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1. Executive Summary

Boscalid is a synthetic carboxamide fungicide which is proposed for use as a seed treatment on rapeseed (*Brassica napus*), including canola. The compound has demonstrated at least limited systemic activity and residues are persistent and stable to metabolism in plants. Boscalid has a moderate potential to reach aquatic environments, including surface and ground water, for several months or more following terrestrial application. The available data indicate that boscalid is likely to dissipate to some extent through various mechanisms, including runoff, erosion, and leaching to ground water. Because boscalid degrades slowly in soil and aquatic systems, the compound may persist in soil, in water, and in benthic sediment, once transported or partitioned to these environmental compartments.

In aquatic ecosystems, although the octanol-water partition coefficient values for boscalid indicate that the compound does not have a strong affinity for sediment, the compound's relatively slow degradation rate increases the likelihood that partitioning will occur over time. Boscalid adsorbed to soil may also enter the benthic compartment through sedimentation processes, although dissipation through other routes (*e.g.*, leaching prior to and following sedimentation) will reduce the fraction of adsorbed boscalid available for transport. Overall, there is high confidence in the data that show little or no degradation of boscalid residues in soil and aquatic systems. However, the presence of unidentified, unextracted residues in the aerobic soil metabolism study creates some uncertainty about the extent of persistence of boscalid in soil. In the absence of clarifying data, this screening-level assessment makes the conservative assumption that unidentified residues are parent boscalid, thereby increasing estimates of persistence.

Previous assessments have identified that boscalid is moderately-to-highly toxic to fish and aquatic invertebrates, but practically non-toxic to mammals, birds, and terrestrial invertebrates, following acute exposure. Chronic effects have been observed in both terrestrial and aquatic organisms exposed to boscalid, and toxic effects have been noted in registrant-submitted studies with aquatic and terrestrial plants. Ecotoxicity data gaps exist with respect to potential effects on sediment-dwelling organisms, acute effects on freshwater invertebrates and passerine birds, and potential chronic effects on estuarine/marine organisms. Additional uncertainties surround the actual measured concentrations associated with effects in various aquatic studies, although the toxicity of boscalid appears to be limited by its solubility.

Beekeepers have reported incidents involving honey bee (*Apis mellifera*) mortality and adverse effects on honey bee brood (larval) development, associated with the use of boscalid. Although these incidents have not been associated with the Coronet® Fungicide (18.0% boscalid and 9.0% pyraclostrobin) end-use product proposed for the new seed treatment use, some of them have been associated with another co-formulated product (Pristine® Fungicide, 25.2% boscalid and 12.8% pyraclostrobin). The reported incidents have been associated with foliar applications of boscalid-containing products and not with seed treatment uses. The level of boscalid and/or pyraclostrobin that honey bees and other terrestrial invertebrates could be exposed to as a result of the proposed seed treatment use is uncertain.

Based on estimated environmental concentrations (EECs) and the available ecotoxicity data, the proposed new use of boscalid as a seed treatment on rapeseed may result in chronic risk to terrestrial vertebrates, including birds (reptiles and terrestrial-phase amphibians) and mammals that consume treated seed. Acute risk to listed species of birds cannot be precluded, based on sublethal effects observed in a subacute dietary test, but frank mortality of birds is not expected. Despite the uncertainties regarding the ecotoxicity profile of boscalid, the proposed new use is considered unlikely to result in acute or chronic risk to aquatic organisms. The potential for adverse effects on aquatic and terrestrial plants is considered low. There is uncertainty regarding the potential for adverse effects to larval honey bees from the use of boscalid products co-formulated with the fungicide pyraclostrobin; nonetheless, the likelihood of exposure from seed treatments is uncertain because, although boscalid demonstrates some systemic activity, the extent to which the compound may be translocated to nectar and pollen from a treated seed is unknown. Exposure of ground-nesting bees and wasps may be more likely than exposure of honey bees, given that the compound is expected to persist in soil and on organic matter.

The potential for direct and indirect effects to listed non-target organisms for which risk is assessed as a result of the proposed new use of boscalid is summarized in **Table 1.1**. This screening level assessment does not evaluate risk to terrestrial invertebrates.

Table 1.1. Potential effects to federally listed taxa associated with the proposed new use of boscalid.

Listed Taxon	Direct Effects		Indirect Effects from Risk to Other Taxa	
	Yes/No	Acute/Chronic	Yes/No	Through ...
Terrestrial and semi-aquatic plants – monocots and dicots	No	NA	Yes	Acute sublethal[1] and chronic effects on birds, chronic effects on mammals, when required for pollination or seed dispersal.
Birds	Yes	Acute sublethal[1] and Chronic	Yes	Chronic effects on mammals that serve as prey; acute sublethal[1] and chronic effects on reptiles and amphibians that serve as prey.
Terrestrial-phase amphibians	Yes	Acute sublethal[1] and Chronic	Yes	Chronic effects on mammals which provide critical habitat (*e.g.*, burrows) and serve as prey.
Reptiles	Yes	Acute sublethal[1] and Chronic	Yes	Chronic effects on mammals that serve as prey; acute sublethal[1] and chronic effects on birds, reptiles, and amphibians that serve as prey.
Mammals	Yes	Chronic	Yes	Acute sublethal[1] and chronic effects on birds, reptiles, and amphibians that serve as prey; chronic effects on mammals that serve as prey.
Aquatic plants	No	NA	No	NA
Freshwater fish	No	NA	No	NA
Aquatic-phase amphibians	No	NA	Yes	Acute sublethal[1] and chronic effects on terrestrial-phase amphibians.
Freshwater invertebrates	No	NA	No	NA
Molluscs	No	NA	No	NA
Marine/estuarine fish	No	NA	No	NA

Marine/estuarine invertebrates	No	NA	No	NA

[NA] Not applicable.
[1] Acute risk of sublethal effects in listed species of birds, and therefore in reptiles and terrestrial-phase amphibians, could not be precluded based on the submitted ecotoxicity data.

2. Problem Formulation

2.1. Nature of Chemical Stressor

Boscalid is in the carboxamide family of fungicides (FRAC Group 7). The chemical's mode of action is the inhibition of mitochondrial ATP production in fungal cells. Specifically, boscalid inhibits the succinate-ubiquinone oxidoreductase system in Complex II of the mitochondrial electron transfer chain (proposed label and Wharton 2010). This mode of action is shared with the pesticide active ingredients carboxin (CAS Number 5234-68-4) and flutolanil (CAS Number 66332-96-5).

Coronet® Fungicide, the boscalid end-use product associated with the petition for new use as a seed treatment on rapeseed, is co-formulated with the pesticide active ingredient pyraclostrobin (18.0% boscalid and 9.0% pyraclostrobin). Pyraclostrobin (CAS Number 175013-18-0) is a strobilurin fungicide that inhibits electron transfer in mitochondria by disrupting the ubiquinone (Q) cycle at the outer binding site of the cytochrome bc_1 complex (*i.e.*, quinone outside inhibitor, FRAC Group 11) (proposed label and Wharton 2010).

2.2. Stressor Source and Distribution

Boscalid is a fungicide associated with eight formulated end-use products, labeled for uses on food crops (including seed treatments), cotton, ornamentals, and turf. Outside of the registered uses, boscalid has been used in California, Minnesota, and South Dakota under Section 18 emergency exemptions. Estimates of the total current usage of boscalid are unavailable.

For the proposed use as a seed treatment on rapeseed, the boscalid end-use product Coronet® will be applied to seeds as a water-based slurry or mist. The proposed label does not indicate how treated seeds will be planted or applied to the field. Based on publicly available agricultural extension documents for canola, used as a surrogate for rapeseed throughout this assessment, it is assumed that treated seeds will be broadcast-applied and may be chained in (Boyles *et al.* 2007). The proposed label states 0.12 lb a.i./100 lbs seed as the maximum use rate on rapeseed seed treatment. The maximum seeding rate is 10 lb seed per acre (Boyles *et al*. 2007). Therefore the maximum application rate is calculated as 0.012 lbs a.i./A (boscalid).

2.3. Receptors

The receptor is the biological entity that is exposed to the stressor (USEPA 1998). For this assessment, the receptor includes terrestrial and aquatic animals inhabiting fields where boscalid treated seeds are planted and non-target areas to where boscalid is transported (via runoff or leaching to groundwater). Consistent with the process described in the Overview Document (USEPA 2004), the risk assessment uses a surrogate species approach in its evaluation of boscalid. Toxicological data generated from surrogate test species, which are intended to be representative of broad taxonomic groups, are used to extrapolate to potential effects on a variety of species (receptors) included under these taxonomic groupings.

2.4. Assessment Endpoints

Assessment endpoints represent the actual environmental value that is to be protected, defined by an ecological entity (species, community, or other entity) and its attributes (EPA 1998). For boscalid, the ecological entities may include birds, mammals, freshwater fish and invertebrates, estuarine/marine fish and invertebrates, terrestrial plants, insects, and aquatic plants and algae. The attributes evaluated for each of these entities may include growth, reproduction, and survival.

2.5. Conceptual Model

For a pesticide to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a pesticide moves in the environment from a source to an ecological receptor. For an ecological pathway to be complete, it must have a source, a release mechanism, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure.

A conceptual model provides a written description and visual representation of the predicted relationships between boscalid (used as a seed treatment), the potential routes of exposure, and the predicted effects for each assessment endpoint. A conceptual model consists of two major components: the risk hypothesis and the conceptual diagram (EPA 1998).

2.5.1. Risk Hypothesis

For boscalid, the following ecological risk hypothesis is employed for this risk assessment:

> *Boscalid has slight to moderate mobility in soil and can move to surface water through spray drift, runoff, and erosion; it also has limited potential to leach to ground water. Based on previous assessments and the compound's persistence, boscalid is expected to pose a chronic risk to small birds, terrestrial-phase amphibians and reptiles and to all size classes of mammals. In addition, boscalid may produce adverse effects on survival, growth, and/or fecundity of aquatic animals. There is also uncertainty regarding the potential risk to benthic invertebrates, given boscalid's persistence in water and sediment. Although not expected to pose a risk to aquatic plants or to monocotyledonous terrestrial*

plants, there is uncertainty regarding its potential effects through runoff on dicotyledonous terrestrial plants.

2.5.2. Conceptual Diagram

The environmental fate properties of boscalid indicate that runoff represents a potential transport mechanism of boscalid to aquatic habitats where non-target organisms may be exposed. It is expected that non-target terrestrial organisms can be exposed to boscalid through consumption of treated seeds. These transport mechanisms (*i.e.*, sources) are depicted in the conceptual models below (**Figures 1** and **2**) along with the receptors of concern and the potential attribute changes in the receptors due to exposures of boscalid. Dotted lines represent transport pathways that are assumed to have a low likelihood of occurring and/or of contributing to ecological risk.

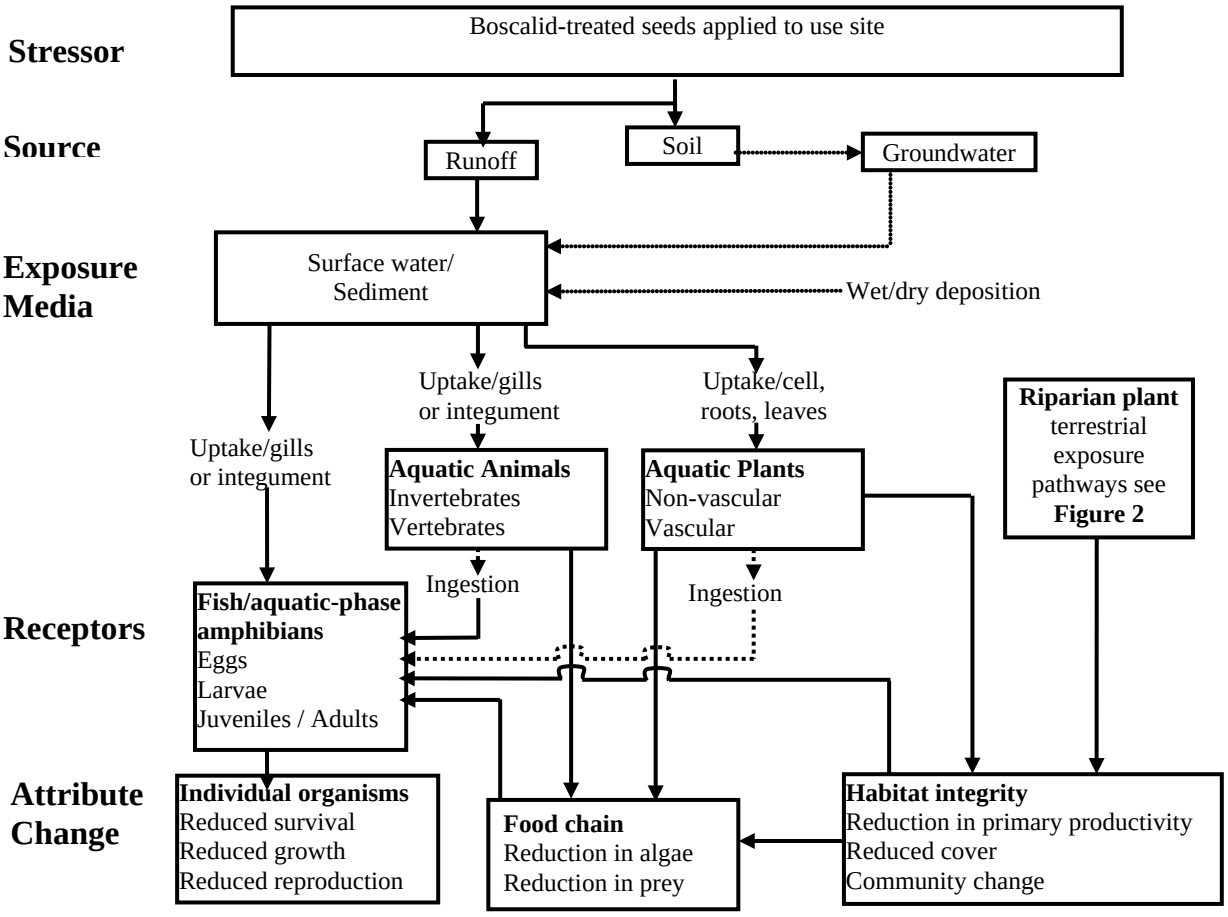

Figure 1. Conceptual model for potential boscalid seed treatment effects on aquatic organisms.

