Human Health and Ecological Risk Assessment
for the Use of Wildlife Damage Management Methods
by USDA-APHIS-Wildlife Services

Chapter XVII

The Use of DRC-1339 in Wildlife Damage Management

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THE USE OF DRC-1339 IN WILDLIFE DAMAGE MANAGEMENT

EXECUTIVE SUMMARY

DRC-1339 is a toxicant registered to control various pest bird species under a variety of agricultural and nonagricultural uses. The USDA-APHIS-Wildlife Services (WS) Program uses DRC-1339 to control damage caused by specific species of blackbirds, grackles, cowbirds, starlings, pigeons, collared-doves, crows, ravens, magpies, and gulls. WS took an annual average of 2.8 million birds with DRC-1339 lethally from fiscal year (FY) 2011 to FY 2015 and 52% of these were European starlings, an invasive species. Of all WS take nationally for all species and with all methods, DRC-1339 represented 71% of the lethal take. WS annually averaged the use of 77.4 pounds of technical product for FY11-FY15 and took a total of 15 species in this time. APHIS is the registrant for DRC-1339 Technical and its end use products. DRC-1339 is a restricted use pesticide and only USDA APHIS certified applicators or by persons under their direct supervision trained in bird control use the product.

USDA APHIS evaluated the potential human health and ecological risks from the proposed use of DRC-1339 to control bird damage. DRC-1339 is corrosive to eyes and skin and the acute inhalation toxicity is unknown, but assumed to be Category I (most hazardous) by EPA. Although the hazard potential could be high, the anticipated minimal exposure to this pesticide will be low risk due to the limited use of the product. Exposure is greatest for workers who mix the product with a bait material; however, required personnel protective equipment results in a low potential for exposure and risk when factoring in available health effects. The potential exposure and risk to the general public is low due to the use pattern and label restrictions, as well as lack of dietary exposure through food or drinking water. WS is unaware of any exposure from 1987 to present to WS personnel or the general public.

Ecological risks to aquatic nontarget organisms is low based on the use pattern, available toxicity data and labeled mitigation measures designed to reduce exposure to aquatic habitats. Risks to terrestrial invertebrates and plants are also low based on available effects data and the method of application. Risk is greatest for sensitive terrestrial nontarget vertebrates, in particular birds, but these risks can be reduced with label requirements and other measures that are designed to reduce exposure.

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1 INTRODUCTION

DRC-1339 is an avicide (toxicant for birds) used by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) Program to reduce bird conflicts at livestock facilities and airports, and to reduce damage to crops, livestock, property, and natural resources, including threatened and endangered species, per label allowances. The primary target species include European starlings[1], rock pigeons, Eurasian collared-doves, and specific species of blackbirds[2], corvids[3], and gulls. DRC-1339 is a very pale yellow, crystalline powder that is highly soluble in water and other polar solvents. It was named from a code it received at the Denver Research Center[4] (DRC), as the 1,339th chemical tested at the Center, which became its common name. It has also been known by the tradename Starlicide®, which was originally registered as a pelleted bait for starlings under a label from Purina Mills in 1967.

This human health risk assessment (HHRA) and ecological risk assessment (ERA) provides a qualitative and quantitative evaluation of potential risks and hazards to human health and the environment, including nontarget fish and wildlife, as a result of exposure to DRC-1339 from proposed WS uses, which are limited and targeted in scope (USDA 2012). The methods used to assess potential human health effects follow standard regulatory guidance and methodologies (National Research Council 1983), and generally conform to other Federal agencies such as the U.S. Environmental Protection Agency (USEPA 2017c). The methods used to assess potential ecological risk to nontarget fish and wildlife generally follow USEPA (2017c) methodologies.

The risk assessment is divided into four sections: problem formulation (identifying hazard), toxicity assessment (dose-response assessment), and exposure assessment (identifying potentially exposed populations and determining potential exposure pathways for these populations). Lastly, the information from the toxicity and exposure assessments is combined to characterize risk (determining whether there is adverse human health or ecological risk). A discussion of the uncertainties associated with the risk assessment and cumulative effects is also included in this risk assessment.

1.1 Use Pattern

For more than 50 years, DRC-1339 has proven to be an effective tool for starling, pigeon, blackbird, corvid, and gull damage management (West et al. 1967, West and Besser 1976, Besser et al. 1967, and DeCino et al. 1966). DRC-1339 is a slow acting avicide that kills target birds between 3 and 80 hours after ingestion of a lethal dose (Dawes 2006). The slow action of the avicide allows the chemical to be partially or mostly metabolized prior to the birds succumbing to the chemical (Schafer 1984, Goldade 2017). DRC-1339 appears to pose little risk of secondary poisoning to nontarget animals, including avian scavengers (Cunningham et al. 1979, Schafer 1984, Knittle et al. 1990). The technical grade[5] of the active ingredient is very highly acutely toxic to many pest birds, but generally less acutely toxic to raptors, waterfowl, finches, and other birds, and most mammals (DeCino et al. 1966, Palmore 1978, Schafer 1981). For example, an 89 g starling, a highly sensitive species, requires a dose of only 0.3 mg/bird to cause death (Royall et al. 1967) while many other bird species such as raptors, house sparrows, and finches are classified as non-sensitive, requiring a much higher dose (Eisemann et al. 2003). A 29 g house sparrow would require a dose of 9 mg, while a 22 g house

[1] Scientific names are given in the Risk Assessment Introduction Chapter I, unless first time used.
[2] Generic use of blackbirds for this risk assessment includes specific species of blackbirds, cowbirds, and grackles on labels.
[3] Corvids refers to the family Corvidae, which includes ravens, crows, magpies, and jays, but jays are not on any DRC-1339 label.
[4] Later was renamed the WS-National Wildlife Research Center when it moved from Denver to Fort Collins, CO.
[5] Technical grade chemicals are good quality used for commercial and industrial purposes. Not pure enough to meet the chemical standards of purified, lab grade, or above.

finch and a 118 g American kestrel would require more than 5 mg and 38 mg (DeCino et al. 1966, Schafer et al. 1983). It should be noted that larger birds and pigeons require more product (more toxicant) to be taken lethally. Secondary hazards of DRC-1339 are likely very low unless toxic bait is still largely intact in the carcass. DRC-1339 acts in a relatively humane manner producing a quiet death (Timm 1994, Dawes 2006). Prior to the application of DRC-1339, prebaiting is often required to monitor for nontarget species that may consume the bait. If nontarget species are observed, then the use of DRC-1339 would be postponed or not applied at that particular location. The application method such as the use of prebaiting to assess palatability of the bait and prevent overbaiting, and the low risk of secondary hazards reduce the potential exposure to sensitive threatened and endangered species as well as preclude hazards to most other non-target species.

Some people have stated that DRC-1339 is an inhumane toxicant and should not be used. WS recognizes that any use of lethal methods, toxicants in particular, is considered by many individuals to be inhumane even if time until death and symptoms exhibited appear to be minimal. DRC-1339 causes renal failure in treated birds (Timm 1994). Renal failure in birds causes weight loss, depression, lethargy, increased thirst (polydipsia) and urination (polyuria), dehydration, articular gout, and eventually death (Merck 2018a). Death in birds occurs typically within a few days following ingestion of a lethal dose (Timm 1994). Mammals can succumb rather quickly with those ingesting a lethal dose dying in 3 to 12 hours (Timm 1994). Higher doses do not increase the speed of mortality (Timm 1994). Research is not available on pain experienced by birds treated with DRC-1339, just observational reports (DeCino et al. 1966, Timm 1994, Dawes 2006); convulsions, spasms or distress calls have not been observed in birds receiving a lethal dose, rather the birds die a seemingly quiet death. Birds that get a lethal dose may show no outward clinical signs for many hours and go about normal activities. About four hours before death, the birds cease to eat or drink and become listless and inactive, and possibly comatose (Timm 1994, Dawes 2006). They perch with their feathers puffed up (piloerection) and appear to doze. The product has been assessed as relatively humane and suitable for further investigation into potential use in Australia (Dawes 2006, Bentz et al. 2007) and is registered in New Zealand.

The end use product, Compound DRC-1339 Concentrate (100% DRC-1339 Technical, which is 97% purity DRC-1339), is used to control various bird species under various agricultural and non-agricultural uses in the U.S. Labels have varied over the last 50 years when the first formulation was registered, changing species that can be targeted, allowing additional bait substrates, restricting amounts that can be used over a given area, and types of areas that can be treated. For FY11[6] to FY15, the data used for this risk assessment, the federal DRC-1339 labels included new labeling updates for various uses during this time (Table 1).

Table 1. DRC-1339 labels and significant dates when use restrictions on the label changed, to provide a comparison to take (Table 2) and label usage (Table 3) for the labels used from FY11 to FY15.

DRC-1339 LABEL CHANGES FOR FY11 TO FY15					
Product (Parent Label)	**EPA Registration No.**	**Significant Label Change Dates**			
Feedlots	56228-10	10/26/2009	02/01/2011	01/30/2014	03/05/2014
Gulls	56228-17	05/19/2010	12/11/2013		
Pigeons	56228-28	10/26/2009	12/11/2013		
Livestock, Nest & Fodder Depredations	56228-29	10/26/2009	12/11/2013		
Staging Areas	56228-30	10/26/2009	03/29/2011	12/11/2013	

In 2018, the Bird Control label (USDA 2017a) was developed, and replaced the Feedlots, Gulls, Pigeons, and Staging Areas labels as of January 2019; this Bird Control label also incorporated 14 state Special Local Needs (SLN) labels. The labeling lists the bait substrates, target species, and sites where DRC-1339 can be used. Mixing directions depend on the bait substrate (e.g., rice, cracked and whole corn, French fries, and livestock

[6] FY11 equals the federal Fiscal Year 2011, which is October 1, 2010-September 30, 2011 (the year is denoted by FY11, FY12, and so on).

pellets) that can be used to mix with DRC-1339 and how much untreated bait to cut with the treated bait. Prebaiting is required for all applications. DRC-1339 prepared baits deteriorate rapidly and need to be used relatively soon after preparation or disposed according to label directions.

WS took an annual estimated average of 2,810,095 target birds of 15 species using an annual average 35,122 grams (1,239 oz. or 77 lbs.) of DRC-1339 in 18 states from FY11 to FY15 (Table 2). During this time, WS applied DRC-1339 under 18 Section 3 and SLN (Section 24(c)) labels operationally (Table 3). The most common resources protected by WS were livestock and feed, aircraft, other wildlife, and crops. The species groups taken were starlings and blackbirds (99.1%), pigeons (0.5%), corvids (0.4%), and gulls (0.004%). The most common target species lethally taken were European starlings (52%), brown-headed cowbirds (27%), red-winged blackbirds (16%), and common grackles (4%) (Table 2). Weight-wise, the majority of DRC-1339 used targeted starlings (89%), common ravens (2.9%), feral pigeons (2.5%), American crows (1.8%), and brown-headed cowbirds (1.6%); it should be noted that some DRC-1339 targeting a specific species may have had minimal take for various reasons like birds did not show up to feed or bait was ruined by weather.

Table 2. The annual average number of target birds taken with DRC-1339 treated baits used by WS in wildlife damage management from FY11 through FY15. Take was estimated for WS projects that did not determine take.

ANNUAL AVERAGE DRC-1339 USE AND SPECIES TAKEN			
Species*	**Take**	**DRC-1339 (g)**	**States Where Used**
Target			
European Starling*	1,449,656	31,222.8	AZ CA CO CT IA ID IL IN KS MA MD ME MI MN MO MT NE NJ NM NV NY OH OK OR PA SD TX UT VA VT WA WI WV WY
Yellow-headed Blackbird	80	4.6	OK
Red-winged Blackbird	452,014	450.8	AZ CA CO LA NM NV OR TX WV WY
Brown-headed Cowbird	744,988	549.5	AZ CA LA NV OH OK TX
Brewer's Blackbird	6,062	41.1	AZ CA NM NV OR
Common Grackle	123,624	255.6	LA OK TX WV
Boat-tailed Grackle	60	0.2	LA
Great-tailed Grackle	7,897	34.9	AZ NM OK TX
Rock Pigeon*	13,112	896.0	AZ CA CO IA ID IL KS KY ME MI MN MO MT ND NE NM NV OK OR PA TN TX UT VT WA WV WY
Great Black-backed Gull	6	0.5	ME
California Gull	6	1.2	ID
American Herring Gull	90	7.9	ME
Black-billed Magpie	321	18.4	ID OR WY
American Crow	3,385	631.8	CA ID MA NE OK OR TX WA WY
Common Raven	8,794	1,006.5	AZ CA ID MT NM NV OR TX UT WA WY
TOTAL (15 sp.)	**2,810,095**	**35,121.8**	**38 States**
Nontarget			
Brown-headed Cowbird	12	0.1	WI
Rock Pigeon*	152	3.0	NM WV WY
American Crow	80	3.0	NM
Common Raven	0.4	0.1	NM
TOTAL (4 sp.)	**244**	**6**	**5 States**
GRAND TOTAL (15 sp.)	**2,810,339**	**35,128**	**38 States**

* Introduced species

WS personnel took an annual average of 244 nontarget birds of four species (Table 2); of these, 164 were being targeted at feedlots, but accidentally taken while targeting other species with a particular DRC-1339 formulation. The annual average of American crows (80) and common ravens (0.4) were not target species at the sites where they were accidentally taken. All of the nontarget species taken are species WS would take with DRC-1339 under different circumstances. WS did not take other nontarget species unintentionally, including threatened, endangered, or sensitive species, or species not listed on the label.

