Herbicide Strategy

to Reduce Exposure of Federally Listed Endangered and Threatened Species and Designated Critical Habitats from the Use of Conventional Agricultural Herbicides

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Office of Pesticide Programs
Office of Chemical Safety and Pollution Prevention
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Table of Contents

List of Other Documents Included in the docket to support this final Herbicide Strategy

- Appendix A: Listed plant and obligate information, overlap analysis and species included and excluded from Pesticide Use Limitation Areas

- Appendix B: Pesticide Runoff Vulnerability Mitigation Relief Points

- Application of EPA's Runoff and Erosion and Spray Drift Mitigations Through Scenarios that Represent Crop Production Systems in Support of Endangered Species Strategies, dated August 2024

- Ecological Mitigation Support Document to Support Endangered Species Strategies, Version 1.0, dated July 2024

- Crosswalk of EPA's Ecological Mitigation Measures with USDA NRCS Conservation Practices in Support of EPA's Endangered Species Strategies, Version 1.0, dated August 2024

- Response to Public Comments Received on the Draft Herbicide Strategy, dated August 2024

1. Executive Summary

When the Environmental Protection Agency (EPA or Agency) takes an action on a pesticide registration (*e.g.,* registers a pesticide or reevaluates it in registration review) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Agency is responsible under the Endangered Species Act (ESA) to ensure that the action is not likely to jeopardize the continued existence of federally threatened or endangered (referred to as "listed") species, or result in the destruction or adverse modification of their designated critical habitats. Chemical stressors, such as pesticides, are one of many factors that can contribute to population declines of listed species. Meeting this ESA responsibility is a formidable task, considering the tens of thousands of pesticide products and registration amendments for which EPA is required to review the potential effects for over 1,700 U.S. listed species.

Given these challenges, in April 2022, EPA released a workplan (USEPA, 2022a) and an update to the workplan in November 2022 (USEPA, 2022b) that describe how it plans to meet its ESA obligations as part of pesticide registration processes under FIFRA. The update also describes strategies for identifying early mitigation measures to address potential population-level impacts to listed species across groups of chemicals (*e.g.*, herbicides, rodenticides, insecticides) or in certain regions of the U.S. These strategies intend to more efficiently determine whether, how much, and where mitigations may be needed to protect listed species from many uses of conventional pesticides. This final Herbicide Strategy is another key step in meeting this goal.

This Herbicide Strategy covers only conventional herbicides - an important, widely used tool for growers to prevent or eliminate weeds that compete with crops for light, moisture, and nutrients. EPA focused the strategy on agricultural uses in the lower 48 states because hundreds of millions of pounds of herbicides (and plant growth regulators) are applied each year (USEPA, 2017), which is substantially more than for non-agricultural uses and for other pesticide classes (*e.g.*, insecticides, fungicides). In addition, there are hundreds of species listed by the U.S. Fish & Wildlife Service (FWS)[1] in the contiguous U.S. The mitigations identified in the strategy would address potential impacts to listed plants (terrestrial, wetland, and aquatic), which are the types of species likely to be most impacted by herbicides. By identifying mitigations to protect plants, listed animal species that depend on plants would also be protected. This includes animals that depend on plants for food and shelter (habitat). By identifying and defining mitigations for these listed plant and animal species, EPA will consider and apply this final Herbicide Strategy as appropriate in FIFRA actions, which should result in reductions of population-level impacts to over 900 listed species in the lower 48 states.

The Herbicide Strategy is intended to create a consistent, reasonable, transparent, and understandable approach to assess potential impacts and identify mitigations to reduce potential population-level impacts to listed species from the use of agricultural herbicides. The strategy does not include ESA effects determinations, but instead is meant to identify proactive mitigations that can be applied in registration and registration review actions to reduce pesticide impacts to listed species. The strategy is intended to provide similar and consistent mitigations for herbicides with similar characteristics (*e.g.*,

[1] EPA is separately working with the National Marine Fisheries Service (NMFS) to develop a programmatic consultation process to address potential impacts of herbicides to NMFS' listed species and their critical habitat.

exposure, toxicity, application method) that are applied to the same crops. This approach creates equitable mitigations based on objective criteria and more predictability for applicators, growers, and other stakeholders.

The Herbicide Strategy includes a three-step decision framework for EPA to use when considering FIFRA actions for herbicides (such as new chemical registrations and registration review), including how to apply mitigations from the strategy. **Step 1** establishes the potential for population-level impacts to the listed species as not likely, low, medium, or high. The low, medium, and high categories indicate a potential concern for population-level impacts that may need mitigation. The first step relies on a refined assessment of potential impacts to plants that builds from EPA's longstanding ecological assessments (uses the typical environmental fate and toxicity data submitted by registrants and EPA's standard models for estimating exposures). This strategy refines assessment processes that evaluate effects to individual organisms or small groups of individuals by considering more realistic and less conservative toxicity endpoints that represent impacts to populations and communities of plants. The refined assessment process also considers whether EPA's standard exposure models represent a listed species' habitat and adjusts the identified level of mitigations to address overly conservative assumptions that would not apply to a particular species.

The refined assessment considers direct impacts to listed plants in terrestrial, wetland, and aquatic areas. The assessment also considers indirect impacts to listed animals from loss of their plant habitat and/or diet. EPA begins by considering the proposed and registered uses of the herbicide (*e.g.,* application rates, crops, application methods), fate in the environment (*e.g.,* major transport routes off field and degradation), likely exposures for listed species to the herbicide, and the toxicity of the herbicide to listed species and habitats of listed species.

In **Step 2** of the Herbicide Strategy, EPA uses the potential for population-level impacts to plants identified in **Step 1** to identify levels of mitigations needed to reduce spray drift and runoff/erosion to non-target habitats to levels that are not likely to impact populations of listed species. EPA developed menus of spray drift and runoff/erosion mitigations from practices that EPA has deemed effective at reducing spray drift or runoff into these habitats, and that are available to growers and other applicators in different parts of the country. The menus in this final Herbicide Strategy improve on those in the draft strategy by incorporating feedback EPA received on the draft strategy from a variety of groups. The amount of mitigation identified in **Step 2** depends on the potential for population-level impacts identified in **Step 1** (*e.g.,* low impacts would be addressed with less mitigation than medium or high potential impact classifications). To mitigate spray drift exposure, EPA would generally identify a spray drift buffer with a length that increases as the corresponding potential for population-level impacts increases. To address impacts from runoff/erosion, EPA would identify mitigation points: 3 points of mitigation for low impacts, 6 points for medium impacts, and 9 points for high impacts. In developing this point system, EPA incorporated several refinements into the mitigation approach, including considering variability in runoff intensity across the U.S. to account for differences in runoff mitigation needed.[2]

[2] This approach incorporated concepts from EPA's refined assessment methods, such as the Spatial Aquatic Model, to identify areas where lower levels of exposure compared to its conservative screening models would result in less need for mitigation.

EPA updated the mitigation menus based on public comment on the draft strategy that was released in July 2023. EPA also worked with the U.S. Department of Agriculture (USDA) and other organizations to identify and add other effective and practical measures to the menus for growers of different crops in different areas of the country. In May 2024, for example, the EPA and USDA hosted a workshop with agricultural stakeholders to identify other possible measures to add to the menus, particularly for specialty crops. The mitigation menus in this final Herbicide Strategy include more mitigation options to provide flexibility for growers, while still protecting listed species.

The strategy reduces the level of mitigation needed (fewer points needed for run-off and erosion and reduced buffer distances for spray drift) for growers who have already implemented certain measures to reduce pesticide runoff (*e.g.,* installed tailwater return systems), who are in areas less prone to pesticide runoff such as flat lands and regions with less rain to carry pesticides off fields, or who use measures to reduce pesticide drift (*e.g.,* use larger droplet sizes or have drift barriers downwind of the application). EPA assigned two points of mitigation relief to counties with medium runoff potential, three points to counties with low runoff potential, and six points to counties with very low runoff potential. Thus, for example, if six mitigation points were identified for a specific use of an herbicide but application is in a geographic area with very low runoff potential, then no mitigation points associated with this strategy would be needed for that use. **Figure 9** in this strategy depicts the runoff potential of each county in the contiguous U.S.

In **Step 3** of the Herbicide Strategy, EPA identifies where in the contiguous U.S. the mitigations identified in **Step 2** would apply. In some cases, EPA expects the mitigations would apply across the full spatial extent of a use pattern (*e.g.,* specific crops) within the contiguous U.S. In other cases, through its FIFRA actions, EPA plans to require any necessary mitigations only in geographically-specific areas (referred to as Pesticide Use Limitation Areas or PULAs). Pesticide applicators would be responsible for reviewing these specific areas located on the EPA's Bulletins Live! Two (BLT) website to determine whether they are required to abide by any geographically-specific mitigations. Further, EPA is in the process of refining maps for these PULAs so that any resulting mitigations are targeted to protect listed species while minimizing impacts to users.

Taken together, the three-step framework includes many refinements to EPA's standard process to assessing the potential for population-level impacts for listed species and identifying mitigations to address those impacts. The refinements consider concepts such as variability in exposure across geography, usage, and differences in listed species biology and habitats when evaluating potential impacts to listed species. The strategy will allow EPA to confidently identify when the uses of an herbicide are likely to cause impacts to listed species populations. These refinements will result in identifying restrictions for use of herbicides only where they would be needed.

This final Herbicide Strategy is not self-implementing. EPA will implement the strategies through its FIFRA actions in registration and registration review. This document explains how EPA plans to consider and apply the strategy to conventional new active ingredient registration actions and conventional registration review actions. As is current practice, EPA will seek public comment on these new chemical

registration and registration review actions that would include, among other things, descriptions of how a specific strategy (*e.g.,* herbicide, insecticide, rodenticide, Hawaii, etc.) was applied to the action.

For this strategy, when appropriate, EPA may propose label language as part of a FIFRA action that directs a user to access the BLT website for geographically specific mitigations through Bulletins. The Agency may propose label language that requires mitigation measures irrespective of where the pesticide is applied. EPA may also propose label language that requires a specific level of mitigation and directs the user to a mitigation menu website. EPA may propose one or more of these for FIFRA actions. Using a website allows EPA to update the menu over time with additional mitigation options, which allows applicators to use the most up-to-date mitigations without requiring pesticide product labels to be amended each time new measures become available. Further, EPA may determine that additional mitigations would be appropriate for some listed species beyond the mitigations on the general pesticide product label. Those additional mitigations would be identified on Bulletins accessed through EPA's BLT website. Thus, mitigation measures may appear in up to three places: on a product label, on a mitigation menu website, and in Bulletins.

EPA understands that some pesticide users may find the spray drift and runoff/erosion mitigation described in this strategy complicated. EPA has developed a document, "Application of EPA's Technical Runoff and Spray Drift Mitigations Through Scenarios that Represent Crop Production Systems in Support of Endangered Species Strategies," that details multiple real-world examples to illustrate how a pesticide applicator could comply with the listed species mitigation measures or benefit from the mitigation relief described in this document. To help applicators consider their options, EPA is also developing a calculator that applicators could use to help them determine what mitigations are already in place and what further actions they may need to take. EPA also plans to continue to develop educational materials to help applicators, growers, and other agricultural stakeholders understand and employ listed species mitigation. EPA may also apply other ESA strategies (*e.g.*, Hawaii Strategy) and the Vulnerable Species Pilot to an herbicide action once these are final. EPA continues to work with stakeholders to identify potential offset opportunities for herbicides and other types of pesticides.

To help pesticide users properly implement the runoff/erosion measures identified in this strategy, EPA encourages users to consider seeking help from technical experts or participating in a soil and water conservation program that can help implement those measures. The strategy includes one (1) mitigation relief point for those who use an expert that meets the three characteristics specified in the strategy. The strategy also includes two (2) mitigation relief points for those who participate in a conservation program that meets the five characteristics specified in the strategy. Additionally, the strategy includes one (1) point for those who keep written record of the measures they implement under this strategy.

To summarize, a user would follow the directions for use on the label and any subsequent steps to determine the total number of runoff mitigation points needed to achieve prior to applying a herbicide product:

- For a particular use, start with the number of runoff mitigation points (3, 6, or 9) needed, if any, as indicated on the pesticide label.

- Subtract the number of mitigation relief points, if any, for farming conducted in geographic areas determined to have limited runoff potential, or other reasons specified in this strategy.
- Subtract the number of mitigation relief points, if any, for working with an expert, participating in a conservation program, and/or tracking mitigation measures.
- Subtract the number of mitigation points, if any, for mitigation measures from EPA's menu that the user has already implemented.
- The result is the total number of points that a user would need to achieve to apply the herbicide product. After these subtractions, if mitigation points are still greater than or equal to 1, the user would need to find enough measures from the mitigation menu to meet or exceed those remaining mitigation points. In other situations, a user might not need to employ any additional mitigations measures from this strategy before applying a pesticide. For example, if a grower applies a pesticide that specifies 6 points of runoff mitigation in a county with very low runoff potential (6 points of mitigation relief), that grower would not need to employ any additional runoff mitigation measures. EPA has identified 462 counties across 12 states with very low potential that would receive 6 points of mitigation relief, 780 counties across 37 states with low potential that would receive 3 points of mitigation relief, and 1536 counties across 44 states with medium potential that would receive 2 points of mitigation relief (**Appendix B**).

Similar to runoff mitigation, the user would rely upon the product label and BLT to identify the level of spray drift mitigation required and where it would apply. Additional information on spray drift mitigations may also be located on EPA's mitigation menu website. In many instances, the user could reduce the size of a spray drift buffer, if a label specifies one, by employing any of the several spray drift buffer reduction mitigation options as described in the strategy. However, the maximum buffer distance may still be needed for some applications. For other applications, the surrounding conditions and/or buffer reduction mitigations may eliminate the need for a spray drift buffer altogether. Pesticide labeling will more precisely describe what measures would be needed and where additional information describing the measures can be found, if necessary.

Finally, this strategy should increase the efficiency of future pesticide consultations with FWS. EPA has coordinated with FWS on the development of this final strategy. EPA and FWS expect to formalize their collective understanding of how this strategy can inform future biological evaluations and consultations. Thus, implementing the Herbicide Strategy through FIFRA actions would provide earlier mitigation measures to protect the listed species most impacted by herbicides even before effects determinations are made or consultations are completed, thereby accelerating EPA's ability to meet its ESA obligations for all conventional herbicides, reduce the legal vulnerability of EPA's pesticide decisions, and better ensure the continued availability of pesticides.

2. Introduction

2.1 Background

EPA regulates the sale, distribution, and use of pesticides under FIFRA and the Federal Food, Drug, and Cosmetic Act. EPA considers applications for pesticide products containing new active ingredients and new uses of currently registered pesticides and decides whether to register these products. If the application meets the standard for registration under FIFRA section 3, EPA approves the application with any necessary restrictions on its sale, distribution, or use. FIFRA section 3(g) requires that EPA periodically reevaluates existing registered pesticides as part of registration review. In addition to EPA's obligations under FIFRA to regulate pesticides, EPA also has obligations under the ESA. Under ESA Section 7(a)(1), all federal agencies shall "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species." Under Section 7(a)(2), federal agencies shall insure that their actions are "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species." Where appropriate for a FIFRA action, EPA may be required to consult with the FWS and National Marine Fisheries Service (NMFS) (the Services) to ensure that the relevant actions are not likely to jeopardize the continued existence of listed species or adversely modify their designated critical habitats.

Plant Type Definitions

A **dicotyledon (dicot)** is a flowering plant species that has 2 seed leaves and flower parts are in 4s or 5s. Dicots are often referred to as "broadleaves." Examples of dicots are violets, roses, sunflowers and milkweed.

A **monocotyledon (monocot)** is a flowering plant species with one seed leaf and flower plants are in 3s. Examples of monocots include grasses, orchids and lilies.

A **non-flowering plant** does not produce flowers. Examples of non-flowering plants are ferns and lichens.

In past decades, the Agency has had trouble meeting its Section 7(a)(2) obligations for the thousands of pesticide actions it completes annually under FIFRA. The entire process, including consulting with the Services to implement protections they determine are necessary through biological opinions, can take years for a single pesticide. EPA expects that thousands of FIFRA actions could require an ESA review over the next decade. EPA has been unable to keep pace with its ESA workload, resulting in the need for more efficient approaches for integrating listed species evaluations and protections into pesticide registration activities even before ESA effects determinations are made or consultations with the Services are completed.

In its April 2022 workplan (USEPA, 2022a), "Balancing Wildlife Protection and Responsible Pesticide Use: How EPA's Pesticide Program Will Meet its Endangered Species Act Obligations" (the "workplan"), EPA described several challenges to implementing timely and effective strategies for specifically protecting listed species from possible pesticide impacts. The workplan also described how EPA is working to 1) improve assessment of potential impacts to listed species in its pesticide evaluations, 2) increase efficiency of the consultation processes, and 3) implement through registration and registration review actions protections for listed species prior to completion of effects determinations or consultations, if

necessary. In November 2022, EPA released an update to the workplan (USEPA, 2022b) which described EPA's efforts to reduce pesticide exposure to non-target organisms, including listed species, during the FIFRA registration and registration review processes.

As described in the update, EPA is developing a series of strategies that group mitigations by pesticide type, use site, location, or other consideration. These strategies are intended to inform EPA's registration and registration review decisions to address landscape level exposures and impacts to listed species. This strategy is intended to identify early protections for hundreds of FWS listed species. Once implemented through FIFRA actions, the protections would substantially improve the efficiency of mitigating and consulting on pesticides, and result in conservation actions being implemented sooner and at a landscape scale. As part of the development of this strategy, EPA worked with FWS and continues to do so. This coordination lays a foundation for further efficiencies in the FIFRA-ESA consultation process. The Herbicide Strategy focuses on listed species under the jurisdiction of FWS as they have authority over approximately 95% of the listed species in the contiguous U.S. EPA is separately working with the National Marine Fisheries Service (NMFS) to develop a programmatic consultation process to address potential impacts of herbicides to NMFS' listed species and their critical habitat.

This strategy supports EPA's commitment to achieve early protections for over 900 listed species and their critical habitat potentially directly or indirectly affected by conventional herbicides. The strategy incorporates improvements based on public comments on the draft Herbicide Strategy to increase flexibility and improve ease of implementation while still protecting listed species. EPA identified mitigations focused on those that would reduce spray drift and runoff/erosion transport to non-target areas from agricultural uses in the contiguous U.S. and on mitigating impacts to species that are similar to the target pests of the pesticides (*i.e.,* for herbicides, mitigations focus on non-target plants).

The Herbicide Strategy takes a different approach to mitigating direct impacts to listed species that are taxonomically similar to the target pests than the approach for mitigating impacts to listed animal species that rely on a variety of plants (generalists). Often less mitigation is identified for these generalists than for listed plants or species that are "obligate" listed species (*i.e.,* they rely on one (or a small number) of listed plant species that may be directly affected by the use of a specific herbicide). The literature may refer to obligate species using different terms, such as 'specialist.' This document will refer to these types of species as obligates. Further, in this final strategy, EPA assumes that listed plants or other non-target plants do not need on field mitigations because the majority of species are not likely to occur on highly managed agricultural areas.

2.2 Scope and Goals of the Final Herbicide Strategy

This strategy covers conventional herbicides and plant growth regulators (referred to as "herbicides" throughout this document) and is focused on agricultural uses[3] of herbicides in the contiguous United States (CONUS). The strategy focuses on mitigating population-level impacts on listed species that may be caused by impacts to listed plants. The two major mitigation components for listed species are: mitigating direct impacts on listed plants and mitigating impacts on listed animals that depend on listed

[3] To include cultivated land (including orchards, vineyards, Christmas trees, row crops, specialty crops, and flooded crops) but not pasture/grass or range lands.

plants for food (diet) or shelter (habitat). Based on this, EPA included in this strategy 450 listed plant species[4,5] (**Figure 1**), most of which are broadleaf plants, which are a type of flowering plants referred to in this document as "dicots." Other types of listed plants include monocot flowering plants (*e.g.*, orchids, grasses) and non-flowering plants (*e.g.*, lichens[6], ferns, pines). Examples of monocots and dicots are included in **Figure 3**. There are nearly 580 listed animal species in the contiguous U.S. (under FWS authority) that depend on plants for food or shelter (**Figure 2**).

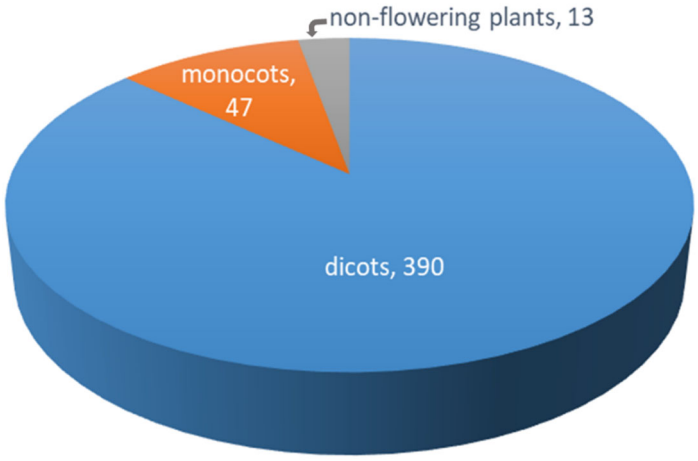

Figure 1. Number of dicot, monocot, and non-flowering listed plant species in contiguous United States. Dicots and monocots are types of flowering plants.

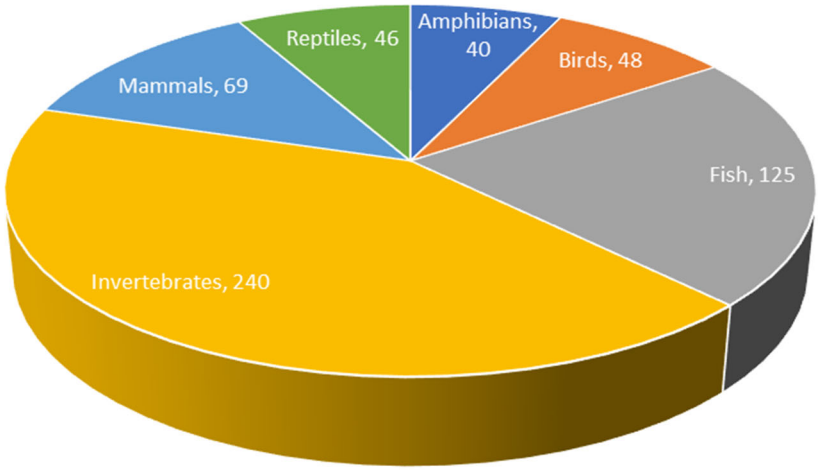

Figure 2. Types (*i.e.,* taxa) and numbers of listed animal species that depend on plants for food or shelter.

[4] This total reflects the number of unique listed species as of December 1, 2023. This includes federally listed endangered, threatened, and proposed species.

[5] Listed species being considered under EPA's Vulnerable Species Pilot are also excluded from consideration in the Herbicide strategy.

[6] Lichen are organisms that consist of a fungal and algal symbiotic relationship. The closest toxicity data surrogate EPA has for lichen are plants therefore they are lumped together with the non-flowering plants.

Figure 3. Examples of listed plant species. Top: Kincaid's lupine, a dicot. Bottom left: eastern prairie fringed orchid, a monocot. Bottom right: Florida bristle fern, a non-flowering plant. Images from FWS.[7,8,9]

[7] https://www.fws.gov/species/kincaids-lupine-lupinus-sulphureus-ssp-kincaidii?aggregated_content_type=%5B%22Image%22%5D

[8] https://ecos.fws.gov/ecp/species/601

[9] https://www.fws.gov/media/castellow-bristle-fern-heather-hitt-usfwsjpg

The Herbicide Strategy focused on agricultural uses (*e.g.,* row crops, orchards) given the high degree of herbicide usage in these areas and the similarity of mitigation measures that apply to these uses. In 2022, approximately 264 million acres of cropland were treated with herbicides according to the Census of Agriculture.[10] In this strategy EPA focused on agricultural uses, which account for more than half of the U.S. land base.[11] Despite covering only agricultural uses, this strategy is expected to make great strides in protecting listed species. The primary goals of the Herbicide Strategy include:

1. Identifying mitigations for listed species likely impacted at the population-level by the agricultural use of conventional herbicides;
2. Considering mitigations that would reduce major routes of herbicide exposure to listed species;
3. Improving the efficiency of future ESA consultations on conventional herbicides including, where appropriate, applying the final strategy to future registration and registration review actions; and
4. Increasing regulatory certainty for growers and other stakeholders regarding the use and availability of conventional herbicides.

Each of these goals is discussed more below. Goal three is described in the implementation section of this document.

