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. Updated tables

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.

Ecological risks to aquatic nontarget organisms are 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, or 3-chloro-p-toluidine hydrochloride, 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 and ecological risk assessment 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-gram (g) starling, a highly sensitive species, requires a dose of only 0.3 milligrams (mg)/bird on average to cause death (Royall et al. 1967) while many other bird species such as raptors, 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 DRC-1339 is ≥97% pure and contains no added inert ingredients. The end-use products consist of 100% of the technical grade DRC-1339.

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 finch and 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 ingested to be lethal. 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 minimal outward clinical signs (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 nontarget 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 for potential use in Australia (Dawes 2006, Bentz et al. 2007) and is registered in New Zealand.

The current end use products, named Compound DRC-1339 Concentrate – Bird Control and Compound DRC-1339 Concentrate – Livestock, Nest & Fodder Depredations (both are 100% DRC-1339 Technical, which is ≥97% purity DRC-1339), are 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).

In late 2017, the Bird Control label (USDA 2017a) was approved by EPA, and replaced the Feedlots, Gulls, Pigeons, and Staging Areas labels as of January 2019; this Bird Control label also fully or partially incorporated uses from 20 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 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

[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).

rapidly and need to be used relatively soon after preparation or disposed according to label directions.

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	

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 38 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 birds WS killed with DRC-1339 treated baits in bird 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 That Used DRC-1339**
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.

The number of target and nontarget birds estimated to be taken is determined by monitoring the bait site to see the composition and number of bird species feeding on baits and collecting carcasses post application as required by the label for the various use sites. This especially true for nontargets that may not be seen when thousands of birds such as starlings are being treated. WS personnel estimate take using the WS Unified Model for Estimating DRC-1339 Bait Applications developed by the WS National Wildlife Research Center, which takes into account species composition and number, weather, bait type, bioenergetics, dose-response, and other relevant factors. The take estimator is always being refined. It results in the maximum number of birds that could be taken, which is generally higher than the number actually taken. Without these factors, take can be estimated using species responsible for damage and grams of DRC-1339 used based on a less conservative method (Appendix 1). This has been used to estimate take where a WS specialist forgot to estimate take, did not want to estimate take (some specialists are very uncomfortable making estimates of how birds are present), how effective the bait was (e.g., precipitation), and so on and decline to make an estimate, or an estimate was not required (it has been policy since about 2013 to estimate take). From FY11 to FY15, an annual average of about 70 projects had to be estimated, but this declined to 4 from FY16-FY20 after a requirement was made to ensure take was estimated. For the analysis in this document, take was estimated for any project without the take except for small numbers of eggs put out for ravens and crows to protect sensitive species because they often have no take and it was usually denoted in comments.

Historically, APHIS registered five DRC-1339 Section 3 labels, but only two Section 3 labels are currently registered as of 2019 (Table 3). Four Section 3 labels (Feedlots, Gulls, Pigeons, and Staging Areas) were incorporated into the Bird Control label, while the Livestock, Nest & Fodder Depredations (LNFD) label remains a separate Section 3 label and registration. Additionally, states have since registered additional state-limited uses for DRC-1339 under SLN registrations. In addition to the cancelation of the four Section 3 labels, 25 SLN registrations were cancelled in late 2018 to early 2019 after their uses were incorporated under the Bird Control label or were determined to no longer be needed. As of 2022, WS has 9 active DRC-1339 SLN registrations (4 under the LNFD parent label and 5 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 now cancelled APHIS Feedlots label or SLN labels under the Feedlots parent label (83.5%). The APHIS Staging Areas label or SLN labels under the Staging Areas parent label were used next most (11.3%). The others were used minimally.

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 commercial animal operations such as livestock and poultry feedlots, buildings and fenced non-crop areas, airports, industrial sites, dumps and landfills, 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.

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 annual average number of projects and Work Task (WT) applications.

ANNUAL AVERAGE DRC-1339 USE BY PODUCT FOR FY11 TO FY15				
Abbr. Product Name or State Registered SLN (Parent Label)	**EPA Registr. No.**	**Applied (g)**	**Projects**	**WTs**
Feedlots* 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* Cancelled	56228-30	3,252.4	53	143
SLN ID (Feedlots)** Cancelled	ID-050014	122.4	4	7
SLN ID (LNFD)^	ID-140005	0.8	0.2	0.2
SLN ID (Staging Areas)* Cancelled	ID-050013	-	-	-
SLN IL (Feedlots) Cancelled	IL-120002	155.9	7	7
SLN IN (Feedlots)* Cancelled	IN-080003	-	-	-
SLN IN (Staging Areas)* Cancelled	IN-040001	-	-	-
SLN KS (Staging Areas)* Cancelled	KS-120003	-	-	-
SLN KY (Feedlots)* Cancelled	KY-020003	-	-	-
SLN KY (Staging Areas) Cancelled	KY-020002	-	-	-
SLN MD (Staging Areas)* Cancelled	MD-080005	-	-	-
SLN MS (Staging Areas)* Cancelled	MS-050008	-	-	-
SLN ND (Feedlots)** Cancelled	ND-920001	-	-	-
SLN NE (Staging Areas & Feedlots)* Cancelled	NE-100003	-	-	-
SLN NM (Staging Areas)** Cancelled	NM-110004	-	-	-
SLN NV (LNFD)^	NV-150001	395.7	38	139
SLN NV (LNFD) Cancelled	NV-040004	40.1	3	14
SLN NV (Staging Areas)* Cancelled	NV-020005	-	-	-
SLN OK (Staging Areas)** (Replaced by OK-180002 in 2018)	OK-990001	567.6	50	117
SLN OR (Staging Areas)** (Replaced by OR-190004 in 2019)	OR-010024	-	-	-
SLN TN (Feedlots)* Cancelled	TN-080003	-	-	-
SLN TN (Staging Areas)* Cancelled	TN-080004	-	-	-
SLN TX (Feedlots)** Cancelled	TX-890001	7.1	0.6	0.8
SLN TX (SA)** (Replaced by TX-190006 in 2019)	TX-020003	9.2	1	1
SLN TX (Feedlots) Cancelled	TX-090010	975.2	1	1
SLN TX (LNFD) Cancelled	TX-060016	-	-	-
SLN UT (LNFD) Cancelled	UT-130005	7.7	0.2	0.2
SLN WV (Staging Areas)* Cancelled	WV-110001	-	-	-
SLN WV (Staging Areas)* Cancelled	WV-010002	-	-	-
SLN WV (Staging Areas)* Cancelled	WV-040001	46.7	6	7
SLN WY (LNFD)^	WY-110002	58.5	11	16
SLN WY (Staging Areas)** (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.
* USEPA Registration No. 56228-63 - Bird Control label fully replaced these labels by January 2019.
** Labels not fully incorporated in Bird Control label, cancelled, and re-registered by the state under the Bird Control parent label, or no longer used and cancelled by January 2019.
^ SLN labels are still registered under the LNFD parent label.

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 end-use 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 end-use 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 and incorporate most of the associated SLN uses. The label, approved by USEPA in December 2017, fully replaced the following Section 3 labels by January 2019 (USDA 2017a), which were:
    - 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 – Livestock, Nest & Fodder Depredations** (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 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 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 around commercial animal operations where beef cattle, dairy cattle, swine, sheep, goats, mink, poultry, or game birds are confined primarily for the purpose of production and eventual sale in agricultural and commercial 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 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).

- **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, crows, or magpies prey on newborn livestock, or refuges or other areas where they 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.

