Potential effects on farmed animals and wild animals that are hunted have been assessed in the market economy registers (Section 4.1A), in respect of financial effects, and in the social and community registers (Section 4.1B), in respect of emotional effects. Potential effects on working animals (such as farm dogs) and pets have also been assessed in those registers.

1. Assessment of Benefits

The assessment of benefits to the environment is based on the relative benefit between future scenarios WITH 1080 and WITHOUT 1080, as described in the Pest Control Scenarios section of the application, over a timeframe of approximately 10 years (2006-2015).

Each benefit was assessed by asking the following questions:

What is the relative likelihood that the benefit will occur WITH 1080 compared to WITHOUT 1080?

What is the magnitude of the benefit when the effect WITH 1080 is compared to the effect WITHOUT 1080?

2. Assessment of Adverse Effects

Adverse effects on the environment have been assessed differently to the benefits, which assessed the relative effect by comparing the future WITH 1080 and WITHOUT 1080. In this section, as in the assessment of adverse effects on human health and safety, the adverse effects on the environment have been assessed separately for a future WITH 1080 and a future WITHOUT 1080, using the same magnitude and likelihood matrices. This is because the effects of hazardous substances on the environment vary throughout the lifecycle of the substance, and may vary with substance formulation.

There are therefore two registers in this section identifying adverse effects: one, the adverse effects WITH 1080 (that is, the adverse effects of the use 1080 on the environment), and the other, the adverse effects WITHOUT 1080 (that is, the adverse effects of the use of cyanide and traps on the environment).

Assessing the effects throughout the lifecycle

Each register has been divided into the different activities that result in the substance being released into the environment throughout it's lifecycle. The lifecycle of 1080 is described in Section 3.5 of the application, and the register of adverse effects WITH 1080 is divided into the following major activities:

Transport to manufacturing site

Manufacture

Application (aerial and ground application)

Disposal

These are the same as used in Section 4.1C – Effects on Human Health and Safety. A similar approach has been used in the register of adverse effects WITHOUT 1080, for cyanide, as the lifecycle of cyanide is similar to that of 1080, with the exception that there is no aerial application of cyanide. The assessment of adverse effects from the use of traps has been made only for the "application" phase of the lifecycle (the use of traps).

Assessing how the environment may be exposed to the substance

In addition to the consideration of lifecycle, risk assessment considers the type of receptors, in this case environmental receptors, that may be exposed to the substance.

The "environment" includes soil, water (surface water and groundwater), plants and animals. As stated at the beginning of this section, this assessment is only concerned with effects on **native animals**. The native animals considered in the assessment are :

- native birds
- native mammals (native bats)
- invertebrates (terrestrial and freshwater)
- herpetofauna (native frogs and lizards)
- freshwater vertebrates

In some cases, effects on native birds have been assessed separately depending on their particular characteristics. For example, tomtits have been assessed separately in the register of effects WITH 1080 due to their higher susceptibility to 1080 coated baits compared to other birds. Ground birds, particularly weka, have been assessed separately in the register of adverse effects WITHOUT 1080 due to their susceptibility to some applications of cyanide and trapping.

Effects on the environment have been assessed on a formulation and method-specific basis, depending on the environmental receptors that may be exposed and the exposure pathways.

Aerial application of either pellets or coated baits results in the most indiscriminant application, therefore this application method has the greatest potential for environmental exposure. Most studies on the environmental effects of 1080 use are of aerial applications, as these form such an important and significant part of the pest control agencies operations.

The potential for 1080 to enter a water system only occurs during aerial operations. The controls on aerial applications require that Ministry of Health approval be given for operations in catchment areas from which potable water is supplied, and in practice this means that aircraft flight patterns are routed to avoid major water bodies, in order to minimise the potential for human health effects. However pellets may fall into smaller streams or ephemeral streams. The assessment of potential environmental exposure to 1080 in water has therefore been assessed for aerial operations only (which may be either pellet or coated baits). During ground operations, baits are not placed in or near water.

The assessment of **ground operations** has been divided into uncontained and contained application methods:

Uncontained application methods (such as hand-broadcast of pellets, application of pastes, gels to natural features) provide no physical barrier to contact. They are virtually the same as aerial operations, with the exception that the scale of the operation is less (covers less ground) and placement by pest control workers is targetted at specific locations or natural features to maximise pest exposure to the bait. All environmental receptors may come into contact with any of the formulations used by such methods (except for water and freshwater vertebrates/invertebrates).

Contained application methods include bait stations and bait bags where the poison is not open to the environment. There is no or minimal exposure of any 1080 formulation that is used in a contained application method to soil, water or plants. Similarly, potential for native animals to come into contact with 1080 in any formulation that is contained is minimal, or insignificant compared to uncontained applications. The exception is ground birds, particularly weka, that are inquisitive and susceptible in particular to some formulations of cyanide.

Indirect (secondary) effects occur when the exposure to the substance is not direct exposure but via another medium, for example, meat from an animal that has been poisoned or has been exposed to a sub-lethal dose of the poison. Secondary effects may occur following either aerial or ground control operations, using any of the poison formulations. These indirect pathways have therefore been assessed only once in the register; the assessment applies to all formulations and all application methods.

Significant Effects

Significant effects that have been identified in these registers have been discussed further in Section 4.2. The relative adverse effects between the WITH 1080 and WITHOUT 1080 scenarios have been compared in the Overall Evaluation (Section 4.6 of the Application).

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
Benefits to native flora species and ecosystem level effects					
Reduction in populations of pest species use attributable to 1080 use through targeted kill, integrated pest management or by-kill. Browsing/grazing animals that feed on native plant species include: possums, wallabies, ungulates (e.g. deer and goats), rats, rabbits, and hares. They damage the vegetation canopy and under-storey, browsing on seedlings, leaves, flowers, fruits and new growth. Possums, rodents, cats and mustelids (stoats, weasels and ferrets) also prey on native species (birds, lizards, invertebrates) that have important relationships with native flora e.g. aid in seed dispersal, fertilisation, and other symbiotic, or mutualistic relationships.					
E-B1	Increased protection of vulnerable plant species from browsing by pest species and resulting biodiversity benefits	Very likely	Extreme	F	The impacts possums and other introduced browsing animals have had on New Zealand's forests have been extensively documented. Where possums preferentially feed on the canopy species such as rata (*Metrosideros robusta* and *M umbellata*), pohutukawa (*Metrosideros excelsa*); kohekohe (*Dysoxylum spectabile*), kamahi (*Weinmannia racimosa*), Halls totara (*Podocarpus hallii*) and pahautea (*Libocedrus bidwillii*), they can kill the trees by defoliation over a period of several years. This can result in the loss of these species from the canopy and, where the preferred species are dominant, canopy collapse. As a result of possums and other introduced species browsing on species such as mahoe (*Melicytus ramiflorus)*, pate (*Schefflera digitata*) and tree fuchsia (*Fuchsia excorticata*) the composition and regeneration of forest under-storeys have been highly modified. The range and population sizes of a number of native plants (e.g. mistletoe, *Dactylanthus taylori*, kaka beak (*Clianthus puniceus*) and *Pittosporum patulum* have been extensively reduced as a direct consequence of browsing by introduced animals. This has led to these species being classified as chronically or acutely threatened. Continued browsing will potentially lead to the extinction of these species at either a local or national level. WITHOUT 1080 the species composition and regeneration of extensive tracts of forests will become highly modified as possum control would only occur at localised representative sites. The range and numbers of some threatened plants would continue to contract and for some species, the scale of protection would not be sufficient to ensure their long term survival. This is a significant effect and is discussed in section 4.2D Significant Effects.

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
E-B2	Increased protection of native ecosystem health and habitat values	Very likely	Major	E	While change within any ecosystem is inevitable and necessary, change caused by pest species can threaten the health of an ecosystem and the physical and biological resources that define the life-supporting capacity of its habitats (i.e. habitat values). A key impact of pest species browsing or grazing on preferred plant species in forests (as in E-B1) is that the overall composition and structure of forests are changed thereby threatening forest ecosystem health and habitat values. For example it is possible for possums to initiate canopy collapse in forests dominated by northern and southern rata. Ecosystem level impacts also occur with the impact of pest browse on regeneration processes. Possums reduce forest health by browsing or grazing on new shoots, fruits, flowers. Deer and goats also impact on regeneration by eating seedlings and new shoots. A study by Green (2003) considered 70 monitoring reports from mostly aerial operations. The overall finding was that the use of 1080 has clearly benefited native forest habitat and health at many different levels from the understorey to canopy level. This is a significant effect and is discussed in section 4.2D Significant Effects.
E-B3	Increased capacity to create and maintain predator-free offshore islands	Likely	Major	D	Preservation of New Zealand's offshore islands is paramount to the nation's conservation efforts because they function as important biological reservoirs for native plants, animals, communities and habitats. Some offshore islands (e.g. Kapiti Island) have had intensive pest control campaigns to create predator-free sanctuaries for native fauna. These sanctuaries have proved very effective in protecting threatened species that are nationally significant such as the kakapo (on Codfish Island), and provide New Zealanders with an opportunity to appreciate restored native ecosystems e.g. open sanctuaries such as Tiritiri Matangi and Ulva islands. While establishing and maintaining predator-free offshore islands is not necessarily dependent on the use of 1080, it is dependent on the ability to select from a range of pest control methods to find the best solution for a given situation. In some offshore island environments 1080 may be the best pest control method to achieve the objectives of the operation. For example, initial decreases in possum and wallaby populations from Rangitoto and Motutapu Island were achieved using 1080 poisoning (Mowbray 2002). This was followed by intensive cyanide poisoning and trapping to achieve eradication. All three pest control methods were required in this instance. Rangitoto Island is recognised as such a unique ecosystem it was allocated to an ecological region of its own under the Protected

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
					Natural Areas Programme, making any benefits to the Island from the use of 1080 of national significance. On Motuihe Island the extremely high population of rabbits was initially knocked down by 1080 poisoning to allow the more costly and intensive rabbit eradication techniques to be deployed effectively. Without the ability to use aerial 1080 poisoning, the eradication would not have been feasible. If 1080 was no longer available for pest control, increased reliance would be placed on remaining pest control methods and the capacity to establish pest-free offshore islands would be threatened. Thus, in a future WITH 1080 it is LIKELY that there will be an increased capacity to create and maintain pest free offshore islands compared to a future WITHOUT 1080. The eradication of pests on offshore islands may not be able to be achieved on some offshore islands where the terrain and pest species mix is suited to initial eradication by 1080, or requires a complete suite of pest control methods to achieve eradication. WITH 1080 there is an increased capacity to create and maintain predator free offshore islands compared to WITHOUT 1080 and the magnitude of the effect is considered MAJOR. Based on the above the likelihood of this benefit occurring is LIKELY (a good chance that it may occur under normal operating conditions). The effect is MAJOR (Long term benefit to localised species and/or ecosystem(s), major benefits to native species or of national significance), therefore the benefit is D (benefits are considerable but do not justify high costs or risks).
Benefits to native animal species (e.g. birds, bats, invertebrates, freshwater vertebrates, herpetofauna)					
Benefits to native birds from a reduction in populations of predators and competitors attributable to 1080 use through targeted kill, integrated pest management or by-kill. Predators of native species include: possums, rodents, cats and mustelids (e.g. stoats and ferrets). These species also prey on native birds species that have important ecological relationships with native plants including seed dispersion, fertilisation, and other symbiotic, or mutualistic relationships. Browsing/grazing animals feed on native plant species and include: possums, wallabies, ungulates (deer and goats), rats, mice, rabbits, hares, wasps and pigs. These animals diminish native fauna habitat values and forest ecosystem functionality as a whole. The combined effect of multiple pest species means conservation impacts are increased and pest management operations require complex planning to achieve desired outcomes.					

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
E-B4	Reduced predation of mohua (yellowhead), kakariki (orange fronted parakeets) and Southern New Zealand dotterel	Extremely likely	Extreme	F	Mohua (*Mohoua ochrocephala*) and kakariki (*Cyanoramphus malherbi*) are acutely threatened species living in South Island beech forests. They are particularly vulnerable to predation during beech mast years when ship rat and stoat numbers irrupt. Aerial 1080 operations are capable of achieving a rapid reduction of these predators when they are at high densities (Innes et al. 1995; Brown et al. 1997; Henderson et al. 1999; Murphy et al. 1999; Alterio 2000). The Southern New Zealand dotterel (*Charadrius obscurus obscurus)* was once widespread in the South Island but now breeds only on the alpine tops of Stewart Island. Numbers declined to a low of 62 in 1992 primarily due to predation of adults by feral cats (and possibly rats) (Dowding 1993). 1080 is the only poison registered to target feral cats. Due to the isolation of nesting sites a toxin is the only feasible option for controlling cats. Since the use of 1080, the dotterel numbers have increased to 253. WITHOUT 1080 the risk of extinction for mohua and kakariki is increased because there is no capability to rapidly respond to large scale rat and stoat irruptions. The risk of extinction for Southern NZ dotterel is also increased as controlling feral cats is dependent 1080. This is a significant effect and will be discussed further in section 4.2D Significant Effects.
E-B5	Reduced predation of native birds, particularly threatened species (excluding mohua, kakariki and Southern New Zealand dotterel)	Extremely Likely	Major	F	Predators such as possums, feral cats, rats and mustelids (particularly stoats) prey on adult birds, chicks and eggs, threatening individuals and population stability. Aerial 1080 operations can effectively kill possums, ship rats and stoats (Innes et al. 1995; Brown et al. 1997; Henderson et al. 1999; Murphy et al. 1999; Alterio 2000). Acutely threatened species that are expected to benefit from aerial 1080 operations include the North Island kokako (*Callaeas cinerea*), North Island kaka (*Nestor meridonalis septentrionalis*), South Island kaka (*Nestor meridonalis meridonalis*), and Rowi/Okarito brown kiwi (*Apteryx mantelli* (Okarito)). Chronically threatened species that are expected to benefit from aerial 1080 operations include the North Island brown kiwi (*Apteryx mantelli*), South Island brown kiwi (*Apteryx australis),* great spotted kiwi (*Apteryx haastii*) and kereru/kukupa (*Hemiphaga novaeseelandiae novaeseelandiae*). Birds that are not threatened but are expected to benefit from aerial 1080 operations include tui (*Prosthemadera novaseelandiae novaseelandiae*), bellbird (*Anthornis melanura melanura*),

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
					fantail (*Rhipidura fuliginosa)*, whitehead (*Mohuoa albicilla*), North Island robin (*Petrocia australis longipes*) and tomtit *(Petroica macrocephala)* (Pest Control Context). WITHOUT 1080, kokako and kaka populations will only be secure in a smaller number of restricted sites. This places pressure on the long term survival of the species if the gene pool of surviving populations is too small. Where pest control is not undertaken populations will continue to retract and local extinctions may result. Other acutely threatened species may be affected in similar ways to a lesser extent. WITHOUT 1080, kiwi will be dependent solely on ground control and are likely to continue declining over their natural range outside sanctuaries. WITHOUT 1080, current efforts to provide gains for other bird species such as tomtit, whitehead and kereru though 1080 operations would not be realised. This is a significant effect and will be discussed further in section 4.2D Significant Effects.
E-B6	Reduced competition for food supply and some habitat resources for native birds particularly threatened species	Very Likely	Major	E	Possums feed on flowers, fruit and invertebrates, reducing food supply for many native birds. Rats, and mice are also significant competitors for food. Frugivorous birds are particularly susceptible to competition from possums (King 1990) as are honeyeaters. The loss of flowers reduces nectar availability for chicks and adults of many native honeyeaters e.g. tui. Loss of fruits reduces food supply for birds and invertebrates e.g. for kaka and kereru affecting bird breeding condition and nesting success. Possums also compete for nest sites with hole nesting birds such as kaka. Insectivorous birds may suffer competition for invertebrates and all native birds suffer from degraded habitat caused by possums or other pests. Many NZ invertebrates are host specific, meaning that possums depleting preferred plant species will as a consequence be affecting the invertebrates which depend on those plants exclusively for habitat. The honeydew beech forests of the upper South Island are particularly vulnerable to wasps (*Vespula spp*) harvesting the honeydew in direct competition with native birds such as kaka. Wasps also prey directly on native invertebrate fauna of the forest. It is likely that there will be reduced diversity of species, decreasing security and an increase in local extinctions of threatened species in areas that are not able to be managed for pests WITHOUT 1080. Competition is reponsible for many of these threats to native bird species.

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
					This is a significant effect and will be discussed further in section 4.2D Significant Effects.
Benefits to native bats from a reduction in populations of predators and competitors attributable to pest control through targeted kill, integrated pest management or by-kill					
E-B7	Reduced predation of, and competition for food supply for native short-tailed and long-tailed bats	Likely	Minor	B	Predation from rats, possums and mustelids (particularly stoats) are a potential threat to lesser-short tailed bat (*Mystacina tuberculata*) and long tailed bat (*Chalinolobus tuberculatus*) populations. Both bats are classified as threatened, and may face extinction if conservation management is not successful. Rats are believed to have caused the extinction of one species of bat on the North, South and Stewart Islands (Lloyd 2005). Video monitoring of bat roosts has been carried out at a number of sites in New Zealand. Rats, stoats and possums have all been recorded visiting roost entrances and attempting to enter the roost. Usually the entrance is too small for the predator to enter, although stoats have been recorded entering roost holes (B Lloyd pers. comm.). Daniel & Williams (1984) reported that both species of *Mystacina* became extinct on Big South Cape and Solomon Islands following the arrival and irruption of ship rats in 1965. Rats are thought to impact on bat populations through competition for food and direct predation. When young bats are learning to fly, they jump out of the roost and land on the ground, then climb back up the tree to try again. During the few days of this process the young bats are extremely vulnerable to predators. Short-tailed bats are also known to forage for food on the forest floor, making them susceptible to predation. Although no direct predation has been observed or recorded, annual population surveys suggest that survival during high predator years is reduced. There is strong evidence that bat populations suffer significantly during rat and stoat irruptions (Pryde et al 2005). In the Eglington Valley, the average survival rates of female long tailed bats in low and high predator years using model average estimates were 0.59 and 0.79 respectively for adults and 0.72 and 0.47 for juveniles. If the frequency of occurrence of years with high predator numbers continues at the current rate (3 times/10 years), it is predicted that the population will decline on average 5% per year, leading to a high probability of extinction in 50 years. Effective predator control is necessary to avert this decline. Possums and rodents also compete with bats for food such as fruits, nectar and pollen. For example, short tailed bats are potentially significant pollinators of Dactylanthus (*Dactylanthus taylorii)* and bats may rely on its nectar as a food source (Ecroyd 1996). Possums and rats are significant threats to Dactylanthus and compete with bats for the nectar by destroying the

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
					flowers. No monitoring of bats to record benefits to bat populations from 1080 operations could be found. However, given the observed impact of predation by pests on bat populations it is considered that the benefit to bat population viability is likely to exist. It is conservatively estimated that there will be increased predation of bats, and decreasing security of bats in areas of bat habitat that are not able to be managed for pests WITHOUT 1080. Further, as the bats are threatened species, the protection of food sources that aids the survival of even a small proportion of a population is likely to assist bat populations. In the absence of direct evidence of benefits to bats it is estimated that the benefit to bats from a future WITH 1080 is LIKELY, compared to a future WITHOUT 1080. The magnitude of the effect is estimated as MINOR. Based on the above the likelihood of this benefit occurring is LIKELY (a good chance that it may occur under normal operating conditions). The effect is MINOR (localised impact benefiting a few (<10) individuals and local biodiversity, no discernible ecosystem benefit, some benefits to native species), therefore the benefit is B (either insignificant or minor benefit).
Benefits to native herpetofauna species from a reduction in populations of predators and competitors attributable to pest control through targeted kill, integrated pest management or by-kill using 1080					
E-B8	Reduced predation of and competition for food supply for herpetofauna (including native lizards, skinks and frog)	Likely	Minor	B	New Zealand has four native frog species, 17 species of native geckos and 22 species of native skinks that can benefit from pest control. Native lizards, skinks and frogs are vulnerable to predation from rats, mustelids, and feral cats. The consequences of mammalian predation on New Zealand native lizards are evidenced by extinctions, severe range restrictions and population declines (Hoare et al. 2005). Possums, rats and mice are all in competition for food that would be utilised by herpetofauna. Mammalian predators are considered a key threat to herpetofauna based on: • their sheer numbers; • the numbers of common and McCann's skink (*Oligosoma maccanni*) remains found in

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
					ferret, stoat and hedgehog guts (van der Sluijs & Spitzen, 2000); and • the fact that lizard populations respond positively to the removal of mice on offshore islands (Newman 1994). Introduced predators are largely responsible for frog species decline over many decades, pushing frogs into a few remaining refuges where predators may not occur in high densities. Rabbits and hares degrade habitat used by lizards and high numbers of rabbits leads to more rabbit-specialist predators which in turn prey on lizards (Norbury 2001). While 1080 is not currently a key tool for control of rabbits it is likely to become so in the future. If a population of skinks is at a low level it is possible for predation to result in local extinctions (Norbury 2001). Many skink and gecko species have a 'threatened' status. No monitoring of lizard or frog populations to record benefits from 1080 operations could be found. However, given the observed impact of predation by pests on herpetofauna populations (especially lizards) and the vulnerable status of many herpetofauna populations (i.e. all frogs, and some lizards are considered threatened at some level) the protection of a small proportion of a herpetofauna population is likely to be a significant help to threatened herpetofauna species viability. It is likely that there will be increased predation of lizards and possibly frogs, and decreasing security of some herpetofauna populations in areas that cannot be managed for pests WITHOUT 1080. Thus, it is LIKELY that a future WITH 1080 will achieve benefits for native herpetofauna when compared to a future WITHOUT 1080. In the absence of direct evidence, it is estimated that the benefit to herepetofauna from a future WITH 1080 is MINOR. Based on the above the likelihood of this benefit occurring is LIKELY (a good chance that it may occur under normal operating conditions). The effect is MINOR (localised impact benefiting a few (<10) individuals and local biodiversity, no discernible ecosystem benefit, some benefits to native species), therefore the benefit is B (either insignificant or minor benefit).