Identifying Early Protections. This strategy focuses on developing and implementing mitigations to protect listed species earlier in the registration and registration review process before EPA makes ESA effects determinations or completes any necessary consultation with FWS for more than 450 listed plants. It also includes identifying mitigations to protect nearly 580 listed species that depend on plants for food or shelter and explaining how the strategy would be implemented in FIFRA actions. The goal of the mitigations are to minimize exposure from the use of conventional agricultural herbicides that EPA registers or reevaluates. This effort would reduce the potential for population-level impacts, which could reduce the likelihood of future jeopardy or adverse modification and increase efficiency in future consultations with FWS. EPA expects that implementation of this final strategy through FIFRA actions will protect listed species from potential population-level herbicide impacts.

Reducing Major Routes of Exposure. EPA identified mitigation measures for conventional agricultural herbicides that have the potential to reduce off-field pesticide exposure via spray drift (pesticide movement as spray droplets at the time of application) and runoff and/or erosion (pesticide movement with water and/or soil) that would likely result in exposure of listed species and impact their populations. EPA focused on measures to reduce spray drift, runoff, and erosion transport because FIFRA risk assessments commonly identify risk concerns for plants in terrestrial, wetland, and/or aquatic habitats due to offsite transport of herbicides via these exposure pathways. This strategy does not cover other potential exposure routes for a chemical or species (*e.g.*, volatilization, bioaccumulation in aquatic food webs). This strategy also does not include evaluation processes or describe mitigations associated with protecting human health. These types of considerations would be included in the FIFRA registration or registration review actions along with all other non-target ecological exposures (*e.g.*, to fish, birds, mammals) that are not included in this strategy, as appropriate for the specific chemical and use.

[10] www.nass.usda.gov/AgCensus

[11] https://www.ers.usda.gov/topics/farm-economy/land-use-land-value-tenure/

Improving Efficiency of ESA Consultations. EPA expects this strategy will help improve the efficiency of future pesticide consultations with FWS.[12] Currently, the process for assessing and mitigating effects to listed species takes many years to complete. This process typically starts with EPA conducting a chemical-specific effects determination that is included in a biological evaluation. The assessment analyzes the potential effects of the FIFRA action (*e.g.,* assessment of all uses for a particular active ingredient) to one or more individuals of all listed species. If EPA finds that effects may occur to one or more individuals of a listed species or to the physical and biological features of designated critical habitat, EPA initiates consultation (informal or formal) with the responsible Service. EPA initiates informal consultation when it concludes that its action may affect but is not likely to adversely affect listed species or their designated critical habitat. At the end of informal consultation, the Service will either provide concurrence with EPA's finding that the effects are not likely to adversely affect a listed species or destroy or adversely modify designated critical habitat and the process ends, or the Service may recommend EPA initiate formal consultation.

EPA initiates formal consultation when it concludes that its actions are likely to adversely affect one or more listed species or its designated critical habitat. More recently, consistent with the ESA counterpart regulations[13], EPA provides to the Service(s) predictions of the potential likelihood of future jeopardy or adverse modification for such species in the biological evaluation or during formal consultation. During formal consultation, the Service(s) determine whether the action is likely to result in jeopardy to the listed species or destruction or adverse modification of designated critical habitat. In addition, during formal consultation, EPA, the Service(s), and the pesticide applicant/registrants discuss needed measures to mitigate likely jeopardy, destruction, or adverse modification determinations made by FWS in the draft Biological Opinion. At the end of formal consultation, the Service(s) will generate a final biological opinion where it documents its evaluation, including agreed upon conservation measures, reasonable and prudent measures, and/or reasonable and prudent alternatives as applicable. Before Biological Opinions are finalized, EPA solicits public comments on draft versions of the opinions to ensure that the public has an opportunity to review and comment on them.

Historically, EPA and the Services have completed the consultation process for relatively few conventional herbicides due in part to the complexity and length of the ESA consultation process. This strategy involves a substantial and necessary change in process to identify and mitigate potential impacts from agricultural uses of conventional herbicides using a streamlined analysis even before EPA makes effects determinations or initiates/completes consultation. To this end, FWS provided input on the development of this strategy.

EPA and FWS expect to formalize their collective understanding of how this strategy can be used to inform future biological evaluations and consultations. EPA is working with FWS to develop a plan to: 1) help further the conservation and recovery of listed species by reducing pesticide exposures and resultant impacts to listed species, which includes this strategy; and 2) streamline section 7(a)(2) consultations on specific actions based on the analysis described in this strategy. Implementation of the

[12] Listed species overseen by the National Marine Fisheries Service are currently being address through programmatic consultation.

[13] 50 CFR Part 402, subpart D

Herbicide Strategy would identify mitigations to be used in FIFIRA actions to protect the listed species most impacted by herbicides more quickly and accelerate the EPA's ability to meet its ESA obligations for a particular herbicide and across the herbicide classes.

Regulatory Certainty. The Herbicide Strategy will also provide greater regulatory certainty about the level and type of mitigation EPA would consider in future registration and registration review decisions. EPA further expects these efforts could reduce the legal vulnerability of the pesticide actions that include them, and thus lead to continued availability of these herbicides.

2.3 Public and State Input

EPA released the draft Herbicide Strategy for public comment on July 24, 2023. EPA received more than 18,000 comments from a variety of groups, including states, other federal agencies, the pesticide industry (*e.g.*, pesticide companies, applicators), grower groups, environmental groups, academics, and individuals. EPA received approximately 250 unique comments, with the remainder being from mail-in campaigns that either supported or opposed the draft strategy. In general, commenters reiterated the importance of protecting listed species from herbicides. Commenters also identified concerns with specific aspects of the draft strategy and suggested revisions. See accompanying response to comment document.

In addition to public comment on the draft Herbicide Strategy, the final strategy incorporates information and suggestions that EPA gathered during meetings with growers and grower groups, pesticide applicators, environmental groups, extension agents, registrants, mitigation measure providers, and certified crop advisors. EPA has also been working with the State FIFRA Issues Research and Evaluation Group (SFIREG) and the Association of American Pesticide Control Officials (AAPCO), to discuss, among other things, potential implementation challenges. EPA also hosted or participated in various conferences and workshops including an Interagency Workgroup Group Roundtable Meeting in February 2024 to obtain input on EPA's efforts to comply with the ESA for pesticide decisions, and a May 2024 Mitigation Workshop (which EPA co-hosted with USDA) to identify other effective and practical measures for growers of different crops in different parts of the country to add to the mitigation menus.

2.4 Case Studies

The draft Herbicide Strategy was informed by case studies of herbicides representing diverse modes of action, agricultural uses, environmental fate profiles and impacts. EPA conducted the case studies for illustrative purposes only and EPA does not intend to use them to support a future FIFRA action for a particular herbicide. Rather, the case studies allowed EPA to develop, evaluate, and revise the draft strategy. For example, the case studies helped EPA to identify differences in the sensitivity of different taxa. The case studies also helped EPA consider how these differences in sensitivity can allow EPA to identify more mitigation for more sensitive species and less mitigation for other species. This allowed EPA to protect listed species from population-level impacts while minimizing impacts of mitigation on growers in areas with less sensitive species. Not all herbicides will have the same amount of data, so it is not possible to differentiate sensitivities and mitigation levels of all species in those cases. The case studies were valuable for developing a decision framework for the strategy that is flexible and uses

available information and refinements for herbicides to identify the level of mitigation and where they would be expected to apply, as well as lessen mitigations when appropriate. The case studies developed to support this strategy are available in the docket. These case studies reflect the draft Herbicide Strategy, but each case study may not reflect all aspects of the final strategy.

2.5 Organization of This Document and Supporting Documents

The Herbicide Strategy is composed of two major parts: the framework for identifying mitigations and the plan for implementing the final strategy. **Section 3** explains the three-step framework that EPA will use to identify potential population-level impacts, identify mitigation measures to address these impacts, and determine the geographic extent of the mitigation measures in FIFRA actions. **Section 4** describes EPA's plan for implementing the strategy in FIFRA actions. This document includes several supporting appendices with more information on the 3-step strategy framework.

This strategy is informed by Version 1.0 of the *Ecological Mitigation Support Document to Support Endangered Species Strategies*[14] (referred to throughout this document as the "**Ecological Mitigation Support Document**"). The **Ecological Mitigation Support Document** contains supporting information on potential mitigation measures EPA identified to date and for which EPA has data on their efficacy in reducing exposure. The development of the support document includes consideration of stakeholder feedback and information collected during the development of the Herbicide Strategy. EPA expects the Ecological Mitigation support document to evolve as other strategies are developed and as the Agency obtains additional information on potential mitigations to add to the strategies. EPA expects to provide updated versions of the **Ecological Mitigation Support Document** in the future.

3. Herbicide Strategy Framework for Identifying Mitigation Measures

The decision framework in this strategy identifies the need for, level of, and extent of mitigation that could be needed when considering conventional agricultural herbicide FIFRA actions (**Figure 4**)**.** EPA developed this strategy to identify mitigation measures that could be applied consistently to decrease pesticide exposure, and thereby reduce the potential for population-level impacts to listed species from the use of conventional agricultural herbicides.

[14] This document replaces USEPA 2023. Draft Technical Support for Runoff, Erosion, and Spray Drift Mitigation Measures to Protect Non-Target Plants and Wildlife, released July 2023 in support of the draft Herbicide Strategy. https://www.regulations.gov/document/EPA-HQ-OPP-2023-0365-0007. EPA took comment on the earlier version of this document during the proposal of the draft Herbicide Strategy.

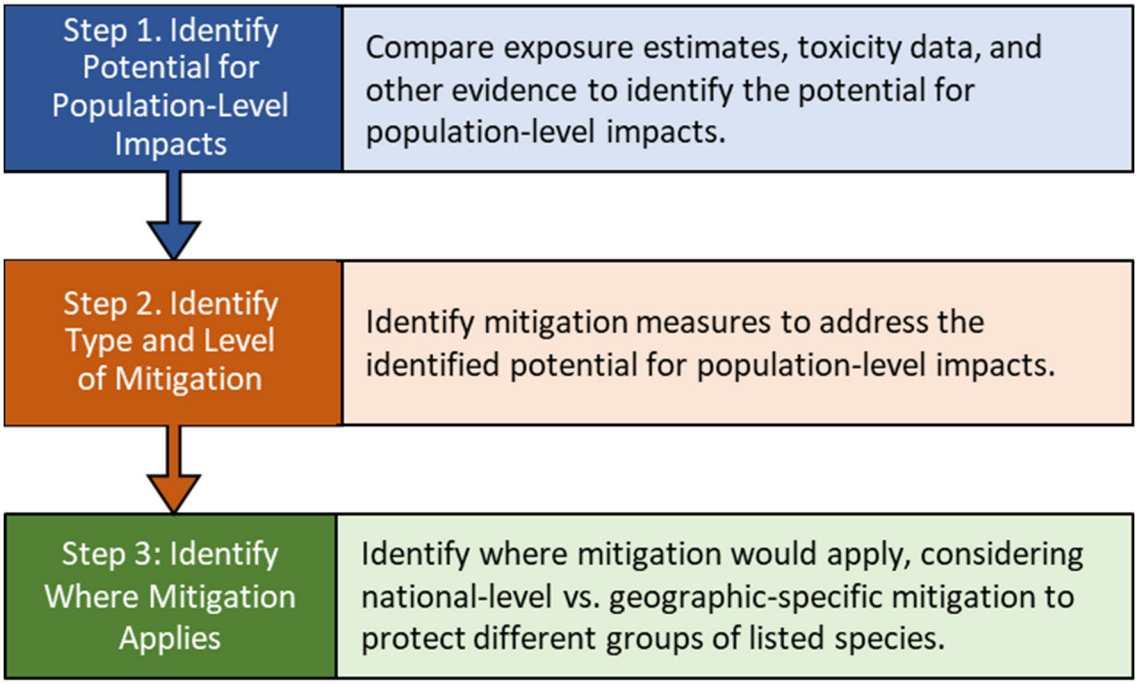

Figure 4. Overview of the Herbicide Strategy 3-step framework.

Step 1 establishes the process for assessing the potential for population-level impacts to the listed species. This step is based on long standing FIFRA risk assessment approaches EPA uses to identify potential ecological risk to non-target species, with additional considerations to refine the typical FIFRA risk assessment to account for evaluations of population level effects. In this strategy, EPA considers the use pattern and environmental fate characteristics of an herbicide to estimate exposures in aquatic, wetland, and terrestrial environments. EPA then compares these exposure estimates to toxicity data that are most relevant to the herbicide and relevant listed species. This comparison of exposure to toxicity is considered by EPA for determining the potential for population-level impacts to occur from an herbicide's registered or proposed use to listed species. In the assessments, EPA supplements this analysis with other information including available incident and monitoring data in addition to how well exposure and toxicity estimates reflect important characteristics of the listed species. This process results in the designation of not likely, low,[15] medium or high potential for population-level impacts to the grouped listed species, which are commensurate with a level of mitigation (**Step 2**).

Step 2 involves identifying the level of mitigation to reduce exposure via drift or runoff/erosion to address the potential for any identified population-level impacts. EPA identified a greater level of mitigation where the potential for population-level impacts is higher and less mitigation where there is a lower potential for population-level impacts. For reducing exposure from spray drift transport, EPA typically identifies a buffer. The distance associated with that buffer increases with the level of mitigation (low, medium, and high). If a buffer is identified, EPA identified other mitigation measures that a pesticide applicator could use to reduce that buffer distance. For reducing exposure from herbicide runoff/erosion, EPA identified a level of mitigation (none, low, medium, and high) as points, up

[15] A low potential for population-level impacts is a concern because there are still potential impacts. Low potential for impacts is associated with less mitigation.

to 9 points of mitigation. The point system allows for greater flexibility and inclusion of mitigation measures that have different levels of efficacy to address pesticides with different levels of potential impacts to different species. With few exceptions, the mitigations available for herbicides are expected to be the same as those available for insecticides because the application methods and approaches for reducing off-site transport are similar for both types of pesticides. The goals for spray drift and runoff/erosion mitigations are the same - mitigate potential for population-level impacts. Different approaches are used to communicate the level of mitigations and flexibility of options because of differences in the types of mitigations available, effectiveness of practices, and nature of exposure.

Step 3 involves identifying where in the contiguous U.S. the different mitigations for listed species identified in **Step 2** would apply. In some cases, EPA expects the mitigations would apply across the full spatial extent of a use pattern (*e.g.,* specific crops) within the contiguous U.S., specifying the mitigations on the general pesticide product label. In other cases, EPA expects the mitigations would apply in geographically specific areas only (referred to as Pesticide Use Limitation Areas or PULAs) through Bulletins using its web-based system, Bulletins Live! Two (BLT).

Taken together, the 3-step framework includes many refinements to EPA's standard process for assessing potential impacts and to identify mitigations to protect listed species from potential population-level impacts. The strategy considers higher tier concepts such as variability in exposure across geography and differences in listed species impacts and habitats beyond the typical FIFRA ecological assessment for non-target organisms. This strategy is intended as a process for EPA to identify when the uses of an herbicide have the potential for population-level impacts to listed species and how to identify effective and reasonable mitigations that are flexible and practical for growers of different crops and in different parts of the country. Additional information on each step is provided below.

EPA incorporated elements of FWS's approach to developing biological opinions for pesticides and identifying mitigations (*e.g.,* FWS 2022, FWS 2024) into the 3-step framework. For example, FWS assesses potential population-level effects by considering multiple factors such as pesticide exposures and impacts from direct toxicity and loss of diet or habitat, overlap with potential use sites, and usage of pesticides. FWS considers a combination of species-specific mitigations that could be included on pesticide product labeling, including directing applicators to EPA's BLT system as well as general label mitigations. EPA incorporated elements from FWS's approaches to align this strategy where there is a potential for population-level impacts and what early mitigations could be applied to address those impacts.

3.1 Step 1. Identify Potential for Population-level Impacts

The first step in the Herbicide Strategy is to identify potential population-level impacts of an herbicide's agricultural uses to listed plants (*i.e.,* direct impacts) and listed species that depend on plants (*i.e.,* indirect impacts). The population-level refined analysis in this strategy builds on EPA's standard FIFRA ecological risk assessment process for pesticides. Similar to the FIFRA ecological risk assessment (which generally assess impacts at an individual-level), the analysis for this strategy includes calculations of ratios of exposure to toxicity estimates for species grouped by toxicity and different exposures by habitat for population-level impacts.

A key component of this step is calculating the Magnitude of Difference (MoD) for each of the assessed herbicide uses. The MoD is the ratio of the herbicide exposure, known as the estimated environmental concentration (EEC), to its corresponding toxicity threshold value. MoDs are calculated for different types of exposures (spray drift, runoff/erosion), different types of habitats (*e.g.,* terrestrial, wetland and aquatic), and different groupings of species (referred to as "taxa", *e.g.*, dicots and monocots) when they differ substantially in their sensitivity to an herbicide. MoDs are also typically calculated for each labeled use (or groups of uses) of a pesticide, which may consider different application methods.

MoDs for assessing direct impacts to listed plants are based on toxicity thresholds for population-level impacts to a single species. Listed plant species relevant to the strategy include any listed plant species in terrestrial, wetland, or aquatic habitats that are likely exposed to herbicides from spray drift and/or

Key Definitions for Step 1 of the Herbicide strategy Framework

Magnitude of Difference (MoD): The MoD is the ratio of pesticide exposure to toxicity. Higher MoDs indicate greater potential for species/population-level impacts. For listed plants with direct impacts from herbicides (and listed obligate species), the denominator reflects the relevant population-level toxicity threshold. The MoD informs the potential for population-level impacts. For species that are generalists, the denominator reflects the relevant community-level impact threshold (*i.e.,* multiple species populations) since generalists depend on a community of species.

Direct Impacts: Adverse impacts to listed plants that may occur from direct exposure to herbicides. Examples include contact with herbicide spray droplets on plant tissues (*e.g.*, stems, roots, leaves) or plant uptake of contaminated runoff from a treated agricultural field.

Indirect Impacts to Obligates: In this analysis, obligate listed species are those that depend exclusively on a plant species or genus to survive. For example, the Karner Blue Butterfly (*Plebejus samuelis*) depends on wild lupine (*Lupinus perennis*) for its diet and is considered an obligate listed species to wild lupine. There are approximately 30 listed animal obligate species.

Indirect Impacts/Generalists: In this analysis, generalist listed species are those that depend broadly on aquatic, wetland, or terrestrial plants for its survival. For example, the Mississippi Sandhill Crane (*Grus canadensis pulla*) relies on many different types of terrestrial, wetland, and aquatic plants for diet and habitat and, therefore, is considered to have a generalist relationship with plants. The majority (~550 of 580) of listed animal species are generalists.

runoff/erosion from agricultural areas (examples in **Figure 3**).

MoDs for assessing indirect impacts to listed animal species which obligately depend on one or a few species of plants for survival (*i.e.,* "obligates") are also based on the same population-level toxicity thresholds as those for assessing direct impacts. This is because the survival of obligates depends on one or a few populations of plants. Examples of obligate species are the Fender's Blue Butterfly (*Icaricia icarioides fenderi*) and the Karner blue butterfly (**Figure 5**), which relies on Lupine (*Lupinus spp.*). The majority of listed species that are known obligates to listed plants are invertebrates, specifically butterflies. There are also listed birds and mammals that are obligate to plants, such as the Gunnison Sage-Grouse (*Centrocercus minimus*) and the Columbia Basin Pygmy Rabbit (*Brachylagus idahoensis*) which are obligate to sagebrush (*Artemisia spp.*).

Figure 5. Examples of listed animals that depend on plants. Left: Karner blue butterfly, which is an example of a listed animal species that is obligate to a plant species (wild lupine). Center: Mississippi sandhill crane is a listed generalist species. Right: California tiger salamander is also a listed generalist species[16,17,18]

Listed species of animals that generally depend on many different plant species for food or shelter are referred to as "generalists" (examples in **Figure 5**). MoDs for assessing indirect impacts of herbicides on generalists are based on toxicity thresholds for community-level impacts for plants. Typically, as EPA moves from protecting populations to communities, the relevant toxicity endpoints increase in concentration (*i.e.,* are less sensitive), and MoDs decrease. Sometimes the population- and community-level toxicity thresholds (and associated MoDs) are similar due to factors such as high toxicity across multiple plant species.

The MoD is comparable to the risk quotients (RQs) that EPA calculates and compares to regulatory Levels of Concern (LOC) in FIFRA assessments. RQs and MoDs are similar in that they both are a ratio of exposure to toxicity; however, they differ by the toxicity endpoint, estimated exposures, and how they are interpreted. RQs typically rely upon toxicity information more representative of potential effects to an individual organism. RQs also include assumptions of exposure in terrestrial, wetland and aquatic environments that represent potential exposure of an individual. EPA's standard LOC also looks at potential effects to an individual of a species (USEPA, 2004). When interpreting RQs, if the LOC is

[16] https://www.fws.gov/media/male-karner-blue-butterfly
[17] https://www.fws.gov/media/mississippi-sandhill-crane-3
[18] https://www.fws.gov/media/california-tiger-salamander-headshot

exceeded, EPA concludes that there is a potential risk and additional refinement is needed to determine the potential that adverse effects will occur. The RQ approach is conservative, deterministic, and intended to be used as a screen, where additional refinements can be done if appropriate.

MoDs and their interpretation for identifying mitigations (in **Step 2**) represent a more refined approach. MoDs use toxicity information, such as endpoints from a species sensitivity distribution as described later in this document, to represent potential population- or community-level impacts. Interpretation of MoDs considers concepts relevant to variability in exposures and responses, and to where the EPA standard FIFRA models may overpredict exposures (bias of the model's parameters in representing exposures to small ponds and wetlands when applied to other habitats, such as fast-moving streams and large rivers used by listed species). This refined approach is intended to help EPA confidently identify pesticide uses that have the potential for population-level impacts to a listed species. This refined approach also establishes the potential level of impacts (not likely, low, medium and high) to listed species' populations. That way, EPA can adjust the levels of mitigations to address the potential levels of impacts associated with the specific pesticides use.

EPA investigated the degree of variability of various data and analyses (*e.g.,* variability in laboratory testing, exposure estimates) and determined that when levels of potential population-level impacts are more than an order of magnitude (10x) different from each other, EPA has higher confidence that the impacts are actually different. Ultimately, EPA uses the MoD and other information to determine the potential population-level (or community-level) impacts according to **Table 1**.

Table 1. Relationship between the magnitude of difference and potential for population-level effects.

Magnitude of Difference (MoD)[1]	Potential for Population-Level Impacts[2]
<1	Not Likely
1 to <10	Low
10 to <100	Medium
≥100	High

[1] The MoD is the ratio of the exposure estimate to the relevant toxicity threshold value for population-level impacts (listed invertebrates and listed obligates) or community-level impacts (listed generalists).
[2] Other evidence being considered in the analysis may alter the assignment of categories of population/community-level impacts to the MoD ranges shown here. In some cases, bias in exposure or toxicity estimates, typically due to modeling assumptions, may increase the categories by 10X. In rare cases, the categories may be lowered by 10X.

MoDs that are >1 but less than 10 are classified as 'low' potential for population-level impacts to species. EPA considers other factors such as how EPA's standard modeling approach relates to species' habitats as described in the following paragraph when determining if a low level of mitigation is appropriate for a 'low' MoD.

In addition to the MoD ranges, EPA considers other information such as the level of confidence and bias in exposure or toxicity threshold estimates when assigning the potential for population/community-level impact to a listed species. For example,, EPA's EECs for the standard farm pond are typically used as a proxy to represent exposure of listed species in rivers and streams since EPA currently lacks a reliable exposure model for these flowing water systems. Previous analyses indicate that EPA's pond-based EECs

tend to overestimate exposures in rivers and streams by an order of magnitude or more (USEPA 2016). Similarly, EPA may base an MoD calculation on a wetland habitat, in these cases, EPA would use a higher MoD category to indicate a potential for population level impacts to account for expected lower exposure levels in such habitats relative to wetlands. Also, the model used to estimate spray drift tend to overestimate exposure for some habitats where substantial interception of spray droplets is expected (*e.g.,* forests, shrubland). Therefore, for listed species that live in such habitats, the potential for population-level impact categories shown in **Table 1** are assigned higher MoD ranges by one category (*i.e.,* an MoD range of 10 to <100 would equate to low potential for population-level impacts, representing the lower exposure and potential for population-level impacts in these habitats).

3.1.1 Developing Exposure Estimates for the MoD

The first step in estimating exposures for MoD ratios is to estimate the exposure level or EEC for a particular exposure route. EPA starts its exposure analysis by considering the currently registered or proposed uses of an herbicide. This includes the relevant crops, application rates, and methods of application. EPA also considers any existing or proposed mitigations that the registrant(s)/applicant(s) included on the pesticide product label or committed to in writing to amend their registration or application.