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 sp.	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 Grackle, Brown-headed Cowbird and European Starling, and Brewer's, Tricolored & Yellow-headed Blackbirds, American Crow, and Black-billed Magpie when in mixed flocks with one or more of the above species	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 at airports, industrial sites, dumps, landfills, and non-crop areas	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

In 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 (*Apis mellifera*) 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. Results from the honeybee acute oral toxicity study (Section 3.2.2) and aerobic soil metabolism (Section 2.3) are summarized in this risk assessment. 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). DRC-1339's parent compound, 3-chloro-p-toluidine, has a melting point ranging from 21 to 24^{o}C and a boiling point ranging 220 to 230^{o}C at 760 mm Hg. DRC-1339, on the other hand, has a melting point of 260˚, at which point it vaporizes. DRC-1339 has a reported vapor pressure of 1.06 x 10^{-4} torr at 25^{o} C and calculated Henry's Law Constant of 1.47 x 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 (Batelle 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 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 FY21 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 toxic (Category II) 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 (Category I) in acute inhalation exposures based on its oral toxicity and the moderate to severe irritation and corrosivity observed in ocular and dermal irritation studies, although an acute inhalation study was not performed. 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 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 New Zealand Rabbit	Dermal LD_{50}	> 2,000 mg/kg	III
Laboratory Brown Rat	Inhalation LC_{50}	Not Required	I
Domestic New Zealand Rabbit	Eye Irritation	Corrosive	I
Domestic New Zealand Rabbit	Dermal Irritation	Corrosive	I
Domestic 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 milligrams per liter (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 milligrams per kilogram (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 DCI 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 mg/L (Bowman 1991a). The 96-hour LC_{50} for the rainbow trout is 9.7 mg/L (Bowman 1991b). 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 0.079 mg/L (USEPA 2011a; Blasberg and Herzog 1991) while marine species appear to be more tolerant with 96-hour LC_{50} values of 10.8 and 16.0 mg/L 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}	0.08 mg/L	USEPA 2011a; Blasberg and Herzog 1991
	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*	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} values 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).

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} values 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} values 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).

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. woodhouseii*) 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).

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 mg/kg-diet, respectively, for European starlings. The same study also reported a 28-day LC_{50} of 18 mg/kg-diet 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 mg/kg-diet. 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 mg/kg-diet) 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 mg/kg-diet and above for quail including decreased egg and live-chick production, and increased incidence of egg breakage and at 25 mg/kg-diet 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 do 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 honeybee demonstrates very low toxicity with a 48-hr LD_{50} greater than the nominal dose of 72 micrograms (µg)/bee, and a no observable effect concentration (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 nuisance 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 potentially large number of birds 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*" (RUP), 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 Pigeons, Gulls, and Staging Areas label uses (now Bird Control label 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 Areas label use (now Bird Control label) 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 Feedlots label use (now Bird Control label) 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 cleaning up would be minor and expected to degrade quickly in the environment based on the reported short 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 RUPs 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;

- Chemical-resistant footwear plus socks;
- Protective eyewear (goggles and face shield); and
- NIOSH-approved elastomeric half mask respirator with organic vapor (OV) cartridges and combination R or P filter OR a NIOSH-approved gas mask with OV canisters; OR a NIOSH-approved powered air purifying respirator with OV cartridges and combination HE filters.

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 bird species being targeted. 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 LNFD labels require a 50-feet "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 maximum 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 the material would be deposited into a static water body. This scenario is not expected to occur under field conditions and would only occur from an accidental spill into a small waterbody. 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 any potential for risk under the proposed exposure scenario would occur. The results of this comparison are discussed in more detail in Section 5.2.1, the aquatic risk characterization.

4.2.2 Terrestrial Wildlife and Domestic Animals 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 is 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 areas 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 diluted bait mixture ranged from 0.05% w/w for whole raisin, culled French fries, waste potato, crouton, and small bread cube baits, to 0.2% w/w for high nutrition animal feed, dry pet food, and dry processed grain and seed baits. 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 Terrestrial Invertebrates and Terrestrial Plants Exposure Assessment

The methods of application for DRC-1339 preclude significant exposure to terrestrial invertebrates and plants. Some terrestrial invertebrates may be attracted to baits containing DRC-1339 but exposure would be reduced since baits are consumed by the target species during the baiting period or removed from the application site per label requirements. Applicators are required to remove any unconsumed, regurgitated, or spilled bait at the conclusion of the baiting period. Any bait that may be left after the baiting period and is not removed would degrade quickly in the environment once exposed to sunlight. DRC-1339 would also bind to organic matter reducing bioavailability to most terrestrial invertebrates and plants.

4.2.4 Assessment of Indirect Effects of Carcasses from Control Actions

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. However, the bacteria only produce toxin under certain environmental conditions that favor bacterial growth, which include times when ambient temperatures are above 77˚F, water levels are low, and rotting vegetation, and invertebrate and vertebrate carcasses are present. High fly[7] numbers (e.g., Order Diptera family Muscidae (housefly and allies)) and environments with no oxygen (Rosen 1971, Locke and Friend 1987) also favor the production of botulism bacteria. 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 a 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).

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[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.).

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 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 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 the 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 lean dry weight values were 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 are 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

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

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.

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)					
Avg Wt. (♂ & ♀)/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 Wt. P (1.3% bird - 1.5% feces)	0.429[4]	0.020	0.247	0.011[3]	0.208	0.010
Dry Wt. K (0.7% bird - 1.4% feces)	0.231[4]	0.018	0.133	0.010[3]	0.133	0.009
Dry Wt. N (14% bird - 9.2% feces)	4.62	0.121	2.66	0.067[3]	2.24	0.059
Nutrient	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, there has been one minor incident of a worker exposure to DRC-1339. This incident occurred in January 2022 and was reported to USEPA under FIFRA 6(a)2 adverse effect reporting. The incident involved a worker who was mixing DRC-1339 Concentrate (EPA Reg. No 56228-63) outdoors under windy conditions. Some of the material was blown into his face and inhaled resulting in lung irritation. No other adverse effects were reported from the exposure. 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.

WS personnel pick up and dispose of carcasses found. WS personnel attempt to find roosts prior to baiting but these can change. Since carcasses can sometimes be found elsewhere, WS personnel notify relevant agencies such as local law enforcement, state wildlife, agriculture, and health agencies, and local veterinarians that may receive calls that people have found dead bird carcasses. Carcasses can be a nuisance or disturbance to people that find them. Carcasses found are disposed at a landfill, deep burial, or incinerations. Part of the decision is the potential presence of disease and what method of disposal is best.

5.2 Ecological Risks

5.2.1 Aquatic Risks

The risk to aquatic organisms from the use of DRC-1339 is minimal (Table 6) with *Daphnia magna,* a cladoceran, having the lowest 48-hr EC50 value at 0.079 mg/L and LC_{50} value at 1.6 mg/L. The method of application, label requirements for removal of unused bait and carcasses, and "No treatment" buffers adjacent to aquatic habitats (50 feet) results in a low potential for exposure and risk. Additional restrictions on the label that prohibit applications directly to water, to areas where surface water is present or runoff is likely to occur, or to intertidal areas below the mean highwater mark reduce exposure and risk to aquatic organisms. A comparison of the available effects data for aquatic vertebrates and invertebrates summarized in Section 3.2.1 to the estimated maximum acute aquatic residues in static waterbodies that were estimated in the aquatic exposure assessment show wide margins of safety for aquatic organisms (Figure 1). These risks were estimated based on an accidental spill into a small static waterbody. Actual risk would be significantly less based on the use pattern and environmental fate for DRC-1339, and label restrictions that reduce exposure to aquatic organisms. The maximum amount of a.i. would be 0.036 mg/L if all a.i. was dropped into a small waterbody accidentally, which is just above the estimated 48-hr No Observed Effect Level for *Daphnia magna* at 0.32 mg/L (Blasberg and Herzog 1991).

