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

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1 EXECUTIVE SUMMARY

This document provides scenarios as examples of implementation of runoff/erosion and spray drift mitigations included in strategies for early mitigation measures to address potential population-level impacts to listed species across groups of pesticides (e.g., herbicides, insecticides). The first iteration of this document was released with the **Draft Herbicide Strategy** to provide example field scenarios for applicators to achieve points for runoff/erosion mitigation that could be included on pesticide product labeling through FIFRA registration and registration review actions. This version reevaluates those initial scenarios (**Sections 3 and 5**) to reflect new mitigations added to the mitigation menu, as well as changes to the efficacy rankings of some mitigation measures (see **Appendix A** for more information on new measures and efficacy scores, and **Appendix B** for changes in scenarios). This version also incorporates spray drift mitigations (**Sections 4 and 5**). Additionally, this version does not focus solely on herbicides, and is intended to also inform the other listed species strategies that EPA is developing.

To update the scenarios to better represent what growers and/or applicators are doing, EPA reexamined the recent USDA/NRCS Conservation Effects Assessment Project (CEAP) report and used it to inform which mitigation measures would be a realistic representation of what applicators have already adopted and what they could adopt in the future. Using what applicators may already have in place as a guide, EPA presents multiple field-level options for how applicators in different regions can achieve up to 9 points. Nine points is assigned to the highest level of mitigation for runoff/erosion under the Draft Insecticide and Final Herbicide Strategies and for the purposes of this document assume applicators will want to use 9-point chemicals. As a terminology note, the mitigations EPA identified are consistent with many conservation measures identified in the CEAP report. EPA acknowledges that, based on the CEAP report, many acres in production have one mitigation measure in place (about 50% of acres), while a lesser number of acres have more than one measure in place (about 30% of acres), and some acres do not have any practices in place (about 20%) (**Section 3.1**).

In this document, EPA finds that impacts to listed species depend on the regions, cropping system, and conservation measures that are already in place on a field. Some conservation measures also serve EPA's purposes as mitigation measures. Therefore, applicators with conservation measures already in place would likely have lower impacts. However, achieving 9 points could be difficult for applicators applying to fields in counties that are not assigned geographic mitigation relief points[1].

EPA acknowledges that, while many growers and applicators may be able to comply with new product labels through FIFRA actions that implement the strategies, some growers may face a range of economic and managerial burdens (**Appendix D**). Applicators in some CEAP-specified regions (e.g. East Central, Midwest) are assigned geographic mitigation relief points for reduced runoff vulnerability and already have many runoff/erosion mitigation measures in place, therefore will likely have minimal impacts from up to 9 points to apply a pesticide with these mitigation requirements on its labeling. Applicators in other regions (e.g. Lower Mississippi) are not assigned mitigation relief points for reduced runoff vulnerability and will likely need to install multiple mitigation measures to achieve up to 9 points, therefore will likely be impacted when strategies are implemented through FIFRA actions (**Section 3.1**). Similarly, EPA acknowledges that not all of the options to reduce the ecological spray drift buffer distances may apply to every individual field/grower because of differences in local climate, off-field characteristics that intercept drift, efficacy concerns for

[1] 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.

pesticide-target pest combinations, ability to adopt hooded sprayers, or suitability of application methods for control of target pest. EPA designed the strategies to provide growers and/or applicators enough flexibility to choose what is technologically and economically feasible for their specific circumstances, but complying with new requirements that could appear on pesticide product labels may create additional burden for many applicators.

In agriculturally dense areas, many applicators may not have to employ additional runoff/erosion and/or spray drift mitigations because many fields are likely more than 1,000 feet (for runoff/erosion) or 320 feet (for spray drift via aerial application) from non-managed areas or aquatic habitats. Additionally, even when mitigation has been identified, mitigations likely are not needed on all sides of a field. EPA has only identified runoff/erosion mitigation on the edge of a field that is adjacent to non-managed lands or aquatic habitats when the field slopes in the direction of area needing protection. Additionally, EPA has only identified spray drift mitigation on the edge of a field that is adjacent to the non-managed land or aquatic habitat when the wind is blowing towards the non-managed land or aquatic habitat. Thus, the side of the field where spray drift mitigation is needed may change based on wind direction.

In developing the strategies EPA has considered the impacts on growers of achieving the applicable levels of mitigation. In response, EPA identified as many options as possible to tailor mitigation to their specific field to minimize the impacts to growers and/or applicators, while providing earlier protections for listed species. However, the mitigation system EPA developed is more complex for applicators than a traditional labeling approach where applicators have few or no options to reduce the extent of mitigations they need to implement (**Appendix C**). During EPA's outreach efforts between the release of the **Draft Herbicide Strategy** and the **Final Herbicide Strategy**, agricultural stakeholders have indicated that they prefer the flexibility of EPA's current approach, despite the complexity. To minimize the managerial burden, EPA is developing educational materials, including this memo, to provide additional information to help growers and pesticide applicators better understand the strategies, and to better inform decisions they may need to make in the future.

2 INTRODUCTION

EPA has developed or is developing mitigation strategies to address potential population-level impacts to listed species across groups of conventional pesticides (e.g., herbicides, insecticides). The goal is to reduce spray drift and/or runoff/erosion, which are the major routes of pesticide exposure for listed species. Based on chemical characteristics (e.g., toxicity, mobility) and use patterns (e.g., allowable application rates) and considering the location of listed species, EPA identifies the level of mitigation to reduce pesticide transport via spray drift and runoff/erosion where there could be a low, medium, or high potential for population-level effects with associated low, medium, or high mitigation. For run-off/erosion, EPA is utilizing a point system to indicate the level of mitigation. EPA has also identified a suite of run-off/erosion mitigation measures and assigned a point-value to each based on their efficacy at reducing offsite transport via runoff/erosion EPA has also assigned points for other factors, including specific field characteristics such as slope and regional climatic conditions such as rainfall that differ from the standard FIFRA risk assessment models. The currency of spray drift mitigations to address potential population-level impacts is expressed as a wind-directional buffer distance from the edge of the field (where there are population-level concerns and exposures need to be reduced). EPA identified a suite of measures that applicators can employ to reduce that buffer distance. Once a strategy is implemented through FIFRA actions, including labeling statements, pesticide users may need to implement sufficient measures to achieve a given number of points for runoff/erosion and/or implement spray drift mitigations. The purpose of this document is to provide examples of how users may achieve points that may be required on pesticide labeling for runoff/erosion and implement spray drift mitigation and to discuss the potential impacts pesticide users may incur to meet these requirements.

The first version of this document (USEPA 2023)[2] focused on examples (referred to as "scenarios") of how runoff and erosion mitigation measures described in an earlier version of the **Ecological Mitigation Support Document**[3] might be employed in various crop production systems[4]. The evaluation provided in this document broadens the scope to include spray drift. EPA took comment on the earlier version of this document during the proposal of the draft Herbicide Strategy (USEPA, 2022; USEPA, 2023a-b). Among other things, after consideration of the comments and input through further stakeholder engagement, EPA identified additional mitigation measures, expanded descriptions of existing mitigation measures, and revised efficacy determinations of some measures based on the information provided by the public[5,6].

The scenarios in this document are illustrative examples to help pesticide users and other interested stakeholders better understand how the identified mitigations may be used to reduce the potential exposure from conventional pesticides with agricultural uses. It does not provide examples of all possible crop/environment/production system combinations or even mitigation options that are likely available to growers, but rather presents a subset of scenarios. The scenarios presented here encompass a range of production systems including large acreage field crops (e.g., corn, cotton) as well as multiple specialty crop production systems, including vegetables, orchards, and small perennial fruits. The scenarios in this document do not focus on particular pesticides unless otherwise noted, but rather are intended to illustrate some of the mitigations that have been identified in the strategies to reduce runoff, erosion, and spray drift. Additionally, this document provides options on how mitigations may be employed in a particular crop/environment/production system to achieve a level of mitigation that could appear on a pesticide product label when the strategies are implemented through FIFRA actions. Exact scenario specifications (e.g. points values, identified mitigation practices) are subject to change.

2.1 Acknowledgement of Public Comments

During the 90-day public comment period on the **Draft Herbicide Strategy** and associated documents, 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

[2] *Application of EPA's Draft Herbicide Strategy Framework Through Scenarios that Represent Crop Production Systems* https://www.regulations.gov/document/EPA-HQ-OPP-2023-0365-0006

[3] *Ecological Mitigation Support Document to Support Endangered Species Strategies Version 1.0.* This document is available in the docket at https://www.regulations.gov/docket/EPA-HQ-OPP-2023-0365 and https://www.regulations.gov/docket/EPA-HQ-OPP-2024-0299.

[4] The Draft Herbicide Strategy Framework also considered spray drift mitigation. EPA did not evaluate spray drift mitigation in the original version of this document.

[5] Comments received on recent pesticide registration actions and in the Endangered Species Act (ESA) Workplan Update (USEPA, 2023c) were also considered.

[6] Comments were received on the Draft Herbicide Strategy, Vulnerable Species Pilot, and associated mitigation measures as posted to the docket in 2023 (https://www.regulations.gov/docket/EPA-HQ-OPP-2023-0327; https://www.regulations.gov/docket/EPA-HQ-OPP-2023-0365).

campaigns that either supported or opposed the draft strategy. EPA identified three main themes from the comments associated with the initial version of this scenarios document, which are described below.

The scenarios provided do not cover my crop or region. EPA recognizes that the earlier scenarios document, as well as this revised one, does not cover all possible scenarios, nor could it. However, that was not the intent of the document. EPA's intent was to give examples to help growers and applicators see the thought process they could work through for example field scenarios to put together different measures to be able to achieve required points.

EPA received comments about how the Herbicide Strategy, if implemented as proposed, would cost growers a large amount of time, land, and resources that will be hard for many to implement. Specialty crops and small farms expressed concerns for a greater impact to them with more limited mitigation practices, along with costs of compliance and enforcement. Additionally, EPA received comments about the complexity and impacts/feasibility of implementing mitigation measures at the field level. Growers who lease farmland were concerned they may have difficulty in achieving enough points because they may not be able to put structural measures on land they do not own. Commenters expressed concern with the availability of resources to help with implementing mitigation measures as there can be waiting lists to enroll in programs that may subsidize adoption of mitigation measures. EPA recognizes that these strategies are new and could be complicated; however, the Agency identified flexibilities for growers, while still identifying mitigations to provide protections for non-target organisms, including listed species. Additionally, through EPA's outreach efforts (e.g., mitigation workshop, various stakeholder meetings), many agricultural stakeholders indicated that they prefer the flexibility of EPA's current thinking, despite the complexity. As such, EPA is developing educational materials, including this memo, to provide additional information to help pesticide applicators better understand the strategies, and to better inform decisions they may need to make in the future. In response to these comments, EPA added a discussion about the feasibility of the mitigation measures for growers who own or lease land (**Appendix D**) and a decision tree to help applicators see the process in working to develop runoff and erosion plans (**Appendix C**).

EPA over-estimated what mitigation measures growers and/or applicators already had in place. While several initial scenarios may have included more mitigation measures than an average field may currently have in place, the intent was to demonstrate how growers could put a program together that would achieve the mitigation goals for a pesticide product and use. In this version, EPA reevaluated the USDA/NRCS' recent Conservation Effects Assessment Project (CEAP) report to highlight where and how much mitigation is already in place to make the scenarios more realistic and provide options on how growers and applicators could implement an adequate program for their fields.

Additionally, some of the changes to scenarios reflected in this document were made to incorporate stakeholder comments and outreach. For scenarios that were discussed in the first version of this document, a comparison of the original attainable point values and changes made in this version of the document are in **Appendix B**.

3 RUNOFF and EROSION MITIGATIONS

3.1 BACKGROUND ON RUNOFF AND EROSION MITIGATIONS

In the Strategies, EPA identifies runoff/erosion mitigations to reduce identified potential for population-level impacts to listed species associated with agricultural uses of conventional pesticides. If through a FIFRA action, EPA identifies the potential for population-level impacts as not likely, it does not expect to identify further mitigations. If EPA identifies the potential for population-level impacts to listed species to be low, medium, or high, it will identify mitigations to address those impacts. The mitigations associated with a low, medium, or high level of identified mitigation depend on the exposure route. For run-off and erosion, the level of runoff and erosion mitigations on the label is expressed as points, up to nine. Implementation of the strategies will occur through registration and registration review actions. Through those actions, EPA will use the strategies to inform what level of mitigation is necessary for the FIFRA action. The pesticide product labeling would contain the necessary information about the level of mitigation and other relevant directions for use. If EPA were to identify mitigations for run-off/erosion, the pesticide product labeling would identify the number of points to achieve. So, if a label indicates 3 points are necessary for runoff/erosion mitigation, mitigations totaling 3 points would be needed for the application of that pesticide product.

In the **Ecological Mitigation Support Document**, EPA describes the runoff/erosion mitigation measures that it has identified to date and their associated effectiveness. These measures include application parameters such as applying less than the maximum annual application rate on label and partial field treatment; field characteristics such as the slope of the field; on-field mitigations and adjacent-to-field mitigations; systems that capture runoff; and other measures which don't fit into the previous categories such as combining on-field and adjacent-to-field mitigations. EPA assigned efficacy points to each of these run-off measures based on the efficacy of reducing offsite transport via runoff/erosion. High efficacy mitigation measures are worth 3 points, medium efficacy measures are worth 2 points, and low efficacy measures are worth 1 point. One mitigation measure, reducing the area of a field treated with pesticide, ranges from 2 to 4 points for low to high efficacy instead of ranging from 1 to 3 points. The **Ecological Mitigation Support Document** also describes mitigation relief in the form of points for sites located in areas that are not highly vulnerable to pesticide run-off and erosion, points for growers and/or applicators that work with a run-off/erosion specialist or participate in a conservation program designed to reduce run-off/erosion, and points for mitigation tracking. EPA also identified application methods where runoff/erosion exposure would be limited and thus the potential for population-level impacts to listed species is unlikely.

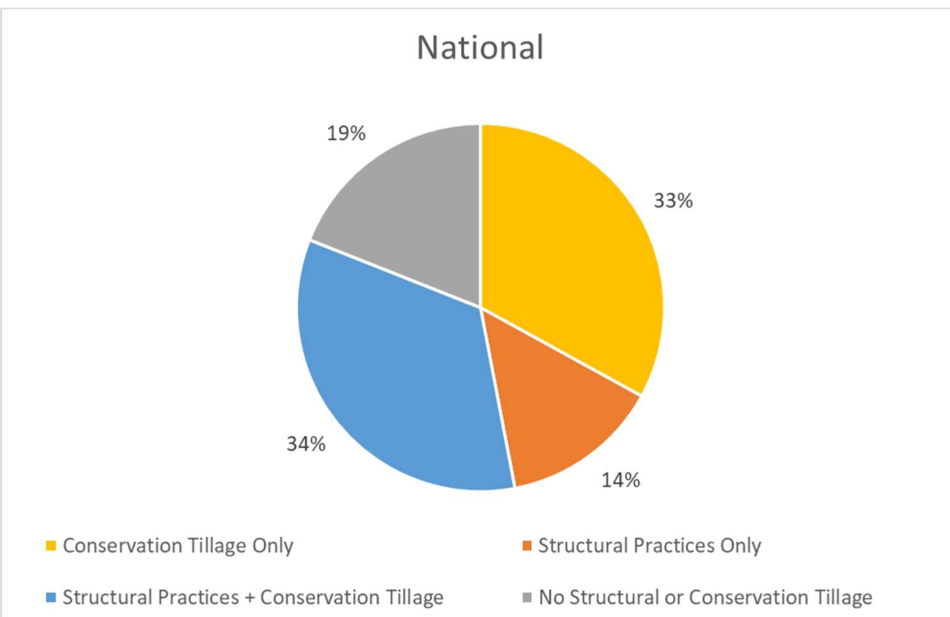
Additionally, to inform these scenarios, EPA considered the most recent CEAP report from 2022. The CEAP report summarizes adoption rates of conservation practices on cropland in the U.S. from surveys conducted in 2013 and 2016 and provides information regarding runoff and erosion mitigation measures that may be used in a region. EPA evaluated the CEAP report to highlight where and how much mitigation is already in place or in practice to inform the scenarios.

- Both the CEAP report and EPA use the term conservation tillage as a term encompassing both reduced tillage and no-tillage. The report also provides data on structural conservation practices and describes them as follows:
    - Field borders are permanent strips of vegetation on one or more sides of a field that are at least 30 feet wide. EPA considers these to be "adjacent to the field" mitigation measures. Adjacent to the field measures are those outside of the pesticide application area.

- Buffers or filters at the edge of the field include riparian forest and herbaceous buffers, vegetative filter strips and critical area plantings. EPA considers these to be “adjacent to the field” measures.
- Practices that reduce concentrated flow include grassed waterways, grade stabilization structures, diversions, and water control structures. EPA considers grassed waterways to be in the “adjacent to the field” measures, and the remaining practices are part of water retention systems that can be relevant to individual fields, multiple fields, or the entire farm depending on the design.
- Practices that reduce overland flow include terraces, contour buffer strips, contour farming, strip cropping, and in-field vegetative barriers. EPA considers these to be “on field management” measures.

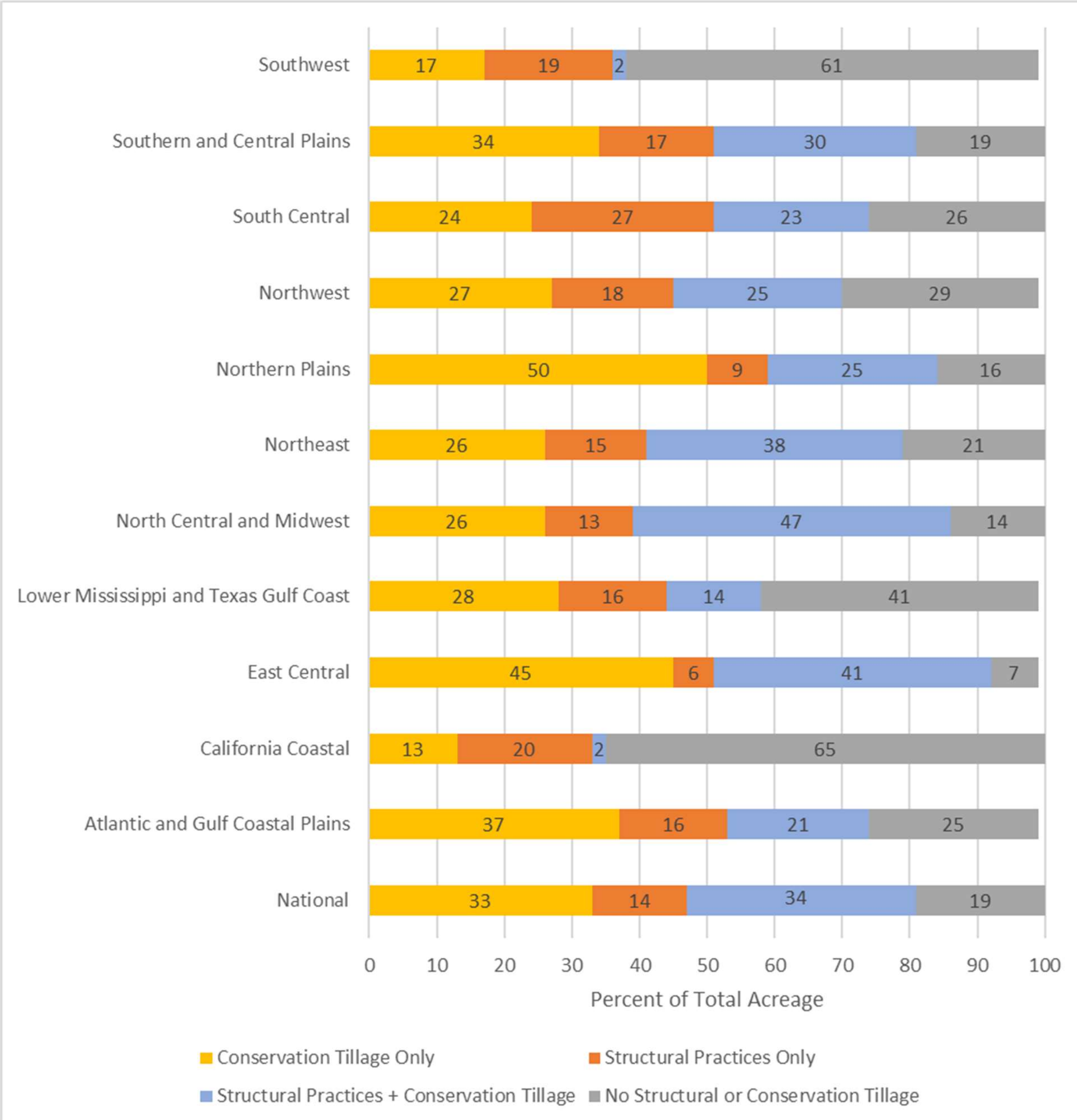
To further orient readers, below are key adoption rates from CEAP (2022) nationally and by region to provide context for the scenarios presented in this document. The CEAP report is representative of 315.2 million acres nationally with 33% with only conservation tillage, 14% with only structural practices, 34% with both conservation tillage and structural practices, and 19% with no structural practices or conservation tillage (**Figure 3.1.1**).