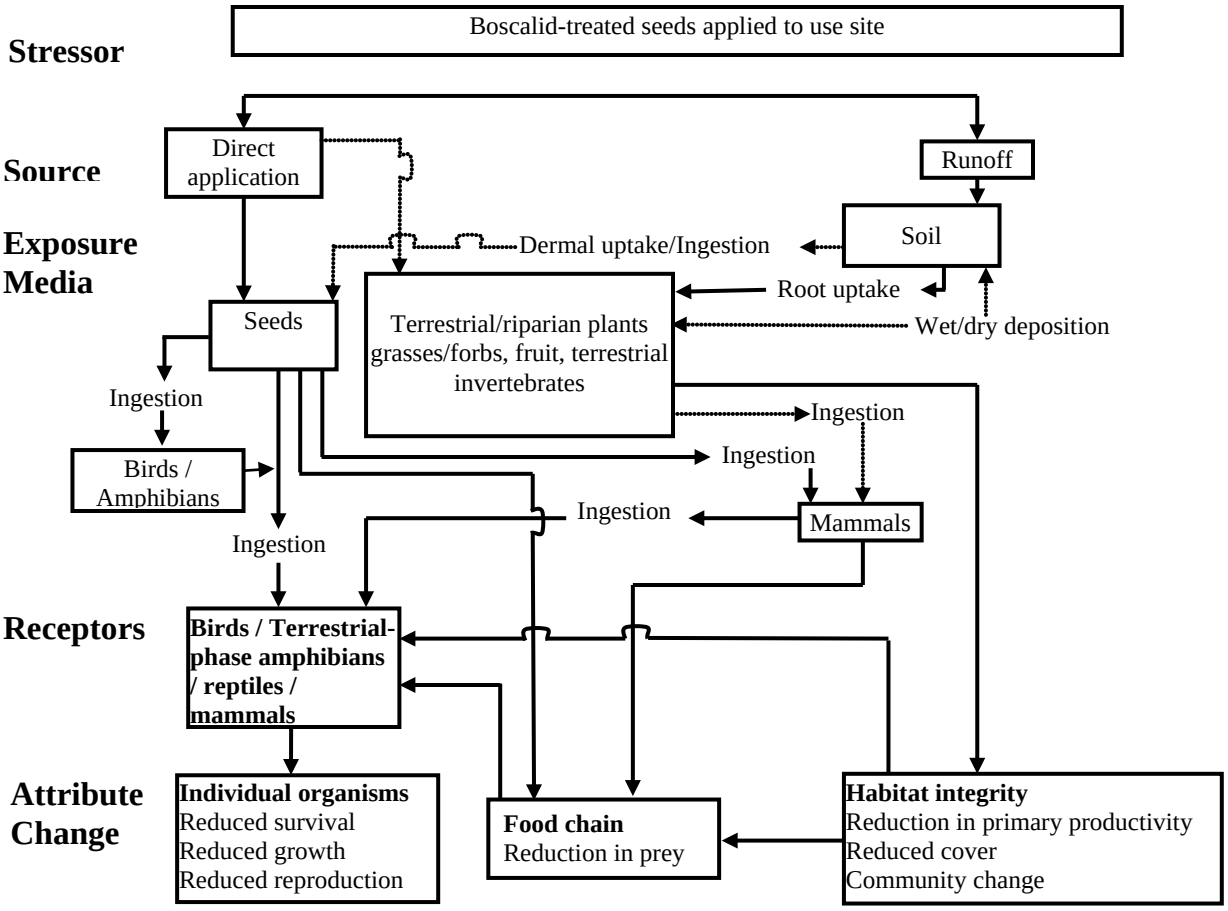

Figure 2. Conceptual model for potential boscalid seed treatment effects on terrestrial organisms.

2.6. Analysis Plan

The analysis plan is the final step in Problem Formulation. During this step, an assessment design is developed, the scope of the assessment is outlined, the methods for conducting the assessment are determined, measurements of effects and exposure to evaluate the risk hypothesis being delineated, and initial data gaps and assumptions required to address them are identified.

2.6.1. Conclusions from Previous Risk Assessments

Previously this year, EFED completed a review of the Section 3 request for new uses of boscalid on alfalfa (Endura®: 70.0% a.i., and Pristine®: 25.2% a.i. plus 12.8% pyraclostrobin) and citrus (Pristine®) (DP Barcode D363523). The proposed maximum single application rates for boscalid new uses were 0.48 lbs a.i./A (1.44 lbs a.i./A seasonally) on alfalfa and 0.29 lbs a.i./A (1.17 lbs a.i./A seasonally) on citrus. The results of the assessment indicated a potential for direct adverse effects to aquatic and terrestrial organisms. Specifically, the application of boscalid according to the proposed label specifications was expected to result in acute risk to listed freshwater fish and to estuarine/marine molluscs. Chronic risk was identified for freshwater fish and for mammals. In addition, reports of honey bee "brood effects" associated with the application of boscalid, especially as the Pristine® formulation, suggested a potential for adverse effects on terrestrial

invertebrates. Although boscalid may reach groundwater, estimated concentrations in groundwater for the previously proposed uses indicated that likelihood of adverse effects on non-target organisms from groundwater exposure was low. Acute risk to birds and mammals and chronic risk to birds did not exceed the Agency's level of concern (LOC).

Ecotoxicity data gaps previously resulted in the presumption of acute risk to freshwater invertebrates and acute (listed species) and chronic risks to estuarine/marine fish and invertebrates. Risks to terrestrial dicotyledonous plants (dicots) from spray drift could not be precluded based on the available data. However, potential risk to terrestrial monocotyledonous plants (monocots) and to dicots exposed to runoff alone did not exceed the Agency's LOC.

2.6.2. Identification of Data Gaps and Uncertainties

Data gaps and uncertainties in the assessment of the proposed boscalid seed treatment use for rapeseed remain the same as those identified in the previous new use assessment for alfalfa and citrus (DP Barcode D363523). The absence of and deficiencies in particular ecotoxicity and environmental fate studies are discussed in detail in that assessment and in the associated transmittal memo of the previous assessment (19 February 2010).

The largest uncertainty in the environmental fate data for boscalid pertains to the unidentified, unextracted residues in the aerobic soil metabolism and anaerobic aquatic metabolism studies. In this assessment, the unidentified, unextracted residues are conservatively assumed to be the parent compound. As described in the previous assessment (DP D363523), revision of the aerobic soil metabolism half-life values to reflect the uncertainty regarding unextracted residues resulted in higher aquatic PRZM/EXAMS modeling EECs

PRZM/EXAMS may overestimate aquatic EECs for persistent compounds, because peak concentrations are not independent. EXAMS uses a standard pond with a static water body of fixed volume and no outlet. The model simulates the impact of daily weather on the field over a period of thirty years. The pesticide is washed-off into the water-body by the rainfall and runoff events. The persistence of boscalid results in accumulation in the water-body, which results in a yearly peak concentration that is correlated to each previous year's peak concentration. In a natural environment, over the course of thirty years, some loss of the bioavailable fraction of the compound would be expected due to sediment burial and other dissipation processes.

2.6.3. Measures of Exposure

Screening-level assessments are intended to be protective of wildlife on a national level, as opposed to being a regionally- or locally-specific. Therefore, this assessment is not intended to represent a spatially- or temporally-specific analysis. Maximum application rates for seed treatment on canola, as a surrogate for all proposed rapeseed uses, are used for modeling environmental concentrations. Measures of exposure are based on aquatic and terrestrial models that calculate estimated environmental concentrations (EECs) using labeled application rates and methods. Exposure modeling assumes that the seed treatment use will not result in spray drift. Particulate drift, which may occur from abrasion of treated seeds during field application, is not assessed in the screening level exposure models. Groundwater is also assessed due to the

moderate leaching potential of boscalid. There are currently no monitoring data for boscalid for comparison to model-generated EECs.

Surface water EECs are calculated using the Pesticide Root Zone Model (v3.12.2, May 2005) coupled with the Exposure Analysis Model System (EXAMS, v2.98.4.6, April 2005) and using the input shell, pe5.pl (August 2006) (USEPA 2006a). Groundwater concentrations are estimated using SCIGROW (Screening Concentration in Ground Water), incorporating the same method of calculation used in the PRZM and EXAMS modeling. The Terrestrial Residue Exposure Model (T-REX, version 1.4.1, 12/11/2008) is used to derive terrestrial EECs on food items (USEPA 2008) for terrestrial vertebrates. The TerrPlant model (version 1.2.2, 12/26/2006) is used to derive runoff EECs for estimating exposures to terrestrial plants inhabiting dry and semi-aquatic areas (USEPA 2006b). These models are parameterized using relevant use and environmental fate data according to EFED input parameter guidance.

2.6.4. Measures of Effect

Measures of effect are obtained from a suite of registrant-submitted guideline studies which were conducted with a limited number of surrogate species. The test species are not intended to be representative of the most sensitive species but rather were selected based on their ability to thrive under laboratory conditions. For example, toxicity testing reported in this risk assessment utilizes surrogate species to represent all freshwater fish (>2000 species) and birds (>680 species) identified in the U.S. In addition, the ECOTOXicology database (ECOTOX), was searched in November 2010 to provide more ecological effects data for boscalid (CAS 188425-85-6); however, no additional data were located.

The acute measures of effect used in this screening level assessment include the median lethal dose (LD_{50}), median lethal concentration (LC_{50}), and the median effect concentration (EC_{50}). These are measures of acute toxicity which result in 50% of the respective effect in tested organisms. The endpoints for chronic measures of effect are the No Observed Adverse Effects Concentration (NOAEC) and the No Observed Adverse Effects Level (NOAEL). Toxicity studies were submitted for freshwater fish and invertebrates, estuarine/marine fish and invertebrates, aquatic and terrestrial plants, birds, mammals and honey bees. The measurement endpoints used for risk characterization were derived from studies which underwent review and were classified as “acceptable” (conducted under guideline conditions and considered to be scientifically sound) or “supplemental” (conditions deviated from guidelines but the results are scientifically sound).

2.6.5. Integration of Exposure and Effects

The exposure and toxicity effects data are integrated to evaluate the risks of adverse ecological effects on non-target species. For the screening-level assessment of boscalid, the deterministic, risk quotient (RQ) method is used to compare estimated exposure and measured toxicity values. The RQ method involves dividing EECs by acute and chronic toxicity values. The resulting RQs are then compared to the Agency’s levels of concern (LOCs) (USEPA 2004). These criteria are used to indicate if applications of boscalid, as directed on the label, have the potential to cause adverse effects to non-target organisms.

Although risk is often described in terms of the likelihood and magnitude of adverse effects, the risk quotient-based approach does not provide a *quantitative* estimate of likelihood or magnitude of an adverse effect, but rather provides a "yes" or "no" answer depending upon whether or not LOCs are exceeded. For example, although a chronic RQ value equal to 4 exceeds the chronic LOC and indicates that an EEC is 4 times the highest test concentration where no adverse effects were observed in a chronic study; however, this does not imply that adverse effects are 4 times more likely to occur.

3. Analysis

3.1. Use Characterization

Boscalid is a fungicide active ingredient (a.i.) included in multiple, formulated end-use products, and is registered for use on food crops (including seed treatments), cotton, ornamentals and turf. It was first registered by USEPA in 2003. The seed treatment of Coronet® Fungicide is a dual-active ingredient formulation containing 18.0% boscalid and 9.0% pyraclostrobin. Coronet® seed treatment is registered for use on cole crops (*Brassica* sp.; not including rapeseed/canola), bulb vegetables, cotton, cucurbits, legume vegetables, soybean, and sunflower seeds. Application of the fungicide to seeds can be accomplished through water-based slurry, using standard slurry or mist-type seed treatment application equipment. The current seasonal rates are 0.015 – 0.12 lbs a.i./100 lbs seed (cwt) based on all previous labels and depending on crop.

This ecological risk assessment evaluates the use of boscalid as a fungicide (Coronet®) to control fungal diseases (*e.g*., *Rhizoctonia solani*, *Phoma lingam*, *Cladosporium* spp., and *Penicillium*, ssp.) of rapeseed, including canola and crambe. Throughout this assessment, canola is used as a surrogate for all proposed rapeseed uses. The proposed label for the new use on rapeseed allows a maximum application of 0.12 lbs a.i. per 100 lbs of seed (cwt). Canola seed is planted at 4 to 10 lbs seed per acre (Boyles *et al*. 2007), which corresponds to a maximum application rate of 0.012 lbs a.i./A (0.013 kg ai/ha)[1]. This maximum application rate is used as the basis of screening-level calculations for aquatic and terrestrial exposure.

3.2. Exposure Characterization

3.2.1. Environmental Fate and Transport

The environmental fate and transport properties of boscalid and a description of the total toxic residue (TTR) modeling approach employed in this assessment are discussed in detail in the

[1] At maximum seeding rate of 10 lbs seed/Acre and the maximum seed treatment rate of 0.012 lbs ai/A: 10 lbs/A x 0.12 lbs a.i./100 lbs seed = **0.012 lbs ai/A (**equivalent to **0.013 kg ai/ha)**; at the maximum seeding rate of 10 lbs seed/A and the minimum seed treatment rate of 0.015 lbs ai/100 lbs seed: 10 lbs/A x 0.015 lbs ai/100 lbs seed=**0.0015 lbs ai/A (0.0017 kg ai/ha)**; at the low seeding rate of 4 lbs seed/A and the minimum seed treatment rate of 0.015 lbs ai/100 lbs seed: 4 lbs/A x 0.015 lbs ai/100 lbs seed=**0.0006 lbs ai/A (0.0007 kg ai/ha)** .