EPA uses its models to calculate EECs to which listed species may be exposed. EPA uses different models to calculate EECs depending on the exposure route and whether the species resides in an aquatic or terrestrial habitat. More specifically, EPA evaluates exposures for listed species using established standardized exposure models[19] to calculate aquatic and terrestrial EECs based on:

- Relevant application parameters (*e.g.,* application rates, application method, equipment) for the chemical
- Chemical-specific environmental fate characteristics (*e.g.,* ability to bind to soil particles or remain in water, half lives in soil and water)
- Ecological scenario (based on soil, climatic and agronomic practices to determine runoff)
- Modeled habitat where the listed species lives (*e.g.,* terrestrial area, wetland)
- Degree to which the habitat for a given listed species reflects EPA's modeling assumptions.

A list of exposure models that EPA typically uses is provided in **Table 2.** When this strategy is implemented to inform a particular registration or registration review decision, EPA will use the most recent exposure model. Additional details on the exposure modeling approaches included in the Herbicide Strategy can be found in **Appendix A**.

[19] Current models and their user guides can be found at https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment and https://www.epa.gov/endangered-species/models-and-tools-national-level-listed-species-biological-evaluations

Table 2. EPA's standard models currently used to assess exposure to herbicides.

Environment	Exposure/Transport Pathway (Relevant Habitat)	Models or Assumption
Terrestrial	Off-field spray drift exposure	AgDRIFT®
	Runoff and drift to terrestrial areas adjacent to treated areas	PAT (TPEZ)
Wetland	Off-field spray drift exposure	AgDRIFT®
	Runoff and drift to wetlands (includes vernal pools, non-riparian wetlands, and similar systems)	PAT (WPEZ)
Aquatic	Runoff and drift for EPA farm pond or larger waterbody (includes riparian wetlands, medium/fast flowing waters, ponds, lakes, reservoirs)	PWC

PAT = Plant Assessment Tool version 2.8 available online at: https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological#pat;
PWC = Pesticide in Water Calculator, available online at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#PWC
AgDRIFT® version 2.1.1 available online at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#AgDrift

In the Herbicide Strategy, EPA relied on these standard, conservative EECs to calculate MoDs. Variability associated with exposures and the conservative bias of the model estimates are all considered when interpreting the MoDs. EPA also considered cases where the habitat (*e.g.*, coastal, forest, desert) of a listed species is likely to result in overestimated exposures due to the type of habitat of the species and lower expected exposures compared to EPA's standard models. So, although the MoD includes conservative exposures for some habitats, EPA included refinements when it interprets these MoDs. EPA also accounts for assumptions it needs to make with respect to evaluating label directions when conducting an assessment at a national scale that may not apply to all users across the country. For example, EPA may assume that a user applies a pesticide at the maximum application rate. EPA understands that the actual application rate may vary by region and pest pressure but cannot exceed the maximum on the label. Therefore, users that apply a pesticide at lower rates or fewer number of times may need less mitigation to protect against population level impacts. EPA accounts for these and some other localized practices and environments through EPA's mitigation menus. These factors are described later in Section 3.2 of this document and in greater detail in the **Ecological Mitigation Support Document**.

For listed plant species in terrestrial habitats (and listed species that have an obligate relationship to a terrestrial plant), EPA assumes the primary route of exposure is from spray drift and runoff/erosion exposure off the treated field. EPA use the Pesticide in Water Calculator (PWC) and the Terrestrial Plant Exposure Zone (TPEZ) module of the Plant Assessment Tool (PAT) to calculate runoff/erosion herbicide concentrations in the identified terrestrial habitats. EPA uses the AgDRIFT® model to estimate deposition of pesticides via spray drift onto downwind areas. For the MoD, EECs represent exposures at the edge of the treated area. EPA uses a similar approach for wetland species, where the Wetland Plant Exposure Zone (WPEZ) module of PAT is used to estimate runoff/erosion. For aquatic habitats, EPA

currently uses the PWC to calculate runoff/erosion herbicide concentrations. EPA uses standard PWC agricultural crop scenarios with weather information to assess runoff/erosion potential from vulnerable agricultural use sites. The PWC model generates high-end EECs associated with a particular pesticide, aquatic habitat, and use pattern within a specific geographic region. Each scenario is specific to an area where the use occurs (*i.e.*, where a crop is commonly grown). The EECs generated represent maximum annual concentrations that occur once every 10 years and consider the runoff/erosion and spray drift pathways of exposure. EPA considered the habitat requirements of currently listed plants, as well as any obligates, and identified which of EPA's standard model scenarios is most representative of the expected exposures for that species. In some cases, the standard model is a reasonably good fit for the habitat of the species in other cases, EPA expects that the model will overestimate exposures to the species' habitat (*e.g.,* the standard pond will likely have much higher exposures than rivers with larger volumes, dilution, and flow). When interpreting MoDs, EPA considers how well or how poorly the models estimate exposures for listed plants in the habitat being evaluated.

Similarly, the AgDRIFT® model for spray drift assumes a bare field with no interception which will overestimate site-specific exposures if the landscape contains features that would intercept spray drift. For example, spray drift exposure from a treated field to a listed species located in a forest is unlikely because the trees would intercept the spray drift. Therefore, before deciding on the potential for population-level impacts, EPA would consider the habitat of the species (and the representativeness of the exposure estimates from its models).

The scope of the Herbicide Strategy includes herbicide applications made via broadcast spray using ground or aerial equipment, soil treatment, and granular formulations. Runoff/erosion transport pathways are a potential concern for all application methods. For spray drift, as described in the **Ecological Mitigation Support Document,** several application methods would likely not result in population-level impacts, irrespective of the characteristics of a particular herbicide. Therefore, EPA would not evaluate the potential for population-level impacts for these application methods (**Table 3**)**.**

Table 3. Herbicide application methods and relevant exposure pathways for this strategy.

Application Method	Spray Drift	Runoff/Erosion
Foliar Applications[1]	Yes	Yes
Soil Treatment	Yes[2]	Yes
Granular formulations	No	Yes

[1] Foliar applications include those made by aerial broadcast spray, ground broadcast spray, airblast and chemigation.

[2] As described in the **Ecological Mitigation Support Document**, soil treatment with certain equipment (*e.g.,* drip tape, in-furrow sprays) are not expected to result in meaningful exposures of spray drift that would have the potential to result in population-level impacts.

Additional details on the exposure modeling approaches included in the Herbicide Strategy can be found in **Appendix A**.

3.1.2 Developing Toxicity Thresholds for the MoD

The toxicity values selected for MoD calculations are intended to represent either potential impacts to: 1) a population for direct toxicity or impacts to a species with an obligate relationship to a plant species or 2) a community (*i.e.,* multiple species' populations) for species with a general relationship with plants. In general, different toxicity thresholds are used to represent population and community level impacts, where population-level impacts are assumed to occur at lower levels of exposure.

EPA relies on standardized toxicity data that are submitted to the Agency during the registration (or registration review) process for deriving its toxicity threshold values used to calculate an MoD.[20] EPA also supplements these submitted toxicity data with data obtained from the scientific (open) literature.[21] For plants, a variety of toxicity data are available from submitted data and the open literature. These studies involve different types of species habitats (aquatic, wetland, and terrestrial), exposure routes (spray drift and/or runoff), durations (seedling emergence (SE) and vegetative vigor (VV), growth stages (seedlings and young plants), and type of species (*i.e.,* monocot, dicot; vascular, nonvascular).

For terrestrial plants, EPA matches up the available toxicity data to represent different types of listed species. For example, SE and VV studies are required to include 4 monocots and 6 dicots. EPA also uses other reliable toxicity endpoints from the scientific literature when available, but these typically fall into the same growth stages of the SE and VV studies. Seedling emergence studies begin at the seed germination growth stages and continue into early seedling development. Vegetative vigor studies are conducted when plants are 2-3 weeks old seedlings and are carried out for 28 days after exposure. These growth stages of plants are considered sensitive to herbicides, such that the establishment of endpoints based on this early exposure has been shown to be protective of effects observed at later growth stages and for reproductive effects (USEPA 2020b; USEPA 2022). In the landscape, exposure to plants may occur at different times, meaning that different plant life stages may be exposed. EPA uses the most sensitive of these endpoints and assumes that exposure occurs at the relevant life stage for the assessed plants. Since plants grow over the course of the season and herbicides are applied at different times, it is important to consider that herbicide exposures could occur during less sensitive plant life stages, and vice versa.

[20] EPA's standard ecological toxicity data requirements are defined in 40 CFR Part 158 subpart G (https://www.ecfr.gov/current/title-40/chapter-I/subchapter-E/part-158/subpart-G)

[21] Toxicity data obtained from the open literature are reviewed according to OPP's open literature guidelines and classified as to whether they are of sufficient quality to be used in deriving toxicity thresholds in regulatory risk assessment (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/evaluation-guidelines-ecological-toxicity-data-open).

A similar approach is used for aquatic plants, where available vascular and nonvascular *(i.e*., algal) toxicity data are considered and matched to these types of listed species. In some cases, larger amounts of data are available to represent the toxicity of an herbicide to multiple species within a taxon. In that case, EPA will consider the full set of data in a species sensitivity distribution (SSD)[22] (a ranking of the different species toxicities). This distribution is helpful in selecting population-level endpoints (HC_{05}) that represent more sensitive species. In addition, SSDs are useful for deriving community-level endpoints (HC_{25}) that represent levels where multiple species may be impacted and result in an impact to a generalist species.

The following sections summarize the process for deriving toxicity thresholds for calculating MoD values.

3.1.2.1 Assessing Species Sensitivity Differences

EPA relates the sensitivity of particular groups of listed plants to species that have toxicity test data available if those data show meaningful differences in sensitivity to an herbicide. The majority of listed plants in the contiguous U.S. are considered dicots, with some monocots and non-flowering plants. The majority of listed plants use terrestrial areas as habitats, with many of these species also in wetlands. Because the physiology of a species may be linked to the type of species, it is reasonable to expect that some groups of listed plants may differ in their sensitivity to a given herbicide compared to other plant groups. Furthermore, some herbicides are developed to target specific groups of pests (*e.g.,* broadleaf plants, which are dicots), which supports the notion that differences in sensitivity of different plant groups may occur. Given this expectation of broad sensitivity differences among listed plants groups for some herbicides, it is prudent to ensure that any identified mitigations for an herbicide also reflect such differences in sensitivity (*i.e.,* for the same exposure, greater mitigation would generally be needed for more sensitive species types vs. less sensitive species types).

When deriving toxicity thresholds for MoD ratios, EPA determines whether the toxicity data for various groups of species (*e.g.,* monocot or dicot) suggests different sensitivity to the pesticide, or if they could be lumped together (*e.g.,* all flowering plants). In some cases, EPA has found differences in sensitivity of herbaceous versus woody plants. The extent to which EPA is able to assess potential different sensitivities to a pesticide is limited by the available data. EPA considers available information to identify if differences in sensitivity likely exist across taxonomic groups of listed plants. These differences are particularly impactful if an herbicide's mode of action (MoA) targets certain groups of plants. In some cases, additional information may be used to supplement available toxicity data. Additional details are provided in **Appendix A**.

Based on the available dataset, EPA determines whether it is appropriate to derive separate toxicity thresholds (and MoD) for different plant groups. Terrestrial, wetland and aquatic plants are distinguished here because the exposure routes for these types of habitats are different and, therefore,

[22] Species Sensitivity Distributions (SSD) are a common tool used for setting limits on exposure to a chemical or stressor. SSDs model the variation in the sensitivity of different species to a chemical and fit equations to understand the distribution of species sensitivity to a chemical. EPA uses the SSD Toolbox to generate SSDs. The Toolbox is available at: https://www.epa.gov/chemical-research/species-sensitivity-distribution-ssd-toolbox.

so are the toxicity data. Different toxicity thresholds and MoDs may be calculated for the following groups:

- Terrestrial
    - Listed dicot plants (includes obligates)
    - Listed monocot plants (includes obligates)
    - Listed woody plants (includes obligates)
    - Terrestrial plant communities
- Wetland
    - Listed dicot plants (includes obligates)
    - Listed monocot plants (includes obligates)
    - Listed woody plants (includes obligates)
    - Wetland plant communities
- Aquatic
    - Aquatic plant communities

3.1.2.2 Toxicity Thresholds Supporting MoDs for Assessing Impacts to Listed Plants and Obligates

Once EPA determines whether or not the toxicity data support calculating distinct toxicity thresholds for different listed plant groups, EPA then calculates toxicity thresholds for supporting MoDs for direct population-level impacts to listed plants. The approach for setting these toxicity thresholds depends on how much toxicity data are available for the plant species within each group and their corresponding MoDs. MoDs generated for terrestrial, wetland, and aquatic plants are used in **Step 2** to consider runoff/erosion and spray drift mitigations.

When toxicity data are available for enough species within a group for a given herbicide, EPA uses a SSD to set the toxicity threshold used in the MoD for evaluating direct population-level impacts on listed plants. EPA does not use aquatic plant endpoints to represent direct impacts to currently listed plants. EPA assesses those impacts using monocot and dicot endpoints only. This is because all of the currently listed plants that may occur in aquatic habitats also occur in wetlands and are more taxonomically and structurally relevant to the monocot and dicot endpoints. EPA used aquatic plant toxicity data to evaluate the potential impacts to habitat and diet for the relevant listed animals, all of which are generalists.

SSDs reflect a ranking of species by their sensitivity (*i.e.,* toxicological response to an herbicide) from most to least sensitive. A statistical procedure is used to describe this ranking such that a concentration can be identified which corresponds to a desired percentile of the SSD. For example, a concentration corresponding to the 5^{th} percentile of an SSD means that 5% of the tested species are equally or more sensitive than this concentration and 95% are less sensitive. Therefore, setting a toxicity threshold at the 5^{th} percentile of an SSD would be protective of 95% of tested species. SSDs require toxicity data from a relatively large number of species to be scientifically robust (*e.g.,* generally 8 or more species within a group). Since species can vary widely in their sensitivity to chemicals and toxicity data are mostly available for standard test species rather than listed species themselves, the HC_{05} is considered

protective in that it assumes the listed species are highly sensitive with respect to most of the tested species.

When data are not sufficient to derive an SSD (which is typically the case for aquatic plants), consistent with common risk assessment practice, EPA sets the toxicity threshold using data on the most sensitive species for which reliable toxicity data are available. Furthermore, EPA bases the population-level toxicity endpoint for that species on the IC_{25} (EC_{50} for aquatic plants), which corresponds to a concentration or dose that resulted in a 25% or 50%, effect, respectively, to the tested individuals. Use of the most sensitive test species or 5th percentile of the SSD is conservative for the majority of species; however, EPA does not know where specific listed species fall on the SSD. Therefore, to consider the potential for population-level impacts to listed plants that may be anywhere on the SSD, EPA used the most sensitive test species or 5th percentile from the SSD to identify when mitigation is needed. In general, sufficient data are often available to generate an SSD for terrestrial/wetland plants and rarely available to generate an SSD for aquatic plants.

The same toxicity thresholds used for assessing direct impacts to populations of listed plants are also used for listed species that obligately depend on a species or genus of plants. The rationale for using the same toxicity endpoints determined for assessing direct impacts to populations reflects the expectation that population-level impacts to obligate listed species only requires impacts to one or a few plant species. Therefore, the protection goals for assessing direct impacts to populations of listed plants and listed obligate species are the same.

3.1.2.3 Toxicity Thresholds Supporting MoDs for Assessing Impacts to Listed Generalists and Plant Communities

Toxicity thresholds used to assess indirect population-level impacts to listed generalists that depend on plants broadly (rather than a specific plant species) are intended to protect against impacts to the plant community as a whole since listed generalists may depend on many different plant species for survival. When sufficient data are available to develop an SSD, EPA uses the 25th percentile (also called the HC_{25} or community-level endpoint) to set this toxicity threshold. A higher percentile (lower sensitivity) of the SSD is used to evaluate potential population-level impacts to listed generalists compared to direct impacts described in **Section 3.1.2.2** because such impacts are presumed to occur at the community level, rather than for a population of a single species.

If available toxicity data are not sufficient to derive an SSD, EPA sets the toxicity threshold for listed generalists at a level that most closely approximates the expected lower quartile of species sensitivity. In many cases, this is represented by a toxicity threshold slightly above the most sensitive IC_{25} (EC_{50} for aquatic species) value when very few species have been tested. In 2023, the case studies released with the draft Herbicide Strategy included SSDs for 10 different chemicals. When comparing the HC_{05}, HC_{25}, and the most sensitive IC_{25}, EPA was able to develop an adjustment factor to calculate a toxicity threshold for plant communities and populations of generalists when SSDs could not be calculated. This

factor (5x) is applied to the most sensitive IC_{25} when an SSD cannot be derived. In 2011[23], EPA compared the most sensitive of the typical aquatic plant test species submitted under FIFRA to SSDs generated using available aquatic plant toxicity data. In general, the most sensitive test species is similar to (within 2x) the 25th percentile of the SSD. The evaluation of the 2011 dataset concluded that the most sensitive EC_{50} was a reasonable estimation of the HC_{25} when an SSD was available. Therefore, no adjustment factor is applied for aquatic plants. EPA considers other information (*e.g.,* ECOTOX data and SSDs published in the scientific literature) when selecting the most appropriate IC_{25} or EC_{50} value to apply these adjustment factors and to represent a threshold for community-level impacts. The goal is to select a toxicity threshold that can reasonably represent the lower quartile of the SSD (HC_{25}).

3.1.3 Assigning Potential for Population-Level Impacts

MoDs represent numerical comparisons of estimated exposure levels to population-level toxicity thresholds. A list of exposure estimates and toxicity thresholds used to calculate MoD values in this strategy is shown in **Table 4.** EPA is using MoDs to inform the potential for population-level impacts to listed plant species and community-level impacts to species that rely on multiple plant species for diet or habitat. For this strategy, EPA calculates MoDs for each labeled use (or groups of labeled uses) as well as for the major exposure routes associated with mitigation (spray drift, runoff/soil erosion). MoDs are categorized into four levels associated with the potential for population-level impacts to a listed species. The levels range from "not likely" to "high" (**Table 1**). Before deciding the potential for population-level impacts, EPA also considers several lines of evidence, including the habitat of the species (and the representativeness of the exposure estimates).

[23] USEPA 2012. FIFRA Science Advisory Panel Meeting: Appendix F. Estimating Aquatic Plant Community Hazard Concentrations for Pesticide Effects. Dated December 20, 2011. https://www.regulations.gov/document/EPA-HQ-OPP-2011-0898-0012

Table 4. Summary of magnitude of difference calculations for different species groups.

Species Group (also includes CHs)	Magnitude of Difference (MoD) = Ratio of the Estimated Environmental Concentration (EEC) to the Toxicity Endpoint	
	EEC (Model)	**Toxicity Endpoint**
Terrestrial Habitats (Represented by the Terrestrial Plant Exposure Zone)		
Listed **terrestrial dicots** and listed animals with an obligate relationship to terrestrial dicots	1-in-10 year daily average Terrestrial EEC in units of lbs a.i./A (PAT) Spray drift point deposition in units of lbs a.i./A (AgDRIFT®)	5th percentile of SSD of IC_{25} or lowest IC_{25} for dicots
Listed **terrestrial monocots** and listed animals with an obligate relationship to terrestrial monocots		5th percentile of SSD of IC_{25} or lowest IC_{25} for monocots
Listed **terrestrial woody plants** and listed animals with an obligate relationship to terrestrial woody plants		Most sensitive woody plant IC_{25}, or lowest IC_{25} across monocots and dicots, or 5th percentile of SSD of IC_{25} for monocots and dicots
Plant communities, CH and Listed **animals** that use terrestrial habitats and have a generalist relationship to plants in these habitats		25th Percentile of SSD of IC_{25} values or 5x lowest IC_{25} for terrestrial plants
Wetland Habitats (Represented by the Wetland Plant Exposure Zone)		
Listed **wetland dicots** and listed animals with an obligate relationship to wetland dicots	1-in-10 year daily average Wetland EEC in units of lbs a.i./A (PAT) Spray drift point deposition in units of lbs a.i./A (AgDRIFT®)	5th percentile of SSD of IC_{25} or lowest IC_{25} for dicots
Listed **wetland monocots** and listed animals with an obligate relationship to wetland monocots		5th percentile of SSD of IC_{25} or lowest IC_{25} for monocots
Plant communities, CH and Listed **animals** that use wetland habitats and have a generalist relationship to plants in these habitats		25th Percentile of SSD of IC_{25} or 5x lowest IC_{25} for dicot or monocot plants
	1-in-10 year daily average Standard Pond EEC in units of µg a.i./L (PAT)	25th Percentile of SSD of EC_{50} or lowest EC_{50} for aquatic non-vascular plants
Aquatic Habitats (Represented by the Standard Pond)		
Plant communities, CH and Listed **animals** that use aquatic habitats and have a generalist relationship to plants in these habitats	1-in-10 year daily average Standard Pond EEC in units of µg a.i./L (PWC)	25th Percentile of SSD of EC_{50} or lowest EC_{50} for aquatic non-vascular plants

CH=designated Critical Habitat; EEC = estimated environmental concentration; IC_{25} = concentration resulting in 25% inhibition in growth; EC_{50} = concentration resulting in 50% inhibition in growth; PAT = Plant Assessment Tool; PWC = Pesticide in Water Calculator; SSD = Species Sensitivity Distribution

Looking closer at the listed plant species within the scope of the final Herbicide Strategy, there is a large diversity of habitats where these listed species can occur. Terrestrial species can be found in meadows adjacent to agriculture, at high elevation mountainous regions, remote areas like cliff faces and waterfalls, and in nearby forests. Wetland and aquatic species can be found in small vernal pools that seasonally dry up, prairie potholes that are interspersed with agriculture, small and large wetlands, ponds, lakes, and streams and rivers. Since EPA has a finite set of exposure models to represent such a large diversity of aquatic and terrestrial habitats of listed plants, an important consideration when assigning the potential for population-level impacts is how well its models represent these habitats. For example, EPA's previous analyses indicate that its exposure estimates for the farm pond have a tendency to overestimate concentrations in streams and rivers with substantial flow regimes by an order of magnitude or more (USEPA 2016). Similarly, exposure estimates generated for wetland areas are expected to overestimate exposures for flowing wetlands (*e.g.*, riparian areas associated with streams and rivers). Since exposure estimates for the wetland are used as a proxy for flowing wetlands, the potential for population-level impacts begins at a MoD of 10 in these environments rather than 1 as shown previously in **Table 1** in recognition of the upward bias in the wetland exposure estimates for these habitats. A similar situation exists when considering estimates of spray drift for species that live in areas where pesticide sprays may be intercepted by trees, shrubs, and other obstacles to direct contact with spray droplets. EPA's spray drift estimates assume relatively little or no interception of spray droplets as they move from the treated field. In such cases, EPA allows a spray drift buffer distance reduction when these habitat types are downwind of the treated field.

With respect to toxicity, EPA also considers the uncertainty and potential bias in toxicity data when assigning the potential for population-level impacts. The MoD ranges shown in **Table 1** could conceivably be lowered when other information indicates the available toxicity test data does not adequately capture the expected sensitivity of one or more types of listed plants. Conversely, the MoD ranges may be increased if information suggests the opposite situation is likely to occur.

Finally, EPA considers information such as data on pesticide residues in environmental media (*i.e.,* monitoring data) in conjunction with model-based estimates of exposure. Generally, monitoring data can support the model-based exposure estimates when concentrations are reasonably similar; however, monitoring data often are not targeted to when and where herbicides are applied, so lack of agreement does not usually impact the MoD ranges associated with the potential for potential population-level impacts. Ecological incident data reported to EPA also represent a similar confirmatory line of evidence as monitoring data.

In summary, EPA decides on the potential for population-level impacts (not likely, MoD<1; low, MoD 1 to <10; medium, 10 to <100; high, $\geq$100) by considering multiple factors, including:

- MoDs
- Representativeness (or lack thereof) of exposure estimates of species habitat
- Representativeness of toxicity estimates of surrogate test species
- Monitoring and incident data as confirmation

The potential for population-level impacts is used to identify the level of mitigation in **Step 2** of the strategy, which is discussed in the next section.

3.2 Step 2. Identify Type and Level of Mitigation Measures

Step 2 involves relating the MoD to the appropriate level and type of mitigation measures. The mitigation goals are to reduce spray drift, and runoff/erosion exposure pathways such that population-level impacts are not likely. In this step, as described earlier, EPA also considers any existing or proposed mitigations that the registrant(s) included on the pesticide product label or committed to in writing. When EPA identifies the potential for population-level impacts for a particular exposure pathway to be low, medium, or high, it similarly identifies mitigations to address those impacts as shown in **Table 5**. The mitigations associated with a low, medium, or high level of identified mitigation depend on the exposure route and are described below in **Sections 3.2.1 and 3.2.2**.