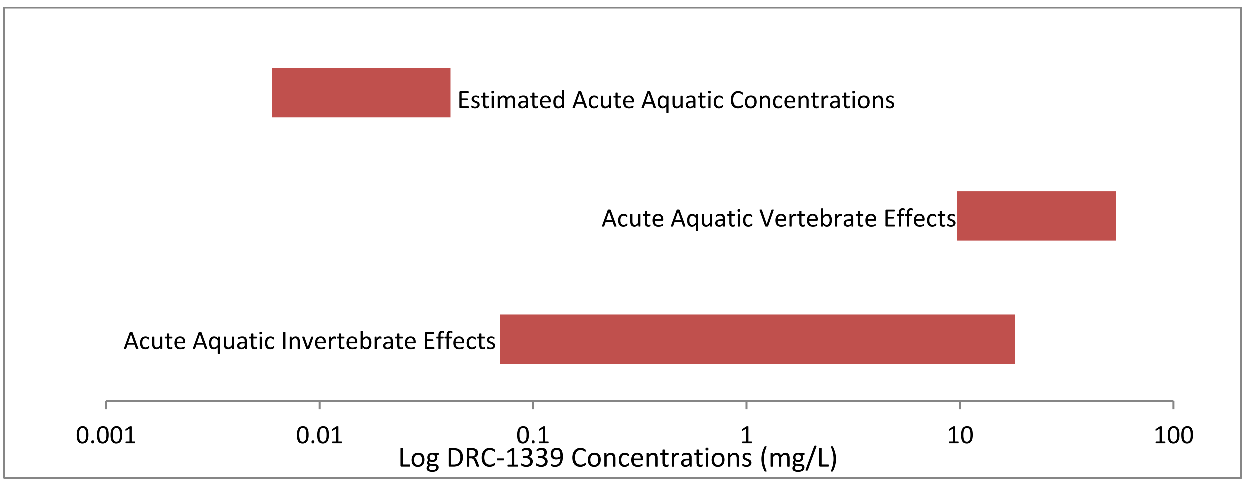

Figure 1. Acute aquatic risk characterization for DRC-1339.

Chronic effects data for aquatic invertebrates and vertebrates are not available, but the method of application for DRC-1339, collecting unused bait, and label restrictions to protect aquatic resources, 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 Risks

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 dried processed grains or whole seeds (corn, barley, distillers grain, milo, lentils and peas), 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 bird 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 how most bait formulations are made. 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, pet food, culled 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).

Nontarget species anticipated for a DRC-1339 treatment are dependent on the bait type used and location. Grain baits attract many granivorous birds such as finches, house sparrows, field sparrows, doves, blackbirds, and gallinaceous birds (quail, pheasants, and turkeys). They also attract rodents such as deermice, house mice, and brown rats. Most grain baits are used in feedlots or staging areas where the birds that are present are almost exclusively the target species. 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.

Processed potatoes such as peels and culled french fries and tater tots are used in areas where these are fed to livestock, mostly in a feedlot or dairy situation. Potatoes mostly attract corvids, starlings, blackbirds, house sparrows, and periodic gulls. Cull potatoes are used almost exclusively for feedlots and starlings, a few blackbirds, and magpies. Cubed bread “sandwiches” are used almost entirely for gulls, but periodically ravens as well. Generally, other than corvids, few nontarget species are present during applications. The primary concern is raptors and meat cubes. These are monitored while they are out to ensure that no nontargets attempt to take the baits. Spencer (2002) gives standard procedures for making egg baits and baiting ravens with them. These may be used at landfills, electrical infrastructure, livestock bedding grounds, and sensitive species nesting sites. While not many eggs may be used protecting sensitive species like the western snowy plover and piping plover nest sites, the most work tasks are associated with them. Few nontargets are typically associated with these projects but most nontargets would include badgers, skunks, foxes, coyotes, and ground squirrels; these species are generally unaffected by taking baits and ground squirrels typically only get into eggs because the eggs are punctured to put in DRC-1339 with a syringe or are cracked (this often prevents caching eggs by corvids).

For corvids (ravens, crows, and magpies) the primary bait substrates are eggs, dog food, and meat cubes. Dog food is generally used for magpies and sometimes crows and ravens at feedlots where the potential for nontargets are too high. Bread cubes are used for gulls and periodically ravens. Sites where these are used are to protect sensitive species especially nesting shorebirds and grouse, feedlots, livestock lambing and calving areas. Livestock predation by corvids can be significant and mostly caused by nonbreeding juveniles and adults in “floating flocks” that can number in the hundreds.

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 in juncos and blackbirds, 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 Risks

The risk of DRC-1339 use to terrestrial invertebrates and plants is negligible. The available data shows low toxicity to the honeybee and terrestrial plants that have been tested at concentrations above those expected from applications in the field (USEPA 2018a). In addition, the methods of application for DRC-1339 suggest that potential exposure to terrestrial invertebrates and plants 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 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 low and would not occur with repeat applications. The potential for accidental exposure is reduced since DRC-1339 products are restricted-use and for use 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":

Primary Writer: Fan Wang-Cahill
Position: USDA-APHIS-Policy and Program Development (PPD), Environmental and Risk Analysis Services (ERAS), Environmental Health Specialist, Riverdale, MD
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Primary Writer: Jim Warren
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Education: B.S. Forest Ecology and M.S. Entomology – University of Missouri; Ph.D. Environmental Toxicology – Clemson University
Experience: Sixteen 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.

Writer: 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.

Editors/Contributors for "Use of DRC-1339 in Wildlife Damage Management Risk Assessment":

Editor: Michelle Gray
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Position: USDA-APHIS-Wildlife Services (WS), National Wildlife Research Center (NWRC), Registration manger, Fort Collins, CO
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Editor/Contributor: Emily Ruell
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Experience: Eight 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
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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, National Environmental Policy Act, Freedom of Information Act, Endangered Species Act, 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 (National Environmental Policy Act, 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 (retired)
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, 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, Asst. Regional Director, Fort Collins, 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.

9.3 Peer Review

The Office of Management and Budget requires agencies to have peer review guidelines for scientific documents. The APHIS guidelines were followed to have "Use of DRC-1339 in Wildlife Damage Management" peer reviewed. WS worked with the Association of Fish and Wildlife Agencies to have experts review the documents.

9.3.1 Peer Reviewer Agencies Selected by the Association of Fish and Wildlife Agencies

California Department of Fish and Wildlife
Montana Fish, Wildlife, and Parks
Oklahoma Department of Wildlife Conservation
Wyoming Game and Fish Department

9.3.2 Comments

Peer reviewers provided editorial comments on the manuscript. These were appreciated and incorporated into the final document. Following are the comments regarding concerns with the risk assessment and a response:

1. **Comments:** Convert all ppm values to mg/L values to describe LC50 values in section 3.2.1

   Response: These were converted. Ppm and mg/L are the same concentration, but the change specifies whether solid or liquid, respectively.

2. **Comment:** Section 5.2.3 does not reference the honeybee toxicity study that Wildlife Services conducted. A summary of that study should be included in Section 5.2.3 and it would be helpful if some references or examples were included to support the statement made in the second sentence that "Available data show low toxicity to both taxa …."

   Response: The reference was added and statement amended.

3. **Comment**: This risk assessment lacks the procedures that are followed in order to use this chemical safely and effectively in the field, and the best practices that should be followed during site selection, pre-baiting, monitoring during the application phase, and clean-up procedures post-application. Some of these topics are touched upon in scattered parts of the document, but they are never collated into a set of procedures or multiple sets of procedures that follow each of the four primary applications of the product (feedlots, gull control, pigeon control, and blackbird staging areas).