Historically, APHIS registered five DRC-1339 Section 3 labels, but only two Section 3 labels are currently registered as of 2019 (Table 3). Four labels (Feedlots, Gulls, Pigeons, and Staging Areas) were incorporated into the Bird Control label, while the Livestock, Nest and Fodder (LNFD) Depredations label remains a separate labeled use. Additionally, states have registered specific uses for DRC-1339 under SLN registrations. In addition to the cancelation of the four Section 3 labels, 25 SLN registrations were cancelled in 2018 after their uses were incorporated under the Bird Control label or were determined to no longer be needed. As of 2019, WS has only 6 active DRC-1339 SLN registrations (4 under the LNFD label and 2 under the Bird Control label), and two pending SLN registration applications under the Bird Control label (Table 3). Of the 36 labels active within FY11 to FY15, only half were used in those five years (Table 3). The majority of DRC-1339 product used by WS was used under the APHIS Feedlot label or SLNs that used it as the parent label (83.5%). The APHIS Staging Area label or SLN labels developed from it were used next most (11.3%). The others were used minimally.

Table 3. The annual average number of grams of DRC-1339 applied by APHIS-WS in WDM from FY11 thru FY15 by all labels with the number of projects and applications.

ANNUAL AVERAGE DRC-1339 USE BY Product FOR FY11 TO FY15				
Product (Parent Label)	**EPA Registration No.**	**Applied (g)**	**Projects**	**WTs**
Feedlots* (FLot) Cancelled	56228-10	28,065.0	302	350
Gulls* Cancelled	56228-17	9.6	0.4	0.4
Pigeons* Cancelled	56228-28	837.6	36	60
Livestock, Nest & Fodder Depredations (LNFD)	56228-29	471.6	118	394
Staging Areas* (SA) Cancelled	56228-30	3,252.4	53	143
SLN ID (FLot)** Cancelled	ID-050014	122.4	4	7
SLN ID (LNFD)^	ID-140005	0.8	0.2	0.2
SLN ID (SA)* Cancelled	ID-050013	-	-	-
SLN IL (FLot) Cancelled	IL-120002	155.9	7	7
SLN IN (FLot)* Cancelled	IN-080003	-	-	-
SLN IN (SA)* Cancelled	IN-040001	-	-	-
SLN KS (SA)* Cancelled	KS-120003	-	-	-
SLN KY (FLot)* Cancelled	KY-020003	-	-	-
SLN KY (SA) Cancelled	KY-020002	-	-	-
SLN MD (SA)* Cancelled	MD-080005	-	-	-
SLN MS (SA)* Cancelled	MS-050008	-	-	-
SLN ND (FLot)** Cancelled	ND-920001	-	-	-
SLN NE (SA & FLot)* Cancelled	NE-100003	-	-	-
SLN NM (SA)** Cancelled	NM-110004	-	-	-
SLN NV (LNFD)^	NV-150001	395.7	38	139
SLN NV (LNFD)^ Cancelled	NV-040004	40.1	3	14
SLN NV (SA)* Cancelled	NV-020005	-	-	-
SLN OK (SA)** (Replaced by OK-180002 in 2018)	OK-990001	567.6	50	117
SLN OR (SA)** (2019 Replacement Pending)	OR-010024	-	-	-
SLN TN (FLot)* Cancelled	TN-080003	-	-	-
SLN TN (SA)* Cancelled	TN-080004	-	-	-
SLN TX (FLot)** Cancelled	TX-890001	7.1	0.6	0.8
SLN TX (SA)** (2019 Replacement Pending)	TX-020003	9.2	1	1
SLN TX (FLot) Cancelled	TX-090010	975.2	1	1
SLN TX (LNFD)^	TX-060016	-	-	-
SLN UT (LNFD)^ Cancelled	UT-130005	7.7	0.2	0.2
SLN WV (SA)* Cancelled	WV-11001	-	-	-
SLN WV (SA)* Cancelled	WV-010002	-	-	-
SLN WV (SA)* Cancelled	WV-040001	46.7	6	7
SLN WY(LNFD)^	WY-110002	58.5	11	16
SLN WY (SA)** (Replaced by WY-180003 in 2018)	WY-070002	98.9	12	31
TOTAL	**5 FEDERAL 31 SLN**	**35,122.0**	**643**	**1,289**

Lightly shaded lines - registrations with no use from FY11-FY15. WTs – Work Tasks associated with using DRC-1339

* USEPA Registration No. 56228-63 - Bird Control label replaced these labels January 2019.

** Labels not fully incorporated in Bird Control label and re-registered by state under the Bird Control parent label or canceled January 2019.

^ Labels are under the LNFD parent label.

2 PROBLEM FORMULATION

DRC-1339 is used by APHIS WS for various projects on specific species of birds. The various use sites, depending on target species, include livestock and poultry feedlots, buildings and fenced non-crop areas, federal and state wildlife refuges and protected areas, gull colonies in coastal areas, and bird staging areas and roost sites. The following sections discuss the chemical description and product use; physical and chemical properties; environmental fate; and hazard identification for DRC-1339.

2.1 Chemical Description and Product Use

DRC-1339 ($C_7H_9Cl_2N$, CAS No. 7745-89-3) is 3-chloro-p-toluidine hydrochloride (synonyms: 3-chloro-4-methylbenzenamine hydrochloride, or 3-chloro-4-methylaniline hydrochloride). Technical DRC-1339 (DRC-1339 Technical, USEPA Reg. No. 56228-59) was first registered with USEPA in 1967 (USEPA 1995). PM [Purina Mills] Resources, Inc., which was acquired by Virbac Corporation, was previously the registrant for Starlicide Technical (USEPA registration No. 67517-7); however, the company transferred the registration to APHIS (USEPA registration No. 56228-59) in September 2013 (USEPA 2013b). When the registration was transferred, APHIS changed the name of the product to DRC-1339 Technical. All APHIS Compound DRC-1339 Concentrate products are prepared from and identical in composition to DRC-1339 Technical, which is comprised of 97% purity DRC-1339 (USDA 2019), the active ingredient (a.i.). APHIS currently has just two Compound DRC-1339 Concentrate Section 3 products registered with USEPA, but four Section 3 labels were replaced by the Bird Control label at the end of 2018 and are included below as these labels were used for the data included in this risk assessment.

- **Compound DRC-1339 Concentrate – Bird Control** (USEPA Reg. No. 566228-63), a combined label designed to replace the feedlots, gulls, pigeons, and staging areas labels. The label was approved by USEPA in December 2017 and supersedes the other four labels as of January 2019 (USDA 2017a); and

    - Compound DRC-1339 Concentrate – Feedlots (USEPA Reg. No. 56228-10) for bird control in feedlots (cancelled in 2018) (USDA 2017b);

    - Compound DRC-1339 Concentrate – Gulls (USEPA Reg. No. 56228-17) for control of gulls at landfills and to protect colonial nesting seabirds (cancelled in 2018) (USDA 2016a);

    - Compound DRC-1339 Concentrate – Pigeons (USEPA Reg. No. 56228-28) for control of pigeons causing health, nuisance, or economic problems in and around structures or in non-crop areas (cancelled in 2018) (USDA 2016c); and

    - Compound DRC-1339 Concentrate – Staging Areas (USEPA Reg. No. 56228-30) for bird control in non-crop staging areas associated with roosts (cancelled in 2018) (USDA 2016d);

- **Compound DRC-1339 Concentrate –LNFD** (USEPA Reg. No. 56228-29) for control of crows, ravens, and magpies that damage and feed on the contents of silage/fodder bags, prey on newborn livestock, eggs or the young of federally-designated Threatened or Endangered species, or of other species designated to be in need of special protection (USDA 2016b).

For the purpose of this risk assessment, the new Bird Control label will be used when assessing risk related to the feedlots, gulls, pigeons and staging areas use sites, because the separate Section 3 labels for each of those uses were cancelled at the end of December 2018. The four older Section 3 labels are discussed when describing prior projects conducted under these labels for the data used in this risk assessment. The Bird Control label also incorporated many of the State SLN registrations (Table 3).

In cases where an active SLN use was not incorporated into the Bird Control label and was still needed, a new SLN was submitted for that specific use under the Bird Control parent label. However, a summary of information for the old SLN labels regarding each use pattern as well as species controlled is given below and in Table 4, as well as referenced because these are the labels that WS used to apply DRC-1339 from FY11 to FY15.

- **Feedlots (Commercial Animal Operations):** Various bait materials can be used such as rolled barley, cracked corn, and rolled whole corn, but baits can only be used in feedlots to control target bird species identified on the label such as European starlings, rock pigeons, and specific species of blackbirds, crows, and ravens, as well as bronzed cowbirds (*Molothrus aeneus*) when in mixed flocks (Table 4). Feedlots are defined on the label as areas of commercial livestock operations where beef cattle, dairy cattle, swine, sheep, goats, poultry, or game birds are confined primarily for the purpose of production and eventual sale in agricultural markets. From FY11 to FY15, WS applied an annual average of 39,326 g of DRC-1339 under the Feedlots label and two SLN labels under the parent Feedlots label for 315 unique properties in 364 work tasks, primarily for European starlings (Table 3).

- **Gulls:** Bread cubes are mixed with DRC-1339 and can be used to control targeted species of gulls in coastal or inland gull colonies, within predation radii of important colonial nesting sites of terns, puffins, or other colonially nesting birds that will be protected; or close to areas where target gull species damage property or crops during the breeding season (Table 4). It may also be used at feeding sites located at airports, industrial sites, dumps or landfills, or other noncrop areas throughout the year. From FY11 to FY15, WS applied an annual average of 10 g of DRC-1339 under the Gulls label for gull damage on 0.4 unique properties in 0.4 work tasks (Table 3).

- **Pigeons:** Whole-kernel corn is mixed with DRC-1339, which then can be used to control feral pigeons in roosting or loafing areas on flat rooftops, or within fenced areas (Table 4). From FY11 to FY15, WS applied an annual average of 838 g of DRC-1339 under the Pigeons label for feral rock pigeon damage on 36 unique properties in 60 work tasks (Table 3).

- **Staging Areas:** Baits prepared with one of the grain components (cracked corn, rolled barley, brown rice, or poultry pellets) may only be used in noncrop, staging areas, "SA," associated with nighttime roosting sites of blackbirds, cowbirds, grackles, and starlings (Table 4) and crows under the various SLNs. From FY11 to FY15, WS applied an annual average of 3,975 g of DRC-1339 under the Staging Areas label and four SLN labels under the parent Staging Areas label for 122 unique properties in 286 work tasks, primarily for starlings, brown-headed cowbirds, red-winged blackbirds, common grackles, and crows (Table 3).

Table 4. Summary of use patterns for DRC-1339 (USDA 2017b, 2016a, b, c, d, USEPA 2017b).

Product Use	Target Species	Application Site	Application Method	Application Rate
Feedlots	Brewer's, Red-winged & Yellow-headed Blackbirds, Common, Boat-tailed & Great-tailed Grackles, Brown-headed Cowbird, European Starling, Common & Chihuahuan Ravens, American & Fish Crows, Black-billed Magpie, Rock Pigeon, and Eurasian Collared-Dove, and Bronzed Cowbird when in mixed flocks with one or more of the above species	Feedlots with beef or dairy cattle, swine, sheep or goats, and poultry or game bird farms	Manual baiting – bait stations/trays using a scoop or other appropriate utensil Mechanical baiting – hopper of truck-mounted or trailer-type feeder and apply with mechanical applicator	Maximum single: 0.1 lbs. a.i./treated acre (2% a.i. - 1:10 dilution of untreated bait: 50 lbs. of diluted bait/acre, or 1 lb. of diluted bait/1000 ft^2)
Gulls	Gull spp. - Herring, Great Black-backed, Ring-billed, Laughing (non-protected areas), Western & California Gulls	Target gull's nesting colonies and gull feeding areas at airports, industrial sites, dumps, landfills, and non-crop areas	Manual broadcast or place treated bread cubes wearing rubber gloves and using a scoop or other utensil	Maximum: 0.1 lb. a.i./per treated acre/treatment (bait densities of 5 treated cubes/100 ft^2 and 2200 treated cubes/ treated acre)
Pigeons	Feral pigeons	Roosting or loafing areas on flat rooftops, or within fenced areas from which the public, pets, domestic animals, and most non-avian wildlife can be excluded during bait application	Manual dispense or broadcast treated whole-kernel corn wearing rubber gloves and using a scoop or other utensil	Maximum: 0.05 lb. a.i./ treated acre (25 lbs./acres of a 1:1 dilution of properly treated whole-kernel corn with untreated whole-kernel corn)
Livestock, Nest & Fodder Depredations	Common & Chihuahuan Ravens, American & Fish Crows, and Black-billed Magpie	Rangeland and pasture areas where ravens, magpies, or crows prey upon newborn livestock; Refuges or other areas where ravens, magpies, or crows prey upon the eggs or young of federally designated Threatened or Endangered Species, or Federal or State protected wildlife; and within 25 feet of silage/fodder bags damaged or likely to be damaged by crows, ravens, or magpies	Manually place (wearing rubber-gloves) <75 meat cube baits at each baited site (5 to 10 baits in clusters over an area not to exceed 1000 ft^2)	Maximum: 0.083 lbs. of a.i./treated acre (18 treated-egg baits in at least 5 bait sets applied over an area of 400 ft^2 surrounding an animal carcass draw station). For meat baits, <0.01 a.i./treated acre, 5-10 baits per 1000 ft^2, no more than 75/baited site, and baits must be observed. Assuming a maximum used per acre, max of 0.003 lb. a.i./acre for meat baits.
Staging Areas	Red-winged Blackbird, Common, Boat-tailed & Great-tailed Grackles, Brown-headed Cowbird and European Starling, and Brewer's, Tricolored & Yellow-headed Blackbirds, American Crows, and Black-billed Magpie when in mixed flocks with one or more of the above species	SA: Stubble fields, harvested dormant hay fields, open grassy or bare-ground noncrop areas, roads, roadsides, rooftops, industrial and commercial structures, and secured parking areas	Feeding stations; Mechanical broadcasting with ground-based equipment; and Manual broadcasting – wearing rubber gloves and using a scoop or other utensil	Maximum: 0.1 lb. a.i./treated acre/ treatment or Maximum yearly: 0.5 lb. a.i./ acre (<58 lbs./treated acre of cracked corn or rolled barley baits, 110 lbs./treated acre of diluted poultry pellet bait, or 137 lbs./treated acre of diluted brown rice bait. Do not make more than 5 treatments per year to any one treated site)
Bird Control	Combined bird species	Commercial animal operations; staging areas; gull colonies; and gull feeding or loafing sites	Retrievable feeding stations, bait stations, or trays; manual or mechanical baiting; and hand or mechanical broadcast.	For broadcast applications: do not exceed a maximum single application rate of 0.1 lbs. a.i./acre (1.12 g a.i./100 m^2) or a maximum yearly application rate of 0.5 lb. a.i./acre (5.61 g a.i./100 m^2). For manual baiting: 1 lb./ 1000 ft^2 (0.49 kg/100 m^2) over dry or frozen areas