Figure 3.1.1. National Adoption Rates for Structural Practices and Conservation Tillage from CEAP (2022)



CEAP (2022) divides the U.S. into 11 production regions and adoption rates for structural practices and conservation tillage vary across those regions (**Figure 3.1.2**).

Figure 3.1.2. Regional Adoption Rates for Structural Practices and Conservation Tillage from CEAP (2022)



Some regions may not add to 100% due to rounding in the original report (CEAP, 2022). Numbers for some adoption rates do not meet the 95% confidence for significance; these include: "conservation tillage only" in the California Coastal and Southwest Regions; "no structural practices or conservation tillage" in the California Coastal, Southwest, and East Central Regions; and "structural practices only" in the Southwest Region.

In addition to adoption rates for structural practices and conservation tillage, CEAP (2022) also provides estimates of total irrigated acreage and cover crop use by region. To provide context for cover crops, irrigation management practices, and points for non-irrigated land in the scenarios in this document, regional estimates of percent of cropland with irrigation and percent of cropland using cover crops are summarized below (**Table 3.1.1**).

Table 3.1.1 Prevalence of Irrigation and Cover Crop Use from CEAP (2022).

Geographic Area	Total Cropland Acres (1,000s)	Irrigated Cropland Acres (1,000s)	Percent of Acres Irrigated	Cover Crops Acres (1,000s)	Percent of Acres with Cover Crops
Atlantic and Gulf Coastal Plains	13,825	2,902	21%	2,587	19%
California Coastal	3,913	3,193	82%	169	4%
East Central	10,166	233	2%	1,511	15%
Lower Mississippi and Texas Gulf Coast	20,916	11,651	56%	506	2%
North Central and Midwest	123,296	5,218	4%	7,815	6%
Northeast	7,597	177	2%	1,611	21%
Northern Plains	51,130	1,762	3%	1,995	4%
Northwest	13,438	4,554	34%	227	2%
South Central	5,107	672	13%	170	3%
Southern and Central Plains	62,732	16,778	27%	2,231	4%
Southwest	3,183	2,571	81%	77	2%
National	**315,303**	**49,711**	**16%**	**18,900**	**6%**

Source: CEAP (2022), Tables 11 and 12

The prevalence of conservation tillage, structural practices, cover crops, and irrigation help illustrate how many growers and/or applicators already have mitigation measures in place that could achieve points, and as shown in some of the scenarios, may be sufficient to meet requirements that could appear on pesticide product labeling. The information from CEAP (2022) presented in this section and some of the scenarios also highlight that some growers and/or applicators would need to install or adopt additional mitigations to meet requirements that could appear on pesticide product labeling. Additionally, some growers and/or applicators have already adopted these practices through local runoff and erosion reduction programs or qualified conservation programs. (CEAP, 2022). Since CEAP (2022) relies on surveys conducted in 2016, USDA OPMP conducted another survey following the publication of the **Draft Herbicide Strategy** to provide a more recent estimate of adoption. USDA OPMP estimates that 34% of agricultural operations participate in a site-specific runoff and erosion reduction program on at least one of their fields (Paisley-Jones, 2024).

To help orient readers, below is a summary of key terms used throughout the Strategies. For detailed descriptions please see the **Mitigation Menu website**[7], or the **Crosswalk of EPA's Mitigation Measures with USDA-NRCS Conservation Practices in Support of EPA's Endangered Species Strategies**[8].

[7] http://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 update the menu with additional mitigation measures from each of the strategies, as appropriate, when they are finalized. EPA will also provide details on how this website should be used for these strategies. EPA intends to update this mitigation menu website annually in the fall so pesticide users can review any changes and prepare for the next growing season.

[8] Available in the Herbicide Strategy Docket: https://www.regulations.gov/docket/EPA-HQ-OPP-2023-0365.

- For the scenarios where runoff/erosion mitigation measures apply, this document includes categories based on how permanent a mitigation measure or relief point. Relief points can be available based on field location, and mitigation points can be available for permanent or semi-permanent field characteristics, on or adjacent to the field mitigation measures that are applied to a field each year, or measures for individual pesticide applications.
    - Permanent or semi-permanent field characteristics are inherent to the field and a grower will likely be able to count them toward the total point requirement for a pesticide on that field throughout the year and likely every year unless there is a major change in agronomic practices or a change in the number of points assigned to these characteristics. This includes field characteristics such as county-based pesticide runoff vulnerability, soil type, and field slope, as well as long-term structural or cropping-system-based mitigation measures such as water retention systems, irrigation water management, and continuous cover for perennial crops. This category also includes mitigations like active enrollment in a qualifying conservation program or working with a qualifying runoff/erosion specialist. Permanent or semi-permanent field characteristics are not categorized separately in the **Ecological Mitigation Support Document** but are highlighted in this document to illustrate mitigation measures within scenarios that likely do not change over time.
    - On-field mitigation measures are those that are placed in the field and could be present for one or more years. These could include but are not limited to mitigation measures such as tillage management, contour farming, in-field vegetative strips, cover crops, and soil amendments.
    - Adjacent to the field mitigation measures occur outside the field on the downslope edge of the field. These measures could be present adjacent to a field for one or more years. These could include, but not limited to mitigation measures such as grassed waterways, field buffers, and vegetated ditches. These measures often provide mitigation for one or more fields in proximity.
    - Mitigation measures related to applying a particular pesticide product would not apply to all pesticide applications in a year. Instead, these could include, but not limited to application reductions, treating a portion of the field, soil incorporation (for some herbicides).

For the runoff and erosion scenarios in this document, EPA presents information in tables that illustrate ways EPA expects growers and/or applicators could implement various mitigation measures to achieve points. These tables are color coded based on the level or permanence of each category of field characteristic or mitigation measure as follows:

- Grey rows: Field location and permanent or semi-permanent field characteristics. Pesticide runoff vulnerability refers to relief points awarded due to a field's location in a county that EPA has identified as having reduced runoff and erosion. EPA expects these characteristics will remain relatively static year after year. This is important because once a grower assesses the number of points associated with these characteristics, the grower may be able to claim these points repeatedly (given points allowed for these practices do not change) and more easily determine the extent of remaining mitigation needed. Because some on-field mitigation measures are field characteristics that are not likely to change over time (*e.g.,* irrigation management, soil type), EPA combined these with permanent or semi-permanent field characteristics in the tables below.
- Blue rows: On-field mitigation measures

- Yellow rows: Application parameters
- Orange rows: Adjacent to the field mitigation measures.
- White rows: A point is achieved where growers and/or applicators are using mitigation practices from both on- and adjacent-to-field practices.

EPA specifies a "grower" as the person (e.g., farm manager, landowner) who is planting and cultivating the crop and implementing the mitigations that change the landscape on and off the field. An "applicator" is the individual who applies the pesticide. The Agency acknowledges that in some circumstances the grower and applicator may be the same person. However, when the grower and the applicator are not the same person, communication among applicators, farm managers, and landowners on necessary mitigation measures is essential when planning an application.

3.1.1 RUNOFF/EROSION SCENARIO METHODOLOGY

Runoff/erosion scenarios represent a crop grown in a particular location, and for each scenario EPA provides one or more likely examples of how a grower could employ runoff/erosion mitigation measures on individual fields. Examples for a scenario are intended to show multiple ways of achieving points, depending on field characteristics (e.g., slope) or agronomic practices (e.g. irrigation methods). The examples present either multiple fields in an area that have different field characteristics, or in some cases a single field where a grower may have multiple options for applying mitigation measures to achieve points. EPA selected scenarios to show a range of different crop production types for both field crops and specialty crops. EPA used the USDA Census of Agriculture (USDA NASS, 2022) to identify counties with production of the crop (i.e., acres harvested) to determine the location for each scenario. Runoff/erosion scenarios are intended to represent application of any pesticide type, unless otherwise specified.

Each example begins with field location and permanent or semi-permanent characteristics that field may already have in place based on the crop production practices and regional practices indicated in the CEAP report discussed above. For the purposes of this document, EPA is using 9 points as the benchmark, not because most pesticides will require 9 points, but rather because 9 points is the number of points required to use chemicals with the highest potential for population level impacts to non-target species under the Draft Insecticide and Final Herbicide Strategies. Therefore, 9 points represents the maximum requirement and would help determine where growers and/or applicators may face the greatest challenges. If the field's location and permanent and semi-permanent characteristics achieve 9 points, examples do not include additional mitigation measures, since they already achieve the 9 points. Examples do not add mitigation measures beyond what would be needed to achieve 9 points other than when points incidentally total more than 9 (e.g., a field achieves more than 9 points for relief points and permanent characteristics). If a field's location and permanent and semi-permanent characteristics do not achieve 9 points, examples include additional mitigation measures that could be appropriate to the crop and region until 9 points are achieved. EPA provides one or more examples of how 9 points could be achieved for each scenario but does not provide every possible combination of mitigation measures and relief points that could be used to achieve 9 points. EPA acknowledges that not all of the mitigation measures identified are appropriate to every individual field because of differences in land characteristics, regional differences, and individual agronomic practices. Achieving 9 points may be more challenging for some fields than others. If a field cannot achieve 9 points, the applicator would only be able to use pesticides with less than 9 points as required on the pesticide product labeling. For a list of available mitigation measures and assigned point values, see **Appendix A**.

In selecting the mitigation measures for each example, EPA based decisions on the CEAP report data and best professional judgement. EPA considers mitigation measures with high current adoption rates in the CEAP report in the scenario's region to be already in place for most example fields in that scenario, and mitigation measures with moderate adoption to be likely options that growers could implement, unless otherwise noted in the scenario. In some cases, scenarios differ from what the CEAP report indicates because EPA highlights a specific type of example, or because broad regional practice adoption rates do not reflect agronomic practices in a specific crop. For example, specialty crops like fruits and vegetables are commonly irrigated even if irrigation is uncommon in that region. Because many conservation practices identified in the CEAP report are broad classes that encompass several EPA mitigation measures (e.g., structural practices), EPA selects a specific mitigation measure based on best professional judgement or by using information from extension publications or scientific literature.

For the purposes of these scenarios, EPA assumes users will maximize the number of points from non-application parameter mitigations before considering altering application parameters. One reason for this is that altering application parameters applies only to a specific pesticide application and would likely not be appropriate for every pesticide the grower would apply in a growing season (e.g., soil incorporation can be used for soil applied pesticides but not for foliar pesticides). It may be more efficient for planning purposes for growers and/or applicators to adopt a set of mitigation measures that would apply to all pesticide applications expected for the growing season. EPA acknowledges that applicators often use rates lower than the labeled maximum rate (e.g., when co-applying pesticides). However, some stakeholders expressed concern that using lower rates could detrimentally affect resistance management of target pests. Therefore, EPA has intentionally developed the majority of scenarios presented here to not include rate reductions. However, if applicators intend to use reduced rates, Section 5.2 provides a reduced-rate scenario. In situations such as an unexpected insect pest outbreak, growers and/or applicators may not know in advance of the growing season whether they may need to apply the maximum annual application rate, so for mitigation planning purposes they may prefer not to rely on using a reduced rate. However, in site-specific cases, users may be able to use soil incorporation or reduce per acre annual application rates and achieve associated mitigation points by using rate reductions, banded applications, and precision spraying equipment that may allow for the use of less pesticide overall while maintaining an efficacious application rate.

As mentioned previously, for the strategies, EPA identified runoff/erosion mitigations to protect listed species, located down-gradient or down-slope from the pesticide application site (e.g., field) for the field edge(s) adjacent to the non-cultivated areas or aquatic habitats. For the purposes of the following scenarios regarding runoff and erosion, the Agency assumes that a species' habitat or waterbody exists within 1,000 feet down-gradient from the field, unless otherwise specified. Therefore, mitigation to reduce runoff/erosion down-gradient from the field is identified. For these scenarios, EPA assumes that runoff/erosion mitigation measures listed as adjacent to the field are installed on the down-slope side of the application area. Runoff/erosion mitigation would not be needed up-gradient from the application area.

3.2 RUNOFF AND EROSION (R/E) SCENARIOS

Because growers and applicators may need to employ runoff/erosion mitigations prior to application of a pesticide product where the labeling requires it, EPA provides a handful of scenarios to show how the labeling requirement could be met.

3.2.1 FIELD CROPS

3.2.1.1: Non-irrigated corn and soybeans on flat land, non-sandy soil in Indiana

This scenario is for application of any pesticide on corn and soybean grown in Clinton County, Indiana on flat fields. The soils are non-sandy. As the field is flat, many of the runoff/erosion mitigations like terraces, contour farming, and grassed waterways are not applicable to this production system. However, as less runoff is expected in flat fields, the ≤3% slope characteristic is assigned 2 points. Two examples are provided; one field that has tile drainage without a controlled outlet, and one field using reduced tillage. The geographic location is assigned 2 points of mitigation relief for having moderate pesticide runoff vulnerability.

	# of Points	
Field Location, Characteristic, or Mitigation Measure	**Reduced Tillage**	**Conventional Tillage, Tile Drainage**
Pesticide Runoff Vulnerability	2	2
Flat Field (≤3% slope)	2	2
Irrigation Water Management[1]		
Non-irrigated	3	3
Systems that Capture Runoff		
Tile Drainage without Controlled Outlet		1
TOTAL POINTS for FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**7**	**8**
Reduced Tillage Management		
Reduced Tillage	2	
Cover Crop		
Short Duration		1
TOTAL:	**9**	**9**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

This scenario suggests that Midwestern corn and soybean production systems on flat fields could achieve 9 points with use of the identified mitigations. Fields with reduced tillage may be able to achieve 9 points with mitigation measures already in place without adding any additional mitigation measures, which would be sufficient for the pesticides with uses identified in the low (3 points), medium (6 points), and high (9 points) level of mitigation categories. While tile drainage and reduced tillage are common in the region, fields that do not have these may need to implement additional mitigation measures. Possible mitigation measures include cover crops, vegetative buffers, vegetated ditch, etc.

3.2.1.2: Non-irrigated corn and soybeans on sloped land, non-sandy soil in Iowa

This scenario represents an application of any pesticide type on corn and soybean grown in Buchanan County, Iowa on sloped land, in contrast with Scenario 1 which considered flat land. This scenario considers three separate fields in Buchanan County, Iowa. The first field does not have tile drainage installed on the field, and two possible mitigation examples are presented for this field. The second field has subsurface tile drainage without a controlled outlet that empties into a ditch that carries water to a nearby creek. The third field has subsurface tile drainage with a controlled outlet that empties into a pond on the farm. For fields with tile drainage with a controlled outlet that allows runoff to stay on the farm, EPA did not find a potential for population level impacts and therefor did not identify runoff/erosion mitigation.

The soils on the fields in this scenario are not sandy. Conservation tillage (residue tillage management) is regularly used as are measures like grassed waterways and cover crops. The geographic location is assigned 2 points of mitigation relief for having moderate runoff vulnerability.

	# of Points			
Field Location, Characteristic, or Mitigation Measure	**No Tile Drainage, Cover Crop**	**No Tile Drainage, Grassed Waterway**	**Tile Drainage w/o Controlled Outlet**	**Tile Drainage w/ Controlled Outlet**
Pesticide Runoff Vulnerability	2	2	2	2
Irrigation Water Management[1]				
Non-irrigated	3	3	3	3
Systems that Capture Runoff				
Tile Drainage without Controlled Outlet			1	
Tile Drainage with Controlled Outlet				YES
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**5**	**5**	**6**	**No Additional Mitigation Needed**
Reduced Tillage Management				
Reduced Tillage	2	2	2	
Cover Crop				
Short Duration			1	
Long Duration	2			
Grassed Waterway		2		
Point for both on and off-field measures		1		
TOTAL:	**9**	**10**	**9**	**N/A**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations, and orange rows represents mitigation measures that are adjacent to the field. The white row indicates a point awarded for the use of both on and adjacent-to-field practices.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

This scenario suggests that Midwestern corn and soybean systems on sloped fields could achieve 9 mitigation points with use of the identified mitigations, which would be sufficient for the pesticides with uses identified in the low (3 points), medium (6 points) and high (9 points) level of mitigation categories. Fields without tile drainage or with tile drainage that does not have a controlled outlet may need to add on-field or adjacent to the field mitigation measures to use pesticides with labeling that requires a high level of mitigation prior to application.

3.2.1.3: Non-irrigated, low rainfall grain sorghum or wheat in the Western U.S.

These scenarios are for application of a pesticide on relatively low-input, drought-resistant sorghum and small grains in dry areas of Ness County, Kansas. In areas where there is limited rainfall, runoff and erosion mitigations that incorporate vegetation, like cover crops, grassed waterways, and vegetative filter strips may not be adopted due to insufficient water to establish and maintain them, as well as potential soils moisture loss associated with cover crops (Meeker and Lust, 2022). This scenario considers a flat field, and a field on sloped land. Reduced tillage is common in the region, and mitigation measures like contour farming could be adopted on sloped land. As less runoff is expected from flat fields in dry regions, the flat field characteristic is assigned 2 points, and the geographic county location is assigned 3 points of mitigation relief for having low pesticide runoff vulnerability.

	# of Points	
Field Location, Characteristic, or Mitigation Measure	**Flat**	**Sloped**
Pesticide Runoff Vulnerability	3	3
Flat Field	2	
Irrigation Water Management[1]		
Non-irrigated	3	3
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**8**	**6**
Reduced Tillage Management		
Reduced Tillage	2	2
Contour Farming		2
TOTAL:	**10**	**10**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

This scenario suggests that in this region it is possible that employing the identified mitigations could achieve 10 mitigation points on either sloped or flat land, which would be sufficient for the pesticides with uses identified in the low (3 points), medium (6 points), and high (9 points) levels of mitigation category.

3.2.1.4: Non-irrigated High Plains Texas cotton

This scenario represents application of any pesticide type on non-irrigated cotton in the Texas High Plains, and considers four fields located in Crosby County, Texas. Both sandy and non-sandy soils are present in this area,

and this scenario considers non-sandy soils. Precipitation in this environment is limited, making the ability to adopt measures like cover crops, vegetated filter strips, and grassed waterways low. Cotton production areas in the high plains are generally flat. As less runoff is expected, the flat field characteristic is assigned 2 points, and the geographic location is assigned 3 points of mitigation relief for having low pesticide runoff vulnerability. The first field presented is the baseline of points for existing practices.
In the second example, is a field where the grower has adopted reduced tillage to improve soil moisture based on their soil type (Lascano et al. 2020). Reduced tillage also serves to reduce erosion/runoff from the field.

The next field is farmed by a grower who is not working with a runoff/erosion specialist or enrolled in a qualifying conservation program but is tracking on paper or electronic format the mitigations they employed.

The last field is farmed following recommendations from a qualifying runoff/erosion specialist and has adopted reduced tillage following the recommendation of the specialist.

	# of Points			
Field Location, Characteristic, or Mitigation Measure	**Existing Practices**	**Reduced Tillage**	**Mitigation Tracking**	**Working with a R/E Specialist**
Pesticide Runoff Vulnerability	3	3	3	3
Following Recommendations from a Qualifying Runoff/Erosion Specialist				1
Mitigation Tracking			1	
Flat Field	2	2	2	2
Irrigation Water Management[1]				
Non-irrigated	3	3	3	3
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**8**	**8**	**9**	**9**
Reduced Tillage Management				
Reduced Tillage		2		2
TOTAL:	**8**	**10**	**9**	**11**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations.
[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

This scenario suggests that non-irrigated Texas High Plains cotton growers and/or applicators could achieve 8 to 10 mitigation points with use of the identified mitigations, which would be sufficient for the pesticides with labeling that requires low (3 points), medium (6 points), and high (9 points) levels of mitigation to be achieved prior to application.

3.2.1.5: Irrigated Georgia cotton

This scenario represents application of a pesticide in cotton production in Georgia. Both irrigated and non-irrigated cotton are produced in Worth County, Georgia. This scenario considers irrigated cotton. Cotton in Georgia and other areas of the Southeastern U.S. are generally produced on sandy soils in flat fields. Both conventional and reduced tillage (residue tillage management) are practiced in cotton production in Georgia. EPA recognizes that conventional tillage in Georgia cotton is practiced for several reasons including weed management and insect management (University of Georgia, 2021). This scenario considers three fields, two with conventional tillage production and one with reduced tillage production. One of the fields with conventional tillage is enrolled in a conservation program and has installed a vegetative filter strip as part of that program. As less runoff is expected on flat fields, the flat field characteristic is assigned 2 points, and the geographic location is assigned 2 points of mitigation relief for moderate pesticide runoff vulnerability.