   Response: The risk assessment discusses the label requirements for using DRC-1339. This includes site selection, pre-baiting, monitoring, and post treatment measures designed to reduce risk to human health and the environment. The measures are not listed in one place in the document but are discussed where relevant to characterize exposure and risk to human health and the environment. Users should rely on the label for the list of procedures followed instead of those given in this risk assessment. Additionally, a reference (Spencer 2002) was added to in Section 5.2.2 that describes standard operating procedures for making egg baits and placing them out for common ravens, which is somewhat similar to other procedures.

4. **Comment:** A criticism sometimes voiced by those that oppose the use of DRC 1339 is that egg bait sites are inadequately monitored following implementation. It would be useful in this document to demonstrate that it has been monitored in some (not all) instances, and how nontarget take is determined.

Response: DRC-1339 egg bait sites targeting corvids, especially ravens, are typically monitored prior to and sometimes during or after treatment (Spencer 2002). Research conducted on egg baits in Nevada using videography indicated that the traditional 1:2 ratio (ravens to missing eggs) used by managers to estimate raven take may result in substantial overestimation of raven numbers, especially if ground squirrels begin consuming egg baits (Coates et al 2007). WS monitors many DRC-1339 treated bait sites for nontarget species. For egg baits specifically, the primary nontarget species found taking baits are ground squirrels and striped skunks, mammalian nontargets that mostly go unaffected by taking baits. Many of these projects are done to protect nesting sensitive species such as the greater sage-grouse and sharp-tailed grouse. Mammals would need to eat over 50 eggs to get a lethal dose of DRC-1339, which could not physically occur and is precluded by label bait restrictions. Basically, in the areas where baits are placed, few nontarget species that could be affected by DRC-1339, are present. For the most part, the site locations dictate the species that will likely be present. In general, feedlots and staging areas have few birds other than the target species where baits are placed.

5. **Comment:** Early on, the document stresses that few nontarget animals, primarily birds, are taken and some of those are a target species but not during implementation. The document acknowledges that detecting all nontarget take is difficult if not impossible.

   Response: The nontarget species taken from FY11-FY15 were species being targeted at treatment sites but were not being targeted by the treatment. The labels specify the species that can be targeted under each label. While these species may be targeted with a given label, they cannot be with some labels. Hence, if species are not on the label being used, they are not target species generally. The new Bird Control label combined several labels and allowed taking several species, which will reduce the number of nontargets taken. Appendix 2 has take from FY16-FY20 and no nontargets were taken. This may be partially due to being able to target a broader number of species under a single label. Additionally, if nontarget species that would likely feed on the bait are noticed prior to baiting or during prebaiting, a site may not be treated or the nontargets hazed out of the area prior to baiting. It should be noted that nontarget species seen eating baits are considered nontarget species taken.

6. **Comment:** Section 2.3 has two seemingly contradictory sentences that need further explanation. The last sentence of the first paragraph states that DRC-1339 has a low migration potential to ground and surface waters as a result of its high affinity to soil organic matter. But the first sentence in the next paragraph states that the DRC-1339 is highly soluble in water. Many of the sites on which this chemical is applied, are bare-soil sites with no guarantee of high organic content. If this chemical is highly soluble in water, then it seems likely that there would be some potential for it to move into groundwater or surface waters following storm events. If the chemical readily binds to organic material, then it would seem prudent to incorporate an organic compound into the post-treatment clean up procedure as a way of controlling off-site movement via stormwater.

   Response: The statements are not necessarily contradictory. Most all soil, whether bare on top or not, has organic matter and DRC-1339 is not likely to escape in groundwater. Clarification was added to that section. The primary note is that it would be highly unlikely for DRC-1339 to get to groundwater and an analysis was given if DRC-1339 were accidentally spilled directly into water, which showed low potential for any adverse events as a result. That, along with buffers to surface water for placement, makes it unlikely that DRC-1339 would have an effect on water organisms.

7. **Comment:** In Section 6 it suggests in the third paragraph that exposure to DRC-1339 will not occur because PPE will never be used improperly by WS Certified Applicators or persons under their direct supervision. This could happen to anyone including WS personnel and should be a changed.

   Response: We agree. This paragraph was changed to reflect the possibility that exposure could occur.

8. **Comment:** How were the take numbers shown in Table 2 calculated. Section 1.1 describes the typical use patterns for DRC-1339 and assesses how widespread its use is and how many birds are killed annually, but the section leaves a few unanswered questions. According to the report, avian mortalities typically occur off-site several days after the poison is ingested (page 2); therefore. it would seem difficult to accurately quantify the level of take achieved. This needs greater clarification.

   Response: A paragraph on estimates was added in Section 1.1. However, formulas are now available to field personnel to use to calculate the number of birds taken. Field personnel input the number of species at bait site, their composition, temperature, precipitation, bait type, and grams of DRC-1339 used and that gives the calculations for take. For the few where the field personnel did not enter any take (average 42 annually), it was calculated using formulas developed for National Environmental Policy Act documents (Appendix 1). Prior to FY13, take in several states was the number of carcasses found, which does not always represent the number taken. It should be noted that almost all birds die within two days after ingesting the bait.

9. **Comment:** There appeared to be little information pertaining to storage and disposal of unconsumed DRC-1339 bait mixtures and the associated risks.

   Response: Section 5, the Summary, has been amended to include this statement. Thank you for the comment.

10. **Comment:** Rock Pigeons were taken unintentionally in the state of West Virginia where the only control measures that were implemented for other species were for European Starlings, Red-winged Blackbirds, and Common Grackles (Table 2, page 3). The lethal dose for Rock Pigeons appears to be five to six times greater than it is for European Starlings and Red-winged Blackbirds (Table 7, page 13), so it is surprising that Rock Pigeons could be killed incidentally during control work for starlings and blackbirds. Do you have a hypothesis for how they acquired a dose that was 5 to 6 times greater than designed for the target species? Large crops?

    Response: If the WS Specialist sees a bird feeding on the bait, even if it is unlikely to die, they are included in nontarget take. We agree that it takes more treated bait to kill feral rock pigeons and believe these may not have been taken. This is done to err on the side of being conservative (it is possible if it got enough treated baits). Actual rock pigeon bait is mixed with higher levels of DRC-1339. It should be noted that at all feedlots where these were actually taken, rock pigeons were being targeted too. But the label used was the label for feedlots which would be less toxic bait for rock pigeons unless they consumed larger quantities.

11. **Comment:** One aspect of a procedure that is not addressed in the document is whether and how the state and federal wildlife agencies are notified of these control actions. Is there a protocol to notify the U.S. Fish and Wildlife Service and the jurisdictional state wildlife agency before specific control actions are implemented, or is there a procedure for notifying these agencies after-the-fact that a control action was taken and a quantified number of birds were taken? It would be helpful if agencies could be notified of these actions ahead of time in case there are calls from the public, and it would be helpful if an annual report of the birds taken was provided. One or both of these measures could be incorporated into the standard procedure for the application of DRC-1339.

12. **Comment:** We are not aware of any toxicosis in nontarget wildlife but acknowledge that DRC-1339 is not routinely tested in vertebrate tissues.

    Response: WS generally monitors projects to determine if nontarget species could be impacted. If a bird consumes bait, it is considered taken, even if it does not get a toxic dose. Fortunately, few nontarget species are seen feeding on baits. WS responds to any dead birds found in the vicinity of a DRC-1339 project, usually within 20 miles, to ensure that they are picked up and disposed appropriately. Since birds can feed, leave, and not die for many hours, they may show up in places we did not anticipate. Generally, most projects involving flocking birds are conducted during winter months when birds are roosting in massive flocks. WS typically finds the roost and collects birds from the site. Occasionally, birds may change roosts, and these may not be found or found from the public notifying an agency. These too then are retrieved and disposed appropriately. Some roosts are in areas where the public will not see and WS has no potential to retrieve them; as discussed, the toxicant is metabolized and excreted in animals within 2 hours after ingestion.