[2] EFED 2009 updated input parameter guidance is located at:
http://www.epa.gov/oppefed1/models/water/input_parameter_guidance.htm

Table 3.5 Tier II surface water and pore water estimated environmental concentrations (EECs) of boscalid from seed treatment on rapeseed

Proposed Use	App Rate (lbs a.i./A) (Formulation)	Scenario (Weather)	App Method	Compartment	EECs (µg/L) Peak	1-in-10-yr 21-d avg	1-in-10-yr 60-d avg
Canola	0.012 (Coronet®)	NDcanolaSTD (w24013)	Seed treatment	Surface water	0.72	0.72	0.72
				Pore water	0.71	0.71	0.71
Abbreviations: App - Application. Avg - Average. d -Day. yr - Year.							

The estimated ground water concentrations reported in **Table 3.6** represent concentrations that might be expected in shallow, unconfined aquifers under sandy soils, which are expected to be most vulnerable to pesticide contamination.

Table 3.6 Summary of Tier I estimated concentrations of boscalid residues in ground water.

Use	Use/Application Rate (lbs a.i./A)	EECs (µg/L) Acute and Chronic
Canola	Seed treatment/0.012 x 1 applications; annual total of 0.012	0.01

3.2.3. Terrestrial Exposure

T-REX is used to calculate dose-based EECs of boscalid for birds and mammals that consume treated seeds. Seeding rates for canola (Boyles *et al.* 2007), as a surrogate for all proposed rapeseed uses, and the maximum application rate according to the proposed label are used to calculate dose-based EECs (Nagy dose) and the mass of boscalid per unit area (mg ai/ft^2) available for consumption by birds and mammals (**Table 3.7)**.

Table 3.7. Avian and mammalian dose-based EECs calculated for the proposed new use of boscalid as a seed treatment on rapeseed, based on seeding rate for canola (T-REX).

Use	App Rate (lbs a.i./100 lbs seed)	Seeding Rate[1] (lbs seed/A)	App Rate (lbs a.i./A)	Seed App Rate (mg a.i./ kg seed)	Nagy Dose (mg a.i./kg-bw/day) Birds	Nagy Dose (mg a.i./kg-bw/day) Mammals	Spatial (available a.i. per unit area) (mg a.i. /ft^2)
Canola	0.12	10	0.012 (0.013 kg ai/A)	1200	304	254	0.13
Abbreviations: App Application. cwt Hundred weight (100 lbs seed). [1]Reference: Boyles *et al.* (2007).							

TerrPlant is used to calculate EECs for non-target plants that inhabit dry and semi-aquatic areas. In this assessment, exposure to non-target plants is calculated based on the potential runoff of boscalid following the broadcast application of treated seeds on the field (**Table 3.8**). Potential exposure resulting from spray drift is not calculated because any spray drift of boscalid associated with the seed treatment use is expected to be negligible. TerrPlant does not account for particulate drift.

Table 3.8. Terrestrial plant EECs for nontarget plants exposed to boscalid through runoff, based on the proposed use of boscalid as a seed treatment on rapeseed (TerrPlant). Canola is used as a surrogate for all proposed rapeseed uses.

Use	Single Max. Application Rate (lbs a.i./A)	Runoff EECs (lbs a.i./A)	
		Dry Areas	Semi-Aquatic Areas
Canola	0.012	<0.001	0.001

3.3. Ecological Effects Characterization

3.3.1. Ecotoxicity Data

A detailed description of the available ecotoxicity data for boscalid is provided in the most recent risk assessment for proposed new uses on alfalfa and citrus (DP Barcode D363523). No new ecotoxicity data have been submitted. Toxicity endpoints used in risk estimation and characterization for the proposed use of boscalid as a seed treatment on canola are shown in **Table 3.9** and **Table 3.10**. These endpoints represent the most sensitive endpoints available from suitable, guideline toxicity studies. A search of the ECOTOX database in November 2010 returned no other acceptable ecotoxicity studies for boscalid.

Based on the available data, boscalid is moderately toxic to freshwater fish and at least moderately toxic to freshwater invertebrates on an acute exposure basis, at concentrations approaching its water solubility limit; however, the submitted acute test with freshwater invertebrates (MRID 45405001) is not used quantitatively for risk estimation because it may have overestimated the actual exposure concentrations of the test organisms and thus underestimated the toxicity endpoint (see DP Barcode D363523 for discussion). Non-definitive toxicity endpoints indicate that boscalid is moderately toxic to benthic invertebrates, estuarine/marine fish and to non-molluscan estuarine/marine invertebrates on an acute exposure basis. However, it is highly toxic to estuarine/marine molluscs based on reductions in shell growth.

Chronic toxicity has been demonstrated for freshwater fish based on reduced survival and for freshwater invertebrates (*i.e.*, waterflea) based on reduced survival and growth (decreased length and dry weight) and impaired reproduction (reduced number of young). Acceptable chronic toxicity data for other aquatic animals, including benthic freshwater invertebrates and estuarine/marine fish and invertebrates, are unavailable. Specifically, the chronic study for benthic freshwater invertebrates (*i.e.*, midge) was inadequate because sediment was not spiked. However, the available supplemental data indicate that boscalid can reduce emergence and development in the midge and reduce growth (decreased dry weight) in the freshwater amphipod. No chronic studies were submitted for estuarine/marine fish or invertebrates.

Exposure of aquatic vascular plants (*Lemna gibba*; duckweed) to boscalid at 3.9 mg/L did not result in sufficient inhibition of frond growth or biomass to estimate an IC_{50}; exposure of nonvascular plants, *i.e.*, green algae (*Pseudokirchneriella subcapitata*) to boscalid resulted in a 50% inhibition of cell growth at 1.34 mg/L.

Table 3.9 Toxicity endpoints used in risk estimation and characterization for aquatic organisms exposed to boscalid residues.

Aquatic Animals			
Acute Toxicity			
Study Type	**Species**	**Endpoints[1] (mg a.i./L)**	**Toxicity Classification (MRID)**
Acute toxicity to freshwater fish	Rainbow trout (*Oncorhynchus mykiss*)	LC_{50} = 2.7	Moderately toxic (45404927)
Subacute sediment toxicity to freshwater invertebrates	Freshwater amphipod (*Hyalella azteca*)	EC_{50} > 1.066 NOAEC = 0.298 (pore water)	Moderately toxic (45405009)
Acute toxicity to estuarine/marine fish	Sheepshead minnow (*Cyprinidon variegatus*)	LC_{50} > 3.86	Moderately toxic (45405004)
Acute toxicity to estuarine/marine invertebrates	Mysid shrimp (*Americamysis bahia* formerly *Mysidopsis bahia*)	LC_{50} > 3.81	Moderately toxic (45405002)
Toxicity to estuarine/marine molluscs – shell deposition	Eastern oyster (*Crassostrea virginica*)	EC_{50} = 1.02 (2.14, 0.89 - 3.39)	Highly toxic (45405003)
Chronic Toxicity			
Study Type	**Species**	**NOAEC & LOAEC (mg a.i./L)**	**Effects (MRID)**
Early life stage toxicity to freshwater fish	Rainbow trout (*Oncorhynchus mykiss*)	0.116 & 0.241	Mortality (45405006)
Chronic toxicity to freshwater invertebrates	Waterflea (*Daphnia magna*)	0.79 & 1.54	Reduced number of young (46351406)
Chronic toxicity to sediment-dwelling invertebrates (spiked water)	Freshwater midge (*Chironomus riparius*)	2.0 & 4.0 nominal (overlying water)	Reduced emergence (45405008)
Aquatic Plants			
Study Type	**Species**	**Endpoints (mg a.i./L)**	**Effects (MRID)**
Toxicity to vascular aquatic plants	Duckweed (*Lemna gibba*)	IC_{50} > 3.9 NOAEC = 0.99	Frond number, necrosis (45405013)
Toxicity to nonvascular aquatic plants	Freshwater alga (*Pseudokirchneriella subcapitata*)	IC_{50} = 1.34 NOAEC = 0.49	Growth rate, biomass (45405017)

[1] Dose-response slope values for the estuarine/marine mollusc are indicated in parentheses (value, 95% confidence interval). For other studies, where slope data are not available, the default value of 4.5 (with 95% confidence intervals of 2.0 and 9.0) is used to derive the probability of an individual effect (Urban and Cook 1986).

Based on the available data, boscalid is practically non-toxic to terrestrial invertebrates (*e.g.*, adult honey bees, *Apis mellifera*) on both an acute contact and acute oral exposure basis, to birds on both an acute oral and subacute dietary exposure basis, and to mammals on an acute oral exposure basis. However, adverse effects on honey bee larval development have been reported in incident data following application of boscalid, specifically as the Pristine® formulation, to almonds and other unspecified crops.

In birds and mammals, chronic exposure to boscalid was associated with reproductive and growth effects, including reduced number of eggs and embryo mortality in bobwhite quail (*Colinus virginianus*) and reduced F_2 body weight in rats (*Rattus norvegicus*). Based on the results of the Tier II terrestrial plant studies, cabbage (*Brassica oleracea*) appears to be particularly sensitive to boscalid exposure, while other dicot species and all tested monocots are relatively insensitive to boscalid exposure.

Table 3.10 Toxicity endpoints used in risk estimation and characterization for terrestrial organisms exposed to boscalid.

Terrestrial Animals			
Acute Toxicity			
Study Type	**Species**	**Endpoints[1] (LD_{50} mg a.i./kg bw) (LC_{50} mg a.i./kg diet)**	**Toxicity Classification (MRID)**
Acute oral toxicity to upland game birds	Bobwhite quail (*Colinus virginianus*)	LD_{50} > 2000	Practically nontoxic (45404922)
Subacute dietary toxicity to upland game birds and waterfowl	Bobwhite quail (*Colinus virginianus*) Mallard duck (*Anas platyrhynchos*)	LC_{50} > 5000	Practically nontoxic (45404923) (45404924)
Acute oral toxicity to mammals[2]	Norway rat (*Rattus norvegicus*)	LD_{50} > 5000	Practically nontoxic (45404814)
Acute contact and oral toxicity to honey bees	Honey bee (*Apis mellifera*)	LD_{50} > 166 µg/bee (oral) LD_{50} > 200 µg/bee (contact)	Practically non-toxic (45405019)
Toxicity to soil dwelling invertebrates (14-day)[3]	Earthworm (*Eisenia foetida*)	LD_{50} > 1000 mg a.i./kg dry weight soil (nominal)	NA (45405020)
Chronic Toxicity			
Study Type	**Species**	**NOAEC (mg a.i./kg diet) NOAEL (mg a.i./kg bw)**	**Effects (MRID)**
Avian reproduction with upland game birds	Bobwhite quail (*Colinus virginianus*)	NOAEC = 300 NOAEL = 25	Number of eggs laid, fertility rate, embryo mortality, and number of 14-day survivors (45404925)
Chronic toxicity to mammals[2] – two-generation reproduction	Norway rat (*Rattus norvegicus*)	NOAEC = 100 NOAEL = 11.2	Decreased F2 body weight (45404906)
Terrestrial Plants			
Study Type	**Most Sensitive Species**	**IC_{25} & NOAEC (lbs a.i./A)**	**Effects (MRID)**
Tier II seedling emergence (Emerald, 69.9% a.i.)	*Monocot*: Corn *Dicot*: Cabbage	> 0.576 & 0.275 0.44 & 0.275	Seedling emergence Dry weight (47627401)
Tier II vegetative vigor (Emerald, 69.9% a.i.)	*Monocot*: Corn *Dicot*: Cabbage	> 0.626 & 0.035 < 0.035 & < 0.035	Shoot length Dry weight (47627402)

[1] Slope data were not available from the acute terrestrial studies. The default value of 4.5 (with 95% confidence intervals of 2.0 and 9.0) is used to derive the probability of an individual effect (Urban and Cook 1986).
[2] Mammalian toxicity data provided and reviewed by OPP Health Effects Division (USEPA).

[3] The submitted earthworm study was labeled as an acute test, although the duration (14 days) was considerably longer than most acute toxicity tests. The guideline-recommended duration for a chronic test with earthworms is 28 days.

3.3.2. Incident Reports

The Ecological Incident Information System (EIIS)**,** which is maintained by the Agency's Office of Pesticide Programs, was searched to determine if ecological incidents have been reported for boscalid. Because of limitations in the incident reporting system, the lack of additional incident reports cannot be construed as the absence of incidents from the registered use of boscalid. At the time of the search, EIIS contained information on incidents reported through December 2008.

Based on a search of EIIS conducted in October 2010, one ecological incident with honey bees was reported for boscalid (USEPA 2010). Communications from the registrant (BASF 2008) indicate further concern on the part of beekeepers for potential effects on honey bee brood development. Although no acute toxicity to adult honey bees has been demonstrated in laboratory studies with boscalid, individual beekeepers have reported honey bee "brood effects" following the application of boscalid, specifically as the Pristine® formulated product (25.2% boscalid and 12.8% pyraclostrobin), to nearby crops (BASF 2008). For example, a California beekeeper reported that "brood effects" were observed within ten days of the application of Pristine® (application rate and target crop unspecified; BASF 2008; USEPA 2010). Other beekeepers reported concerns to the registrant regarding "improper [brood] development" 17 days after application of Pristine® to almonds (BASF 2008). Additionally, "adverse effects" on larval development were noted after queen bees were fed almond pollen from Pristine® treated crops, but the nature and magnitude of these effects were not reported (BASF 2008). The mechanism of these alleged effects is likewise unknown. Some data have been presented to suggest that carboxamide pesticides, including boscalid, may interfere with hormonally-regulated development in juvenile honey bees (*eg*. Mussen 2009, Frazier *et al*. 2008, Ladurner *et al*. 2005, Mussen *et al*. 2004, Atkins and Kellum 1986). However, this hypothesis has not been rigorously tested.