Table 5. Relationship between the potential for population-level impacts and mitigation identified.

Potential for Population-Level Impacts[2]	Level of Mitigation Identified	Magnitude of Reduction in Exposure to Result in a Not Likely for Population-Level Impact Conclusion
Not Likely	None	None
Low	Low	10 x
Medium	Medium	100 x
High	High	1000 x

When identifying mitigations to reduce the off-field transport of herbicides in spray drift and runoff/ erosion, EPA considered whether the mitigation measures would be effective at reducing exposure and would not in themselves be so burdensome to prevent the intended use. EPA identified mitigations that are already used by various applicators and growers and included as many measures as possible (meaning EPA had enough information to evaluate it for potential inclusion here) to ensure flexibility and allow growers to use mitigations that are economically and technologically feasible to them. The mitigations identified in this strategy improve on those in the FIFRA Interim Ecological Risk Mitigations (IEM) measures discussed in the ESA Workplan Update and the draft Herbicide Strategy by incorporating feedback from stakeholders.

As detailed in the **Ecological Mitigation Support Document,** for each of these mitigation measures, EPA evaluated their effectiveness at reducing offsite transport. EPA relied upon multiple sources of information about mitigations that are commonly utilized in agriculture for spray drift and runoff/ erosion. EPA also included information about other landscape management practices that may effectively achieve similar reductions in exposure. While runoff/erosion mitigation practices may have previously been installed to reduce transport of nutrients and/or soil, they would also be effective in reducing transport of pesticides. This also applies to mitigation measures such as windbreaks which can be installed to protect wind-sensitive crops and control soil-wind erosion, but they can also be effective in reducing pesticide spray drift. The process EPA followed for considering the inclusion of a mitigation in this strategy was based on the following:

- Scientific principles, the mitigation resulted in meaningful reductions in pesticide spray drift, and runoff/erosion based upon the design, placement, and characteristics of the mitigation;
- Existing EPA models indicated a potential reduction in environmental exposure if the mitigation were in place;
- Empirical studies described the reductions in pesticide concentration as a result of the mitigation;
- The mitigation is similar to other mitigations such that they are functionally equivalent.

Sections 3.2.1 and 3.2.2 discuss the spray drift mitigation measures and runoff/erosion mitigation measures, respectively, that EPA identified in this strategy to address potential population-level impacts to listed species.

3.2.1 Spray Drift Mitigation Measures

Spray drift exposures are a potential concern for pesticide applications made via broadcast spray (aerial and ground equipment), airblast, and some chemigation methods (overhead sprayers such as center pivot and traveler sprayers). This section first describes a suite of baseline mitigation measures applicable to most herbicides to reduce exposure to non-target species via spray drift (**Section 3.2.1.1**). The remainder of this section discusses use of a combination of buffers and/or other mitigations to reduce low, medium, or high potential for population-level impacts associated with spray drift identified in **Step 1**. The currency of spray drift mitigations to address potential population-level impacts is expressed as a distance from the edge of the field (where there are population-level concerns and exposures need to be reduced). **Section 3.2.1.2** explains how EPA selects that distance based on the MoDs calculated in **Step 1** and **Section 3.2.1.3** discusses mitigation measures for reducing exposures within that distance so that there are no longer concerns for population-level impacts to listed species. **Section 3.2.1.4** also explains how, if a buffer is used to represent that distance, what types of areas can represent that buffer so that in-field buffers are not needed in all fields. **Section 3.2.1.5** discusses spray drift mitigations for some mitigation methods (*e.g.*, overhead sprinklers).

There are herbicide application methods in addition to ground, aerial, airblast, and overhead/traveler sprayer chemigation. EPA's evaluation described in the **Ecological Mitigation Support Document** indicates that spray drift exposure from these application methods would be limited and thus the potential for population-level impacts is unlikely. These application methods include:

- Chemigation methods, including: micro-sprinklers, drip-tape, drip emitters, subsurface or flood, and under non-permeable plastic surfaces;
- In-furrow sprays when nozzle height is <8 inches above soil surface;
- Tree trunk drench, tree trunk paint, tree injection;
- Soil injection;
- Solid formulations that are used as a solid; and
- Less than 1/10 acre (<4356 square feet) treated and Spot treatment: <1000 square feet treated (*e.g.,* when applied with backpack or hand held sprayers).

3.2.1.1 Baseline Spray Drift Mitigations

EPA has identified several mitigations that it generally includes on pesticide product labels to reduce spray drift exposure to non-target species. When considering the potential for population-level impacts, EPA includes these mitigations as baseline application assumptions. These common mitigations typically include:

- restricting the maximum windspeed to 10 to 15 miles per hour,
- prohibiting applications during temperature inversions,
- boom length restrictions and swath displacements for aerial applications,
- maximum release heights for ground and aerial applications, and
- directing sprays into the canopy for airblast and turning off the outer nozzles at the last row.

3.2.1.2 Spray Drift Mitigation Distances

If EPA determines the potential for population-level impacts (MoD category) associated with spray drift exposure to be low, medium, or high, EPA then identifies the level of mitigation needed to address the potential for population-level impacts. To address potential ecological impacts via spray drift exposure, EPA typically identifies a spray drift buffer. For this strategy, for aerial, ground, and airblast sprays, the distance associated with that buffer increases with the level of mitigation (low, medium, and high) and that the buffer be located on the downwind edge of the field. EPA is also identifying mitigation measures (described in **Section 3.2.1.3**) that a pesticide applicator can employ to reduce any identified buffer distance because these mitigation measures are likely to reduce exposure within that buffer distance. For chemigation, EPA did not identify a spray drift distance, but rather mitigation measures to reduce exposure to non-target areas. The **Ecological Support Document** describes how EPA determined the efficacy of the mitigation measures included, which EPA expresses as a percentage decrease in any identified buffer distance.

To address a low potential for population-level impacts for aerial, airblast and ground applications, EPA has identified what it refers to as lower limit buffers. If EPA identifies a medium potential for population-level impacts for aerial, airblast and ground applications, EPA identifies that buffer distance by calculating a chemical-specific distance based on the toxicity of the pesticide and estimated off-field deposition. If EPA identifies a high potential for population-level impacts for aerial, airblast and ground applications, EPA identifies a maximum buffer distance that varies depending on the application method. See **Table 6**.

EPA recognizes that for a pesticide application, droplet size can impact the distance which spray drift travels, with larger droplets generally not traveling further than finer droplet sizes. As shown in **Table 6**, EPA identified a single distance based on how pesticides are typically applied for each type of application method. If a smaller droplet size is needed for a particular pesticide, EPA may identify a larger buffer distance. If a pesticide applicator can use a larger droplet size or a low boom, as described in **Section 3.2.1.3**, they would be able to decrease the identified buffer distance. The text below and the

Ecological Support Document provide additional discussion and details about the distances to mitigate potential low, medium and high population-level impacts.

Table 6. Potential for population-level impacts identified in Step 1 and corresponding spray drift distance to reduce impacts.

Potential for Population-Level Impacts from Step 1	Distance from Edge of Treated Area (ft)		
	Aerial Spray[1]	Ground[2] Spray	Airblast
Not Likely	None	None	None
Low	50	10	25
Medium	Calculated for specific chemical[3]		
High	320	230	160

MoD = Magnitude of Difference

[1] EPA based aerial distances on the assumption that most aerial applications in agricultural settings will use a medium droplet size distribution. If very fine or fine applications are needed for a pesticide, EPA may increase the distance. There are mitigation measures for reducing this distance when using droplets larger than medium.

[2] EPA based these distances on the assumption that ground applications are made using a high boom and very fine to fine droplet size distribution. There are options for reducing this distance when using larger droplets and a low boom.

[3] EPA anticipates that chemical specific buffers will be between the lower limit (used for low potential population-level impacts) and at or lower than the maximum (used for high impacts) buffer distances.

Where there is a low potential for population-level impacts, EPA identifies a low level of mitigation for aerial, airblast, and ground applications using a lower limit distance. EPA based the identified distances in **Table 6** on the distance where the deposition fraction is estimated to be 10% of the application rate for the different application methods. This equates to 50, 25, and 10 feet, for aerial, airblast, and ground applications, respectively. EPA based these distances on the common droplet size distribution for aerial (medium), the common droplet size distribution for ground (fine) and high boom and on the sparse orchard setting for airblast.

Where EPA identifies medium potential for population-level impacts, EPA uses AgDRIFT® to calculate the chemical specific buffer distance for aerial, airblast, and ground applications. EPA will calculate the distance where the deposition exposure is equal to the toxicity threshold (discussed above for **Step 1, Section 3.1.3**).

Where EPA identifies high potential for population-level impacts, the Agency identifies a maximum spray drift distance beyond which exposure does not substantially change using the AgDRIFT® model for aerial, airblast, and ground applications. The main reasons for determining a maximum buffer distance include:

1) The impact of the buffer in reducing exposure decreases with distance, such that at distances far offsite there is only a small change in the spray drift deposition,
2) Uncertainty for exposure estimates predicted by the model increases with distance, and
3) The larger a buffer distance is, the less feasible it is to implement for many applicators.

In many cases, the likelihood that spray drift will be partially intercepted by a drift barrier (*e.g.,* trees, crop canopy or other vegetation, buildings) increases with distance, and, as such, the model may overestimate the maximum spray drift buffer because it assumes a bare treated area with no obstructions to intercept

spray droplets that drift off-field. The maximum spray drift buffer will be different for different application equipment (*i.e.*, aerial, ground and airblast).

3.2.1.3 Spray Drift Mitigation Measures for Reducing Buffer Distance

EPA reviewed available mitigation measures for reducing the distance of identified ecological spray drift buffers on a site-specific basis. Mitigation measures for reducing the distance include application parameters (such as specific application equipment, reducing application rate, and/or droplet size distribution), the width of the treated area, use of a windbreak/ hedgerow or forested/shrubland area as a physical barrier or the relative humidity. While many of these measures apply to all spray drift application methods, some application parameters are specific to the application method. For example, the applicator may choose larger droplet size distributions to reduce the aerial or ground drift, and buffer, distances. For ground applications, the applicator may reduce the buffer distance by using hooded sprayers or drop nozzles that result in applications under the crop canopy. For all types of applications, the buffer distance can be reduced by using a lower application rate than the maximum rate on the label or by using a windbreak or hedgerow on the downwind side of the application area. **Tables 7-9** summarize the ecological spray drift mitigation measures for reducing the distances associated with aerial, ground and airblast applications. The **Ecological Mitigation Support Document** has detailed information describing the basis for each percent reduction in distance.

Table 7. Mitigation measures identified when making broadcast aerial applications.

Mitigation Measures	% Reduction in Distance[5]
Application Parameters	
Reduced single application rate	% reduction corresponds to application rate reduction from maximum on pesticide product label[2]
Coarse DSD[1]	20%
Very coarse DSD[1]	40%
Spray drift reducing adjuvants, Medium DSD	30%
Spray drift reducing adjuvants, Coarse or Very coarse DSD	15%
Reduced Proportion of Field Treated (# of Airplane/Helicopter Passes)[3]	
1 pass	55%
2-4 passes	20%
5-8 passes	10%
Other Mitigation Measures	
Downwind windbreak[4]/hedgerow/riparian/forest/ woodlots/shrubland	50% for basic windbreak/hedgerow 75% for advanced windbreak/hedgerow 100% for riparian/forests/woodlots/shrubland $\geq$ 60 ft width
Relative humidity is 60% or more at time of application	10%

DSD = droplet size distribution

[1] This % reduction is based on the assumption/baseline of using medium droplet size for aerial.

[2] Example 10% reduction in the spray drift buffer for 10% lower single application rate than labeled maximum single application rate.

[3] A spray drift buffer applies to downwind non-target areas. The reduced number of passes applies to the upwind part of the treated field.

[4] Artificial windbreaks (*e.g.,* a curtain or netting) are also applicable.

[5] After mitigation reductions in the spray buffer are applied, round to the nearest 5ft increment (*e.g.*, 50ft, 35ft)

Table 8. Mitigation measures identified when making broadcast ground applications.

Mitigation Measures	% Reduction in Distance[5]
Application Parameters	
Reduced single application rate	% reduction corresponds to application rate reduction from maximum on pesticide product label[2]
High boom, fine to medium-coarse DSD[1]	55%
High boom, coarse DSD[1]	65%
Low boom, very fine to fine DSD[1]	40%
Low boom, fine to medium-coarse DSD[1]	65%
Low boom, coarse DSD[1]	75%
Over-the-top Hooded Sprayer	50%
Row-middle Hooded Sprayer	75%
Sprays below crop using drop nozzles or layby nozzles	50%
Spray drift reducing adjuvants, Medium DSD	30%
Spray drift reducing adjuvants, Coarse or Very coarse DSD	15%
Reduced Proportion of Field Treated (Number of Ground Application Equipment Passes)[3]	
1 pass	75%
2-4 passes	35%
5-10 passes	15%
Other Mitigation Measures	
Downwind windbreak[4]/hedgerow/riparian/forest/woodlots/shrubland	50% for basic windbreak/hedgerow 75% for advanced windbreak/hedgerow 100% for riparian/forests/woodlots/shrubland ≥ 60 ft width
Relative humidity is 60% or more at time of application	10%

DSD = droplet size distribution

Low boom height=release height is less than 2 feet above the ground

high boom=release height is greater than 2 feet above the ground

[1] This % reduction assumes use of high boom, very fine to fine droplet size for ground.

[2] Example 10% reduction in the spray drift buffer for 10% lower single application rate than labeled maximum single application rate.

[3] A spray drift buffer applies to downwind non-target areas. The reduced number of passes applies to the upwind part of the treated field.

[4] Artificial windbreaks (*e.g.*, a curtain or netting) are also applicable.

[5] After mitigation reductions in the spray buffer are applied, round to the nearest 5ft increment (*e.g.*, 50ft, 35ft)

Table 9. Mitigation measures identified when making airblast applications

Mitigation Measure	% Reduction in Distance[3]
Application Parameters	
Reduced single application rate	Divide % reduction in application rate by 2
Reduced Proportion of Orchard Treated (Number of Treated Rows[1])	
1 row	70%
2-4 rows	30%
5-10 rows	15%
Other Mitigation Measures	
Downwind windbreak[2]/hedgerow/riparian/forest/woodlots/shrubland	50% for basic windbreak/hedgerow 75% for advanced windbreak/hedgerow 100% for riparian/forests/woodlots/shrubland ≥ 60 ft width

[1] A spray drift buffer applies to downwind non-target areas. The reduced number of passes applies to the upwind part of the treated field.

[2] Artificial windbreaks (*e.g.,* a curtain or netting) are also applicable.

[3] After mitigation reductions in the spray buffer are applied, round to the nearest 5ft increment (*e.g.*, 50ft, 35ft)

For aerial, ground and airblast applications, EPA based the ecological spray drift buffer distances (**Table 6**) on assumed swath widths and the number of passes, flight lines, or rows treated. EPA assumes the size and number of pesticide application equipment passes for the airplane/helicopter, tractor and airblast sprayer results in spray drift that deposits on the downwind side of the field/orchard. On a site-specific basis for a broadcast application, if the number of rows treated for an orchard is fewer than EPA's assumptions, there will be less spray drift deposition in the non-target area on the downwind side of the field. For aerial, ground and airblast applications, the applicator could reduce any identified spray drift buffer by the percent shown in **Tables 7-9** depending on the number of passes or treated rows (parallel to the wind direction, perpendicular to the downwind side of the treated field/non-target area). **Figure 6** illustrates such an example. **Tables 7-9** includes the percent reductions associated with different numbers of passes/treated rows of the treated field/orchard.

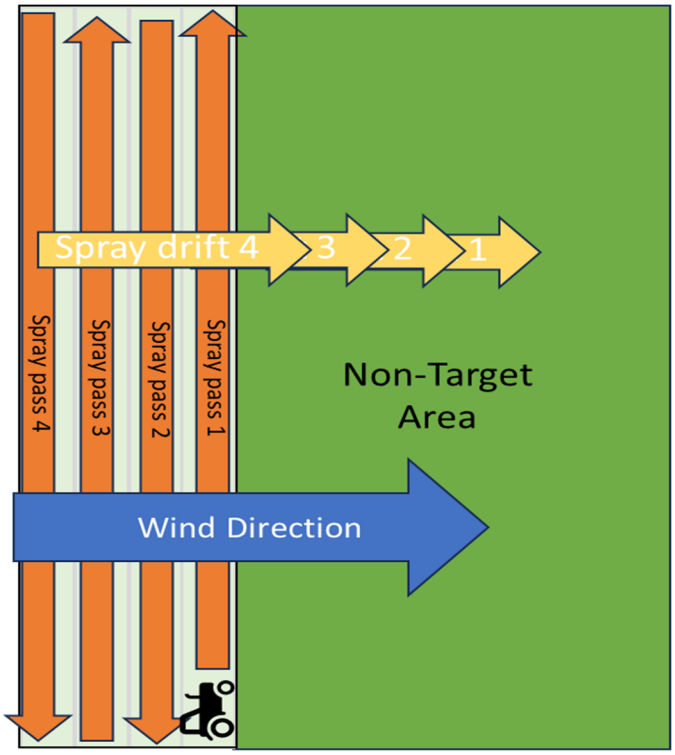

Figure 6. Cumulative spray drift in non-target area from tractor passes on four parallel rows on treated area. For example, if this was a ground application and the applicator only made 4 passes of their field, then they could reduce identified spray drift buffer distance by 35%.

To use mitigation measures to reduce the spray drift distance (**Tables 7-9**), the applicator should first consider the application equipment that they plan to use for the application. With this information and the directions for use on the pesticide labeling, the applicator could identify the appropriate spray drift distance for the pesticide and use (determined by EPA as either lower limit, chemical specific or maximum, **Table 6**). The applicator could then select from any of the appropriate mitigation measures relevant to the application type (either aerial, airblast, or ground). The applicator could add up the corresponding percent reductions for all the mitigation measures selected. This total percent could be applied to the spray drift buffer distance. If the percent is 100% or more, the applicator would not need a buffer as the mitigations put in place already address the potential for population-level impacts. If the percent is above zero and less than 100%, a buffer would be identified but the distance could be reduced from that specified on the pesticide product label. For example, if the pesticide product label specifies a 230-foot buffer and there is a downwind windbreak (50% reduction) and the relative humidity is 70% at the time of the application (10% reduction), the label would allow for a 60% (50%+10%) reduction in the buffer. The remaining spray drift distance would be 90 feet (100%-60% = 40% * 230 ft)[24]. If the applicator used a low boom instead of a high boom, an additional 40% reduction in distance could be used and no buffer distance would be identified (50%+10%+40% = 100%).

[24] After applying mitigations to reduce the spray drift buffer distance, the final calculated distance should be rounded to nearest 5 ft increment. (*e.g.,* 32 ft is rounded to 30 ft; 48 ft is rounded to 50 ft)

3.2.1.4 Description of Managed Areas that can be Subtracted from Spray Drift Distances

As described above, EPA relies upon the AgDRIFT® model for ground and aerial spray drift estimations. The models for ground and aerial drift were developed based on several underlying assumptions, including drift depositing onto a bare field, no obstructions to intercept spray droplets that drift off-field, and a prevailing wind direction. In practice, farms may have managed lands in areas adjacent to a pesticide application. While these managed practices may not be intentionally created for the purpose of mitigating pesticides, their composition and size on the landscape could act like a buffer (*e.g.,* roads) or intercept spray drift (which the model does not take into account) and reduce the distance it may travel. Therefore, to the extent that such managed areas are downwind and immediately adjacent to a pesticide application (provided that people are not present in those areas and they themselves not being treated with the pesticide), EPA has included these areas in what can be considered within the buffer distance. In other words, growers/applicators could subtract managed areas immediately adjacent to treated field from their identified buffer distance. See **Table 10**.

Table 10. Downwind managed areas that can represent ecological spray drift buffers.

When spray drift buffers are identified as mitigations, the following managed areas can be included in the buffer if they are immediately adjacent/contiguous to the treated field in the downwind direction and people are not present in those areas (including inside closed buildings/structures). Any label requirements that prohibit or restricts spray drift in any of these specific managed areas (*e.g.,* to protect human health) must also be followed.

a. Agricultural fields, including untreated portions of the treated field;
b. Roads, paved or gravel surfaces, mowed grassy areas adjacent to field, and areas of bare ground from recent plowing or grading that are contiguous with the treated area;
c. Buildings and their perimeters, silos, or other man-made structures with walls and/or roof;
d. Areas maintained as a mitigation measure for runoff/erosion or drift control, such as vegetative filter strips (VFS), field borders, hedgerows, Conservation Reserve Program lands (CRP)[1], and other mitigation measures identified by EPA on the mitigation menu;
e. Managed wetlands including constructed wetlands on the farm; and
f. On-farm contained irrigation water resources that are not connected to adjacent water bodies, including on-farm irrigation canals and ditches, water conveyances, managed irrigation/runoff retention basins, and tailwater collection ponds.

[1]Growers may need to ensure that pesticide use does not cause degradation of the CRP habitat.

In some cases, areas maintained as a mitigation measure for spray drift or runoff/erosion control, managed areas, and CRP lands could potentially represent habitat for listed species. There can be significant benefits of these habitats to listed species, with a net gain to the species when considering benefits vs. impacts of pesticides. Not all of these areas represent high quality habitat for listed species (*e.g.*, listed plants are not expected to occur within these areas). In some cases, individuals of a species may be attracted to an area that represents habitat (*e.g.*, insects may be attracted to habitat created for pollinators); however, not enough individuals are expected to be impacted within the portion of the exposed area of the habitat such that there would be an impact on the population that would outweigh the overall benefit provided by creation of the habitat. EPA does not want to disincentivize grower/applicators from providing such habitats, which may have considerable benefits to species, their environment, and pesticide use reductions. Therefore, managed areas that include habitat may be part or all of the spray drift buffer.

Figures 7 and 8 represent examples of how ecological spray drift buffers can be reduced where a pesticide product label identifies a 50-foot downwind spray drift buffer. The grower/applicator could subtract the 10 foot off-field area downwind where the grower has CRP land and the 20-foot-wide downwind windbreak, leaving only a 20 foot in-field buffer to meet the identified buffer distance (**Figure 7**). In contrast, if the off-field downwind areas of the CRP land and windbreak totaled 50 feet or more this would equal the identified spray drift buffer distance (as shown **Figure 8**).

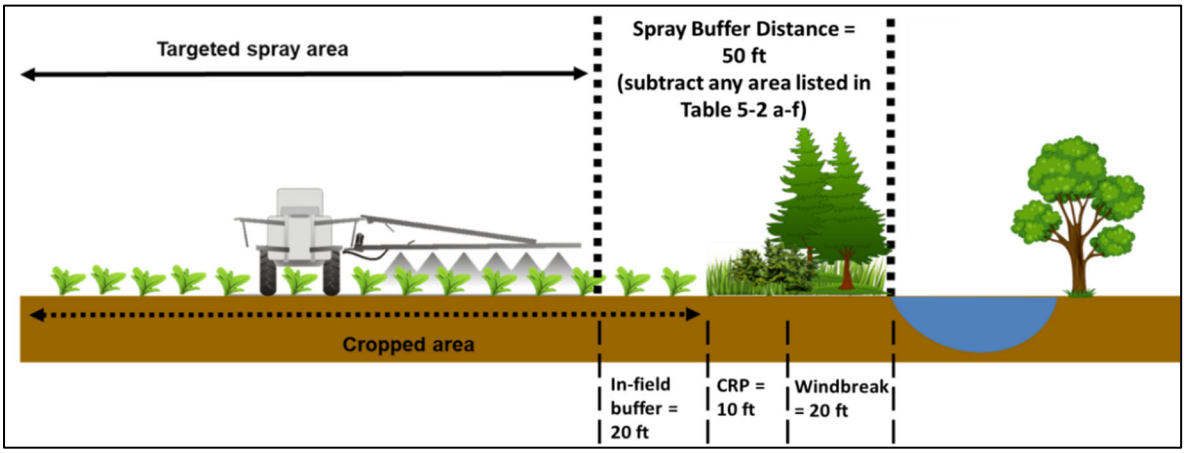

Figure 7. Diagram of the field (cropped area) with a downwind ecological spray drift buffer which includes a portion of the cropped area because the adjacent managed areas are less than the identified spray drift buffer distance.[25]

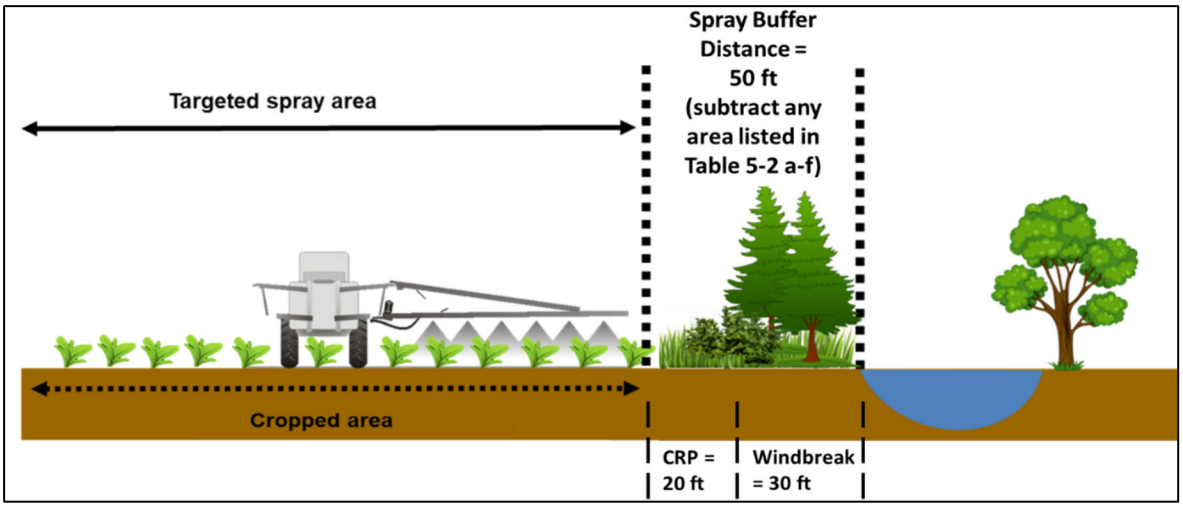

Figure 8. Diagram of the field (cropped area) with no cropped area included in the downwind ecological spray drift buffer because adjacent managed areas are equal to the identified spray drift buffer distance.[25]

[25] This figure is based on a diagram from the Pest Management Regulatory Agency of Health Canada (2020), which EPA was permitted to reproduce. The original figure is available at: https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/growers-commercial-users/drift-mitigation/protecting-habitats-spray-drift.html. EPA has edited the original figure to provide an example of the areas that can be subtracted from spray drift buffer distances.