13. **Comments:** Potential exists for the unintentional take of other birds with large crops such as mourning doves, white-winged doves, northern bobwhite, scaled quail, and waterfowl, and it suggests that the pre-baiting and monitoring protocol should be particularly sensitive for the presence of these non-target species.
    The calculation of take of non-target species needs to be more completely described. It seems unlikely that only four species of non-target birds were taken when you consider that the chemical was applied at over 3,000 project sites (see Table 3 – 643 projects per year over five years). I have no doubt that Wildlife Services is very cautious and efficient in their use of this chemical but given the wide range of projects on which this chemical was applied over the 34-state area, is seems unlikely that there weren't incidental takes of Horned Larks, native sparrows, and meadowlarks – the latter of which is closely related to blackbirds and should have a very similar susceptibility to DRC-1339.

    Response: We added further language in Section 1.1 on nontarget take. Prebaiting helps identify if nontarget birds are feeding at a site or monitoring treated sites for their presence. WS monitors sites for nontarget birds to include these species. Doves have been species with most potential and have been taken in the past 20 years. Nontarget birds can be missed, especially at sites where thousands of birds are feeding on bait. If a nontarget bird is seen feeding on the bait, it is assumed to be taken. However, at these projects none were seen as no nontarget species were noted to be taken. We believe that some may have been taken as they can be easily missed in big flocks, but none were documented.

14. **Comment:** When used properly, DRC-1339 appears to be effective at killing targeted species with minimal take of nontarget species when compared to other methods (e.g., Table 2).

    Response: We agree. It is a very target-specific method when used appropriately.

15. **Comment:** The layout from one section to the next (i.e., Sections 3, 4, and 5) should have corresponding section in each.

    Response: Sections were added to correspond. In the original version, short sections had been combined, but they have been parsed out again. Thank you for the comment.

16. **Comment:** Currently, DRC 1339 is limited to the take of about 5,000 common ravens in Nevada annually (between agriculture and wildlife uses). A currently developing environmental assessment being undertaken by USDA WS could provide reasoning and rationale that may be used to increased permitted take through the Migratory Bird office with USFWS. That increased take could become as high as 12,500 common ravens annually within the state of Nevada alone. If the maximum increased take were pursued, could you anticipate if that level of increased use of DRC 1339 would have any additional adverse environmental effects? Is it worth addressing that potential in this document?

    Response: Take of species in a given state is analyzed in National Environmental Policy Act documents for that state such as Nevada (WS 2020). WS analyzed the take for 10,000 common ravens in Nevada and total take in the state by all permittees was set by USFWS at 19,000 without harm to the population.

    The risk assessment was prepared based on the current labeling for DRC-1339. Exposure and risk in the risk assessment were based on maximum use rates for each use site. Any potential future changes to labeling that could occur were not addressed since they have not been approved for use by USEPA. Any changes to the label for DRC-1339 resulting in increased use would require an update to this risk assessment. In the example provided by the commenter it appears that frequency of use would increase with proposed usage under current labeling. Increased usage of any pesticide may result in additional risk but adherence to label requirements will minimize risk to human health and the environment.

17. **Comment:** In the Aquatic Exposure Assessment, Section 4.2.1, second paragraph, the document states that maximum DRC-1339 residues are estimated to range from 0.006 to 0.035 mg/L and that this is characterized as a “conservative estimate” of exposure. I’m not sure that this is a conservative estimate; instead, it appears to be a maximum estimate. The conservative approach in this type of analysis would be to use maximum estimates, but the estimates themselves are not conservative estimates and probably shouldn’t be characterized that way.

    Response: Conservative, in this sense, is to convey that if the maximum amount of DRC-1339 from a treatment occurred, we would anticipate that the effects would be less than the maximum because it is not likely this would ever occur. DRC-1339 cannot be applied within 50 feet of any waterbody, which reduces risks considerably.

18. **Comment:** It is obvious why this chemical is used to control European Starlings and various species of blackbirds; however, it’s not clear why this product is used for pigeon and gull control. Pigeons and gulls require a much larger effective dose in order to obtain lethal control, and the document is not clear why DRC-1339 is used for this purpose rather than potentially more lethal chemical control for these larger birds.

    Response: DRC-1339 is an effective toxicant for gulls and feral pigeons. Table 4 in the risk assessment discusses maximum use rates for various use sites and pest species. Pigeon and gull control rates are the same or less than other species that are listed on the label. Other WDM methods may be easier to implement for these species compared to DRC-1339 treatments, so they are not often targeted with DRC-1339 in comparison to starlings mostly due to the sheer numbers in a flock.

    To illustrate efficacy for pigeons, an analysis of feral pigeon take with DRC-1339 can be calculated. The standard average number of whole corn kernels in a pound is about 1,300, but variable depending on variety of corn. However, lower or higher weights for kernels would not change the outcome. If 1,300 kernels weigh one pound and are treated, each kernel would have about 3.5 mg DRC-1339 (prior to being cut with untreated baits). The oral LD50 for pigeons is 18 mg/kg (Timm 1994, Eisemann et al. 2003). Thus, it probably takes more for 100% efficacy (acute doses for all) with pigeons, and a minimum of about 30 mg/kg; for pigeons at an estimated average weight of 360 g, this would require 10.5 mg treated bait necessary to kill them or at least 3 baits. Pigeons eat about 36 gm of feed per day or, with whole corn, about 100 kernels (depending on weight of kernels). It is likely that when feed is put out, pigeons will consume a quarter to half their daily intake (depending on the number of pigeons feeding, the distribution of baits, and the length of time the pigeons are exposed to the baits), or about 25 to 50 kernels. This would be enough to get a lethal dose for most birds, averaging about 4 to 8 treated baits for cut baits (1:5 ratio of treated:untreated). Similarly, the same results occur for gulls, but the substrate is usually bread.

19. **Comment:** The aquatic risk characterization, Section 5.2.1, is noticeably short and provides no analysis. It could be improved upon by referencing Table 6 and explaining how/why the toxicity values shown in that table are much greater than the concentrations that are expected to occur in the aquatic environment.

    Response: Section 4.2.1 gave the exposure assessment and the analysis there was shown to be minimal precluding a robust discussion in Section 5.2.1. However, further information was added to the discussion. We believe that the risk is very minimal from potential toxicity levels and use restrictions from the label. Additionally, no known occurrence of an aquatic system has been reported.

Comments received not requiring a response. We appreciate these comments.

1. **Comment:** Overall the method risk assessment was complete and thorough in describing methods, consequences, and successes.

2. **Comment:** All uncertainties and assumptions were adequately considered and described.

3. **Comment:** The list of references presented in the methods risk assessment seemed appropriate.

4. **Comments:** The Terrestrial Wildlife Risk Assessment, section 5.2.2, is especially important and I'm pleased to see that it was thorough. I especially appreciated the section discussing the take of nontarget birds because of the risk that DRC-1339 poses to meadowlarks, mourning doves, and potentially other birds that co-occur with blackbirds.

5. **Comments:** This is a comprehensive review of DRC-1339. This review provides information about target take, nontarget risks, secondary toxicity, and environmental fate for DRC-1339.

6. **Comments:** My experience and knowledge supports the use of DRC 1339 as a safe and effective toxicant that is narrowly targeted without substantive nontarget effects.

7. Comment: We appreciate Wildlife Services reporting on the take of target and nontarget species, including their fates (killed, freed, dispersed) in the Introduction Chapter.