a.i. = Active Ingredient

- **Livestock, Nest & Fodder Depredations:** Hard boiled eggs or meat-cube baits are treated with DRC-1339, which can be used to control species such as common raven, Chihuahuan raven (*Corvus cryptoleucus*), American crow, black-billed magpie, and fish crow (Table 4). Baits (eggs or meat cubes) can be used in rangeland or pastureland where ravens or crows prey upon newborn livestock, or refuges or other areas where ravens or crows prey upon the eggs or young of federally designated threatened or endangered Species, or federal or state protected wildlife. From FY11 to FY15, WS applied an annual average of 974 g of DRC-1339 under the LNFD label and five SLN labels under the parent LNFD label for 170 unique properties in 552 work tasks, primarily for common ravens (Table 3).

USEPA has been reevaluating the data supporting DRC-1339 and the registered products under Registration Review since September 2011. The final work plan for registration review stated that USEPA (2012a) would require human health data for conducting a revised occupational risk assessment. The work plan also listed data needs for performing a comprehensive ecological risk assessment including an endangered species assessment for all uses. USEPA (2013a) issued a Data Call-In (DCI) formally listing the studies that would be required for continued registration of products containing DRC-1339. After reviewing submissions to address many of the initial data requirements in the DCI, USEPA reduced the number of required studies. In June 2014, USEPA (2014a) further agreed to waive some of the remaining studies by including additional mitigation language on product labels to reduce the likelihood of DRC-1339's movement to water and improve the success of leftover bait cleanup. Waived studies included photodegradation in soil, aerobic aquatic metabolism, anaerobic aquatic metabolism, terrestrial field dissipation, estuarine/marine fish acute toxicity, freshwater invertebrate lifecycle, terrestrial plant toxicity, and aquatic plant and algal toxicity studies (USEPA 2014a). With the approval of the amended DRC-1339 labels on October 20, 2015, USEPA (2015) officially waived the above-mentioned studies.

For the environmental study requirements that remained, APHIS agreed to conduct the studies using a phased approach as funds became available. These studies include honeybee acute oral toxicity, adsorption/ desorption or soil column leaching, aerobic soil metabolism, and environmental chemistry analytical methods and independent laboratory validation in soil and water. APHIS has completed the acute oral honeybee toxicity study, the aerobic soil metabolism study, and the analytical methods and independent laboratory validation study in water. The two remaining environmental fate studies have not been completed.

2.2 Physical and Chemical Properties

DRC-1339 is an off-white to yellow powder with a moth ball odor (USDA 2019). The 3-chloro-p-toluidine parent product, not DRC-1339, has a melting point ranging from 21 to 24°C and a boiling point ranging 220 to 230°C at 760 mm Hg. DRC-1339, on the other hand, has a melting point of 260°, at which point it sublimes (vaporizes). DRC-1339 has a reported vapor pressure of 1.06×10^{-4} torr at 25° C and calculated Henry's Law Constant of 1.47×10^{-8} atm/m^{3}/mol (USEPA 2011a). DRC-1339 has a bulk density of 0.44 g/ml. The water solubility for DRC-1339 ranges from 53 to 91 g/L (USEPA 1995, 2011a).

2.3 Environmental Fate

The environmental fate describes the processes by which DRC-1339 moves and degrades in the environment. The environmental fate processes include: 1) persistence, degradation, and mobility in soil; 2) movement to air; 3) migration potential to groundwater and surface water; 4) degradation in water; and 5) plant uptake.

In general, DRC-1339 is unstable and does not persist in soil. It degrades rapidly in soil when exposed to sunlight, heat, or ultraviolet radiation (USDA 2001). DRC-1339 has an average degradation half-life in soil of 0.17 days based on results from four different soil types (Battelle 2018). Dissipation half-life values ranged from 0.02 days in a Texas loam to 2.0 days in a clay soil. DRC-1339 has low mobility in high organic matter soils because it strongly binds to organic matter. DRC-1339 binds rapidly and irreversibly to soil organic matter suggesting that volatilization from soil into the atmosphere is not a significant pathway for exposure. DRC-1339 has moderate vapor pressure (1.06 X 10^{-4} torr at 25^{0}C) and a high Henry's Law constant value (estimated - 1.47 x 10^{-8} atm-$m^{3-}$$mol^{-1}$), suggesting a low potential for volatilization into the atmosphere from aqueous solutions (USEPA 2018a). DRC-1339 has low migration potential to groundwater and surface water due to its high affinity to soil organic matter.

DRC-1339 is highly soluble in water. DRC-1339 is resistant to hydrolysis but sensitive to light with a photodegradation half-life in water ranging from 6.5 to 41 hours depending on the season, as it is faster in summer than winter (USDA 2001, USEPA 2011a). DRC-1339 is not expected to bioconcentrate in aquatic environments. DRC-1339 slightly accumulates in bluegill with average bioconcentration factors of 33x (edible tissues), 150x (nonedible tissues), and 88x (whole fish) (Spanggord et al. 1996, USEPA 2018a).

Uptake by plants is unlikely since DRC-1339 is mixed with a bait that is used on bare soil, fallow ground, or in trays. Any DRC-1339 that would leach from the bait material would degrade quickly in soil or bind to soil organic matter reducing bioavailability to plants. In addition, most of the bait is removed by the target species reducing the amount of DRC-1339 available for any potential plant uptake.

2.4 Hazard Identification

DRC-1339 is hazardous to human health because of its acute inhalation toxicity and eye and skin corrosiveness. Pesticide label statements regarding the health effects based on toxicity studies include "*Fatal if inhaled. Corrosive. Causes irreversible eye damage and skin burns. May be fatal if swallowed. Harmful if absorbed through skin. Prolonged or frequently repeated skin contact may cause allergic reactions in some people.*" (USDA 2016b, 2017a, b).

USEPA evaluated human incident reports for DRC-1339 during product reregistration and did not identify any human incident cases from their Office of Pesticide Program Incident Data Systems (IDS) between 2006 and 2011 (USEPA 2011b). The aggregate IDS module includes less severe human incidents with minor, unknown, or no effect outcomes. WS has no "Adverse Incidence Reports" (6(a)2) from FY87 to FY18 for DRC-1339 for WS personnel or the public. An additional literature review did not identify any human exposure cases related to DRC-1339.

2.4.1 Mode of Action

The biochemical mechanism of action for DRC-1339 is not well understood. Previous studies suggest that ingested DRC-1339 is rapidly hydrolyzed to 3-chloro-p-toluidine, which is the toxic compound (Eisemann et al. 2003). In sensitive birds, DRC-1339 causes irreversible kidney and heart damage resulting in death normally within 1 to 3 days of ingestion. In mammals, DRC-1339 depresses the central nervous system at 10-100 times higher the dose that can cause effects in birds. Central nervous system depression can cause cardiac or respiratory arrest resulting in death 2 to 10 hours after ingestion. The effects to the central nervous system in non-sensitive mammals can be successfully treated symptomatically (USDA 2001, Eisemann et al. 2003). The kidney mitochondrial enzyme, deacetylase, may be responsible for the difference in susceptibility

to 3-chloro-p-toluidine (Eisemann et al. 2003). The enzyme is present in chickens, starlings, pheasants, and rock pigeon, which are sensitive to 3-chloro-p-toluidine. The enzyme is not present in red-tailed hawks and mammals resulting in lower sensitivity to 3-chloro-p-toluidine (Mull and Giri 1972).

2.4.2 Acute Toxicity

The acute oral median lethality values (LD_{50}), and ocular and dermal irritation scores in rats indicates that DRC-1339 is moderately (Category II) toxic via the oral route and highly toxic (corrosive, Category I) when in contact with skin and eyes (Table 5). USEPA (1995) concluded during registration review that DRC-1339 is highly toxic in acute inhalation exposures based on its oral toxicity and the moderate to severe irritation observed in ocular and dermal irritation studies, although an acute inhalation study was not performed. The eye and dermal irritation studies show that DRC-1339 is highly corrosive to skin and eyes when using rabbits as a test species (Category I). The dermal sensitization study shows that DRC-1339 is a mild to moderate skin sensitizer in guinea pigs. The DRC-1339 Safety Data Sheet (USDA 2019) states that contact exposure to the eye causes severe damage. Dermal contact can result in severe skin burns or an allergic reaction. Table 5 summarizes the acute toxicity values of DRC-1339 used by USEPA to assess acute toxicity risk to human health.

Table 5. Acute technical and formulation DRC-1339 toxicity data for mammals (USEPA 1995, USDA 2019).

Test Species	Test	DRC-1339 Conc.* 97% a.i.	USEPA Category
Laboratory Brown Rat	Oral LD_{50}	302-350 mg/kg	II
Domestic Rabbit	Dermal LD_{50}	> 2,000 mg/kg	III
Laboratory Brown Rat	Inhalation LC_{50}	Not Required	I
Domestic European Rabbit	Eye Irritation	Corrosive	I
Domestic European Rabbit	Dermal Irritation	Corrosive	I
Guinea Pig (*Cavia porcellus*)	Dermal Sensitization	Mild/Moderate	-

a.i. = active ingredient M = male, F = female, - = Does not apply

2.4.3 Subchronic and Chronic Toxicity

USEPA (2018b) waived the DRC-1339 subchronic toxicity study, as well as other chronic toxicity studies, based on a weight of evidence approach that considered use pattern, toxicology and exposure. However, two subchronic toxicity studies were performed in rats using 3-chloro-p-toluidine, the toxic non-protonated parent compound of DRC-1339. A 5-day study in male and female Wistar albino laboratory brown rats exposed to 3-chloro-p-toluidine administered through inhalation at doses of 0.027, 0.105, 0.382, or 1.284 mg/L for 6 hours/day showed no signs of toxicity up to 0.105 mg/L (No Observable Adverse Effects Level (NOAEL)). Clinical signs of toxicity at higher doses included neglected skin and ruffled fur, cyanosis, apathy, and decreased motility (Hazardous Substance Data Bank 2019). Rats in another study were orally dosed for two weeks with 3-chloro-p-toluidine at 300 mg/kg body weight (bw)/day (10% solution in peanut oil), for 5 days/week. The rats were ill and cyanotic after the third and fourth treatments (Hazardous Substance Data Bank 2019).

Long-term exposure to DRC-1339 concentrate may cause an allergic skin reaction (USDA 2019).

2.4.4 Developmental and Reproductive Effects

A literature review did not identify mammalian toxicity studies on reproductive or developmental effects. USEPA (2018b) waived a developmental toxicity study due to the low potential for repeat oral, dermal or inhalation exposure to workers or applicators.

2.4.5 Neurotoxicity Effects

A literature review shows depression of the central nervous system in mammals from exposure to DRC-1339 (Eisemann et al. 2003, Felsenstein et al. 1974, Borison et al. 1975). Although the direct effects on neurological function are unknown, 3-chloro-p-toluidine has been detected in brain tissue and the observed central nervous system effects include intense weakness, dyspnea, and complete paralysis following intraperitoneal administration (Eisemann et al. 2003). Other observed central nervous system effects include centrally induced skeletal muscle relaxation or paralysis, such as loss of the righting reflex in mice and rats (Felsenstein et al. 1974, Borison et al. 1975). USEPA (2013a) initially requested a neurotoxicity screening battery test in its data call-in notice during registration review. However, the USEPA Office of Pesticide Programs subsequently waived the neurotoxicity study in a Hazard and Science Policy Council meeting on August 30, 2012 (USEPA 2014b) and still considers it waived (USEPA 2018b).

2.4.6 Carcinogenicity and Mutagenicity

The USEPA (1995) human health assessment concluded that DRC-1339 is not a carcinogen based on two 78-week exposure studies of the free base (3-chloro-p-toluidine) in rats and mice performed by the National Cancer Institute (1978). The study results found body weight depression without inducing tumors at the highest dose administered (3,269 ppm).