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
Benefits to invertebrates from a reduction in populations of predators (including wasps) and competitors attributable to pest control through targeted kill, integrated pest management or by-kill					
E-B9	Protection of native invertebrates (particularly threatened species) from predation and reduced competition for food	Likely	Major	D	The major predators of invertebrates are rodents, possums, cats, mustelids and wasps. Large, nocturnal species such as giant weta, stag beetles and weevils are thought to be most at risk from possums and rodents. While invertebrates form a small part of possum diet, at times insect larvae can constitute up to 28% of the contents of a possums stomach (Green 2004). Possums, rats and mice also eat flowers, fruits and leaves that may be an important part of invertebrate diets. There are few data recording the benefits to invertebrate species from the use of 1080. Some insects that browse leaves probably benefit (Veltman 2000). These species probably include weta and at least leaf miners. The latter have been observed to increase on rata leaves after a 1080 operation in Whirinaki Forest Park (Veltman 2000). WITHOUT 1080 it is likely that there will be decreased availability of food supply and habitat for native invertebrate species and increased predation. Increased predation may contribute to an increase in local extinctions in areas where pest management cannot be undertaken WITHOUT 1080. The benefit to invertebrates is LIKELY. While maintaining the overall biodiversity of invertebrates is likely to be similar in a future WITH or WITHOUT 1080, some populations of invertebrates may become locally extinct WITHOUT 1080. The benefits in a future WITH 1080 are therefore MAJOR compared to WITHOUT 1080. Based on the above, the likelihood of this benefit occurring is LIKELY (a good chance that it will occur under normal operating conditions). The effect is MAJOR (long term benefit to localised species), therefore the benefit is D (benefits are considerable but do not justify high costs or risks.
E-B10	Protection of *Powelliphanta* land snails from predation	Very likely	Major	E	Population decline of the iconic *Powelliphanta* land snails (large-bodied land snails) is attributed largely to possum and rat predation. Many populations of extant species of *Powelliphanta* have been lost in the last 150 years as a result of vegetation clearance. However, the primary cause of the snails' decline is now introduced possums, ship rats, pigs, and less frequently thrushes and hedgehogs preying on

BENEFITS REGISTER					
ID	**Effect**	**How likely?**	**Magnitude of effect**	**Level of benefit**	**Explanation**
					eggs, juveniles and adults year round (Walker 2003). WITHOUT 1080, DOC would be unable to protect the small, widely scattered populations in large remote forest blocks. This is a significant effect and is discussed in Section 4.2.
Native fish, eels and freshwater invertebrates: No direct benefits identified other than a general benefit from improved ecosystem health and biodiversity					
E-B11	Improved habitat for native fish, eels and freshwater invertebrates from enhanced ecosystem services	Likely	Minor	B	The impact of pests on the health of native ecosystems and particularly native forests, can impact on the water quality of waterways. For example increased soil erosion as a result of pest damage to catchment plantings or forest can result in increased sediment loading in waterways in times of heavy rain or flooding. Improved water quality will have positive benefits for survival of native fish, freshwater invertebrates and eels, many of which cannot survive in waterways with low water quality. The government has acknowledged the potential benefit of reduced soil erosion and reduced flooding from pest management by funding the Thames Coast Project. The Project has recognised that the effectiveness of pest control for soil erosion and flood mitigation purposes is dependent on pest numbers being maintained at a low level (Environment Waikato 2000). This has a secondary effect of improving water quality for native fish, eels and freshwater invertebrates in catchments that are treated. It is likely that there will be increased damage to catchment forests and plantings (also see M-B15) in areas that cannot be managed for pests WITHOUT 1080. It is estimated that it is LIKELY that a future WITH 1080 will achieve improved habitat for native fish, eels and freshwater invertebrates from enhanced ecosystem services when compared to a future WITHOUT 1080. In the absence of direct evidence of this benefit it is estimated that the magnitude of the benefit for freshwater fauna WITH 1080 is MINOR. Based on the above the likelihood of this benefit occurring is LIKELY (a good chance that it may occur under normal operating conditions). The effect is MINOR (localised impact benefiting a few (<10) individuals and local biodiversity, no discernible ecosystem benefit, some benefits to native species), therefore the benefit is B (either insignificant or minor benefit).

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
TRANSPORT TO MANUFACTURING SITE						
E-A1	Technical Grade Active (solid powder form)	Transport by road from Port of Auckland to ACP Wanganui manufacturing plant.	No exposure during normal operations as crates containing 1080 are not opened during transit. There is potential for discharge to the environment in event of accident during transport, causing release of packaged goods. *Controls* In the event of an accident an emergency services team will ensure the spill is well contained and cleaned up quickly ensuring minimal impact on the environment. *Risk Profile* The likelihood of human exposure to 1080 occurring during transport is therefore considered to be IMPROBABLE [only occurring in very exceptional circumstances]; the magnitude of effect would be MINOR [low sensitivity to 1080, low environmental impacts, low persistence, rapid breakdown, and present at low concentrations around level of detection] and the risk is therefore assessed as B [either insignificant or minor and not warranting further assessment].	Improbable	Minor	B
E-A2	Stock Solution (200 g/L)	Transported by road from ACP Wanganui to ACP Waimate.	No exposure during normal operations as crate is not opened during transit. Potential for discharge to environment in event of accident during transport, causing release of packaged goods. *Controls* In the event of an accident a rapid response team will ensure the spill is well contained and cleaned up quickly ensuring minimal impact on the environment. *Risk Profile* The likelihood of human exposure to 1080 occurring during transport is therefore considered to be IMPROBABLE [only occurring in very exceptional circumstances]; the magnitude of effect would be MINOR [low sensitivity to 1080, low environmental impacts, low persistence, rapid breakdown, and present at low concentrations around level of detection] and the risk is therefore assessed as B [either insignificant or minor and not warranting further assessment].	Improbable	Minor	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
MANUFACTURE						
Preparation of 1080 products						
E-A3	Active, stock solution 200 g/L.	Preparation of stock solution 200 g/L (in 5 L containers).	None - all activities contained within factory except for waste discharges (see activity E-A9, E-A50 and E-A51).			
E-A4	Pellets (all concentrations); stock solution 200 g/L.	Preparation of pellets 0.4-0.8, 1.0, 1.5-2.0 g/kg (in 25 kg bags).	None - all activities contained within factory except for waste discharges (E-A9, E-A50 and E-A51).			
E-A5	Paste (all concentrations); stock solution 200 g/L.	Preparation of pastes 0.6, 0.8 & 1.5 g/kg (in 20 kg plastic pails).	None - all activities contained within factory except for waste discharges (E-A9, E-A50 and E-A51).			
E-A6	Gels (all concentrations); stock solution 200g/L.	Preparation of gels 1.5, 50, 100 g/kg (in 250g or 500g packs).	None - all activities contained within factory except for waste discharges (E-A9, E-A50 and E-A51).			
Disposal / offsite discharges (normal manufacturing process)						
E-A7	Active and traces of all formulations may be present on disposable items, packaging etc.	Solid waste disposed to landfill, including packaging etc.	**Soil and water within a landfill** 1080 present in waste will decompose relatively quickly, through similar mechanisms for degradation in soil and water (see further discussion on the degradation rates of 1080 in soil and water in E-A14 and E-A15). *Controls* The use of hazardous substances must comply with the relevant Hazardous Substances and New Organisms (HSNO) Regulations for that substance, and the substance registration as approved by the Agricultural Compounds and Veterinary Medicines Group (ACVM), and the New Zealand Food Safety Authority. The HSNO controls applicable to 1080 formulations are contained in Section 3.4 (Default Controls). In particular product labels must describe one or more methods of disposal that comply with the Hazardous Substances (Disposal) Regulations 2001 for waste materials. Further, packaging must be either decontaminated/treated or	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			rendered incapable of containing any substance (hazardous or otherwise). The labels for 1080 products note that product which is surplus or spoiled should be disposed of by burying with other organic material on the active tip face of an appropriately managed landfill or buried within the biologically active layer of soil elsewhere within a secure area. A good covering of earth is also applied over the bait immediately to prevent access by scavenging birds. Animals are also excluded from the landfill as much as possible. *Potential Effects* Soil from three tip/landfill sites was sampled for 1080 residues in 1996-97. The Balgownie landfill in Wanganui had 1080 residues ranged from 330–930 mg/kg (n=2). Winton tip, central Southland had 1080 residues ranged from 50-1450 mg/kg (n=4) and at an unspecified landfill site 1080 residues ranged from 0.0008-3 mg/kg (n=11) (VPRD 2002). It is unlikely that these levels of 1080 would pose a risk in a landfill environment due to degradation rates. Leachate from a landfill may enter groundwater, and could contain trace amounts of 1080 as a result of dissolution of 1080 from the waste. Monitoring a landfill site in Winton, central Southland was undertaken following burial of 12000 kg of 1080 bait which had expired. 1080 was detected in 5 of 28 groundwater samples analysed. The amount of 1080 in groundwater sampled 5 and 13 metres from the disposal site decreased until none was detected after 10 months (Bowman 1999). *Risk Profile* Based on the above, the likelihood of this exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions]. The effect would be MINIMAL [no persistence, below detection limits, and negligible environmental impact] therefore the risk is D [risks within the ALARP band (As Low as Reasonably Practicable and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A8	Active and traces of all formulations may be present on disposable items,	Solid Waste disposed to landfill, including packaging etc.	**Fauna within a landfill** Fauna within a landfill may be exposed through direct ingestion of waste material contaminated with 1080 residues from solid waste from 1080 product manufacturing	Unlikely	Minor	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
	packaging etc.		processes. *Controls* Refer E-A7 for controls that reduce exposure to fauna within a landfill. *Potential Effects* However, some animals may still be present in the landfill i.e. gulls, mice, cats (especially feral cats), and possums. As most of these species are pest species no further assessment is required for them. Domestic cats and gulls are not considered pest species so it necessary to consider effects on these species. While domestic cats are considered unlikely to be present in a landfill refer to S-A6 for the effects of 1080 on cats and E-A17 for a worse case scenario (1080 pellet aerial application) of effects on gulls. *Risk Profile* Based on the above the likelihood of this exposure occurring is UNLIKELY [could occur, but is not expected to occur under normal operating conditions]. The effect would be MINOR [sub-lethal to some non-target individuals within a population, limited but medium term effects, no biodiversity loss, highly localised impact, and lethal to some non-target individuals at a local level] therefore the risk is D [risks within the ALARP band (As Low as Reasonably Practicable and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A9	Active, stock solution 200 g/L (in solution, diluted with washwater).	Wastewater collected in waste tank and disposed of through local sewage system	No impact on environment as wastewater is combined with other wastewater streams and treated by sewage treatment system.			
Site Spills (abnormal events)						
E-A10	Active, all solid formulations (pellets, gels, pastes).	Accidental spill of solid solids	No impact on environment as spills of solids can be controlled within the manufacturing site. Any waste generated is subject to controlled disposal as per the Hazardous Substances (Disposal) Regulations 2001 8 and 9. (Also see E-A7).			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
E-A11	Active, stock solution 200 g/L (in solution, diluted with washwater).	Of solution / wastewater	No impact on environment as site is sufficiently bunded and all activities contained within factory. Spills can be controlled within site and washwater retained in waste tank for controlled disposal (see activity E-A9, E-50 and E-A51). Any waste generated is subject to controlled disposal as per the Hazardous Substances (Disposal) Regulations 2001 8 and 9.			
TRANSPORTATION FROM MANUFACTURING SITE TO APPLICATION SITE						
E-A12	Pellets (all concentrations); Paste (all concentrations); Gels (all concentrations); stock solution 200 g/L.	Transportation of packaged goods by road from the manufacturing site to the application site.	No exposure is likely during normal operations as packages not opened during transit. There is potential for discharge to the environment in the event of accident during transport, causing release of packaged goods. *Controls* The HSNO controls applicable to 1080 formulations are contained in Section 3.4. In particular Regulation 9A of Schedule 2 of the Gazette Notice applies - Land Transport Rule: Dangerous Goods 2005 (Rule 45001/1) must be complied with and drivers of vehicles containing 1080 must have an approved dangerous good endorsement on their driver licence. Emergency management conditions that apply in the event include an emergency services team dispatched to ensure the spill is well contained and cleaned up quickly ensuring minimal impact on the environment. *Risk Profile* The likelihood of human exposure to 1080 occurring during transport is therefore considered to be IMPROBABLE [only occurring in very exceptional circumstances]; the magnitude of effect would be MINOR [low sensitivity to 1080, low environmental impacts, low persistence, rapid breakdown, and present at low concentrations around level of detection] and the risk is therefore assessed as B [either insignificant or minor and not warranting further assessment].	Improbable	Minor	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
APPLICATION OF 1080 – AERIAL **1080 baits are sown from an aircraft onto the ground**						
PELLETS (0.4-0.8, 1.5-2.0 g/kg 1080)						
E-A13	Pellets (0.4-0.8, 1.5-2.0 g/kg 1080)	**Preparation**: Pellets arrive at site pre-prepared. Bags of pellets are loaded directly into aircraft hopper.	No environmental exposure to water, soil or flora is expected. Loading site is manually checked and cleared of pellets at completion of the operation. A restricted zone is maintained with signs and a fence in place or until the place is decontaminated (Sec.3.4 Default Controls; Schedule 3: 6 (6)).			
E-A14	Pellets (0.4-0.8, 1.5-2.0 g/kg 1080)	**Aerial Application**: Pellets are sown from the aircraft onto ground.	**Soil** Baits are deposited from the aircraft directly to the ground or the vegetation cover. Baits come into direct contact with the soil breaking down fairly rapidly and potentially leaching 1080 into the soil. Sowing rates for aerial operations are typically 2-5kg of bait per hectare (usually 1.5g/kg active 1080 ingredient). At the upper end of this range (5kg/ha), this represents 7.5gs of 1080 – about 1.5 teaspoons of 1080 spread over a hectare. Most current operations are of 2-3kg/ha. *Controls* The current HSNO controls that reduce the amount of 1080 deposited into soil are contained in Section 3.4 Default Controls and include: • Schedule 5 (of Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. *Potential Effects* Once pellets are exposed to the elements they begin to break down. The 1080 in the pellets is either defluorinated or leaches into the soil. This can take from 1 - 2 weeks under favourable conditions (11-20º C and 8-15% moisture) to several months in extreme cold or drought conditions (Eason *et al.* 1991a, 1991b, Bowen *et al.* 1995, Booth *et al.* 1999a, Ogilvie *et al.* 2004, Wright 2004). Thomas *et al.* (2004) calculated that most of the 1080 content is removed from pellets following 150 – 200	Extremely Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			mm of rainfall. When 1080 enters soil, laboratory studies have shown that it will be biodegraded by soil micro-organisms (Bong *et al.* 1979, Walker and Bong 1981, Wong *et al.* 1992) and within the physical (abiotic) soil matrix (David and Gardiner 1966, Parfitt *et al.* 1994). This degradation process takes 1-4 weeks under favourable conditions (Parfitt *et al.* 1994). Bong *et al*. (1979) isolated species of *Pseudomonas* and *Fusurium* from New Zealand soils which were capable of growth on 1080. They also noted some 1080-contaminated soils also contained species of the algae *Chlorella* and *Chlamydomonas* which were unaffected by 1080. O'Halloran *et al.* (2003) reported that there was no negative effect on soil microbial mineralisation in soil spiked with 1080 at concentrations up to 1000 mg/kg dry weight soil. If 1080 is not degraded by micro-organisms present in most NZ soils, it is likely to be removed from soil by leaching (Parfitt *et al.* 1994). Soil samples taken during three aerial 1080 operations recorded low, but detectable, 1080 (mean 0.0092 µg/g) residues in soil after two of the operations. The highest residue (0.19 µg/g) was recorded in a litter sample taken 5 days after the operation. No residues were recorded in soil samples taken 30 days after the operations (Wright *et al.* 2002). The effects of 1080 on soil invertebrates are discussed in A-19. *Risk Profile* The likelihood of this exposure occurring is EXTREMELY LIKELY [almost certain]. The effect would be MINIMAL [no persistence, non toxic breakdown products and negligible environmental impact], therefore the risk is D [risks within the ALARP band (As Low as Reasonably Practicable and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A15	Pellets (0.4-0.8, 1.5-2.0 g/kg 1080)	**Aerial Application**: Pellets are sown from the aircraft onto ground.	**Waterways (freshwater)** Baits are applied aerially and may land in small waterways, or be washed into streams during subsequent rain events. *Controls*	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			The current HSNO controls that reduce the amount of 1080 being deposited into waterways are contained in Section 3.4 Default Controls and include: • Schedule 3 (of Gazette Notice 92): 3 (2), the requirement to obtain permission to use 1080 in a catchment that supplies water for human consumption; • Schedule 3 (of Gazette Notice 92): 6 (1), the requirement not to fly over any place where permission states aircraft applying 1080 may not fly; public drinking water supplies, or waterways less than 100m metres upstream of drinking water supply extraction points; and • Schedule 5 (of Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. Note: Regional or unitary authorities may impose conditions relating to the sowing of 1080 near or over water via a resource consent issued under the Resource Management Act 1991. *Potential Effects* 1080 is highly water soluble and mobile (Parfitt *et al.* 1994), meaning it could enter water via pellets that end up in the waterbody or by leaching out of soil following rainfall. Suren (2006) reported that 1080 baits submerged in laboratory flow tanks fragmented within 3-4 days. 1080 was found to leach rapidly from the submerged baits: almost 50% of original 1080 had leached after 5 hrs and over 90% after 24 hrs. Laboratory experiments have shown that while the concentration of 1080 in deionised (sterile) water remains relatively constant and independent of temperature, the concentration of 1080 in natural stream water declines over time (Booth *et al.* 1999b). The decline in natural water is a result of the presence of aquatic plants (e.g. *Elodea canadensis*) and microbes (e.g. *Pseudomonas* species) degrading the 1080 (Parfitt *et al.* 1994, Ogilvie *et al.* 1996, Wright *et al.* 2001, Eason 2002). The overall degradation rate of 1080 in stream water (when measured in the laboratory) declined by approximately 25% in the first 24 hours. After this the rate of decline was temperature dependent (Ogilvie *et al.* 1995, Ogilvie *et al.* 1996). The flow and volume of the waterway will affect the dilution of 1080 in natural water, but			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			are unlikely to significantly affect degradation at the low concentrations of 1080 that have been found in the environment. Between 1990 and 2003 the Landcare Research Toxicology Laboratory analysed 1649 water samples collected from streams on the days immediately following 230 possum control operations (pellet and carrot) throughout New Zealand (Green 2004). In 96.5% of the samples no 1080 was found above the level of detection (0.1 µg/L). Out of the 3.5% (58) samples where 1080 residues were detected, only five had 1080 levels exceeding 2 ppb. Where these higher 1080 residues have been found in water, the samples were mostly from very small streams and/or associated with the presence of bait. The maximum level ever recorded in water (9 µg/L) was probably as a result of contamination by a worker handling the sample (Eason 2002). 1080 from pellets could theoretically leach into groundwater through soil. However, this is extremely unlikely. Eason *et al.* (1992) collected surface and ground water samples from Rangitoto Island following the application of 1080 baits at 14 kg/ha (equivalent to 0.11 mg of 1080 per m^2). There is a scarcity of soil on the volcanic Rangitoto Island and a concomitant lack of soil micro-organisms, so any 1080 leachate from baits was expected to percolate through the larva into the water table – a theoretical 'worst case' scenario. Despite consistent, heavy rainfall over the sampling period, no 1080 was detected in any of the 24 water samples taken. No 1080 residues were detected in groundwater monitored during two other aerial operations (Parfitt *et al.* 1994). *Risk Profile* The likelihood of this exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions]. The effect would be MINIMAL [no persistence, below detection limits, and negligible environmental impact] therefore the risk is D [risks within the ALARP band broadly classed as tolerable subject to ongoing monitoring and control]. Note that as this is a significant issue of public concern this effect is discussed further in Section 4.1C – Adverse effects to Human Health WITH 1080 Use.			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
E-A16	Pellets (0.4-0.8, 1.5-2.0 g/kg 1080)	**Aerial Application**: Pellets are sown from the aircraft onto ground.	**Plants** Plants could be exposed to 1080 from aerially sown pellets as a result of pellets landing on or adjacent to them, or via uptake from contaminated soil or water. *Controls* The current HSNO controls that reduce plants being exposed to 1080 are contained in Section 3.4 Default Controls. Current default controls, and include: • Schedule 5 (Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. *Potential Effects* During laboratory experiments 1080 up take has been reported in a number of plants including: cabbage (*Brassica oleracea*) (Negherbon 1959), *Elodia canadensis* (Ogilvie *et al.* 1996), *Helianthus annus* (Cooke 1976), peanut (*Archis hypogeae*) (Preuss and Weinstein 1969), New Zealand broadleaf (*Griselinia littoralis*) (Ogilvie *et al.* 1998), perennial ryegrass (*Lolium perenne*) (Ogilvie *et al.* 1998) and sugar cane (*Saccharum* spp.) (Hilton *et al.* 1969). While plants can take up 1080, it is unlikely to be in large amounts. Ogilvie *et al.* (1998) reported that rye grass took up only 0.15% of that available in the soil. Ogilvie *et al.* (2004) placed single 1.5 g/kg 1080 pellets at the base of individual pikopiko (*Asplenium bulbiferum*) and karamuramu (*Coprosma robusta*) in the field, and then monitored 1080 uptake by the plants. No 1080 was detected in any of the pikopiko samples. 1080 was detected in the karamuramu at a maximum concentration of 5 µg/kg plant material after 7 days, and 2.5 µg/kg plant material after 14 days. 1080 residues have been reported to persist less than 38 days in plants (Ogilvie *et al.* 1998, Ogilvie *et al.* 2004) Fluoroacetate has been reported as toxic to duckweed at concentrations of 100 mg/kg in laboratory studies (Bong *et al.* 1980). This concentration is thousands of times in excess of 1080 residues recorded in water during aerial 1080 operations. Oxygen consumption in seedling roots was blocked by fluoroacetic acid (Polter 1967), and the formation of fluorocitrate and increased citrate levels in lettuce was recorded following incubation with fluoroacetate (Ward and Huskisson 1972).	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			O'Halloran *et al.* (2003) reported a reduction in both germination and seedling growth in lettuce and oat seeds planted in soil containing 1080 at 7 mg/kg dry weight. The predicted average soil concentration of 1080 due to leaching of 1080 from baits is 0.015 mg/kg (Wright *et al.* 2002) is well below the effect levels reported by O'Halloran *et al.* (2003). Manufactured 1080 is chemically identical to the toxic compounds found in some poisonous plants (de Moraes-Moreau *et al.* 1995) and toxic fluoroacetate-producing plants are globally distributed. 1080 also occurs naturally in many plants at non-toxic levels e.g. tea leaves (Vartiainen and Kauranen 1984) and the degradation of fluoroacetate by plants has also been reported (Preuss and Weinstein 1969, Ward and Huskisson 1972, Meyer and Grobbelaar 1991). All available evidence suggests that 1080, at the concentrations used during aerial operations, will not pose any significant risk to plants. *Risk Profile* The likelihood of this exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions]. The effect would be MINIMAL [no or perceived effects on very few non-target species, and minor short-term effects] therefore the risk is D [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
			DIRECT EXPOSURE OF NATIVE FAUNA TO PELLETS DURING AERIAL OPERATIONS			
E-A17	Pellets (0.4-0.8, 1.5-2.0 g/kg 1080)	**Aerial Application**: Pellets are sown from the aircraft onto ground.	**Native birds** Omnivorous and herbivorous native birds could eat pellets, and other inquisitive birds could handle pellets. *Controls* The current HSNO controls that reduce exposure of native birds are contained in Section 3.4 Default Controls and include: • Schedule 3 (Gazette Notice 92): 3 (1), the requirement to obtain permission to use 1080 on land administered or managed by DOC. This enables DOC to	Very unlikely	Minor	C