8. **Comments:** This technical report addressing the use of the chemical DRC-1339 for avian damage management is very thorough in terms of why Wildlife Services uses this compound, how this chemical works and the risks posed by this chemical.

Appendix 1. Estimating DRC-1339 Take

WS estimated take for DRC-1339 in many outdated National Environmental Policy Act Environmental Assessments prior to estimating this take became mandatory. The following is a synopsis of data used to estimate take from some of the documents (e.g., Texas, Colorado, and Arizona). About 42 projects were estimated annually from FY11 to FY15, data for this document, which included European starling, brown-headed cowbird, great-tailed grackle, feral pigeon, and black-billed magpie projects. Common raven, American crow, and fish crow projects were estimated only for projects other than those involving the protection of sensitive species where only a few eggs are placed at a time and take is only made when a few individuals were recorded From FY16 to FY20, about 4 projects per year were estimated, which included pigeons and starlings, and a few ravens and American crows.

> Precise information on bird mortality due to WS control operations involving toxicants is not available. Prior to FY14, the MIS required WS Specialists record the dead birds found following a control operation, which may only be a small percentage of the birds actually taken. However, some WS State Directors or District Supervisors required Specialists to estimate the number of birds such as starlings and blackbirds taken during a control operation. Since recording data in the MIS has been variable from one operation to another and one state to the next, MIS data for birds taken with DRC-1339 were used for determining total take, unless take has been estimated for all projects; if it was in a state that counted carcasses, it was not used because this was often not all. However, potential take can be estimated with a basic knowledge of DRC-1339, bait type (e.g., cracked corn), and basic bird species biology for those birds targeted. This appendix provides estimates of birds taken with DRC-1339 by WS for species that had estimates determined from the number of grams DRC-`339 used and the species targeted.
>
> Most bird mortality by WS operations involves DRC-1339 treated baits. Glahn and Avery (2001) described methods to estimate bird mortality from using assessments of bait consumption and calculations. Homan et al. (2005) developed an empirical model based on bioenergetics for starlings at feedlots and the model predicted that 93 starlings would be killed for every pound of treated cattle ration pellet baits used (116 starlings/g DRC-1339). However, field studies testing the model found that the baits only killed an average of 67 starlings per pound used (72.5% of the "ideal" model). This would equate to 84 starlings taken for every gram of DRC-1339 used. Packham (1965) found that an average of 57 starlings were killed per pound of DRC-1339 treated French fries (a larger bait size) used at feedlots or 71 starlings taken per gram of DRC-1339. Thus, a difference exists between what models predict for results to that which actually occurs under field conditions and take with different baits. Most models predict the maximum number of target species that can be taken or the "ideal." However, ideal conditions rarely exist in the field and take is typically only a fraction of the expected results (Glahn and Avery 2001).
>
> Part of the problem with predicting take with DRC-1339 treated baits is that breakdown of the chemical starts relatively quickly once baits are prepared. Within hours to several days after baits are prepared and once the baits are exposed to environmental conditions (e.g., precipitation, heat, and sunlight), baits degrade, lose potency, and discolor turning dark gray which are often not selected by the target species. Thus, baits may be consumed and not be toxic (degraded) or discolored and not selected making them less effective. Additionally, baits may be made for a set number of birds seen during prebaiting operations and this number may not return when baits are placed out. Thus, baits may remain following treatments which then are disposed according to the label. The MIS system does not capture this "wastage" (bait placed in the field and not consumed, and, hence, disposed), but only the amount placed in the field. These factors (degradation, discoloration, and wastage) inherently would increase the estimated target species take using WS MIS data because all DRC-1339 used in operations is recorded whether or not it was successful. Homan's et al. (2005) field trials, compared to the empirical model, accounted for most problems with discoloration and degradation (did not likely include precipitation because all trials had an estimated take) problems (72.5% efficacy from predicted to actual field trial take), but did not account for wastage because the amount of bait consumed was recorded for each field trial (baits placed less baits picked up after treatment). For WS projects using

DRC-1339, wastage likely averages between 10% and 25% of the baits placed. Thus, realistically the baits used that are successful in typical field conditions (from preparation to take of the target species) are probably closer to 60% of the estimated “ideal” or modeled take for the grams of DRC-1339 used, instead of the 72.5%. To conservatively estimate the number of target starlings taken for a given project, the Homan et al. (2005) field trial data multiplied by a factor of 90% to account for wastage, thus assuming wastage of 10%, or 76 starlings taken per gram of DRC-1339 used.

WS also targets blackbirds in the family Icteridae at feedlots and other damage sites. Take would be different for each species of blackbird, as well as sex with most males weighing much more than females, based on the target species weight and daily feed consumption. Average weights for a species including females and males are 54 grams for Red-winged Blackbirds, 76 grams for Yellow-headed Blackbirds, 66 grams for Brewer’s and Rusty Blackbirds, 107 for Common Grackles, 169 for Great-tailed Grackles, 40 grams for Brown-head Cowbirds, and 63 grams for Bronzed Cowbirds. It is expected that these species, respectively, would consume an average of 11g, 13g, 12g, 12g, 18g, 24g, 23 g, 9g, and 12 g of baits when feeding. DRC-1339 treated baits for feedlots are not broadcast but put in feeding lanes and so birds have easier access to large quantities of baits whereas more searching is required for baits that are broadcast. It is estimated that blackbirds will get 12.5% of their daily intake needs from baited sites. Take for each species is estimated for feedlot baits in Table 1.1. For blackbirds, because of varying weights, Table 1.1 estimates the number taken with the different baits and formulations based on their daily consumption. Blackbirds move around in feedlots and fallow fields and, thus, could get much of their diet from non-baited areas. It is assumed that blackbirds get an eighth of their daily dietary needs from treated areas whereas starlings and pigeons, which are much more sedentary in feedlots than blackbirds, would probably get at least 25% (likely much higher for these species). These are likely conservative estimates, but adequate for determining impacts.

WS also targets blackbirds in the family Icteridae at feedlots, rice fields, and for other resources. Estimated take is very different depending on the bait substrate used and method of baiting (piles or broadcast). Take is different for each species, as well as sex with most males weighing much more than females, based on the target species weight and daily feed consumption. Average weights for a species, the average of the mean weight for males and females (Table 1.1) and assuming a 1:1 sex ratio, are 54 grams for Red-winged Blackbirds, 76 grams for Yellow-headed Blackbirds, 66 grams for Brewer’s and Rusty Blackbirds, 107 for Common Grackles, 169 for Great-tailed Grackles, 157 grams for Boat-tailed Grackles, 40 grams for Brown-head Cowbirds, and 63 grams for Bronzed Cowbirds. It is expected that these species, respectively, consume 11g, 13g, 12g, 12g, 18g, 24g, 23 g, 9g, and 12 g of bait. DRC-1339 treated rice baits are broadcast at 10 to 20 pounds/acre. DRC-1339 treated baits for feedlots are not broadcast but put in feeding lanes and so birds have easier access to large quantities of baits whereas more searching is required for rice baits. It is estimated that blackbirds get 12.5% of their daily intake needs from baited sites, but it is likely that less would be obtained from areas treated with rice baits as compared to feedlots and other sites. However, wastage would be much greater in rice treated fields, probably a third or up to half, because baits are broadcast requiring searching by birds which becomes more tedious as the number of baits decline. The percentage of birds obtaining a lethal dose in rice fields is much less, about 50% mortality (Johnston et al. 2005, 2006).