3.2.1.5 Spray Drift Exposure Associated with Overhead and Impact Sprinkler Chemigation Systems

Overspray from overhead and impact sprinkler chemigation systems can expose non-target species to herbicides. EPA identified mitigation measures for overhead and impact sprinkler chemigation equipment to address identified potential for population-level impacts to listed species. The measures are listed below in **Table 11**. Unlike aerial/ground or airblast applications, it does not include identified spray drift distances (buffers), but rather measures intended to reduce the potential for irrigation overspray into non-target areas. The type and extent of the identified measures depends on the level of the potential for population-level impacts as well as the type of chemigation equipment. The table below and the **Ecological Mitigation Support Document** provides additional discussion and details about the measures identified to mitigate low, medium and high population-level impacts.

Table 11. Mitigation measures identified when making pesticide applications via overhead and impact sprinkler chemigation systems.

Potential for Population-level Impacts from Step 1	Mitigation Measures	
	Overhead Chemigation[1]	Non-End Gun Impact Sprinklers
Not Likely	None	None
Low	No end gun	Limit throw distance to edge of field (treated area)[2]
Medium	No end gun and one of the following: reduce pressure (<20 psi); reduce release height (<5 ft); have a windbreak[3]	
High	No end gun and two of the following: reduce pressure (<20 psi); reduce release height (<5 ft); have a downwind windbreak[3]	Limit throw distance to edge of field (treated area) AND have downwind windbreak[3]

[1] Refers to *e.g.*, center pivot, overhead systems, traveler systems that have sufficient pressure/end guns.
[2] This can be accomplished by either reduced pressure and/or reduced throw angle.
[3] This can be a windbreak/hedgerow/riparian/forest/shrubland/woodlots. See Ecological Mitigation Support Document for additional details.

3.2.2 Runoff/Erosion Mitigation Measures

EPA developed a runoff/erosion mitigation menu that included mitigations for non-target species, including listed species. As this strategy is implemented through FIFRA actions, pesticide product labeling would direct the user to the mitigation menu website (see **Section 3.2.2.2**). EPA elected to develop a mitigation menu to provide flexibility for growers/applicators to use mitigations that are best for their situation when a pesticide product they want to use includes the requirement to achieve a level of mitigation and directs the user to the menu. These measures are identified in **Table 13** and described in more detail in the **Ecological Mitigation Support Document** Version 1.0. EPA categorized these runoff/erosion mitigation measures as follows:

- **Application Parameters** that growers/applicators may elect to employ to reduce potential pesticide runoff and erosion (annual application rate reduction, partial field treatment, soil incorporation).
- **Field Characteristics** that are likely to indicate the field will have less runoff and erosion than other fields and thus need fewer mitigation measures to reduce runoff/erosion transport (*e.g.,*

fields with a low slope likely have less runoff/erosion, permeable sandy soils have less runoff than high clay content soils).

- **In-field Mitigation Measures** that users may elect to employ to reduce potential pesticide runoff and erosion are those that involve the management of the field. (*e.g.,* management of irrigation water, cover crops, or reduced tillage).
- **Adjacent to the Field Mitigation Measures** are those that occur next to the field and down-gradient from where the pesticide application occurs and between the treated field and species' habitat (*e.g.,* grassed waterway, VFS). Some measures may occur on the field and also adjacent to the field, so they are included in both categories (*e.g.,* VFS).
- **Systems that Capture Runoff and Discharge** are those that capture, collect, and discharge runoff through discrete conveyances (*e.g.,* water retention systems such as ponds and sediment basins).
- **Other Mitigation Measures** are those that may be considered but that do not fit into the categories above.

Additional considerations associated with the extent of mitigation associated with any particular field/area include:

- **Pesticide Runoff Vulnerability**: an analysis of pesticide runoff vulnerability across the lower 48 states that may influence the amount of runoff/erosion mitigation for a particular site.
- **Areas 1000 feet Down-Gradient from Application Areas**: areas where there is not a potential for population-level impacts from off-site exposure to runoff/erosion from pesticide applications.
- **Conservation Program and Runoff/Erosion Specialists/Mitigation Tracking:** recognition that growers/applicators that work with a runoff/erosion specialist or participate in a conservation program would likely achieve higher than average mitigation measure efficacy and benefits of mitigation tracking.

As described in **Section 3.2.2.5,** EPA has identified several mitigation measures that when employed on a field by themselves, would result in runoff/erosion exposures that would not likely have a potential for population-level impacts. If the following mitigation measures are employed, then no further runoff/erosion mitigations would be needed:

- systems with permanent berms;
- tailwater return systems; and
- subsurface tile drains, *with* controlled drainage structures

In addition, EPA's evaluation indicated the run-off/erosion exposure from several herbicide application methods would be limited and thus the potential for population-level impacts is unlikely. These application methods include the following:

- tree injection;
- some chemigation methods, including subsurface and under non-permeable plastic surfaces;
- soil injection; and

- less than 1/10 acre (<4356 square feet) treated and spot treatment (<1000 square feet treated) (*e.g.*, when applied with backpack or hand-held sprayers;

As detailed in the **Ecological Mitigation Support Document,** for each of the measures included in the runoff/erosion mitigation menu, EPA evaluated their effectiveness at reducing offsite transport via runoff/erosion (high, medium, or low). In general, a mitigation with a low, medium, or high efficacy achieves an average of 10-30%, 30-60%, and greater than or equal to 60% reduction, respectively. EPA's evaluation of the efficacy for each mitigation measure is based on empirical evidence, modeling, the efficacy of functionally equivalent measures, and EPA's best professional judgment of the mitigation's potential to be effective at reducing offsite transport of pesticides.

In order to include as many options as feasible across dozens of measures with varying degrees of efficacy, EPA utilized a point system for runoff/erosion mitigations to 1) associate the number of points with each MoD category for runoff/erosion; and 2) assign lower or higher point values to mitigation practices that are less or more effective, respectively, in reducing runoff/erosion. EPA assigned efficacy points to each of the measures on the runoff/erosion mitigation menu based on the efficacy of reducing exposure of the mitigation measure. High efficacy mitigation measures are worth 3 points, medium efficacy measures are worth 2 points, and low efficacy measures are worth 1 point (**Table 13**).

3.2.2.1 Level of Mitigation Identified for Runoff/Erosion

Where EPA determines a potential for listed species population-level impacts associated with runoff/erosion to be low, medium, or high, EPA would identify the level of mitigation needed to reduce exposures so that population-level impacts are no longer likely. EPA determines this first based upon the MoDs associated with the use of the pesticide being evaluated, which are related to the potential for population-level impacts. Mitigation measures (or combination of mitigation measures) that achieve three points are functionally equivalent to approximately an order of magnitude (*i.e.,* 10x) reduction in off-field exposure concentrations of pesticides transported via runoff. For erosion-prone chemicals, and those bound to sediment, EPA adjusts the points required to achieve an order of magnitude reduction in exposure concentrations. For erosion, 2 points are generally equivalent to an order of magnitude reduction in exposure concentration given the lower mobility of soil particles relative to water and increased effectiveness of mitigation practices at reducing soil in runoff. This order of magnitude reduction is equivalent to the reduction needed to drop from one category of potential for population-level impacts to a lower category (*e.g.,* from high to medium). **Table 12** presents the number of points EPA has identified to address potential for population-level impacts of runoff/erosion to wetland and aquatic habitats used by plants.

Table 12. Number of mitigation points identified to reduce exposure via runoff and erosion.

Potential for Population-level Impacts	Magnitude of Reduction in Exposure Needed to Result in a Not Likely Potential for Population-Level Impacts Conclusion	Mitigation Points Identified	
		Runoff-Prone [K_{OC} <1000 or K_d <50][1]	Erosion-Prone [K_{oc} ≥1000 or K_d ≥50][1]
Not Likely	None	None	
Low	10 x	3	2
Medium	100 x	6	4
High	1000 x	9	6

[1] The soil-water distribution coefficient (K_d) and organic-carbon normalized soil-water distribution coefficient (K_{OC}) are measures of the propensity of a chemical to be dissolved in water or sorbed to soil or sediment. K_{OC} and K_d values are measured in studies conducted under OCSPP Guideline 835.1230 (USEPA, 2008). The average K_{OC} or K_d is used to distinguish between runoff-prone and erosion-prone pesticides.

While a multitude of factors determine the fate and transport of a pesticide in the environment, one fundamental physio-chemical property of a pesticide is the sorption coefficient, otherwise known as the Koc[26]. This property describes whether a chemical tends to adsorb (*i.e.,* bind to) to soil particles or remain in water (USEPA, 2006). Chemicals with a higher Koc tend to adsorb to soil and are more likely to be transported by soil erosion, while chemicals with lower Koc tend to partition to water and are more likely to be present in runoff. Several of the runoff/erosion mitigation measures listed in the **Ecological Mitigation Support Document** function by removing soil, and therefore soil-sorbed pesticides, from runoff. This difference between chemicals results in runoff and erosion mitigations being inherently more effective for erosion prone pesticides. Examples of this phenomena can be seen in the literature for various mitigation measures, including vegetative filter strips, sedimentation basins, and cover crops/mulching. Across these three examples, the mitigations were found to be 20-30% more efficacious for erosion-prone pesticides compared to runoff-prone pesticides (**Ecological Mitigation Support Document**). EPA used this difference as the basis for the reducing the number of mitigation points erosion-prone pesticides.

3.2.2.2 Runoff and Erosion Mitigation Measures Menu

EPA identified runoff/erosion mitigations that would be included on EPA's mitigation menu website for growers/applicators to employ when EPA identifies mitigations for non-target species, including listed species, are needed to address population-level impacts from runoff/erosion. EPA assigned efficacy points to each of the runoff/erosion mitigation measures based on the efficacy of the mitigation measure to reduce exposure. The mitigation menu website will show the efficacy points assigned to each mitigation. The identified mitigation measures included on the menu and associated point values are presented in **Table 13.** EPA will update the menu with additional mitigation measures when appropriate (see **Section 4.0**).

[26] The organic-carbon normalized soil-water distribution coefficient (K_{OC}) is a measure the propensity of a pesticide to be dissolved in water or sorbed to soil or sediment. For some pesticides, sorption is described using the soil-water distribution coefficient (K_d) without organic-carbon normalization. K_{OC} and K_d values are measured in studies conducted under OCSPP Guideline 835.1230 (USEPA, 2008).

Mitigation measures that have been identified as of July 2024 are described in the **Ecological Mitigation Support Document** Version 1.0, and the mitigation list and point system outlined in that document are expected to be incorporated into the mitigation menu website later in 2024.

EPA has identified runoff/erosion mitigations for which efficacy data is available to provide options and flexibility to the grower.[27] EPA welcomes input on the efficacy of additional measures that growers may be using that the Agency did not include. EPA acknowledges that the mitigation menu will continue to evolve over time and the Agency plans to update the mitigation menu website with additional measures or refinements to those identified to date as new information becomes available.

[27] The Herbicide Strategy provides mitigation points for measures growers/applicators already employ if the measures are known to be efficacious for reducing runoff/erosion. If a grower/applicator is already implementing a mitigation measure on the menu, they may be able to implement fewer additional measures on their field to achieve the identified by the Herbicide Strategy.

Table 13. Runoff/erosion mitigation measures and associated point-values for reducing exposures. [28]

Mitigation Measure Title[1]	Conditions that Qualify[1,2]	Efficacy Classification	Points
Application Parameters			
Annual Application Rate Reduction	Any application 10% to <30% less than the maximum labeled annual application rate	Low	1
	Any application 30% to <60% less than the maximum labeled annual application rate	Medium	2
	Any application ≥60% less than the maximum labeled annual application rate	High	3
Reduction in Proportion of Field Treated[29]	10 to <30% of Field Area treated (Banded application, partial treatment, precision sprayers)	Low	2
	30 to <60% of Field Area treated (Banded application, partial treatment, precision sprayers)	Medium	3
	≥60% of Field Area treated (Banded application, partial treatment, precision sprayers)	High	4
Soil incorporation	Watering-in or mechanical incorporation before runoff producing rain event	Low	1
Field Characteristics[3]			
Field with slope ≤ 3%	Naturally low slope or flat fields; flat laser leveled fields	Medium	2
Predominantly Sandy Soils[4]	Fields with sand, loamy sand, or sandy loam soil without a restrictive layer that impedes the movement of water through the soil	Medium	2
In-Field Mitigation Measures[3]			
Reduced Tillage Management	Reduced tillage, mulch tillage, strip till, ridge tillage	Medium	2
	No-till	High	3
Reservoir Tillage	Reservoir tillage, furrow diking, basin tillage	High	3
Contour Farming	Contour farming, contour tillage, contour orchard and perennial crops	Medium	2
In-field Vegetative Strips	Inter-row vegetated strips, strip cropping, alley cropping, prairie strips, contour buffer strips, contour strip cropping, prairie strip, alley cropping, vegetative barrier (occurring in a contoured field)	Medium	2
Terrace Farming	Terrace farming, terracing, field terracing	Medium	2

[28] Current as of Herbicide Strategy Publication Date. The actual menu should be consulted from the website: https://www.epa.gov/pesticides/mitigation-menu At the time of the release of this document, the website reflects the ecological mitigation associated with the FIFRA IEM effort. EPA will periodically update the website with additional mitigation measures as the mitigation options and efficacy evaluation evolves. EPA will also provide details on how this website should be used for these strategies.

[29] See the **Ecological Mitigation Support Document** for an explanation of the points for this mitigation measure.

Mitigation Measure Title[1]	Conditions that Qualify[1,2]	Efficacy Classification	Points
Cover Crop/Continuous Ground Cover	Cover crop, double cropping, relay cropping	Low (tillage used)	1
		Medium (no tillage, short term)	2
		High (no tillage, long term)	3
Irrigation Water Management	Use of soil moisture sensors/evapotranspiration meters with center pivots & sprinklers; above ground drip tape, drip emitters; micro-sprinklers	Medium (general irrigation management)	2
	Below tarp irrigation, below ground drip tape; dry farming, non-irrigated lands	High (subsurface irrigation; no Irrigation)	3
Mulching with Natural and Artificial Materials	Mulching with artificial materials (*i.e.,* landscape fabrics, synthetic mulches)	Low	1
	Mulching with natural materials	High	3
Erosion Barriers	Wattles, Silt Fences	Medium	2
Adjacent to Field Mitigations[5]			
Grassed Waterway	Grassed waterway	Medium	2
Vegetative Filter Strips - Adjacent to the Field	20 to <30 ft Vegetative filter strip (VFS), field border	Low	1
	30 to <60 ft Vegetative filter strip (VFS), field border	Medium	2
	≥60 ft Vegetative filter strip (VFS), field border	High	3
Vegetated Ditch	Vegetated ditch	Low	1
Riparian Area	20 to <30 ft Riparian forest buffer, riparian herbaceous cover Riparian forest buffer, riparian herbaceous cover	Low	1
	30 to <60 ft Riparian forest buffer, riparian herbaceous cover	Medium	2
	≥60 ft Riparian forest buffer, riparian herbaceous cover	High	3
Constructed and Natural Wetlands	Constructed wetlands, Wetland and Riparian Landscape/Habitat Improvement	High	3
Terrestrial Habitat Landscape Improvement	20 to <30 ft Terrestrial Landscape/habitat improvement	Low	1
	30 to <60 ft Terrestrial Landscape/ habitat improvement	Medium	2
	>60 ft Terrestrial Landscape/ habitat improvement	High	3
Filtering Devices with Activated Carbon or Compost Amendments	Filters, sleeves, socks, or filtration units containing activated carbon	High	3
	Filters, sleeves, socks, or filtration units containing compost	Low	1
Systems that Capture Runoff and have Controlled Discharges			
Water Retention Systems	Retention pond, sediment basins, catch basins, sediment traps	Medium	2
Subsurface Drainages and Tile Drainage Installed *without* Controlled Drainage Structure	Subsurface tile drains, tile drains	Low	1

Mitigation Measure Title[1]	Conditions that Qualify[1,2]	Efficacy Classification	Points
Other Mitigation Measures			
Mitigation measures from multiple categories (*i.e.*, in-field, adjacent to the field, or water retention systems) are utilized.[6]	See measures in categories above.	Low	1

[1] Proposed mitigation measures descriptions specific to pesticides were published in the Ecological Mitigation Support Document to Support Endangered Species Strategies Version 1.0 (USEPA, 2024). Not all measures are applicable to all fields and crops.

[2] Only one of the practices that qualify from a 'mitigation measure' can be used. For example, a user could get mitigation points for cover cropping or double cropping but not both.

[3] Multiple field characteristics may apply to an individual field.

[4] Soil texture is as defined by USDA's soil classification system. See USDA's Web Soil Survey tool to determine soil texture: https://websoilsurvey.nrcs.usda.gov/app/.

[5] Adjacent to the field mitigations should be located downgradient from a treated field to effectively reduce pesticide exposure in runoff and erosion.

[6] For example, if a cover cropping and adjacent to the field VFS are both utilized, the efficacy of the mitigation measures in combination may be increased.

3.2.2.3 Mitigation Relief based on Pesticide Runoff Vulnerability

The amount of runoff and erosion transport differs across the contiguous U.S., especially due to differences in frequency and amount of rainfall. EPA evaluated the scientific literature and developed analyses to differentiate geographical areas by runoff vulnerability and reduced the amount of runoff/erosion mitigation identified in those areas. In practice, this is county level relief points that reduces the amount of additional mitigation that would be needed in areas that do not have high pesticide runoff vulnerability. A list of counties and associated relief points (**Appendix B**) will be provided on the mitigation menu website[30]. As described in more detail in the **Ecological Mitigation Support Document**, EPA evaluated the relative vulnerability of areas across the lower 48 states to pesticide runoff using PWC. EPA used a generic runoff-prone chemical with approximately three million scenarios across the lower 48 states to rank runoff vulnerability relative to the modeled maximum scenario. The scale of this modeling simulation was conducted at a much finer resolution than that of EPA's standard aquatic modeling for regulatory actions (*i.e.,* 2-digit HUC resolution).

The evaluation of this information resulted in a determination that pesticide runoff vulnerability can be defined at a county level with four categories (very low, low, medium and high) representing spatially where exposures of pesticides in runoff may be representative of EPA's upper bound estimates (*e.g.,* high pesticide runoff vulnerability counties) compared to areas where concentrations in pesticide runoff are likely being overestimated (*e.g.,* counties with very low pesticide runoff vulnerability). The relative level of pesticide runoff vulnerability that EPA expects for each of these categories is summarized in **Table 14**.

Counties classified as highly vulnerable to pesticides occurring in runoff would reflect those that have greater potential for population-level impacts. EPA chose the county level scale to communicate runoff vulnerability to balance ease of communication, data resolution, and environmental variability. For medium, low, and very low vulnerability areas, EPA's evaluation shows the potential for population-level impacts may be increasingly overestimated. To account for this overestimation, EPA will provide mitigation relief in the form of points. EPA assigned relief[31] points to all counties with medium (2 points), low (3 points), or very low (6 points) pesticide runoff vulnerability (**Table 14, Figure 9; Appendix B**). This county-level relief reduces the amount of additional mitigation that would be identified in areas that do not have high pesticide runoff vulnerability. This approach represents a spatially refined analysis (compared to EPA's national-level screening assessments; **Ecological Mitigation Support Document**) where EPA can consider differences in exposure across the country and the amount of relief points align with the magnitude of difference methodology described in **Step 2 (Figure 9)**. Just as in **Step 2**, each order of magnitude reduction is equivalent to 3 relief points, so EPA assigned areas with very low pesticide runoff vulnerability 6 relief points (approximately 2 orders of magnitude reduction), 3 relief points to areas with low pesticide runoff vulnerability (approximately 1 order of magnitude reduction), and 2 relief points to areas with medium pesticide runoff vulnerability (approximately ½ order of magnitude reduction).

[30] Mitigation menu website: https://www.epa.gov/pesticides/mitigation-menu

[31] EPA defines relief as a level of reduction for required points of a given pesticide and is based on a field's geographic location.

EPA estimates that these relief points may reduce the additional runoff mitigation burden (level of mitigation points identified) for approximately 80% of cultivated agriculture acres and 95% of specialty and minor crop production acres. Relief points can be used when mitigations are implemented on the general pesticide product label or on PULAs that fall within counties where relief points are available.

Table 14. Categories of magnitude of difference from nationwide maximum pesticide runoff vulnerability score with corresponding percentiles and classifications.

Order of Magnitude Lower than Max	Pesticide Runoff Vulnerability	
	Percentile	Classification
~2	0 – 9%	Very low
~1	10 – 49%	Low
~Half	50 – 84%	Medium
Maximum	85 – 100%	High

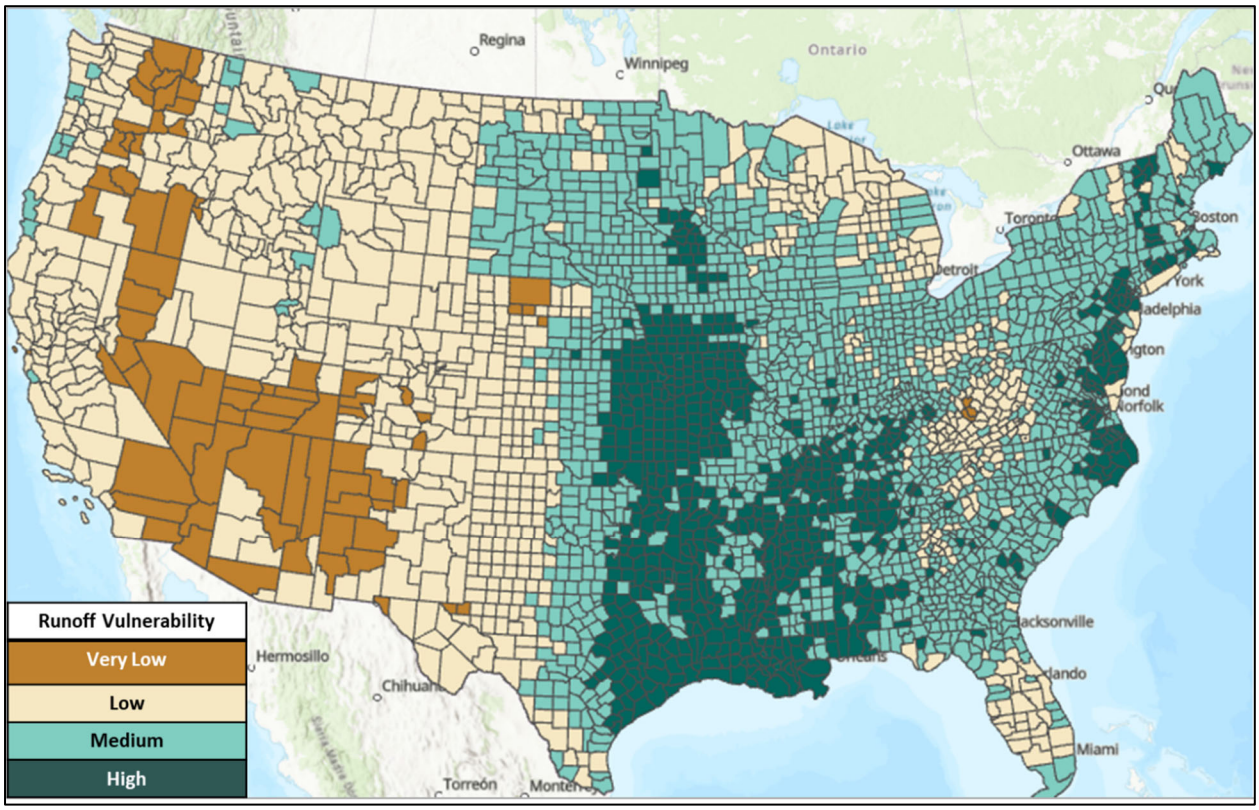

Figure 9. Pesticide runoff vulnerability at the county level.