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			impose conditions on the use of 1080 if there are concerns about potential effects on native species at a particular site; • Schedule 5 (Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare; and • Schedule 6 (Gazette Notice 92): 1 Methods of release and Colour, bait must be coloured green or blue. This makes them less attractive to birds whose colour vision is more focussed at the red/orange end of the spectrum. *Potential Effects* The reported 1080 LD_{50}s for birds range between 2.5-12.6 mg/kg (Kalmbach 1945, Cottral *et al.* 1947, Ward and Spencer 1947, Chenoweth 1949, Peacock 1964, McIntosh *et al.* 1966, Tucker and Crabtree 1970, Hudson *et al.* 1972, McIlroy 1984). The only native New Zealand species for which LD_{50}s have been determined are the silvereye (*Zosterops lateralis*): 9.25 mg/kg (McIlroy 1984) and the weka (*Gallirallus australis*) - 8.0mg/kg (McIntosh *et al.* 1966). During pen trials, reported sublethal effects of 1080 on birds are damage to the wing muscle in mallard ducks (*Anas platyrynchos*) (Ataria *et al.* 2000), and reduced testes weight in starlings (*Sturnus vulgaris*) (Balcomb et al. 1983). The following native bird species have been reported as non-target deaths during aerial pellet operations: silvereye, morepork, tomtit, weka and kereru. However, the number of individuals dying has been very low during any one application and the impact of 1080 operations on populations *as a whole* is more important for overall survival than the fate of a few individuals. Extensive monitoring programmes have been conducted over the last 30 years to determine whether aerially sown 1080 pellets impact on native bird species at a population level. No long term negative impacts on native bird species have been reported. The monitoring includes: New Zealand Falcon (*Falco novaeseelandiae*): Spurr & Powlesland (1997) reported that all falcon territories monitored during 4 operations remained occupied. Fernbirds (*Bowdleria punctata*): 4 out of 23 banded fernbirds disappeared during two operations (Pierce and Montgomery 1992, Walker 1997). However, the cause of			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			the disappearance was not necessarily attributed to poisoning by 1080. Australasian harrier (*Circus approximans*): No impact on this species was detected during an operation on Rangitoto Island (Miller and Anderson 1992) and there was no evidence of dead harriers during aerial rabbit poisoning operations in the McKenzie Basin (Pierce and Maloney 1989). Kaka: 35 radio tagged birds were monitored during two operations with no deaths reported (Greene 1998, Powlesland *et al.* 2003). Kakariki: Five minute bird counts did not detect any impact on kararikі during four operations (pellet and carrot) (Spurr and Powlesland 1997). Kereru: Powlesland *et al.* (2003) reported that none of the 6 birds offered pellets in a trial ate non-toxic baits and no population changes were detected using 5-minute bird counts during five operations. North Island Brown Kiwi: A total of 59 radio tagged NI brown kiwi have been monitored during three 1080 operations with no deaths reported (DOC records, Pierce and Montgomery 1992, Robertson *et al.* 1999). Great spotted Kiwi: 16 radio-tagged individuals were monitored during two operations with no deaths reported (Walker 1997, Robertson *et al.* 1999). North Island Kokako: Between 1986 and 1992 302 individual kokako were monitored throughout thirteen aerial operations, with only 2 disappearing. Flux and Innes (2001) estimated that the maximum mortality of kokako is 1.4% per operation. Mohua: There was no significant decline in the mohua population following an operation where the birds were monitored using 5 minute bird counts and 30 minute search on 1km gird squares (Ross 2006). Morepork (*Ninox novaeseelandiae*): None of 12 radio tagged individuals monitored during 4 operations died (Pierce and Montgomery 1992, Walker 1997, Powlesland *et al.* 1999b). Robins: 42 colour banded robins were monitored over one operation. Two were reported to have disappeared (Powlesland *et al.* 1999b), although the cause of			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			disappearance was not determined. However, where 1080 operations occur prior to the robin breeding season, nesting success has improved significantly – more than compensating for any losses (Powlesland *et al.* 1999b). Tomtits: Of 29 colour banded tomtit monitored over two aerial 1080 cereal pellet operations, one disappeared (Powlesland *et al.* 2000, Westbrooke *et al.* 2003), although the cause of disappearance was not determined. A further monitoring study using distance sampling found no significant difference in the mortality of tomtits between treatment and non-treatment sites (Westbrooke *et al.* 2003). Following distance sampling monitoring of tomtits during a further three operations, Westbrooke and Powlesland (2005) concluded that 'cereal bait operations have little, if any immediate impact on tomtit populations'. Weka: Of 40 weka monitored (colour banded or radio tagged) during 4 operations only one weka was found dead (Spurr and Powlesland 1997, Walker 1997, van Klink and Tansell 2003). This weka contained lethal levels of 1080 in its tissue (Walker 1997). Whio (*Hymenolaimus malacorhynchos)*: Whio (blue duck) are considered unlikely to eat pellet baits and there was no reduction in visual counts in the Otira Valley following an aerial pellet operation (Spurr and Powlesland 1997). While extensive monitoring has shown no negativeimpacts from aerial pellet operations on a wide range of native bird species there have been significant benefits for these species following aerial application of 1080 (E-B4 to E-B6). *Risk Profile* The likelihood of this exposure occurring is VERY UNLIKELY [considered only to occur in very unusual circumstances]. The effect would be MINOR [sub-lethal to some non-target individuals within a population, lethal to a very few non-target individuals, limited but medium term effects, no biodiversity loss and highly localised impact], therefore the risk is C [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
E-A18	Pellets (0.4-0.8, 1.5-2.0 g/kg 1080)	**Aerial Application**: Pellets are sown from the aircraft onto ground.	**Native mammals - bats** The long tailed bat is an aerial insectivorous feeder (O'Donnell 2005) and therefore highly unlikely to eat cereal pellets. The lesser short tailed is primarily insectivorous, but also eats nectar, pollen and fruit (Lloyd 2005), so it could conceivably eat pellets. *Controls* The current HSNO controls that reduce exposure of bats are contained in Section 3.4 Default Controls. They are: • Schedule 3 (Gazette Notice 92): 3 (1), the requirement to obtain permission to use 1080 on land administered or managed by DOC. This enables DOC to impose conditions on the use of 1080 if there are concerns about potential effects on native species at a particular site; and • Schedule 5 (Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. *Potential Effects* New Zealand has two species of native bat. In a study by Lloyd (1994) aimed at determining the risk to lesser short tailed bats from eating pellets he offered non-toxic cereal pellets to captive and wild bats. He concluded that lesser short-tailed bats are unlikely to eat cereal pellets. In a second bait acceptance trial by Beath *et al.* (2004), short-tailed baits fed on small amounts of cereal pellets, but the authors concluded that the use of cereal pellets during pest control operations did not pose a meaningful risk to short-tailed bat populations. Lloyd and McQueen (2002) captured 269 lesser short-tailed bats returning from foraging during the period after a 1080 operation when 1080 would have been available for consumption by the bats. The bats were held then held for 48 hours and mortality monitored. All the bats survived and none showed signs of poisoning. *Risk Profile* The likelihood of this exposure occurring is VERY UNLIKELY [considered only to occur in very unusual circumstances]. The effect would be MINIMAL [no or	Very unlikely	Minimal	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			perceived effects on very few non-target species and minor short-term effects], therefore the risk is B [either insignificant or minor and not warranting further assessment].			
E-A19	Pellets (0.4-0.8, 1.5-2.0 g/kg 1080)	**Aerial Application**: Pellets are sown from the aircraft onto ground.	**Native fauna - terrestrial invertebrates** Invertebrates may directly ingest 1080 by feeding on baits laid in their locality (20cm or closer) (Green 2004). *Controls* The current HSNO controls applicable to 1080 formulations that reduce exposure of terrestrial invertebrates are contained in Section 3.4 Default Controls. They are: • Schedule 3 (Gazette Notice 92): 3 (1), the requirement to obtain permission to use 1080 on land administered or managed by DOC. This enables DOC to impose conditions on the use of 1080 if there are concerns about potential effects on native species at a particular site; and • Schedule 5 (Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. *Potential Effects* Published 1080 LD_{50}s for invertebrates range from 8 to 91 mg/kg (Matsumura and O'Brien 1963, Booth and Wickstrom 1999), with the New Zealand native ant (*Huberia striata*), having an LD_{50} of 42-72 mg/kg and the tree weta, *Hemideina crassidens*, an estimated LD_{50} of 91 mg/kg (Booth and Wickstrom 1999). Sublethally poisoned invertebrates are likely to metabolise 1080 within a relatively short-time frame. Tree weta (*Hemideina crassidens*) orally dosed with 15 mg 1080/kg body weight eliminated the 1080 within 4-6 days (Eason *et al.* 1993). Native ants dosed with 36 mg 1080/kg body weight still had detectable levels of 1080 (0. 27 mg/kg) seven days after dosing (Booth and Wickstrom 1999). Reported 1080 sublethal effects on invertebrates include: suppressed predator responses in New Zealand cockroaches (Dictyoptera Blattidae) (McIntyre 1987), disruption of nocturnal behaviour of a tree weta (*Hemideina thoracica*) (Hutcheson 1989), and decreased egg production by *Bracon hebetor,* a parasitoid wasp found in North America (Smith and Grosch 1976). O'Halloran *et al.* (2004) reported that	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			compost worms (*Eisenia fetida*) lost weight over the first 14 days in soil concentrations greater than or equal to 100 mg1080/kg, but weights had returned to normal 28 days after initial exposure. It appeared that adult compost worms were channelling their energy resources into maintaining body weight. However, condition appeared to be maintained at the expense of reproduction because cocoon production and the number of live juveniles produced decreased progressively as 1080 concentrations increased, particularly at 1080 concentrations in the soil of greater than or equal to 100 mg/kg. These soil concentrations were well above those that normally occur following the field use of 1080. A range of invertebrates eat cereal pellets, so some invertebrates will be poisoned during aerial 1080 pellet operations (Powlesland *et al.* 2005). However, in a typical aerial 1080 operation using 6g pellets sown at 3kg/ha there would be 500 baits applied per ha - equating to 0.05 pellets per square metre, or 1 pellet in 20 square metres. Only a small proportion of invertebrates will encounter baits, and there is no evidence that invertebrate populations are significantly impacted by aerial 1080 pellet applications or that invertebrates are a significant factor in secondary poisoning of other animals. An extensive study of forest invertebrates found on 1080 baits by Sherley *et al*. (1999) found that at any time only a small proportion of baits had invertebrates on them, and the few individuals per bait represented a small section of the fauna present in the litter. The number of invertebrates recorded on baits in treatment grids declined when 1080 pellets were laid at 18 kg/ha (which is 6-9 times the current sowing rates), but started to return to original levels (relative to control grids) within 6 days of removal of the toxic baits. The reduction in invertebrate numbers did not extend further than 20cm from each bait. Spurr & Berben (2004) hand laid 1080 pellets at 5 kg/ha to simulate aerial poisoning in Tararua Forest Park in 1999 and monitored the occupancy of artificial refuges by tree weta (*Hemideina crassidens*) and cave weta (*Isoplectron* sp.). No significant impact of bait application was found for these species, nor on numbers of slugs, spiders and cockroaches which commonly used the same refuges. The concentration of 1080 in a cave weta collected alive from a bait (4.0 µg/g), and in a tree weta collected alive from outside an artificial refuge (8.6 µg/g), was less than			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			10% of the average lethal dose. No impact was detected on populations of weta in Waipoua Forest and all cockroaches, centipedes, millipedes, kauri snails and all but one beetle survived in enclosures with 1080 Pellets (Pierce and Montgomery 1992). Spurr (1994) reported no impacts on populations of amphipods, ants, beetles, collembolans, millipedes, mites, slugs, snails, spiders and cave weta in Puketi Forest or Titirangi Scenic Reserve where 1080 pellets were aerially applied at 5 kg/ha. In Mapara where 1080 pellets were aerially applied in three consecutive years 1990-92, a comparison of invertebrate fauna showed a greater number of predatory insects in the treatment site, characteristic of a healthy forest, and more fungal eating insects in the non-treatment site, characteristic of unhealthy forest (Bradfield 1993). A range of invertebrate species on Rangitoto Island were sampled using a range of collection techniques, before and after aerial poisoning with 1080 pellets at 12 kg/ha. No population effects were observed (Anon. 1990). From the above scientific evidence it can be concluded that while there may be losses of individual invertebrates, invertebrate populations are not significantly impacted by aerial 1080 pellet applications. *Risk Profile* The likelihood of this exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions]. The effect would be MINIMAL [no or perceived effects on very few non-target species or minor short term effects], therefore the risk is D [risks within the ALARP band (As Low As Reasonably Practicable) and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A20	Pellets (0.4-0.8, 1.5-2.0 g/kg 1080)	**Aerial Application**: Pellets are sown from the aircraft onto ground.	**Native herpetofauna – frogs and lizards** Native frogs and lizards may ingest baits directly from the ground. *Controls* The current HSNO controls that reduce exposure of herpetofauna to 1080 are	Unlikely	Minimal	C