Field studies with rice found that birds ingested an average of about 25 rice kernels (0.5g) or about 2% to 6% of their daily intake requirements with red-winged blackbirds and brown-headed cowbirds, the species most targeted with treatments to protect rice, between 5% and 6% of their daily intake. Thus, using the current assumptions of 12.5% of the daily intake would be similar to take with rice baits (for red-winged blackbirds, the assumptions 100% mortality with 12.5% intake and 10% wastage results in 840 birds taken per gram of DRC-1339 vs. 50% mortality with 5% intake and 42% wastage results in 820 taken per gram of DRC-1339) and used for estimating take for each species in Table 1.1. The take for each species of blackbird is estimated for feedlot baits and rice baits in Table 1.1. For blackbirds, because of varying weights, Table 1.1 estimates the number taken with the different baits and formulations based on their daily consumption. Blackbirds move around in feedlots and fallow fields and thus get much more of their diet from non-baited areas. It is assumed that blackbirds get an eighth of their daily dietary needs from treated areas whereas starlings, and pigeons, also discussed herein, which are much more sedentary in feedlots than blackbirds, would probably get at least 25% (likely much higher for these species). These are conservative estimates, especially because the efficacy of baits in the field compared to the "ideal" take is not used for blackbirds which would reduce take estimates by at least 25% (Homan et al. 2005), but adequate for determining impacts.

Cummings et al. (unpubl data, NWRC, pers. comm. 2006) found that treated baits at feedlots "ideally" would take an estimated 400 blackbirds per gram of DRC-1339 used. Table 1.1 found that take would range from 163 per gram of DRC 1339 used for "other" baits for Great-tailed Grackles to 434 for Brown-headed Cowbirds. Cummings et al. (unpubl data, NWRC, pers. comm. 2006) also found that for each pound of treated cut (1 treated: 26 untreated) rice baits placed in fields, 374 blackbirds were killed. Johnston et al. (2005) predicted that 324 Red-winged Blackbirds from a pound of rice baits would be killed (this number declined with the days of baiting to 285 for 5 days). These estimates would equate to 1,057 and 913 blackbirds killed per gram of DRC-1339 used. It should be noted that the first estimate included primarily Red-winged Blackbirds and Brown-headed Cowbirds and the second only Red-winged Blackbirds. Table 1.1 estimates that take will range from 385 for Great-tailed Grackles to 1,027 for Brown-headed Cowbirds. It also should be noted that birds were captured following feeding in treated fields and not all birds died from the dose they received. Several birds were collected and the number of rice grains in all birds was not enough to kill them (about 50% mortality rate for birds feeding in treated rice fields). However, their take estimates were similar to those determined in Table 1.1. It should also be noted that efficacy, similar to what Homan et al. (2005) found for starlings (the "ideal" take vs. actual take), was not calculated into these estimates. This would reduce take estimates by a fourth. However, our estimates in Table 1.1 include an assumed 10% wastage loss which would make the estimates very close to those found by researchers.

The MIS allowed WS Specialists to use a code, "Mixed Blackbirds," for sites where several species of blackbirds (starlings, blackbirds, cowbirds, and grackles) were present. Thus, species composition at operational sites was estimated using Audubon Christmas Bird Count data or USGS Breeding Bird Survey data (Christmas Bird Count data for winter projects (December 1 to March 31) or an average of the two for migration time frames (April 1 to November 30). Most projects are conducted when species are flocking, which excludes breeding and summertime months. Additionally, the habitat preference of a species was also considered. For example, starlings are the most prevalent species at feedlots in the United States. Starlings require a high protein, high calorie diet, and livestock feed such as cattle ration, pelleted feed are a great source. Unlike most blackbirds, starlings eat little grain due to their poor assimilation efficiency (turning feed into energy) for grain (Twedt 1985). Starlings prefer insects and eat them as available. As insects wane in cold weather, starlings turn to feedlots to acquire the necessary energy to survive. Thus, starlings can be found in abundance at feedlots during winter. On the other hand, blackbirds efficiently assimilate grains into energy and have more opportunity to find them in harvested and fallow fields (spillage) and rangeland (weed seeds), and, therefore, may forage more in these areas rather than in feedlots (Twedt 1985). It should be noted that rusty blackbirds, a species of concern, typically prefer bottomlands and wetlands and do not often feed with other blackbirds even though they will roost with them.

WS also targets feral pigeons with DRC-1339. Per label directions, WS uses whole kernel corn for these projects with 1.7 g DRC-1339 treating 1 pound of bait which is then cut at 1 treated: 5 untreated. Baits can be cut at 1 treated: 1 untreated depending on the needs of the project and the length of time birds are observed feeding during prebaiting. The standard average number of whole corn kernels in a pound is 1,300 (Ontario Corn Producer Association 2007), but this is variable depending on variety of corn. However, lower or higher weights for kernels would not change the outcome. Assuming that 1,300 kernels equals one pound and are treated, each kernel (350 mg) would have about 1.3 mg DRC-1339 (prior to being cut with untreated baits). The oral LD50 for pigeons is 18 mg/kg (Timm 1994, Eisemann et al. 2003). Thus, it likely takes more than 18 mg for 100% efficacy (acute doses for all) because only 50% of the pigeons would be killed at this level. At an estimated average weight of 310 g (270 g (Sibley 2000) or 350 g (Johnston 1992) equals 4.9 mg to 6.3 mg – website searches came up with similar weights)) it would take 5.6 treated baits to kill 50% or 6 baits (rounded up). Pigeons eat about 36 gm. of feed per day (British Columbia Ministry of Environment 2001) or, with whole corn, about 103 kernels at 1,300/pound. It is likely that when feed is put out, pigeons will consume between a quarter to half their daily consumption (depending on the number of pigeons feeding, the distribution of baits, and the length of time the pigeons are exposed to the baits), or about 26 to 52 kernels. This would be enough for about half of the birds to get a lethal dose averaging about 4 to 9 treated baits for cut baits (1:5 ratio of treated:untreated). Assuming pigeons feed on whole kernel corn baits that have 1,300 kernels per pound and consume a third of their daily intake (34 kernels) while baits are placed out, one pound of cut bait would take 19 pigeons (each pigeon would get an average of 5.7 treated baits – the level for 50% to be killed). This would equate to taking 67 pigeons per gram of DRC-1339. Using a similar factor to account for wastage in field use (10%) as above, would result in a conservatively estimated 60 pigeons taken with each gram of DRC-1339 used. It should be noted that baits can be cut at 1:1 to 1:5 for pigeons depending on how much bait is required at a site for the number of pigeons present; WS Specialists use the 1:1 treated to untreated baits for projects with very few pigeons or when there are a lot of pigeons present to ensure they get enough toxicant. A lower ratio of treated to untreated would reduce the number of birds that could be taken. It is assumed that all baits are cut at the 1:5 rate which would increase the number of birds taken but be a more conservative estimate for the purposes of analysis. Additionally, baits are often left out for pigeons as long as they are feeding. It is likely that pigeons would consume at least half their dietary needs, if not 100%. If pigeons consumed 100% of their daily consumption requirements and this reached a level of LD100, then 13 pigeons would be killed per pound of bait or 40 per gram of DRC-1339 (taking wastage into account). It is likely that the latter is closer to the estimate.

WS Specialists also target American Crows under a Special Local Need labels to protect pecans and other crops with whole kernel corn and pecan baits. Take would be similar to pigeons, except that crows would likely take fewer baits when they feed. The average crow weighs about 515 grams (Verbeek and Caffrey 2002) and consumes about 52 grams of feed per day. The oral LD50 for crows is 1.33-1.78 mg/kg and they are likely to get a lethal dose consuming low quantities of bait (1 kernel would likely be enough to kill a crow). If crows consume a fourth of their daily diet at a treated site (similar to pigeons because would tend to remain at a feeding station longer), they would consume 13 grams of prepared baits. Assuming that baits are made with whole kernel corn (about 1300 kernels/pound), crows would consume about 37 kernels or about 6 treated baits. At this consumption rate, a pound of prepared bait would take 35 crows. This would equate to taking 45 crows per gram of DRC-1339. Using the same wastage percentage (10%) as discussed, WS expects that it could take 40 crows per gram of DRC-1339 used.