The National Pesticide Information Center (NPIC) reported one incident associated with a putative misuse of boscalid in Utah (Stone 2010). Application rates were unknown, but the report indicated that products were likely tank mixed. The incident report described dead bees, lost hives, and hives in poor health with no honey crop despite fall feedings; observations of adverse effects were made from June through December 2009. Laboratory tests confirmed the presence of boscalid residues (149 ng a.i./g wax) and residues of other pesticide active ingredients, including pyraclostrobin, chlorothalonil, 2,4-dimethylphenyl formamide, chlorpyrifos, cyprodinil, diflubenzron, and tebuconazole. Aerial spray applications of Bravo® (chlorothalonil) flowable concentrate and Elite® (tebuconazole) dry flowable fungicide were identified in the report as well. The report has not been verified, although laboratory results of residue analysis have been submitted.

The Avian Incident Monitoring System (AIMS), a database maintained by the American Bird Conservancy (2010), was searched in October 2010 and returned no incidents related to the use of boscalid.

4. Risk Characterization

Toxicity data and exposure estimates for boscalid are used to evaluate the potential for adverse ecological effects on non-target species. This screening-level assessment employs a deterministic risk estimation method, based on risk quotient (RQ) values, to provide a metric of potential risks (**Section 4.1**). The potential for risk is characterized further in the Risk Description (**Section 4.2**) based on the risk estimation results and other relevant information about toxicity, incidents, ecosystems potentially at risk, and the environmental fate and transport characteristics of boscalid. In cases where an RQ value exceeds the listed species LOC, the potential for risk to listed species is characterized in greater detail in **Section 5**. The LOCATES database is queried to identify listed species that may co-occur within potential use areas for the proposed action, *i.e.*, areas where rapeseed (including canola and crambe) is grown and where the proposed new use of boscalid as a seed treatment may occur.

4.1. Risk Estimation

Unitless RQ values are compared to the Agency's LOCs to identify taxonomic groups potentially at risk of acute or chronic effects associated with the proposed new use of boscalid as a seed treatment on rapeseed.

4.1.1. Aquatic Organisms

RQ values are calculated for acute and chronic risk to fish and aquatic invertebrates, including molluscs, where the submitted ecotoxicity data are sufficient to use in risk estimation. As shown in **Table 4.1**, none of the RQ values calculated either approach or exceed the Agency's levels of concern (LOCs) for acute or chronic risk to listed or nonlisted species of aquatic organisms, nor do they exceed LOCs for risk to nonvascular aquatic plants (*e.g.*, algae) or to listed vascular aquatic plants.

The submitted data are insufficient to calculate RQ values for (1) acute risk to freshwater invertebrates, (2) acute and chronic risk to benthic invertebrates, (3) acute and chronic risk to estuarine/marine fish and non-molluscan invertebrates, and (4) risk to nonlisted species of vascular aquatic plants. These data gaps and uncertainties are described in more detail in the recent assessment of boscalid proposed uses on alfalfa and citrus (DP Barcode D363523). Further characterization of the potential for adverse effects to aquatic organisms, based on the available data, is provided as part of the Risk Description in **Section 4.2.1**.

Table 4.1. Acute and chronic RQ values for aquatic organisms exposed to boscalid in surface water following seed treatment use on rapeseed, based on seeding rate for canola.

Use	App Rate lbs a.i./A (#app)	App Method	EECs (µg/L)			Toxicity Endpoints	RQ Values	
			Peak	21-d	60-d	Aquatic Animals	Acute	Chronic
Canola	0.012 (1)	Seed Treatment	0.72	0.72	0.72	**Freshwater Fish** LC_{50}=2.7 mg/L NOAEC=0.116 mg/L	<0.001	0.006
						Freshwater Invertebrate EC_{50}=NA NOAEC=0.79 mg/L	NA[1]	0.001
						Estuarine/Marine Mollusc EC_{50}=1.02 mg/L NOAEC= NA	0.001	NA[2]
			Peak			Aquatic Plants	Listed	Nonlisted
Canola	0.012 (1)	Seed Treatment	0.72			**Vascular Plants** IC_{50} > 3.9 mg/L NOAEC = 0.99 mg/L	0.001	NA[3]
						Nonvascular Plants IC_{50} = 1.34 mg/L NOAEC = 0.49 mg/L	0.002	0.001

[1] An acute freshwater invertebrate study was submitted (MRID 45405001); however, the results are not used in risk estimation because they may underestimate toxicity (see DP Barcode 363523 for discussion). Potential acute risks to freshwater invertebrates are discussed as part of the Risk Description (Section 4.2).
[2] Chronic toxicity data for molluscs have not been submitted.
[3] An RQ value for risk to nonlisted species of vascular aquatic plants is not calculated because the most sensitive toxicity endpoint (IC_{50}) is a non-definitive value.
NA Not available.

4.1.2. Terrestrial Organisms

RQ values are not calculated for acute risk to birds or mammals in this assessment because the acute toxicity endpoints for boscalid are nondefinitive, *i.e.*, the LD_{50} values are greater than the limit dose. RQ values for chronic risk to birds and mammals, based on the proposed use of boscalid as a seed treatment on rapeseed (maximum application rate = 0.12 lbs a.i./cwt or 1,200 mg a.i./kg seed), are calculated as follows:

RQ = Exposure (mg a.i./kg seed) / NOAEC (mg/kg diet)

The resulting RQ values exceed the Agency's LOC for chronic risk to birds and mammals (RQ > 1) by factors of 4 and 12, respectively (**Table 4.2**). For birds, this screening calculation indicates that a bird that consumes 1 kg of treated seed over an unspecified time period will have been exposed to a dietary concentration of boscalid that is 4 times the chronic NOAEC. Similarly, a mammal that consumes 1 kg of treated seed will have been exposed to a dietary concentration of boscalid that is 12 times the chronic NOAEC. The amount of time it would take a small bird or mammal to consume 1 kg of seed would depend upon the physiology, life history, and energy requirements of the individual.

For terrestrial plants, RQ values are calculated based on the most sensitive toxicity endpoints from the submitted seedling emergence test, but not from the vegetative vigor test, because foliar exposure of non-target plants is considered unlikely to result from the proposed seed treatment use (**Table 4.2**). RQ values for listed monocots and for listed and nonlisted dicots are all <0.1 and therefore are below the Agency's LOC (RQ>1). RQ values are not calculated for risk to non-listed monocot plants because the IC_{25} value for monocots is outside the range of concentrations tested.

Table 4.2. RQ values for birds, mammals, and terrestrial plants exposed to boscalid residues following seed treatment use on rapeseed, based on seeding rate for canola.

Use	App Rate lbs a.i. /A (#app)	App Method	EECs			Toxicity Endpoints	RQ Values	
			Spatial (mg a.i. /ft^2)	Nagy Dose (mg a.i. /kg-bw /d)	Chronic (mg a.i. /kg seed)	Animals	Acute	Chronic
Canola	0.012 (1)	Seed Treatment	0.13	304	1,200	**Birds** LD_{50}>2,000 mg/kg-bw LC_{50}>5,000 mg/kg diet NOAEC=300 mg/kg diet NOAEL=25 mg/kg-bw	NA[1]	4.0[3]
				254	1,200	**Mammals** LD_{50}>5,000 mg/kg-bw NOAEC=100 mg/kg diet NOAEL=11.2 mg/kg-bw	NA[1]	12[3]
			Runoff (lbs a.i./A)			Plants	Listed	Non-listed
Canola	0.012 (1)	Seed Treatment	Dry Areas <0.001			**Monocot** IC_{25} > 0.576 NOAEL = 0.275	<0.1	NA[2]
						Dicot IC_{25} = 0.44 NOAEL = 0.275	<0.1	<0.1
			Semi-Aquatic Areas 0.001			**Monocot** IC_{25} > 0.576 NOAEL = 0.275	<0.1	NA[2]
						Dicot IC_{25} = 0.44 NOAEL = 0.275	<0.1	<0.1

[1] RQ values for acute risk to birds and mammals are not calculated because the most sensitive acute toxicity endpoints (LD_{50}) are greater than the tested limit dose.
[2] RQ values for risk to nonlisted species of terrestrial monocot plants are not calculated because the most sensitive toxicity endpoint (IC_{25}) is a nondefinitive value that is greater than the highest concentration tested.
[3]Exceeds chronic risk LOC (RQ≥1.0)
NA Not available.

Although the Agency does not typically quantify risk to non-target terrestrial invertebrates using the RQ method, acute toxicity studies with the young adult honey bee (*Apis mellifera*) indicate that boscalid is practically non-toxic to young adult honey bees on an acute oral and an acute contact exposure basis (LD_{50} >11 µg a.i./bee).

The potential for risk to non-target aquatic and terrestrial organisms, associated with the proposed use of boscalid as a seed treatment on rapeseed, is discussed further in the Risk Description (**Section 4.2**).

4.2. Risk Description and Conclusions

Boscalid is a synthetic carboxamide fungicide (FRAC Group 7) that inhibits mitochondrial respiration and the subsequent production of ATP in fungal cells, which inhibits spore germination, mycelial growth, and sporulation of the fungus on the surface of leaves (proposed label and Wharton 2010). Boscalid is persistent, is stable to most environmental degradation and plant metabolism processes, and has demonstrated at least some systemic activity. This assessment evaluates the potential for ecological risks associated with the proposed new use of boscalid as a seed treatment on rapeseed, including canola. The end-use product (Coronet® Fungicide) in the petition includes two active ingredients (18.0% boscalid and 9.0% pyraclostrobin); however, risk estimation in this assessment (**Section 4.1**) focuses on potential effects associated with boscalid alone. Where available, information about similarly formulated end-use products is included in the discussion of incident reports.

4.2.1. Aquatic Organisms

The proposed use of boscalid as a seed treatment on rapeseed, including canola, results in acute and chronic surface water EECs that are at least two orders of magnitude lower than EECs for the most recently assessed uses on alfalfa and citrus (DP Barcode D363523). Therefore, despite uncertainties regarding the toxicity of boscalid to some aquatic organisms at concentrations near its limit of solubility in water, the likelihood of adverse effects to aquatic organisms is expected to be low, based on the low potential for surface water exposure following the proposed seed treatment use. Acute and chronic RQ values are <0.01 and are therefore far below the listed and non-listed species acute (RQ≥0.05) and chronic risk (RQ≥1.0) LOCs for all assessed aquatic organisms. Risk to listed and nonlisted aquatic plants is not expected to exceed the Agency's LOC (RQ ≥ 1).

The potential for risk to benthic organisms exposed to pore water is also considered, using the conservative assumption that the highest concentration tested in the amphipod study represents the endpoint (*i.e.*, acute: EC_{50} = 1.066 mg a.i./L pore water; **Table 4.3**). In this estimation, the RQ value for acute risk to benthic invertebrates (RQ<0.01) is similar to the RQ values for fish and invertebrates in the water column, and it does not exceed the listed or non-listed species LOCs.

Table 4.3. RQ value calculated from the non-definitive endpoint for benthic freshwater invertebrates, based on mean measured pore water concentrations in a spiked sediment study with the amphipod.

Use	Application Rate lbs a.i./A (#app)	Application Method	EEC (µg/L)	Characterization Benthic Invertebrate RQ EC_{50} > 1.066 mg a.i./L
			Peak	Acute
Canola	0.012 (1)	Seed Treatment	0.71	0.001

In addition to potential surface water exposure, aquatic and amphibious organisms may be exposed to ground water through ground water discharge into surface systems or in unique and sensitive ground water ecosystems, such as caves, montane gravels, *etc*. Because boscalid has moderate mobility to ground water and degrades only slowly, primarily through aerobic soil metabolism, estimated concentrations in shallow ground water were calculated (see **Table 4.4**). Estimated concentrations of boscalid residues in ground water (EEC=0.01 µg/L) are lower than estimated concentrations in surface water (EEC=0.72 µg/L). Therefore, adverse effects to aquatic organisms exposed to boscalid residues in ground water are unlikely.

Table 4.4 RQ values for aquatic animals exposed to boscalid residues in shallow ground water.

Use	App Rate lbs a.i./A (#app)	App Method	EECs (µg/L)			Toxicity Endpoints	Ground Water RQ Values	
			Peak	21-d	60-d	Aquatic Animals	Acute	Chronic
Canola	0.012 (1)	Seed Treatment	0.01	0.01	0.01	**Freshwater Fish** LC_{50}=2.7 mg/L NOAEC=0.116 mg/L	<0.001	<0.001
						Freshwater Invertebrate EC_{50}=NA NOAEC=0.79 mg/L	NA[1]	<0.001

[1] An acute freshwater invertebrate study was submitted (MRID 45405001); however, the results are not used in quantitative risk estimation because they may underestimate toxicity (see DP Barcode 363523 for discussion). Potential acute risks to freshwater invertebrates are discussed as part of the Risk Description (Section 4.2).
[App] Application. [NA] Not available.

Finally, laboratory tests resulted in a maximum bioconcentration factor (BCF) of 105x (nonedible tissues of rainbow trout) under test conditions. Boscalid in fish tissues depurated rapidly after exposure ceased, with a modeled half-life of 0.8 – 1 days. Sublethal behavioral effects (lethargy and loss of equilibrium) were noted during the study and physiological effects (darkened livers and gall bladders and a discolored gastrointestinal tract) were noted at necropsy in fish exposed to boscalid at 200 µg/L. Sublethal effects (lethargy, narcosis, and extended yolk sacs) were observed at a similar concentration (241 µg a.i./L) in the early life stage test with rainbow trout, beginning approximately one week after termination of hatch (day 35). However, the concentrations associated with chronic effects in both studies are far greater than chronic EECs for the proposed new use of boscalid (0.72 µg a.i./L in surface water, 0.01 µg a.i./L in ground water).