3.2.2.4 Run-Off/Erosion Mitigation Relief for Areas 1000 feet Down-Gradient from Application Areas

Pesticide exposure to non-target organisms and their habitat via runoff/erosion is highest the closer the non-target species are to the pesticide application area. Runoff and erosion are directional, meaning off-site transport occurs when an adjacent area is at a lower elevation than a pesticide application area. As described in the **Ecological Mitigation Support Document**, based on an analysis of overland flow and sheet flow and the distance to various watersheds and waterbodies, EPA concluded that pesticide concentrations in runoff that have the potential to rise to population-level impacts can extend up to 1,000 feet downslope from a pesticide application. Accordingly, areas beyond 1,000 feet are likely to receive less runoff and erosion from the treated field, if at all, making the potential for population-level impacts unlikely. EPA does not identify runoff/erosion mitigations for pesticide applications areas more than 1,000 feet downwind from a terrestrial or aquatic habitat for listed species. EPA received comments from a wide variety of stakeholders that EPA should not rely on habitat descriptions to determine if an application is within 1,000 feet of such habitats because stakeholders could not readily identify them based on those descriptions. When EPA develops PULAs for geographically specific runoff/erosion mitigations, it ensures the geographic extent of the mitigations does not extend beyond 1,000 feet from those areas it identifies for conservation of a listed species and its critical habitat (See **Section 3.3.3** for additional information on PULA development). However, in **Step 3** of the Herbicide Strategy and as described in **Section 3.3.1**, in some cases, when this strategy is applied to a FIFRA action, EPA expects to identify mitigations for listed species that would apply across the full spatial extent of a use pattern (*e.g.*, specific crops) within the contiguous U.S., specifying the mitigations on the general pesticide product label. In this case, EPA's assessment similarly does not show that growers/pesticide applicators should need to implement mitigations unless they are within 1,000 feet of habitat or a waterbody. To account for this and in light of the stakeholder comments, rather than describe habitats, EPA is relying on managed lands as described in **Section 3.2.1.4** above for spray drift. Many farms have highly managed lands in areas adjacent to a pesticide application and EPA does not expect these managed lands to contain sufficiently suitable species habitat that enough individuals would be exposed to rise to a potential population-level impact. This similarly extends to mitigation measure for drift or runoff/erosion or drift control, and CRP lands (See **Section 3.2.1.4**). Therefore, to the extent that managed areas represent the entirety of 1,000 feet downslope and immediately adjacent to a pesticide application (and they themselves not being treated with the pesticide), EPA did not identify a potential for population-level impacts. Therefore, EPA did not identify runoff/erosion mitigations. **Table 15** describes the managed areas that EPA has identified for purposes of runoff/erosion mitigation.

Table 15. Downslope managed areas within 1000 feet downslope of treated area where runoff/erosion mitigations were not identified.

a. Agricultural fields, including untreated portions of the treated field; b. Roads, paved or gravel surfaces, mowed grassy areas adjacent to field, and areas of bare ground from recent plowing or grading that are contiguous with the treated area; c. Buildings and their perimeters, silos, or other man-made structures with walls and/or roof; d. Areas maintained as a mitigation measure for runoff/erosion or spray drift control, such as vegetative filter strips (VFS), field borders, hedgerows, Conservation Reserve Program lands (CRP)[32], and other mitigation measures identified by EPA on the mitigation menu; e. Managed wetlands including constructed wetlands on the farm; and f. On-farm contained irrigation water resources that are not connected to adjacent water bodies, including on-farm irrigation canals and ditches, water conveyances, managed irrigation/runoff retention basins, and tailwater collection ponds.

3.2.2.5 Mitigation Measures that in and of Themselves Reduce Exposure Such That Potential Population-Level Impacts are Unlikely

In some instances, EPA may determine that growers and applicators would not need additional runoff/erosion mitigation measures because a particular measure in and of itself reduces exposure such that potential population-level impacts are unlikely. Each of these measures is described in more detail in the **Ecological Mitigation Support Document** and summarized below.

Systems with permanent berms are treated fields that are surrounded by an elevated border or perimeter (*e.g.,* berms) are in place at the time of application and carried through the cropping season. Under these conditions rainfall and irrigation water is expected to be kept on the treated field. Example cropping systems include cranberry bogs, rice paddies, and drainage ditch & berm systems.

For treated fields with irrigation tailwater return systems, all runoff water from rainfall or irrigation is collected and stored on site for later use. Thus, runoff and/or erosion offsite from the field is not expected. Tailwater return systems are frequently paired with furrow and border-strip irrigation systems in both row and field crop agriculture.

If the field has subsurface drainage installed and maintained (*e.g*., tile drains), runoff from the field will be greatly reduced. To maintain protection of non-target taxa, the subsurface tile drains must release the effluent (water) into water-controlled drainage structures or a saturation buffer zone that do not release water into downstream off-farm aquatic areas. Runoff from the entire field would need to be controlled and directed into a pond/saturation zone.

[32] Although some areas associated with mitigation or conservation measures (*e.g.,* Conservation Reserve Program (CRP), Agricultural Conservation Easement Program (ACEP) areas) may be attractive to species such as pollinators, these areas may be included in the identified buffer distance because EPA does not want to disincentivize growers from providing such habitats, which may have considerable benefits to species, their environment, and pesticide use reductions. Growers may need to ensure that pesticide use does not degrade the degradation of the CRP habitat.

3.2.2.6 Conservation Program, and Runoff/Erosion Specialist, and Mitigation Tracking

EPA's evaluation of available efficacy data for many of the runoff/erosion mitigation measures demonstrates that the efficacy of many mitigations is highly variable from one study to the next (and from site to the next). For example, for some measures, studies show that efficacy may range from 0% to 100%. For any given mitigation measure, a range of efficacy is expected depending on the specific implementation of the measure, the environmental conditions of the area, site and soil characteristics of the treated field, maintenance, upkeep of the mitigation measure, and the physical-chemical properties of the pesticide.

Often, grower/applicators work with a technical expert in runoff/erosion control or a conservation program with a goal of reducing runoff/erosion. Because these experts consider and make recommendations for the site-specific conditions, when a grower/applicator installs a runoff/erosion measure to the specifications from such an expert, EPA has higher confidence that mitigation measures identified and implemented at the field level would achieve the higher end of the available efficacy data. As such, EPA identified mitigation points available for grower/applicators that work with a qualifying technical expert **or** participate in a qualifying conservation program.

A grower/applicator may receive mitigation points working with a technical expert or participating in a conservation program, but not both. The grower/applicator would receive points for any of their fields that are included in the expert consultation or conservation program, which could be an entire farm or a fraction of it (*e.g.*, some fields, but not all within a farm). The grower/applicator would not get additional points for both working with an expert/specialist and for participating in a conservation program, since the expert/specialist is inherently part of the program. Additionally, these points are not applicable to each mitigation measure but rather would be in addition to the points a grower/applicator obtains from other mitigation menu items (*e.g*., if the farm is located in an area of low pesticide runoff vulnerability) and for implementing mitigation measures. Each of these options and the associated mitigation points are described in more detail below.

3.2.2.6.1 Follow Recommendations from a Runoff/Erosion Specialist

Grower/applicators may work with a technical expert to develop mitigation plans that work for their field and that are efficacious in reducing runoff and/or erosion. As described above, when a grower/applicator is working with a technical expert who embodies the characteristics below, EPA expects that the mitigation measures would be selected and implemented considering site-specific conditions, including the soil type, field slope, hydrology, local climate, crop(s) grown, pest concerns, drainage systems, irrigation needs, and equipment availability. Specific cropping systems and regions have established norms and practices based on real-world experience that on-site professionals (*i.e*., technical experts) can account for in the planning process. In this case, EPA expects the efficacy of runoff/erosion mitigation measures would be on the higher end of the range of efficacy. To account for this, EPA identified **one runoff/erosion mitigation point** available to grower/applicators that work with a runoff/erosion technical expert that meets the characteristics described below. The point for working with the technical expert is in addition to the points for implementing mitigation measures identified in the strategy.

EPA has reviewed available information regarding characteristics that often apply to meet the description of a technical expert. At a minimum, there is usually an education (and a continuing education) and an experience component. Based on this review, EPA identified three benchmarks for technical experts, which include:

- Have technical training, education and/or experience in an agricultural discipline, water or soil conservation, or other relevant discipline that provides training and practice in the area of runoff or erosion mitigation technologies/measures; **And**
- Participate in continued education or training in the area of expertise which should include run off and erosion control; **And**
- Have experience advising on conservation measures designed to develop site specific runoff and erosion plans that include mitigation measures described in EPA's Mitigation Website.[33]

EPA has identified the following examples of technical experts: NRCS and similar state or regional level program staff, Certified Crop Advisor, Pesticide Control Advisor, Certified Professional Agronomist, National Alliance of Independent Crop Consultants (NAICC), EnviroCert International, Inc., Certified Professionals in Erosion and Sediment Control, Technical Service Providers, and extension agents. **EPA acknowledges that this list is not exhaustive, and the inclusion of an organization should not be construed as an endorsement of any particular group by EPA.**

3.2.2.6.2 Participate in a Conservation Program

Conservation programs provide technical expertise as described above, as well as additional support to grower/applicators. Based on EPA's review of available information on existing programs, this support may include oversight in the form of a review of design, installation, and upkeep/maintenance plan for the identified mitigations. In addition, the programs typically include documentation demonstrating the site-specific plan meets any program requirements.

While conservation programs are not solely designed to reduce offsite transport of pesticides, several of the same types of mitigations that reduce offsite transport of nutrients and/or soil erosion from an agricultural field also reduce offsite transport of pesticides. Evaluating a field for the purpose of reducing nutrients in runoff and/or soil erosion is likely to result in similar recommended mitigations as those included in the runoff mitigation menu.

However, with few exceptions, EPA is not aware of any conservation programs that are designed specifically to reduce offsite transport to an extent where population-level impacts to listed species are unlikely. Therefore, while existing conservation programs may recommend similar mitigation measures, these measures may or may not be enough to address potential impacts to listed species. In addition, data is not readily available on the extent to which grower/applicators that participate in these conservation programs (and participation is voluntary) implement all program recommendations. For

[33] EPA's mitigation menu is available at: https://www.epa.gov/pesticides/mitigation-menu and a description of the mitigations is available at https://www.epa.gov/pesticides/menu-measure-descriptions.

these reasons and given the goals of the strategies, EPA is not able to provide a full exemption for these programs at this time. Rather, EPA identified **two runoff/erosion mitigation points** available to grower/applicators that participate in a conservation program. The additional mitigation point for participation in a conservation program over consulting a technical expert is because programs include some additional minimum characteristics summarized below.

EPA has developed the following minimum characteristics for a conservation program to receive the two points. Only programs that include all of these characteristics are eligible for the points.

- The program provides advice from individuals who meet the same benchmarks provided above for technical experts; **And**
- The program provides site-specific guidance tailored to the grower/applicator's crop and/or location; **And**
- The program focuses on reducing or managing runoff and/or erosion (including for example, soil loss, soil conservation, water quality protection) from agricultural fields or other pesticide use sites; **And**
- The program provides documentation of program enrollment. EPA is **not** suggesting that this documentation be provided to EPA; **And**
- The program includes verification of implementation of the recommended measures or activities (measures were established and maintained). Verification can be done through the conservation program and provided to the program enrollee. Verification is **not** required to be submitted to EPA.

Note: EPA identified that mitigation points should be available for past participation in programs that meet the minimum characteristics, provided that measures are currently on the field, have been maintained over time, and are recertified by a runoff and erosion technical expert [federal, state, or local; *e.g.*, Certified Crop Advisor, Pesticide Control Advisor, Conservation Crop Protector, Certified Professional Agronomist, National Alliance of Independent Crop Consultants (NAICC), agronomists that are part of grower cooperatives].

3.2.2.6.3 Mitigation Tracking

All of the mitigation measures identified for the Herbicide Strategy and described in the Mitigation Support Document have been determined by EPA to provide some level of reduction of the potential for population-level impacts to listed species from pesticide exposure in runoff/erosion. Consistent with typical agricultural practices, EPA expects that mitigation tracking would be done on paper or on an electronic format. Tracking the mitigations a grower/applicator employs at the field and farm level could provide several benefits to the grower/applicator. Tracking of the employed mitigation measures could help a grower/applicator ensure that they are achieving the number of points to satisfy any labeling requirements that include mitigations to address population-level impacts. Additionally, tracking the mitigations employed could assist with future planning of farm needs, and is generally aligned with the concepts of agricultural best management practices (commonly known as BMPs). Where a grower/applicator has a well thought out plan for the growing season which includes the tracking of mitigation measures employed, EPA would have increased confidence that measures have been

implemented and properly accounted for. Therefore, EPA is assigning **one point** for any grower/applicator who tracks their mitigations on paper or in electronic format in addition to any points for working with a specialist or participating in a conservation program. Working with a runoff/erosion specialist or participation in a program is not required to be eligible for this point, and therefore this point is available for any grower/applicator that tracks their mitigation measures.

3.3 Step 3. Identify Geographic Extent of Mitigation

For the Herbicide Strategy, EPA intends to apply mitigations, when appropriate, broadly across the full spatial extent of a use pattern (*e.g.,* specific crops) within the contiguous U.S., specifying the mitigations on the general pesticide product label. Through FIFRA actions, where EPA identifies mitigations that would apply in geographically specific areas only (referred to as Pesticide Use Limitation Areas or PULAs). Depending on the herbicide, EPA may use both or one or the other option or a combination of both. As discussed below, where mitigations are identified for listed generalists, these measures would be included on the general label, and labeling statement directing a user to BLT when additional mitigations are identified for listed plants.

EPA expects that applicants/registrants include mitigations on their proposed general pesticide product label where mitigations broadly apply (*e.g.,* cover large geographic areas, for generalists) instead of to certain geographic areas (*e.g.,* PULAs).

Where EPA identifies mitigations specific to certain geographic areas, it generally uses Geographic Information System (GIS) mapping information to identify where a pesticide limitation applies to a listed species or group of species. Such areas, along with a description of the use directions applicable to that area for a pesticide, are called PULAs. PULAs focus on areas where pesticide exposures are likely to impact the continued existence of a listed species, which may include a reduction in survival or recovery of the species. Thus, the purpose of a PULA is to identify geographic areas where pesticide mitigations apply to conserve a

Key Definitions for Step 3 of the Herbicide Strategy Framework

Bulletins Live! Two (BLT): BLT is the web-based application to access Endangered Species Protection Bulletins (Bulletins). EPA uses BLT to communicate where additional pesticide use directions may be needed to protect listed species in geographically specific areas.

Pesticide Use Limitation Areas (PULAs): A PULA is the specific geographic area associated with particular pesticide mitigations for a listed species, groups of listed species, or designated critical habitat. PULAs are used in BLT to provide pesticide applicators with specific locations where use restrictions may apply to their intended pesticide application to protect listed species or their designated critical habitat.

Endangered Species Protection Bulletins: A bulletin is the printed copy from the BLT application that provides the geographically specific mitigations for the pesticide application. The general pesticide product labeling directs applicators to the BLT system. Bulletins typically include both the PULA and the mitigations that apply within that PULA. Once PULAs are developed, each PULA # that applies for a pesticide product would be on the general pesticide product label and the BLT system will be used to help the applicator identify which PULA # applies to their location. When directed by the label to Bulletins these become enforceable pesticide use limitations to protect listed species or designated critical habitat.

listed species and designated critical habitat. EPA develops PULAs so applicators can determine if their intended pesticide application falls within a location where additional use restrictions apply to protect listed species or critical habitat. These geographic-specific restrictions are published in Bulletins that are accessed through the BLT website. In other words, where the pesticide product labeling directs an applicator to BLT, the information in BLT informs the applicator where and/or what additional restrictions or mitigations must be followed to protect listed species for a particular location. To date, EPA has typically used this system to mitigate for specific pesticide products and individual species. Pesticide product labels direct applicators to BLT and follow any applicable Bulletins. The BLT system allows EPA to reduce complexity on pesticide product labels and limit geographically specific listed species protections to only where they would apply. Bulletins typically include: 1) the geographic extent (PULA) of the area where the same set of mitigations apply, and 2) a description of additional mitigations that apply within the PULA (referred to as "pesticide use limitations"). In the Herbicide Strategy, when the mitigation measures apply only to a limited geographic area, EPA would publish a specific PULA representing the area that would have additional use restrictions in BLT.

There are approximately 1030 listed species under FWS authority located within the contiguous U.S. Of those species, EPA has identified approximately 550 listed species that are listed generalists for the Herbicide Strategy (examples in **Figure 5**). These species range across the majority of the contiguous U.S. (**Figure 10**), therefore, as explained above, when EPA determines a potential for community-level impacts for a listed generalist species (or groups of listed generalist species), mitigations for listed generalists would apply across the full spatial extent of a use pattern within the contiguous U.S. In addition, as described in **Section 3.3.2**, EPA identified approximately 230 listed plants and listed animals that are obligate to a plant that may have a potential for population-level impacts from direct exposures to off-site transport of spray drift or runoff/erosion. The following sections describe how the general pesticide product label and PULAs (using BLT) may both be used to identify mitigations associated with this strategy. The following sections describe how the general pesticide product label and PULAs (using BLT) may both be used to identify mitigations associated with this strategy. This geographic framework is relevant to both runoff/erosion mitigation measures and spray drift mitigation measures.

3.3.1 Mitigations to Apply Broadly

When EPA identifies mitigation that would cover an entire use area in the contiguous U.S., such restrictions would likely appear on the general pesticide product label. When EPA identifies mitigation that would cover an entire use area in the contiguous U.S., such restrictions would likely appear on the general pesticide product label. In general, EPA expects mitigations would apply broadly when there is potential for population-level impacts to entire plant communities (*e.g.,* multiple species with impacts) that would lead to impacts to listed generalists (listed species that depend on plant communities). EPA expects to identify less mitigation for such generalists compared to listed plant species that are directly affected by herbicides or obligate listed species that depend on a single (or very few) plant species. This is because a population-level impact to generalists is expected to occur only when more than just a very few species of plants within a community are impacted whereas a population-level impact to a listed plant or obligate is expected to occur when just a single, or very few, species are impacted. **Figure 10** below shows the distribution (based on range data from FWS) within the contiguous U.S. of the ~550 listed animal generalists that depend on plants for diet or habitat. This does not mean that EPA has

determined that a particular herbicide would have a potential for population-level impacts to these species as that determination is chemical-specific as described in **Step 1** of the Herbicide Strategy and could result in a determination that the potential for population-level impacts for some or all of these species is unlikely. Rather, it means that these ~550 listed generalist species represent the maximum number of generalists species where EPA may find a potential for population-level impacts for a particular herbicide and to demonstrate the geographic extend of generalists and why it may be appropriate to include such mitigations on the general product label.

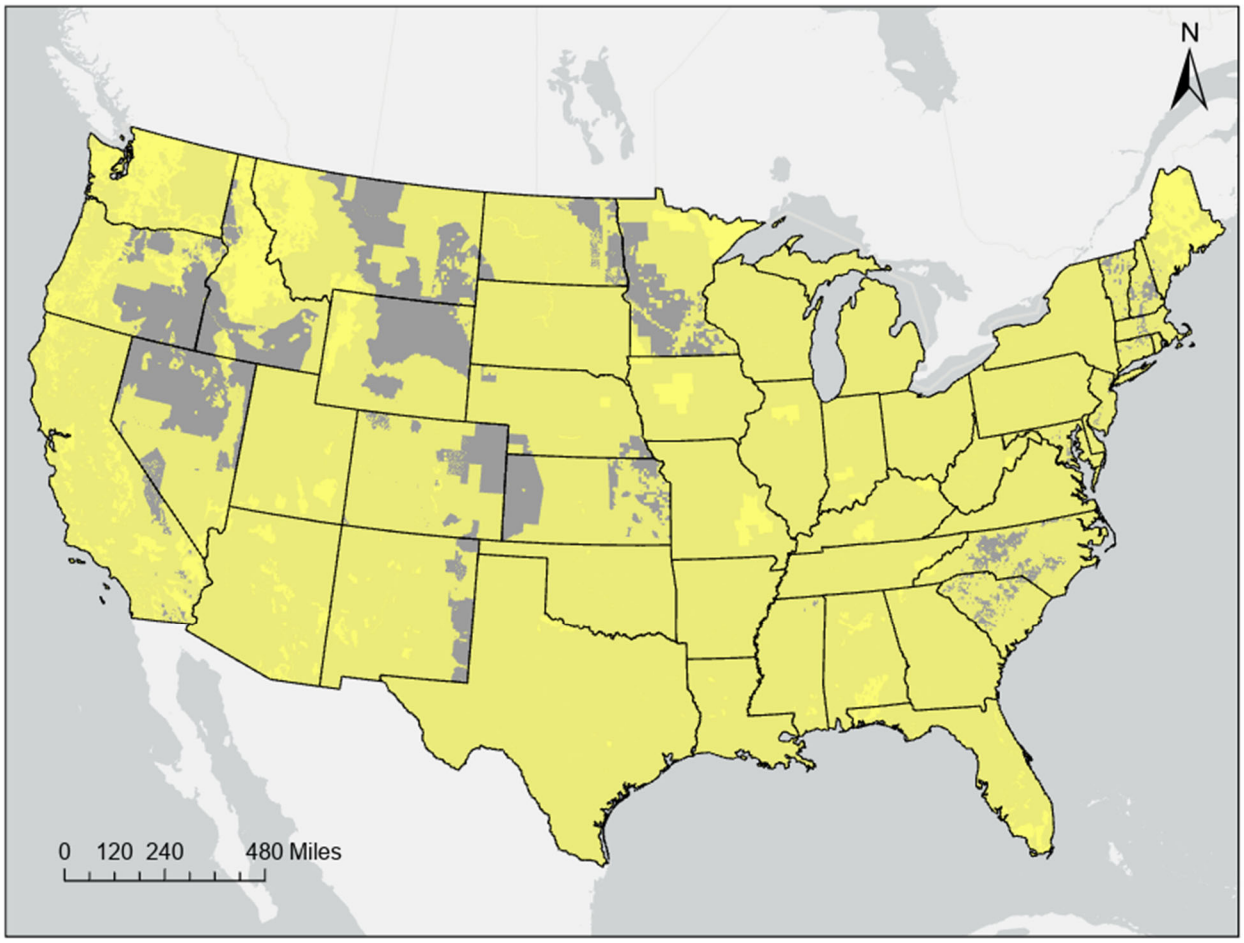

Figure 10. Yellow areas represent the distributions within the contiguous U.S. of listed animal generalists that depend on listed plants for diet or habitat. This map includes the ranges and critical habitats of approximately 550 listed animal species (generalists) under the jurisdiction of FWS.

3.3.2 Mitigations That Apply In Geographically Limited Areas (identified using BLT)

3.3.2.1 Listed Plants and Obligate Animals

There are currently 450 listed (endangered, threatened and proposed) plant species under FWS authority within the contiguous U.S. Most of these species are flowering plants that are dicots (*e.g.*, sunflowers) or monocots (*e.g.*, orchids), with some non-flowering plants (*e.g.*, ferns). There are also approximately 30 listed animal species that are obligate to plants (most of which are listed butterflies).