	# of Points		
Field Location, Characteristic, or Mitigation Measure	**Conventional Tillage, Enrolled in a Program, No Runoff Control**	**Conventional Tillage, Not Enrolled in a Program, Runoff Control**	**Reduced Tillage, Not Enrolled in a Program, Runoff Control**
Pesticide Runoff Vulnerability	2	2	2
Flat Field	2	2	2
Sandy Loam Soil[1]	2	2	2
Participate in a Conservation Program	2		
Irrigation Management[1, 2]			
Flood with Runoff Control		2	2
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**8**	**8**	**8**
Reduced Tillage Management			
Reduced Tillage			2
Vegetative Filter Strip			
20-30 ft wide		1	
30-<60 ft wide	2		
Point for both on and off-field measures	1	1	
TOTAL:	**11**	**10**	**10**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations, and orange rows represents mitigation measures that are adjacent to the field. The white row indicates a point awarded for the use of both on and adjacent-to-field practices.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management and soil type are on-field measures; however, EPA assumes that irrigation and soil type will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as semi-permanent field characteristics.

[2] Points for irrigation management are not available for the 68% of cotton in Georgia that is not irrigated (USDA NASS, 2023). Those fields would instead be assigned 3 points for the lower runoff potential associated with non-irrigated fields.

These scenarios suggests that irrigated Georgia cotton systems could achieve 10 to 11 mitigation points with use of the identified example mitigations, which would be sufficient for the use of pesticides with labeling that requires low (3 points), medium (6 points), and high (9 points) level of mitigation to be achieved prior to application. This scenario identified potential mitigation points for irrigated cotton in Georgia. However, 68% of cotton in Georgia is not irrigated (USDA NASS, 2023). Non-irrigated cotton would not achieve points for irrigation management with runoff control but would achieve 3 points for the lower runoff potential associated with non-irrigated fields as demonstrated in Scenario 3.2.1.4 above.

3.2.1.6: Rice Production in California and the Mississippi Delta

Rice is produced in the Sacramento Valley of California and the Mississippi River delta in the southern U.S. In California, most rice fields are surrounded by permanent levees with weirs that control movement of water between fields and canals (University of California, 2023). Fields have flooded conditions maintained for most of the rice-growing season and often during winter, and discharge of water to waterbodies is highly controlled. Rice is usually water-seeded into flooded fields. Levees/berms reduce exposure such that EPA has found the potential for population-level impacts is unlikely and did not identify any level of additional runoff/erosion mitigation measures for this situation as long as levees are in place prior to application and kept in place until the end of the crop season.

In the Mississippi Delta region of rice production, growers will either water-seed or drill seed the rice (Louisiana State University, 2014). Water-seeding would be a similar scenario as California where the levees are permanent or built prior to planting. However, when growers drill seed in north Louisiana, they frequently plant the entire field prior to building levees around the field. Early season pesticide applications are also frequently applied prior to levees being built so applicators would not have a measure in place that reduces run off/erosion exposure such that potential for population-level impacts is unlikely. Therefore, applicators would need to adopt additional runoff/erosion mitigations before making an application if the pesticide product labelling required runoff/erosion mitigation. Additionally, some rice producers in the midsouth grow rice using furrow-irrigation and may not install levees. In these cases, furrow-irrigated rice would be similar to the “Louisiana: Prior to Levees Being Built” scenario except growers and/or applicators may never build the levees.

This scenario represents a rice field in Butte County, California and a rice field in Richland Parish, Louisiana. In both states, levees/berms allow rice fields to be flooded. In Butte County, CA, the geographic location is assigned 3 points of mitigation relief for low pesticide runoff vulnerability, but the Richland Parish, Louisiana location is not assigned mitigation relief points for pesticide runoff vulnerability as it is located in a high runoff prone area.

	# of Points		
Field Location, Characteristic, or Mitigation Measure	**California**	**Louisiana: Pesticide Applications Prior to Levees Being Built**	**Louisiana: Levees in Place**
Pesticide Runoff Vulnerability	3		
Systems that Capture Runoff & Discharge			
Elevated Field Berm System at the Time of Application	YES		YES
Flat Field		2	
Irrigation Management[1]			
Flood with Runoff Control		2	
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**No Additional Mitigation Needed**	**4**	**No Additional Mitigation Needed**
Vegetated Ditch		1	
Point for both on and off-field measures		1	
TOTAL:	**N/A**	**6**	**N/A**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Orange rows represent mitigation measures that are adjacent to the field.
[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

This scenario suggests that rice fields in California that have permanent levees/berms may not require additional runoff/erosion mitigation measures. In Louisiana where levees are often built annually, if the levees are not in place prior to all pesticide applications where the labeling requires a level of mitigation, employing the identified mitigations could achieve 6 mitigation points before levees are built, which would be sufficient for the pesticides where the mitigation requirements on the labeling include low (3 points) and medium (6 points) levels of mitigation. However, applicators may need to adopt additional mitigation measures to achieve 9 points if that is required on the pesticide labeling. For instance, the grower could build levees prior to making a pesticide application, work with a conservation specialist (1 point), enroll in a conservation program (2 points), or track mitigation on paper or electronic format (1 point) to achieve additional points.

3.2.2 SPECIALTY CROPS (VEGETABLES, ORCHARD FRUIT, SMALL FRUIT)

3.2.2.1: Non-irrigated, field grown vegetables in Delaware

This scenario represents application of pesticides in commercial field grown vegetable production in the Eastern U.S. (Sussex County, Delaware), which generally has sufficient precipitation for crop production. Compared to field crops, like corn and soybean, vegetables are produced on smaller acreage, with more specialized equipment. Agronomic characteristics, like small seeds and low seeding vigor, make tillage advantageous for successful production of many vegetable crops. In this scenario vegetables are produced in flat fields. However, vegetables may also be produced on sloped fields. There may be potential for the use of measures like conservation tillage (residue tillage management) and cover crops with vegetables, but potential adoption will vary by the agronomic characteristics of the individual vegetable species. This region produces a mix of vegetable and field crops and vegetables may be rotated with field crops on the same field (Johnson, 2010), so field-adjacent mitigation measures like vegetative filter strips that may be used for fields where field crops are grown may also be present in those fields when vegetables are grown. Banded applications are common for some pesticide types in vegetable production, such as for herbicides or insecticides applied early after crop emergence. Soil incorporation is an option for some soil applied pesticides, but not all pesticides can be applied this way. The geographic location is not assigned any mitigation relief points for pesticide runoff vulnerability, as it is a high runoff-prone area.

	# of Points		
Field Location, Characteristic, or Mitigation Measure	**Reduced Application Rate**	**Soil Incorporation**	**Mitigation Tracking**
Flat Field	2	2	2
Sandy Loam Soil[1]	2	2	2
Irrigation Management[1]			
Non-irrigated	3	3	3
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**7**	**7**	**7**
Soil Incorporation		1	
Banded Applications – 25% of field not treated	1		
Vegetative Filter Strip			
20-30 ft wide	1	1	1
Point for both on and off-field measures	**1**	**1**	**1**
TOTAL:	**10**	**10**	**9**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations; yellow rows indicate application parameters; and orange rows represents mitigation measures that are adjacent to the field.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management and soil type are on-field measures; however, EPA assumes that irrigation and soil type will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management and soil type as a semi-permanent field characteristic.

This scenario suggests that in the non-irrigated Eastern U.S. vegetable production systems, it is possible that use of a pesticide with labeling requiring a level of mitigation could achieve ≥9 mitigation points prior to application. Achieving ≥9 mitigation points would be sufficient for the pesticides where the mitigation requirements on the labeling include low (3 points), medium (6 points), and high (9 points).

3.2.2.2: Irrigated leafy vegetables in California and Arizona

This scenario represents application of any pesticide type in leafy green production in Monterey County, California and Yuma County, Arizona. The scenario assumes that these leafy vegetables are produced in flat fields and that drip irrigation is used. Water is highly controlled in California and Arizona and this scenario assumes that the California field drains into a sediment basin. Soil incorporation is applicable for some soil applied, residual pesticides but not for postemergence pesticides. Mitigations that employ vegetation, including vegetative filter strips and field borders, can create issues in leafy green production systems in the region as vegetation around fields can lead to food safety concerns due to contamination from vertebrate pests (PMSP, 2020). Furthermore, sufficient water is unlikely to be available to establish and maintain vegetation for mitigation measures that require additional vegetation growth. The geographic location of the field in Monterey County is assigned 3 points of mitigation relief for low pesticide runoff vulnerability, and the location of the field in Yuma County is assigned 6 points of mitigation relief for having very low pesticide runoff vulnerability.

	# of Points	
Field Location, Characteristic, or Mitigation Measure	**California (Monterey County)**	**Arizona (Yuma County)**
Pesticide Runoff Vulnerability	3	6
Flat Field	2	2
Irrigation Management[1]		
Drip Tape Irrigation	2	2
Systems that Capture Runoff		
Sediment Basin	2	
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**9**	**10**
Point for both on-field measures and systems that capture runoff[2]	**1**	
TOTAL:	**10**	**10**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations; yellow rows indicate application parameters; and orange rows represents mitigation measures that are adjacent to the field.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

[2]Irrigation management and sediment basins are both colored grey as semi- or permanent mitigation measures, but irrigation management is an on-field measure and sediment basins are a System that captures runoff and discharge, so the field is assigned 1 point for multiple mitigation categories.

This scenario suggests that in leafy green vegetables in California and Arizona, it is possible that the use of pesticides with labeling requiring a level of mitigation could achieve 10 mitigation points, which would be sufficient for pesticides requiring the low (3 points), medium (6 points), and high (9 points) levels of mitigation on their labeling.

3.2.2.3: Irrigated, field grown vegetables in Florida

This scenario represents application of any pesticide type field grown vegetable production in Florida, with a field in Hillsborough County on sandy soil and a field in Palm Beach County on muck organic soil. The scenario assumes that vegetables are produced in flat field and drip irrigation is used in Hillsborough County and sub-surface (seepage) irrigation in Palm Beach County. Banded applications are common for some pesticide types in vegetable production, such as for herbicide applications to control weeds between crop rows. In contrast with vegetable production in Delaware described in Section 3.2.2.1, this region has more concentrated vegetable and specialty crop production, with fewer field crops grown in the area. Mitigations that employ vegetation, including vegetative filter strips and field borders, are not used in vegetable production systems in the region as vegetation around fields is discouraged to mitigate contamination from vertebrate pests. Cover crops are not used in much of this region because fields are seasonally flooded. Permanent elevated field berm systems that surround the field on all sides and prevent water from leaving the field are common in this area. Conservation tillage (residue tillage management) is unlikely to be practiced in these systems. The geographic locations of both fields are assigned 3 points of mitigation relief for having low pesticide runoff vulnerability.

	# of Points		
Field Location, Characteristic, or Mitigation Measure	**Sandy Soil with Banded Applications**	**Sandy Soil**	**Muck Soil**
Systems that Capture Runoff & Discharge			
Permanent Elevated Field Berm System			YES
Pesticide Runoff Vulnerability	3	3	3
Sandy Loam Soil	2	2	
Flat Field	2	2	2
Irrigation Management[1]			
Drip Tape Irrigation	2	2	
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**9**	**9**	**No Additional Mitigation Needed**
Banded Applications – 33% of field not treated	2		
TOTAL:	**11**	**9**	**N/A**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations; yellow rows indicate application parameters; and orange rows represents mitigation measures that are adjacent to the field.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

This scenario suggests that in irrigated, field-grown vegetables in Florida, fields with permanent field berm systems would not need additional runoff/erosion mitigation. For fields without elevated berm systems, it is possible that the use of pesticides that require a level of mitigation on their labeling could achieve 9 mitigation points with field characteristics and mitigation measures currently on the field. Growers and/or applicators would have sufficient mitigation options for pesticides requiring low (3 points), medium (6 points), and high (9 points) levels of mitigation on their labeling.

3.2.2.4: Apple orchard in Washington on sloped land with drip irrigation

This scenario represents application of any pesticide type in tree-fruit orchard production using apple as an example in the intermountain region of Eastern Washington, in Grant County. Although this is a very low rainfall area, vegetation or natural mulch is maintained between the tree rows for soil conservation (DuPont, Granatstein, and Sallato, 2020). This scenario is for non-sandy soil, but there are some sandy-loam soils used for tree fruit production in this area. Fields in this area are typically sloped. This scenario assumes the orchard is an established fruit bearing orchard. As many pesticides in apple orchards are applied as banded applications of herbicides or soil drench insecticides, reductions of pesticides applied in terms of a reduced area treated for certain pesticides may be achieved in these systems. CEAP (2022) data suggest that only 33% of cropland in this region is irrigated. However, given the limited rainfall in some areas of Washington, irrigation is common in fruit orchards (WSU, undated). The geographic location is assigned 6 points of mitigation relief for having very low pesticide runoff vulnerability.

	# of Points
Field Location, Characteristic, or Mitigation Measure	**Washington Apples**
Pesticide Runoff Vulnerability	6
Irrigation Management[1]	
Drip emitter irrigation	2
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**8**
Cover Crop/Continuous Vegetation	
Perennial crop with continuous ground cover	3
In-field Vegetative Strips	2
TOTAL:	**13**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are “on-field” mitigations.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

This scenario suggests that in apple production systems in the Northwest region, it is possible to achieve 13 mitigation points when using a pesticide that requires a level of mitigation and would be sufficient for the pesticides requiring low (3 points), medium (6 points), and high (9 points) level of mitigation.

3.2.2.5: Apple orchard in New York sloped land, heavy soils, drip irrigation

This scenario considers any pesticide application in apple and other tree fruit orchards in the Eastern U.S., represented by an apple orchard in Wayne County, New York. In comparison to the Washington apple scenario, apples are assumed to be produced on non-sandy soil types in sloped fields with irrigation. This scenario assumes orchards are established fruit bearing orchards. This scenario presents two fields. In the first orchard, the orchard was established so that the tree rows follow the contour. In the second orchard, a 20-foot wide densely wooded area exists near the downslope edge of the orchard. As pesticides in orchards are often applied as a soil drench, through chemigation, or via banded ground boom applications, growers and/or applicators may achieve points for a reduction in area treated if specified on pesticide labels. Mowed turf is between rows of trees. The geographic location is assigned 2 points of mitigation relief for having moderate pesticide runoff vulnerability.

	# of Points	
Field Location, Characteristic, or Mitigation Measure	**Contour Orchard**	**Vegetated Ditch**
Pesticide Runoff Vulnerability	2	2
Irrigation Management[1]		
Drip emitter irrigation	2	2
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**4**	**4**
Contour Orchards and Perennial Crops	2	
Cover Crop/Continuous Vegetation		
Perennial crop with continuous vegetation	3	3
Terrestrial Habitat Landscape Improvement		
20 to 30 ft wide		1
Point for both on and off-field measures		1
TOTAL:	**9**	**9**

Color scheme Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations; yellow rows indicate application parameters; and orange rows represents mitigation measures that are adjacent to the field.
[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

While only 2% of cropland in the Northeast Region is irrigated, high-value crops like apples are frequently grown with irrigation (Courtney, 2017). This scenario suggests that Eastern U.S. orchard production systems could achieve 9 mitigation points prior to application of a pesticide with labeling requiring mitigations, which would be sufficient for pesticides that require low (3 points), medium (6 points), and high (9 points).

3.2.2.6: Bare ground almond in California with drip irrigation

This scenario represents application of any pesticide type in almond and other tree nut production that use fully bare ground weed control scenarios to aid in harvest. This scenario assumes the orchard is an established fruit bearing orchard. Almonds are generally grown in flat fields and drip or microirrigation is used in most orchards (Schwankl, Prichard and Fulton, 2020). Water is highly controlled in California, so this scenario assumes that runoff is controlled in a way to achieve water retention system points, in this case with a sediment basin. Because almond orchards do not have continuous ground cover, they would not achieve points for a perennial crop with continuous cover. This orchard in located in Kern County, and the geographic location is assigned 3 points of mitigation relief for having low pesticide runoff vulnerability.

	# of Points
Field Location, Characteristic, or Mitigation Measure	**Almond**
Pesticide Runoff Vulnerability	3
Flat Field	2
Systems that Capture Runoff & Discharge	
Sediment basin	2
Irrigation Management[1]	
Microirrigation	2
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**9**
Point for both on-field measures and systems that capture runoff[2]	1
TOTAL:	**10**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

[2]Irrigation management and sediment basins are both colored grey as semi- or permanent mitigation measures, but irrigation management is an on-field measure and sediment basins are a system that captures runoff and discharge, so the field is assigned 1 point for multiple mitigation categories.

This scenario suggests that in the bare-ground almond production systems, it is possible that users could achieve 9 mitigation points prior to applying pesticides with labeling requiring a level of mitigation. Achieving 9 mitigation points would be sufficient for pesticides with low (3 points), medium (6 points), and high (9 points) of mitigation on their labeling.

3.2.2.7: You-pick blueberry and strawberry operations in Maryland

This scenario represents application of any pesticide type in small, you-pick fruit operations in the Eastern U.S., represented by a blueberry field and a strawberry field in St. Mary's County, Maryland. It is assumed that these operations are in flat fields to optimize parking and picking experiences for customers. In this scenario, mulching with natural materials is used as a mitigation option in blueberries, because low soil pH is optimal for blueberry production growers often mulch with pine shavings to reduce soil pH (UMD, undated). Strawberry production often occurs under impermeable plastic mulch to reduce disease and weed pressure. Some pesticides may be applied to strawberries through the irrigation system underneath the plastic, while others are applied above the plastic either to the foliage or between rows. Mulching may also be practiced in crops, like raspberry, that are grown upright in rows. This scenario assumes that irrigation is not used in blueberry, but that strawberry uses drip irrigation beneath the impermeable plastic mulch (Lamont, 2004). Mown grass is maintained between the rows of blueberries, but not in a low-growing crop like strawberries. The geographic location is not assigned any mitigation relief for pesticide runoff vulnerability because it is a high runoff-prone area.

	# of Points		
Field Location, Characteristic, or Mitigation Measure	**Blueberry**	**Strawberry, Foliar Application**	**Strawberry, Application Under Plastic**
Flat Field	2	2	2
Irrigation Management[1]			
Non-Irrigated	3		
Drip emitter irrigation under plastic		3	3
TOTAL POINTS FOR FIELD LOCATION, SEMI-OR PERMANENT CHARACTERISTICS:	**5**	**5**	**5**
Inter-field Vegetative Strips	2		
Mulching			
Natural materials	3		
Impermeable plastic mulch		1	1
Cover Crop/Continuous Vegetation			
Perennial crop with continuous ground cover	3		
Vegetative Buffer			
30-60 ft wide		2	
Point for both on and off-field measures		1	
Chemigation applied under impermeable plastic			YES
TOTAL:	**13**	**9**	**No Additional Mitigation Needed**

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations; and orange rows represents mitigation measures that are adjacent to the field. The white row indicates a point awarded for the use of both on and adjacent-to-field practices.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management is an on-field measure; however, EPA assumes that irrigation will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management as a semi-permanent field characteristic.

[2] If any applications are made via chemigation under plastic, additional mitigation would not be needed for those applications as this application is not likely to lead to population-level impacts.

While only 2% of cropland in the Northeast Region is irrigated (**Table 3.1.1**), high value crops like small fruits are frequently grown with irrigation. This scenario suggests that small fruit operations in this region, could achieve 9 to 13 mitigation points prior to application of a pesticide where its labeling requires a level of mitigation, which would be sufficient for pesticides that require low (3 points), medium (6 points), and high (9 points) level of mitigation. Applications to strawberries made through the irrigation system under impermeable plastic may not require additional runoff/erosion mitigation measures to use pesticides, because EPA found that this application method reduces exposure such that potential for population-level impacts is unlikely.

3.2.2.8: Cranberry Production in Wisconsin
This scenario represents application of any pesticide type in cranberry production in the upper Midwest, represented by a field in Wood County, Wisconsin. Cranberries are grown in fields with permanent elevated field berm systems that allow fields to be flooded for cranberry harvest, irrigation, field, and pest management, and for frost control. Fields often include a tailwater return system where water is drained into a holding pond so that it can be stored or moved between fields.

This scenario suggests that cranberry fields in the Midwest may not require additional runoff/erosion mitigation measures to use pesticides, because EPA found that permanent berms and tailwater return systems reduce exposure such that potential for population-level impacts is unlikely.