4.2.2. Terrestrial Organisms

Although the available data indicate that the likelihood for adverse effects on aquatic organisms as a result of the proposed new use of boscalid as a seed treatment on rapeseed is very low, greater uncertainty surrounds the potential for risk to terrestrial organisms. Acute RQ values are not calculated in the Risk Estimation for birds and mammals because the necessary toxicity endpoints (LD_{50}/LC_{50}) were determined to be greater than the limit dose in the submitted studies. Therefore, although boscalid is classified as practically non-toxic to birds and mammals on an acute exposure basis, the nature and potential dose-response relationship of any effects of boscalid at exposure levels above the limit dose are unknown. The potential for acute risk is characterized in **Table 4.5**, using the conservative assumption that the limit dose represents the toxicity endpoint (LD_{50}), which is then adjusted for the body weight (bw) of the test specimens (default bw=178 g for bobwhite quail, 350 g for Norway rat) and compared to the estimated exposure per unit area (mg a.i./ft^2) and per daily dose of treated seed (*i.e.*, Nagy dose; mg a.i./kg bw/day).

Table 4.5. Characterization of potential risk to terrestrial birds and mammals, assuming that the limit dose tested in effects studies is the definitive toxicity endpoint.

Use	App Rate lbs a.i. /A (#app)	App Method	EECs		Toxicity Endpoints	Characterization Terrestrial RQ Values	
			Spatial (mg a.i./ft^2)	Nagy Dose (mg a.i./kg-bw /d)	Animals	Acute Spatial	Acute Dose-Based
Canola	0.012 (1)	Seed Treatment	0.13	304	**Birds** LD_{50}>2,000 mg/kg-bw LC_{50}>5,000 mg/kg diet NOAEC=300 mg/kg diet NOAEL=25 mg/kg-bw	0.21	<0.01
				254	**Mammals** LD_{50}>5,000 mg/kg-bw NOAEC=100 mg/kg diet NOAEL=11.2 mg/kg-bw	0.02	<0.01

The available data indicate that acute risk to mammals is unlikely to exceed the Agency's LOC. No mortality was observed in any of the submitted limit dose tests, and boscalid is not expected to cause frank mortality in birds. However, acute risk of sublethal effects to listed species of birds (and therefore to listed reptiles and terrestrial-phase amphibians) cannot be precluded. The Agency's LOC for acute risk to listed species of birds is based on the determination that the LD_{50}/ft^2 value is at least 10 times greater than the EEC (*i.e.*, LOC = 0.1). However, the submitted limit tests only establish that the LD_{50}/ft^2 value for bobwhite quail is at least five times greater than the spatial EEC for the proposed new use as a seed treatment on rapeseed. This uncertainty, coupled with the absence of data for acute effects on passerine birds, results in an incomplete understanding of the potential effects of boscalid exposure from seed treatment uses on avian species.

The low potential for acute risk to listed species of birds can be further characterized by considering how foraging ecology affects the potential for exposure. To consume a mass of

boscalid equivalent to the limit dose in the submitted study with bobwhite quail, a 20-g bird would have to consume 28.8 mg a.i., equivalent to 24 g (0.053 lbs) of rapeseed treated at the maximum proposed application rate (0.12 lbs a.i./cwt). This is considered an unlikely, though not impossible, scenario for most species. Smaller, migrating birds that eat seeds are expected to be at the highest risk of exposure, since they have higher surface area-to-body weight ratios and they must rapidly refuel energy reserves exhausted during migration (Klassen & Lindstrom 1996). In a short period of time (*e.g.*, one day or less), these birds may consume larger amounts of seeds, relative to body size, in proportions that approach or exceed their own body weight. Nonetheless, given that no adult mortality was observed in avian tests, frank mortality would be unlikely to result if a bird did consume the large amount of rapeseed necessary to be exposed to the limit dose.

As the foraging efficiency of a seed predator (granivore) decreases, the area of exposure (*i.e.*, treated field) necessary to trigger the LOC increases. For example, assuming conservatively that the limit dose in the submitted studies represents the LD_{50} value for birds, a 20-g, seed-eating bird with 100% foraging efficiency (*i.e.*, that eats all seeds within a given area) would consume enough boscalid in a 23-ft^2 area to exceed the Agency's LOC for listed species of birds. Using the same assumption, a 20-g bird would consume enough boscalid to trigger the acute risk LOC for listed birds if it displayed 50% foraging efficiency in a 46-ft^2 foraging area, or if it displayed 10% foraging efficiency within a 231-ft^2 foraging area. The actual foraging area necessary to result in mortality to birds at a level equivalent to an LD_{50} (*i.e.*, mortality of 50% of exposed birds) is likely much greater given that no mortality was observed at the limit dose.

As with birds and mammals, acute laboratory tests with terrestrial invertebrates (*i.e.*, honey bee) have demonstrated no adverse effects to young adults exposed to boscalid at the limit dose. However, multiple ecological incidents have been reported wherein boscalid use was associated with adverse effects on managed honey bees (see **Section 3.3.2**). Bee keepers have reported adverse honey bee brood effects, particularly following the use of the formulated product Pristine® (25.2% boscalid and 12.8% pyraclostrobin) on almonds (BASF 2008, US EPA 2010), which require active pollination by managed honey bees or other pollinators. The maximum single application rate for the proposed seed treatment use of boscalid on rapeseed (0.012 lbs a.i./A) is much lower than the maximum labeled rate for use on almonds (0.234 lbs a.i./A, Pristine®); additionally, the difference in application method (*i.e.*, foliar spray to almonds versus seed treatment to rapeseed) suggests a reduced potential for honey bee exposure for the proposed new use. Although boscalid demonstrates some systemic activity, the extent to which the compound may be translocated to nectar and pollen from a treated seed is unknown. Exposure of ground-nesting bees and wasps may be more likely than exposure of honey bees, given that the compound is expected to persist in soil and on organic matter.

Following another incident of adverse effects on honey bees, not yet verified by EPA, residue analysis confirmed the presence of boscalid (149 ng a.i./g wax) and pyraclostrobin (141 ng a.i./g wax) in hive samples (Stone 2010). Multiple other pesticides were also detected. Unlike the previous incidents, both adult bee mortality and hive effects were reported, and the report indicated that pesticide misuse may have occurred. Nonetheless, boscalid residues detected in the samples were at the upper bound of the laboratory's historical boscalid detection range (16.9

– 154 ng a.i./g wax) and were considerably higher than the average residue level (70.4 ng a.i./g wax) detected in laboratory samples through 2008.

Finally, the proposed new use of boscalid as a seed treatment is not expected to result in risk to non-target terrestrial plants exposed through runoff from a field where treated seeds are planted. RQ values for listed plants (monocots and dicots) and for nonlisted dicot plants are less than 0.1, and potential risk to nonlisted monocot plants is not expected to exceed risk to listed monocot plants. However, the proposed new use is on a *Brassica* crop (rapeseed), and the most sensitive terrestrial plant in both seedling emergence and vegetative vigor tests was also a *Brassica* species (cabbage). Risk estimates are not calculated for labeled crop species, but the potential adverse effects on *Brassica* sp. emergence would not be expected to trigger concern (LOC = 1) for crop species because the calculated application rate (0.012 lbs a.i./A) is less than one-twentieth of the seedling emergence NOAEC value (0.275 lbs a.i./A).

4.2.3. Conclusions

The physico-chemical properties of boscalid indicate that the fungicide has a moderate potential to reach aquatic environments, including surface and ground water, for several months or more following application of treated seeds. Although the available ecotoxicity data demonstrate that boscalid is acutely toxic to aquatic organisms and may cause chronic effects, including effects linked to reproduction and sublethal behavioral effects in some aquatic test species, the aquatic exposure levels (EECs) that result from the proposed new use as a seed treatment on rapeseed are relatively low. Therefore, the potential for direct acute or chronic effects on aquatic organisms, including fish, aquatic invertebrates, aquatic-phase amphibians, and aquatic plants is low.

Terrestrial vertebrates may be exposed to boscalid by contact with or ingestion of treated rapeseed. Seed-eating (granivore) birds and mammals may be exposed to boscalid as a result of the seed treatment use. This assessment concludes that the proposed new use of boscalid as a seed treatment on rapeseed will result in chronic risk to mammals, birds, reptiles, terrestrial-phase amphibians, and mammals that exceeds the Agency's LOC. Acute risk to mammals and to non-listed birds, reptiles, and terrestrial-phase amphibians does not exceed the Agency's LOC. Likewise, risk to non-target terrestrial and semi-aquatic plants does not exceed the LOC.

The submitted avian tests show that boscalid is practically non-toxic to birds at the limit dose on an acute exposure basis. However, uncertainty surrounds the potential for adverse effeects in listed species of birds because (1) the avian toxicity tests did not establish whether effects might occur at threshold exposure levels (higher than the limit dose) for listed species determinations (*i.e.*, ten times the EEC for the proposed new use), (2) sublethal effects were observed in one subacute dietary study, and (3) no data have been submitted for potentially sensitive passerine species. Therefore, acute risk of sublethal effects in listed species of birds, and therefore in listed species of reptiles and terrestrial-phase amphibians, cannot be precluded. Nonetheless, the absence of mortality at the limit dose suggests that frank mortality is unlikely, and no ecological incidents with birds have been reported for boscalid.

This assessment does not assess risk to terrestrial invertebrates. However, ecological incidents of adverse effects on honey bees indicate a potential for adverse effects to terrestrial

invertebrates. The effects on honey bee brood reported in several incidents would not be captured in current guideline toxicity studies with young adult honey bees.

5. Federally Threatened and Endangered (Listed) Species of Concern

Section 7 of the Endangered Species Act, 16 U.S.C. Section 1536(a)(2), requires all federal agencies to consult with the National Marine Fisheries Service (NMFS) for marine and anadromous listed species, and the United States Fish and Wildlife Service (USFWS) for listed wildlife and freshwater organisms, if they are proposing an "action" that may affect listed species or their designated critical habitat. Each federal agency is required under the Act to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. To jeopardize the continued existence of a listed species means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species" (50 C.F.R. § 402.02).

To facilitate compliance with the requirements of the Endangered Species Act (subsection (a)(2)), the Office of Pesticide Programs has established procedures to evaluate whether a proposed registration action may directly or indirectly appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of any listed species (USEPA 2004). After the Agency's screening level risk assessment is conducted, if any of the Agency's listed species LOCs are exceeded for either direct or indirect effects, an analysis is conducted to determine if any listed or candidate species may co-occur in the area of the proposed pesticide use or areas downstream or downwind that could be contaminated from drift or runoff/erosion. If listed or candidate species may be present in the proposed action area, further biological assessment is undertaken. The extent to which listed species may be at risk is considered, which then determines the need for the development of a more comprehensive consultation package, as required by the Endangered Species Act.

The federal action addressed herein is the proposed registration of a new use for boscalid as a seed treatment on rapeseed, including canola. It is expected that the new uses of boscalid could occur nationwide; however, according to the USDA National Agricultural Statistics Service (NASS) 2007 census, the proposed new seed treatment uses for canola are likely to predominantly occur in the states of North Dakota, Minnesota, Idaho, and Washington (USDA 2009; www.agcensus.usda.gov; searched on 25 October 2010). Based on the reported crop acreage harvested per state, other varieties of rapeseed are expected to be grown primarily in Idaho, Oregon, and Washington (USDA 2009).

5.1. Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by boscalid use and not merely the immediate area where boscalid is applied. At the initial screening-level, the risk assessment considers broadly described taxonomic groups and conservatively assumes that listed species within those broad groups are

co-located with the pesticide treatment area. This means that terrestrial plants and wildlife are assumed to be located on or adjacent to the treated site and aquatic organisms are assumed to be located in a surface water body adjacent to the treated site. The assessment also assumes that the listed species are located within an assumed area, which has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area. **Section 5.2** of this risk assessment presents the proposed pesticide use sites that are used to establish initial co-location of species with treatment areas.

5.2. Taxonomic Groups Potentially at Risk

If the assumptions associated with the screening-level action area result in RQs that are below the listed species LOCs, a "no effect" determination conclusion is made with respect to listed species in that taxa, and no further refinement of the action area is necessary. Furthermore, RQs below the listed species LOCs for a given taxonomic group indicate no concern for indirect effects on listed species that depend upon the taxonomic group for which the RQ was calculated. However, in situations where the screening assumptions lead to RQs in excess of the listed species LOCs for a given taxonomic group, a potential for a "may affect" conclusion exists and may be associated with direct effects on listed species belonging to that taxonomic group or may extend to indirect effects upon listed species that depend upon that taxonomic group as a resource. In such cases, additional information on the biology of listed species, the locations of these species, and the locations of use sites are considered to determine the extent to which screening assumptions regarding an action area apply to a particular listed organism. These subsequent refinement steps will consider how this information would impact the action area for a particular listed organism and potentially include areas of exposure that are downwind and downstream of the pesticide use site.

Assessment endpoints, exposure pathways, the conceptual models addressing the proposed new boscalid use, and the associated exposure and effects analyses conducted for the boscalid screening-level risk assessment are in **Sections 2** to **3**. The assessment endpoints used in the screening-level risk assessment include those defined operationally as reduced survival and reproductive impairment for both aquatic and terrestrial animal species and survival, reproduction, and growth of nontarget aquatic and terrestrial plant species from exposure via runoff. These assessment endpoints address the standard set forth in the Endangered Species Act requiring federal agencies to ensure that any action it authorizes does not appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species. Risk estimates (RQ values) integrating exposure and effects are calculated for broad-based taxonomic groups in the screening-level risk assessment and are presented in **Section 4.**

Both acute listed species and chronic risk LOCs are considered in the screening-level risk assessment to identify direct and indirect effects to taxa of listed species. This section identifies direct and indirect effect concerns, by taxa, that are triggered by exceeding listed LOCs in the screening-level risk assessment (**Table 5.1**). When applicable, probit dose response analysis to used to evaluate the probability of individual acute effects for exposures that occur at the established listed species LOC (**Section 5.2.1**). Data on exposure and effects collected under

field (when available) and laboratory conditions are evaluated to make determinations on the predictive utility of the direct effect screening assessment findings to listed species.