USEPA (1995) also concluded that DRC-1339 is not a mutagen based on the negative results of three mutagenicity assays performed in *Salmonella* spp. strains and Chinese hamster (*Cricetulus griseus*) ovary cells (Stankowski et al. 1997). In the Ames assay with *Salmonella* strains TA1535, TA1537, TA1538, TA98, and TA100, DRC-1339 was negative for inducing reverse gene mutation at the histidine locus at levels up to 2,500 µg/plate with and without metabolic activation. In the Chinese hamster ovary mammalian cell forward gene mutation assay, DRC-1339 was also negative for inducing forward mutation at the hypoxanthine-guanine phosphoribosyltransferase locus with and without metabolic activation to cytotoxic/precipitating doses up to 600 µg/mL. In the chromosomal aberration assay in Chinese hamster ovary cells, DRC-1339 was positive in a dose-related manner for structural aberrations in S9-activated cultures at moderately cytotoxic doses of 250 or 350 µg/mL. However, DRC-1339 was negative without metabolic activation at cytotoxic doses up to 350 µg/mL.

2.4.7 Immunotoxicity Effects

A literature review did not identify any DRC-1339 mammalian immunotoxicity studies. USEPA (2013a) requested an immunotoxicity test (870.7800) in its DCI notice during registration review, but waived the study based on the weight of evidence approach considering all the available hazard and exposure information provided by USDA APHIS in a Hazard and Science Policy Council meeting on December 27, 2014 (USEPA 2014b). The low volume/minor use waiver justification included: 1) the limited time period a mixer, handler, or applicator would be exposed while using DRC-1339; (2) the current worker protection requirements on the

DRC-1339 labels; (3) the limited annual use of DRC-1339; and 4) data from 3-chloro-p-toluidine that can be used to bridge to 3-chloro-p-toluidine hydrochloride.

2.4.8 Endocrine Effects

A literature search did not identify any studies indicating the potential of DRC-1339 to affect the endocrine system. DRC-1339 is not among the group of 99 pesticide active ingredients on the initial and second lists to be screened under the USEPA (2014c) Endocrine Disruptor Screening Program. However, both lists were generated based on exposure potential and not whether the pesticide is a known or likely chemical to disrupt the endocrine system (USEPA 2014c). DRC-1339 is not among the EU (European Union) list of chemicals with the potential to impact the endocrine system (Danish Centre on Endocrine Disrupters 2018). The EU list includes three categories: Category 1 – endocrinal effect recorded at least on one type of animal; Category 2 – a record of biological activity *in vitro* leading to disruption; and Category 3 – not enough evidence or no evidence data to confirm or disconfirm endocrinal effect of tested chemicals (Hrouzková and Matisova 2012).

3 DOSE-RESPONSE ASSESSMENT

3.1 Human Health Dose-Response Assessment

A dose-response assessment evaluates the dose levels (toxicity criteria) for potential human health effects including acute and chronic toxicity. USEPA did not establish an oral reference dose for DRC-1339 because USEPA does not believe that the potential exists for significant exposure to occupational workers. USEPA did not establish a tolerance for DRC-1339 because there are no registered food or feed uses. The maximum contaminant level has not been established for drinking water.

3.2 Ecological Effects Analysis

This section of the risk assessment discusses available ecological effects data for terrestrial and aquatic biota. Available acute and chronic toxicity data are summarized for all major taxa and will be integrated with the exposure analysis section to characterize the risk of DRC-1339 to nontarget wildlife and domestic animals. Information in this section was gathered from on-line databases and searches for relevant peer reviewed and other published literature.

3.2.1 Aquatic Effects Analysis

DRC-1339 is moderately toxic to fish. The 96-hour median lethality concentration (LC_{50}) for bluegill is 11 ppm. The 96-hour LC_{50} for the rainbow trout is 9.7 ppm. The 96-hour LC_{50} for southern leopard frog (*Rana sphenocephala*) tadpoles is 44 mg/L (Marking and Chandler 1981).

DRC-1339 has moderate to high toxicity to aquatic invertebrates depending on the test species (Table 6). The 48-hour median effective concentration (EC_{50}) for the freshwater cladoceran is 0.07 ppm (USEPA 2011a) while marine species appear to be more tolerant with 96-hour LC_{50} values of 10.8 and 16.0 ppm for the penaeid shrimp and blue crab, respectively (Walker et al. 1979) (Table 6).

Table 6. Acute aquatic invertebrate toxicity for DRC-1339 technical.

Test species	Test	Results	Reference
Cladoceran (*Daphnia magna*)	EC_{50}	0.07 mg/L	USEPA 2011a
	LC_{50}	1.6 mg/L	Marking and Chandler 1981
Caddisfly (*Isonychia* sp.)	LC_{50}	6.5 mg/L	Marking and Chandler 1981
Mayfly (*Hydropscyche* sp.)	LC_{50}	12 mg/L	Marking and Chandler 1981
White River Crayfish (*Procambarus acutus acutus*)	LC_{50}	15 mg/L	Marking and Chandler 1981
River Horn Snail (*Oxytrema catenaria*)	LC_{50}	6.7 mg/L	Marking and Chandler 1981
Glass Shrimp (*Palaemetus kadiakensis*)	LC_{50}	6.1 mg/L	Marking and Chandler 1981
Panaeid Shrimp (*Panaeus* sp.)	LC_{50}	10.8 mg/L	Walker et al. 1979
Blue Crab (*Callinectes sapidus*)	LC_{50}	16.0 mg/L	Walker et al. 1979
Asiatic Clam (*Corbicula manilensis*)	LC_{50}	18.0 mg/L	Marking and Chandler 1981

3.2.2 Terrestrial Effects Analysis

Mammals

DRC-1339 appears to have moderate acute toxicity to rats with acute oral LD_{50}'s of 302-350 mg/kg (Table 5). Additional mammalian toxicity data indicate low to moderate acute toxicity for various mammals (Table 7), although DRC-1339 may be more toxic to cats (Felsenstein et al. 1974). In a swine gavage study with DRC-1339, none died and no adverse clinical or histopathological effects were reported when dosed with 50 mg/kg of DRC-1339. Swine were also fed poisoned birds with no reported mortalities or any external clinical effects (Caslick et al. 1972).

Table 7. Acute oral median lethality and subacute dietary DRC-1339 toxicity studies for mammals and birds.

Test species	Test	Results	Reference
Mammals			
Brown Rat (Laboratory)	LD_{50}	302 mg/kg	USEPA 2018a
North American Deermouse	ALD	1,800 mg/kg	Schafer and Bowles 1985
Brown Rat (white lab)	LD_{50}	1,170-1,770 mg/kg	Ford 1967
Domestic Dog ^	LD_{50}	>100 mg/kg	Ford 1967
Domestic Sheep	LD_{50}	>200 mg/kg	Ford 1967
Birds			
Mallard	LD_{50}	105 mg/kg	USEPA 1995
	LC_{50}	322 mg/kg (98% a.i.)	
Chachalaca (*Ortalis* sp.)	LD_{50}	42.1 mg/kg	Eisemann et al. 2003
Northern Bobwhite	LD_{50}	2.9 mg/kg	USEPA 1995
	LC_{50}	14.1 mg/kg (98% a.i.)	
Ring-necked Pheasant	LD_{50}	10 mg/kg	Eisemann et al. 2003
Domestic Turkey	LD_{50}	10.26 mg/kg	Eisemann et al. 2003
Rock pigeon	LD_{50}	17.7 mg/kg	Eisemann et al. 2003
Mourning Dove	LD_{50}	3.2 mg/kg	Eisemann et al. 2003
Herring Gull	LD_{50}	4.6 mg/kg	Eisemann et al. 2003
Cooper's Hawk	LD_{50}	562 mg/kg	Eisemann et al. 2003
Barn Owl	LD_{50}	4.2 mg/kg	Eisemann et al. 2003
Scrub-Jay (*Aphelocoma* sp.)**	LD_{50}	1.8 mg/kg	Eisemann et al. 2003
American Crow	LD_{50}	1.33 mg/kg	Eisemann et al. 2003
Common Raven	LD_{50}	2.9 mg/kg	Eisemann et al. 2003
European Starling	LD_{50}	3.2 mg/kg	Eisemann et al. 2003
House Sparrow	LD_{50}	375 mg/kg	Eisemann et al. 2003
Red-winged Blackbird	LD_{50}	2.4 mg/kg	Eisemann et al. 2003

*ALD – Acute Lethal Dose estimated LD_{50} when unable to calculate ^ Emetic at doses of 10, 50 and 100 mg/kg a.i. = active ingredient

** Species split into 4 species (Island (*Aphelocoma insularis*), California, Florida (*A. coerulescens*), and Woodhouse's (*A. woodhousei*) Scrub-Jays) since Schafer et al. (1983), the data used in Eisemann et al. 2003 (likely California or Woodhouse's, or both, knowing where birds captured).

Birds

A large amount of toxicity data is available for acute exposures to a range of bird species (Table 7). Eisemann et al. (2003) summarized DRC-1339 avian toxicity data for more than 55 species available from published and unpublished sources. Available acute oral dosing studies show high toxicity to corvids, red-winged blackbirds, starlings, gallinaceous birds, doves, herring gulls, and barn owls with LD_{50}'s ranging from 1.33 to 42.1 mg/kg (Table 7). DRC-1339 ranges from slightly to moderately toxic for mallards, house sparrows, and cooper's hawks with LD_{50}'s ranging from 105 to 562 mg/kg (Table 7).

Available acute dermal toxicity testing using birds report an LD_{50} of 14 and 80 mg/kg for the breast and foot respectively, using the European starling (Schafer et al. 1969).

Subacute dietary testing using the northern bobwhite and mallard (Table 7) demonstrated that DRC-1339 is moderately to highly toxic to surrogate bird species representing upland game birds and waterfowl. Both studies were five-day exposures and are part of the USEPA standardized protocols for conducting avian subacute dietary toxicity studies.

Additional dietary toxicity studies have also been conducted with other species and different durations. Eisemann et al. (2003) summarized the available published and unpublished dietary toxicity data for various bird species with similar sensitivities to those reported in acute oral exposures. Schafer et al. (1977) reported 30 and 90-day LC_{50} values of 4.7 and 1.0 ppm, respectively, for European starlings. The same study also reported a 28-day LC_{50} of 18 ppm for the northern bobwhite and a 30-day LC_{50} of less than 100 ppm for rock pigeon. Cummings et al. (2003) exposed savannah sparrows, Canada geese, snow geese, western meadowlarks, mourning doves, and American tree sparrows for five days to dietary DRC-1339 concentrations of 769 ppm. No significant mortalities occurred in Canada geese, snow geese and savannah sparrows, but 80% mortality was observed in American tree sparrows and 90% mortality was observed for mourning doves and western meadowlarks. Cummings et al. (2002) reported no mortalities of wild-caught savannah sparrows, white crowned sparrows, field sparrows, song sparrows, and chipping sparrows offered 2% treated brown rice (714 ppm) over a five-day period.

Additional non-standardized studies evaluating chronic and reproductive effects are also available for various bird species. Schafer et al. (1977) conducted chronic reproduction studies using Japanese quail (*Coturnix japonica*) and domestic pigeons. Reproductive effects were seen at 10 ppm and above for quail including decreased egg and live-chick production, and increased incidence of egg breakage and at 25 ppm for pigeons including increased proportion of infertile eggs; no effects were observed in the first generation offspring for either of these species. Hubbard and Neiger (2003), in a 5-day reproduction study using ring-necked pheasants, dosed females and males three times each with a dose of 2 or 4 mg DRC-1339 and compared reproductive endpoints to a control group found a statistically significant effect on brood size and a non-statistical negative correlation on clutch and brood size with increasing dose.

Reptiles and Terrestrial Phase of Amphibians

DRC-1339 toxicity data for reptiles and the terrestrial phase of amphibians does not appear to be available. In cases where data is lacking, USEPA assumes that avian toxicity data is representative of reptiles. There are uncertainties in this assumption related to differences between the two taxa, but for this risk assessment DRC-1339 is considered moderately to highly toxic to reptiles when considering the range of sensitivities to

surrogate avian species. In the case of terrestrial phase amphibians, DRC-1339 is considered moderately toxic based on the aquatic phase LC_{50} value for the southern leopard frog.

Terrestrial Invertebrates

The acute oral toxicity study of DRC-1339 to the honey bee (*Apis mellifera*) demonstrates very low toxicity with a 48-hr LD_{50} greater than the nominal dose of 72 µg/bee, and a NOEC of 72 µg/bee, the highest concentration tested (USEPA 2018a).

Terrestrial Plants

DRC-1339 phytotoxicity is low based on available limited data with foliar applications to the pinto bean (*Phaseolus vulgaris*) and Douglas fir (*Pseudotsuga menziessi*) reporting no observed effects when treated with a 6% solution of DRC-1339 (Schafer and Bowles 2004).

3.2.3 Toxicity of Formulations and Metabolites to Nontarget Wildlife and Domestic Animals

Available toxicity data for nontarget mammals and birds to the technical DRC-1339 would be similar to the formulations since they are composed primarily of the technical active ingredient (97% a.i.) (Tables 5 and 7). The toxicity of DRC-1339 degradates and metabolites to nontarget species is unknown but is assumed to be similar to the parent for this risk assessment for two of the three metabolites. The three major degradates identified from environmental fate studies include carbon dioxide, 3-hydroxy-p-toluidine, and N-acetyl-3-chloro-p-toluidine. Carbon dioxide and N-acetyl-3-chloro-p-toluidine were measured in the aerobic soil metabolism study and 3-hyroxy-p-toluidine was the primary degradate identified in the aqueous photolysis study (USEPA 2011a).