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			contained in Section 3.4 Default Controls. They are: • Schedule 3 (Gazette Notice 92): 3 (1), the requirement to obtain permission to use 1080 on land administered or managed by DOC. This enables DOC to impose conditions on the use of 1080 if there are concerns about potential effects on native species at a particular site; and • Schedule 5 (Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. Native frogs which live near stream edges are also protected to some extent by controls to reduce deposition into water bodies (see E-A15). *Potential Effects* New Zealand geckos and skinks are primarily insectivorous, but seasonally take significant amounts of soft fruits (and nectar by geckos), so theoretically could eat 1080 pellets. Freeman *et al*. (1997) reported that captive McCann's skinks ate non-toxic cereal pellets, especially when the baits were wet, but the level of consumption (0.01-0.02g) was probably insufficient for the animals to have received a lethal dose had the baits been toxic. The susceptibility of animals to 1080 is linked to their metabolic rate. Even if lizards did consume 1080 baits, being cold blooded, their low metabolic rate means they are probably relatively tolerant to 1080 (McIlroy 1994). There are no LD_{50} figures for native species of lizards, but LD_{50} data for species not present in NZ range from 43.6 – 535 mg/kg (Eisler 1995) which supports view that lizards are less susceptible to 1080. Native frogs are insectivorous and are therefore highly unlikely to eat 1080 pellets. Based on the 1080 LD_{50} figures (54.4 - 2000 mg/kg) from overseas amphibian species (Eisler 1995), they are the most poison-resistant animal group (Perfect and Bell 2005). Monitoring of a population of Archey's frog (*Leiopelma archeyi*) in the Coromandel Ranges before and after the aerial application of 1080 pellets, showed no decline in Archeys frog (Perfect and Bell 2005). McNaughton and Greene (1994) monitored Hochstetter's frogs (*Leiopelma hochstetteri*) during an aerial 1080 pellet operation in			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			the Hunua Ranges. One frog was found dead immediately following the poison operation but tested negative for 1080. Fluctuations in frog numbers counts were influenced so strongly by short term environmental effects that any effect of the poison drop could not be detected. *Risk Profile* The likelihood of this exposure occurring is UNLIKELY [could occur but not expected to occur under normal operating conditions]. The effect would be MINIMAL [no or perceived effects on very few non-target species or minor short term effects], therefore the risk is C [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A21	Pellets (0.4-0.8, 1.5-2.0 g/kg 1080)	**Aerial Application**: Pellets are sown from the aircraft onto ground.	**Freshwater vertebrates and invertebrates** Freshwater vertebrates and invertebrates could, theoretically, be exposed to 1080 by consuming bait that has landed in the water or by contact with/consumption of 1080-contaminated water. *Controls* See controls in E-A15. These controls will reduce exposure of freshwater vertebrates and invertebrates to 1080. *Potential Effects* <u>Vertebrates</u> 96-hour 1080 LC_{50}s for fish range from 54 – 3500 mg/L (King and Penfound 1946, Bauermeister *et al.* 1977, Rammell and Fleming 1978, Fagerstone *et al.* 1994). To achieve even the 96 hour LC_{50} of 54 mg/L (for rainbow trout), all the 1080 in 3.6kgs of 1.5 g 1080/kg bait would have to leach out of the bait, and then remain in 100 L of still water, without breaking down, for 96 hours. This is highly unlikely to occur under pest control conditions in New Zealand. Suren and Lambert (2004) undertook field trials to assess the effects of 1080 on native longfin eels (*Anguilla dieffenbachii*), koaro (*Galaxias brevipenis*) and upland bullies (*Gobiomorphus breviceps*). Fish of each species were placed into fish cages at 4 different stream sites representative of the types of stream that might be exposed to 1080 aerial operations. Based on the maximum number of baits found in	Unlikely	Minimal	C

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			10 m lengths of streams during actual possum operations, ten times as many 1080 pellets were placed upstream of the fish cages. No fish mortality was observed in any of the fish species after the 1080 baits were added, suggesting that these species were tolerant to 1080 that leached from the baits. Lyver *et al.* (2004) reported no evidence that captive long finned eels (*Anguilla dieffenbachia*) in New Zealand ate 1080 cereal pellets added to their water, nor was any 1080 detected in eel tissue from water contaminated by baits. <u>Invertebrates</u> The water flea *Daphina magna* has a 48 hour 1080 EC_{50} of 350mg/L (Fagerstone *et al.* 1994). Based on sublethal exposure trials, Suren & Bonnett (2006) suggest that the LC_{50} of koura (*Paranephrops planifrons)* is relatively high. In the trials, minimal concentrations of 1080 were detected in koura exposed to water containing 1080. The highest concentration was 3.3µg/g in the body tissue and 5 µg/g in tail muscle. 1080 concentrations declined between days 4 – 8 of the trial suggesting that 1080 can be successfully metabolised by koura. While koura did eat cereal pellet baits, none died. Suren and Lambert (2004) quantified the effect of 1080 on natural invertebrate communities in New Zealand in a field trial. Invertebrates were collected from 4 sampling sites by sampling invertebrates on ten replicate rocks at each site. 1080 cereal pellets were placed upstream of each site. A total of 72 taxa were collected during the study. The caddisflies *Helicopsyche*, *Pycnocentrodes* and *Pycnocentria*, orthoclad midges, and the leptophlebid mayfly *Deleatidium* dominated the fauna. These animals are indicative of streams with good water quality. Statistical analyses showed that there were no ecologically significant effects of the 1080 baits on the invertebrate communities in any of the streams. <u>Overall Assessment</u> Aquatic species are not considered to be at risk from aerial 1080 poisoning operations because both fish and aquatic invertebrates appear to be very tolerant of 1080, water contamination is rarely found during aerial possum control operations, and when it is, it is at extremely low levels (see E-A15), well below reported LC_{50}s.			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Risk Profile The likelihood of this exposure occurring is UNLIKELY [could occur but not expected to occur under normal operating conditions]. The effect would be MINIMAL [no or perceived effects on very few non-target species or minor short term effects], therefore the risk is C [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
COATED BAITS (typically 0.8 or 1.5 g/kg 1080 coated carrot for possums and 0.2 g/kg 1080 coated carrot or grain for rabbit control) **Most studies on the impact of aerially applied 1080 apply to carrot baits, and this should be assumed unless stated otherwise in the following text.**						
E-A22	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Preparation:** Stock solution diluted from 200 g/L to 100 g/L (at application site). Uncoated bait is diced up and coated with diluted stock solution. Coated Baits are loaded into hopper.	**Soil and Plants** Soil and plant exposure occurs at the preparation site for coated baits when stock solution may spill onto the ground during application to baits. *Controls* The HSNO controls applicable to 1080 formulations are contained in Section 3.4 Default Controls. In particular the control in place to reduce the amount of 1080 being deposited on soil during application to coated baits is to decontaminate the loading area and any area where the 1080 is stored in preparation for loading on to the aircraft (Section 3.4 Default Controls; Gazette Notice 92 Schedule 3: 6 (1)). *Potential Effects* The potential exposure to soil and plants from coated baits is the same as that for E-A23 and E-A25 respectively. *Risk Profile* The likelihood of this exposure occurring is EXTREMELY LIKELY [almost certain]. The effect would be MINIMAL [no persistence and little sensitivity to 1080], therefore the risk is D [risks within the ALARP band (As Low As Reasonably Practicable) and broadly classed as tolerable subject to ongoing monitoring and control].	Extremely likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
E-A23	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Aerial Application:** Coated baits are sown from the aircraft onto ground.	**Soil** Coated baits are deposited from the aircraft directly to the ground or vegetation cover. 1080 may then leach from baits into the soil. Application rates are similar to those for pellets, being equivalent to about 7.5 g of 1080 (about 1.5 teaspoons) spread over a hectare, at the upper end of current application rates. *Controls* See controls in E-A14. *Potential Effects* Once 1080 coated bait is sown and become exposed to the elements it will begin to break down. 1080 in the bait will either biodegrade in the bait or leach into the soil. During simulated rainfall trials Bowen *et al.* (1995) reported that there was no decline in 1080 concentrations in the 1080 coated carrot after 200mm of rain and Thomas *et al.* (2004) found carrot retained more than 60% of its 1080 concentration after 500mm of simulated rainfall. However, using data collected during 8 operations, Thomas *et al.* (2004) estimated that most 1080 content was lost from carrot baits following 200 mm of natural rainfall. The authors noted the results conflicted with the simulated rainfall studies. They suggested that the difference may have been a result of the carrots being present in the field for a longer period than the 2 day duration of the simulated rainfall trials. During this period the carrots would have been subjected to decay and microbial action, which may have contributed to the more rapid 1080 loss under natural conditions. Once 1080 enters soil, the potential effects will be the same as those given in EA-14. The only specific research relating to 1080 concentrations in soil following aerial 1080 carrot operations comes from a field trial using 1.5g/kg 1080 carrot baits in the Tararua Forest Park. Litter samples had 1080 residues of between 0.0-0.6 mg/kg on the day the baits were laid and between 0-16 mg/kg seven days post-poisoning (Spurr *et al*. 2002). *Risk Profile* The likelihood of this exposure occurring is EXTREMELY LIKELY [almost certain]. The effect would be MINIMAL [no persistence and non toxic breakdown products], therefore the risk is D [risks within the ALARP band and broadly classed as tolerable	Extremely likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			subject to ongoing monitoring and control].			
E-A24	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Aerial Application:** Coated baits are sown from the aircraft onto ground.	**Waterways (freshwater)** The potential exposure to waterways from coated baits is the same as for pellets applied aerially (E-A15). *Controls* See controls in E-A15. *Potential Effects* In addition to the information in E-A15, monitoring of rabbit control operations using 1080 coated carrots was undertaken in Otago during 1992. Streams and rivers were monitored for 4 weeks after the operations. Only 2 out of 29 samples contained measurable amounts of 1080 (0.3 and 0.6 µg/L). These samples occurred with 48 hours of bait application, and all subsequent samples were below the limit of detection (Hamilton and Eason 1994). *Risk Profile* The likelihood of this exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions]. The effect would be MINIMAL [no persistence, non toxic breakdown products and negligible environmental impact] therefore the risk is D [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].	Likely	Minimal	D
E-A25	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Aerial Application:** Coated baits are sown from the aircraft onto ground.	**Plants** Plants could be exposed to 1080 from aerially sown coated baits as a result of baits landing on or adjacent to them, or via uptake from contaminated soil or water. *Controls* See controls in E-A16. *Potential Effects* While no specific research has been undertaken on the potential exposure to plants from aerially sown 1080 coated baits, it is likely to be identical to exposure from 1080 pellets applied aerially (E-A16).	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Risk Profile Based on the assessment made for E-A16 (appropriate to use in the absence of specific coated bait information due to the similar quantities and application rates involved) the likelihood of this exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions]. The effect would be MINIMAL [no or perceived effects on very few non-target species and minor short-term effects], therefore the risk is D [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
			DIRECT EXPOSURE OF NATIVE FAUNA TO COATED BAITS DURING AERIAL OPERATIONS			
E-A26	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Aerial Application:** Coated baits are sown from the aircraft onto ground.	**Native birds – tomtits** Tomtits may be exposed to bait through direct consumption of bait deposited from the aircraft directly to the ground. *Controls* See controls in E-A17. *Potential Effect* Tomtits have been found dead after aerial 1080 carrot possum control operations. This was particularly common in the 1970's when 1080 was applied to unscreened carrots (Powlesland *et al.* 2000). For example, in Cone State forest, Southland, carrot baits were sown at 30 kg/ha, using 0.6 g/kg 1080 and no tomtits were seen or heard two weeks afterwards. Even when carrot is screened to remove chaff, tomtit deaths still occur. Immediately following an aerial carrot operation in Pureora in 1994 at 15 kg/ha, live tomtits were not seen or heard. These sowing rates were much higher than those currently used. In a 1997 study in Pureora using banded tomtits, 78.6% of the marked individuals disappeared following a poison drop (Powlesland *et al.* 2000). Westbrooke and Powlesland (2005) monitored tomtits during three carrot operations in 2003 using transect territory counts. Tomtit counts decreased between 15 and 49% during these operations. However, in a 2002 carrot operation, tomtits showed no decline when monitored using transect territory counts (Hamilton 2004).	Likely	Minor	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Tomtits are a resilient species that can rapidly colonise suitable habitats and they have a high reproductive rate when mammalian predators are reduced to very low densities i.e. following 1080 operations (Powlesland *et al.* 2000). Powlesland *et al*. (2000) reported tomtit nesting success rates of 67% and 80% in two blocks following 1080 possum control operations compared to 8% of nesting attempts being successful at an unmanaged site. This means that despite losses during 1080 operations, tomtit populations can recover within one to two years. *Risk Profile* The likelihood of this exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions]. The effect would be MINOR [sub lethal to some non-target individuals within a population, limited but medium term effects, highly localised impact, lethal to some non-target individuals at a local level and no biodiversity loss], therefore the risk is D [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A27	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Aerial Application:** Coated baits are sown from the aircraft onto ground.	**Native birds – other** Native birds may be exposed to bait through direct consumption of bait deposited from the aircraft directly to the ground. *Controls* See controls in E-A17. *Potential Effects* Omnivorous and herbivorous native birds could eat coated baits, and other inquisitive birds could investigate the baits. See E-A17 for general LD_{50} data and sublethal effects. Individuals from the following native species have been reported as non-target deaths during aerial coated bait operations: fantail, kereru, morepork, North Island robin, rifleman, tui, grey warbler and whiteheads. Most of the deaths occurred after just four aerial operations in 1976-7 and were attributed to the use of unscreened, poor quality carrot bait containing a large amount of chaff (Green 2004). Chaff is small fragments of carrot (less then a gram) which can be lethal to small birds. Fewer birds have been reported dead after aerial 1080 operations using coated	Very unlikely	Minor	C

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			baits since 1977 as a result of improved bait quality and screening of chaff (Spurr 2000). Due to concerns about the potential impacts these losses may have at a population level, a number of species have been monitored during 1080 coated bait aerial possum control operations: New Zealand Falcon: Falcon territories remained occupied, presumably by resident birds, during an aerial 1080 carrot operation (Spurr and Powlesland 1997). Kaka: 38 birds have been monitored using radio tagging during 2 operations with no deaths reported (Greene 1998, Powlesland *et al.* 2003). In a non-toxic carrot trial using a fluorescent marker only 1 juvenile out of 20 birds examined had consumed carrots. A large number of kaka droppings were also examined and none had fluoresced (Lloyd and Hackwell 1993). Kakariki: Five minute bird counts did not detect an impact during aerial 1080 carrot operations (Spurr and Powlesland 1997) and Greene (1998) reported that kakariki also remained common during an intensively monitored aerial carrot operation in 1994. Kereru: All 10 radio tagged individuals monitored during an aerial carrot operation survived (Powlesland *et al.* 2003) and monitoring of kereru during nine aerial 1080 carrot operations did not detect population changes using the five minute count method (Spurr and Powlesland 1997). Lloyd and Hackwell (1993) reported no trace of pyranine on two kereru during a non-toxic carrot bait trial in which carrot containing the biomarker pyranine was aerially sown. However, pyranine fluorescence was observed in one kereru dropping. North Island Brown Kiwi: Two individuals monitored during a 1080 carrot operation survived (Robertson *et al.* 1999). Little Spotted Kiwi: During non-toxic carrot bait trials (using a fluorescent marker) there was no indication that kiwi had consumed bait (Lloyd and Hackwell 1993). North Island Kokako: None of 44 individuals monitored during two aerial 1080 carrot operations died (Flux and Innes 2001). Morepork: Six radio tagged individuals were monitored during one 1080 carrot			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			operation with one death being reported. There was some evidence of bait not being screened correctly during this operation (Powlesland *et al.* 1998). Robin: Banded robins were monitored during three years of aerial 1080 carrot operations (1996-1998) in Pureora Forest Park. Robin mortality rates were 43-55%, 9.7% and 0% for each year's operations respectively. The relatively high mortality rate during the 1996 operation was considered to have been due to failure to adhere to carrot bait protocols resulting in excessive chaff. However, robin populations show improved nesting success following aerial operations as a result of predator numbers declining and populations recover rapidly (Powlesland *et al.* 1999a). Weka: Five minute bird counts of weka during an aerial 1080 carrot operation in the Copeland Valley in 1986 found no observable effect on weka populations (Spurr 1988). During a non-toxic carrot trial using a fluorescent marker 10 out of 87 weka droppings examined fluoresced and weka were observed feeding on baits on several occasions (Lloyd and Hackwell 1993). Whio: Whio are unlikely to eat carrot baits and their aquatic invertebrate prey is unlikely to be contaminated by 1080. All 19 radio tagged whio survived for at least four weeks following an aerial carrot operation in Waihaha in 1994 (Greene 1998). *Risk Profile* Based on the above, the likelihood of this exposure occurring is VERY UNLIKELY [considered only to occur in very unusual circumstances]. The effect would be MINOR [sub lethal to some non-target individuals within a population, limited but medium term effects, highly localised impact, lethal to some non-target individuals at a local level and no biodiversity loss], therefore the risk is C [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A28	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Aerial Application:** Coated baits are sown from the aircraft onto ground.	**Native mammals – bats** New Zealand has two species of native bat. The long tailed bat is an aerial insectivorous feeder (O'Donnell 2005) and therefore highly unlikely to eat coated baits. The lesser short-tailed bat is primarily insectivorous, but also eats nectar, pollen and fruit (Lloyd 2005), so it could conceivably be exposed to 1080 through direct consumption of 1080 coated baits.	Very unlikely	Minimal	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Controls See controls in E-A18. *Potential Effects* Ecroyd (1993) conducted a field trial in Pureora Forest Park to test whether short-tailed baits would consume green dyed and cinnamon lured non-toxic carrot. He recorded no evidence of bats landing near the carrot over three nights of monitoring, nor any evidence of bats eating the carrot. Lloyd (1994) offered non-toxic carrot to captive lesser short-tailed bats and concluded short-tailed bats are unlikely to eat carrot baits. *Risk Profile* Based on the above, the likelihood of this exposure occurring is VERY UNLIKELY [considered only to occur in very unusual circumstances]. The effect would be MINIMAL [no or perceived effects on very few non-target species and minor short-term effects], therefore the risk is B [either insignificant or minor and not warranting further assessment).			
E-A29	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Aerial Application:** Coated baits are sown from the aircraft onto ground.	**Native fauna - terrestrial invertebrates** Native terrestrial invertebrates may be exposed to bait through direct consumption of bait deposited from the aircraft directly to the ground in their locality (20cm). *Controls* See controls in E-A19. *Potential Effects* See E-A19 for overall potential effects on invertebrates. An extensive study of forest invertebrates found on 1080 baits by Sherley *et al*. (1999) found that at any time only a small proportion of baits had invertebrates on them, and the few individuals per bait represented a small section of the fauna present in the litter. Fewer invertebrates were found on non-toxic (green dyed, cinnamon lured) carrot baits than non-toxic cereal pellets. No impact on the numbers of ground-dwelling invertebrates caught in pitfall traps was observed up to 1 year following aerial application of carrot bait at Waihaha	Unlikely	Minimal	C