4 SPRAY DRIFT (SD) SCENARIOS

4.1 BACKGROUND ON ECOLOGICAL SPRAY DRIFT MITIGATION

In the Strategies, EPA identifies ecological spray drift mitigations to reduce identified potential for population-level impacts to listed species associated with agricultural uses of conventional pesticides. If through a FIFRA action, EPA identifies the potential for population-level impacts for listed species as not likely, it does not expect to identify further mitigations. If EPA determines the potential for population-level impacts 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 the strategies, 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 that a grower and/or 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 Mitigation 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.

EPA identifies "lower limit buffers" when there is a low potential for population-level impacts for aerial, airblast, and ground applications (i.e., EPA would identify buffers of 10 to 50 feet, depending on the application method when the potential for population-level impacts is low). (See Table **4.1**). If EPA identifies a medium potential for population-level impacts for aerial, airblast and ground applications, the buffer distance is calculated at 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, a maximum buffer is identified that varies depending on the application method. (See Table **4.1**). All these ecological buffers would only apply if the wind is blowing toward non-managed areas or aquatic habitat as described in the **Ecological Mitigation Support Document**.

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 4.1**, 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.

As mentioned previously, EPA also identified measures that a grower and/or pesticide applicator can employ to reduce any ecological wind-directional drift buffer distance for aerial, ground, and airblast applications because these measures would reduce exposure within the buffer. The **Ecological Mitigation Support Document** describes how EPA determined the efficacy of the measures included, which EPA expresses as a percentage decrease in any identified buffer distance. Growers and/or applicators can use as many of the options to reduce the spray drift buffer distance as they can and potentially eliminate the identified buffer distance because the percent reductions are additive.

EPA also identified application methods where spray drift exposure would be limited and thus the potential for population-level impacts to listed species is unlikely. These application methods include: chemigation methods that include micro-sprinklers, drip-tape, drip emitters, subsurface or flood (and exclude overhead and impact sprinkler chemigation); in-furrow sprays when nozzle height is ≤8 inches above soil surface; tree trunk drench, tree trunk paint, tree injection; soil injections; solid formulations that are used as a solid, and less than 1/10 acre (<4356 square feet) is treated or spot treatment (<1000 square feet) occurs. Because the potential for population-level impacts is not likely, EPA did not identify mitigation measures for these application methods.

Table 4.1. The Range of Potential for Population-Level Impacts Identified and Corresponding Spray Drift Distance to Reduce Impacts.

Potential for Population- Level Impacts	Distance from edge of treated area (in feet)		
	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

[1] EPA based aerial distances on the assumption that most aerial applications 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 mitigation measures for reducing this distance when using larger droplets and a low boom.
[3] EPA anticipates that chemical specific buffers would 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.

As mentioned previously, in a FIFRA action where EPA determines a drift buffer is necessary to reduce the potential for population-level impacts to listed species, EPA also identified buffer reduction options that may be included as part of labeling to reduce the identified spray drift distance. Growers and/or applicators will have options to reduce buffer distance; however, they differ by application method, which are described below.

For **broadcast aerial** applications, buffer distance may be reduced when:

Buffer Reduction Measure	% Reduction in Distance
Application Parameters	
Reduced single application rate	% reduction corresponds to application rate reduction from maximum on pesticide product label[1]
Coarse DSD[2]	20%
Very coarse DSD[2]	40%
Spray drift reducing adjuvants, Medium DSD	30% for herbicides Under evaluation for insecticides[3]
Spray drift reducing adjuvants, Coarse or Very coarse DSD	15% for herbicides Under evaluation for insecticides[3]
Reduced proportion of field treated (number of airplane/helicopter passes[4])	
1 pass	55%
2-4 passes	20%
5-8 passes	10%
Other Measures	
Downwind windbreak/hedgerow/riparian/forest/woodlots/shrubland	50% for basic windbreak/hedgerow 75% for advanced windbreak/hedgerow 100% for riparian/forests/shrubland/woodlots ≥60ft width
Relative humidity is 60% or more at time of application	10%

DSD = droplet size distribution

[1] A 10% reduction in rate would be equivalent to a 10% reduction in buffer; A 20% reduction in rate would be equivalent to a 20% reduction in buffer, etc. Growers and/or applicators can achieve this “reduction in rate” by reducing the area treated and/or by reducing the maximum single application rate.

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

[3] EPA anticipates receiving spray drift reduction adjuvant data for insecticide formulations and will be evaluating this as a mitigation measure for insecticides prior to finalizing the Insecticide Strategy.

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

For **airblast applications**, buffer distance may be reduced when:

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

[1] For example, a 10% reduction in rate would be equivalent to a 5% reduction in buffer; A 20% reduction in rate would be equivalent to a 10% reduction in buffer, etc. Growers and/or applicators can achieve this “reduction in rate” by reducing the area treated and/or by reducing the maximum single application rate.

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

For **broadcast ground** applications, buffer distance may be reduced when:

Buffer Reduction Measure	% Reduction in Distance
Application Parameters	
Reduced single application rate	% reduction corresponds to application rate reduction from maximum on pesticide product label[1]
High boom, fine to medium-coarse DSD[2]	55%
High boom, coarse DSD[3]	65%
Low boom, very fine to fine DSD[2]	40%
Low boom, fine to medium-coarse DSD[2]	65%
Low boom, coarse DSD[3]	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% for herbicides Under evaluation for insecticides[4]
Spray drift reducing adjuvants, Coarse or Very coarse DSD	15% for herbicides Under evaluation for insecticides[4]
Reduced proportion of field treated (number of ground application equipment passes[5])	
1 pass	75%
2-4 passes	35%
5-10 passes	15%
Other Measures	
Downwind windbreak/hedgerow/riparian/forest/shrubland/woodlots	50% for basic windbreak/hedgerow 75% for advanced windbreak/hedgerow 100% for riparian/forests/shrubland/woodlots $\geq$60ft 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] A 10% reduction in rate would be equivalent to a 10% reduction in buffer; A 20% reduction in rate would be equivalent to a 20% reduction in buffer, etc. Growers and/or applicators can achieve this “reduction in rate” by reducing the area treated and/or by reducing the maximum single application rate.
[2] This % reduction is based on the assumption/baseline of using high boom, very fine to fine droplet size for ground.
[3] Based on evaluation of additional ground spray drift data for an additional 10% reduction in distance beyond fine/medium DSDs.
[4] EPA anticipates receiving spray drift reduction adjuvant data for insecticide formulations and will be evaluating this as a mitigation measure for insecticides prior to finalizing the Insecticide Strategy.
[5] A spray drift buffer applies to downwind non-target areas. The reduced number of passes applies to the upwind part of the treated field.

EPA identified mitigation measures for overhead and impact sprinkler **chemigation** equipment. However, 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.

<table>
<tr><th rowspan="2">Potential for population-level impacts</th><th colspan="2">Mitigation Measures</th></tr>
<tr><th>Overhead chemigation[1]</th><th>Non-end gun impact sprinklers</th></tr>
<tr><td>Not likely</td><td>None</td><td>None</td></tr>
<tr><td>Low</td><td>No end gun</td><td rowspan="2">Limit throw distance to edge of field (treated area)[2]</td></tr>
<tr><td>Medium</td><td>No end gun and one of the following: reduce pressure (<20 psi); reduce release height (<5 ft); have a downwind windbreak[3]</td></tr>
<tr><td>High</td><td>No end gun and two of the following: reduce pressure (<20 psi); reduce release height (<5 ft); have a downwind windbreak[3]</td><td>Limit throw distance to edge of field (treated area) AND have downwind windbreak[3]</td></tr>
</table>

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

After accounting for ways to reduce ecological drift buffers, growers and/or applicators also can look at the managed landscape features on the downwind edge of the application site (e.g., field) to determine how much of the buffer distance contains managed areas[9] that can be included in the buffer, further reducing the distance. As a standard on pesticide product labels, EPA specifies maximum release height, droplet size, and windspeed, prohibits applications during temperature inversions, restricts boom length and swath displacements for aerial applications, and directs sprays into the canopy for airblast applications and turning off the outer nozzles at the last row.

EPA specifies a “grower” as the person (e.g., farm manager, landowner) who is planting and cultivating the crop and implementing the mitigations that change the landscape on and off the field. An “applicator” is the individual who applies the pesticide. The Agency acknowledges that in some circumstances the grower and applicator may be the same person. Communication among applicators, farm managers, and landowners on necessary mitigation measures is essential when planning an application.

[9] 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), 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.

4.1.1 ECOLOGICAL SPRAY DRIFT SCENARIO METHODOLOGY

Spray drift scenarios represent a crop grown in a particular location, and for each spray drift scenario, EPA provides one or more likely examples of how a grower or applicator could employ spray drift mitigation measures. Examples for a scenario are intended to demonstrate there may be multiple ways of reducing the spray drift buffer, depending on the presence of a downwind windbreak or woodlots or forests, climate, and/or differences in application parameters (e.g., use of coarser droplets or hooded sprayers). The examples present either multiple fields in an area that have different types of downwind windbreaks or woodlots or forests, or in some cases a single field where an applicator may have multiple options via altering different application parameters to achieve a spray drift buffer reduction. EPA selected scenarios to show a range of different crop production types for both field and specialty crops. EPA used the USDA Census of Agriculture (USDA NASS, 2022) to identify counties with production of the crop (i.e., acres harvested) for the location for each scenario. Additionally, EPA used best professional judgement when describing the field conditions and possible spray drift buffer reduction measures. Spray drift scenarios are intended to represent application of any pesticide type, unless otherwise specified.

Each scenario begins with field location and a description of whether basic or advanced downwind windbreaks/hedgerows/riparian/forests/shrubland/woodlots are present. For the purposes of this document, the Agency is starting with the use of the maximum spray drift buffer for each application method. This is not because EPA anticipates that all the fields will require the maximum spray drift buffer but because it would present the worst-case scenario and help determine where growers and/or applicators would face the greatest potential challenges. While EPA provides one or more examples of how ecological spray drift buffer distances might be reduced in each scenario, the goal is not to present a 100% reduction in distance for each scenario. EPA acknowledges that not all of the mitigation measures identified to reduce the spray drift buffers are appropriate to every individual field/grower or applicator because of differences in local climate (e.g., humidity), downwind basic/advanced windbreaks/hedgerows or downwind riparian/forests/shrubland/ woodlots ≥60 feet, efficacy concerns for pesticide-target pest combinations (e.g., rate reductions, larger droplets, use of adjuvants), ability to adopt hooded sprayers (e.g., availability of equipment), or suitability of application methods for control of target pest (e.g., not practical to treat between rows for a crop pest). As a reminder, spray drift ecological buffers apply only to fields if winds blow toward non-managed areas or aquatic habitats. For these fields, reducing the spray drift buffer distance may be more challenging for some growers and/or applicators than others.

In selecting the mitigation measures for each example for spray drift, EPA based decisions on reviewing extension and peer-reviewed literature and best professional judgement. EPA acknowledges that applicators often use rates lower than the labeled maximum rate (e.g., when co-applying pesticides). However, some stakeholders expressed concern that using lower rates could detrimentally affect resistance management of target pests. Therefore, EPA has intentionally developed the majority of scenarios presented here to not include rate reductions. However, if applicators intend to use reduced rates, Section 5.2 provides a reduced-rate scenario. In situations such as an unexpected insect pest outbreak, growers may not know in advance of the growing season whether they may need to apply the maximum annual application rate, so for mitigation planning purposes, they may prefer not to rely on using a reduced rate. However, applicators may effectively reduce the per acre rate depending on the application method (e.g., banded applications) even though the application rate in the sprayer tank is not reduced. Similarly, applicators may use a lower rate of a pesticide when co-applying more than one pesticide, a common practice where efficacy concerns are unlikely. EPA assumes that some applicators may rely on increasing droplet size to reduce the spray drift buffer distance, as long as an increase in droplet size does not compromise performance against the target pest.

As mentioned previously, for the strategies, EPA identified spray drift buffers to address the potential for population-level impacts located downwind from the pesticide application site (e.g., field) for the field edge(s) adjacent to the non-cultivated areas or aquatic habitats. For the purpose of these scenarios, EPA assumes that spray drift buffer reduction measures, such as basic or advanced windbreaks, are established on the downwind side of the application area. Spray drift buffers are not needed upwind from the application area.

4.2 ECOLOGICAL SPRAY DRIFT SCENARIOS

Because growers and applicators may need to employ spray drift mitigations prior to application of a pesticide product where the labeling requires it, EPA provides a handful of scenarios to show how the labeling requirement could be met.

4.2.1 FIELD CROPS

4.2.1.1: Aerial use of insecticides on corn grown in Illinois

This scenario represents aerial applications of an insecticide to field corn grown in Iroquois County, Illinois. The applicator is planning a non-ultra-low volume (ULV) aerial application of an insecticide with a single maximum application rate of 0.6 lbs. active ingredient (ai)/ acre, and the pesticide labeling requires a buffer of 320 feet. Some options for how the applicator can reduce their required spray drift buffer distance include using a coarse droplet size, particularly if the insecticide moves systemically in the plant (Option A), having a windbreak in place (B and C), applying when relative humidity >60% (A and B), or reducing the treated area (C).

	Buffer Size (feet)		
	Option A	**Option B**	**Option C**
Spray Drift Buffer Distance	320	320	320
Application parameters			
Coarse droplet size	-20%		
Other measures			
Basic downwind windbreak/hedgerow		-50%	
Advanced downwind windbreak/hedgerow			-75%
Reduced proportion of field treated			
5-8 passes			-10%
Relative humidity ≥60%	-10%	-10%	
Total % Reductions[1]	**-30%**	**-60%**	**-85%**
FINAL BUFFER SIZE[2]	**224**	**128**	**48**
FINAL ROUNDED BUFFER SIZE[3]	**225**	**130**	**50**

[1] Total % Buffer Reductions are determined by adding up all reductions within a column.
[2] Final Buffer size = Initial Buffer – (Initial Buffer * Total % Reductions)
[3] Final Rounded Buffer Size = Final buffer size after rounding to the nearest increment of 5 ft.

4.2.1.2: Aerial use of insecticides on safflower grown in San Joaquin Valley, California.
This scenario represents safflower production in Kings County, California. Insecticide use is minimal except for three or four well-timed non-ULV aerial applications by helicopter or fixed wing aircraft to manage insects across the entire safflower production area (not just this infested field) (Crop Profile 2016, Western IPM Center 2016). Pesticide labeling requires a buffer of 320 feet.

Target insects are small, so droplet sizes, particularly of contact insecticides, cannot be too coarse because performance is affected. If the insecticide moves systemically within the plant, a coarse droplet size may be an option against the pest. Due to low levels of annual precipitation and water restrictions in California, growers may not be able to establish and maintain windbreaks or hedgerows. However, for growers who have a basic downwind windbreak, buffers may be able to be reduced. The Central Valley of California is arid, so the applicator will not be able to take advantage of higher relative humidity to reduce spray drift buffer distances.

	Buffer Size (feet)		
	Option A	**Option B**	**Option C**
Spray drift buffer distance	320	320	320
Application parameters			
Coarse droplet size	-20%		-20%
Other measures			
Basic downwind windbreak/hedgerow		-50%	-50%
Total % Reductions[1]	**-20%**	**-50%**	**-70%**
FINAL BUFFER SIZE[2]	**256**	**160**	**96**
FINAL ROUNDED BUFFER SIZE[3]	**250**	**160**	**95**

[1] Total % Buffer Reductions are determined by adding up all reductions within a column.
[2] Final Buffer size = Initial Buffer – (Initial Buffer * Total % Reductions)
[3] Final Rounded Buffer Size = Final buffer size after rounding to the nearest increment of 5 ft.

4.2.2 SPECIALITY CROPS (ORCHARD FRUIT, SMALL FRUIT)

4.2.2.1: Chemigation use of pesticides with drip tape under plastic mulch in strawberries in California
This scenario represents a strawberry grower applying pesticides via chemigation applied through drip tape under plastic mulch (or polyethylene mulch). Because the chemigation is taking place via drip tape under plastic, EPA would not identify a spray drift buffer for this application method.

4.2.2.2: Broadcast ground applications of insecticides on blueberries in Oregon
This scenario represents broadcast ground applications of insecticides to blueberries grown in Oregon. The applicator is planning a ground application of an insecticide with a single maximum application rate of 0.6 lbs. ai/acre, with a spray drift buffer of 230 feet on the pesticide labeling. The applicator may be able to reduce the buffer for this application by using one of a few application parameters (Options A, D), having a windbreak in place (Options B, C), and treating specific sized areas smaller than the field (Options A, B, D).

	Buffer Size (feet)			
	Option A	**Option B**	**Option C**	**Option D**
Spray drift buffer distance	230	230	230	230
Application parameters				
Over-the-top hooded sprayer	-50%			
Spray beneath crop canopy using drop nozzles				-50%
Other measures				
Basic downwind windbreak/hedgerow		-50%		
Advanced downwind windbreak/hedgerow			-75%	
Reduced proportion of field treated				
1 pass				-75%
2-4 passes		-35%		
5-10 passes	-15%			
Total % Reductions[1]	**-65%**	**-85%**	**-75%**	**-125%**
FINAL BUFFER SIZE[2]	**81**	**35**	**58**	**0***
FINAL ROUNDED BUFFER SIZE[3]	**80**	**35**	**60**	**0***

* Note: 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.

[1] Total % Buffer Reductions are determined by adding up all reductions within a column.

[2] Final Buffer size = Initial Buffer – (Initial Buffer * Total % Reductions)

[3] Final Rounded Buffer Size = Final buffer size after rounding to the nearest increment of 5 ft.

4.2.2.3: Trunk/bark sprays of insecticides for control of wood boring insects in peaches

This peach orchard is in Macon County, Georgia. This scenario represents a post-harvest trunk, crotch, and scaffold limb directed spray of an insecticide to peach and nectarine trees (Blaauw 2023). Insecticides are applied as a barrier treatment to each tree in the orchard to manage peach tree borer and lesser peach tree borer. Insecticides are applied only by handgun, as airblast sprays provide poor coverage on tree trunks (Blaauw 2023, Blaauw et al. 2024). Sprays are allowed to pool at the base of each tree (Blaauw et al. 2024). Only one application is needed per year per tree beginning the year that the tree is planted (Blaauw et al. 2024). Because the application is being made directly to individual tree trunks with handheld equipment, the treated areas would be limited and considered a spot treatment (<1000 square feet treated). Therefore, spray-drift that could result from this type of application would be limited. This would result in lower spray drift exposure than broadcast ground boom or airblast equipment. Thus, the potential for population-level impacts is unlikely, so the pesticide labeling would not include a spray drift buffer for listed species.

4.2.2.4: Border airblast sprays of insecticides in peach orchards in New Jersey

This peach orchard is in Gloucester County, New Jersey. Brown marmorated stink bug (BMSB) is an annual pest that feeds on ripening peach fruit. It is inherently an "edge pest" (Akotsen-Mensah et al. 2020). This means individual stink bugs are arrested at the border of peach orchards when arriving from another host crop or field. Borders typically have the highest damage from BMSB feeding. This arrestment behavior has been exploited by pest managers to minimize damage throughout the entire orchard block (Blaauw et al., 2015). Airblast equipment is the application method by which pesticides are typically applied in peach orchards for management of foliar and fruit attacking pests. Current extension recommendations in New Jersey for BMSB management include applying insecticides using airblast equipment initially to an entire block of trees and then weekly thereafter to the border and the first full row of trees of an orchard block starting the last week of May (Rutgers University, 2024).

Pesticide labels include a spray drift buffer of 160 feet. Throughout the eastern United States, including New Jersey, orchard blocks frequently border woods or narrow non-managed wooded lots of land, so in certain circumstances, growers and/or applicators have existing windbreaks that curtail off site pesticide drift and could reduce their spray drift buffer distance 50%-100%.

	Buffer Size (feet)			
	Option A	**Option B**	**Option C**	**Option D**
Spray drift buffer distance	160	160	160	160
Other measures				
High efficiency downwind windbreak/hedgerow	-75%		-75%	
Downwind Forests/Woodlots/Riparian Areas/Shrublands ≥60 ft		-100%		
Width of treated area				
4 rows[1]			-30%	-30%
Total % Reductions[2]	**-75%**	**-100%**	**-105%**	**-30%**
FINAL BUFFER SIZE	**40**	**0***	**0***	**112**
FINAL ROUNDED BUFFER SIZE[3]	**40**	**0***	**0***	**110**

* Note: 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.

[1] The recommendations in the literature for use in this scenario are to treat 2, not 4, rows on the orchard borders. EPA presents a spray drift buffer reduction with 4 rows to be inclusive of spray drift from the application to 2 rows.

[2] Total % Buffer Reductions are determined by adding up all reductions within a column.

[3] Final Rounded Buffer Size = Final buffer size after rounding to the nearest increment of 5 ft.

5 BOTH RUNOFF/EROSION AND ECOLOGICAL SPRAY DRIFT MITIGATIONS SCENARIOS

Because growers and applicators may need to employ both runoff/erosion and spray drift mitigations prior to application of a pesticide product where the labeling requires it, EPA provides a handful of scenarios to show how the labeling requirement could be met.