Peoples (1965) found that starlings primarily excreted one metabolite, 4-amino-3-chlorobenzoic acid, categorized as an irritant and otherwise nontoxic, along with DRC-1339. The majority of excreta (89%) came within the first 2 hours following ingestion, which consisted of 82% 4-amino-3-chlorobenzoic acid and 18% DRC-1339; no DRC-1339 was excreted in four birds after 4 hours following ingestion. Thus, the majority of DRC-1339 is converted to nontoxic metabolites in excreta. The total weight of all excreta prior to death for 8 birds given 1 mg of DRC-1339 orally was the same percentage at 82% 4-amino-3-chlorobenzoic acid (0.64 mg) and 18% DRC-1339 (0.15 mg). Starling digestive systems change seasonally, primarily as the diet changes from invertebrates to plant material, which is typically the beginning of WDM targeting starlings (they really begin flocking as well as consume livestock food). Starling intestines and villi becoming longer and the gizzard gets larger when they change diets (Feare 1984); starlings consume more and thus the rate of food passage though the gut increases (Levey and Karasov 1989). Therefore, it would be expected that DRC-1339 passes with greater potential during this time.

Issues have been raised concerning the risk from birds killed with DRC-1339, exposure of carcasses to people and pets, and the impact of their carcasses on the environment. Birds often die in their nighttime roost. One issue is that birds could die near people's residences, which could be a bother to the property owner and pets. WS personnel try to determine the whereabouts of a roost associated with a project and try to pick up all birds that expire at these roosts. It is possible for birds, though, to leave a treated site and roost at a site not known to WS personnel. This could be at a residence or an area where the public may or may not have access. The primary concern has been the number that could die from a treatment on a property and their potential to be a risk to pets and people from the birds or their excrement. Mammals and birds metabolize or

excrete DRC-1339 within a matter of hours, and known metabolites are nontoxic to birds and mammals (Peoples 1965, Cunningham et al. 1979, Timm 1994). However, some DRC-1339 remains in the excreta from starlings. Species sensitive to DRC-1339 such as crows may be able to get a toxic dose of DRC-1339 from undigested gut contents, but this has only been anecdotally reported for crows (Knittle et al. 1990). Raptors (e.g., Cooper's hawk and American kestrel) fed a diet of birds killed with DRC-1339 for over 100 days were not found to suffer any ill effects and all gained weight (DeCino et al. 1966). WS personnel attempt to find all carcasses associated with a project, especially those associated with public areas. Some projects, especially treatment of ravens, occurs in areas where it is unlikely the public would be exposed and where WS personnel have the lowest potential for knowing where birds are roosting.

3.2.4 Indirect Effects of Carcasses from Control Actions on Wildlife and the Environment

Concerns have been voiced that the birds that die in a nighttime roost over water, such as in a cattail (*Typha* spp.) marsh, could increase the risk of communicable diseases or quicken eutrophication of the wetland. Birds may die and fall into the waters. The risks of these issues are analyzed, but are an indirect effect of the use of DRC-1339 on the environment and not directly related to the chemical analysis. The disease risk or quickened eutrophication would not likely occur from such a possibility, especially as compared to the excrement that would be deposited in those same waters should the birds continue to roost at that location.

4 EXPOSURE ASSESSMENT

4.1 Human Health Exposure Assessment

The exposure analysis evaluates the potential for exposure of humans to DRC-1339. The exposure assessment begins with the use pattern for DRC-1339. An exposure pathway for DRC-1339 includes (1) a release from a DRC-1339 source, (2) an exposure point where human contact can occur, and (3) an exposure route such as ingestion, inhalation, or dermal contact by which contact can occur. Exposures for the identified human populations are evaluated qualitatively for each identified exposure pathway.

4.1.1 Potentially Exposed Human Populations and Complete Exposure Pathways

DRC-1339 is a "*restricted use pesticide*," which currently is limited to use by USDA APHIS certified applicators trained in bird control, or by persons under their direct supervision (USDA 2016a, b, c, d, 2017a, b). DRC-1339 applications are typically conducted on small acreage (~1 acre), and typically occur once or twice before the project is completed (USDA 2011). Prebaiting is required for most uses to ensure that the bait is well accepted and nontarget species are not foraging on the baits. The treated baits are applied via manual or mechanical broadcast applications; manually by placing or dispensing baits into feeding stations or other application sites. The treated bait cannot be applied by air. All DRC-1339 labels are for non-food use only.

Based on the expected use patterns for DRC-1339, WS handlers and applicators (occupational workers) in the program who are mixing and applying the pesticide in the field are the most likely subgroup of the human population to be exposed to DRC-1339. A potential complete direct contact exposure pathway is identified for handlers and applicators with the potential for exposure evaluated in Section 4.1.2.

Exposure by the general public to DRC-1339 is unlikely when applicators follow label requirements concerning application sites, entry restrictions, prebaiting, and post-treatment cleanup requirements. Entry restrictions only allow protected applicators in the area during application. Persons other than authorized

handlers must stay away from the treated area at all times, and pets and livestock kept away from the treated area. Each DRC-1339 use has restrictions on storage, application, and temporary placement of treated bait to locations that are not accessible by children, pets, or domestic animals. Residential use is prohibited and unauthorized persons are restricted from entering application sites during application. Signage may be posted near treatment sites to warn people against handling bait, especially where it would be easily seen, or make owners of pets and possibly livestock from being exposed. During the prebaiting assessment, WS personnel determine which bait is most readily accepted by the target birds and assess the risk to children, livestock, and nontarget species for each potential use site. The prebaiting assessment also ensures that the proper amount of bait is used minimizing potential exposure to humans, domestic animals, and nontarget species. Labels also require observation of bait sites throughout the day when practical. The post-treatment cleanup requirement after application, especially broadcast applications, minimizes the potential for human exposure to uneaten baits. For several days after the baits are applied, applicators are required to search for and remove poisoned bird carcasses from the area to minimize exposure to the general public and nontarget wildlife. For example, the pigeon, gull, and staging area uses require burial of uneaten bait mechanically or manually covering baits to a minimum depth of 2 inches when the application is made to bare ground (USDA 2016c), to areas such as landfills or other non-crop lands (USDA 2016b), or to areas such as stubble fields, harvested dormant hay fields, open grass or bare-ground non-crop areas and roadsides (USDA 2016d, 2017a). The LNFD label (USDA 2016b) requires collecting unconsumed and leftover meat daily, and unconsumed and leftover egg baits, and carcasses within 7 days of treatment.

A complete exposure pathway is not identified for dietary exposure. DRC-1339 labels have no registered food or feed uses. All DRC-1339 uses have restrictions on using the treated baits as food, feed, or in any way used such that they could contaminate food commodities or animal feed. The labels have entry restrictions to keep livestock away from the bait at all times. The staging area use also includes a restriction against grazing animals or growing most crops for 365 days after areas are treated with DRC-1339 (USDA 2016d, 2017a). Other plant back restrictions are 15 days for rice, wheat, corn and barley and 30 days for sunflower and soybeans. The 365-day restriction is USEPA's default value in the absence of specific environmental fate/residue information. To address USEPA's (2011b) consideration of the registered use of DRC-1339 in livestock and poultry feedlots constituting a food use, the feedlot use prohibits placing treated bait in pens that are occupied by livestock (USDA 2017b). The label use restrictions are sufficient to preclude exposure to livestock and poultry.

A complete exposure pathway is not identified for drinking water because of the limited use pattern of DRC-1339, and label restrictions that prohibit placing treated baits near water bodies (within 50 feet of permanent manmade or natural bodies of water). Depending upon the use site, DRC-1339 can be applied by targeted broadcast application techniques, in open bait stations, or in individual meat or egg baits. Bait stations and meat and egg baits significantly reduce the risk of environmental contamination. Broadcast applications occur infrequently to limited areas and are designed so that bait remains on the ground for just a short duration. Bait removal by the target pest further reduces the chance of offsite transport via runoff. In addition, current labeling requires the applicator to retrieve unconsumed toxic bait. Any toxic bait that may be left on the ground after clean up would be minor and expected to degrade quickly in the environment based on the short reported half-lives in soil. The use patterns and environmental fate of DRC-1339 preclude contamination of surface and ground water that could be used for drinking water.

4.1.2 Exposure Evaluation

This section qualitatively evaluates worker exposure from direct contact while mixing DRC-1339 with baits and applying them in the field, as well as re-entering treated sites for post treatment cleanup activities. The Bird Control and LNFD labels are restricted use pesticides and are handled by certified applicators or persons under their direct supervision. As discussed in Section 2.4, DRC-1339 is an acute inhalation toxicant and corrosive to eye and skin. Exposure from inhalation and other direct contact to DRC-1339 for a handler (mixing the concentrate formulations) or an applicator (applying diluted baits) are minimized under normal conditions with proper worker hygiene and the use of personal protective equipment (PPE).

PPE requirements for handlers who mix packages containing 1 lb. or more of the product include:

- Coveralls over long-sleeved shirt and long pants;
- Chemical-resistant gloves;
- Footwear plus socks;
- Protective eyewear (goggles and face shield); and
- Respirator (this may be updated to an organic vapor respirator).

PPE requirements for handlers who mix packages containing less than 1 lb. include:

- Long-sleeved shirt and long pants;
- Chemical resistant gloves; and
- Protective eyewear (goggles or face shield).

PPE requirements for applicators who handle treated bait and for workers who collect carcasses or uneaten bait during post-treatment cleanup include:

- Long-sleeve shirt and long pants;
- Chemical-resistant gloves; and
- Protective eyewear (goggles or face shield).

Other safety requirements for users on the labels include:

- Properly cleaning and maintaining PPE following manufacturer's instructions or using detergent and hot water if no such instructions are provided,
- Washing hands before eating, drinking, chewing gum, using tobacco, or using the toilet;
- Removing clothing immediately if pesticide gets inside, then washing thoroughly and put on clean clothing; and
- Removing PPE immediately after handling the product.

Accidental exposure may occur during mixing and application of baits, but the chance of this type of exposure is low since DRC-1339 use is only allowed by USDA APHIS personnel that are certified applicators or persons under their supervision. The limited use of DRC-1339 reduces the potential for accidental exposure.

4.2 Ecological Exposure Assessment

Various application methods are allowed on the Bird Control label depending on the use site and the pest species. All applications are made by mixing DRC-1339 with a bait that can be applied to the target area. For the purpose of this ecological exposure assessment and the associated risk characterization section, the

broadcast application staging area use was used to estimate aquatic and terrestrial residues. Use rates for staging area applications are higher and allow for broadcast applications over larger areas, and therefore, increase potential for exposure to nontarget aquatic and terrestrial wildlife.

4.2.1 Aquatic Exposure Assessment

Aquatic exposure from proposed DRC-1339 applications is expected to be low based on the method of application, proposed use pattern and mitigation measures to protect aquatic resources. The current use restrictions for the Bird Control and LNF labels require a 50-foot "No-treatment" application buffer from manmade and natural water bodies that will reduce the potential for DRC-1339 to enter water bodies from runoff. Drift is not a potential pathway for exposure since applications are made as a bait and only broadcast in limited applications. No applications are allowed on either label using aerial application equipment, further reducing the potential for any off-site transport.

A very conservative estimate of aquatic residues was made using the maximum application rate from the Bird Control label (0.1 lb. a.i./acre) and assuming that all of the material would be deposited into a static water body. The maximum application rate for the LNFD label is 0.083 lb. a.i. per acre. The water body dimensions evaluated in this assessment were one acre in area and one to six feet deep. The maximum instantaneous DRC-1339 residues from this estimate ranged from 0.006 to 0.035 mg a.i./L. These are conservative estimates of exposure since it assumes all material from a treatment area would be deposited into a water body, assumes no DRC-1339 degradation and does not account for the mitigating effects of the "No treatment" application buffer. The aquatic residue values can be compared to the aquatic effects data for DRC-1339 to determine whether there is any potential for risk under the proposed exposure scenario. The results of this comparison are discussed in more detail in the aquatic risk characterization section of this risk assessment.

4.2.2 Terrestrial Exposure Assessment

Exposure estimates for nontarget birds and mammals were made using the USEPA (2012b) terrestrial exposure model, T-REX (Terrestrial Residue Exposure Model). The model allows the user to input pesticide use and environmental fate data as well as effects data for birds and mammals that can be used as a deterministic estimator of risk by deriving risk quotients. The model can be used for liquid pesticide applications as well as granular and treated seed applications. The LD_{50} per square foot method was used in this assessment to determine potential risk to nontarget birds and mammals since it's applicable for broadcast uses of treated seeds, or baits such as DRC-1339. The use of the LD_{50} per square foot does not have any ecological relevance since nontarget animals may forage over larger areas but it does provide a means to quantify risk with the assumption that risk increases as the number of LD_{50}s per square foot increases. This method is commonly used for granular pesticide applications. The staging area maximum labeled broadcast treatment (0.1 lb. a.i./acre) was used to develop exposure residues that could be compared to mammal and bird effects data for DRC-1339 and then used to extrapolate the risk for various sized birds and mammals. USEPA (2018a) estimated DRC-1339 residues for various bait types that may be applied using trays, bait stations, or feeding stations and can result in the concentration of treated bait to smaller areas than what would occur using broadcast applications. DRC-1339 exposure residues were estimated for various-sized birds and mammals similar to those used in estimating DRC-1339 exposures using broadcast treatments. Concentrations of DRC-1339 in the final bait mixture ranged from 680 ppm in whole raisins, culled French fries, and waste potatoes, to 2000 ppm in high nutrition animal feed. These estimates were used to estimate doses for various sized mammals and birds that could then be compared to weight-adjusted median lethality values.