EPA predicts that herbicides are likely to cause population-level impacts from direct exposures for some of these species, but not all. This depends on numerous factors including species characteristics, pesticide properties, and use patterns. In this strategy, EPA's evaluation of the potential for population-level impacts for these listed species is based on similar analyses that EPA and FWS have conducted (*e.g.,* EPA Biological Evaluation and FWS Biological Opinion for Enlist, USEPA 2022c and USFWS 2023c, respectively). To evaluate if a listed species might rise to the level of population-level impacts from agricultural uses of herbicides, EPA first conducted an analysis by considering the degree of overlap of a species range with cultivated land (areas reported by USDA where crops are grown; 1000 ft buffer added to account for spray drift and runoff/erosion transport). If that overlap for a species was less than 5% after taking into account available usage data from Census of Agriculture and California Department of Pesticide Regulation, EPA did not consider that species to have a potential for population-level impacts. For those species with a 5% or higher overlap, EPA also considered whether there were species-specific factors that would limit exposure such that there would not be a population-level concern.[34,35] EPA similarly applied this approach to listed animals with obligate relationships to plants. EPA identified 227 species of listed plants or obligate species that may have a potential for population-level impacts, meaning EPA would likely identify mitigations to address those impacts (**Table 16**). This does not mean that EPA has determined that a particular chemical would have a potential for population-level impacts to these species. Rather, it means that these 227 listed species (of plants and obligate animals) represent the maximum number of species where EPA may find a potential for population-level impacts and therefore, identify mitigations[36]. EPA expects the list of species included in the Herbicide Strategy PULAs to evolve over time. EPA anticipates updating this list of species through lessons learned during consultations with FWS, as new information becomes available for species, and as the listing status of species change. EPA also anticipates updating overlap analyses and revisiting species over time as data sets that describe where commodities are produced, pesticide usage, and where listed species are located evolve.

The current ranges and critical habitats of these 227 listed plants and obligate animals are presented in **Figure 11.** This figure shows that the spatial extent of these species is much smaller than the spatial extent of the generalist species, so where EPA finds a potential for population-level impacts for these species, mitigations to address these impacts would be in limited geographic areas and communicate the locations where mitigations would apply in BLT. In this case, the pesticide product label would direct applicators to the BLT system. **Appendix A** includes more detail on how EPA evaluated the 450 listed plant species and any obligate species to identify the 227 species that could have a potential for population-level impacts. EPA notes that **Figure 11** represents the maximum spatial extent because it is currently developing a process to refine PULAs and EPA expects the result will be that many PULAs will be smaller than the species ranges. See **Section 3.3.3** for more information.

[34] EPA used spatial data representing the listed species range and designated critical habitat locations provided by the FWS as of December 1, 2023 (USFWS, 2022).

[35] This is referred to as "modifiers" because we considered factors relevant to species life history and habitats that could modify the standard exposure assumptions such that exposure would be limited.

[36] For these ~290 species, EPA might identify additional mitigations that would be incorporated into the general label throughout the contiguous US (to address effects to ~550 generalists).

Table 16. Summary of number of species of listed plants where mitigations may involve bulletins on Bulletins Live! Two. Also included are listed animals that are obligate to plant species for diet and habitat.

Taxon	Number of Species
Dicots	178
Monocots	32
Non-flowering plants	3
Insects (obligates; primarily butterflies)	10
Birds (obligates)	3
Mammals (obligates)	1
Total	**227**

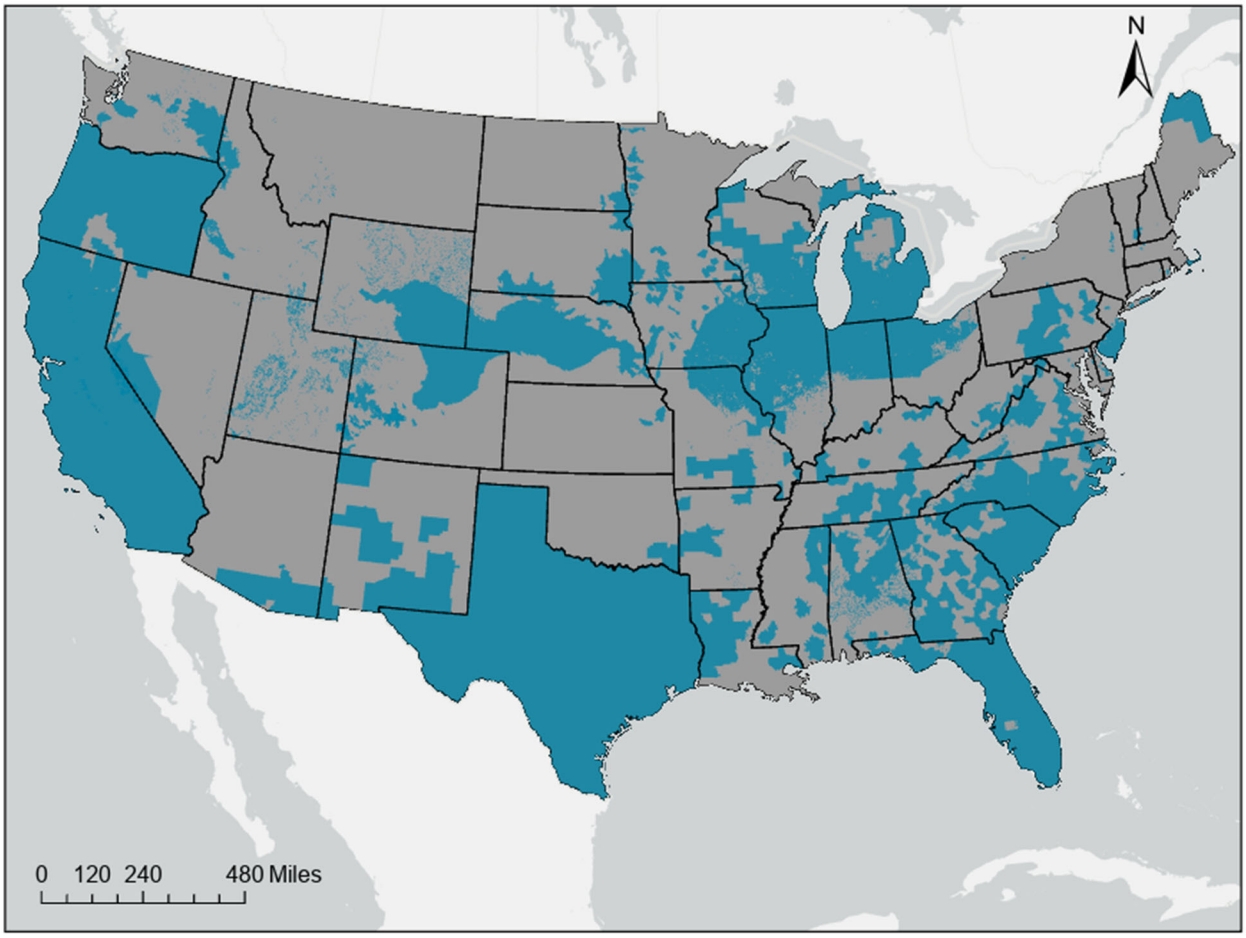

Figure 11. Blue areas represent geographic extent of species range and designated critical habitats for 227 listed plant species and animal species with obligate relationships with plants in the Herbicide Strategy.

3.3.2.2 PULAs Representing Groups of Species with Similar Mitigations

Many of the 227 listed species described above will likely share the same level of mitigation for a particular herbicide. This is because they share similar modeled habitats and/or population-level endpoints based on the assessment of sensitivity differences among species groupings. While the mitigations identified may vary across herbicides, EPA anticipates the level of mitigation for a particular pesticide would be the same. Therefore, EPA plans to group these species into common PULAs. Where multiple species share the same levels of mitigations, EPA is expecting to group the areas important for the conservation of each of those species into one aggregated PULA. EPA has identified 8 possible groups where listed species would generally have the same mitigations due to similarity of habitat and taxonomy. To differentiate impacts to different types of listed plants (*i.e.*, monocots, dicots, and woody plants), EPA needs sufficient toxicity data, which depends on a chemical by chemical (or chemical class) basis. Where possible, EPA grouped species that allow for the appropriate level of mitigation when identified including areas where less mitigation may be appropriate as EPA's standard modeling is expected to overestimate population-level impacts due to factors such as unlikely runoff and erosion exposure or flowing wetlands greater dilution potential. These groupings are based on the concepts incorporated in **Step 1** where EPA identifies the potential for population-level impacts based on different considerations of exposure, species habitat, taxonomy and characterization of the expected differences in EPA's exposure models and exposures in species habitats. **Table 17** summarizes the 8 groups. Specific species that fall into each group are included in **Appendix A**.

Over time, the list of species may change (as the listing status of species change) or as available information and categories for a species changes (*e.g.,* through consultation, through PULA development). Therefore, EPA expects to revisit the species included in the grouped PULAs and update them as needed. EPA may also change the groupings based after it gains experience in implementing ESA strategies. EPA is currently developing a process on how best to communicate the groupings and associated mitigations on pesticide product labels, BLT, and other possible platforms (such as EPA's website).

Table 17. Summary of eight herbicide species groups for Herbicide Strategy PULAs.

HS Group (PULA) #	# of Species Currently Included in Group	Habitat Description	Taxon	Toxicity Surrogate Used to Derive Buffer	EPA Standard Habitat Used to Calculate EECs	MoD Level Where There is Potential for Population-Level Impacts	Types of Mitigations[1]
1	32	Terrestrial	All taxa[2]	HC_{05}	Near field	≥1	Spray drift
2	108		Dicots + non-flowering plants	Dicots or HC_{05}	Near field, Terrestrial (TPEZ)	≥1	Spray drift and runoff/erosion
3	12		Monocots + non-flowering plants	Monocots or HC_{05}			
4	20		Woody plants	Dicots, monocots, HC_{05} or woody plant			
5	40	Wetlands	Dicots[3]	Dicots or HC_{05}	Near field, Wetland (WPEZ)	≥1	Spray drift and runoff/erosion
6	24		Monocots	Monocots or HC_{05}			
7	21	Flowing wetlands and riparian areas	Dicots[3] + non-flowering plants	Dicots or HC_{05}	Near field, Wetland (WPEZ)	≥10 (wetland)	Spray drift and runoff/erosion[4]
8	10		Monocots + non-flowering plants	Monocots or HC_{05}			

[1] For this type of mitigations, applicators would use BLT to identify the mitigations needed (in place of the mitigations on the general label).
[2]The majority of these species are dicots. For simplicity, all taxa are included in one group.
[3]Herbaceous and woody plants are lumped into this group due to a low number of woody plant species.
[4]EPA anticipates that 2-3 fewer runoff erosion points will be needed for these PULAs compared to the wetland PULAs (5 and 6) because the MoD representing potential population level impacts is an order of magnitude higher.

3.3.3 Plan for Developing PULAs for the Herbicide Strategy

As EPA noted in its update on the Herbicide Strategy[37], EPA is developing an approach to refine maps that EPA plans to use for PULAs. EPA received comments on the draft Vulnerable Species Pilot[38] and the draft Herbicide Strategy that asked EPA to reconsider the maps that EPA plans to use when identifying geographically specific locations for mitigations to address population-level impacts to a given listed species. Commenters stated that using entire species ranges as the basis for a PULA overburdens pesticide applicators unnecessarily because this captures many areas that are not needed to protect listed species at a population-level. Commenters requested that EPA refine PULAs that are overly broad, such that they minimize impacts on agriculture. In response, EPA is developing an approach to refine maps to develop PULAs so that when the Agency applies the strategy to a FIFRA action, those areas where mitigations would apply are to conserve a listed species and its critical habitat (if designated) and reduce the potential for including extraneous areas. This approach is being developed with input from FWS, USDA and other technical experts. EPA expects that for many species, the refined PULAs would represent parts of the range, not the entire range. Therefore, refining the PULAs would provide more realistic locations and lessen their impact for growers/applicators. This approach focuses on identifying those areas most critical to conserve a listed species and then adding buffers (1000 feet or less) to account for potential offsite transport from a treated field). Most of these species are not expected to occur on agricultural fields, so, EPA would identify mitigations only for those parts of fields located within the extent of the buffered PULA.

Through this developing approach, PULAs would be created for the species relevant to the Herbicide Strategy EPA would then create grouped PULAs by combining the species specific PULAs where the same mitigations have been identified (groups described above, species in each group provided in **Appendix A**). EPA expects this approach would be used by other strategies (*e.g.,* insecticide strategy) and the Vulnerable Species Pilot.

As EPA further works on its strategies, the Agency expects hundreds of PULAs would need to be developed. EPA is currently prioritizing PULA development that relate to the Vulnerable Species Pilot and Herbicide Strategy. EPA has identified approximately 230 species needing PULAs for the Herbicide Strategy. EPA is prioritizing PULA development for the Herbicide Strategy species with ranges that fall within the high runoff zones, that have high overlap with specialty crops and that have >1-million-acre ranges. EPA has chosen to prioritize these species because refinement of the spatial footprint captured by the PULAs is expected to reduce the impact of these PULAs on growers/applicators and focus mitigations where they are needed for these species. If needed, EPA may revise the specific species included in the Herbicide Strategy or the groupings based on lessons learned from development of the species-specific PULAs. EPA will provide updates on its progress in the development of all PULAs across the different strategies on its website.

[37] https://www.epa.gov/system/files/documents/2024-04/hs-public-update-4-16-24.pdf

[38] Additional information on the vulnerable species pilot is available at: https://www.epa.gov/endangered-species/implementing-epas-workplan-protect-endangered-and-threatened-species-pesticides

4. Plan for Implementing the Final Herbicide Strategy

The strategy itself is not self-implementing. Rather, EPA will consider the applicability of this strategy to inform conventional active ingredient registration and registration review actions. This section describes EPA's plan for implementing the final Herbicide Strategy through these actions.

As EPA considers applications for new conventional active ingredients and works on conventional registration review actions, the Agency will continue its current practice of providing opportunities for public input on proposed decisions, including mitigation that may come from this strategy. EPA expects to consider the appropriateness of applying the Herbicide Strategy for other actions on already registered active ingredients (*e.g.,* new uses).

EPA may propose label language as part of a FIFRA action that directs a user to access the BLT website for geographically specific mitigations through Bulletins. The Agency may also propose label language that requires mitigation measures irrespective of where the pesticide is applied. The label language proposed in either of these scenarios may require a specific level of mitigation and direct the user to the Mitigation Measure Menu Website. EPA may propose one or more of these for FIFRA actions.

Through the FIFRA registration or registration review action, EPA will decide what type(s) of mitigation language is needed. Pesticide product labeling would direct the user to EPA's mitigation menu website[39], which will describe the runoff/erosion mitigation measures from which the user can select to achieve the necessary level of mitigation specified on the label. EPA is not including a mitigation menu on the label itself because the Agency plans to update the menu with additional measures systematically, on a defined timeline as data to support additional measures is reviewed. Only by posting the menu online can EPA easily update the menu. The current mitigation menu website only reflects ecological mitigation for FIFRA IEM. EPA plans to revise the website to reflect how it could be used with this final strategy. EPA also plans to provide educational outreach and support to stakeholders as EPA begins implementing this strategy through FIFRA actions.

EPA also plans to continue its discussions with FWS to streamline ESA consultations. The development of this strategy and the future issuance of other strategies is expected to inform these processes. Finally, this section describes how this strategy interplays with FIFRA IEMs and other strategies and efforts (*e.g*., the Insecticide Strategy, the Vulnerable Species Pilot, offsets).

4.1 Registration Review and Registration Decisions

The conventional pesticide registration review workload includes hundreds of pesticide active ingredients, which represent thousands of individual products. EPA is regularly updating its registration review schedule, which takes into consideration the expected timing of the issuance of the final herbicide, insecticide, and rodenticide strategies. However, there may be instances where the timing of herbicide reviews does not coincide with the timing of the final Herbicide Strategy due to other risk mitigation priorities (*e.g.*, human health protection), existing consultation schedules, litigation, and/or Agency resource constraints. Overall, however, the Agency's efforts to align its registration review

[39] The website is available at https://www.epa.gov/pesticides/mitigation-menu. Currently the website provides information relevant to FIFRA IEM and has not yet incorporated information for any strategies.

schedule with the timing of the final strategy should improve efficiency and consistency in the consideration and application of early mitigations for the protection of listed species in EPA's registration review work.

As part of the registration review process, EPA issues a Proposed Interim Registration Review Decision (PID) or Proposed Final Registration Review Decision (PFD) with proposed mitigation measures before issuing an Interim Registration Review Decision (ID) or Final Registration Review Decision (FD). Stakeholders can comment on proposed decisions that would include proposed mitigation measures, including those that will be informed by the final Herbicide Strategy. After comments received on the PID or PFD are considered, EPA would determine whether any changes are needed to what was proposed before issuing any ID or FD.

As indicated in its April 2022 Workplan, EPA is prioritizing making effects determinations, and consulting as appropriate, for new conventional active ingredient actions. Typically, as part of the process for reviewing a new active ingredient, EPA takes comment on a proposed decision. The proposed decision would include a discussion of mitigation determined to be necessary, including measures to protect listed species. EPA would then consider comments received before making the final registration decision. In addition, EPA determine that applying the strategy is appropriate in other registration actions (*e.g.* new uses).

When EPA identifies mitigation to address population-level impacts using this strategy, a proposed decision associated with that action would include information on the mitigation. EPA may propose spray drift restrictions on use, such as spray drift buffers based on the application method, as well as runoff/erosion mitigation. As described in **Section 3.3**, in some cases, EPA expects to propose that the mitigations would apply across the full spatial extent of a use pattern (*e.g.*, specific crops) within the contiguous U.S., specifying the mitigation requirements on the general pesticide product label. In other cases, EPA plans to propose mitigations in geographically specific areas only.

When EPA identifies the need for runoff/erosion mitigation for a particular conventional herbicide new active ingredient registration or registration review action, the proposed decision would discuss product label statements related to these mitigations. The statements may include directions for use that require mitigation measures to achieve the minimum number of mitigation points for that pesticide. There could also be a statement on the pesticide product labeling directing the user to the mitigation menu website and/or BLT. EPA may also propose that the labeling include specific mitigation measures to be followed such as application restrictions within certain distances around water bodies or holding times for treated fields that use flood-irrigation systems. The mitigation points on product labeling would be specific to the approved agricultural uses for that product.

If a label requires a minimum number of mitigation points to be achieved, it will direct users to access EPA's mitigation menu website for detailed information on what mitigation measures a pesticide user could choose from (and the points associated with each measure) to meet the minimum points. The mitigation menu website is also expected to contain options that provide mitigation relief and their corresponding points. Currently, the website has a helpful section describing many of the mitigation measures being considered in this strategy.[40] The current version of the mitigation menu website does not have the associated points for each mitigation measure (EPA plans to upload this information in the Fall 2024). Therefore, please refer to **Table 13** and **Section 3.2** in this document for that information.

[40] Available at this pinpoint site https://www.epa.gov/pesticides/mitigation-menu#measures

For example, a pesticide product label could include a requirement that three runoff/erosion mitigation points must be achieved prior to an application to an agricultural crop (*e.g.*, corn) across the lower 48 states, but could also direct the user to BLT where a Bulletin requires six points to be achieved prior to applications to fields located in a PULA. This same label could state a different number of points to be achieved for a different crop (*e.g.*, soybean). For more detailed examples, see "Application of EPA's Runoff and Erosion and Spray Drift Mitigations Through Scenarios that Represent Crop Production Systems in Support of Endangered Species Strategies," located in the Herbicide Strategy Docket on www.regulations.gov for more detailed examples.

When a pesticide product label directs a user to the mitigation menu website for measures to meet the associated points on the label, the measure would need to be employed consistent with the description on the website. EPA has been working with USDA on the descriptions of the mitigation measures. In the fall of 2024, EPA will provide information on the Agency's descriptions and the cross-references to NRCS conservation practices. Providing a mitigation measure menu on a website allows EPA to update and expand the menu as the Agency receives more information on the efficacy of additional potential mitigation measures and to incorporate emerging and future technologies. EPA can therefore provide up-to-date available mitigations in a timely manner, providing for more flexibility for applicators and growers. As a result, applicators and growers would likely have multiple options when deciding what mitigation measures to apply to achieve the total number of points required by a product's labeling. It is essential that EPA communicates with applicators, farm managers, and landowners in the agricultural community. Likewise, communication among applicators, farm managers, and landowners on necessary mitigation measures is essential when planning an application.

EPA understands that many pesticide applicators use multiple pesticides on the same field at the same time. In this case, if a pesticide user applies more than one pesticide at the same time to a field, then the user would need to comply with the most restrictive set of mitigations among the pesticides that they plan to apply. This principle applies to listed species mitigation and all other use restrictions on the label, as these other use restrictions may be associated with ecological and/or human health risks identified by the Agency.

EPA understands that the spray drift and runoff/erosion mitigation can be complicated. While complex, providing a mitigation menu allows for much greater flexibility to growers to meet the mitigation needs for individual pesticides. EPA's aforementioned "Application of EPA's Runoff and Erosion and Spray Drift Mitigations Through Scenarios that Represent Crop Production Systems in Support of Endangered Species Strategies" details multiple real-world examples of how a pesticide user would comply with pesticide product labeling requirements. To help growers/applicators consider their options, EPA is also developing a calculator that growers and applicators could use to help determine what mitigation relief measures apply to them and their associated points for runoff/erosion, number of points associated with mitigations they may already have in place, and what further actions they may need to take to meet the total required points. EPA plans to develop other resources that could further help applicators, farm managers, and landowners work through the label complexity.

4.2 Education and Outreach

EPA acknowledges the critical need for additional education and outreach as this and other strategies are finalized and implemented in pesticide decisions. This section describes EPA's education and outreach efforts over the past two years and describes EPA's next steps.

Various educational webinars were held in 2022 and 2023 that pertain to early listed species mitigation efforts under FIFRA and help users navigate Bulletins Live! Two. In November 2022, EPA organized a webinar to present the Workplan Update. The webinar covered the FIFRA Interim Ecological Mitigation measures, draft section 3 label language that directs users to the BLT system for implementing geographically specific mitigation measures, and current and future initiatives to prioritize mitigation for listed species. The Workplan Update webinar can be accessed online at: https://www.youtube.com/watch?v=ENMUQdPdvyY.

In July 2023, EPA and USDA OPMP held a webinar to introduce the Draft VSP. The webinar covered the pilot species, the draft mitigation measures, the draft implementation plan, and a StoryMap demonstration (where a vulnerable species range is overlapped with crop data and draft pesticide use limitation areas). The VSP webinar recording can be accessed online at: https://www.youtube.com/watch?v=H8FmuN7AEY4.

In August 2023, another similar webinar was held by EPA and USDA OPMP to introduce the draft Herbicide Strategy. The webinar covered the draft Herbicide Strategy, including draft mitigation measures, implementation plan, example crop scenarios, and topics for public comment. The draft Herbicide Strategy webinar recording can be accessed online at: https://www.youtube.com/watch?v=vmm_oTmxdLU.

In November 2023, EPA organized a webinar to provide an overview of the BLT system. The November 2023 webinar described how Bulletins relate to the general label, explained how to use BLT, demonstrated how to look for geographically specific mitigation, and addressed frequently asked questions. Materials from the November 2023 webinar can be accessed online at: https://www.epa.gov/endangered-species/materials-november-2023-bulletins-live-two-webinar.

In 2023 and 2024, EPA also met with affected stakeholders, including various crop/commodity groups, to understand the grower perspective and potential land/crop management challenges associated with implementation of the strategy.

In spring 2024, EPA and USDA hosted a workshop on ecological risk mitigation. EPA also hosted stakeholder workshops to discuss PULA refinements and offsets.

On June 18, 2024, EPA held another public webinar to introduce the first version of the mitigation menu website (currently being used for FIFRA IEM) and seek stakeholder feedback.[41,42]

[41] June 18th, 2024 public webinar recording, transcript, and slides on the mitigation menu webpage: https://www.epa.gov/pesticides/mitigation-menu.

[42] June 18th, 2024 public webinar YouTube recording link: https://www.youtube.com/watch?v=kVkjWlX03go

Additional educational webinars are being considered as other strategies are finalized and as the strategies are implemented in pesticide decisions.

EPA continues to work with external stakeholders, such as the states through the State FIFRA Issues Research and Evaluation Group (SFIREG) and the Association of American Pesticide Control Officials (AAPCO), to discuss the enforcement perspective and potential implementation challenges.

EPA plans to compile existing and develop new communication and education materials. These materials are intended to support awareness of new label requirements resulting from implementation of the Herbicide Strategy and of the new types of mitigations included in the strategies and efforts. Because pesticide users may have been using these products for several years or decades, awareness of any changes in how these pesticides may be used is key to their ability to comply.

EPA has developed and is planning to create various educational materials, including handouts, presentations, webpages, and informational webinars. EPA also recognizes that the main sources of information for many growers/applicators are the states, crop consultants, extension agents, and pesticide distributors and that it needs to partner with them to improve grower/pesticide user awareness. EPA believes that providing the appropriate support materials to the professionals that advise pesticide applicators will help improve compliance with label restrictions, including bulletins, and thus help decrease pesticide exposures to listed species. EPA is planning to create a webpage that will serve as a repository of education materials.