Table 5.1 Potential effects to federally listed taxa associated with the proposed new use of boscalid.

Listed Taxon	Direct Effects		Indirect Effects from Risk to Other Taxa	
	Yes/No	Acute/Chronic	Yes/No	Through ...
Terrestrial and semi-aquatic plants – monocots and dicots	No	NA	Yes	Acute sublethal[1] and chronic effects on birds, chronic effects on mammals, when required for pollination or seed dispersal.
Birds	Yes	Acute sublethal[1] and Chronic	Yes	Chronic effects on mammals that serve as prey; acute sublethal[1] and chronic effects on reptiles and amphibians that serve as prey.
Terrestrial-phase amphibians	Yes	Acute sublethal[1] and Chronic	Yes	Chronic effects on mammals which provide critical habitat (*e.g.*, burrows) and serve as prey.
Reptiles	Yes	Acute sublethal[1] and Chronic	Yes	Chronic effects on mammals that serve as prey; acute sublethal[1] and chronic effects on birds, reptiles, and amphibians that serve as prey.
Mammals	Yes	Chronic	Yes	Acute sublethal[1] and chronic effects on birds, reptiles, and amphibians that serve as prey; chronic effects on mammals that serve as prey.
Aquatic plants	No	NA	No	NA
Freshwater fish	No	NA	No	NA
Aquatic-phase amphibians	No	NA	Yes	Acute sublethal[1] and chronic effects on terrestrial-phase amphibians.
Freshwater invertebrates	No	NA	No	NA
Molluscs	No	NA	No	NA
Marine/estuarine fish	No	NA	No	NA
Marine/estuarine invertebrates	No	NA	No	NA

[NA] Not applicable.
[1] Acute risk of sublethal effects in listed species of birds, and therefore in reptiles and terrestrial-phase amphibians, could not be precluded based on the submitted ecotoxicity data.

5.2.1. Probit Dose-Response Analysis

The Agency uses the probit dose-response relationship as a tool for providing additional information on the potential for acute direct effects to individual listed species and to terrestrial and aquatic animals that may indirectly affect the listed species of concern (USEPA 2004). However, the proposed new use of boscalid as a seed treatment on rapeseed results in RQ values that do not exceed the Agency's LOC for acute risk to listed species of freshwater fish or estuarine/marine molluscs. Despite uncertainties in the ecotoxicity profile of boscalid, the available data further indicate that acute risk to mammals and other aquatic organisms is not expected to exceed the Agency's LOC for listed or nonlisted species. Although acute risk of sublethal effects in listed species of birds, and therefore in listed reptiles and terrestrial-phase

amphibians, cannot be precluded, probit dose-response analysis is not conducted for these taxa because no mortality was observed at the limit dose in the submitted acute avian studies. Potential risks to listed species of birds and to other taxa are characterized in **Section 4.2** (above).

5.2.2. Listed Species Occurrence with Proposed New Use of Boscalid

A preliminary analysis of the co-occurrence of listed species and the proposed new uses of boscalid was conducted using OPP's LOCATES database (v. 2.10.4). The goal of the analysis for co-location is to determine whether sites of pesticide use are geographically associated with known locations of listed species. The objective is to provide insight into the potential for exposure of listed species and to identify those areas, crop uses, and listed species that warrant further attention. The LOCATES database uses location information for listed species at the county level and compares it to agricultural census data (from 2002) for crop production at the same county level of resolution. The product is a listing of federally-listed species that are located within counties known to produce the crops upon which the pesticide will be used. **Appendix H** provides a species listing by state for those listed species that may potentially be impacted by the proposed new uses of boscalid.

A tabulation of the number of unique listed species in each state that may co-occur with the proposed new use of boscalid as a seed treatment on rapeseed is provided in **Table 5.2**. Although this assessment does not evaluate risk to terrestrial invertebrates, adverse effects on honeybees, associated with the use of boscalid, have been reported. Terrestrial invertebrates are included in the tabulation of species that may co-occur with areas of boscalid use. Secondary effects may occur in predatory birds, reptiles, amphibians, and mammals that rely on mammals, birds, reptiles, or terrestrial amphibians as prey. LOCATES does not currently differentiate between different feeding guilds or identify those plant species that require particular interactions for pollination or seed dispersal. Therefore, the number of potentially affected listed mammals, birds (also reptiles and terrestrial-phase amphibians), and terrestrial plants may be overestimated and include species that are not likely to be indirectly affected if they do not (1) rely on mammals, birds, amphibians, reptiles, or seeds as prey or (2) require mammals or birds for pollination or seed dispersal. Additionally, in cases where a listed amphibian species with an aquatic phase does not also have a terrestrial phase or use terrestrial habitat, the number of potentially affected amphibian species may be overestimated.

Based the results of the LOCATES database query, there are a total of 123 listed species of terrestrial plants, birds, reptiles, terrestrial and aquatic-phase amphibians, mammals, and terrestrial invertebrates associated with counties where boscalid may be used nationwide on rapeseed, including canola. It is expected that the actual total number of potentially affected listed species would be less than 123 because there are redundancies where a given species is listed in more than one state. A total of 23 states have listed species that are potentially affected by direct or secondary effects of boscalid exposure and are associated with rapeseed crops where boscalid may be used. California has the highest number (25) of listed species in the identified taxa that may co-occur with the proposed boscalid uses on rapeseed, followed by Oregon (12), Michigan (11) and Georgia (10).

This preliminary analysis indicates that there is a potential for boscalid use to overlap with listed species and that a more refined assessment is warranted. The more refined assessment should involve clear delineation of the action area associated with proposed uses of boscalid and the best available information on the temporal and spatial co-location of listed species with respect to the action area. This analysis has not been conducted for this screening level assessment.

Table 5.2. Tabulation by state and taxonomic group of listed species at potential risk of direct or secondary effects of boscalid use as a seed treatment, in areas where rapeseed (including canola and crambe) is grown.

State	Amphibians	Aquatic Mammals	Birds	Crustaceans	Dicot Plants	Ferns	Other Invertebrates	Mammals	Monocot Plants	Reptiles	Total per State
Alabama			1		2			2			5
Alaska											0
Arizona											0
Arkansas			1								1
California	2		1	2	11		1	4	1	3	25
Colorado			2		1			2	1		6
Connecticut											0
Delaware											0
Florida											0
Georgia	2		2		3	1		1		1	10
Hawaii											0
Idaho			1		3		2	2			8
Illinois								1			1
Indiana								1			1
Iowa											0
Kansas			3				1		1		5
Kentucky			1					2			3
Louisiana											0
Maine					1			1	1		3
Maryland											0
Massachusetts											0
Michigan			2		3		2	2	2		11
Minnesota			1					1	1		3
Mississippi											0
Missouri											0
Montana			3		1			2			6
Nebraska											0
Nevada											0
New Hampshire											0
New Jersey											0
New Mexico											0
New York											0
North Carolina		1	1								2
North Dakota			3						1		4
Ohio								1	1		2
Oklahoma											0
Oregon			3		7		2				12

State	Amphibians	Aquatic Mammals	Birds	Crustaceans	Dicot Plants	Ferns	Other Invertebrates	Mammals	Monocot Plants	Reptiles	Total per State
Pennsylvania								1			1
Rhode Island											0
South Carolina											0
South Dakota			3				1	1			5
Tennessee											0
Texas											0
Utah					1						1
Vermont											0
Virginia											0
Washington			1		2			1			4
West Virginia											0
Wisconsin					2			1	1		4
Wyoming											0
Total Number of Species	4	1	29	2	37	1	9	26	10	4	**123**

6. References

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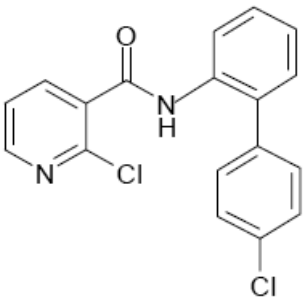
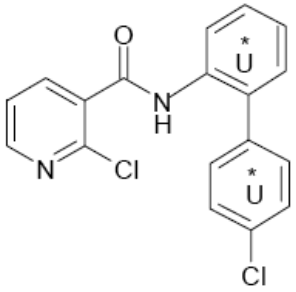
Appendix A. Chemical names and structures of boscalid and its degradates

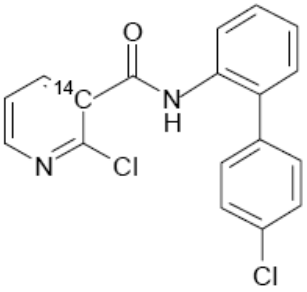
IUPAC Name: **2-chloro-N-(4'-chlorobiphenyl-2-yl)-nicotinamide**
CAS Name: **2-chloro-N-(4'-chloro[1,1-biphenyl-2-yl)-3-pyradinecarboxamide**
CAS Number: **188425-85-6**
Synonyms: **2-chloro-N-(4'-chlorobiphenyl-2-yl)-nicotinamide, BAS 510 F, boscalid, nicobifen**



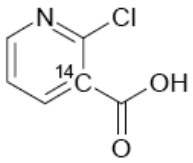
[Diphenyl-U-^{14}C]-labeled BAS 510 F



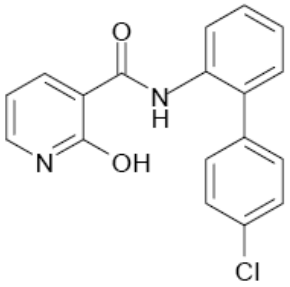
[Pyridine-3-^{14}C]-labeled BAS 510 F



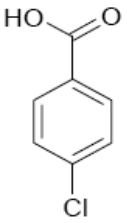
M510F47 2-chloronicotinic acid-[pyridine-3-^{14}C]



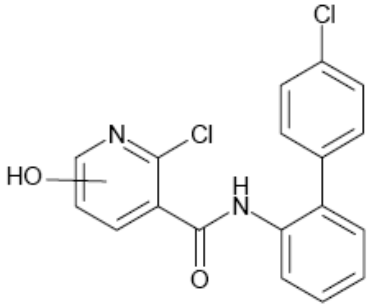
M510F49 (2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotonamide)



M510F64 (*p*-chloro-benzoic acid)



M510F50 Unknown 2



Appendix B. PRZM/EXAMS file names and sample input/output data

PRZM/EXAMS file names

Electronic files available as a compressed attachment.

Surface water: NDcanolaSTD.out
Benthic segment: NDcanolaSTDben.out

PRZM and EXAMS sample input/output data for broadcast application of treated seeds adjacent to the Standard Farm Pond

Chemical: Boscalid
PRZM environment: NDcanolaSTD.txt modified Tueday, 26 August 2008 at 06:16:40
EXAMS environment: pond298.exv modified Tueday, 26 August 2008 at 06:14:08
Metfile: w24013.dvf modified Tueday, 26 August 2008 at 06:15:40
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly		
1961	0.002435		0.002394		0.00225	0.002047	0.001959	0.0009865
1962	0.04269	0.04193	0.03977	0.03774	0.03626	0.0219		
1963	0.08478	0.08401	0.08071	0.07654	0.07611	0.05823		
1964	0.1538	0.1521	0.1474	0.1439	0.1422	0.1135		
1965	0.1587	0.1584	0.1575	0.1565	0.1562	0.1485		
1966	0.1886	0.1877	0.1845	0.1802	0.1791	0.1697		
1967	0.195	0.1945	0.1929	0.1905	0.1894	0.1845		
1968	0.2385	0.2376	0.2344	0.2299	0.2279	0.2091		
1969	0.2378	0.2374	0.2363	0.2343	0.2333	0.2281		
1970	0.2849	0.2839	0.2811	0.2762	0.274	0.256		
1971	0.3759	0.3737	0.366	0.3583	0.3543	0.3049		
1972	0.3418	0.3417	0.3414	0.3409	0.3408	0.3397		
1973	0.3644	0.3639	0.362	0.3607	0.3596	0.3481		
1974	0.3998	0.3988	0.395	0.3904	0.3879	0.3734		
1975	0.4303	0.4291	0.4266	0.4245	0.4238	0.4054		
1976	0.4281	0.4279	0.427	0.4261	0.4254	0.4229		
1977	0.5001	0.4986	0.4941	0.487	0.4857	0.4628		
1978	0.5313	0.5301	0.5273	0.5215	0.5205	0.5046		
1979	0.5706	0.5691	0.5639	0.5562	0.5527	0.5341		
1980	0.5803	0.5791	0.5752	0.5738	0.5737	0.5545		
1981	0.5856	0.5851	0.5834	0.5807	0.5805	0.5741		
1982	0.6265	0.6261	0.6242	0.6215	0.62	0.599		
1983	0.6404	0.64	0.6387	0.637	0.6357	0.6233		
1984	0.6986	0.6975	0.6913	0.6821	0.6777	0.6571		
1985	0.717	0.7157	0.7116	0.7087	0.7084	0.6919		
1986	0.7165	0.7162	0.7148	0.7134	0.7125	0.7092		
1987	0.7946	0.7922	0.7836	0.7713	0.766	0.7302		
1988	0.7568	0.7564	0.7554	0.7538	0.7526	0.7502		

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.0344827586206897	0.7946	0.7922	0.7836	0.7713	0.766	0.7502
0.0689655172413793	0.7568	0.7564	0.7554	0.7538	0.7526	0.7302
0.103448275862069	0.717	0.7162	0.7148	0.7134	0.7125	0.7092
0.137931034482759	0.7165	0.7157	0.7116	0.7087	0.7084	0.6919