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Forest in 1994 (Spurr 2000). Powlesland *et al.* (2005) monitored the effect carrot baits applied aerially had on invertebrates in Whirinaki Forest Park using artificial refuges. They concluded that it was unlikely the aerial operation had a detrimental effect on the numbers of cave weta (*Pharmacus* sp. and *Isoplectron* sp.), cockroaches, tree weta, spiders and harvestmen, and leaf-veined slugs found in artificial refuges attached to tree trunks. *Risk Profile* Based on the above, the likelihood of this exposure occurring is UNLIKELY [could occur but is not expected to occur under normal operating conditions]. The effect would be MINIMAL [no or perceived effects on very few non-target species or minor short term effects], therefore the risk is C [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A30	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Aerial Application:** Coated baits are sown from the aircraft onto ground.	**Native herpetofauna – frogs and lizards** Native frogs and lizards may ingest baits directly from the ground. *Controls* See controls in E-A20. *Potential Effects* There has been no monitoring of frogs or lizards during 1080 coated bait operations. However, information contained in E-A20 will apply. *Risk Profile* Based on the risk assessment for herpetofauna from pellets applied by aerial application (E-A20), the likelihood of this exposure occurring is UNLIKELY [could occur but is not expected to occur under normal operating conditions]. The effect would be MINIMAL [no or perceived effects on very few non-target species or minor short term effects], therefore the risk is C [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].	Unlikely	Minimal	C
E-A31	Coated Baits (0.2, 0.8, 1.5 g/kg)	**Aerial Application:** Coated baits are	**Freshwater vertebrates and invertebrates** Freshwater vertebrates and invertebrates could, theoretically, be exposed to 1080	Unlikely	Minimal	C

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
		sown from the aircraft onto ground.	by consuming bait that has landed in the water or by contact with/consumption of 1080-contaminated water. *Controls* See controls in E-A21. *Potential Effects* Since the toxic loadings and sowing rates of aerially applied coated 1080 baits are similar to those for 1080 pellets it is anticipated the potential effects will be the same as those presented in E-A21. E-A21 concluded that aquatic species are not considered to be at risk from aerial 1080 poisoning operations because both fish and aquatic invertebrates appear to be very tolerant of 1080, water contamination is rarely found during aerial possum control operations, and when it is, it is at extremely low levels, well below reported LC_{50}s. *Risk Profile* Based on the assessment made for pellets (E-A21), the likelihood of this exposure occurring is UNLIKELY [could occur but not expected to occur under normal operating conditions]. The effect would be MINIMAL [no or perceived effects on very few non-target species or minor short term effects], therefore the risk is C [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
GROUND APPLICATION OF 1080 – UNCONTAINED METHODS **Bait is applied, generally by hand, directly to the ground or vegetation. The main difference between these methods and aerially sown methods is that the risk of exposure is reduced for ground application because the overall application rates are generally lower and the size of the operational area is smaller. Baits distributed this way are often placed in targeted, localised, sites e.g. possum and rabbit preferred habitat, resulting in a higher bait density in these sites.**						
PELLETS (0.4-0.8, 1.0, 1.5-2.0 g/kg 1080) UNCONTAINED APPLICATION METHODS **Pellets are laid directly on the ground in selected application areas.** **Waterways are physically avoided when laying baits. Exposure of water, aquatic fauna and terrestrial species that live near waterways (e.g. frogs) will not occur. This assessment of effects does not consider these types of exposure further.**						
E-A32	Pellets (0.4-0.8, 1.0, 1.5-2.0 g/kg 1080)	**Uncontained Application Methods:** Hand laying - sown directly into ground. Hand laying- sown with mechanical spreader.	**Soil, plants and native fauna** The exposure pathways for soil, plants and native fauna for hand laying of 1080 are the same as those identified for aerial application. *Controls* The current HSNO controls that reduce exposure to native fauna are contained in Section 3.4 Default Controls and include: • Schedule 3 (Gazette Notice 92): 3 (1), the requirement to obtain permission to use 1080 on land administered or managed by DOC. This enables DOC to impose conditions on the use of 1080 if there are concerns about potential effects on native species at a particular site; and • Schedule 6 (Gazette Notice 92): 1 Methods of Release and Colour, bait must be coloured green or blue. This makes them less attractive to birds whose colour vision is more focussed at the red/orange end of the spectrum. *Potential Effects* The likelihood and magnitude of effects related to soil, plants, and native fauna from hand laying of 1080 pellets are the same as those assessed for aerial application. The main differences between hand laying and aerially sowing pellets are the scale of operations (handlaying are smaller) and waterways can be physically avoided when laying bait by hand, eliminating potential effects on fauna living in or near waterways. *Risk Profile*	As for aerial pellets application	As for aerial pellets application	As for aerial pellets application

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			As the likelihood and magnitudes of effect for hand laying of 1080 pellets is the same as aerial application refer to E-A14 through E-A21 for assessment of the effects of uncontained ground based application of pellets.			
COATED BAITS (Typically 0.8 or 1.5 g/kg 1080 coated carrot or apple baits for possums and 0.2 g/kg 1080 coated carrot or grain baits for rabbit control) UNCONTAINED APPLICATION METHODS **Coated baits are laid directly on the ground in selected application areas.** **Waterways are physically avoided when laying baits. Exposure of water, aquatic fauna and terrestrial species that live near waterways (e.g. frogs) will not occur. This assessment of effects does not consider these types of exposure further.**						
E-A33	Coated Baits (0.2, 0.4, 0.8, 1.5 g/kg)	**Uncontained Application Methods:** Hand laying - sown directly into ground. Hand laying- sown with mechanical spreader.	**Soil, plants and native fauna** The exposure pathways for soil, plants and native fauna for hand laying of 1080 are the same as those identified for aerial application. *Controls* See controls in E-A32. *Potential Effects* The likelihood and magnitude of effects related to soil, plants, and native fauna from hand laying of 1080 coated carrot and grain baits are the same as those assessed for aerial application. The main differences between hand laying and aerially sowing pellets are the scale of operations (hand laying are smaller) and waterways can be physically avoided when laying bait by hand, eliminating potential effects on fauna living in or near waterways. *Risk Profile* As the likelihood and magnitudes of effect for hand laying of 1080 coated baits is the same as aerial application refer to E-A22 through E-A31 for assessment of the effects of uncontained ground based application of pellets. Note that in the case of waterways the likelihood would be eliminated as they are physically avoided when laying bait by hand.	As for aerial coated bait application	As for aerial coated bait application	As for aerial coated bait applicati on
PASTE (0.6-0.8, 1.5 g/kg 1 080) UNCONTAINED APPLICATION METHODS						

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
Paste is placed on tin lids, cardboard squares or directly onto the ground (known as spits - raised clods of earth). Any spits remaining at the end of the operation are overturned and buried and cardboard and tin lids are retrieved. Waterways are physically avoided when laying baits. Exposure of water, aquatic fauna and terrestrial species that live near waterways (e.g. frogs) will not occur. This assessment of effects does not consider these types of exposure further.						
E-A34	Paste (0.6-0.8, 1.5 g/kg)	**Uncontained Application Methods:** Hand-laying on: • Tin lids • Cardboard squares • Earth spits	**Soil** Soil may be exposed to 1080 through paste hand laid on tin lids, cardboard squares or directly onto the ground (known as spits - raised clods of earth). *Controls* The current HSNO controls that reduce the amount of 1080 deposited into soil are contained in Section 3.4 Default Controls and include: • Schedule 5 (of Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. *Potential Effects* The risk of exposure is reduced compared with aerial applications of bait, as application rates are lower, and the size of operations are smaller. Morgan (2000) reported there was little loss of 1080 from current paste bait formulations 49 hours after they were subjected to 5 mm of simulated rain. Detoxification of 1080 paste baits left on upturned spits took 80 days, but this was reduced to 40 days for buried baits (Morgan 2000). Ross & Henderson (2003) reported that 1080 paste baits buried in soil (dry or damp) retained significant concentrations of 1080 after 20 days (2003). Once 1080 enters soil, the potential effects, degradation and leaching will be the same as those given in E-A14. *Risk Profile* The likelihood of this exposure occurring is EXTREMELY LIKELY [almost certain]. The effect would be MINIMAL [no persistence, non toxic breakdown products, below detection levels and negligible environmental impact], therefore the risk is D [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].	Extremely likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
E-A35	Paste (0.6-0.8, 1.5 g/kg)	**Uncontained Application Methods:** Hand-laying of paste on: • Tin lids • Cardboard squares • Earth spits	**Plants** Plants may be exposed to 1080 through paste hand laid on tin lids, cardboard squares or directly onto the ground (known as spits - raised clods of earth) near a plant. *Controls* The current HSNO controls that reduce plants being exposed to 1080 are contained in Section 3.4 Default Controls. Current default controls, and include: • Schedule 5 (Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. *Potential Effects* The small amounts of paste used in an operational area and the placement of the paste (on tin lids, cardboard or sods) means it is unlikely paste will come into direct contact with plants. If 1080 leached out of pastes into soil, degradation of 1080 by soil micro-organisms would probably breakdown 1080 before plants could absorb it. If 1080 was absorbed by plants, then the potential effects would be similar to those reported in A-E16. *Risk Profile* The likelihood of this exposure occurring is UNLIKELY [could occur but is not expected to occur under normal operating conditions]. The effect would be MINOR [Sub-lethal to some non-target individuals within a population, lethal to a very few non-target individual, limited but medium term effects, no biodiversity loss, highly localised impact], therefore the risk is D [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].	Unlikely	Minor	D
E-A36	Paste (0.6-0.8, 1.5 g/kg)	**Uncontained Application Methods:** Hand-laying of paste on: • Tin lids	**Native birds, mammals, terrestrial invertebrates, and herpetofauna** Native birds (particularly those that feed at ground level), terrestrial invertebrates and herpetofauna may directly ingest paste from tin lids, cardboard or spits. *Controls* The current HSNO controls that reduce exposure to native fauna are contained in Section 3.4 Default Controls and include:	Very unlikely	Minor	C

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
		• Cardboard squares • Earth spits	• Schedule 3 (Gazette Notice 92): 3 (1), the requirement to obtain permission to use 1080 on land administered or managed by DOC. This enables DOC to impose conditions on the use of 1080 if there are concerns about potential effects on native species at a particular site; and • Schedule 6 (Gazette Notice 92): 1 Methods of Release and Colour, bait must be coloured green or blue (see Section 3.4). This makes them less attractive to birds whose colour vision is more focussed at the red/orange end of the spectrum. *Potential effects* Limited studies on the effects of exposure of native fauna to paste have been undertaken as recorded below: <u>Native birds</u> In a non-toxic trial on Tiritiri Matangi Island, visits to green dyed, cinnamon lured paste by birds were observed. Of the 13 native species present in the areas where the paste was laid (tui, bellbird, hihi, Kakariki, robin, saddleback, whitehead, silvereye, kereru, fantail, grey warbler, Australasian harrier and spotless crake (*Porzana tabuensis*)), only seven species visited the paste and only robins and saddlebacks were seen visiting the paste more than once (Morgan *et al.* 1997). Further feeding trials were carried out on robins, kereru, weka and pukeko which were believed to be likely paste-feeders. At the end of the study, the authors concluded that omnivorous ground feeding birds, including robin, saddleback, weka and pukeko may be placed at risk if paste is laid on the ground in habitats containing these species. Morgan (1999) reported on pen trials in which kaka, brown kiwi, weka, kea, kereru and kakariki were all observed eating non toxic paste baits. Of these birds, kaka, brown kiwi, weka and kea ate appreciable amounts. Then in a field trial where non-toxic bait was placed on platforms and on the ground, out of 16 bird species present in the study area (Paparoa National Park), only weka and robins were observed feeding on the bait (Morgan 1999). Individual weka, tui, silvereye, and bellbird have been found dead after paste			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			operations (Spurr 2000). 13 radio-tagged North Island brown kiwi all survived exposure to 1080 paste laid in a Northland forest (Robertson *et al.* 1999). The above evidence suggests that while it is possible for individual native birds to consume a lethal dose of 1080 from paste applications, the general lack of bird fatalities during or after pest control using 1080 paste applications means a population level effect is very unlikely. <u>Bats</u> In a pen trial lesser short-tailed bats showed little interest in paste baits and did not feed on it, and it was concluded that bats were unlikely to be placed at risk (Morgan *et al.* 1997). However, in a second pen trial lesser short-tailed bats were observed feeding on non toxic paste (Morgan 1999). <u>Herpetofauna</u> Two out of eight common skinks fed on non-toxic paste presented to them for two days in a pen trial (Morgan 1999). Herpetofauna (e.g. frogs) that live near waterways are unlikely to be exposed to 1080 paste because the paste is hand laid away from waterways. <u>Terrestrial Invertebrates</u> One of eight giant land snails and two of ten tree weta fed on non-toxic paste presented to them for two days in a pen trial. No ground beetles were observed feeding on the paste (Morgan 1999). <u>Overall Assessment</u> No reports of mortality to native bats, terrestrial invertebrates or herepetofauna could be found. While it is considered theoretically possible for some species of native bats, invertebrates and herpetofana to receive a lethal dose of 1080 from paste operations, given the lack of evidence of dead animals found it is considered very unlikely.			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Refer to E-A17 – E-A21 for assessment of a worse case scenario from aerial application of 1080 pellets. In general the risk of exposure is significantly reduced compared with aerial applications because to use of paste is less frequent, application rates lower and the size of operational areas smaller. *Risk Profile* The likelihood of this exposure occurring is VERY UNLIKELY [considered only to occur in very unusual circumstances]. The effect would be MINOR [sub lethal to some non-target individuals within a population, limited but medium term effects, highly localised impact, lethal to some non-target individuals at a local level and no biodiversity loss], therefore the risk is C [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
GEL (50, 100 g/kg 1080) UNCONTAINED APPLICATION METHODS **Baits consist of branches of palatable tree species either tied down to ground level or cut and placed on the ground. On each branch, the backs of 10 – 20 leaves are each smeared with approximately 0.25g of 1080 gel. Baits are laid at 0.7 – 2.5 baits/ha.** **Waterways are physically avoided when laying baits. Exposure of water, aquatic fauna and terrestrial species that live near waterways (e.g. frogs) will not occur. This assessment of effects does not consider these types of exposure further.**						
E-A37	Gel (50, 100 g/kg 1080)	**Uncontained** Hand-laying gel on vegetation	**Soil** 1080 from gels applied to vegetation could come into contact with the soil if vegetation with gel on it falls to the ground or 1080 leaches out of the bait onto the ground. *Controls* The current HSNO controls that reduce the amount of 1080 deposited into soil are contained in Section 3.4 Default Controls and include: • Schedule 5 (of Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. *Potential Effects* When 100 g/kg 1080 gel with a carbopol carrier was applied to broadleaf, 90% of the 1080 was washed out of the baits by as little as 81 mm of rain (Batcheler and Challies 1988). Parkes (1991) found that when 100 g/kg 1080 Gel in a carbopol carrier was applied to mahoe leaves, 95.2% of the 1080 had leached from the baits	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			after 208 mm of rain. In contrast, 100 g/kg 1080 Gel with a petrolatum carrier is highly resistant to leaching, with 78.8% of the 1080 still remaining in the baits after 64 days and 208 mm of rain. Challies and Thomson (1988) concluded that >5000 mm of rain was required to leach about 75% of the 1080 out of the baits. No specific research on the persistence of gel in soil has been undertaken. The small amount of bait (approximately 12.5 g of bait per hectare) laid means that very little 1080 is likely to enter soil from this pesticides's use. If 1080 did entered soil, the potential effects will be the same as those presented in EA-14. *Risk Profile* The likelihood of this exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions]. The effect would be MINIMAL [no persistence, no persistence, non toxic breakdown products, and negligible environmental impact], therefore the risk is D [Risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A38	Gel (50, 100 g/kg 1080)	**Uncontained** Hand-laying gel on vegetation	**Plants** Generally gel is applied to cut vegetation so will not come in contact with living plants. *Controls* The current HSNO controls that reduce plants being exposed to 1080 are contained in Section 3.4 Default Controls. Current default controls, and include: • Schedule 5 (Gazette Notice 92): 2 Application Rates, a maximum application rate of 30 g 1080/hectare. *Potential Effects* Where gel is applied to living vegetation, 1080 could theoretically be absorbed by plants as it leaches out of the gel, however, no research has been undertaken to confirm this. Should 1080 be absorbed by plants then the potential effects will be the same as those presented in EA-16. *Risk Profile* The likelihood of this exposure occurring is LIKELY [almost certain]. The effect	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			would be MINIMAL [no persistence, little sensitivity to 1080 and negligible environmental impact], therefore the risk is D [risks within the ALARP band (As Low as Reasonably Practicable) and broadly classed as tolerable subject to ongoing monitoring and control].			
E-A39	Gel (50, 100 g/kg 1080)	**Uncontained** Hand-laying gel on vegetation	**Native birds, mammals, terrestrial invertebrates, and herpetofauna** Native birds, mammals, terrestrial invertebrates and herpetofauna may directly ingest gels laid at ground level. *Controls* The current HSNO controls that reduce exposure to native fauna are contained in Section 3.4 Default Controls and include: • Schedule 3 (Gazette Notice 92): 3 (1), the requirement to obtain permission to use 1080 on land administered or managed by DOC. This enables DOC to impose conditions on the use of 1080 if there are concerns about potential effects on native species at a particular site; and • Schedule 6 (Gazette Notice 92): 1 Methods of Release and Colour, bait must be coloured green or blue (see Section 3.4). This makes them less attractive to birds whose colour vision is more focussed at the red/orange end of the spectrum. *Potential effects* There have been no recorded non-target deaths from the use of these gels. No studies have been undertaken on possible population impacts, but the small amounts of bait (approximately 12.5 g of bait per hectare) laid means the use of these gels is unlikely to affect non-target native species as a population level. *Risk Profile* The likelihood of this exposure occurring is IMPROBABLE [only occurring in very exceptional circumstances]. The effect would be MINOR [sub lethal to some non-target individuals within a population, limited but medium term effects, highly localised impact, lethal to some non-target individuals at a local level and no biodiversity loss], therefore the risk is B [either insignificant or minor and not warranting further assessment].	Improbable	Minor	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
GROUND APPLICATION OF 1080 – CONTAINED METHODS **1080 baits are contained within bait bags or bait stations that are fixed to trees or posts.**						
PELLETS (0.4-0.8, 1.0, 1.5-2.0 g/kg 1080) CONTAINED APPLICATION METHODS **Since the pellets are contained, and bait stations and bait bags are not placed near waterways, it is highly unlikely water or aquatic fauna will be exposed to 1080. Bait stations are designed to exclude most non-target animals, and any toxic pellets remaining after a week are usually removed, reducing the time 1080 pellets are in the environment. This means exposure of native mammals, terrestrial invertebrates and herpetofauna does not occur, or is insignificant, compared with uncontained application methods. Therefore, this assessment of effects will not consider these types of exposure.**						
E-A40	Pellets (0.4-0.8, 1.0, 1.5-2.0 g/kg 1080)	**Contained Applications methods:** Bait bags Bait stations	**Soil, plants** Soil and plants may be exposed to 1080 from pellets that spill from a bait bag or station. *Potential effects* Morgan (1999) monitored four penned possums feeding on non-toxic pellets over eight nights. On average, 3.3g of pellet were spilled per night, equivalent to 6.6% of the overall mean weight of bait eaten. Where pellets spill from a bait station/bait bag exposure of soil and plants would be restricted to directly under the bait station/bait bag. By comparison, E – A14 and E – A16 can be considered a 'worst case' scenario for the effects of soil and plants being exposed to 1080 because baits are sown directly onto the ground over a wide area. As a result, the effect described in this section has been assessed as lower than that for aerial 1080 pellet application. *Risk Profile* The likelihood of this exposure occurring is IMPROBABLE [Only occurring in very exceptional circumstances]. The effect would be MINIMAL [non toxic breakdown products, negligible environmental impact, no persistence, below detection limits], therefore the risk is A [either insignificant or minor and not warranting further assessment].	Improbable	Minimal	A
E-A41	Pellets (0.4-0.8, 1.0, 1.5-2.0 g/kg 1080)	**Contained Applications methods:**	**Native birds** Native birds may be exposed to 1080 if they are particularly inquisitive and	Improbable	Minor	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
		Bait bags Bait stations	investigate bait bags or stations or eat spilled bait from the ground. *Controls* The current HSNO controls that reduce exposure to native birds are contained in Section 3.4 Default Controls and include: • Schedule 3 (Gazette Notice 92): 3 (1), the requirement to obtain permission to use 1080 on land administered or managed by DOC. This enables DOC to impose conditions on the use of 1080 if there are concerns about potential effects on native species at a particular site; and • Schedule 6 (Gazette Notice 92): 1 Methods of Release and Colour, bait must be coloured green or blue (see Section 3.4). This makes them less attractive to birds whose colour vision is more focussed at the red/orange end of the spectrum. *Potential effects* There is a chance that native birds may be exposed if they are particularly inquisitive or eat spilled bait from the ground. Individual kea, weka, kaka and bellbirds deaths have been reported during 1080 bait station operations (Spurr 2000). However, 1080 baits in bait stations/bags are generally less accessible to non-target birds than baits on the ground (Spurr 2000). This is due to the design of the bait stations/bags (they exclude the majority of birds) and their placement, and because baits are contained within the bait station/bag. This means that the few non-target deaths reported are extremely unlikely to have any impact at a population level. *Risk Profile* The likelihood of this exposure occurring is IMPROBABLE [only occurring in very exceptional circumstances]. The effect would be MINOR [sub lethal to some non-target individuals within a population, limited but medium term effects, highly localised impact, lethal to some non-target individuals at a local level and no biodiversity loss], therefore the risk is B [either insignificant or minor and not warranting further assessment].			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
COATED BAITS (0.8 or 1.5g/kg 1080) CONTAINED APPLICATION METHODS **Since the baits are contained, and bait stations and bait bags are not placed near waterways, it is highly unlikely water or aquatic fauna will be exposed to 1080. Bait stations are designed to exclude most non-target animals, and any toxic bait remaining after a week is usually removed, reducing the time the 1080 coated bait is in the environment. This means exposure of native mammals, terrestrial invertebrates and herpetofauna does not occur, or is insignificant, compared with uncontained application methods. Therefore, this assessment of effects will not consider these types of exposure.**						
E-A42	Coated Baits (0.8, 1.5 g/kg)	**Contained Application Methods:** Bait bags Bait stations	**Soil, plants** Soil and plants may be exposed to 1080 from coated baits that spills from a bait bag or station. *Potential Effects* No research has been undertaken into spillage of 1080 coated baits from bait stations/bags. However, Morgan (1999) monitored four penned possums feeding on non-toxic pellets over eight nights and on average 6.6% of the overall mean weight of bait eaten was spilt. It is expected that similar amounts of coated baits would be spilt. Where coated baits spill from a bait station/bait bag exposure of soil and plants would be restricted to directly under the bait station/bait bag. By comparison, E – A23 and E – A25 can be considered a 'worst case' scenario for the effects of soil and plants being exposed to 1080 because baits are sown directly onto the ground over a wide area. As a result, the effect described in this section has been assessed as lower than that for aerial 1080 pellet application. *Risk Profile* The likelihood of this exposure occurring is IMPROBABLE [Only occurring in very exceptional circumstances]. The effect would be MINIMAL [non toxic breakdown products, negligible environmental impact, no persistence, below detection limits], therefore the risk is A [either insignificant or minor and not warranting further assessment].	Improbable	Minimal	A
E-A43	Coated Baits (0.8, 1.5 g/kg)	**Contained Application Methods:**	**Native birds** Native birds may be exposed to 1080 if they are particularly inquisitive and investigate bait bags or stations or eat spilled bait from the ground.	Improbable	Minor	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
		Bait bags Bait stations	*Controls* See controls in E-A41. *Potential Effects* There is a chance that native birds may be exposed if they are particularly inquisitive or eat spilled bait from the ground. Individual kea, weka, kaka and bellbirds deaths have been reported during 1080 bait station operations (Spurr 2000). However, 1080 baits in bait stations/bags are generally less accessible to non-target birds than baits on the ground (Spurr 2000). This is due to the design of the bait stations/bags (they exclude the majority of birds) and their placement, and because baits are contained within the bait station/bag. This means that the few non-target deaths reported are extremely unlikely to have any impact at a population level. *Risk Profile* The likelihood of this exposure occurring is IMPROBABLE [only occurring in very exceptional circumstances]. The effect would be MINOR [sub lethal to some non-target individuals within a population, limited but medium term effects, highly localised impact, lethal to some non-target individuals at a local level and no biodiversity loss], therefore the risk is B [either insignificant or minor and not warranting further assessment].			
PASTE (0.6-0.8, 1.5, 10 g/kg 1 080) CONTAINED APPLICATION METHODS **Since the paste is contained, and bait stations and bait bags are not placed near waterways, it is highly unlikely water or aquatic fauna will be exposed to 1080. Bait stations are designed to exclude most non-target animals. This means exposure of native mammals, terrestrial invertebrates and herpetofauna does not occur, or is insignificant, compared with uncontained application methods. Therefore, this assessment of effects will not consider these types of exposure.**						
E-A44	Paste (0.6-0.8, 1.5, 10 g/kg 1 080)	**Contained:** Bait bags Bait stations	**Soil, plants** Soil and plants may be exposed to 1080 from paste that spills from a bait bag or station. *Potential Effects* If paste spilt from a bait station/bait bag exposure of soil and plants would be restricted to directly under the bait station/bait bag. However, the physical characteristics of the paste (it is sticky), means that bait spillage is highly	Highly improbable	Minimal	A