4.3 Consultation with FWS

One of the goals of the Herbicide Strategy is to help increase the efficiency of the pesticide section 7(a)(2) consultation process. In coordination with FWS, EPA plans to use this, other strategies and other activities, as outlined in the Workplan (and Update), to develop a conservation plan consistent with Section 7(a)(1) of the ESA for furthering the recovery of listed species. This will be accomplished, in part, by working with FWS to proactively protect listed species from pesticides, resulting in a streamlined section 7(a)(2) consultation process on individual pesticide actions.

EPA expects that its work with the Services will result in a more efficient tiered approach that includes both ESA section 7(a)(1) (proactive conservation for many species and groups of pesticides) and ESA section 7(a)(2) consultations that could include mitigation for specific species that are informed by the strategies. EPA has been working with FWS on broad landscape scale approaches to reduce pesticide exposure in ways that can further benefit the recovery of many species and designated critical habitat within the U.S. Identification and implementation of these approaches earlier in the FIFRA and ESA process could serve as a filter where impacts to many species can be reduced, leaving a limited number of remaining impacts to focus upon in a streamlined section 7(a)(2) consultation. This approach would also be a more effective and efficient use of agency resources to maximize protections of listed species in a timely manner. **Figure 12** depicts how EPA envisions incorporating the strategies into registration review decisions and how this could help streamline section 7(a)(2) consultations because mitigations could be incorporated into the action prior to initiating or completing any necessary consultation. Throughout this process, there are multiple opportunities for input from the public during comment

periods. This will allow EPA and FWS to consider important feedback from stakeholders on assessments and mitigations.

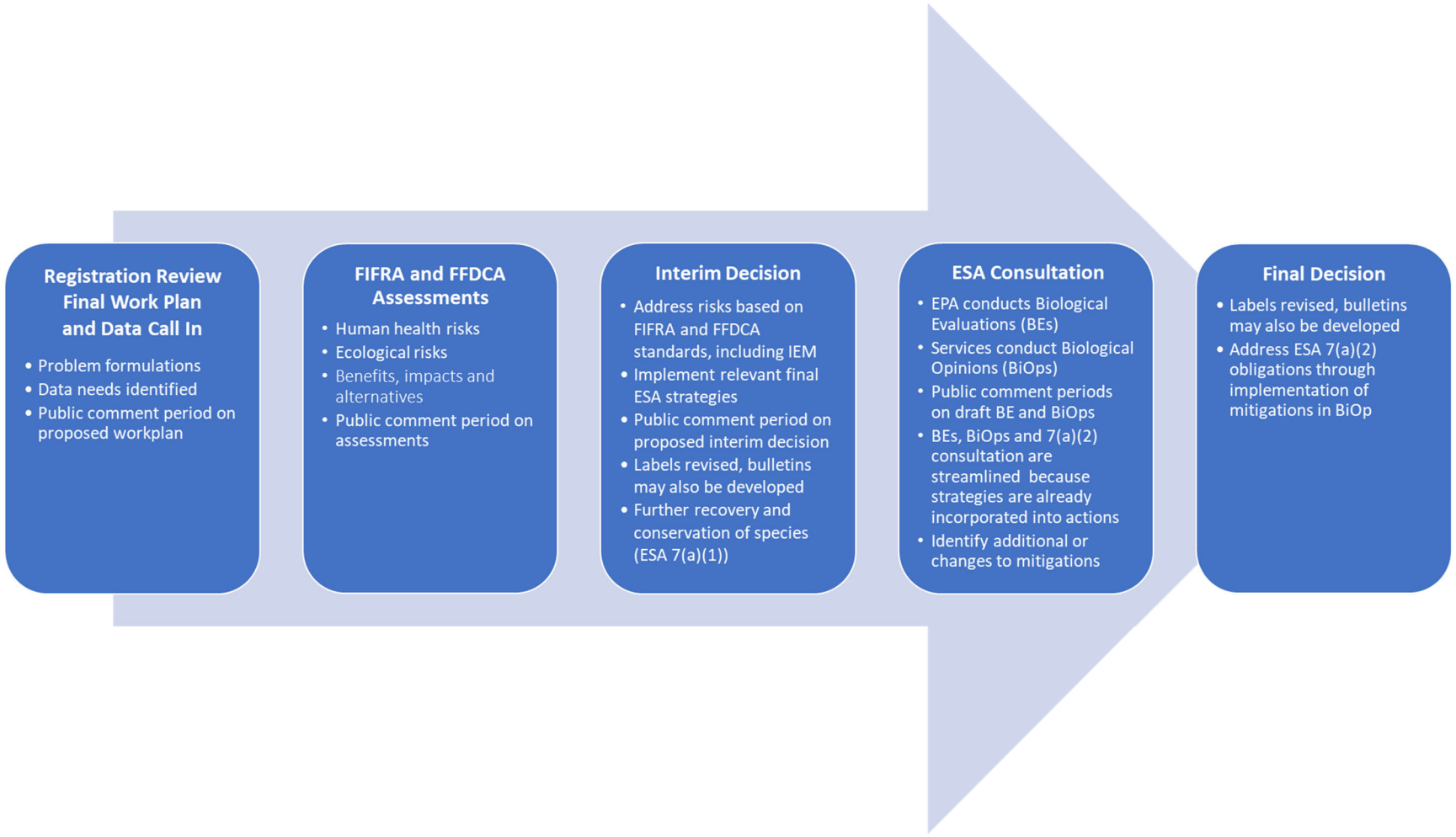

Figure 12. Tiered approach where mitigation strategies are incorporated into registration review of specific pesticides (individual or groups). The application of pesticide exposure reduction strategies early in the process allows EPA to further the recovery and conservation of species.

4.4 Interaction between FIFRA Interim Ecological Measures and the Herbicide Strategy

EPA released in its Workplan Update the FIFRA Interim Ecological Mitigation (IEM) that may be identified as necessary in registration review decisions and registration actions. The FIFRA IEM was released for public comment from November 16, 2022 to February 14, 2023. EPA received comments from over 100 individual stakeholders and stakeholder groups as well as two mass mail campaigns for a total of over 7,700 public comment submissions. EPA subsequently reviewed the comments received and updated the FIFRA IEM measures. EPA considered the need to be consistent across the FIFRA IEM and strategy mitigations to the extent appropriate. To that end, EPA is using the same runoff/erosion "mitigation menu" for FIFRA IEM and the strategy and is considering how the "mitigation menu" approach could work for other types of mitigation across strategies in the future (*e.g.*, insecticide strategy).

There are differences between the FIFRA IEM measures and the strategy mitigations related to the factors considered in determining the type, level, and extent of mitigations. For example, when considering whether mitigations are identified for conventional agricultural uses on herbicides, EPA expects that the level of mitigation in the strategy would supersede the FIFRA IEM for those uses. Refining the example further, both the strategy and FIFRA IEM include mitigations for spray drift and runoff/erosion exposure. For most herbicides, EPA expects to apply any spray drift, runoff/erosion requirements, based on the strategy, instead of the FIFRA IEM, because the mitigations for the strategy, which focus on addressing the potential for population-level impacts to listed species, would be at least as stringent as the IEM. It is possible that some aspects of FIFRA IEM may be appropriate for herbicides (*e.g.,* mitigation that reduces wildlife exposures when planting pesticide-treated seed), even if the spray drift or runoff/erosion requirements are superseded by the strategy. Also, a given pesticide may have unique properties or exposure pathways that EPA evaluates that may result in different types of FIFRA or ESA mitigations. EPA plans to make clear in its regulatory decision documents, which mitigations EPA considered appropriate for the herbicide and why, given the context of different yet overlapping efforts of FIFRA IEM and the strategies. Ultimately, applicators will only need to follow the label directions, as the process for developing label mitigation requirements will generally not be apparent on the label.

Lastly, EPA is in the process of developing the Insecticide Strategy, for which a draft was released for public comment in July 2024. This strategy does which does not impact herbicides directly, but may impact pesticide applications in general, particularly when multiple pesticides are used in the field. As already the case, when multiple pesticide products are used, users will need to check requirements across all products being used and comply with the most restrictive measures.

4.5 Consideration of Other Strategies

This strategy is one of several that EPA is developing to group mitigations by pesticide type, use site, location, or other consideration. These strategies are intended to inform EPA's registration and registration review decisions when addressing population-level exposures and impacts relevant to listed species. FWS has authority over the majority of listed species including plants, insects, mussels, fish, birds, mammals, reptiles and amphibians. These species are diverse in their life history, locations, and potential for pesticide exposures. However, many species can be grouped in terms of what types of impacts may be expected from types of pesticides and the types of mitigations to address those

impacts. Pesticide impacts to a given species may vary based on its life history (*e.g.*, diet, migration). Pesticide uses and potential impacts also vary across the U.S. based on crops grown, non-agricultural use sites (*e.g.,* forestry, residential areas) and associated pest pressures. For example, pesticide usage in the contiguous U.S. (CONUS) is much different than in Hawaii. Pesticide impacts vary from pesticide to pesticide, with unintended survival, growth or reproductive effects to non-target animals and plants (*e.g.,* a particular herbicide may cause reproductive effects to fish, multiple insecticides with the same mode of action may decrease survival in birds). Often classes of chemicals have similar impacts, especially considering their target pests (*e.g.*, rodenticides may impact non-target mammals, herbicides may impact non-target plants). The various strategies are intended to account for the characteristics of the individual chemical and identify landscape scale mitigations, as appropriate, based on location, pesticide class, species or use site (**Table 18**). Grouping species or pesticide uses based on their similarities will allow EPA to more efficiently and effectively identify and implement mitigations at a landscape scale through FIFRA registration and registration review actions. This will allow EPA to further its goals to reduce pesticide exposures and impacts to listed species, further the conservation of listed species, and streamline 7(a)(2) consultations on specific actions. Like this Herbicide Strategy, EPA plans to implement the other strategies as they become final. The final strategies are expected to inform registration and registration review decisions. For more information on the strategies identified in **Table 18**, see EPA's website.

Table 18. Summary of mitigation strategies that EPA is developing or has committed to develop.

Mitigation Strategy	Location[1]	Use Site	Conventional Pesticide Type
Herbicides	CONUS	Agriculture	Herbicides
Insecticides	CONUS	Agriculture	Insecticides
Rodenticides	U.S. and Territories	All	Rodenticides
Fungicides	CONUS	Agriculture	Fungicides
Vulnerable species pilot	CONUS	Agriculture Mosquito adulticide Rights of Way Forestry Rangeland	All
Hawaii	Hawaii	All	All

[1]CONUS = contiguous U.S.

4.6 Consideration of Offsets

The Herbicide Strategy includes mitigations that focus on minimization of exposure and impacts. At times, other federal agencies have used offsets to meet ESA obligations[43] (also known as compensatory mitigation) to address the impacts of their actions that cannot be avoided or minimized. Offsets are considered after feasible avoidance and minimization measures have been exhausted but more is needed to protect species. This could include actions such as habitat preservation or restoration, invasive species control, and species reintroductions. These actions can directly further species recovery

[43] FWS defines offsets as measures to *"compensate for, or offset, remaining unavoidable impacts after all appropriate and practicable avoidance and minimization measures have been applied by replacing or providing substitute resources or environments through the restoration, establishment, enhancement, or preservation of resources and their values, services, and functions…." (USFWS, 2023b).*

(sometimes more than on-site avoidance and minimization) and can provide even greater flexibility by creating more options for EPA to meet its ESA obligations. EPA plans to identify opportunities for offsets to complement traditional avoidance and minimization measures. Although a process still needs to be developed, EPA plans to do so through a multi-step process that would include working with the Services to develop general guidance on using offsets for pesticide consultations, working with registrants and/or other stakeholders to identify and adopt offsets for specific pesticides and species, ensuring that adopted offsets are legally binding as a condition of a FIFRA registration, and working with the Services to oversee implementation of offsets.

5. Conclusions and Next Steps

EPA developed the final Herbicide Strategy to identify and implement early protections for listed species by reducing the potential for population-level impacts to listed plants and species that depend on plants. This strategy has two components: a decision framework and an implementation plan. The strategy decision framework is intended to provide EPA a process for confidently identifying when the uses of an herbicide have a potential for population-level impacts and how to identify effective and reasonable mitigations that are flexible and practical for growers of different crops and different parts of the country. This strategy is designed to reduce exposure to listed plants (and listed species that depend on plants) from spray drift and runoff/erosion. This strategy incorporates valuable insights, information, experience and comments provided by stakeholders on the draft strategy. The implementation plan discusses EPA's plan for how the Final Herbicide Strategy can be applied to FIFRA registration and registration review actions. This strategy includes EPA's implementation expectations on how pesticide applicators will be able to understand necessary mitigations by using the general pesticide product label, a mitigation menu website, and BLT. EPA plans on communicating and educating stakeholders and applicators so that they understand applicable mitigations for their intended herbicide applications. This final strategy is one of many other ESA strategies and efforts that the Agency is developing to efficiently identify early mitigations for listed species. EPA will continue to develop additional mitigation measures, such as offsets, that may increase the types of mitigations that effectively protect listed species and flexibility available to growers and applicators. This strategy is part of a process that EPA has undertaken with FWS, where EPA will identify early protections for listed species that should result in more efficient and effective herbicide specific consultations under ESA 7(a)(2).

6. Literature Cited

Alix, A., Brown, C., Capri, E., Goerlitz, G., Golla, B., Knauer, K., et al. 2017. *Society of Environmental Toxicology and Chemistry. Mitigating the Risks of Plant Protection Products in the Environment. Proceedings of the MAgPIE Workshop.* Available at: https://www.spraydriftmitigation.info/mitigation-toolbox.

FOCUS. 2007. *Landscape and Mitigation Factors in Aquatic Risk Assessment. Volume 1: Extended Summary and Recommendations. Version 2.* EC Document Reference SANCO/10422/2005. September 2007. Report of the FOCUS Working Group on landscape and mitigation factors in ecological risk assessment. Available at: https://esdac.jrc.ec.europa.eu/projects/focus-landscape-mitigation.

Reichenberger, S., Bach, M., Skitschak, A., & Frede, H.-G. 2007. Mitigation strategies to reduce pesticide inputs into ground- and surface water and their effectiveness; A review. *Science of The Total Environment*, 384(1), 1-35.

TXDOT. 2019. *Section 11 Time of Concentration, Hydraulic Design Manual*: Texas Department of Transportation (TXDOT). Available at: http://onlinemanuals.txdot.gov/txdotmanuals/hyd/time_of_concentration.htm.

USDA. 2010. Chapter 15 Time of Concentration. In *Part 630 Hydrology National Engineering Handbook*. U.S. Department of Agriculture. National Resource Conservation Service. Available at: https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=27002.wba.

USEPA. 1998a. *Guidelines for Ecological Risk Assessment*. EPA/630/R-95/002F. Risk Assessment Forum. Office of Research and Development. U.S. Environmental Protection Agency. Available at: http://www.epa.gov/raf/publications/guidelines-ecological-risk-assessment.htm.

USEPA. 1998b. *Guidelines for Ecological Risk Assessment*, United States Environmental Protection Agency (USEPA). Washington, D.C.: Government Printing Office. Available at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=12460.

USEPA. 2004. *Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs*. U.S. Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Office of Pesticide Programs.

USEPA. 2008. *Fate, Transport, and Transformation Guidelines. OPPTS 835.1230 Adsorption/Desorption (Batch Equilibrium).* EPA 712-C-08-009. October 2008. U.S. Environmental Protection Agency. Office or Prevention, Pesticides, and Toxic Substances. Available at: http://www.epa.gov/ocspp/pubs/frs/publications/Test_Guidelines/series835.htm.

USEPA. 2012a. *Ecological Effects Test Guidelines. OCSPP 850.4150: Vegetative Vigor*. EPA 712-C-011. January 2012. U.S. Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Available at: http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0154-0024.

USEPA. 2012b. *Ecological Effects Test Guidelines. OCSPP 850.4500: Algal Toxicity*. EPA 712-C-006. January 2012. U.S. Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Available at: http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0154-0003.

USEPA. 2012c. *Ecological Effects Test Guidelines. OCSPP 850.4550 Cyanobacteria (Anabaena flos-aquae) Toxicity*. EPA 712-C-005. January 2012. U.S. Environmental Protection Agency. Office of Chemical

Safety and Pollution Prevention. Available at: http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0154-0004.

USEPA. 2013. *Guidance on Modeling Offsite Deposition of Pesticides Via Spray Drift for Ecological and Drinking Water Assessment*. U.S. Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Office of Pesticide Programs. Environmental Fate and Effects Division.

USEPA. 2017. *Pesticide Industry Sales and Usage 2008 - 2012 Market Estimates*. U.S. Environmental Protection Agency. Office of Pesticide Programs. Biological and Economic Analysis Division. Available at: https://www.epa.gov/sites/default/files/2017-01/documents/pesticides-industry-sales-usage-2016_0.pdf.

USEPA. 2018. *Guidance for Using ECOSAR as a Line of Evidence for Identifying Residues of Toxicological Concern*. September 26, 2018. U.S. Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Office of Pesticide Programs. Environmental Fate and Effects Division. Available at: https://www.epa.gov/system/files/documents/2022-06/Procedure-for-using-ECOSAR-as-a-%20Line-of-Evidence.pdf.

USEPA. 2019. *Methods for Assessing Aquatic Exposure to Residue(s) of Concern*. June 20, 2019. U.S. Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Office of Pesticide Programs. Environmental Fate and Effects Division.

USEPA. 2020. *Revised Method for National Level Listed Species Biological Evaluations of Conventional Pesticides*. March 12, 2020. Environmental Fate and Effects Division. Office of Pesticide Programs. U.S. Environmental Protection Agency. Available at: https://www.epa.gov/endangered-species/revised-method-national-level-listed-species-biological-evaluations-conventional.

USEPA. 2022a. *Balancing Wildlife Protection and Responsible Pesticide Use: How EPA's Pesticide Program Will Meet its Endangered Species Act Obligations*. April 2022. U.S. Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Office of Pesticide Programs. . Available at: https://www.epa.gov/system/files/documents/2022-04/balancing-wildlife-protection-and-responsible-pesticide-use_final.pdf.

USEPA. 2022b. *ESA Workplan Update: Nontarget Species Mitigation for Registration Review and Other FIFRA Actions*. Docket ID EPA-HQ-OPP-2022-0908. November 2022. United States Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Office of Pesticide Programs. Available at: https://www.epa.gov/system/files/documents/2022-11/esa-workplan-update.pdf.

USEPA. 2022c. *2,4-D Choline and Glyphosate Dimethylammonium: Effects Determinations for Newly Listed and Proposed Species and Critical Habitats for the Use of Enlist One and Enlist Duo on Genetically-Modified Enlist-Tolerant Cotton, Corn, and Soybean.* Office of Chemical Safety and Pollution Prevention. Office of Pesticide Programs. Available at: https://www.regulations.gov/docket/EPA-HQ-OPP-2021-0957/document.

USEPA. 2023a. *Draft Technical Support for Runoff, Erosion, and Spray Drift Mitigation to Protect Non-Target Plants and Wildlife*. Docket ID EPA-HQ-OPP-2023-0327-0003. June 22, 2023. U.S. Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Office of Pesticide Programs. Available at: https://www.regulations.gov/document/EPA-HQ-OPP-2023-0327-0003.

USEPA. 2023b. *Pesticide in Water Calculator User Manual for Version 2.001*. United States Environmental Protection Agency. Office of Pesticide Programs. Environmental Fate and Effects

Division. Available at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment.

USEPA. 2023c. *Plant Assessment Tool Version 2.7.1*. Washington, D.C. Available at: https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological.

USEPA. 2023d. *Vulnerable Listed (Endangered and Threatened) Species Pilot Project: Proposed Mitigations, Implementation Plan, and Possible Expansion: Draft Plan*. Docket ID EPA-HQ-OPP-2023-0327-0002. June 2023. U.S. Environmental Protection Agency. Office of Chemical Safety and Pollution Prevention. Office of Pesticide Programs. Available at: https://www.regulations.gov/document/EPA-HQ-OPP-2023-0327-0002.

USFWS. 2021. *Draft Biological and Conference Opinion on the Registration of Malathion Pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act*. February 2021. U.S. Fish and Wildlife Service Available at: https://www.epa.gov/endangered-species/biological-opinions-available-public-comment-and-links-final-opinions.

USFWS. 2022a. *Biological and Conference Opinion on the Registration of Malathion Pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act*. February 28, 2022. U.S. Fish and Wildlife Service. Ecological Services Program. Available at: https://www.epa.gov/endangered-species/biological-opinions-available-public-comment-and-links-final-opinions.

USFWS. 2022b. *Final Biological and Conference Opinion on the Registration of Malathion Pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act*. February 28, 2022. U.S. Fish and Wildlife Service. Ecological Services Program. Available at: https://fws.gov/media/biological-and-conference-opinion-registration-malathion.

USFWS. 2023a. *Environmental Conservation Online System (ECOS)*. United States Fish and Wildlife Service. Available at: https://ecos.fws.gov/ecp/.

USFWS. 2023b. US Fish & Wildlife Service Mitigation Policy, Appendix 1, 501 FW 2. May 10, 2023. Available online: https://www.fws.gov/sites/default/files/policy/pdfs/FWS-Mitigation-Policy.pdf.

USFWS. 2023c. Biological Opinion on the Registration of Enlist One and Enlist Duo Pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act. November 17, 2023. Available online at: https://www.regulations.gov/document/EPA-HQ-OPP-2021-0957-0047.

VADEQ. 1992. Chapter 5 Engineering Calculations. In *Virginia Erosion and Sediment Control Handbook*. Third Edition. Richmond, VA: Virginia Department of Environmental Quality (VADEQ). Available at: https://www.deq.virginia.gov/water/stormwater/stormwater-construction/handbooks.

Wu, Q., & Lane, C. R. 2017. Delineating wetland catchments and modeling hydrologic connectivity using lidar data and aerial imagery. *Hydrol Earth Syst Sci*, 21(7), 3579-3595.

Yuan, Y., Book, R. S., Mankin, K. R., Koropeckyj-Cox, L., Christianson, L., Messer, T., et al. 2022. An overview of the effectiveness of agricultural conservation practices for water quality improvement. *Journal of American Society of Agricultural and Biological Engineers*, 65(2), 419-426.

7. Abbreviations

a.i.	active ingredient
AAPCO	Association of American Pesticide Control Officials
ACEP	Agricultural Conservation Easement Program
AgDrift	AgDRIFT® version 2.1.1, a spray drift model
BE	Biological Evaluation
BiOp	Biological Opinion
BLT	EPA's Bulletins Live! Two website
CFR	Code of Federal Regulations
CH	designated critical habitat
CONUS	contiguous (or conterminous) United States
CRP	Conservation Reserve Program
DSD	droplet size distribution
EC_{50}	50% Effect Concentration
ECOS	FWS Environmental Conservation System
EEC	Estimated Environmental Concentration
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
°F	degrees Fahrenheit
FD	Final Decision
FFDCA	Federal Food, Drug, and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
ft	feet
FWS	United States Fish and Wildlife Service
GIS	Geographic Information System
ha	hectare
HC_{05}	5^{th} percentile threshold from SSD
HC_{25}	25^{th} percentile threshold from SSD
HUC	Hydrologic Unit Code
IC^{25}	25% Inhibition Concentration
ID	Interim Decision
IEM	Interim Ecological Mitigations
in	inch
Kd	solid-water distribution coefficient where the solid is soil or sediment
KOC	organic-carbon normalized solid-water distribution coefficent where the solid is soil or sediment
lb(s)	pound(s)
m	meters
MOA	Mode of Action
MoD	Magnitude of Difference/ratio of exposure estimate to population-level toxicity endpoint
mph	miles per hour
NAICC	National Alliance of Independent Crop Consultants
NASS	National Agricultural Statistics Service
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NRCS	Natural Resource Conservation Service
OCSPP	Office of Chemical Safety and Pollution Prevention
OPMP	USDA's Office of Pest Management Policy
OPP	Office of Pesticide Programs
PAT	Plant Assessment Tool
PFD	Proposed Final Decision
PID	Proposed Interim Decision
psi	pounds per square inch
PULA	Pesticide Use Limitation Area
PWC	Pesticide in Water Calculator
RH	Relative Humidity
RQ	Risk Quotient
SE	Seedling Emergence
SFIREG	State FIFRA Issues Research and Evaluation Group
SSD	Species Sensitivity Distribution
sq ft	square feet
TPEZ	Terrestrial Plant Exposure Zone
U.S.	United States
UDL	Use Data Layer
µg	microgram
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VFS	vegetative filter strip
VSP	Vulnerable Species Pilot
VV	Vegetative Vigor
WPEZ	Wetland Plant Exposure