0.172413793103448	0.6986	0.6975	0.6913	0.6821	0.6777	0.6571
0.206896551724138	0.6404	0.64	0.6387	0.637	0.6357	0.6233
0.241379310344828	0.6265	0.6261	0.6242	0.6215	0.62	0.599
0.275862068965517	0.5856	0.5851	0.5834	0.5807	0.5805	0.5741
0.310344827586207	0.5803	0.5791	0.5752	0.5738	0.5737	0.5545
0.344827586206897	0.5706	0.5691	0.5639	0.5562	0.5527	0.5341
0.379310344827586	0.5313	0.5301	0.5273	0.5215	0.5205	0.5046
0.413793103448276	0.5001	0.4986	0.4941	0.487	0.4857	0.4628
0.448275862068966	0.4303	0.4291	0.427	0.4261	0.4254	0.4229
0.482758620689655	0.4281	0.4279	0.4266	0.4245	0.4238	0.4054
0.517241379310345	0.3998	0.3988	0.395	0.3904	0.3879	0.3734
0.551724137931034	0.3759	0.3737	0.366	0.3607	0.3596	0.3481
0.586206896551724	0.3644	0.3639	0.362	0.3583	0.3543	0.3397
0.620689655172414	0.3418	0.3417	0.3414	0.3409	0.3408	0.3049
0.655172413793103	0.2849	0.2839	0.2811	0.2762	0.274	0.256
0.689655172413793	0.2385	0.2376	0.2363	0.2343	0.2333	0.2281
0.724137931034483	0.2378	0.2374	0.2344	0.2299	0.2279	0.2091
0.758620689655172	0.195	0.1945	0.1929	0.1905	0.1894	0.1845
0.793103448275862	0.1886	0.1877	0.1845	0.1802	0.1791	0.1697
0.827586206896552	0.1587	0.1584	0.1575	0.1565	0.1562	0.1485
0.862068965517241	0.1538	0.1521	0.1474	0.1439	0.1422	0.1135
0.896551724137931	0.08478	0.08401	0.08071	0.07654	0.07611	0.05823
0.931034482758621	0.04269	0.04193	0.03977	0.03774	0.03626	0.0219
0.96551724137931	0.002435		0.002394		0.00225	0.002047
0.001959	0.0009865					

0.1	0.72098	0.72022	0.71886	0.71744	0.71651	0.7113

Average of yearly averages: 0.391997017857143

Appendix C. SCI-GROW sample input/output data

SciGrow version 2.3
chemical:Boscalid on Rapeseed
time is 8/16/2010 14:58: 1

Application rate (lb/acre)	Number of applications	Total Use (lb/acre/yr)	Koc (ml/g)	Soil Aerobic metabolism (days)
0.012	1.0	0.012	7.16E+02	1305.0

groundwater screening cond (ppb) = 1.02E-02

****

SciGrow version 2.3
chemical:Boscalid on Turf
time is 8/16/2010 14:59:15

Application rate (lb/acre)	Number of applications	Total Use (lb/acre/yr)	Koc (ml/g)	Soil Aerobic metabolism (days)
0.350	6.0	2.100	7.16E+02	1305.0

groundwater screening cond (ppb) = 1.78E+00

****

Appendix D. Example T-REX (v. 1.4.1) input and output data

Chemical:	Boscalid			Data inputs are in blue
Name of seed treatment formulation:	Coronet			
Percent AI in formulation:	100%		Density of product (lbs/gal):	8.33

Endpoints	Reported	Tested Body Weight (g)	Adjusted LD50
Avian LD50:	>2000	178	#VALUE!
Avian repro. NOAEC:	300.00		
Mammalian LD50:	>5000	350	#VALUE!
Mammalian NOAEC:	100.00		

Crop	Maximum Seeding Rate (lbs/acre)	Reference	Application Rate (fl oz/cwt)	Application Rate (lbs. Ai/cwt)
Canola	10	Boyles et al.	0	0.1200

Crop	Maximum Application Rate (lbs ai/A)	Maximum Seed Application Rate (mg ai/kg seed)	Avian Nagy Dose (mg ai/kg-bw/day)	Mammalian Nagy Dose (mg ai/kg-bw/day)	Available AI (mg ai ft-2)
Canola	0.01	1200.00	303.71	254.25	0.13

Animal	Nagy allometry Food ingestion value g/day
20 g Bird	5.061777181
15 g Mammal	3.178078065

Crop	Risk Quotients†					
	Avian (20 g)			Mammalian (15 g)		
	Acute (# 1)	Acute (# 2)	Chronic	Acute (# 1)	Acute (# 2)	Chronic
Canola	#VALUE!	#VALUE!	4.00	#VALUE!	#VALUE!	12.00

† Acute RQ #1 = (mg ai /kg-bw/day) / LD50
Acute RQ #2 = mg ai ft-2 /(LD50*bw)
Chronic RQ = mg kg-1 seed / NOEC

Appendix E. Example TerrPlant (v. 1.2.2) input and output data

TerrPlant v. 1.2.2
Green values signify user inputs (Tables 1, 2 and 4).
Input and output guidance is in popups indicated by red arrows.

Table 1. Chemical Identity.	
Chemical Name	Boscalid
PC code	128008
Use	Rapeseed (Canola)
Application Method	Seed Treatment
Application Form	
Solubility in Water (ppm)	4.64

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	0.012	lbs AI/A
Incorporation	I	1	none
Runoff Fraction	R	0.01	none
Drift Fraction	D	0	none

Table 3. EECs for Boscalid. Units in lbs AI/A.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.00012
Runoff to semi-aquatic areas	(A/I)*R*10	0.0012
Spray drift	**A*D**	**0**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.00012**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.0012**

Table 4. Plant survival and growth data used for RQ derivation. Units are in lbs AI/A.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	x	0.275	x	x
Dicot	0.44	0.275	x	x

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Boscalid through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	#VALUE!	#VALUE!	#DIV/0!
Monocot	listed	<0.1	<0.1	<0.1
Dicot	non-listed	<0.1	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Appendix F. Ecotoxicity data gaps and uncertainties

Guideline (MRID)	Study Type	Classification and Issues
72-1c (45404927)	Acute toxicity to freshwater fish (rainbow trout, *Oncorhynchus mykiss*)	**Supplemental** No measured concentrations.
72-1a (45404928)	Acute toxicity to freshwater fish (bluegill, *Lepomis macrochirus)*	**Supplemental** Water quality; uncertainty with measured concentrations.
72-4a (45405006)	Early life-stage toxicity to freshwater fish (rainbow trout, *Oncorhynchus mykiss*)	**Supplemental** Water quality; uncertainty with measured concentrations.
72-2 (45405001)	Acute toxicity to freshwater invertebrates (waterflea, *Daphnia magna*)	**Supplemental** Precipitate not filtered/centrifuged; water quality; uncertainty with measured concentrations. Data not suitable for quantitative use in risk assessment.
72-4b 850.1300 (46351406)	Chronic toxicity to freshwater invertebrates (waterflea, *Daphnia magna*)	**Acceptable** Use of a solvent and treatment of water samples not specified.
N/A (45405009)	Acute sediment toxicity to freshwater invertebrates (amphipod, *Hyalella azteca*)	**Supplemental** Non-guideline species; boscalid recoveries varied substantially based on analytical method; solvent controls sig. different from negative controls.
850.1735 (45405008)	Chronic toxicity to sediment-dwelling freshwater invertebrates (midge, *Chironomus riparius*)	**Supplemental** Non-guideline species; sediment not spiked; measured concentrations not provided.
72-3 (45405004)	Acute toxicity to estuarine/marine fish (sheepshead minnow, *Cyprinodon variegatus*)	**Acceptable** Ratio of highest concentration tested to EEC not high enough to evaluate risk to listed species.
72-3b (45405002)	Acute toxicity to estuarine/marine invertebrates (mysid, *Americanmysis bahia*)	**Acceptable** Ratio of highest concentration tested to EEC not high enough to evaluate risk to listed species.
123-2 (45405017)	Toxicity to nonvascular aquatic plants (green alga, *Pseudokirchneriella subcapitata*)	**Supplemental** Study conditions poorly described.
71-2a (45404923)	Subacute dietary toxicity to upland game birds (bobwhite quail, *Colinus virginianus)*	**Supplemental** Poor rearing conditions; small sample size.
71-2b (45404924)	Subacute dietary toxicity to waterfowl (mallard duck, *Anas platyrhynchos L..*	**Supplemental** Poor rearing conditions; small sample size.
850.6200 (45405020)	14-day toxicity to soil-dwelling invertebrates (earthworm, *Eisenia fetida*)	**Supplemental** Insufficient acclimation period; measured concentrations and stability unreported; 28-day study recommended.
850.4250 (47627402)	Terrestrial plant toxicity – Tier II vegetative vigor	**Supplemental** Concentrations too high to establish definitive endpoints for cabbage (dicot).

Appendix G. Environmental fate and transport data gaps and uncertainties

Guideline (MRID)	Study Type	Classification and Issues
162-1 835.4100 (45405208)	Aerobic soil metabolism	**Supplemental** Foreign soil, high moisture content, no replicates for degradates, combined data from 2 radiolabel studies to determine half-life of parent compound.
162-1 835.4100 (45405209)	Aerobic soil metabolism	**Supplemental** Info on degradate, 2-chloronicotinic acid only.
162-1 835.4100 (45405210)	Aerobic soil metabolism	**Unacceptable** Half-lives were extrapolated beyond range of data and no replicates. Interim report samples will be up to 360 days post treatment.
162-1 835.4100 (45643802)	Aerobic soil metabolism	**Acceptable** Replicate data not obtained for all sampling intervals to determine variability.
162-1 835.4100 (46715226)	Aerobic soil metabolism	**Supplemental** Not stated that samples incubated in darkness and material balance decreased steadily during study. Info on deg chloronicotinic acid and not parent.
162-2 835.4200 (45405211)	Anaerobic soil metabolism	**Unacceptable** Half-lives were extrapolated beyond range of data and no replicates. Incorrect application prep protocol. Foreign soil, not analyzed by phase but whole system. Study not required because acceptable anaerobic aquatic metabolism study has been submitted (MRID 45405213).
162-2 835.4200 (45405212)	Anaerobic soil metabolism	**Unacceptable** Half-lives were extrapolated beyond range of data and no replicates. Incorrect application prep protocol. Foreign soil, not analyzed by phase but whole system. Study not required because acceptable anaerobic aquatic metabolism study has been submitted (MRID 45405213).
162-4 835.4300 (45405214)	Aerobic aquatic metabolism	**Supplemental** System was flooded and incubated prior to treatment with parent. Should be done simultaneously. Foreign soil. Compound was stable and provides useful info. Additional study was not required at that time.
163-1 835.1230 & 835.1240 (45405216)	Leaching adsorption/desorption	**Supplemental** Material balances not reported for all test concentrations.
163-1 835.1230 & 835.1240 (45405217)	Leaching adsorption/desorption	**Supplemental** Material balances not reported for all test concentrations.

Guideline (MRID)	Study Type	Classification and Issues
164-1 835.6100 (45405218)	Soil field dissipation	**Supplemental** Major degradate from aerobic metabolism study not monitored.
164-1 835.6100 (45405221)	Soil field dissipation	**Acceptable** Note data variability at both sites makes reported DT50s of questionable value.
164-1 835.6100 (45405222)	Soil field dissipation	**Supplemental** Foreign study site. Half-lives at all 3 sites are questionable due to temporal and inter-replicate data variability at all sites and insufficient sampling intervals.

Appendix H. LOCATES output of listed species

THREATENED AND ENDANGERED SPECIES LISTING BY STATE WITH USE CRITERIA

All medium types; minimum of 1 Acre.