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			improbable. *Risk Profile* The likelihood of this exposure occurring is HIGHLY IMPROBABLE [almost certainly not occurring but cannot be totally ruled out]. The effect would be MINIMAL [non toxic breakdown products, negligible environmental impact, no persistence, below detection limits], therefore the risk is A [either insignificant or minor and not warranting further assessment].			
E-A45	Paste (0.6-0.8, 1.5, 10 g/kg 1 080)	**Contained:** Bait bags Bait stations	**Native birds** Native birds may be exposed to 1080 if they are particularly inquisitive and investigate bait bags or stations and directly ingest bait or eat spilled bait from the ground. *Controls* See controls in E-A41. *Potential Effects* The risk is reduced for native birds for contained compared with uncontained applications of paste (see E-A36 for effects of paste on native birds). There is a chance that native birds may be exposed to 1080 paste in bait stations/bags if they are particularly inquisitive. The deaths of individual kaka, silvereye and bellbirds have been reported during 1080 paste bait station operations (Spurr 2000). However, 1080 baits in bait stations/bags are generally less accessible to non-target birds than baits on the ground (Spurr 2000). This is due to the design of the bait stations/bags (they exclude the majority of birds) and their placement, and because baits are contained within the bait station/bag. This means that the few non-target deaths reported are extremely unlikely to have any impact at a population level. *Risk Profile* The likelihood of this exposure occurring is IMPROBABLE [only occurring in very exceptional circumstances]. The effect would be MINOR [sub lethal to some non-target individuals within a population, limited but medium term effects, highly localised impact, lethal to some non-target individuals at a local level and no	Improbable	Minor	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			biodiversity loss], therefore the risk is B [either insignificant or minor and not warranting further assessment].			
GEL (1.5 g/kg 1080) CONTAINED APPLICATION METHODS **1080 gel is contained a specially designed bait station that is fixed to trees or posts.** **Since the gel is contained, and bait stations and bait bags are not placed near waterways, it is highly unlikely water or aquatic fauna will be exposed to 1080. Therefore, this assessment of effects will not consider these types of exposure.**						
E-A46	Gel (1.5 g/kg 1080)	**Contained:** This product comes in 250g or 500g containers that fit into a special bait station.	**Soil and Plants** Soil and plants may be exposed to 1080 from gel that spills from a bait bag or station. *Potential Effects* There is a chance that soil and plants may be exposed to this gel if it spilled from the bait station, but research indicates that spillage is minimal. Morgan (1999) monitored four penned possums feeding on non-toxic gel over eight nights. On average, only 0.1 g of gel was spilled per night, with no bait spilt on 5 of the nights. This is equivalent to 0.4% of the overall mean weight of bait eaten. If gel did fall out of a bait station, exposure of soil and plants would be restricted to directly under the bait station. *Risk Profile* The likelihood of this exposure occurring is HIGHLY IMPROBABLE [almost certainly not occurring but cannot be totally ruled out]. The effect would be MINIMAL [non toxic breakdown products, negligible environmental impact, no persistence, below detection limits], therefore the risk is A [either insignificant or minor and not warranting further assessment].	Highly improbable	Minimal	A
E-A47	Gel (1.5 g/kg 1080)	**Contained:** This product comes in 250g or 500g containers that fit into a special bait station.	**Native Fauna** Native fauna may be exposed to 1080 if they investigate bait bags and or stations and directly ingest bait or eat spilled bait from the ground. *Controls* See controls in E-A41.	Improbable	Minor	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Potential Effects Prior to 1.5 g/kg 1080 gel being registered extensive trials were undertaken to determine whether the gel posed a risk to non-target native fauna. Native Birds During pen trials, kaka, brown kiwi, weka, kea, kereru and kakariki were offered non-toxic gel bait over two days. Only kea ate an appreciable amount of gel bait (Morgan 1999). In a field trial where non-toxic bait was placed on platforms and on the ground, out of 16 bird species present in the study area, only weka and robins were observed feeding on the bait and the amount of gel eaten by these species were less than paste baits used as a comparison (Morgan 1999). It was concluded that only inquisitive ground feeding birds were likely to eat gel bait if they encountered it, and presenting the gel in bait stations would further reduce the risk. Native Bats In a two-night pen trial, short-tailed bats did not feed on gel baits (Morgan 1999). Lizards None of 8 common skink (*Leilopisma nigriplantare*) monitored for 32 hours over two nights fed on gel bait (Morgan 1999). Terrestrial Invertebrates Only three of eight giant land snails (*Powelliphanta hochstetteri hochstetteri*) and one of 10 tree weta (*Hemideina crassidens*) fed on non-toxic gel baits presented on the ground for two days in a pen trial. No ground beetles (*Megadromus bullatus*) were observed feeding on the gel (Morgan 1999). Additional trials indicated that the gel was only palatable to nectivorous invertebrates and these species were unable to feed on the gel because their mouth parts could not penetrate the surface of the solid bait. Overall Assessment At the end of the trials, Morgan (1999) concluded that few non-target animals are likely to be attracted by the gel bait, and using the gel in bait stations would further			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			limit exposure. *Risk Profile* The likelihood of this exposure occurring is IMPROBABLE [only occurring in very exceptional circumstances]. The effect would be MINOR [sub lethal to some non-target individuals within a population, limited but medium term effects, highly localised impact, lethal to some non-target individuals at a local level and no biodiversity loss], therefore the risk is B [either insignificant or minor and not warranting further assessment].			
INDIRECT (SECONDARY) EXPOSURE – ALL APPLICATIONS **Secondary poisoning occurs when the exposure to the poison is not direct, but via another medium. Native scavengers, predators and insectivores could conceivably feed on poisoned carcasses or eat live prey (e.g. birds or invertebrates) that have previously been exposed to 1080.** **The potential exposure pathways described below apply to all 1080 formulations.**						
E-A48	All formulations	**All application methods**	**Native birds – scavengers, predators and insectivores** Native birds (scavengers, predators and insectivores) may feed on poisoned carcasses or live kill of lethally/sub-lethally exposed animals. *Controls* No controls exist that specifically address the risk of secondary poisoning of native fauna. *Potential Effects* 1080 has a relatively short half-life in sub lethally dosed animals, being metabolised and eliminated from living animals within days. A number of laboratory studies have measured 1080 residue levels and 1080 elimination rates in sub-lethally poisoned mammals (Eason *et al.* 1993, Eason *et al.* 1994a, Gooneratne *et al.* 1995), marsupials (Ataria *et al.* 2000) and birds (Eason *et al.* 1993). In these studies the highest concentrations of 1080 residues were found in the blood/plasma, moderate levels in muscle and kidneys, and the lowest concentration in the liver. Most sub lethally exposed mammals eliminate 1080 within 12-96 hours (Eason *et al.* 1994b, Gooneratne *et al.* 1994). Laboratory studies have also looked at 1080 residue levels and elimination rates in	Very unlikely	Minimal	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			sub-lethally poisoned insects (Eason *et al.* 1993, Booth and Wickstrom 1999). In the native ant (*Huberia striata*) the maximum recorded 1080 residue was 5.51 mg/kg, one day after sub lethal dosing. This rapidly declined to 0.27 mg/kg after seven days (Booth and Wickstrom 1999). In tree weta (*Hemideina crassidens*) dosed with 15 g 1080/kg, maximum residue levels of between 0.033 and 5.8 mg/kg, were recorded, but all 1080 was eliminated within 4-6 days (Eason *et al.* 1993). Suren & Bonnett (Suren and Bonnett 2004)recorded 1080 residues of up to 3.3 mg/kg in the viscera and 5 mg/kg in the tail muscle of sub-lethally poisoned koura. The 1080 residues decreased by a factor of five after eight days, presumably as a result of the animals metabolising or excreting the compound. 1080 residues recorded in carcasses can be much higher than those reported in sub-lethally exposed animals. The maximum 1080 residue recorded in dead possum tissue is 8.4 mg/kg and greater than 70 mg/kg in stomach contents (Meenken and Booth 1997). Department of Conservation records show that residue levels of up to 5.9 mg/kg have been recorded in the tissue of dead birds. Additionally, while 1080 is metabolised and eliminated from living animals it can persist in carcasses for months. The rate of degradation of 1080 in carcasses will depend on moisture, temperature and the presence of micro-organisms. For example, tissue from possum carcasses monitored following possum and wallaby control on Rangitoto Island contained high 1080 residues 13 days after the operation. However after 28 days (following warm, wet weather) the carcasses had significantly decomposed and consisted of pelts and bone so no further samples were taken (Eason et al. 1991a). In contrast, during winter in the lower North Island, possum carcasses were reported to still contain 1080 residues 75 days after dying (Meenken and Booth 1997). These results indicate that sub lethally poisoned animals and carcasses can pose a threat to other animals that feed on them. <u>Birds of Prey/Scavengers</u> Birds such as Australasian harriers, New Zealand falcons, morepork and weka are potentially at risk from feeding on carrion or live prey that has been exposed to 1080, and individual morepork and weka have been found dead after 1080			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			operations. The following monitoring of these species has occurred: New Zealand Falcon: Spurr & Powlesland (1997) reported that all falcon territories monitored during 5 aerial 1080 operations remained occupied. Australasian harrier: No impact on this species was detected during an aerial 1080 operation on Rangitoto Island (Miller and Anderson 1992) and there was no evidence of dead harriers during aerial rabbit poisoning operations in the McKenzie Basin (Pierce and Maloney 1989). Morepork: Only one of 18 radio tagged individuals monitored during 5 aerial 1080 operations died (Pierce and Montgomery 1992, Spurr and Powlesland 1997, Walker 1997, Powlesland *et al.* 1998). Weka: Of 40 weka monitored (colour banded or radio tagged) during 4 aerial 1080 operations, only one weka was found dead (Spurr and Powlesland 1997, Walker 1997, van Klink and Tansell 2003). Five minute bird counts of weka during an aerial 1080 carrot operation in the Copeland Valley in 1986 found no observable effect on weka populations (Spurr 1988). Insectivorous Birds Theoretically, insects that have consumed 1080 could pose a risk to insectivorous birds such as tomtits, robin, fernbirds and whio. However, based on the residue levels recorded in insects and the LD_{50}s for birds (see E-A17), a bird would have to consume a considerable number of poisoned insects to suffer a lethal dose. Booth and Wickstrom (1999) discuss the potential for ants that have been poisoned with 1080 to secondary poison small insectivorous birds such as tomtits. They concluded it was unlikely to happen because a tomtit would have to consume an estimated 2750 ants that had eaten 1080 baits within the previous 24 hours. Field monitoring on insectivorous bird populations supports the view that insects poisoned with 1080 are unlikely to pose a significant risk. Fernbirds: While 4 out of 23 banded fernbirds disappeared during two operations (1997), the cause of the disappearance was not necessarily attributed to poisoning			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			by 1080. Tomtits: While tomtits numbers have decreased by up to 78.6% following some 1080 carrot operations (Powlesland *et al.* 2000, Westbrooke and Powlesland 2005), very few tomtits have died during aerial 1080 pellet operations (Powlesland *et al.* 2000, Westbrooke *et al.* 2003, Westbrooke and Powlesland 2005). This indicates that the tomtit losses during aerial operations are more likely due to consumption of bait than poisoned insects. Robins: Very few monitored robins have disappeared during aerial 1080 pellet operations (Powlesland *et al.* 1999b), and the number of robin deaths during aerial 1080 carrot operations have been highly variable (0-55%, Powlesland *et al.* 1999a). This suggests that the robin losses during aerial operations are more likely due to consumption of bait than poisoned insects. Whio: The aquatic invertebrate prey of whio are unlikely to be contaminated by 1080 (see E-A21). There was no reduction in visual counts of whio during an aerial 1080 operation (Spurr and Powlesland 1997) and all 19 radio tagged whio survived for at least four weeks following another aerial operation (Greene 1998). Overall Assessment Based on the information presented above, secondary poisoning of birds of prey, scavengers, and insectivorous birds rarely occurs and is unlikely to have any impact at a population level. *Risk Profile* The likelihood of this exposure occurring is VERY UNLIKELY (considered only to occur in very unusual circumstances). The effect would be MINIMAL (no or perceived effects on very few non-target species or minor short term effects), therefore the risk is B (either insignificant or minor and not warranting further assessment).			
E-A49	All pellets or coated baits	**All application methods**	**Other native fauna** Native terrestrial invertebrates and insectivorous vertebrates (i.e. bats, and herpetofauna species) and aquatic species such as eels may feed on poisoned	Very unlikely	Minimal	B

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			carcasses of lethally exposed animals or lethally/sub lethally exposed invertebrates. *Controls* No controls exist that specifically address the risk of secondary poisoning of native fauna. *Potential Effect* There is no specific literature or studies on secondary impacts from ground-control operations. In general the risk of exposure is reduced compared with aerial applications of bait because application rates are lower and the size of operational areas smaller. <u>Bats</u> Both the New Zealand long tailed bat and the lesser short tailed (*Mystacina tuberculata)* are insectivorous, and could, theoretically, be vulnerable to secondary poisoning after 1080 operations. The New Zealand long tailed bat is an aerial insectivore and most of the insects recorded in its diet, Diptera, Coleptera and Lepidoptera (O'Donnell 2005), have not been recorded as feeding on 1080 baits. This suggests that long tail bats are unlikely to be affected by secondary poisoning. No short tail bats deaths have been reported during 1080 operations. Lloyd and McQueen (2000) considered that short tailed bats could be at risk from secondary poisoning because of they forage on, or close to, the ground and because bats may be sensitive to 1080. However, Lloyd and McQueen (2002) captured 269 lesser short-tailed bats as they return from foraging during the period after a 1080 operation when 1080 would have been available for consumption by the bats. They held the bats for 48 hours and monitored mortality. All the bats survived and none showed signs of poisoning. <u>Invertebrates</u> Invertebrates are relatively tolerant of 1080 (see E-A19) and would need to consume a considerable amount of 1080 to be lethally poisoned. Insects consuming plant material that has absorbed 1080 could be poisoned. In			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			laboratory studies, broad bean plants have been shown to take up fluoroacetate through the roots and subsequently become toxic to aphids feeding on them. However, 1080 concentrations in plants necessary to kill the aphids were approximately 1 mg/kg of plant tissue, when applied to the plant through a cut tap-root (David and Gardiner 1953). This is a much higher concentration of 1080 than has been reported in plant material samples in the context of using 1080 baits for vertebrate pest control. Scavengers and insects that feed on decomposing carcases could be poisoned. However, only a small proportion of the total invertebrate fauna in an operational area will be feeding on poisoned carcases, so these species are unlikely to be affected at a population level. Carnivorous invertebrates could consume prey that had consumed 1080. However, as stated earlier, only a very small proportion of the total invertebrate fauna in an operational area will be feeding on 1080 baits or poisoned carcases, reducing the chances of carnivorous invertebrates coming across poisoned prey. <u>Herpetofauna</u> The LD_{50}s for amphibians and lizards are high (see E-A20), making the risk of secondary poisoning low (Booth and Wickstrom 1999). It is likely that herpetofauna would need to consume huge quantities of poisoned insects to receive a lethal dose. <u>Aquatic fauna</u> Lyver *et al.* (2005, 2006) conducted trial to look at whether eating 1080 contaminated possum tissue had an effect on long finned eels (*Anguilla dieffenbachii)*. No eels died during this study and, while sub-lethal 1080 residues were recorded, no sub-lethal effects were recorded. <u>Overall Assessment</u> The information presented here indicates that secondary poisoning unlikely to have any impact at a population level.			