5.1: Furrow irrigated crops on laser leveled fields in Mississippi Delta

This scenario represents furrow irrigated crops, like cotton corn, and soybean, in the Mississippi Delta, at six different fields in Washington County, Mississippi. Fields in Washington County are located in a high pesticide runoff vulnerability area; therefore, these fields would not be assigned runoff vulnerability mitigation relief points. The fields here are generally precision leveled to a grade of <u><</u>3%, so the <u><</u>3% slope characteristic is assigned 2 points. This is an agriculturally dense area, which means many fields may not have to employ additional runoff/erosion mitigations because the fields are more than 1,000 feet from a non-managed area or aquatic habitat.

Reduced tillage is unlikely to be adopted here as crops are grown on raised beds to facilitate furrow irrigation and are rebuilt annually using conventional tillage practices. Some growers may choose to use cover crops depending on a grower's agronomic practices. Growers who use cover crops would plant a cover crop in the fall shortly before or after harvest. If the grower builds beds in the fall and terminates the cover crop with herbicides in the spring, this short duration cover crop not terminated by tillage could achieve 2 points. Alternatively, if the grower terminates the cover crop with tillage in the spring prior to building beds, the short duration cover crop terminated by tillage would achieve 1 point. Because the scenario is for furrow irrigated cotton, two options for irrigation management are presented, one with flood controls and one without flood controls.

Figure 5.1.1 shows an aerial view of several fields near a Wildlife Management Area (WMA), as well as a creek, both of which are non-managed areas that are well delineated on maps (Note: the WMA and creek are for illustrative purposes; other types of terrestrial and aquatic habitats may also require buffers). A handful of fields are outlined by lines to represent areas where mitigation may be needed based on information that would appear on a pesticide labeling:

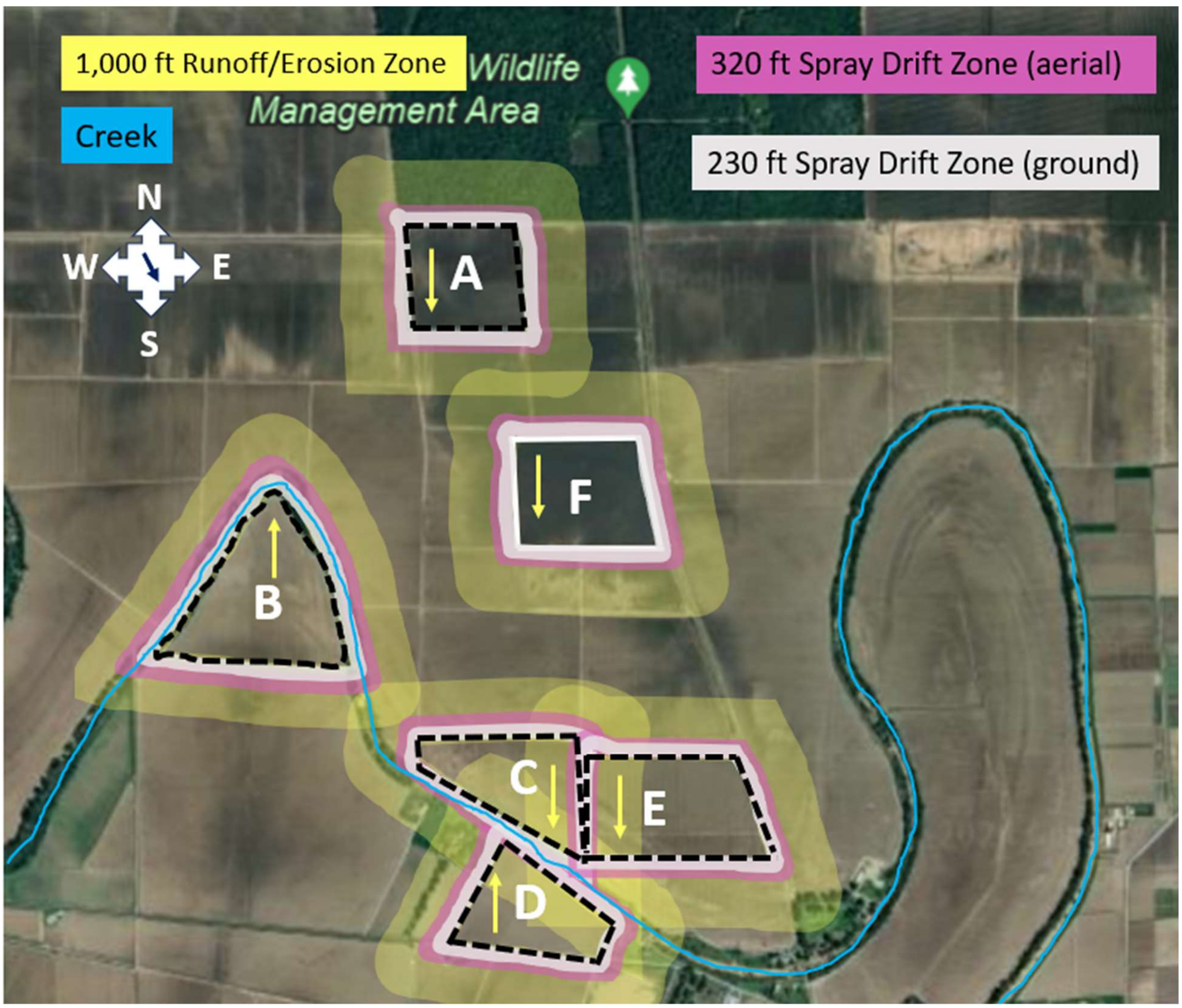
- The transparent yellow lines represent a possible 1,000-foot area for runoff/erosion mitigations.
- The transparent pink line that represents a possible 320-foot wind directional buffer for spray drift when an applicator makes an aerial application with a medium droplet.
- The transparent light grey line that represents a possible 230-foot wind directional buffer for spray drift when an applicator makes an application with a ground boom with a very fine droplet and high boom (>2 ft but <4 ft).

EPA is demonstrating these boundaries around individual fields because, during the public comment period, stakeholders expressed concern about identifying "habitat." As a result, EPA is illustrating how growers, can assess the land around individual fields for "managed areas"[9] to determine when mitigations may be needed. For example, Field A has the east, west and southern edges of the field that overlap managed areas, primarily other agricultural fields. Therefore, mitigation on those three edges would not be needed. However, the northern edge of the field is adjacent to the WMA; therefore, the applicator would need to assess the slope of the field and the wind direction (at the time of application) to determine if offsite movement of pesticides would end up in the non-managed area of the WMA. In the case of **Field A**, the field slopes to the south (away from the WMA, indicated by the yellow arrow in the field boundary); therefore, the grower may not have to employ additional runoff/erosion mitigation before making an application. Additionally, given that the wind is from the northwest, spray drift mitigation may not be needed. So, while this grower may have existing measures in their field (e.g., <u><</u>3% slope and is primarily as sandy, loam soil) the field does not need additional runoff/erosion mitigation. However, if the wind direction was southwest, spray drift mitigation may be needed.

Field B: This field has runoff/erosion and spray drift zones that overlap a non-managed area (the creek), and the slopes to the north (towards the non-managed area, as indicated by the yellow arrow within the field boundary), which indicates runoff/erosion mitigation may be needed depending on the pesticide being used. Additionally, given that the wind is from the northwest, spray drift mitigation may be needed. Runoff/erosion mitigation would be needed along the field edges adjacent to the creek. Given that the wind is from the northwest, spray drift mitigation may be needed only along the eastern edge of the field. This field does not have runoff controls for the irrigation system, so it does not achieve points for irrigation water management. The field is flat, so the grower would achieve $\leq$3% slope characteristic and is assigned 2 points. This grower does not use a cover crop and the soil type is not a sandy loam. There is a 50-foot riparian area, which is assigned 2 points, that is a mixture of herbaceous and forest buffer between the field edge and the creek.

Field C: This field has runoff/erosion and spray drift zones that overlap a non-managed area (the creek) and slopes to the south (towards the non-managed area, as indicated by the yellow arrow within the field boundary), which indicates runoff/erosion mitigation may be needed depending on the pesticide being used. Additionally, given that the wind is from the northwest, spray drift mitigation may be needed. Both runoff/erosion and spray drift mitigations would only be needed along the field edge adjacent to the creek. This field does not have runoff controls for the irrigation system, so it does not achieve points for irrigation water management. The field is flat, and the $\leq$3% slope characteristic is assigned 2 points. The sandy, loam soil characteristic is assigned 2 points. This grower plants a cover crop shortly after harvest and terminates the cover crop with herbicides in the spring. There is a 50-foot riparian area that is a mixture of herbaceous and forest buffer between the field edge and the creek. This grower has both in-field and adjacent to field practices.

Figure 5.1.1. Aerial view of six fields with 1,000-foot runoff/erosion zones illustrated as a yellow transparent area surrounding the example fields. Potential maximum spray drift buffers that may be included on labels are 320-foot (pink transparent line for aerial applications) and 230-foot (light grey transparent line for ground boom application). For runoff mitigations, fields are sloped in a direction (indicated by the yellow arrow) away from landscapes where runoff/erosion mitigations would be required; therefore, no runoff/erosion mitigation would be identified by the strategy; however, fields B, C, D and E all have a stream down gradient; therefore, runoff/erosion mitigation could be identified for these fields, depending on the pesticide used. For spray drift mitigations, wind direction is NW, as indicated by the black arrow in the compass rose. Fields B, C, and E, have non-managed areas (creek) within the spray drift zones, that cannot be included within a spray drift buffer. Therefore, a spray drift buffer would be identified by the strategy on the SE sides of the fields. The wind is not blowing in the direction of non-managed areas adjacent to fields A and D; therefore, a spray drift buffer would not be needed in fields A and D. Field F is surrounded on all edges by managed areas acceptable to be included in the spray drift buffer distance; therefore, the strategy would not identify a spray drift buffer in any direction if the label did not specify additional restrictions. (see text for additional information).



Field D: This field has runoff/erosion and spray drift zones that overlap a non-managed area (the creek) and slopes to the north (towards the non-managed area, as indicated by the yellow arrow within the field boundary), which indicates runoff/erosion mitigation may be needed depending on the pesticide being used. However, given that the wind is from the northwest, spray drift mitigation may not be needed. If runoff/erosion mitigation is on the pesticide labeling, it would only be needed along the field edge adjacent to the creek. The field is flat, and the ≤3% slope characteristic is assigned points. This field has runoff control for the irrigation system. This grower plants a cover crop after harvest and works the field (tillage) in the spring, prior to planting. There is a 50-foot riparian buffer that is a mixture of herbaceous and forest buffer between the field edge and the creek. This grower has both in-field and adjacent to field practices.

Field E: This field has runoff/erosion and spray drift zones that overlap a non-managed area (the creek). This field slopes to the south (towards the non-managed area, as indicated by the yellow arrow within the field boundary), which indicates runoff/erosion mitigation may be needed depending on the pesticide being used. Additionally, given that the wind is from the northwest, spray drift mitigation may be needed depending on the pesticide being used. If both runoff/erosion and spray drift mitigation are on the pesticide label it would only be needed along the field edge adjacent to the creek. However, one difference between this field and Field C is that this field does not overlap the spray drift buffer for ground boom applications; therefore, if the applicator uses a ground boom when treating the field, they would not need to employ a spray drift buffer. This field has runoff controls for the irrigation system. The field is flat, and the ≤3% slope characteristic is assigned 2 points. The sandy, loam soil characteristic is assigned 2 points. This grower does not use cover crops. There is a 50-foot riparian area that is a mixture of herbaceous and forest buffer between the field edge and the creek. This grower has both in-field and adjacent to field practices.

Field F: This field is flat field with a sandy loam soil that is more than 1,000 feet from the creek or WMA (which is inclusive of the potential 230- or 320-feet spray drift buffers); therefore, the grower and/or applicator may not have to employ additional runoff/erosion or ecological spray drift mitigations depending on the pesticide being used.

Scenario 5.1, which encompasses Fields A through F, presents examples demonstrating how different growers and/or applicators may implement various measures on their fields based on field conditions and what is adjacent to the field to be treated. Additionally, the wind direction is southwest (starting in the north, blowing in the direction of southeast as indicated by the black arrow in the compass rose in **Figure 5.1.1**). The points assigned for mitigation measures can be found in **Table 5.1.1.**

Table 5.1.1. Number of points achieved for runoff/erosion mitigation for fields in **Figure 5.1.1**, based on individual field conditions.

Field Location, Characteristic, or Mitigation Measure	Field A	Field B	Field C	Field D	Field E	Field F
Does my field slope toward an area identified for runoff/erosion mitigation?	NO	YES	YES	YES	YES	NO
Flat Field	2	2	2	2	2	2
Sandy Loam Soil	2		2		2	2
Irrigation Water Management[1]						
Flood/furrow irrigation with runoff control				2	2	
TOTAL POINTS FOR FIELD LOCATION, & (SEMI-) PERMANENT CHARACTERISTICS:	**No additional mitigation needed[2]**	**2**	**4**	**4**	**6**	**No additional mitigation needed**
Cover crop/Continuous Ground Cover						
Ground cover after harvest, terminated with tillage				1		
Ground cover after harvest, terminated with herbicides			3			
Riparian Buffer						
30-<60 ft width		2	2	2	2	
Point for both on and adjacent-to-field characteristics			1	1	1	
TOTAL:	**No additional mitigation needed**	**4**	**10**	**8**	**9**	**No additional mitigation needed**

Empty cells indicate a given measure was not present for that field.

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows that are colored blue are "on-field" mitigations; yellow rows indicate application parameters; and orange rows represents mitigation measures that are adjacent to the field. White rows indicate additional mitigation options.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management and soil type are on-field measures; however, EPA assumes that irrigation and soil type will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management and soil type as semi-permanent field characteristics.

[2] Exposure is not likely to cause population level impacts if the slope of the field is not in the direction of an area identified for mitigation; therefore, additional runoff/erosion mitigation is not needed.

This scenario suggests that growers who use furrow irrigation in Mississippi in cotton should be able to achieve four to nine points of mitigation when mitigation is needed. However, additional mitigation may not be needed depending on the slope of the field and/or proximity to non-managed areas (Fields A and F). Knowing the number of points that can be achieved would then inform the applicator on which pesticide product they could use. Growers who are in situations like Fields B or D may need to adopt additional measures to achieve points to apply pesticides that may require high (9 points) runoff or erosion mitigation. These growers and/or applicators have options such as applying at a reduced rate, use mitigation tracking, work with a conservation specialist, participate in conservation program, and/or adopting runoff controls for their irrigation system as a means of getting additional points.

Spray Drift:

When making applications, the growers who farm the fields in **Figure 5.1.1** sometimes hire an aerial applicator but most frequently apply with a ground boom; therefore, EPA provides buffer distances for the same product applied at the maximum rate of 0.6 lbs. ai/A for both aerial and ground boom applications. For ground boom applications, to address potential population-level impacts to listed species, EPA identified a 230-foot buffer when the application occurs at the maximum labeled rate with nozzles producing fine droplets and a release height of >2 feet but <4 feet. For aerial application, to address potential for population-level impacts, EPA identified a 320-foot buffer when applying with nozzles that produce medium droplets. The spray drift distance will depend on the pesticide product and the droplet size that will be used for the application.

Table 5.1.2 shows how the different spray drift buffer reduction options can reduce the buffer distances when the applicator adopts them. Because the prevailing wind is from the northwest at the time of application, exposure is not likely to cause a potential for population level impacts; therefore, spray drift mitigation would not be identified for **Fields A, D, and E** (**Figure 5.1.1**). Because this scenario is based in Mississippi, EPA expects applicators to be able to achieve a 10% buffer reduction due to relative humidity being greater than 60% for most applications.

Field B: When treating aerially, the applicator applies using nozzles that produce medium droplets (0% reduction). When treating with a ground boom, the grower uses a nozzle that produces very fine droplets with a high boom (>2 ft but <4 ft) (0% reduction). Because the 50-foot riparian buffer along the creek is contiguous, the applicator can count that as another reduction measure (75%). Therefore, for either application method, the drift buffer may be reduced by 85%, leaving a buffer distance of ~50 feet for aerial applications or 35 feet for applications with ground booms.

The applicator could adopt measures to further reduce the buffer distance (e.g., use a drift reducing adjuvant, use a different nozzle that make a larger droplet). Additionally, this grower may be able to avoid in-field buffers if there are other managed areas immediately adjacent to the treated field that can be included in the buffer distances[9].

Field C: Because the 50-foot riparian buffer along the creek is contiguous, the applicators using either application method can count the riparian buffer as a 75% reduction measure. Additionally, an aerial applicator could use a drift reducing adjuvant, for a 30% reduction in the drift buffer. Therefore, without accounting for a 10% reduction for humidity, the applicator has employed enough measures to reduce the identified buffer distance to zero feet. Similarly, if the applicator used a ground boom, they would not need to implement a spray drift buffer, because the buffer reduction measures employed were greater than 100% (i.e., riparian buffer and using a nozzle that produces medium droplets and lower boom).

Field E: Because the field does not overlap the 230-foot spray drift buffer zone because there is sufficient managed land between the field edge and the non-managed area, exposure from spray drift when using a ground boom is not likely. Therefore, the applicator would not need a spray drift buffer for applications with a ground boom. However, the field does fall within the 320-foot buffer for aerial applications; therefore, EPA does identify a buffer for aerial applications. An aerial applicator can count the riparian buffer as a 75% reduction measure, a larger than medium droplet for a 20% reduction, and a 10% reduction for applying when humidity is greater than 60%. Therefor the applicator would have enough mitigations in place to account for the identified buffer distance and would not need to implement a buffer.

Table 5.1.2. Determination of ecological spray drift buffers when making applications with either a ground boom (GB) or aerial (A) equipment based on buffer reduction measures adopted by growers who farm fields in Figure 5.1.1.

Ecological Spray Drift Buffer Reduction Calculations	**Fields A, D & F**	**Field B**		**Field C**		**Field E**	
	A/GB	**A**	**GB**	**A**	**GB**	**A**	**GB**
Is the wind blowing toward a non-managed area or aquatic environment (per Figure 5.1.1, the Wildlife Management Area or Creek)?	**NO**	**YES**		**YES**		**YES**	
	No additional mitigation needed [1]	Buffer required per pesticide product label					**No additional mitigation needed [2]**
Initial Buffer Based on Labeled Application Parameters							
Aerial							
0.6 lbs. ai/ acre x medium droplets		320		320		320	
Ground boom							
0.6 lbs. ai/ acre x very fine droplets x high boom (>2 ft but <4 ft)			230		230		
Buffer Reduction Options							
Nozzles producing medium droplets and low boom (<2 ft)					-65%		
Nozzles producing coarse droplets						20%	
Use of drift reduction adjuvant (medium droplet) [3]				-30%			
Riparian Buffer (*>30 ft but <60 ft*) *(also serves as an Advanced Windbreak)*		-75%	-75%	-75%	-75%	-75%	
Relative Humidity >60%		-10%	-10%	-10%	-10%	-10%	
Total % Reductions [4]		**85%**	**85%**	**115%**	**-150%**	**-105%**	
FINAL BUFFER SIZE [5]		**48**	**35**	**0**	**0**	**0**	
FINAL ROUNDED BUFFER SIZE[6]		**50**	**35**	**0**	**0**	**0**	

Empty cells indicate a given measure was not adopted for that field.

[1] Because exposure is not likely to cause population level impacts when the wind is not blowing in the direction of the areas identified for mitigation; additional spray drift mitigation would not be needed.

[2] Because this field is outside the spray drift buffer zone for ground boom applications, exposure is not likely to cause population level impacts; therefore, additional spray drift mitigation would not be needed.

[3] Assume using an herbicide, as adjuvants are still under consideration for other pesticide types.

[4] Total % Buffer Reductions are determined by adding up all reductions within a column.

[5] Final Buffer size = Initial Buffer – (Initial Buffer * Total % Reductions) = 320 ft – (320 ft * 85%) = 320 ft – 272 ft = 48 ft

[6] Final Rounded Buffer Size = Final buffer size after rounding to the nearest increment of 5 ft.

5.2: Two vegetable crops grown in a single calendar year under plastic mulch in Georgia.

Given that growers often have multiple different pests (i.e., insect, weeds, and/or pathogens) to control throughout the growing season, EPA is using an illustrative example pest management program, that involves multiple pesticide applications. This scenario represents a real-world situation for a field that has tomatoes and squash produced in the same year when multiple pesticides are needed. The intent of this scenario is to walk growers and/or applicators through the process by which they could achieve points for runoff/erosion mitigation for using less than the annual maximum rate (referred to as "rate reduction" or "reducing rate" for this scenario). Additionally, EPA also discuss how a grower could account for "rate reductions" for spray drift.