Crops: *Canola, rapeseed, crambe.*
Taxa (dispersed species included): *Mammal, marine mammal, bird, amphibian, reptile, crustacean, gastropod, arachnid, insect, dicot, monocot, ferns, conifer, coral, lichen.*

Alabama (5) species:		**Taxa**	Critical Habitat
Woodpecker, Red-cockaded	Endangered	Bird	No
(Picoides borealis)		Terrestrial	
Bladderpod, Lyrate	Threatened	Dicot	No
(Lesquerella lyrata)		Terrestrial	
Clover, Leafy Prairie	Endangered	Dicot	No
(Dalea foliosa)		Terrestrial	
Bat, Gray	Endangered	Mammal	No
(Myotis grisescens)		Subterraneous, Terrestrial	
Bat, Indiana	Endangered	Mammal	Yes
(Myotis sodalis)		Subterraneous, Terrestrial	

Arkansas (1) species:		**Taxa**	Critical Habitat
Tern, Interior (population) Least	Endangered	Bird	No
(Sterna antillarum)		Terrestrial	

California (25) species:		**Taxa**	Critical Habitat
Salamander, California Tiger	Endangered	Amphibian	No
(Ambystoma californiense)		Terrestrial, Vernal pool	
Toad, Arroyo Southwestern	Endangered	Amphibian	Yes
(Bufo californicus (=microscaphus))		Freshwater, Terrestrial	
Rail, Yuma Clapper	Endangered	Bird	No
(Rallus longirostris yumanensis)		Terrestrial	
Fairy Shrimp, Vernal Pool	Threatened	Crustacean	Yes
(Branchinecta lynchi)		Vernal pool	
Tadpole Shrimp, Vernal Pool	Endangered	Crustacean	Yes
(Lepidurus packardi)		Vernal pool	
Adobe Sunburst, San Joaquin	Threatened	Dicot	No
(Pseudobahia peirsonii)		Terrestrial	
Bird's-beak, Palmate-bracted	Endangered	Dicot	No
(Cordylanthus palmatus)		Terrestrial	
Checker-mallow, Keck's	Endangered	Dicot	Yes
(Sidalcea keckii)		Terrestrial	
Clover, Fleshy Owl's	Threatened	Dicot	Yes
(Castilleja campestris ssp. succulenta)		Vernal pool	
Dudleya, Santa Clara Valley	Endangered	Dicot	No
(Dudleya setchellii)		Terrestrial	
Golden Sunburst, Hartweg's	Endangered	Dicot	No
(Pseudobahia bahiifolia)		Terrestrial	
Grass, Hairy Orcutt	Endangered	Dicot	Yes
(Orcuttia pilosa)		Vernal pool	
Jewelflower, California	Endangered	Dicot	No
(Caulanthus californicus)		Terrestrial	
Milk-vetch, Pierson's	Threatened	Dicot	Yes

(Astragalus magdalenae var. peirsonii)			Terrestrial	
California	(25) species:		**Taxa**	Critical Habitat
Pussypaws, Mariposa		Threatened	Dicot	No
(Calyptridium pulchellum)			Terrestrial	
Woolly-threads, San Joaquin		Endangered	Dicot	No
(Monolopia (=Lembertia) congdonii)			Terrestrial	
Beetle, Valley Elderberry Longhorn		Threatened	Insect	Yes
(Desmocerus californicus dimorphus)			Terrestrial	
Fox, San Joaquin Kit		Endangered	Mammal	No
(Vulpes macrotis mutica)			Terrestrial	
Kangaroo Rat, Fresno		Endangered	Mammal	Yes
(Dipodomys nitratoides exilis)			Terrestrial	
Kangaroo Rat, Giant		Endangered	Mammal	No
(Dipodomys ingens)			Terrestrial	
Sheep, Peninsular Bighorn		Endangered	Mammal	Yes
(Ovis canadensis)			Terrestrial	
Grass, San Joaquin Valley Orcutt		Threatened	Monocot	Yes
(Orcuttia inaequalis)			Vernal pool	
Lizard, Blunt-nosed Leopard		Endangered	Reptile	No
(Gambelia silus)			Terrestrial	
Snake, Giant Garter		Threatened	Reptile	No
(Thamnophis gigas)			Freshwater, Terrestrial	
Tortoise, Desert		Threatened	Reptile	Yes
(Gopherus agassizii)			Terrestrial	
Colorado	(6) species:		**Taxa**	Critical Habitat
Crane, Whooping		Endangered	Bird	Yes
(Grus americana)			Terrestrial, Freshwater	
Owl, Mexican Spotted		Threatened	Bird	Yes
(Strix occidentalis lucida)			Terrestrial	
Butterfly Plant, Colorado		Threatened	Dicot	Yes
(Gaura neomexicana var. coloradensis)			Terrestrial	
Ferret, Black-footed		Endangered	Mammal	No
(Mustela nigripes)			Terrestrial	
Mouse, Preble's Meadow Jumping		Threatened	Mammal	Yes
(Zapus hudsonius preblei)			Terrestrial	
Ladies'-tresses, Ute		Threatened	Monocot	No
(Spiranthes diluvialis)			Terrestrial	
Georgia	(10) species:		**Taxa**	Critical Habitat
Salamander, Flatwoods		Threatened	Amphibian	No
(Ambystoma cingulatum)			Freshwater, Vernal pool, Terrestrial	
Salamander, Reticulated flatwoods		Endangered	Amphibian	No
(Ambystoma bishopi)			Terrestrial	
Stork, Wood		Endangered	Bird	No
(Mycteria americana)			Terrestrial	
Woodpecker, Red-cockaded		Endangered	Bird	No
(Picoides borealis)			Terrestrial	
Amphianthus, Little		Threatened	Dicot	No
(Amphianthus pusillus)			Freshwater	
Dropwort, Canby's		Endangered	Dicot	No
(Oxypolis canbyi)			Terrestrial, Freshwater	
Pondberry		Endangered	Dicot	No
(Lindera melissifolia)			Terrestrial	

Georgia	(10) species:		**Taxa**	Critical Habitat
Quillwort, Black-spored		Endangered	Ferns	No
(Isoetes melanospora)			Vernal pool	
Bat, Indiana		Endangered	Mammal	Yes
(Myotis sodalis)			Subterraneous, Terrestrial	
Snake, Eastern Indigo		Threatened	Reptile	No
(Drymarchon corais couperi)			Terrestrial	

Idaho	(8) species:		**Taxa**	Critical Habitat
Crane, Whooping		Endangered	Bird	Yes
(Grus americana)			Terrestrial, Freshwater	
Catchfly, Spalding's		Threatened	Dicot	No
(Silene spaldingii)			Terrestrial	
Four-o'clock, Macfarlane's		Threatened	Dicot	No
(Mirabilis macfarlanei)			Terrestrial	
Howellia, Water		Threatened	Dicot	No
(Howellia aquatilis)			Freshwater	
Snail, Bliss Rapids		Threatened	Gastropod	No
(Taylorconcha serpenticola)			Freshwater	
Snail, Snake River Physa		Endangered	Gastropod	No
(Physa natricina)			Terrestrial	
Bear, Grizzly		Threatened	Mammal	No
(Ursus arctos horribilis)			Terrestrial	
Caribou, Woodland		Endangered	Mammal	No
(Rangifer tarandus caribou)			Terrestrial	

Illinois	(1) species:		**Taxa**	Critical Habitat
Bat, Indiana		Endangered	Mammal	Yes
(Myotis sodalis)			Subterraneous, Terrestrial	

Indiana	(1) species:		**Taxa**	Critical Habitat
Bat, Indiana		Endangered	Mammal	Yes
(Myotis sodalis)			Subterraneous, Terrestrial	

Kansas	(5) species:		**Taxa**	Critical Habitat
Crane, Whooping		Endangered	Bird	Yes
(Grus americana)			Terrestrial, Freshwater	
Plover, Piping		Endangered	Bird	Yes
(Charadrius melodus)			Terrestrial	
Tern, Interior (population) Least		Endangered	Bird	No
(Sterna antillarum)			Terrestrial	
Beetle, American Burying		Endangered	Insect	No
(Nicrophorus americanus)			Terrestrial	
Orchid, Western Prairie Fringed		Threatened	Monocot	No
(Platanthera praeclara)			Terrestrial	

Kentucky	(3) species:		**Taxa**	Critical Habitat
Warbler, Bachman's		Endangered	Bird	No
(Vermivora bachmanii)			Terrestrial	
Bat, Gray		Endangered	Mammal	No
(Myotis grisescens)			Subterraneous, Terrestrial	
Bat, Indiana		Endangered	Mammal	Yes
(Myotis sodalis)			Subterraneous, Terrestrial	

Maine	(3) species:		**Taxa**	Critical Habitat
Lousewort, Furbish		Endangered	Dicot	No

(Pedicularis furbishiae)		Terrestrial	
Lynx, Canada	Threatened	Mammal	No
(Lynx canadensis)		Terrestrial	
Orchid, Eastern Prairie Fringed	Threatened	Monocot	No
(Platanthera leucophaea)		Terrestrial	

Michigan (11) species:		**Taxa**	Critical Habitat
Plover, Piping	Endangered	Bird	Yes
(Charadrius melodus)		Terrestrial	
Warbler (=Wood), Kirtland's	Endangered	Bird	No
(Dendroica kirtlandii)		Terrestrial	
Goldenrod, Houghton's	Threatened	Dicot	No
(Solidago houghtonii)		Terrestrial	
Monkey-flower, Michigan	Endangered	Dicot	No
(Mimulus glabratus var. michiganensis)		Terrestrial, Freshwater	
Thistle, Pitcher's	Threatened	Dicot	No
(Cirsium pitcheri)		Terrestrial	
Butterfly, Karner Blue	Endangered	Insect	No
(Lycaeides melissa samuelis)		Terrestrial	
Butterfly, Mitchell's Satyr	Endangered	Insect	No
(Neonympha mitchellii mitchellii)		Terrestrial	
Bat, Indiana	Endangered	Mammal	Yes
(Myotis sodalis)		Subterraneous, Terrestrial	
Lynx, Canada	Threatened	Mammal	No
(Lynx canadensis)		Terrestrial	
Iris, Dwarf Lake	Threatened	Monocot	No
(Iris lacustris)		Terrestrial	
Orchid, Eastern Prairie Fringed	Threatened	Monocot	No
(Platanthera leucophaea)		Terrestrial	

Minnesota (3) species:		**Taxa**	Critical Habitat
Plover, Piping	Endangered	Bird	Yes
(Charadrius melodus)		Terrestrial	
Lynx, Canada	Threatened	Mammal	No
(Lynx canadensis)		Terrestrial	
Orchid, Western Prairie Fringed	Threatened	Monocot	No
(Platanthera praeclara)		Terrestrial	

Montana (6) species:		**Taxa**	Critical Habitat
Crane, Whooping	Endangered	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Plover, Piping	Endangered	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	Endangered	Bird	No
(Sterna antillarum)		Terrestrial	
Catchfly, Spalding's	Threatened	Dicot	No
(Silene spaldingii)		Terrestrial	
Bear, Grizzly	Threatened	Mammal	No
(Ursus arctos horribilis)		Terrestrial	
Ferret, Black-footed	Endangered	Mammal	No
(Mustela nigripes)		Terrestrial	

North Carolina	(2) species:		**Taxa**	Critical Habitat
Woodpecker, Red-cockaded		Endangered	Bird	No
(Picoides borealis)			Terrestrial	
Manatee, West Indian		Endangered	Marine mml	Yes
(Trichechus manatus)			Saltwater	

North Dakota	(4) species:		**Taxa**	Critical Habitat
Crane, Whooping		Endangered	Bird	Yes
(Grus americana)			Terrestrial, Freshwater	
Plover, Piping		Endangered	Bird	Yes
(Charadrius melodus)			Terrestrial	
Tern, Interior (population) Least		Endangered	Bird	No
(Sterna antillarum)			Terrestrial	
Orchid, Western Prairie Fringed		Threatened	Monocot	No
(Platanthera praeclara)			Terrestrial	

Ohio	(2) species:		**Taxa**	Critical Habitat
Bat, Indiana		Endangered	Mammal	Yes
(Myotis sodalis)			Subterraneous, Terrestrial	
Orchid, Eastern Prairie Fringed		Threatened	Monocot	No
(Platanthera leucophaea)			Terrestrial	

Oregon	(12) species:		**Taxa**	Critical Habitat
Murrelet, Marbled		Threatened	Bird	Yes
(Brachyramphus marmoratus marmoratus)			Freshwater, Terrestrial, Saltwater	
Owl, Northern Spotted		Threatened	Bird	Yes
(Strix occidentalis caurina)			Terrestrial	
Plover, Western Snowy		Threatened	Bird	Yes
(Charadrius alexandrinus nivosus)			Terrestrial	
Catchfly, Spalding's		Threatened	Dicot	No
(Silene spaldingii)			Terrestrial	
Checker-mallow, Nelson's		Threatened	Dicot	No
(Sidalcea nelsoniana)			Terrestrial	
Daisy, Willamette		Endangered	Dicot	No
(Erigeron decumbens var. decumbens)			Terrestrial	
Four-o'clock, Macfarlane's		Threatened	Dicot	No
(Mirabilis macfarlanei)			Terrestrial	
Lomatium, Bradshaw's		Endangered	Dicot	No
(Lomatium bradshawii)			Terrestrial, Freshwater	
Lupine, Kincaid's		Threatened	Dicot	No
(Lupinus sulphureus (=oreganus) ssp. kincaidii (=var. kincaidii))			Terrestrial	
Thelypody, Howell's Spectacular		Threatened	Dicot	No
(Thelypodium howellii spectabilis)			Terrestrial	
Butterfly, Fender's Blue		Endangered	Insect	No
(Icaricia icarioides fenderi)			Terrestrial	
Butterfly, Oregon Silverspot		Threatened	Insect	Yes
(Speyeria zerene hippolyta)			Terrestrial	

Pennsylvania	(1) species:		**Taxa**	Critical Habitat
Bat, Indiana		Endangered	Mammal	Yes
(Myotis sodalis)			Subterraneous, Terrestrial	

South Dakota (5) species:		**Taxa**	Critical Habitat
Crane, Whooping	Endangered	Bird	Yes
(Grus americana)		Terrestrial, Freshwater	
Plover, Piping	Endangered	Bird	Yes
(Charadrius melodus)		Terrestrial	
Tern, Interior (population) Least	Endangered	Bird	No
(Sterna antillarum)		Terrestrial	
Beetle, American Burying	Endangered	Insect	No
(Nicrophorus americanus)		Terrestrial	
Ferret, Black-footed	Endangered	Mammal	No
(Mustela nigripes)		Terrestrial	

Utah (1) species:		**Taxa**	Critical Habitat
Primrose, Maguire	Threatened	Dicot	No
(Primula maguirei)		Terrestrial	

Washington (4) species:		**Taxa**	Critical Habitat
Owl, Northern Spotted	Threatened	Bird	Yes
(Strix occidentalis caurina)		Terrestrial	
Catchfly, Spalding's	Threatened	Dicot	No
(Silene spaldingii)		Terrestrial	
Howellia, Water	Threatened	Dicot	No
(Howellia aquatilis)		Freshwater	
Rabbit, Pygmy	Endangered	Mammal	No
(Brachylagus idahoensis)		Terrestrial	

Wisconsin (4) species:		**Taxa**	Critical Habitat
Locoweed, Fassett's	Threatened	Dicot	No
(Oxytropis campestris var. chartacea)		Terrestrial	
Thistle, Pitcher's	Threatened	Dicot	No
(Cirsium pitcheri)		Terrestrial	
Lynx, Canada	Threatened	Mammal	No
(Lynx canadensis)		Terrestrial	
Orchid, Eastern Prairie Fringed	Threatened	Monocot	No
(Platanthera leucophaea)		Terrestrial	