REGISTER OF ADVERSE EFFECTS WITH 1080						
ID	**Formulation**	**Activity**	**Potential Environmental Receptors and Description of Exposure to 1080 and 1080 Formulations**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Risk Profile The likelihood of this exposure occurring is VERY UNLIKELY (considered only to occur in very unusual circumstances). The effect would be MINIMAL (sub lethal or no or perceived effects on very few non-target species or minor short term effects), therefore the risk is B (either insignificant or minor and not warranting further assessment).			
DISPOSAL / POST APPLICATION						
E-A50	Pellets (all concentrations); Paste (all concentrations); Gels (all concentrations); Stock Solution.	Wash down of application equipment, protective equipment etc. Waste disposed of ground via sump.	**Soil, groundwater** Washwater containing very dilute 1080 may come into contact with soil and groundwater from wash down of equipment diposed of to ground via a sump of or soakaway. 1080 is rapidly degraded through microbial activity. Refer to E-A14 for assessment of the effects of 1080 coming into contact with soil and groundwater respectively. *Risk Profile* The likelihood of this exposure occurring is EXTREMELY LIKELY [almost certain]. The effect would be MINIMAL [no persistence, non toxic breakdown products and negligible environmental impact], therefore the risk is D [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].	Extremely likely	Minimal	D
E-A51	Pellets (all concentrations); Paste (all concentrations); Gels (all concentrations); Stock Solution.	Solid waste disposal (including packaging).	Empty containers of 1080 are rinsed thoroughly. Empty bags are burned or buried in a suitable location at the landfill at a depth of approximately 60 cm. The empty containers must not be used for any other purpose. Surplus baits may be treated by burial, incineration or alternatively, a sewage oxidation facility or chemical treatment facility is also an acceptable means of disposing of unwanted bait material with the approval of a relevant local authority. When disposing of 1080 via burial, the bait is placed with other organic material on the active tip face of the landfill or buried within the biologically active layer of soil or else within a secure area. Refer to E-A7 through E-A9 disposal / offsite discharges (normal manufacturing process) for further assessment of this risk.			

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
BACKGROUND INFORMATION: In its pure form cyanide is a colourless solid and is soluble in water. It is hydrolysed and decomposed by carbon dioxide and water or acids, generating hydrogen cyanide, which has a characteristic odour of bitter almonds. The gas is lethal. Oil in the paste normally protects the cyanide from exposure to air and prevents the release of hydrogen cyanide. Cyanide rapidly hydrolyses and dissipates with water or damp soil, and does not leave a residue. It is lethal to humans, and extreme care must be taken during the manufacture and handling of all formulations. There are three formulations of cyanide in use in New Zealand: pellets (Feratox®), an encapsulated cyanide paste (Cyanara Ferapaste®) and non-encapsulated cyanide paste (Trappers Cyanide® and Cyanide Paste for Possum Destruction®). The active cyanide in both Feratox pellets and Cyanara Ferapaste is "encapsulated" with a non-toxic moisture and air barrier. This barrier reduces the amount of hydrogen cyanide gas liberated from the active ingredient. This is both a health and safety issue (for workers handling the baits) and an efficacy issue. The odour of the gas can deter pests from ingesting the baits, referred to as "bait-shyness". MAF requires cyanide handlers to hold an Approved Handlers Certificate and Controlled Substance Licence which is issued by the ACVM Group, NZFSA. ERMA require handlers to hold an Approved Handler Test Certificate (satisfying requirements for fit and proper persons). The MOH issues licences to sell or pack cyanide (MOH, 2003). A seller of cyanide must comply with HSNO requirements, which include requirements to securely store the cyanide under lock and key and record details of purchasers (MOH, 2003).						
TRANSPORT TO MANUFACTURING SITE						
E-CN-A1	Active	Transport by road from Port of Auckland to manufacturing facility	There is no exposure during normal operations as crates containing cyanide are not opened during transit. There is potential for discharge to the environment in event of accident during transport, causing release of packaged goods. In the event of an accident, emergency services will ensure the spill is well contained and cleaned up quickly ensuring minimal impact on the environment. Based on the above the likelihood of this exposure occurring is IMPROBABLE [Only occurring in very exceptional circumstances]. The effect would be MINIMAL [negligible environmental impact and no persistence], therefore the risk is A [either insignificant or minor and not warranting further action].	Improbable	Minimal	A
MANUFACTURE						
Preparation of CN products						
E-CN-A2	Feratox Pellet (including pre-	Active, pellet 475 g/kg CN	There will be insignificant or no exposure - all activities are contained within factory except for waste discharges (see activity E-CN-A6 through 10). This pathway has not been assessed further.			

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
	manufactured bait bags)					
E-CN-A3	Encapsulated Paste	Active, paste 500 g/kg CN	There will be insignificant or no exposure - all activities are contained within factory except for waste discharges (see activity E-CN-A6 through A10). This pathway has not been assessed further.			
E-CN-A4	Paste	500 -600 g/kg	There will be insignificant or no exposure - all activities are contained within factory except for waste discharges (see activity E-CN-A6 through A10). This pathway has not been assessed further.			
Disposal/off-site discharges (normal manufacturing process)						
E-CN-A5	Active	Solid waste CN collected by waste contractor for treatment.	No impact on environment as wastewater is combined with other wastewater streams and treated by neturalising prior to disposal via sewage treatment system. This pathway has not been assessed further.			
E-CN-A6	Active and traces of all formulations may be present on disposable items, packaging etc	Solid Waste disposed to landfill, including packaging etc	**Water, soil within landfill.** Cyanide present in waste decomposes rapidly, similar to mechanisms for degradation in soil and water (see further discussion on the degradation rates of cyanide in soil and water in E-CN-A12 and E-CN-A13). If cyanide does come into contact with water in a landfill it is highly soluble and rapidly hydrolyses (dissolving or decomposition of a chemical structure in water by chemical or biochemical means) and does not leave any residue behind. Feratox pellets in water will release about 90% of their cyanide after 34 days (Wright & Manning 2003). Cyanide itself will be degraded within hours. Wright and Manning (2003) found that the soil surrounding buried Feratox pellets had a concentration of 3.1 mg/kg after 8 days and a maximum concentration of 8.4 mg/kg by the end of the trial (16 days). The soil had a background concentration of 0.48 mg/kg. Rainfall, humidity or environmental moisture and presence of soil micro organisms increase the degradation of cyanide in soil (Eason & Wickstrom 2001). Based on the above the likelihood of this exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions]. The effect would be MINIMAL [no persistence and	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
			negligible environmental impact], therefore the risk is D [Risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
E-CN-A7	Active and traces of all formulations may be present on disposable items, packaging etc	Solid Waste disposed to landfill, including packaging etc	**Fauna** Animal pests may be present at a landfill (e.g. gulls, mice, cats, and possums) but it is very unlikely that native species would be present. Any animals present could be exposed to cyanide through direct ingestion of waste material contaminated with cyanide residues. Given the rapid degradation of cyanide in soil and water the effect of exposure to fauna is considered to be low (refer E-CN-A13 and E-CN-A14). Based on the above the likelihood of this exposure occurring is UNLIKELY [could occur, but is not expected to occur under normal operating conditions]. The effect would be MINIMAL [no persistence and negligible environmental impact), therefore the risk is C [Risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].	Unlikely	Minimal	C
E-CN-A8	Active (in solution, diluted with washwater).	Wastewater goes into sewer system	No exposure to water, soil, flora or fauna. Treated water is disposed of to sewer. This pathway has not been assessed further.			
Site Spills (abnormal events)						
E-CN-A9	Active, all solid formulations (pellets and pastes).	Of solids	Insignificant or no exposure - spills of solids can be controlled within site. Any waste generated subject to controlled disposal (see activity A5). This pathway has not been assessed further.			
E-CN-A10	Active	Of wastewater	Insignificant or no exposure - site is sufficiently bunded and activities contained within factory. Spills can be controlled within site and wastewater disposed into sewer system (see activity E-CN-A5). This pathway has not been assessed further.			
TRANSPORTATION FROM FACTORY TO APPLICATION SITE						
E-CN-	Feratox Pellets;	Transportation of packaged goods	There is insignificant or no exposure during normal operations as packages are not opened during transit. There is potential for discharge to environment in event of accident during transport,	Improbable	Minimal	A

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
A11	Encapsulated Paste, Paste.	by road from the manufacturing site to the application site.	causing release of packaged goods. In the event of an accident, emergency services will ensure the spill is well contained and cleaned up quickly ensuring minimal impact on the environment. Based on the above the likelihood of this exposure occurring is IMPROBABLE [Only occurring in very exceptional circumstances]. The effect would be MINIMAL [negligible environmental impact and no persistence], therefore the risk is A [either insignificant or minor and not warranting further action].			
GROUND APPLICATION OF CYANIDE						
CONTAINED APPLICATION METHODS: Feratox Pellets (500 g/kg potassium cyanide) Note: Literature often refers to Feratox pellets with a cyanide concentration of 800 g/kg. This formulation is no longer used; however the toxicological research on the 800g/kg formulation is still relevant.						
E-CN-A12	Feratox Pellets (500 g/kg)	All contained application methods: Bait stations Bait bags (bags containing Feratox pellet encased in pre-feed paste)	**Soil** Feratox pellets are only applied in contained application methods (bait stations), therefore they are not placed on the ground. However, where rodent numbers are high a significant number of Feratox pellets can be dislodged from bait stations/ bags and fall to the ground. DOC records show that during trials up to 25% of Feratox pellets in bait stations were known to fall onto the ground and a further 50% of Feratox pellets were unaccounted for (not in the bait station, on the ground or killed possums). Once on the ground, Feratox pellets will disintegrate over 2-4 months (Eason and Wickstrom 2001). Wright and Manning (2003) reported that when Feratox pellets were buried in soil at a depth of 50 mm and subjected to an average rainfall of 13 mm/day, they retained 49% of the initial concentration of cyanide after 34 days and 9% after 64 days. Cyanide ions (free cyanide) are not strongly absorbed or retained in soils (Eason and Wickstrom 2001), resulting in fast degradation (i.e. within hours) of cyanide from soil once a Feratox pellet starts to breakdown. Wright and Manning (2003) reported that soil surrounding buried Feratox pellets had a maximum concentration of cyanide of 3.1 mg/kg after 8 days and this had increased to 8.4 mg/kg by the end of the trial on day 16. In further laboratory trials, 700 mL of potassium cyanide (1mg/mL) was applied to 300 x 300 mm plots. Directly after dosing, the concentration of	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
			cyanide in the soil was 90mg/kg. 6 hours later cyanide residues were approximately 3 mg/kg and this had declined to less than 2 mg/kg at 24 hours after dosing (Wright and Manning 2003). In both these trials the soil had a background concentration of cyanide of 0.48 mg/kg. Based on these results the half-life of cyanide in soils was calculated as 1.1 hours. Cyanide seldom remains biologically available for long in soil because it is either metabolised by various micro-organisms, lost through volatilisation or forms complexes with other compounds, such as iron (Eisler 1991). These forms are relatively much less toxic and reactive than free cyanide ions (Shifrin et al. 1996). Cyanide salts may be degraded by some bacteria. Under aerobic conditions microbial metabolism rapidly degrades cyanides to carbon dioxide and ammonia, while under anaerobic conditions cyanides are converted by bacteria to gaseous nitrogen compounds that escape to the atmosphere (Knowles 1988). Bacteria exposed to high concentrations of cyanide can be adversely affected (Eisler 1991). Where Feratox pellets are dislodged from bait stations/bags, any contamination will be limited to under the bait station. *Risk Profile* The likelihood of exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions.], the magnitude of effect would be MINIMAL [non toxic breakdown products, negligible environmental impact, and no persistence], and therefore the risk has been assessed as D [Risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
E-CN-A13	Feratox Pellets (500 g/kg)	All contained application methods: Bait stations Bait bags (bags containing feratox pellet encased in pre-feed paste)	**Waterways** Feratox pellets are only used in bait stations or bait bags. Bait stations and bait bags are kept away from waterways so cyanide is unlikely enter water if Feratox pellets are used appropriately. Should cyanide enter a waterway, the flow and volume of the waterway will affect the dilution of cyanide. While cyanide is highly soluble in water (Budavari et al. 1996), sodium cyanide and potassium cyanide both react with water to form hydrogen cyanide gas. This volatilisation reaction depends on the volume of water and the amount of reactive cyanide in the water, and is most effective under conditions of high temperature, high dissolved oxygen levels and increased concentrations of atmospheric carbon dioxide (Eisler 1991). Any cyanide remaining in water will be removed via sedimentation and microbial degradation (Eisler 1991).	Improbable	Minimal	A

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
			If Feratox pellets fall into water they will release about 90% of their cyanide after 34 days (Wright and Manning 2003). *Risk Profile* The likelihood of exposure occurring is IMPROBABLE [only occurring in very exceptional circumstances], the magnitude of effect would be MINIMAL [non toxic breakdown products, negligible environmental impact, and no persistence], and therefore the risk has been assessed as A [either insignificant or minor and not warranting further assessment].			
E-CN-A14	Feratox Pellets (500 g/kg)	All contained application methods: Bait stations Bait bags (bags containing Feratox Pellet encased in pre-feed paste)	**Plants** Plants can take up cyanide (Eisler 1991) and toxic effects reported include inhibition of growth and phloem translocation (Eisler 1991). Plants are also capable of degrading cyanide into non-toxic compounds (Yu *et al.* 2005). The risk of plants being exposed to the cyanide from Feratox pellets is considered to be insignificant. Feratox pellets are only used in bait stations or bait bags, and once cyanide enters the soil it is rapidly broken down. *Risk Profile* The likelihood of exposure occurring is IMPROBABLE [only occurring in very exceptional circumstances], the magnitude of effect would be MINIMAL [non toxic breakdown products, negligible environmental impact, and no persistence], and therefore the risk has been assessed as A [either insignificant or minor and not warranting further assessment].	Improbable	Minimal	A
			DIRECT EXPOSURE PATHWAYS TO NATIVE ANIMALS Exposure of native birds (other than weka), native mammals, terrestrial invertebrates and herpetofauna to cyanide from Feratox pellets is not expected to occur or is very minimal (if exposed to spilt pellets for example). Similarly, because Feratox in bait stations/bags is not used near waterways, no freshwater organisms are expected to be exposed to cyanide. The assessment of the effects of direct exposure has therefore only been carried out for weka.			
E-CN-A15	Feratox Pellets (500 g/kg)	All contained application methods: Bait stations	**Native birds – weka** The weka is a large flightless rail endemic to New Zealand. The North Island (*Gallirallus australis greyi*) and Stewart Island (*G. a. scotti*) subspecies are classified as acutely threatened and the western subspecies (*G. a. australis*) as chronically threatened.	Likely	Major	F

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
		Bait bags (bags containing Feratox Pellet encased in pre-feed paste)	Weka deaths as a result of cyanide poisoning have been confirmed during a number of possum control operations using Feratox pellets. The deaths are a result of weka interfering with bait bags or bait stations, or eating pellets spilt onto the ground by possums and rodents. *Controls* The controls in Gazette Notice No. 141, Hazardous Substances (Vertebrate toxic agents) Transfer Notice 2004, that reduce birds being exposed to cyanide are: • 10(1) specifies the colour baits may be: green or blue. This makes them less attractive to birds whose colour vision is more focussed at the red/orange end of the spectrum; and • Schedule 3: 3 (1), the requirement to obtain permission to use cyanide on land administered or managed by DOC. This enables DOC to impose conditions on the use of cyanide if there are concerns about potential effects on native species at a particular site. When granting permission to use Feratox on land managed by DOC where weka are known to be present, DOC requires that Feratox is only used with a paste that prevents Feratox pellets being dislodged from bait stations/bags and the bait stations/bags are raised at least 70 cm above the ground. Other methods of using Feratox are prohibited because of the high risk to weka at a population level. This assessment assumes that these conditions are applied on land managed by DOC in the majority of cases, however these conditions are not always applied on other land. *Potential Effects* Cyanide LD_{50}s for birds range from 1.43 – 21 mg/kg (Wiemeyer *et al.* 1986, Eisler 1991). Eisler (1991) reported that birds that are predominantly carnivorous appear to be more sensitive to cyanide than predominantly herbivorous species. Reported sub-lethal effects of cyanide exposure to birds are increased thiocyanate excretion rates, and growth reduction of young domestic chickens following repeated sub-lethal dietary intake of 135 mg cyanide/kg (Eisler 1991). In one study, two out of five radio tagged weka (40%) died at a site where Feratox pellets were out for 3–4 nights, and one out of 13 (8%) died at a second site where baits were out for only 1–2 nights. All three weka tested were positive for cyanide. A further four weka without radio-transmitters were also found dead on the bait lines, and the three that were tested all had positive cyanide residues (Mehrtens and Gaze 2003). DOC considers the mortality as a result of Feratox is too high, and has prohibited most uses of Feratox on public conservation land where weka are known to be present. However, weka deaths			