Table 1.1. Estimated blackbird take for DRC-1339 treated baits. The estimated numbers taken per gram of DRC-1339 were used for projects that did not estimate take.

Species*	RWBL	YHBL	BRBL	RUBL	COGR	GTGK	BTGK	BHCO	BROC
Spp. Aver. Weight (g)	54	76	66	66	107	169	157	40	63
Daily Aver. Consumpt. (g)	11	13	12	12	18	24	23	9	12
% Daily Aver. Cons. Eaten	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%
Wastage	10%	10%	10%	10%	10%	10%	10%	10%	10%
DRC-1339 Rice Baits									
Std g DRC Used for Bait	92								
Pounds bait made	260								
Lbs. bait/1 g DRC	2.83								
# birds/g DRC	840	711	770	770	513	385	402	1,027	770
DRC-1339 Other Baits									
Std g DRC Used for Bait	92								
Pounds bait made	110								
Lbs. bait/1 g DRC	1.20								
# birds/g DRC	355	300	325	325	217	163	170	434	325

RWBL = Red-winged Blackbird, YHBL = Yellow-headed Blackbird, BRBL = Brewer's Blackbird, RUBL = Rusty Blackbird, COGR = Common Grackle, GTGK = Great-tailed Grackle, BTGK = Boat-tailed Grackle, BHCO = Brown-headed Cowbird, BROC = Bronzed Cowbird

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Appendix 2. Update on DRC-1339 usage from FY16-FY20.

WS took an annual estimated average of 1,507,858 target birds of 14 species using an annual average 16,233 grams (572 oz. or 36 lbs.) of DRC-1339 in 30 states (total 36 states in the 5 years) from FY16 to FY20 (Table 2.1). This was less use of DRC-1339 and take for all species; this decrease was likely due to a combination of the COVID 19 pandemic and shortage of chemical; the company that manufactured DRC-1339 stopped and it took a while for another company to start producing it. During this time, WS applied DRC-1339 under 18 Section 3 and SLN (Section 24(c)) labels operationally (Table 2.2). The most common resources protected by WS were livestock and feed, aircraft, other wildlife, and crops. The species groups taken were starlings and blackbirds (99.0%), corvids (0.7%), and pigeons (0.3%), and minimal gulls (>0.1%). The most common target species lethally taken were European starlings (45%), red-winged blackbirds (30%), brown-headed cowbirds (19%), and common grackles (5%) (Table 2.2), similar to FY11-FY15. Weight-wise by grams used, the majority of DRC-1339 targeted starlings (84%), common ravens (7.3%), red-winged blackbirds (2.6%). feral pigeons (1.8%), brown-headed cowbirds (1.6%), and American crows (0.9%); 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 and baits were picked up. Most all projects had the take estimated using a WS estimator. The few that did not, if it did not say anything like "rained on bait, so picked up" or picked up bait because birds did not come" on the work task, then take was estimated at standard rates (e.g., 76 starlings/g) based on prior discussion of numbers taken, copied below. During this time, no nontarget species were documented to be taken.

Table 2.1. The annual average number of birds WS killed with DRC-1339 treated baits in bird damage management from FY16 through FY20. 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 That Used DRC-1339**
Target			
European Starling*	674,166	13,630.0	CA CO CT IA ID IL KS MA ME MI MN MO MT ND NE NM NV NY OH OK OR PA SD UT VA VT WA WI WV WY
Yellow-headed Blackbird	420	3.1	NM
Red-winged Blackbird	451,337	414.6	CO LA NH OR TX WA
Brown-headed Cowbird	289,844	248.8	LA NM OK OR TX WA
Brewer's Blackbird	300	1.8	CA OR
Common Grackle	76,707	203.2	LA OK TX
Great-tailed Grackle	236	3.2	AZ NM TX
Rock Pigeon*	3,701	294.2	CO IA ID KS MD ME MI MO MT ND NE NM OK SD TN UT VT WV WY
Eurasian Collared-Dove	520	34.6	ID NM WA
California Gull	10	3.2	ID
Black-billed Magpie	449	67.8	MT OR UT WY
American Crow	2,133	150.8	CA MA NM OK OR TX WY
Fish Crow	1	0.2	MA
Common Raven	8,034	1,178.0	CA ID MA MT NM NV OR TX UT WA WY
GRAND TOTAL (14 sp.)	**1,507,858**	**16,233.5**	**36 States (Ave. 30/year)**

* Introduced species

As of 2022, WS has 9 active labels and DRC-1339 SLN registrations (the Bird Control label and 4 SLNs under it and the LNFD label and 3 SLNs under it) (Table 2.2). While 20 labels were used between FY16 and FY20, most were cancelled and not used following the registration of the Bird Control label since it included most uses (Table 2.2). Many of the cancelled labels and a few other labels had very few work tasks (WTs) associated with them, which correlates to minimal DRC-1339 use. The Feedlots, Staging Areas, and Bird Control labels had the greatest use of DRC-1339, but the Livestock, Nest & Fodder Depredations had the most WTs. Most of these WTs were associated with setting out a minimal number of eggs to take common ravens and American crows depredating threatened and endangered species.

Table 2.2. The annual average number of grams of DRC-1339 applied by APHIS-WS in WDM from FY16 thru FY20 by all labels with the annual average number of Work Task (WT) or applications.

ANNUAL AVERAGE DRC-1339 USE BY PRODUCT FOR FY16 TO FY20			
Shortened Product Name or SLNs' State Registered (SLN Parent Label)	**EPA Registration No.**	**Applied (g)**	**WTs**
Feedlots* Cancelled	56228-10	8,130.5	122
Gulls* Cancelled	56228-17	3.2	0.6
Pigeons* Cancelled	56228-28	110.3	8
Livestock, Nest & Fodder Depredations (LNFD)	56228-29	315.0	330
Staging Areas* Cancelled	56228-30	1,433.9	73
Bird Control	56228-63	5,309.4	103
SLN ID (Feedlots)** Cancelled	ID-050014	10.8	0.2
SLN ID (LNFD)^	ID-140005	12.2	4
SLN ID (Staging Areas)* Cancelled	ID-050013	0.4	0.2
SLN IL (Feedlots) Cancelled	IL-120002	13.8	1
SLN NV (LNFD)^	NV-150001	163.3	50
SLN NV (LNFD) Cancelled	NV-040004	319.9	89
SLN NV (Staging Areas)* Cancelled	NV-020005	15.1	2
SLN OK (Staging Areas)** (Replaced by OK-180002 in 2018)	OK-990001	85.1	16
SLN OR (Staging Areas)** (Replaced by OR-190004 in 2019)	OR-010024	44.2	0.6
SLN TX (SA)** (Replaced by TX-190006 in 2019)	TX-020003	2.8	0.4
SLN UT (LNFD) Cancelled	UT-130005	62.8	3
SLN WV (Staging Areas)* Cancelled	WV-040001	7.2	3
SLN WY (LNFD)^	WY-110002	246.5	61
SLN WY (Staging Areas)** (Replaced by WY-180003 in 2018)	WY-070002	54.9	2
TOTAL	**6 FEDERAL**	**16,341.3**	**869**

Lightly shaded lines - registrations with no use from FY11-FY15.
* USEPA Registration No. 56228-63 - Bird Control label fully replaced these labels by January 2019.
** Labels not fully incorporated in Bird Control label, cancelled, and re-registered by the state under the Bird Control parent label, or no longer used and cancelled by January 2019.
^ SLN labels are still registered under the LNFD parent label.