In this scenario, applicators can reduce rates in a few ways: 1) using a lower rate than the single maximum application rate, 2) using fewer applications than allowed on the label (i.e., reduced annual application rate), and/or 3) only treating part of an acre (e.g., banded applications (with or without between row hooded sprayers). One distinction on how rate reductions factor into mitigation is that annual application rates are used for runoff/erosion mitigation point calculations and single maximum application rates are used for spray drift buffer reduction calculations.

This example presents a double cropped system, where two crops (tomatoes and squash) are grown on the same acre in the same year. Using a double cropped system also allows EPA to explain rate reductions in a single crop or double cropped setting. This is because labels for specialty crops may have annual maximum rates expressed as an annual maximum as a given rate per acre per year or as given rate per crop cycle per year. If the rate is based on a per acre per year basis and the same pesticide is used on more than one crop in the same year, the amount used on multiple crops grown on the same acre in the same year would need to be added together when calculating a reduced rate for runoff/erosion. However, if the pesticide has an annual rate base on a crop cycle, the use on both crops would not need to be added together.

Additionally, because the application method may influence the level of mitigation needed, the scenario walks through how to consider application equipment. For instance, the applicator in this scenario plans to chemigate using drip tape under non-permeable plastic, make broadcast applications with a ground boom, and make banded applications to the area only between rows (i.e., row middles) using a hooded sprayer. Each application method requires a different calculation and understanding this can help a grower achieve points for "rate reductions," if needed and allowed by the label. For instance, applicators could achieve points for a rate reduction if applications made with a hooded sprayers treat row middles only and not the entire field, because the application rate applied to an acre is reduced, even though the concentration in the spray tank is at the full labeled rate is a reduced area treated.

To walk growers and/or applicators through these situations they may face, EPA uses a hypothetical pesticide program for a double cropped fruiting vegetable production system. The pesticide program uses multiple pesticides which could be used within a crop as well as used on both crops grown in a given year (**Table 5.2.1**). Generally, this discussion primarily pertains to any pesticide, but applications with hooded sprayers that treat between rows are generally more applicable to herbicide applications. Many specialty crop growers and/or applicators have between row hooded sprayers because some herbicides will injure the crops, and the design of between row hooded sprayers minimizes the potential for crop injury.

5.2.1. Determining Points Achieved for Runoff/Erosion Based on Field Characteristics and Common Agronomic Practices

This grower plans on producing tomatoes as the first crop, followed by summer squash. This scenario is located in Decatur County, Georgia, and the geographic location is assigned 2 points of mitigation relief for having moderate runoff vulnerability. The field is flat, and the ≤3% slope characteristic is assigned 2 points. While the majority of soils appear to be sand or loamy sand in Decatur County, this county also has some clay loam soils (USDA-BCS, 1933); therefore, this scenario considers both soil types. The sandy or sandy loam soil field characteristic is assigned 2 points.

The grower starts by tilling the field to eliminate all trash and plant debris so that beds can be built easily. Then the grower will make beds and lay drip tape under plastic. Beds are spaced 60 inches (5 feet) apart, such that the width of the bed is equal to the width of the row middles. Additionally, the grower makes some applications as a broadcast application to the entire field and some only to a portion of the field with an in-row-hooded sprayer (variable points).

When accounting for agricultural practices and all features of the field, 7 or 9 points can be achieved based on field location and characteristics, depending on soil type (**Table 5.2.1**). The first planned application is chemigation under non-permeable plastic, which is an application method where exposure to listed species is unlikely, and EPA would not identify run-off/erosion mitigations for this application method. However, since the majority of applications are not by chemigation, and foliarly applied chemicals may have mitigation identified, this scenario considers other mitigation measures that could be on the field to see if this grower can achieve 9 points for foliarly applied pesticides that may have runoff/erosion mitigation identified. Applicators on sandy loam soils can achieve 9 points and use pesticides that include labeling requiring this level of mitigation (**Table 5.2.1**). However, applicators on clay loam soils would only be able to use pesticides that include labeling requiring low (3 points) or medium (6 points) level of runoff/erosion mitigation. If the applicator were to apply a chemical that had 9 points required on the label, they would need to adopt additional mitigation measures.

Table 5.2.1. Number of points achieved for runoff/erosion mitigation for fruiting vegetables grown in Decatur, Georgia on two different soil types.

Field Location, Characteristic, or Mitigation Measure	**Predominately a Clay Loam Soil**	**Predominately a Sandy Loam Soil**	**Chemigation of Select Chemicals**
Pesticide Runoff Vulnerability	2	2	2
Flat Field	2	2	2
Sandy Loam Soil		2	
Irrigation Water Management[1]			
Drip tape under plastic mulch	3	3	3
TOTAL POINTS FOR FIELD LOCATION, SEMI- OR PERMANENT CHARACTERISTICS:	**7**	**9**	**7**
Chemigation under plastic			**No Additional Mitigation Needed for Chemigation Under Plastic[4]**
Reduced application rate [2]	2 to 3	2 to 3	
Reduced area treated[3]	3	3	
TOTAL:	**9 to 13 [5]**	**11 to 15 [5]**	

Color scheme: Grey rows indicate field location and semi- or permanent characteristics which EPA expects growers and/or applicators can claim year after year. Rows colored blue are "on-field" mitigations; yellow rows indicate application parameters.

[1] Irrigation water management encompasses whether or not a field is irrigated and if so, how irrigation water is managed. Irrigation water management and soil type are on-field measures; however, EPA assumes that irrigation and soil type will not frequently change in the middle of the year or even over multiple years. Therefore, for the purposes of this document, EPA is including irrigation management and soil type as semi-permanent field characteristics.

[2] See **Table 5.2.2** to see how many points could be achieved using a rate reduction by applying less than the annual maximum rate. Points may vary for each application.

[3] See **Section 5.2.2.1.2** for more details on how to determine the percent reduction when making an application with a between row hooded sprayer. These points would not apply for applications of chemicals made with a broadcast sprayer.

[4] No additional mitigation required only applies to pesticides applied via chemigation. Foliar applications may runoff and, therefore, may require runoff/erosion mitigations.

[5] 13 or 15 points may be achieved for applications with between row hooded sprayers; broadcast applications made to the entire field would not get the 3 points for reduced area treated.

For growers and/or applicators who cannot achieve 9 points, they may have other features associated with the field that are not accounted for in the **Table 5.2.1** to achieve 9 points. For instance, the grower could achieve additional points to reach 9 points, if the field has a vegetated ditch on the down-slope side or the grower uses a cover crop in row middles. Growers may also work with a conservation specialist, enroll in a conservation program, or track, on paper or electronic format, the mitigation employed to achieve additional points. Applicators may also be able to achieve points for a rate reduction, which is discussed in more detail below.

5.2.2. Calculating Percent Reduction in Amount Applied

The applicator makes multiple applications of pesticides to the row middles only (reduced area treated) or does not apply the maximum annual application rate (reduced annual and/or single maximum application rates). Therefore, the grower could achieve 1 to 3 points for using less than the maximum annual rate allowed on the label or 2 to 4 points for reduced area treated; however, to determine the points achieved, the grower would need to calculate the percent reduction. EPA walks through how an applicator would calculate rate reductions for those who may need to take advantage of reductions in amount applied (either by treating a portion of the field or using less than the maximum annual application rate) as a mitigation measure for runoff/erosion. For this scenario, EPA assumes that Pesticide A through J in **Table 5.2.2** have label language that requires both runoff/erosion and spray drift mitigation and provides options for applicators to reduce buffer distances.

Background on Pesticides Applied in the Double Crop System Scenario

Growers face numerous challenges to throughout the season and often make multiple applications of pesticides (e.g., herbicides, insecticides). Therefore, EPA developed this scenario to walk pesticide users through a season long pest management plan, using tomatoes on squash as an example. In this scenario, each application is referred to as a "pesticide," and rates are provided to walk through a realistic example. While few pesticide labels have mitigation as described in EPA's strategies at the time of release of this document, it is assumed that all the pesticides in this example have required mitigation from the strategies on the pesticide labels. This example focuses on fruiting vegetables; however, the overall process would be similar for growers and/or applicators who want to use "rate reductions" to achieve necessary mitigation in other cropping systems as well.

<u>Tomatoes:</u> The following describes the sequence of applications:

1. Once beds are ready, the grower injects Pesticide A into the irrigation system under the plastic mulch.
2. After planting, the grower may need to treat the row middle band of Pesticide B (0.127 pounds [lbs.] active ingredient [ai] per acre [A]) + Pesticide C 0.71 lbs. ai per A), and the grower would use a shielded/hooded sprayer, treating only 50% of the field.
3. As the season progresses the grower may need to apply Pesticide D (0.07 lbs. ai per A) as a broadcast application across the entire field when grasses reach 3 to 5 inches.
4. If nutsedge becomes problematic, the grower would use Pesticide E (0.023 lbs. ai per A) as a broadcast application.
5. If there is no additional germination of weed species, the grower may not need an additional application in the row middles, but if weed pressure is particularly high, then the grower would use a row middle, hooded spray with Pesticide F (1.13 lbs. of acid equivalent [ae] per acre) + Pesticide G (0.95 lbs. ai per A) + Pesticide C (0.95 lbs. ai per A).
6. Following harvest, the grower will terminate the crop (1.13 lb. ae per A) by making a broadcast application of Pesticide F over the entire field.
7. The applicator would follow up with an injection of Pesticide A (10.5 lbs. a.i./ A), prior ot planting squash.

Squash: The following describes the sequence of applications:

1. Prior to planting, the grower would broadcast apply Pesticide H (0.13 lbs. per A) + Pesticide J (0.75 lbs. per A) or Pesticide F (1.13 lb. ae per A) preplant.
2. At some point after planting, the grower would likely need to treat the row middles again, using a hooded sprayer to apply Pesticide B (0.127 lbs. per A) + Pesticide C (0.95 lbs. ai per A).
3. The grower would likely need another broadcast application of Pesticide C (0.6 lbs. ai per A).
4. As the season progresses, the grower may need to apply Pesticide D (0.07 lbs. ai per A) as a broadcast application across the entire field when grasses reach 3 to 5 inches.
5. If weeds are under control, the grower would not need to make another application; however, another application may be needed in the row middles. If another application is needed, the grower would treat the row middles with hooded sprayer using Pesticide E (0.0230 lbs. ai per A) + Pesticide F (1.13 lbs. ae per A) or Pesticide J (0.75 lb. ai per A) may be applied.
6. Following harvest, the grower will terminate the crop with Pesticide F (1.13 lb. ae per acre) by making a broadcast application over the field.

5.2.2.1 Determining Rate Reductions for Runoff/Erosion:

To calculate rate reductions in this system, a grower will need to have a list of the chemicals planned for use during the entire calendar year for both crops. The EPA recommends that growers and/or applicators account for all products that they think they may use if they want to use a rate reduction to achieve points towards require a level of runoff/erosion mitigations and determine whether the pesticide product labeling allows for calculating a reduction in any spray drift buffer (spray drift is discussed in more detail in **Section 5.2.2.2**). The list should include the single and annual maximum rates, although some products may have rates based upon a crop cycle or per season in lieu of an annual maximum. **Table 5.2.2** provides a summary of this information.

Annual rates can be based upon pounds of active ingredient (ai) or acid equivalent (a.e.), depending on formulation, applied per acre per year or per crop or crop cycle, if more than one crop is grown on a given acre in a year. For instance, Pesticides A, B, C, D and J have an annual rate that is based on the crop cycle, not per acre per year; therefore, the "annual rate" is only based on applications made to the same crop. Pesticides G and H also have annual rates based on crop cycles, but they are not used on both crops; therefore, the applicator does need to consider applications between crops. The grower applies Pesticides A, C, and J two times within the same crop; hence these rows are color coded differently to indicate those rows need to be added within a crop but not across crops. Pesticide E and Pesticide F, however, have an annual rate that is based on per acre per year; therefore, the applications should be added across the usage in both crops. Rows are color coded in **Table 5.2.2** to serve as a visualization to indicate which application should be added to calculate the maximum annual rate.

Table 5.2.2. Important information needed to calculate application rate reductions to determine if any points can be achieved when using less than the maximum annual application rate, either by reducing the application rate or reducing the area treated.

Crop/ Active Ingredient	Sequence Applied	Application Type			Unit for Annual Maximum Rate [per acre (A) /year or per crop cycle (CC)]	Application Rate (lbs./A)					% Reduction to Determine Mitigation Runoff / Erosion (R/E) Points[4]	Corresponding Points for R/E Mitigations [5]
		Under Mulch[1]	Broadcast	Row Middles[1]		Rate of Solution Applied[2]	Application Rate for Area Treated[1]	Grower-Applied Annual Rate[3]	Labeled Maximum Single Rate	Labeled Maximum Annual Rate		
Tomato												
Pesticide A	1	X			Per CC	31.500	15.750	21.000	31.500	55.25	62%	3
Pesticide B	2			X	Per CC	0.127	0.064	0.064	0.127	0.254	75%	3
Pesticide C				X	Per CC	0.710	0.355	0.830	0.950	1.900	56%	2
Pesticide D	3		X		Per CC	0.070	0.070	0.070	0.250	0.485	86%	3
Pesticide E	4		X		per A/year	0.023	0.023	0.035	0.036	0.094	63%	3
Pesticide F	5			X	per A/year	1.130	0.565	3.390	1.500	6.000	44%	2
Pesticide G				X	Per CC	0.950	0.475	0.475	0.950	1.430	67%	3
Pesticide C				X	Per CC	0.950	0.475	0.830	0.950	1.900	56%	2
Pesticide F	6		X		per A/year	1.130	1.130	3.390	1.500	6.000	44%	2
Pesticide A	7	X			Per CC	10.500	5.250	21.000	31.500	55.25	62%	3
Squash												
Pesticide H	1		X		Per CC	0.13	0.13	0.13	0.13	0.39	67%	3
Pesticide J			X		Per CC	0.75	0.750	1.000	1.000	2.500	60%	3
Pesticide B	2			X	Per CC	0.127	0.064	0.064	0.127	0.254	75%	3
Pesticide C				X	Per CC	0.95	0.475	1.075	0.950	1.900	43%	2
Pesticide C	3		X		Per CC	0.6	0.600	1.075	0.750	1.900	43%	2
Pesticide D	4		X		Per CC	0.07	0.070	0.070	0.120	0.485	86%	3
Pesticide E	5			X	per A/yea	0.023	0.012	0.035	0.048	0.094	63%	3
Pesticide F				X	per A/year	1.13	0.565	3.390	1.500	6.000	44%	2
Pesticide J				X	Per CC	0.5	0.250	1.000	0.500	1.400	60%	3
Pesticide F	6				per A/year	1.13	1.130	3.390	1.500	6.000	44%	2

Color coding of rows: Rows of the same color within a crop indicate that the active ingredient needs to be added together to determine the annual maximum rate applied because the maximum annual rate is based on pounds applied per acre per crop cycle because the grower applies the same active ingredient to the same crop more than once (Pesticides A, C, J). If rows are the same color across use sites, these applications should be added together to get the maximum annual rate because these labels have a maximum annual rate based on pounds applied per acre per year (Pesticides E and F). White rows have maximum annual rates based on pounds applied per acre per crop cycle; therefore, since the grower only applies them once per crop, these do not need to be added across crops.

[1] Applications under artificial mulch and to row middles do not treat the entire acre; therefore, the rate applied to the acre is less than if applied as a broadcast (calculated in the "Application Rate for Area Treated" column). Bed and row middles are the same size, so when applications are made under mulch or in row middles only half of the area is treated (i.e., applications under mulch and to row

middles would have a 50% reduction in area since the beds and row middles are the same size). Applicators can calculate this by using the following equation: application rate in the spray tank * % of an acre treated [50%]) = rate for the area treated. This amount would be used to calculate any credit for applying less than the annual application rate.

[2] This is the amount the applicator mixes in the spray tank; spray tank solution cannot be greater than the per acre single maximum application rate allowed on the label.

[3] Grower-Applied Annual Rate is calculated by adding up applications of the same active ingredient in each crop based on whether the label is based on pounds applied per acre per crop cycle or per year. The lines are color coded in each crop to help illustrate which applications should be added together based on labels.

[4] % Reduction to Determine Mitigation Runoff / Erosion (R/E) Points = (1-(Grower-Applied Annual Rate / Labeled Maximum Annual Rate)) *100

[5] Corresponding Points for R/E Mitigations: ≥10 - <30% = 1 point (low efficacy for reducing exposure); ≥30 - <60% = 2 points (medium efficacy); ≥60% = 3 points (high efficacy), as described in the *Ecological Mitigation Support Document for Runoff, Erosion, and Spray Drift Mitigation to Protect Non-Target Plants and Wildlife.* This document is available in the Herbicide Strategy docket at https://www.regulations.gov/docket/EPA-HQ-OPP-2023-0365 and in the Draft Insecticide Strategy Docket, https://www.regulations.gov/docket/EPA-HQ-OPP-2024-0299.

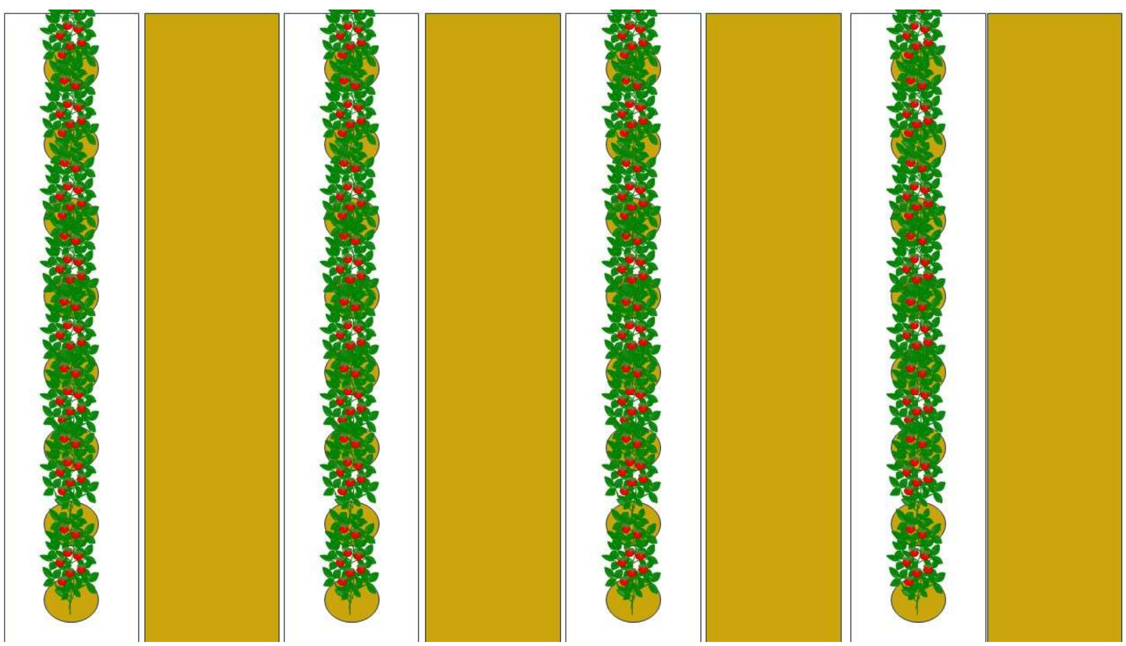
5.2.2.1.1 Calculating Mitigation Needs for Chemigation Under Plastic: Pesticide A Use on Tomato

Pesticide A is applied via the irrigation system under non-permeable plastic mulch, and chemigation under plastic is an application method where EPA found that population level impacts would be unlikely. Therefore, no additional mitigation for runoff/erosion or spray drift would be needed.

5.2.2.1.2 Determining Number of Points When Treating a Portion of the Field

When an applicator treats the row middles using a between row hooded sprayer, they are only treating a portion of the field (**Figure 5.2.2.1.2**). Therefore, the application could achieve points go towards the require runoff/erosion mitigation on the product label. In this example. In this example, beds are 5-foot and are spaced 5 feet apart. Because only every 5-foot section gets treated with a between row hooded sprayer, only 50% of the field is treated.

Figure 5.2.2.1.2. Tomato field that was planted on 5-foot beds that are space 5 feet apart (brown areas). When making a banded application in with the between row hooded sprayer, the applicator only treats the brown areas.



For this example, the steps are:

1. Calculate the percent reduction in area treat requires the applicator to know that field size and the amount of area to be sprayed. If the applicator is going to treat 5 acres of a 10-acre field, only 50% of the field would be treated.
    i. *% reduction in area treated = (100 * (Area treated [5 A]) / Field size [10 A]) = 50%*

2. The second step involves referencing the assigned point values for the corresponding percent reduction (**Table 5.2.2.1.2**). In the **Ecological Mitigation Support Document**, EPA assigned 3 points when the reduction in area treated that is between 30 and <60% of the field.