4.2.3 Assessment of Indirect Effects of Carcasses from Control Actions on Wildlife and the Environment

A few potential issues could arise from the bird carcasses resulting from a control action using DRC-1339. In particular, it has been postulated that outbreaks of two avian diseases, botulism and cholera, could increase where birds fall into wetlands. There is also the potential for accelerated eutrophication of wetlands to result from the bird carcasses adding to nutrient deposits.

Disease

Avian Botulism. Avian botulism is a paralytic disease of birds that occurs when toxins produced by the bacterium *Clostridium botulinum* are ingested (Locke and Friend 1987, Rocke and Bollinger 2007). Seven distinct types of botulism toxins, designated by the letters A through G, have been identified. Type C and E toxins usually cause waterfowl die-offs from botulism (Locke and Friend 1987). Many species of birds and some mammals are affected by Type C and E botulism in the wild. Waterfowl, shorebirds, and gulls are commonly affected and songbirds are only infrequently affected (Locke and Friend 1987).

Botulism bacteria are common in the soil of both terrestrial and aquatic environments, but the bacteria will only produce toxin under certain environmental conditions that favor bacterial growth, such as times of the year with higher ambient temperatures (above 77˚F), low water levels, the presence of rotting vegetation and invertebrate and vertebrate carcasses, high fly[7] (e.g., Order Diptera family Muscidae (housefly and allies, house flies, populations, and areas with no oxygen (Rosen 1971, Locke and Friend 1987). Most botulism outbreaks occur during late summer from July through September. Aquatic invertebrates ingest *C. botulinum* when feeding on sediment, and many die during the summer because of high water temperatures and low water levels. The bacteria within the invertebrates produce the toxin as the invertebrates decay, and fish, waterfowl, and other birds become intoxicated when they consume the dead invertebrates (Reed and Rocke 1992). The affected fish and birds then die and maggots feeding on the carcasses pick up the toxin. These maggots are then eaten by other birds, which become sick, and the cycle continues. Large-scale bird die-offs occur as a result of this toxin amplification. This mode of transmission is common with type C botulism in the western United States, but the maggot-carcass cycle also occurs with type E botulism outbreaks in the Great Lakes. *C. botulinum* bacterium persists in wetlands in a spore form that can persist for many seasons since it is resistant to heat and drying (Locke and Friend 1987).

Management of the environmental conditions in wetlands, especially water levels, and early and continuous clean-up and incineration of botulism-killed waterfowl carcasses, is recommended to prevent or control avian botulism outbreaks (Locke and Friend 1987). In addition, the occurrence of carcass-maggot cycles of botulism is dependent on a number of factors in addition to the presence of carcasses with botulism spores. These factors include fly density, and environmental conditions that facilitate fly egg-laying, maggot development, and maggot dispersal from carcasses (Reed and Rocke 1992).

Control of birds with DRC-1339 is unlikely to cause or enhance a botulism outbreak. First, control operations would occur when botulism infected material is not present (late fall to early spring), but possibly could be exposed to some in drinking water. Thus, it is unlikely most birds would contribute to the maggot-bird transmission cycle since maggots should be unaffected. Secondly, most projects, especially projects that

[7] Insects in the Order Diptera including the families Muscidae – houseflies and allies such as the housefly (*Musca domestica*) and Tabanidae – predatory flies like deer fly (*Chrysops* spp.).

involve hundreds of birds, are conducted by WS from late fall through spring (December to March) when birds congregate. The carcasses would decompose by early summer, prior to when an outbreak would likely occur. Therefore, no evidence exists to suggest that the bird carcasses themselves could initiate rapid bacterial growth and amplification of bird-maggot transmission. Thus, it is unlikely that increased risk of avian botulism would result from bird carcasses killed by DRC-1339 that fell into a wetland.

Avian Cholera. Avian cholera, *Pasteurella multocida*, is a contagious, bacterial disease that most species of birds and mammals worldwide can contract, and particularly virulent strains are usually fatal (Friend 1999, Samuel et al. 2007, Merck 2018b). Avian cholera commonly occurs in waterfowl, with major die-offs occurring almost annually, whereas, it occurs less frequently with only occasional die-offs in coots and scavenging gulls and crows. There are only a small number of reports in shorebirds, cranes and songbirds as well as domestic fowl, and these are usually not associated with wild waterfowl outbreaks. Die-offs from avian cholera can occur any time of year, but predictable seasonal patterns exist, primarily in fall and winter, in areas where avian cholera has become well established in wild waterfowl, such as waterfowl movement corridors west of the Mississippi River. Transmission occurs from direct bird-to-bird contact, by ingestion of contaminated food or water, and possibly by aerosols. Transmission is enhanced by the gregarious nature of most waterfowl species and by dense concentrations of migratory water birds. The bacteria can persist in water for several weeks, in soil for up to 4 months, and in decaying bird carcasses for at least 3 months. Acute infections in birds can result in rapid death 6 to 12 hours after exposure, and birds have been known to fall from the sky due to the rapid onset. Therefore, early detection of outbreaks is crucial in stopping the disease. Rigorous and careful collection, removal, and incineration of waterfowl carcasses is recommended to control the outbreaks and to reduce exposure of scavenging birds.

Studies found that while *P. multocida* bacteria can be detected in water and soil samples from wetlands immediately after an outbreak (Moore et al. 1998), wetlands are probably not an important reservoir for maintaining the bacteria (Lehr et al. 1998). Starlings and blackbirds are susceptible to *P. multocida*, but little evidence has been found to suggest they are involved in many avian cholera outbreaks. The primary concern is blackbirds that roost in cattail marshes, especially during migration. The risk of exposing waterfowl to avian cholera from the presence of blackbird carcasses in the dense cattail marsh habitat where most are likely to occur is considered low.

Potential to Cause Accelerated Eutrophication of Wetland Areas

A concern has been raised that carcasses of birds killed by DRC-1339 might significantly increase nutrients in cattail marsh roosting areas, resulting in accelerated eutrophication. Eutrophication is an ecosystem's response to the addition of artificial or natural nutrients, mainly phosphates, to an aquatic system. The increased key nutrients, phosphorous (P), potassium (K), nitrogen (N), and carbon (C), increase plant production, which leads to increased decomposition of organic material that often reduces or depletes oxygen content in the water (Cole 1975). Less oxygen can reduce or eliminate certain species and the increased biomass can reduce the size of wetlands. The delayed mode of action of DRC-1339 is such that most birds would not become lethargic and die until they were in their nighttime roosts. If birds died in nighttime roosts, they would be an additional source of nutrients introduced into an aquatic system. To make a comparison, blackbirds and starlings deposit large quantities of fecal material into nighttime roost sites and would continue to roost and deposit fecal material into cattail marsh roosts for the entire winter roosting period. Therefore, this analysis looks at a comparison between the amount of nutrients that would be deposited by bird carcasses and the amount of nutrients from the bird droppings that would continue to be deposited into the winter wetland roost.

Most DRC-1339 blackbird projects are conducted from October to March. From FY11 to FY15, the most starlings taken in a single project was an estimated 152,000 in FY12 in Washington. The most red-winged blackbirds and brown-headed cowbirds taken in one project, respectively, was 67,000 in Texas and 65,000 in Louisiana, both in FY11. Of these species, red-winged blackbirds are the most likely species to be found roosting above wetlands, typically cattail marshes (Yasukawa and Searcy 1995), whereas starlings (Cabe 1993) and brown-headed cowbirds (Lowther 1993) prefer evergreen thickets and trees, but can sometimes be found in cattails. However, in order to assess the risk of wetland eutrophication from bird carcasses, we assumed all birds die and fall into a wetland.

The average weight of starlings, red-winged blackbirds, and brown-headed cowbirds (assuming equal male/female ratios) is 87 g (Blem 1981), 49 g (Hayes and Caslick 1984), and 42 g (Lowther 1993), respectively (Table 8). The lean dry weight (excluding the weight of water and fat) of starlings is about 38% of the whole weight (calculated from data in Blem 1981[8]). No data was found for red-winged blackbirds or brown-headed cowbirds. Using the 38% value for all three species, gives a lean dry weight of 33 g for starlings, 19 g for red-winged blackbirds, and 16 g for brown-headed cowbirds (Table 8). The amount of P, K, and N was estimated to be 1.3%, 0.7%, and 14%, respectively, of the lean dry mass. With these assumptions, Table 8 estimates the weights for birds and nutrients of concern added to a wetland.

On the other hand, nightly droppings into the wetland would continue if birds were not taken with DRC-1339. Fecal output, feces, urates and urine, is highly variable depending on the species and the extent of wetland water conservation needed by that species (e.g., arid vs. wet habitats). Daily fecal output varied significantly for starlings depending on the type of food eaten (animal *vs* plant matter (poultry pellets) or 3.5 g/day *vs* 14.7 g/day) (Taitt 1973); animal matter is typically selected if available, but starlings commonly feed on the pelletized grain at confined animal feeding operations. For this analysis, we will assume a starling's fecal output is an average from these two food sources, about 9 g/day, which would be appropriate for the winter months when most control actions occur. Starlings tend to rely more on plant matter intake than animal matter (fewer invertebrates are available in frozen ground and snow) during the winter months when most control actions occur. Additionally, we will consider the nightly fecal output to be half the daily output, about 4.5 g/starling, since that is the portion that would go into the wetland and use the same percentages for red-winged blackbirds and brown-headed cowbirds (Table 8). The dry matter of excreta was found to be an average of 0.73 g for females and male red-winged blackbirds (Hayes and Caslick 1985). This would be about 29% of their nightly output. Using this same percentage for dry fecal matter nightly output, starlings and cowbirds would excrete 1.31 g and 0.64 g. The amount of P, K, and N was estimated to be 1.3%, 0.7%, and 14% of the lean dry mass (Hayes and Caslick 1984, Chilgren 1977, 1985). Table 8 provides estimates of weights of carcasses and nutrients added to wetlands. Considering the estimated weights provided in Table 8, it would take less than a month of roosting for droppings to surpass the weights from bird carcasses in all categories except N, which would take about 39 days. Assuming that birds are on their nightly winter roosts for close to six months of the year (mid-October to mid-April) and that control actions, which occur mostly from mid-November to mid-March (Sept.-April), likely prevent about half the droppings or 3 months (90 nights) accumulation, the dry waste from carcasses would be less than the dry weight of droppings added to the wetland had the control action not occurred. This means that accelerated eutrophication would not be expected to occur from bird damage management activities.

[8] The lean dry weight divided by the overall weight minus weight of lipids (weight without water and fat)

Table 8. Amount of nutrients from bird carcasses and nightly fecal output potentially deposited into wetlands from birds controlled with DRC-1339.

Test Species	European Starling		Red-winged Blackbird		Brown-headed Cowbird	
Nutrient	Bird	Feces	Bird	Feces	Bird	Feces
	Statistics for Individual Birds or Nightly Fecal Output (grams)					
Ave. Wt. (male & female)/50% for feces/night	87	4.5[1]	49	2.5	42	2.2
Total Dry Weight (50% for feces/night)	33[2]	1.31	19	0.73[3]	16	0.64
Dry Weight Phosphorous (1.3%/1.5%)	0.429[4]	0.020	0.247	0.011[3]	0.208	0.010
Dry Weight Potassium (0.7%/1.4%))	0.231[4]	0.018	0.133	0.010[3]	0.133	0.009
Dry Weight Nitrogen (14%/9.2%)	4.62	0.121	2.66	0.067[3]	2.24	0.059
	Statistics for Maximum Single Project Take FY11-FY15 (kilograms)					
Highest WS Project Take (FY11-FY15)	152,000		67,000		65,000	
Project Weight of Birds/Wet Excreta	13,224	686	3,283	168	2,730	143
Project Dry Weight of Birds/Excreta	5,016	199	1,273	49	1,040	42
Total Dry Weight Phosphorous	65	3.0	16	0.75	13	0.65
Total Dry Weight Potassium	35	2.7	8.9	0.68	8.6	0.59
Total Dry Weight Nitrogen	702	18	178	4.5	146	3.8

[1] from Taitt 1973 [2] from Blem 1981 [3] from Hayes and Caslick 1984 [4] from Chilgren 1977, 1985/Murphy and King 1982

5 RISK CHARACTERIZATION

5.1 Human Health Risks

Risks associated with adverse human health are characterized qualitatively in this section. Under the existing WS uses, DRC-1339 baits to control bird populations should pose minimal risks to human health.

Adherence to label requirements regarding PPE minimizes risk to WS workers who mix and apply DRC-1339. Although DRC-1339 is a hazard to humans due to its acute toxicity via the inhalation, ingestion, ocular and dermal routes, the low potential for exposure to DRC-1339 when following label requirements during mixing and application suggests adverse health risks to workers are not expected. Any exposure and risk would be short term based on the methods for baiting and the low frequency of use for DRC-1339 by WS. Since 1987 when USDA APHIS started to record worker chemical exposures, no known cases of DRC-1339 exposure to WS personnel or the public have occurred. Exposure of the general public to DRC-1339 is not anticipated based on the limited use pattern (e.g. entry restriction, non-residential use, prebaiting assessment, and often observing baits throughout the day), and the post-treatment cleanup requirements (e.g. remove unconsumed or spilled baits and collect dying or dead birds for proper disposal). Therefore, adverse health risk to the general public is not expected which is supported by the lack of adverse incidents that have been reported to date.