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
			from Feratox use could still occur outside the known range of weka and off public conservation land. *Risk Profile* The likelihood of weka exposure occurring is LIKELY [a good chance that it may occur under normal operating conditions], the magnitude of the effect would be MAJOR [lethal to a population of non-target species, but no species loss, some biodiversity loss or population loss, heavy ecological damage, costly restoration], and the risk is therefore assessed as F [risks regarded as unacceptable]. This is assessed as a significant adverse risk (see Section 4.2D).			
CONTAINED APPLICATION METHODS: Encapsulated and Non-Encapsulated Pastes (500 g/kg cyanide) Adverse environmental effects posed by exposure to encapsulated and non-encapsulated cyanide pastes have been assessed jointly rather than individually. This is because the concentration of cyanide in both potassium cyanide and sodium cyanide is the same and ingestion is the only pathway considered to cause adverse effects to environmental receptors (i.e. not inhalation). The risk posed by encapsulated potassium cyanide paste (which restricts the release of HCN) is therefore no different from sodium cyanide paste.						
E-CN-A16	Encapsulated Paste and Non-Encapsulated Paste (500 g/kg)	All contained application methods: Bait stations Bait bags	**Soil, Water, Groundwater, Plants** If cyanide entered soil or water, or was absorbed by plants, the effects of the exposure would be the same as outlined in E-CN-A12, 13 and 14. When cyanide paste is contained in bait stations/bags, it is unlikely to fall to the ground. Hence there will be very minimal or no exposure of soil, water, groundwater or plants to cyanide from this application method. These exposure pathways have not been assessed further.			
			DIRECT EXPOSURE PATHWAYS Apart from weka, the only native non-target animal reported to have died from feeding on cyanide paste in a bait station is a single kea. When cyanide paste is used in a bait station, cyanide exposure to birds (except weka), native mammals, terrestrial invertebrates and herpetofauna either does not occur or is very minimal. Since bait stations and bait bags are kept away from waterways, no freshwater organisms are expected to be exposed to cyanide from cyanide pastes in bait stations. The assessment of the effects of direct exposure has therefore only been carried out for weka.			
E-CN-A17	Encapsulated Paste and Non-Encapsulated Paste (500	All contained application methods: Bait stations	**Native birds – weka** *Controls* The controls in Gazette Notice No. 141, Hazardous Substances (Vertebrate toxic agents) Transfer Notice 2004, that reduce birds being exposed to cyanide are:	Unlikely	Minor	D

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
	g/kg)	Bait bags	• 10(1) specifies the colour baits may be: green or blue. This makes them less attractive to birds whose colour vision is more focussed at the red/orange end of the spectrum; and • Schedule 3: 3 (1), the requirement to obtain permission to use cyanide on land administered or managed by DOC. This enables DOC to impose conditions on the use of cyanide if there are concerns about potential effects on native species at a particular site. When granting permission to use cyanide paste on land managed by DOC where weka are known to be present, DOC requires that the paste is raised at least 70 cm above the ground to prevent ground birds coming in contact with the cyanide paste. Other methods of using Feratox are prohibited because of the high risk to weka at a population level. This assessment assumes that these conditions are applied on land managed by DOC in the majority of cases, however these conditions are not always applied on other land. *Potential Effects* Cyanide LD_{50} data and sublethal effects are presented in E-CN-A15. Weka deaths due to cyanide poisoning during bait station operations using cyanide paste have been confirmed. The requirement to raise the paste 70 cm of the ground in the DOC permission has reduced the number of weka deaths. However, this requirement does not apply off public conservation land, so occasional deaths still occur there, and outside known kiwi or weka ranges. As few ground bird deaths have been reported during the use of cyanide paste in bait stations/bags it is thought no population level impacts have occurred. *Risk Profile* The likelihood of exposure is UNLIKELY [could occur, but is not expected to occur under normal operating conditions]. The level of effect would be MINOR [sub-lethal to some non-target individuals within a population, lethal to a very few non-target individuals, limited but medium term effects, no biodiversity loss and highly localised impact], therefore the risk is D [Risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
UNCONTAINED APPLICATION METHODS: Encapsulated Paste and Non-Encapsulated Paste (500 g/kg) Due to the high toxicity of cyanide following ingestion, only a small (approximately pea-sized) amount of cyanide is placed onto natural features such as twigs and rocks. Adverse environmental effects posed by exposure to encapsulated and non-encapsulated cyanide pastes have been assessed jointly rather than individually. This is because the concentration of cyanide in both potassium cyanide and sodium cyanide is the same and ingestion is the only pathway considered to cause adverse effects to environmental receptors (i.e. not inhalation). The risk posed by encapsulated potassium cyanide paste (which restricts the release of HCN) is therefore no different from sodium cyanide paste.						
E-CN-A18	Encapsulated Paste and Non-Encapsulated Paste (500 g/kg)	All uncontained application methods: Hand-laying on natural features	**Soil, plants** Cyanide paste is applied directly onto natural features such as twigs and rocks, rather than on to soil or plants, to minimise degradation of the bait. *Potential effects* Non-encapsulated cyanide paste baits are considered fairly unstable because when they become damp the cyanide dissipates out of them by gaseous diffusion. Oil is incorporated in the paste to increase the stability of the cyanide by decreasing its contact with water. In standard laboratory trials, emission rates of hydrogen cyanide have been recorded at 23.0 to 25.5 µg HCN/hr for non-encapsulated paste (Wright 1999). Therefore, how long baits remain toxic depends on how well they are protected from rainfall (Eason and Wickstrom 2001), but they remain potentially hazardous until broken down and unrecognisable (Rammell and Fleming 1978). Encapsulated cyanide paste has reduced gas emission rates of 3.7 µg HCN/hr (Wright 2000). It is likely that this type of paste remains potentially hazardous until it is broken down and unrecognisable. As cyanide pastes placed directly onto the ground break down, they will release cyanide into soil. Once cyanide enters soils the process outlined in E-CN-A12 will occur. Theoretically plants could absorb cyanide out of soil or directly from paste if it is placed on them. However, the risk of plants being exposed to the cyanide from cyanide pastes is considered to be insignificant. Once cyanide enters the soil it is rapidly broken down and should plants absorb cyanide, they are capable of degrading cyanide into non-toxic compounds (Yu *et al.* 2005). *Risk Profile* The likelihood of exposure of soil and plants to cyanide paste is LIKELY [expected to occur if all conditions met]. The magnitude of effect would be MINIMAL [negligible environmental impact and no persistence], and therefore the risk has been assessed as D [risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].	Likely	Minimal	D

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
E-CN-A19	Encapsulated Paste and Non-Encapsulated Paste (500 g/kg)	All uncontained application methods: Hand-laying on natural features	**Water, Groundwater** If cyanide from pastes entered waterways, the same processes outlined in E-CN-A13 would occur. However, cyanide paste is laid away waterways so cyanide is unlikely enter water if cyanide paste is used appropriately. Therefore, the risk of this exposure is considered to be insignificant.			
			DIRECT EXPOSURE PATHWAYS During uncontained application methods exposure to native birds, native mammals, terrestrial invertebrates and herpetofauna may occur. No records of mortality among invertebrates and herpetofauna following cyanide operations could be found, thus these animals are not assessed further here. As waterways are not expected to be exposed to cyanide, no freshwater organisms are expected to be exposed to cyanide - freshwater organisms (vertebrates and invertebrates) will not be considered further in this assessment**.**			
E-CN-A20	Encapsulated Paste and Non-Encapsulated Paste (500 g/kg)	All uncontained application methods: Hand-laying on natural features	**Native Birds – all species** *Controls* The controls in Gazette Notice No. 141, Hazardous Substances (Vertebrate toxic agents) Transfer Notice 2004, that reduce birds being exposed to cyanide are: • 10(1) specifies the colour baits may be: green or blue. This makes them less attractive to birds whose colour vision is more focussed at the red/orange end of the spectrum; and • Schedule 3: 3 (1), the requirement to obtain permission to use cyanide on land administered or managed by DOC. This enables DOC to impose conditions on the use of cyanide if there are concerns about potential effects on native species at a particular site. *Potential Effects* Cyanide LD_{50} and sub-lethal effects data are presented in E-CN-A15. Significant weka and kiwi deaths (Spurr 2000) occurred in the past as a result of cyanide paste being laid on the ground. As a result of concerns over the number of weka and kiwi being killed by cyanide laid on the ground, DOC stipulates that cyanide pastes must be raised above 70 cm in known weka and kiwi areas on land managed by the Department. This appears to have significantly reduced the numbers of weka and kiwi killed. Individual tomtit, robin, silvereye and tui deaths have also been reported after the use of hand laid cyanide (Spurr 2000) however these deaths do not appear to have a significant impact at a	Unlikely	Minor	D

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
			population level. Assuming that cyanide baits are raised above 70 cm in kiwi and weka areas (in all lands not just DOC lands), it is unlikely that any native bird species will be affected at a population level from the use of uncontained cyanide pastes. *Risk Profile* The likelihood of exposure is UNLIKELY [could occur, but is not expected to occur under normal operating conditions]. The level of effect would be MINOR [sub-lethal to some non-target individuals within a population, lethal to a very few non-target individuals, limited but medium term effects, no biodiversity loss and highly localised impact], therefore the risk is D [Risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
E-CN-A21	Encapsulated Paste and Non-Encapsulated Paste (500 g/kg)	All uncontained application methods: Hand-laying on natural features	**Native Mammals - bats** While one lesser short-tailed bat has been reported dead following hand laying of uncontained cyanide paste (Daniel and Williams 1984), it appears unlikely that native bat populations are affected by the use of cyanide pastes laid on the ground. *Risk Profile* The likelihood of exposure is VERY UNLIKELY [considered only to occur in very unusual circumstances]. The level of effect would be MINOR [sub-lethal to some non-target individuals within a population, lethal to a very few non-target individuals, limited but medium term effects, no biodiversity loss and highly localised impact], therefore the risk is C [Risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].	Very unlikely	Minor	C
INDIRECT (SECONDARY) EXPOSURE PATHWAYS Secondary poisoning occurs when exposure to the poison is not direct but via another medium, for example, ingestion of contaminated carcasses, or live kill of an animal that has been exposed to a sub-lethal dose of the poison. The potential exposure pathways are described below. The pathways apply to all formulations used in cyanide operations.						
E-CN-A22	All formulations	All application methods	*Potential Effects* Cyanide is acknowledged to not be accumulated or stored in any mammal studied, and cyanide biomagnification in food webs has not been reported, possibly due to rapid detoxification of sub-lethal doses by most species and deaths at higher doses (Eisler 1991). In sub-lethally poisoned animals cyanide is metabolised to thiocyanate. Thiocyanate is approximately 120 times less toxic than cyanide, and is excreted over several days (Eason and	Improbable	Minor	B

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to CYANIDE and CYANIDE FORMULATIONS**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Wickstrom 2001). During a USA pen study of chickens, most of a sub-lethal cyanide dose was recovered as thiocyanate within 6 hours (Eisler 1991). Morris, Manning and O'Connor (2003) reported that a possum euthanased 10 days after it had swallowed an intact Feratox pellet, and not died, had 0.51 mg/kg cyanide in its liver. Low cyanide residues have been reported in the stomach contents and liver of possums killed with a Feratox pellet 336 hours after death and in muscle tissue 168 hours after death (Morriss et al. 2003). Where cyanide has been recorded in sub-lethally and lethally exposed animals, the amounts are probably insufficient to cause secondary exposure. *Risk Profile* The likelihood of secondary exposure is IMPROBABLE [only occurring in very exceptional circumstances]. The magnitude of effect could be MINOR [no biodiversity loss and highly localised impact] and therefore the risk is B [either insignificant or minor and not warranting further assessment].			

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to TRAPS**	**How likely?**	**Magnitude of effect**	**Level of risk**
Background: Traps are used for controlling possums and as a tool for monitoring the success of possum control operations. The most commonly used traps are leg-hold, although kill traps are used in some control operations. This assessment of the adverse effects of traps on the environment is confined to the effects of traps on native ground birds which are the non-target species caught in traps most often.						
E-TR-A1	Leg-hold traps Kill traps	Setting trap lines, checking, and killing trapped animals Setting trap lines and retrieving	**Native birds - weka** *Controls* The use of traps and devices is controlled through sections 32 – 36 of the Animal Welfare Act 1999. All traps intended to capture an animal live (including leg-hold traps) must be inspected within 12 hours after sunrise on each day the trap remains set (s. 36 (1)) and at least every 24 hours. Kill traps are excluded from this requirement. While the legal requirement to check traps is primarily to prevent any pest suffering unduly, it has the added benefit that any uninjured non-	Likely	Moderate	E

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to TRAPS**	**How likely?**	**Magnitude of effect**	**Level of risk**
		dead animals	target birds can be released or injured birds taken for treatment. Under the Animal Welfare Act 1999, Ministry of Agriculture and Forestry (MAF) can declare a trap to be prohibited or restricted by an Order in Council if it is considered inhumane. The National Animal Welfare Advisory Committee has recommended to MAF that the Lanes-Ace, Victor No 1 ½ (hard jaw), Victor No 3 and all similar types of traps be prohibited. This recommendation has not been implemented yet. *Potential Effects* The ground foraging habit of weka makes them vulnerable to being caught in traps, and traps can kill or permanently maim them. Significant numbers of weka have been caught where they gain access to traps. For example, traps have been used as a tool for eradicating weka introduced to some offshore islands e.g. Whenua Hou. Where weka numbers are low or in decline, the numbers accidentally caught during pest control operations can place weka populations in jeopardy (Beauchamp *et al.* 1999). During the eradication of possums from Kapiti Island between 1980 and 1987, all practical precautions were taken to minimise bird captures (Spurr 2000). Accidental captures of ground birds, including weka were reduced by raising leg-hold traps 700 mm above the ground (Sherley 1992). Based on these results, DOC introduced guidelines that require traps being used on lands managed by the Department, where ground birds are known to be present, to be set 700 mm above the ground, either on platforms, attached directly to tree trunks, or attached to a sloping board set at 38º to the ground. To comply with these guidelines the National Possum Control Agencies have developed a raised trap set protocol for monitoring possum control operations in ground bird areas. However, research has shown that weka are able to jump 90 cm and can walk up boards and poles sloped at up to 45^{o} (Thomson *et al.* 2001). Additional research by Sweetapple et al. (2006) concluded that weka are at risk from kill traps set up to at least 90 cm above the ground as they can trigger traps with trigger release pressures at the upper limit of what is considered appropriate for possums and above the limit specified for leghold traps. While catch rates of weka have been reduced since the implementation of DOC guidelines on trap heights, weka continue to be caught in traps during pest control operations. It is thought that the current capture rates are not high enough to have a significant population level effect.			

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to TRAPS**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Risk Profile The likelihood of adverse effect on weka resulting from trapping operations is LIKELY [a good chance that it may occur under normal operating conditions]. The effect is considered to be MODERATE [lethal to a number of non-target individuals within a population, little biodiversity loss or population loss] and the risk is therefore E [risks generally warrant further controls to bring them into the tolerable range]. This is assessed as a significant adverse risk (see Section 4.2D).			
E-TR-A2	Leg-hold traps Kill traps	Setting trap lines, checking, and killing trapped animals Setting trap lines and retrieving dead animals	**Native birds - kiwi** *Controls* See controls in E-TR-A1. *Potential Effects* The use of leg hold traps can put kiwi at risk of capture and can kill or permanently maim them. In a survey of 66 possum traps in 1984, 141 kiwi were reported caught in gin traps (Read 1985; 1986). In the early 1990s, extensive surveys showed that about 10% of adult kiwi had damaged feet or toes, indicating that a significant number of kiwi had been caught in leg-hold traps over the previous two to three decades. Kiwi that lost the tip of their bill or receive other fatal injuries would not have survived to be counted, so the actual capture rates were probably considerably (30-50%) higher than those indicated by the number of maimed birds (McLennan *et al.* 1996). McLennan *et al.* (1996) concluded that possum traps (and cyanide) were probably a significant cause of death in adult kiwi, with such losses exceeding 5% and significantly reducing the average longevity and lifetime of kiwi in mainland forests. These losses would have had a significant impact on kiwi populations already in decline due to predation by introduced predators. During the eradication of possums from Kapiti Island between 1980 and 1987, all practical precautions were taken to minimise bird captures (Spurr 2000). Accidental captures of ground birds such as little spotted kiwi (*Apteryx owenii*) and weka were successfully reduced by raising leg-hold traps 700 mm above the ground (Sherley 1992). Based on these results, DOC introduced guidelines that require traps being used on lands managed by the Department, where ground birds are known to be present, to be set 700 mm above the ground, either on platforms, attached directly to tree trunks, or attached to a sloping board set at 38º to the ground. To comply with these guidelines the National Possum Control Agencies have developed a raised trap set protocol for monitoring possum control operations in ground bird areas.	Unlikely	Minor	D

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to TRAPS**	**How likely?**	**Magnitude of effect**	**Level of risk**
			Catch rates of kiwi have been significantly reduced since the implementation of the DOC guidelines. However, occasional kiwi deaths and injuries in traps still occur outside their known range or where the guidelines have not been followed. It is not thought that these few deaths have a significant effect at a population level. *Risk Profile* The likelihood of the adverse effect occurring for kiwi is UNLIKELY [could occur, but is not expected to occur under normal operating conditions]. The level of effect would be MINOR [sub-lethal to some non-target individuals within a population, lethal to a very few non-target individuals, limited but medium term effects, no biodiversity loss and highly localised impact], therefore the risk is D [Risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			
E-TR-A3	Leg-hold traps Kill traps	Setting trap lines, checking, and killing trapped animals. Setting trap lines and retrieving dead animals	**Native birds - other** *Controls* See controls in E-TR-A1. *Potential Effects* Blue penguin (*Eudyptula minor*), paradise shelduck (*Tadorna variegata*), brown teal (*Anas aucklandica*), Australasian harrier, pukeko (*Porphyrio melanotus*), southern black-backed gulls (*Larus dominicanus*), kereru, kakapo, kaka, kea, kakariki, long tailed cuckoo (*Eudynamys taitensis*), morepork, pipit (*Anthus novaeseelandiae*), fantail (*Rhipidura fuliginosa*), tomtit, robin, bellbird, tui and kokako have all been caught in traps. Most of these birds have been caught in leg-hold traps that have been set on the ground without surrounding barriers to reduce accidental capture of non-target species. Unfortunately, where traps are raised to protect native ground birds it appears that the risk of trapping birds such as kereru, morepork, and kaka is increased (Spurr 2000). Little research has been carried out on the long term impacts of trapping on populations of non-target birds (Spurr 2000). During the possum eradication on Kapiti Island, a total of 181 birds were caught during 1.4 million trap nights (Sherley 1992). The most common species caught were kereru (70), morepork (47), weka (29) and kaka (16). Considering the large number of trap nights, the numbers of birds caught was small. While individual birds will continue to be caught and killed or injured by traps, it is unlikely that	Unlikely	Minor	D

REGISTER OF ADVERSE EFFECTS WITHOUT 1080						
ID	**Formulation**	**Activity**	**Potential Receptors and Description of Exposure to TRAPS**	**How likely?**	**Magnitude of effect**	**Level of risk**
			there will be a population level effect. *Risk Profile* The likelihood of the adverse effect occurring for other native birds is UNLIKELY [could occur, but is not expected to occur under normal operating conditions]. The level of effect would be MINOR [sub-lethal to some non-target individuals within a population, lethal to a very few non-target individuals, limited but medium term effects, no biodiversity loss and highly localised impact], therefore the risk is D [Risks within the ALARP band and broadly classed as tolerable subject to ongoing monitoring and control].			

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