Table 5.2.2.1.2. Summary of points assigned for runoff/erosion mitigation when treating only a portion a field.

EPA Mitigation Measure	General Description of Qualifying Practices	Efficacy Classification	Assigned Point Values
Reduction in Proportion of Field Treated	10 to <30% of Field Area treated (Banded application, partial treatment, precision sprayers)	Low to High	2
	30 to <60% of Field Area treated (Banded application, partial treatment, precision sprayers)		3
	≥60% of Field Area treated (Banded application, partial treatment, precision sprayers)		4

<u>5.2.2.1.3 Calculating Mitigation Needs for Using Multiple Applications of the Same Active Ingredient for a Crop Cycle: Pesticide C in Squash</u>

This example uses Pesticide C, which is applied twice in squash, once to the row middles at a rate of 0.95 lbs. ai/A and once to the entire field at a rate of 0.60 lbs. ai/A. Pesticide C has a maximum rate of 1.9 lbs. ai/A for a crop cycle; therefore, even though Pesticide C is also used in tomato, the use in tomato does not count toward the use in squash. Since one of the applications is to row middles and the beds are spaced such that the width of the bed is equal to the width of the row middles and the middle row are the only rows treated, only 50% of an acre would be treated for one of the applications. But the second application is to the entire field and could not claim points for reduced area treated. While this example is for Pesticide C, similar calculations would be relevant to Pesticides A and J because they are also applied more than once within the same crop. This calculation would also be applicable to growers and/or applicators who apply more than one application to a crop when the grower only plants one crop in a season.

For this example, the steps are:

1. Determine the rate applied for all applications of the same pesticide within the same crop:
   i. Calculate broadcast application: Determining the application rate for a broadcast application is relatively simple given that the application is to the entire field, so it would be the rate applied. For this example, the application rate is 0.6 lbs. ai/A.

      *(rate of solution in the spray tank [0.6 lbs./A] * area treated [100%]) = 0.6 lbs. / A*

   ii. Calculate the rate applied for the application with the between row hooded sprayer: The grower mixes a spray tank that has 0.95 lbs. /A of Pesticide C. However, the pesticide is only applied to half of the acre (beds are spaced 60 inches (5 feet) apart, such that the width of the bed is equal to the width of the row middles). Therefore, only 0.475 lbs. ai is applied to an acre.

*(rate of solution in the spray tank [0.95 lbs./A] * area treated [50%]) = 0.475 lbs. / A*

iii. Adding the rate applied for the two applications: Now that the grower has the amount applied to the acre for both applications, the grower would need to add the two amounts to get the total applied, which would be a total of 1.075 lbs. applied to the acre.

(rate of application 1 [0.6 lbs./A] + rate of application 2 [0.475 lbs./A]) = 1.075 lbs. /A

2. Determine the percent reduction by comparing the rate applied to the annual maximum rate applied: Now that the grower has the total amount applied (1.075 lbs./A), they can calculate the percent reduction in the annual maximum application rate. The labeled maximum annual application rate is 1.9 lbs. ai per crop cycle.

(1 – (total amount applied [1.075 lbs. / A] ÷ Annual Maximum Rate [1.9 lbs. / A])) X 100 = 43 % reduction

3. Determine the number of points achieved by comparing to percent reduction to the EPA efficacy scores: Now that the grower knows they used 43% less than the annual maximum rate, they can look at the points assigned (**Table 5.2.2.2**). In the **Ecological Mitigation Support Document**, EPA assigned 2 points for rate reductions that are between 30 and <60% of the annual maximum rate.

Table 5.2.2.1.3. Summary of points assigned for runoff/erosion mitigation when using an application rate that is less than the annual maximum rate.

EPA Mitigation Measure	**General Description of Qualifying Practices**	**Efficacy Classification**	**Assigned Point Values**
Reduction in Annual Application Rate	Lower than maximum labeled annual application rate or reduced number of applications	Low to High	10-<30% reduction – 1 30-<60% reduction – 2 ≥60% reduction – 3

5.2.2.1.4. Calculating Mitigation Needs for Using Multiple Applications of the Same Active Ingredient (Pesticide F) Applied to Both Crops when the Maximum Application Rate Is Based on a Pounds per Acre per Year

This example uses Pesticide F, which is applied twice in both tomatoes and squash, once to the row middles at a rate of 1.13 lbs. ai/A and once to the entire field at a rate of 1.13 lbs. ai/A. Pesticide F has a maximum rate of 1.50 lbs. ai/ application and 6.0 lbs. ai/A per year; therefore, all four applications need to be considered when determining points for a rate reduction. This scenario is similar to the example in 5.2.2.2. with the main difference being that the use across crops need to be considered. While this example is for Pesticide F, similar calculations would be relevant to Pesticide E as well because it is also applied more than once within the same crop and the annual maximum is based on pounds applied per acre per year.

For this example, the steps are:

1. Determine the rate applied for all applications of the same pesticide within the same crop:

i. Calculate broadcast application: Determining the application rate for a broadcast application is relatively simple given that the application is to the entire field, so it would be the rate applied. For this example, the application rate is 1.13 lbs. ai/A; however, because there are two broadcast applications made to the acre throughout the year, the rate needs to be multiplied by 2.

*(rate of solution in the spray tank [1.13 lbs./A] * area treated [100%]) * # of applications [2] = 2.26 lbs. / A*

ii. Calculate the rate applied for the application with the between-row hooded sprayer: The grower mixes a spray tank that has 1.13 lbs. /A of Pesticide C. However, the pesticide is only applied to half of the acre (beds are spaced 60 inches (5 feet) apart, such that the width of the bed is equal to the width of the row middles). Therefore, only 0.565 lbs. ai is applied to an acre for each application, but because the grower makes two applications, they need to multiply by 2.

*(rate of solution in the spray tank [1.13 lbs./A] * area treated [50%]) * # of applications [2] = 1.13 lbs./A*

iii. Add the rate of the applied for the two applications in both crops: Now that the grower has the amount applied to the acre for both applications, the grower would need to add the two amounts to get the total applied, which would be a total of 3.39 lbs. applied to the acre.

(rate of broadcast applications [2.26 lbs./A] + rate of applications with between row hooded sprayer [1.13 lbs./A]) = 3.39 lbs./A

2. Determine the percent reduction by comparing the rate applied to the annual maximum rate applied: Now that the grower has the total amount applied (3.39 lbs./A), they can calculate the percent reduction in the annual maximum application rate. The labeled maximum annual application rate is 6 lbs. ai per acre per year.

(1 – (total amount applied [3.39 lbs./A] ÷ Annual Maximum Rate [6.0 lbs./A])) X 100 = 44 % reduction

3. Determine the number of points achieved by comparing to percent reduction to the EPA efficacy scores: Now that the grower knows they used 44% less than the annual maximum rate, they can look at the points assigned (**Table 5.2.2.1.3**). In **the Ecological Mitigation Support Document**, EPA assigned 2 points for rate reductions that are between 30 and <60% of the annual maximum rate.

Therefore, if a grower was growing vegetables on a non-sandy soil, they could achieve enough points for Pesticide C. The grower would need to do this process for each pesticide to ensure that rate reductions are adequate to achieve the necessary points.

An additional consideration for growers: examples **5.2.2.1.3** and **5.2.2.1.4** included at least one application that is co-applied with another pesticide. **Table 5.2.2** above has the percent reductions provided in the table that were calculated using the steps above. Because there are two active ingredients being applied, growers and/or applicators must find the number of runoff/erosion points for the use site, on both labels and must use the more restrictive mitigation of all co-applied pesticides. For instance, the grower co-applied Pesticides B and C in the second application. **Table 5.2.2** above shows that the grower applied Pesticide B at a 75% reduced annual rate (3 points), but Pesticide C was applied at a 56% reduced annual rate (2 points). Therefore, the grower could only achieve 2 points for this application.

5.2.2.2 Determining Rate Reductions for to Reduce Ecological Wind-Directional Spray Drift Buffers:

"Rate reductions" (i.e., reduction in application rate) can also reduce ecological spray drift buffer distances. Sections **5.2.2.1.3.** and **5.2.2.1.4** focused on rate reductions based on the maximum <u>annual</u> rates for runoff/erosion mitigation; however, rate reductions to reduce ecological spray drift buffers are based on the maximum <u>single</u> application rate for broadcast sprayers (aerial or ground). There is a linear relationship between the rate reduction and buffer reduction. For example, an applicator who reduces their application rate by 10% could then also reduce the buffer distance by 10%. As a reminder, "rate reduction" refers to using a lower than the maximum single applications (e.g., co-applied pesticides).

<u>5.2.2.2.1 Calculating Ecological Wind-directional Spray Drift Buffer Reductions Based on Reduction in Amount Applied</u>

This example uses Pesticide D, which is applied as a broadcast application in tomato and squash at a rate of 0.07 lbs./A) (**Table 5.2.2.2.**). The maximum single application rate in tomato is 0.25 lbs./A and 0.12 lbs./A in squash. Because the application is broadcast and the entire field is treated, there would be no reduction in area to consider. Therefore, grower can follow a relatively simple, two-step process to determine the percent reduction in buffer; however, because the single maximum rate differs between the two crops, the grower needs to do these calculations for both crops.

For this example, the steps are:

1. Determine the rate reduction for single applications:
    i. Calculate a rate reduction for broadcast application:

    *(1 – (Applied Rate / Maximum Single Application Rate)) * 100 = % reduction*

    Tomatoes: (1 – (0.07 lbs./A / 0.25 lbs./A)) * 100 = 72%

    Squash: (1 – (0.07 lbs./A / 0.12 lbs./A)) * 100 = 42%

2. Compare the percent rate reduction to EPA's reduction in ecological spray drift buffers: Rate reductions have a linear relationship to the reductions in the spray drift buffer distances. **The Ecological Mitigation Support Document** indicates that a rate reduction of ≥10 % to <20% equates to a 10% reduction in the buffer distance; a rate reduction of ≥20 % to <30% equates to a 20% reduction in the buffer distance; etc. So, the applicator would be able to achieve a 70% reduction in the ecological drift buffer for the application of Pesticide D in tomatoes and a 40% reduction in the buffer for squash.

Table 5.2.2.2. Ecological Wind-directional Spray Drift Buffer reductions as a result of using less than the single maximum labeled rate[1].

Crop/ Active Ingredient	Sequence Applied	Application Rate (lbs./A)		% Reduction in Application Rate [3]	% Reduction of Spray Drift Buffer [4]
		Rate of Solution Applied [2]	Labeled Maximum Single Rate		
Tomato					
Pesticide A	1	31.5	31.5	**No additional mitigation needed [5]**	
Pesticide B	2	0.127	0.127	0%	0%
Pesticide C		0.71	0.95	25%	20%
Pesticide D	3	0.07	0.25	72%	70%
Pesticide E	4	0.023	0.036	36%	30%
Pesticide F	5	1.13	1.5	25%	20%
Pesticide G		0.95	0.95	0%	0%
Pesticide C		0.95	0.95	0%	0%
Pesticide F	6	1.13	1.5	25%	20%
Pesticide A	7	10.5	31.5	**No additional mitigation needed [5]**	
Squash					
Pesticide H	1	0.13	0.13	0%	0%
Pesticide J		0.75	1	25%	20%
Pesticide B	2	0.127	0.127	0%	0%
Pesticide C		0.95	0.95	0%	0%
Pesticide C	3	0.6	0.75	20%	20%
Pesticide D	4	0.07	0.12	42%	40%
Pesticide E	5	0.023	0.048	52%	50%
Pesticide F		1.13	1.5	25%	20%
Pesticide J		0.5	0.5	0%	0%
Pesticide F	6	1.13	1.5	25%	20%

[1] Reductions in buffers can apply if the applicator used an application rate less than the single maximum application rate.

[2] This is the amount the applicator mixes in the spray tank; spray tank solution cannot be greater than the per acre single maximum application rate allowed on the label.

[3] Percent reduction in application rate = (1-(Application Rate for Area Treated / Labeled Single Maximum Rate)) *100

[4] Percent reduction of spray drift buffer and the corresponding percent reduction in buffer distance: for every 10% "reduction in rate" = 10% reduction in buffer distance (i.e., 10% to <20% rate reduction = 10% reduction in buffer distance; >20% to <30% rate reduction = 20% reduction in buffer distance, etc.), as described in the ***Ecological Mitigation Support Document for Runoff, Erosion, and Spray Drift Mitigation to Protect Non-Target Plants and Wildlife***. This document is available in the Herbicide Strategy docket at https://www.regulations.gov/docket/EPA-HQ-OPP-2023-0365 and in the draft Insecticide Strategy Docket, https://www.regulations.gov/docket/EPA-HQ-OPP-2024-0299.

[6] Pesticide A is applied via chemigation under impermeable plastic; therefore, additional spray drift mitigation would not be needed because exposure is not likely to cause population level impacts with this application method.

5.2.2.2.2 Calculating Spray Drift Buffers when Using Multiple Options to Reduce Spray Drift Buffers:

Table 5.2.2.2 provides a summary rate reductions and buffer reductions for spray drift. This scenario demonstrates how an applicator could reduce the buffer distances when factoring in rate reductions and other options described in the **Ecological Mitigation Support Document**. The applicator generally co-applies other pesticides with Pesticide F. However, for the purposes of this example, EPA assumes that Pesticide F is applied as a single application. **Table 5.2.2.2** shows that an applicator who applies Pesticide F as a broadcast application would achieve rate buffer reduction of 20%.

Because this scenario is based in Georgia, there is a high likelihood the grower would be able to have a 10% reduction because of the relative humidity being 60% or greater.

When the grower sprays the row middles with a between-row hooded sprayer, they would qualify for 75% reduction in buffer, in addition to the 20% reduction for using a reduced application rate (**Table 5.2.2.2.2**). The options would have the grower qualifying for more than a 100% reduction in the buffer when using a hooded sprayer.

For the broadcast application, the grower uses nozzles that produce medium droplets and a low boom (65% reduction) along with a 20% reduction due to an application rate reduction. The applicator would achieve a 95% reduction in the buffer and have a 15-foot wind-directional drift buffer (**Table 5.2.2.2.2**). If applying as a broadcast application, the applicator could use an adjuvant if needed to further reduce the buffer. Additionally, the applicator may be able to avoid in-field buffers if there are other managed areas immediately adjacent to the treated field that can be included in the buffer distances[9].

Table 5.2.2.2.2. Determination of ecological spray drift buffers when making applications with either a between row (row middle) hooded sprayer or broadcast application with a ground boom (GB) based on buffer reduction measures adopted by applicators.

Ecological Spray Drift Buffer Reduction Calculations	**Buffer Size (ft)**	
	Hooded Sprayer	**Broadcast Ground boom**
Is the wind blowing toward a non-managed area or aquatic environment?	**YES**	**YES**
Initial Buffer Based on Labeled Application Parameters	230	230
very fine droplets x high boom (>2 ft but <4 ft)		
Buffer Reduction Options		
Fine to medium-coarse (or greater) low boom (< 2ft)		-65%
Row-middle hooded sprayer	-75%	
Reduced Rate via a 20% reduced rate applied	-20%	-20%
Relative humidity is 60% or more at time of application	-10%	-10%
Total % Reductions[1]	**-105%**	**-95%**
Buffer Size [2]	**0**	**11.5**
FINAL ROUNDED BUFFER SIZE [3]	**0**	**10**

[1] Total % Buffer Reductions are determined by adding up all reductions within a column.
[2] Final Buffer size = Initial Buffer – (Initial Buffer * Total % Reductions)
[3] Final Rounded Buffer Size = Final buffer size after rounding to the nearest increment of 5 ft.

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7 APPENDICES

The appendices for this document are designed to provide illustrations of the range of impacts of the mitigation measures described in the scenarios above and the managerial complexity for growers and/or applicators involved in adapting current pesticide application practices to meet the identified mitigations as informed by the Strategies in registration or registration review actions.

Appendix A provides a table of the runoff/erosion mitigation measures from the mitigation menu that a grower and or applicator may use to achieve points to use a pesticide with labeling that requires mitigations as described in the Strategies. The table includes a general name for the mitigation measure, specific examples that fall under that measure, the efficacy rating for that mitigation measure and the associated number of points.

Appendix B provides a summary comparison between this version of the representative scenarios and the version published alongside the **Draft Herbicide Strategy** in July 2023. For additional details on the original scenarios, please refer to *Application of EPA's Draft Herbicide Strategy Framework Through Scenarios that Represent Crop Production Systems,* available in the Herbicide Strategy docket: EPA-HQ-OPP-2023-0365[10].

Appendix C is designed to illustrate the challenge of employing mitigation measures to achieve the points on a pesticide product labeling. EPA expects that when the grower and/or applicator has a menu of mitigation options on an EPA website to choose from, the impact to them could be less than specific mandatory measures that are described on the pesticide product labeling. It also demonstrates that even with a mitigation menu, the set of options a grower may feasibly choose from may be limited.

Appendix D discusses the impacts of implementing each of the mitigation measures. The impacts of implementing a mitigation measure would only apply to those growers and/or applicators who do not already have the mitigation measure in place. Growers and/or applicators who use a pesticide product for which the pesticide product labeling requires a level of mitigation points to be achieved that would involve employing new mitigation measures from the mitigation menu could be impacted from each additional measure they implement.

[10] https://www.regulations.gov/document/EPA-HQ-OPP-2023-0365-0006

7.1 Appendix A. List of Mitigation Measures, Efficacy Scores for Effectiveness of Reducing Exposure, and the Associated Point Values for Runoff/Erosion Mitigation Measures.

Table A 1. EPA Runoff/Erosion Mitigation Measures

EPA Mitigation Measure Title[1]	Conditions that Qualify[1,2]	Points for Mitigation Measure on Mitigation Menu
Application Parameters		
Annual Application Rate Reduction	Any application 10% to <30% less than the maximum labeled annual application rate	1
	Any application 30% to <60% less than the maximum labeled annual application rate	2
	Any application ≥60% less than the maximum labeled annual application rate	3
Reduction in Proportion of Field Treated	10 to <30% of Field Area treated (Banded application, partial treatment, precision sprayers)	2
	30 to <60% of Field Area treated (Banded application, partial treatment, precision sprayers)	3
	≥60% of Field Area treated (Banded application, partial treatment, precision sprayers)	4
Soil Incorporation	Watering-in or mechanical incorporation before runoff producing rain event	1
Field Characteristics[3]		
Field with slope ≤ 3%	Naturally low slope or flat fields; flat laser leveled fields	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	2
In-Field Mitigation Measures[3]		
Reduced Tillage Management	Reduced tillage, mulch tillage, strip till, ridge tillage	2
	No-till	3
Reservoir Tillage	Reservoir tillage, furrow diking, basin tillage	3
Contour Farming	Contour farming, contour tillage, contour orchard and perennial crops	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)	2
Terrace Farming	Terrace farming, terracing, field terracing	2
Cover Crop/Continuous Ground Cover	Cover crop, double cropping, relay cropping	1 (tillage used)
		2 (no tillage, short term)
		3 (no tillage, long term)
Irrigation Water Management	Use of soil moisture sensors/evapotranspiration meters with center pivots & sprinklers; above ground drip tape, drip emitters; micro-sprinklers	2 (general irrigation management)
	Below tarp irrigation, below ground drip tape; dry farming, non-irrigated lands	3 (subsurface irrigation; no Irrigation)
Mulching with Natural and Artificial Materials	Mulching with artificial materials (i.e., landscape fabrics, synthetic mulches)	1
	Mulching with natural materials	3
Erosion Barriers	Wattles, Silt Fences	2

EPA Mitigation Measure Title[1]	Conditions that Qualify[1,2]	Points for Mitigation Measure on Mitigation Menu
Adjacent to Field Mitigation Measures[5]		
Grassed Waterway	Grassed waterway	2
Vegetative Filter Strips - Adjacent to the Field	20 to <30 ft Vegetative filter strip (VFS), field border	1
	30 to <60 ft Vegetative filter strip (VFS), field border	2
	≥60 ft Vegetative filter strip (VFS), field border	3
Vegetated Ditch	Vegetated ditch	1
Riparian Area	20 to <30 ft Riparian forest buffer, riparian herbaceous cover Riparian forest buffer, riparian herbaceous cover	1
	30 to <60 ft Riparian forest buffer, riparian herbaceous cover	2
	≥60 ft Riparian forest buffer, riparian herbaceous cover	3
Constructed and Natural Wetlands	Constructed wetlands, Wetland and Riparian Landscape/Habitat Improvement	3
Terrestrial Habitat Landscape Improvement	20 to <30 ft Terrestrial Landscape/habitat improvement	1
	30 to <60 ft Terrestrial Landscape/ habitat improvement	2
	≥60 ft Terrestrial Landscape/ habitat improvement	3
Filtering Devices with Activated Carbon or Compost Amendments	Filters, sleeves, socks, or filtration units containing activated carbon	3
	Filters, sleeves, socks, or filtration units containing compost	1
Systems that Capture Runoff and Discharge		
Water Retention Systems	Retention pond, sediment basins, catch basins, sediment traps	2
Subsurface Drainages and Tile Drainage Installed *without* Controlled Drainage Structure	Subsurface tile drains, tile drains	1
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.	1

[1] Mitigation measures 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 credit 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.