5.2 Ecological Risks

5.2.1 Aquatic

The risk to aquatic organisms from the use of DRC-1339 is minimal. The method of application, label requirements for removal of unused bait and carcasses, and “No treatment” buffers adjacent to aquatic habitats results in a low potential for exposure and risk. A comparison of the available effects data for aquatic vertebrates and invertebrates to the estimated acute aquatic residues in static water bodies show wide margins of safety for aquatic organisms (Figure 1).

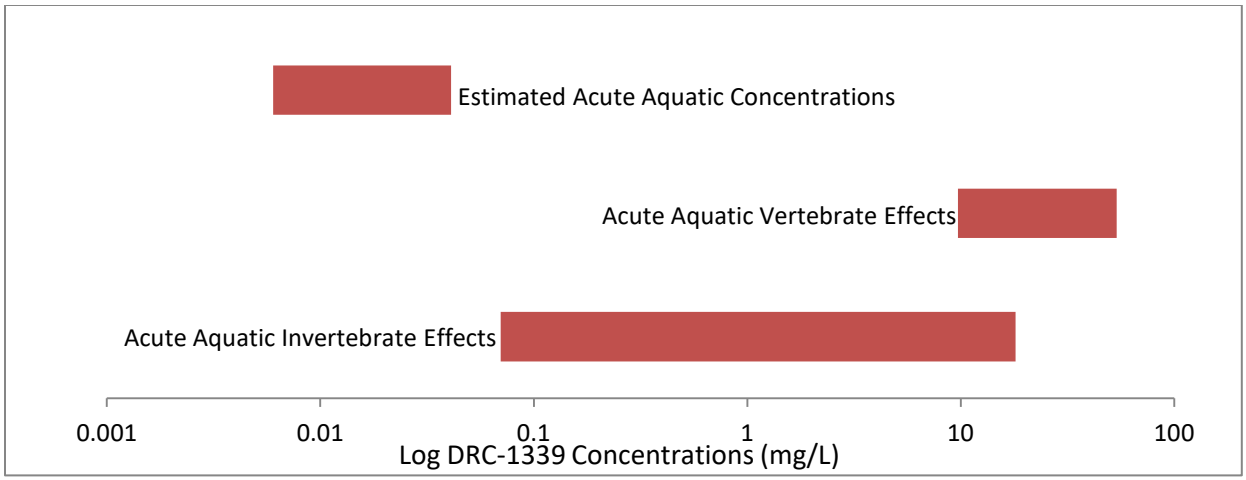

Figure 1. Aquatic risk characterization for DRC-1339.

Chronic effects data for aquatic invertebrates and vertebrates is not available, but the method of application for DRC-1339, collecting unused bait, and no treatment application buffers from aquatic water bodies, in addition to a short half-life in the environment would suggest that chronic risk would be negligible.

5.2.2 Terrestrial Wildlife and Domestic Animals

The risk of DRC-1339 use to domestic animals such as pets and livestock will likely be low. DRC-1339 has moderate toxicity to most mammals, but in the case of pets and livestock, the label provides use restrictions on storing, temporarily placing, and entry into treated areas to preclude harm to most domestic animals. Even under the highest precautions, free-roaming domestic pets and feral animals such as dogs and cats may access treated areas, but monitoring sites during prebaiting and baiting with DRC-1339 should reduce exposure.

The LD_{50} per square foot method was used to determine whether food consumption rates for various sized nontarget wild mammals would exceed median lethality values for DRC-1339 using broadcast applications. Risk quotient values for various sized mammals ranged from less than 0.01 for a 1000 g mammal to 0.10 for a 15 g mammal. Eisemann et al. (2001) reported risk quotient values of 0.01 and <0.01 for 30 and 300 g mammals, respectively, using the LD_{50} per square foot method. USEPA (2004, 2017c) has established levels of concern (LOC) above which there is a presumption of risk for nontarget organisms when a risk quotient is exceeded. The acute high risk LOC is 0.50, thus the acute risk of DRC-1339 exposure to wild mammals is presumed to be low for broadcast applications. DRC-1339 is more typically applied using various bait matrices in bait stations and trays. Risks may be higher for mammals under conditions where highly palatable baits are applied in small piles in bait trays concentrating the quantity of DRC-1339 that could be rapidly consumed by nontarget animals. USEPA (2018a) estimated risk quotient values exceeded the acute high risk LOC for small (15g) and medium-sized (35g) mammals exposed to DRC-1339 baits using seeds (corn, barley, distillers grain, milo, lentils and peast), dry pet food, culled French fries, waste potatoes, and high nutrition animal feed. Risk quotient values ranged from 0.10 for large mammals (1000 g) consuming DRC-1339-treated whole raisins to 0.63 for small mammals consuming the above mentioned baits. Risks from these types of applications are higher than those estimated using the LD_{50} per square foot method but provide a more representative estimate of risk since bait applications typically employ non-broadcast methods of application, concentrating DRC-1339-treated bait to smaller areas using bait stations or trays.

The risk to nontarget birds in broadcast applications is higher compared to mammals due to the higher toxicity of DRC-1339 to most bird species. Using the LD_{50} per square foot approach risk quotient values exceed the LOC of 0.50 for different sized birds using the USEPA T-REX model under broadcast applications. Risk quotient values for a 20, 100 and 1000 g bird were 24.92, 3.92 and 0.28, respectively. These values exceed the LOC for acute high risk suggesting acute risk to nontarget birds. Similar risk quotient values have been estimated for various bird species using the LD_{50} per square foot method (Eisemann et al. 2001). Risk quotient values ranged from 70.3 for the red-winged blackbird to 0.39 for the mallard suggesting acute risk to avian species. USEPA (2018a) estimated risk quotient values that exceeded the acute high risk LOC for all birds sizes (10, 100 and 1000 g), and for all bait types, suggesting acute high risk for all birds that consume treated bait regardless of the type of bait used. Risk quotient values ranged from 12 for large birds (1000 g) consuming DRC-1339-treated raisins to 240 for small birds (10 g) consuming DRC-1339-treated seeds, dry pet food and high nutrition animal feed. Similar to mammals, risks quotient values are higher for birds under use conditions where highly palatable baits are applied using bait trays or stations that result in high concentrations of DRC-1339 in small areas. Linder et al. (2004) estimated risk quotient values for various bird species using bird toxicity data and food ingestion rates to demonstrate acute risk was higher for smaller sized granivorous birds when compared to larger bodied nontarget birds such as the bobwhite and mallard. These estimates assume birds will consume only toxic bait and does not account for dilution of bait with nontoxic bait, which is true of most bait formulations. Nontarget birds that feed on treated bait used in bait stations, trays or broadcast applications are at risk of acute lethal and sublethal effects due to their sensitivity to DRC-1339 and methods of application that can concentrate DRC-1339 in small areas.

The acute risk to nontarget birds and mammals under field use can be reduced depending on the application method, removal of bait by the target species, and other measures, some of which are stated on the DRC-1339 labels. Broadcast label applications allow for individual rates up to 0.1 lb. a.i./acre and a seasonal maximum of 0.5 lb. a.i./acre, but typical application rates are lower. An assessment of use rates in Louisiana rice fields reported typical single application rates of 0.04 lb. a.i./acre with a seasonal maximum of 0.24 lb. a.i./acre. In addition, applications are not made to an entire field but are made to a small area within a field. The area where bait applications are made typically range from 0.5 to 1.0 acre in size with a swath width of no greater than 50 feet. Prebaiting reduces the risk to nontarget wildlife by increasing target species acceptance of the bait and ensures that nontarget species are not feeding on the bait. O'Hare (2013) reported that within the first 12 hours of application greater than 90% of the treated bait was removed in 75-95% of the baiting projects in rice fields in Texas and Louisiana. In addition, the average number of days spent prebaiting was 5.4 to 11 days compared to 1 to 3.5 days for toxic bait suggesting risk to nontarget birds and mammals is short term. The lower application rate, area of treatment, and bait removal efficiency by the target species lowers the risk to nontarget mammals and birds.

Additionally, several label requirements reduce the risk of DRC-1339 to nontarget terrestrial vertebrates and include:

- DO NOT apply toxic baits in locations where nontoxic prebait has not been accepted well by target species or where nontarget wildlife have been observed to feed on prebait.
- DO NOT store toxic baits in locations accessible to children, pets, domestic animals, or nontarget wildlife.
- DO NOT apply in areas where toxic baits may be consumed by Threatened or Endangered Species.
- DO NOT apply toxic baits made from this product by air.
- The applicator must remove all unconsumed, regurgitated, or spilled toxic bait, and as much of the broadcast toxic bait as possible at the conclusion of the treatment period.
- For broadcast applications made to areas such as stubble fields, harvested dormant hay fields, open grassy or bare-ground noncrop areas and roadsides, bury uneaten toxic bait via mechanical (e.g., discing under) methods

or to a minimum depth of 2 inches (5.08 cm) if manual (e.g., shoveling under) methods are used, as appropriate.

- Change prebaiting locations and nontoxic bait material if necessary to achieve good acceptance by target species or if nontarget species have been observed eating the prebait.

The Bird Control and LNFD labels also contain additional use specific information designed to reduce the exposure of DRC-1339 to nontarget wildlife. These label requirements and other measures collectively reduce the risk to nontarget wildlife, in particular, mammals and birds that may forage on treated seed, dog food, cull French fries, meat, and egg baits. Measures such as prebaiting small plots that are placed away from field edges where other bird species frequent can reduce nontarget effects in broadcast applications of DRC-1339 (Knittle et al 1980, Linz et al 2002). Prebaiting also allows observation of nontarget use where locations can be changed in the event of unacceptable nontarget use. Additionally, diluting bait with nontoxic rice or other nontoxic bait materials will reduce risk to nontarget birds that are less sensitive to the effects of DRC-1339 compared to the target species (Avery et al. 1998, Boyd and Hall 1987, Eisemann et al. 2001, Linz et al. 2002, Linz et al. 2004). Cummings et al. (2002) observed nontarget avian species in Louisiana DRC-1339 treated fields, but the number of species was low and was related to the location of the bait sites, feeding activity of blackbirds and bait availability that was designed to maximize blackbird use. Similar results have been observed in other applications (Knittle et al. 1980). The target bird species dominated the treatment areas reducing the potential for exposure to nontarget birds. In cases where applications are made in the spring, baiting can be made prior to the arrival of spring migrants reducing risk to nontarget bird species (Eisemann et al. 2001).

For treated rice applications, risk is greatest to those nontarget bird species that have been observed at feeding sites, are granivorous, and are sensitive to DRC-1339 broadcast treated rice baits. Ringed-necked pheasants, mourning doves, and northern bobwhite are examples of granivorous bird species that have been observed at baiting sites and are sensitive to DRC-1339 (Pipas et al. 2003). Various sparrow species have also been observed at baiting sites, but most appear to have moderate sensitivity to DRC-1339 based on acute oral toxicity data (LD_{50} = 100-400 mg/kg) (Eisemann et al. 2001) and would have to consume larger quantities of the diluted toxic bait than the more sensitive target species. Measures such as those discussed above will reduce the potential impacts to these nontarget species. Avery et al. (1998) suggested that risk will be reduced for ringed-necked pheasants in field applications of DRC-1339 to control blackbirds in sunflower fields when bait dilution is implemented. Acute risk is minimized, but chronic risk may occur in areas where pheasants receive sublethal doses and access other fields.

Other methods to reduce nontarget bird impacts include the use of traps that are specific to the target species that contain treated bait. Glahn et al. (1997) reported no nontarget impacts when using DRC-1339 to control boat-tailed grackles in citrus orchards. DRC-1339 treated watermelon was placed in cage traps that resulted in the control of grackles with no observed nontarget impacts.

The low risk to most nontarget species has been validated by field data where little to no nontarget carcasses have been observed or collected during and after baiting (Smith 1999, Cummings et al. 2002). There is some uncertainty with these results since time to death can be multiple days and locating poisoned carcasses or observing sick birds and mammals can be impacted by several factors (Vyas 1999). Acute risks to birds have been demonstrated in field applications with nine avian incidents reported to USEPA (USEPA 2018a). This is a relatively low number but supports the potential for effects to sensitive avian species. WS field personnel record nontarget species take and collect this information during and after baiting operations. From FY11-FY15, WS took an annual average of 244 nontarget birds including feral pigeons and brown-headed cowbirds,

which were being targeted with other methods where they were taken, and American crows and common ravens (Table 2). This was minimal in comparison to take (see Section 1.1).

Secondary poisoning risks are expected to be low based on the rapid metabolism of DRC-1339 in birds and low residues that have been observed post treatment. Approximately 90% or more of DRC-1339 is metabolized and excreted in animals within 2 hours after ingestion (USDA 2001, Cunningham et al. 1979). Goldade et al. (2004) reported that a rapid elimination phase occurred between 0 to 4 hours with an average half-life of 0.16 hours for juncos and 0.62 hours for blackbirds. A slower elimination phase followed with an average of 3.4 hours for juncos and 5.4 hours for blackbirds. At four hours post dosing approximately 91 and 85% of the parent compound had been excreted for the junco and blackbird, respectively. Residues in various organs for both birds were measured over a 24-hour period with residues highest in the kidneys. Residues as a percentage of the initial dose were low for all organs and tissues 24 hours post-dosing with values ranging from less than 0.01 to 2.20%. These values suggest that any secondary poisoning risks would be short term due to the lack of significant residues in any carcasses. Johnston et al. (1999) demonstrated the low potential for secondary poisoning in various avian and mammalian scavengers and predators based on measured residues in boat-tailed grackles. Residues were compared to available acute oral toxicity data and daily food consumption rates for various species with resulting risk quotients ranging from 0.034 for the barn owl to 0.00057 for the domestic dog. Kostecke et al. (2001) documented potential avian and mammalian scavengers of bird carcasses in South Dakota and determined that secondary poisoning risks for most scavengers and predators is low based on the species identified and their low sensitivity to the effects of DRC-1339. Cunningham et al. (1979) estimated that most scavengers and predators would have to consume two to three times their daily food consumption rates to exceed a lethal dose based on DRC-1339 residues measured in starlings. This type of risk would be low due to the method of application and label requirements to collect and remove bird carcasses during and after the baiting operation. There is the possibility of exposure from feeding on target bird species that receive a sublethal dose of DRC-1339. This type of risk could occur for species that are sensitive to DRC-1339 and feed solely on DRC-1339 exposed birds for greater than 30 days (Cunningham et al. 1979). The use pattern and metabolism of DRC-1339 makes this type of risk negligible.

5.2.3 Terrestrial Invertebrates and Plants

The risk of DRC-1339 use to terrestrial invertebrates and plants is negligible. Available data show low toxicity to both taxa and the methods of application for DRC-1339 suggest that potential exposure would also be low, resulting in a low probability of risk to either group. Some invertebrates may be attracted to the various baits that can be used with DRC-1339, but any impact to sensitive invertebrates would be localized to bait that is not readily consumed by the target species.

5.2.4 Indirect Effects of Carcasses from a Control Action on Nontarget Wildlife and the Environment

Our risk assessment indicated that even if all bird carcasses from the largest control actions between FY11 and FY15 were to fall into a single wetland, an increased risk of avian botulism and cholera would not be expected and the rate of eutrophication would not change.

6 UNCERTAINTIES AND CUMULATIVE IMPACTS

The uncertainties associated with this risk assessment arise primarily from lack of information about the effects of DRC-1339, its formulations, metabolites, and potential mixtures to nontarget organisms that can

occur in the environment. These uncertainties are not unique to this assessment but are consistent with uncertainties in human health and ecological risk assessments with any environmental stressor.

Another area of potential uncertainty in this risk assessment is the potential for cumulative impacts to human health and the environment from the proposed use of DRC-1339. The potential for cumulative impacts is expected to be low based on the low volume and minor use of DRC-1339 in the various APHIS uses. WS used an annual average of 77.4 pounds of DRC-1339 from FY11 to FY15 nationwide in 38 states, which is very minimal. Areas where cumulative impacts may occur include: 1) repeated worker and environmental exposures to DRC-1339 from program activities, and other sources; 2) exposure to other chemicals with a similar mode of action; and 3) exposure to other chemicals affecting the toxicity of DRC-1339.

Repeated exposures that could lead to significant risk from DRC-1339 are not expected due to label requirements that prevent significant exposure. An accidental exposure may occur from improper use of PPE but the potential for this to happen is unlikely because DRC-1339 products are used only by USDA APHIS certified applicators or those under their direct supervision.

Cumulative impacts may occur from DRC-1339 use in relation to other chemicals that have a similar mode of action, as well as others that have a different mode of action but could result in synergistic, additive or antagonistic effects. This is an area of uncertainty since its unknown what other stressors, including chemicals, humans and nontarget wildlife may be exposed to during a DRC-1339 application.

From a human health perspective, the WS low volume and minor use of DRC-1339 is expected to result in negligible cumulative impacts, as well as the potential for cumulative impacts from exposure to other chemicals. DRC-1339 is not registered for food use and is unlikely to impact surface or ground water so risks are negligible for the public. The lack of exposure and risk to the public suggests that cumulative impacts would also be incrementally negligible when factoring in other stressors.

Cumulative impacts to ecological resources are also expected to be incrementally negligible. Risks to aquatic resources and most terrestrial nontarget wildlife is low due to lack of toxicity and significant exposure. There is risk to some sensitive terrestrial vertebrates, including the target species; however, the potential cumulative impacts are expected to be minor for most species. The potential for cumulative impacts from the effects of DRC-1339 to terrestrial vertebrates will be greatest for those species that have low numbers, small home ranges, are sensitive to DRC-1339 and attracted to treated bait. Sensitive terrestrial vertebrates that may be impacted by the use of DRC-1339 and observed at baiting sites typically have wide geographic distributions and home ranges suggesting any potential cumulative impacts from the use of DRC-1339 relative to other stressors would be negligible.

7 SUMMARY

WS uses DRC-1339 to manage several bird species that damage a variety of agricultural and non-agricultural resources. For more than 50 years, DRC-1339 has proven to be an effective method of starling, pigeon, blackbird, corvid, and gull damage management. DRC-1339 is a slow acting avicide that is metabolized or excreted in birds and mammals within a matter of hours. DRC-1339 poses little risk of secondary poisoning to nontarget animals, including avian scavengers. DRC-1339 poses no risk to aquatic nontarget wildlife. Nontarget birds and mammals that are sensitive to DRC-1339 may be at risk to DRC-1339, but this risk can be reduced through label language designed to reduce exposure. Risks to pollinators and terrestrial plants is negligible based on the use pattern of DRC-1339 and available limited effects data. The WS use pattern,

application rates that are mostly on private lands, results in negligible risk for the public. Dietary risk from DRC-1339 exposure to the public is low since the avicide has no registered food uses and does not pose a threat to drinking water. The risk to WS applicators is also low because they receive training in the product's use, are certified by the State to use restricted use pesticides, and follow label instructions, including the use of appropriate PPE. The release of DRC-1339 into the environment is expected to have no or negligible cumulative impacts to nontarget species, the public, and the environment.

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9 PREPARERS: WRITERS, EDITORS, AND REVIEWERS

9.1 APHIS WS Methods Risk Assessment Committee

Writers for "Use of DRC-1339 in Wildlife Damage Management Risk Assessment":

Writer/Editor: Thomas C. Hall
Position: USDA-APHIS-WS, Operational Support Staff, Staff Wildlife Biologist, Fort Collins, CO
Education: BS Biology (Natural History) and BA Psychology – Fort Lewis College; MS Wildlife Ecology – Oklahoma State University
Experience: Special expertise in wildlife biology, identification, ecology, and damage management. Thirty-four years of service in APHIS Wildlife Services including operations and research in CO for research and OR, GU, CA, OK, and NV for operations conducting a wide variety of programs including bird damage research and management, livestock protection (predators and birds), invasive species management, wildlife hazard management at airports, property and natural resource protection including waterfowl, brown tree snake, feral swine, rodent, and beaver damage management. Applied and supervised the use of DRC-1339.

Primary Writer: Fan Wang-Cahill
Position: USDA-APHIS-Policy and Program Development (PPD), Environmental and Risk Analysis Services (ERAS), Environmental Health Specialist, Riverdale, MD
Education: B.S. Biology and M.S. Hydrobiology - Jinan University, Guangzhou, China; Ph.D. Botany (Ultrastructure/Cell Biology) – Miami University
Experience: Joined APHIS in 2012, preparing human health risk assessments and providing assistance on environmental compliance. Prior experience before joining APHIS includes 18 years environmental consulting experience specializing in human health risk assessments for environmental contaminants at Superfund, Resource Conservation and Recovery Act (RCRA), and state-regulated contaminated facilities.

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Education: B.S. Forest Ecology and M.S. Entomology – University of Missouri; Ph.D. Environmental Toxicology – Clemson University
Experience: Thirteen years of experience working for APHIS preparing ecological risk assessments and providing assistance on environmental compliance. Prior experience before joining APHIS includes other government and private sector work regarding ecological risk assessments related to various environmental regulations.

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Experience: Eight years of experience in preparing environmental analyses in compliance with the National Environmental Policy Act. Three years of service in APHIS conducting risk analysis.

Editor: Andrea Lemay
Position: USDA-APHIS-Policy and Program Development (PPD), Environmental and Risk Analysis Services (ERAS), Biological Scientist, Raleigh, NC
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Position: USDA-APHIS-Wildlife Services (WS), National Wildlife Research Center (NWRC), Registration manger, Fort Collins, CO
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Experience: Thirteen years of experience working for WS NWRC providing regulatory compliance support for the development of wildlife damage management tools. Prior experience before joining APHIS includes assessing the environmental fate of pesticides and providing the agency guidance on water quality issues at the state government level, and laboratory experience in the fields of pharmacology and toxicology, and immunology.

Editor/Contributor: Emily Ruell
Position: USDA-APHIS-WS, NWRC, Registration Specialist, Fort Collins, CO
Education: B.S. Zoology and Biological Aspects of Conservation – University of Wisconsin - Madison; M.S. Ecology – Colorado State University (CSU); M.A. Political Science – CSU
Experience: Five years of experience with WS NWRC preparing and reviewing vertebrate pesticide registration data submissions and other registration materials, and providing pesticide regulatory guidance to WS, WS NWRC, and

collaborators. Prior experience before joining APHIS includes seven years of conducting field and laboratory wildlife research at CSU, and environmental policy research for the U.S. Geological Survey.

Editor: Ryan Wimberly
Position: USDA-APHIS-WS, Operational Support Staff, Staff Wildlife Biologist, Madison, TN
Education: BS Wildlife Management and Ecology – Northwest Missouri State University
Experience: Special expertise in wildlife biology, ecology, and damage management. Seventeen years of service with APHIS Wildlife Services, including operations and research, conducting a wide variety of programs, including bird damage research and management, livestock protection, invasive species management, wildlife hazard management at airports, property, and natural resource protection. Expert in preparing environmental documents for WS programs to comply with the National Environmental Policy Act and the Endangered Species Act.

Data Contributor: Joey Millison
Position: USDA-APHIS-WS Information and Technology (IT), Junior Applications Developer
Education: Information and Technology coursework from various sources
Experience: Eleven years of experience in APHIS, WS Management Information System (MIS) Group. Retrieves WS field data from the MIS for writers, reviewers, and editors.

9.2 Internal Reviewers

USDA APHIS Wildlife Services

Reviewer: Anthony G. Duffiney
Position: USDA-APHIS-WS, State Director, Okemos, MI
Education: BS Fisheries and Wildlife Biology, Michigan State University
Experience: Twenty-two years of service with APHIS Wildlife Services in Michigan, Florida and West Virginia. Specialized experience in all levels of WS Operations including pesticide use, NEPA, FOIA, ESA, predator control, feral swine damage management, wildlife hazards at airports, wildlife disease sampling, invasive reptiles, urban wildlife damage. Worked with NWRC and a private livestock feed company in developing new baiting strategy for use of DRC-1339 in cattle feedlots and dairy farms. Conducted bait trials with traditional baits to prove efficacy of new bait material, CU Bird Carrier. Trained WS personnel from 10 State programs in use of new bait. Experience with DRC-1339 to control damage caused by European starlings, common and boat-tailed grackles, rock pigeons, American crows, common ravens, and ring-billed gulls.

Reviewer: Jack W. Sengl
Position: USDA-APHIS-WS, Staff Biologist, Reno, NV
Education: BS Fisheries and Wildlife Biology, Utah State University
Experience: Special expertise in wildlife damage management and oversight. Twenty years of service in APHIS Wildlife Services in the Aleutian islands, AK, IL, NY, OH, VT, and NV with an array of experience including field experience (livestock, dairy, feedlot, property, natural resource, aquaculture, urban-deer management, human health and safety and managing wildlife hazards at airports and disease sampling/reporting) involving predators, birds and rodents and 11 years of program oversight (NEPA, ESA, FOIA, Policy, pesticide registration, monitoring and training, safety, firearms training, controlled material inventory tracking, and coordination of multi-agency meeting). Applied, supervised and provided annual training for the use of DRC-1339; created a 24c label for DRC-1339.

Reviewer: Randal S. Stahl
Position: USDA-APHIS-WS, Chemist, Fort Collins, CO
Education: BS Plant & Soil Science, University of Tennessee; MS Plant Physiology, Texas A&M University; PhD Soil Chemistry, University of Maryland
Experience: Special expertise in developing analytical methods to quantify DRC-1339 in baits and tissue matrices. Eighteen years of service in APHIS Wildlife Services supporting research activities conducted at the National Wildlife Research Center. Developed and support the DRC-1339 Unified Take estimate model used by Wildlife Services to

report take estimates for select species following baiting operations under the Bird Control and Livestock, Nest & Fodder Depredations labels.

Reviewer: Keith Wehner
Position: USDA-APHIS-WS, Assistant Regional Director, Fort Collins, CO
Education: BS in Biology, Michigan Technological University
Experience: Nineteen years of service in APHIS Wildlife Services with experience in a wide variety of programs (livestock, dairy, property, natural resources, and human health and safety protection) including predator, bird, beaver, feral swine, and disease management activities.

Reviewer: Michael Yeary
Position: USDA-APHIS-WS, State Director/Supervisory Wildlife Biologist, Lakewood, CO
Education: BS in Wildlife Ecology, Texas A&M University
Experience: Special expertise in wildlife damage management including supervising an aerial operation program. Thirty-seven years of service in APHIS Wildlife Services in TX, KS, and CO with experience in a wide variety of programs (livestock, aquaculture, dairy, property, natural resources, and human health and safety protection) including predator, bird, beaver, feral swine, and rodent damage management activities.