Table A 2. Crosswalk Between EPA' Other Mitigation Considerations for Runoff/Erosion and Examples of Existing Conservation Practices that Meet EPA's Minimum Requirements

Other Mitigation Considerations[1]	General Description of Qualifying Practices	Points for Mitigation Measure on Mitigation Menu
Additional considerations associated with the extent of mitigation associated with any particular field/area		
Pesticide Runoff Vulnerability	County based mitigation relief, see description below	2 to 6 relief points based on location[2]
Participate in a Qualifying Conservation Program	Enrolled and participating in a qualifying conservation program	2
Follow Recommendations from a Runoff/Erosion Specialist	Working with a runoff/erosion technical specialist	1
Mitigation Tracking	Mitigation measure tracking	1
Areas 1000 ft Down-Gradient from Application Areas[3]	Areas where there is not a potential for population-level impacts from off-site exposure to runoff/erosion from pesticide applications	No additional mitigation needed
Mitigation Measures that in and of Themselves Reduce Exposure Such That Potential Population-Level Impacts are Unlikely		
Soil Injection		No additional mitigation needed
Tree Injection		No additional mitigation needed
Chemigation applied subsurface and under impermeable plastic mulch		No additional mitigation needed
Less than 1/10 Acre Treated or Spot Treatment (<1000 sq ft)		No additional mitigation needed
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		No additional mitigation needed
Irrigation Tailwater Return Systems		No additional mitigation needed
Subsurface or Tile Drainage with Controlled Outlet	Tile drainage with a water control structure and controlled outlet	No additional mitigation needed

[1] Mitigation measures 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] See Appendix B of the Herbicide Strategy for a list of mitigation relief points by State and County, available in the Herbicide Strategy docket (EPA-HQ-OPP-2023-0365) on www.regulations.gov.
[3] 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) , 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.

7.2 Appendix B. Comparison of Initial Draft and Current Scenarios for Runoff/Erosion

An earlier version of this document was published with the **Draft Herbicide Strategy** in summer 2023[11]. The earlier version of the document contained 13 scenarios of how a grower could implement runoff and erosion mitigation measures from the draft mitigation menu. The draft mitigation menu in 2023 contained a smaller set of mitigation measures than the current mitigation menu, revised in summer 2024 following continued EPA review of mitigation measures, stakeholder outreach, and in response to public comment. The current mitigation menu has an expanded set of mitigation measures that growers and/or applicators can select from and updated point values for several mitigation measures. This appendix serves as a comparison of the 13 draft scenarios in the earlier version of this document compared with the revised scenarios with updated mitigation and shows that feasibility of the runoff/erosion mitigation has increased since the draft herbicide strategy published in 2023.

Overall, the revised scenarios have a higher achievable point total, reflecting the expanded mitigation menu options and updated point values. While several initial scenarios could only feasibly gain enough points to use pesticides with a low (3 points) or medium (6 points) level of label-required mitigation, revised scenarios could achieve enough points to use pesticides with low (3 points), medium (6 points), and high (9 points) level of label-required mitigation. The exceptions are irrigated cotton in Mississippi and non-irrigated cotton in Texas. Depending on soil type, irrigation, and agronomic practices, these scenarios may not be able to achieve enough points to use pesticides with high levels of label-required mitigation, or in the Mississippi scenario may not need any additional runoff/erosion mitigation depending on location of the field.

A range of points is presented for several scenarios in **Table 7.2.** This is because those scenarios presented multiple examples comparing different locations, field characteristics, agronomic practices, etc. The numbers listed in **Table 7.2** are the minimum and maximum points of those field scenarios.

Table 7.2.1. Comparison of points for initial runoff/erosion scenarios from 2023 with revised scenarios.

Scenario Description	Initial Scenario Points	Revised Scenario Points
3.2.1.1. Corn/soybean on flat land in Indiana	7	9
3.2.1.2 Corn/soybean on sloped land in Iowa	11	9 to No additional mitigation needed
3.2.1.3 Sorghum in Kansas	4 - 5	10
5.1 Irrigated cotton in Mississippi	4	4 to No additional mitigation needed
3.2.1.4 Non-irrigated cotton in Texas	2	8 to 11
3.2.1.5 Irrigated cotton in Georgia	9	10 to 11
3.2.2.1 Vegetables in Delaware	4 - 6	9 to 10
3.2.2.2 Leafy vegetables in California/Arizona	6 - 8	10
3.2.2.3 Vegetables in Florida	6 - 8	9 to No additional mitigation needed
3.2.2.4 Apples in Washington	9	13
3.2.2.5 Apples in New York	7	9
3.2.2.6 Almonds in California	5 - 7	10
3.2.2.7 Berries in Maryland	10	9 to No additional mitigation needed

[11] https://www.regulations.gov/document/EPA-HQ-OPP-2023-0365-0006

7.3 Appendix C. Flow Chart of Managerial Decisions

Q1. Read label – what mitigations are on the label? And does the label have a BLT link?

Q2. Once in bulletins, determine if I am in a PULA and what mitigations are in BLT.*

Q3. Consolidate label and BLT mitigations

Q3a. Do I have **runoff/ erosion mitigation?**

Q3a1. Do any of these apply to my field/application?
- Does the field slope **away** the "protected" habitat?
- Is the field ≥1,000 feet away from the "protected" area?
- Is the application an Injection (soil or tree)?
- Is the pesticide chemigated under plastic mulch?
- Is the treated area ≤1/10 acre (<4,356 square feet)?
- Does the field have a tailwater return system?
- Is there a tile-drain and a controlled drainage system?
- Are berms in place at the time of application?

Yes – Additional runoff/ erosion mitigation **not** identified

No

Q4a. Do any of these apply to my field?
- Pesticide Runoff vulnerability = 0 to 6 points (pts) *
- Soil type: sandy, loamy sand or sandy loam soil = 2 pts*
- Fields with slope of ≤3% or less = 2 pts
- Part of a conservation program = 2 pts – **OR** – follow recommendations of a conservation expert = 1 pts
- Voluntary mitigation tracking = 1 pts

Q5a. Can I get points for non-structural mitigations by using any of these practices?
- Reduction in area treated (via, banded or spot treatments, smart spray technologies) = 2–4 pts
- Reduced Annual application rate (reducing the rate as part of a premix or number of applications) = 1 to 3 pts
- A cover crop = 1-3 pts *
- Reduced tillage = 2 pts *
- No-till = 3 pts *
- Reservoir tillage = 3 pts *
- Soil incorporation (if not already on the label) = 1 pt

Q6a. Which structural mitigations are/could be adopted? *
- Have vegetative ditched along the field = 1 pt
- Utilize irrigation water management = 2-3 pts*
- Have terraces = 2 pts
- Farm on the contours = 2 pts
- Have grassed waterways = 2 pts
- Use in-field vegetative strips = 2 pts
- Mulch with artificial or natural materials = 1 or 3 pts*
- Have a riparian area = 1-3 pts*
- Have a vegetative filter strip = 1-3 pts*
- Constructed or natural wetland = 3 pts
- Terrestrial habitat landscape improvement = 1-3 pts*
- Filtering devices (activated carbon/compost) = 1-3 pts*
- Use erosion barriers = 2 pts
- Have a water retention system = 2 pts
- Tile drains without controlled drainage systems = 1 pt

Q7a. Did I use 2 of these 3 mitigation categories?
- In field, adjacent to field, or water retention systems = 1 pts

Q3b. Do I need **spray drift mitigation?**

Q3b.1 Is the wind blowing **towards** the "sensitive" habitat?

No – buffer is not needed, but if the direction shifts, buffer is needed. Consider starting all applications near the "sensitive" habitats so shifts in wind are less likely to impact the need for buffer.

Yes

Q3b2. Is the field more than 500 feet (or the maximum buffer distance for the application parameters) away from the "protected" area? – **OR** – Is the treated area ≤1/10 acre (<4,356 square feet)?

Yes – Additional spray drift mitigation **not** identified

No

Q4b. What is my application method?

Q4b-A1. Aerial

Q4b-A1. What is my droplet size and max buffer distance? **

Droplet size	Max buffer distance
Very Fine to Fine	500 feet
Fine to Medium	320 feet
Medium to Coarse	250 feet
Coarse to Very Coarse	200 feet

Q4b-B1. Ground

Q4b-B1 What is my droplet size and max buffer distance? **

Droplet size	Max buffer distance
Very Fine to Fine (high boom)	230 feet
Very Fine to Fine (low boom)	130 feet
Fine to Medium/Coarse (high boom)	100 feet
Fine to Medium/Coarse (low boom)	80 feet

Q4b-C1. Airblast

Q4b-C1 What is my droplet size and max buffer distance? **

Droplet size	Max buffer distance
Sparse	160 feet

Q4b-D1. Other Methods

Q4b-D.1 Is the application made with one of these methods?
- Chemigation with: micro-sprinklers, drip-tape, drip emitters, subsurface or flood (excludes overhead and impact sprinkler chemigation)
- In-furrow sprays when nozzle height is ≤8 inches above soil surface
- Trees: trunk drench, trunk paint, injections
- Soil injections
- Solid formulations that are used as a solid

Yes – Additional spray drift mitigation **not** identified

No – See the other application methods for options.

Q5. Can I Reduce My Buffer? (Options to reduce buffers are additive.)

Q5a-A1. Are there Application Parameters that I can adjust?
- Reduced Application Rate (for every 10% reduction in rate = 10 % reduction in buffer)
- Addition of a drift reducing adjuvant (15 -30% reduction in buffer for herbicides, other pesticide types under consideration)
- Using a larger droplet size than what is on the label (20-40% reduction).

Q5b-A2. How many passes do I need to make to treat my field?
- Making 8 passes or less (10 – 55% reduction in buffer)

Q5c-A3. Do I have certain field/environmental condition?
- Downwind windbreak/hedgerow (50-100%)
- Relative humidity is ≥60% (10% reduction in buffer)

Q5b-B1. Are there Application Parameters that I can adjust?
- Reduced Application Rate (for every 10% reduction in rate = 10 % reduction in buffer)
- Addition of a drift reducing adjuvant (15 -30% reduction for herbicides, other pesticide types under consideration)
- Using a larger droplet size and/or release height than what is on the label (40-75% reduction).
- Application with a broadcast hooded spray (50% reduction)
- Between-row hooded sprayer (75% reduction)
- Spraying below the crop (e.g., drop nozzles, layby) (50% reduction)

Q5b-B2. Can I reduce the area treated?
- Making 10 passes or less (15 – 75% reduction in buffer)

Q5b-B3. Do I have certain field/environmental conditions?
- Downwind windbreak/hedgerow (50-100%)
- Relative humidity is ≥60% (10% reduction in buffer)

Q5b-C1. Are there Application Parameters that I can adjust?
- Reduced Application Rate (for every 10% reduction in rate = 5 % reduction in buffer)

Q5b-C2. Can I reduce the area treated?
- Making 10 passes or less (15 – 70% reduction in buffer)

Q5-C3. Do I have certain field/environmental condition?
- Downwind windbreak/ hedgerow (50-100%)

Q6b. Do my reductions equal ≥100%?

Yes - adequate mitigations in place such that the entire field can be treated

No – Assess the surroundings of the field and see if there are downwind management areas that can further reduce the need for an in-field buffer.

Q8a/Q7b. I have my points requirements for runoff/ erosion and buffer distance; do I have the mitigations in place to be able to apply?

Yes – You can apply.

No – You cannot apply. You must find another product or suffer potential yield/ quality losses.

* **Applicators may need to check the EPA Mitigation Website for more details.**

7.4 Appendix D. Impacts of Mitigation Measures

EPA acknowledges that, while many growers and/or applicators may already have some of the mitigation measures discussed throughout this document already in place (**Section 3.1**), some growers and/or applicators will face a range of economic and managerial burdens to meet revised pesticide product labeling as EPA applies the strategies to FIFRA actions. This appendix provides descriptions of possible per acre impacts (in terms of cost, time, and/or planning) a grower or applicator may incur if they (1) do not already qualify for some mitigation relief and do not have mitigations in place to meet pesticide product labeling and (2) need to select a specific mitigation measure from the menu of options to achieve points. The impacts from these mitigation measures would only apply to those growers and/or applicators who choose that mitigation measure off the menu and do not already have the mitigation measure in place. Growers and/or applicators who use a pesticide product for which EPA has determined a strategy is applicable to the action and the approved pesticide product labeling includes the requirement to achieve points that would involve employing new mitigation measures from the mitigation menu could be impacted from each additional measure they implement.

This appendix also includes descriptions of possible per field impacts of various sizes of spray drift buffers and per acre impacts of the menu of mitigation measures growers and/or applicators have as options to reduce the size of spray drift buffers to demonstrate the range of possible impacts from spray drift mitigation.

EPA has sought to provide growers and/or applicators with as many options as possible to tailor mitigation to their specific field to achieve the necessary points, including for measures already in place. The extent of these options and the varying number of points assigned to each has resulted in a complex process for some growers and/or applicators to follow as they determine which mitigation measures are best for their specific situation. However, during EPA's outreach efforts between the release of the Draft Herbicide Strategy and the Final Herbicide Strategy, agricultural stakeholders have indicated that they prefer the flexibility of EPA's current approach, despite the complexity. EPA acknowledges that complying with new labeling requirements is not without additional burden for many growers and/or applicators, but EPA designed the strategy to provide growers and/or applicators enough flexibility to choose what is technologically and economically feasible for their specific circumstances and minimize that burden.

EPA recognizes that there could be disproportional impacts on small farmers to install some of the mitigation options (e.g., land terracing has a high fixed cost to install). To address this concern, EPA has provided multiple mitigation options to choose from thereby providing flexibility to meet pesticide product labeling that would include the need to achieve a number of points. Some mitigations may be more easily adoptable on large farms and over large acreages compared to farms with small acreages; in-field vegetated filter strips, for example, take up a larger proportion of a smaller field compared to a larger field.

The flexibility allows for growers and/or applicators to weigh the burden of implementing a specific mitigation measure against the agronomic benefit it can provide to adjust the overall set of mitigation measures adopted to what best suits their situation. Each mitigation measure discussed has corresponding benefits to the grower in reducing pesticide runoff/erosion or spray drift as discussed in

Ecological Mitigation Support Document to Support Endangered Species Strategies[12]. Additionally, some measures may have agronomic benefits to the grower beyond reduced runoff/erosion and/or spray draft, including soil nutrient retention and retaining the pesticide on the field (USDA 2019).

7.4.1 Agronomic Mitigations

The following agronomic practices may be feasible for some growers and/or applicators to adopt on an annual basis. Growers and/or applicators may choose to apply a pesticide product that requires more points in one growing season but not another (*e.g.*, in a corn-soybean rotation). Additionally, growers and/or applicators would be able to determine whether or not to employ one of these mitigation measures on an application-by-application basis.

Application Rate Reductions or Partial Field Treatments

The feasibility of single application and annual rate reductions and partial field treatments will be specific to growers' crop and active ingredient combinations. In the case of annual application rate reductions, growers and/or applicators may need to adjust their pest management plan to accommodate reduced rates and replace applications with alternative pesticides. Use of reduced rates may not be feasible depending on the rate needed to control a particular target pest. Using reduced rates can increase the risk of a pest developing resistance to that pesticide.

Droplet Size

Coarser droplets have been demonstrated to be one method to decrease off-target spray drift and, therefore, may reduce potential exposures to listed species, see **Ecological Mitigation Support Document to Support Endangered Species Strategies** for more details. Specific impacts from using a coarse or very coarse droplet size varies depending on the specific pesticide product. In general, growers and/or applicators may experience decreased efficacy with larger droplet sizes. Growers and/or applicators could compensate for decreased efficacy (depending on the pesticide product labeling) by increasing application rates, making more applications, or using alternative products, which could increase production costs or lead to yield loss. Additionally, larger droplet sizes may lead to the evolution of resistance in the long run due to higher rates of survival of the target pest(s).

Soil Incorporation

Applications of pesticides that are made before crop planting can be incorporated into the soil by mechanical incorporation after application. The incorporation of a pesticide into the soil profile reduces the likelihood of that pesticide leaving the field during a rainfall event, as discussed in **Ecological Mitigation Support Document to Support Endangered Species Strategies**. The ability of a grower to incorporate pesticide applications into the soil depends on many factors including their tillage system, the availability of equipment to enable incorporation, and if the pesticide is co-applied with other pesticide(s). For example, a pesticide that includes an herbicide mix often includes a residual herbicide to control weeds that have not yet emerged and a contact herbicide to control already emerged weeds. Furthermore, since soil incorporation is a form of tillage, if a grower chooses to use soil incorporation,

[12] Available at https://www.regulations.gov/docket/EPA-HQ-OPP-2023-0365

they cannot also choose to use no-tillage or reduced tillage production systems to achieve additional points on the same field.

Using a No-Till or Reduced-Tillage Production System

While tillage has many uses in crop production, including weed control and seedbed preparation, there has been increasing adoption of no-till and reduced tillage production systems. CEAP (2022) reports that 33% of acreage nationally has adopted conservation tillage with regional adoption ranging from 13% in the California Coastal region to 50% in the Northern Plains (**Figure 3.1.2**). No-till and reduced tillage production systems minimize the amount of soil disturbance through tillage. These systems reduce pesticide, sediment, and nutrient losses through runoff water, prevent soil erosion, increase soil organic matter which can help to improve soil structure and subsequently water infiltration into the soil. Converting from a conventionally tilled system to a no-till or reduced tillage system reduces grower costs by reducing the number of equipment passes across the field for tillage operations. However, growers and/or applicators switching to a no-till and reduced tillage system may need to invest in new planting equipment designed to properly plant seed under high crop residue conditions.

Cover Crops

Cover crops are a separate crop planted after the main crop is harvested to keep vegetated cover and/or plant residues on the soil until the next cash crop is planted. The plant material in cover crops slow water movement and help to increase water infiltration into the soil and thereby reduce runoff. Cover crops provide agronomic benefits including increased water infiltration into soil, improved soil structure, increased soil organic matter, decreased erosion, and improved weed control (USDA 2019). However, there are costs associated with cover crop establishment including seed costs, planting costs, termination costs, and additional managerial effort. Additionally, cover cropping may not be feasible for all crops or geographic locations. Adequate rainfall or irrigation must be available for successful incorporation of cover cropping into existing crop rotations while maintaining necessary soil moisture for subsequent crops in the rotation.

Irrigation Water Management

Irrigation water management refers to the process of determining and controlling the volume, frequency, and application rate of irrigation water to reduce runoff of water and pesticides from fields resulting from irrigation. Irrigation water management typically results in more efficient irrigation and water use and growers and/or applicators likely already utilize some form of water management. For growers and/or applicators who do not already have irrigation water management in place, it requires managerial expertise by operators and may require the purchase of specialized equipment such as soil moisture sensors and equipment to monitor plant water status to more effectively control the volume, frequency, and rate of water application to a field. Irrigation water management is likely feasible for many growers and/or applicators on irrigated land. However, irrigation water management can only be conducted on irrigated land.

Downwind Buffers

To mitigate potential spray drift impacts to listed species, some pesticide products' labeling may contain a mandatory spray drift buffer. Growers and/or applicators who must comply with buffers on the pesticide labeling could: 1) leave the buffer areas untreated, 2) replace the pesticide with an alternative control method in just the buffer area while treating the interior field with the primary pesticide, or 3) replace the pesticide with an alternative control method for treatment of the entire field. These three options could result in some level of loss of a pesticide as a control method for the particular situation.

Depending on the site, pest, and available alternatives, switching to other controls may result in yield or quality losses, increases in the cost of control, and/or increased likelihood of resistance developing to the alternative pesticide. The second option would likely necessitate extra trips through the field. Extra trips through a field imposes a burden beyond just the time it takes a grower to make the extra trip – growers and/or applicators may need to clean equipment before switching to another chemical. Also, environmental factors (wind, rain) and equipment availability, may further limit the feasibility of making separate applications to buffers. Beyond the increased application costs, growers and/or applicators would also incur any impacts from using alternatives, as with the third option. Yield or quality losses would be highly likely if the buffer area is left completely untreated (first option).

In addition to the options above, growers and/or applicators have multiple options to reduce the spray drift buffer distance (when allowable on pesticide product labeling) including reducing the single application rate, using a coarse or very coarse droplet size, using spray drift reducing adjuvants, reducing the proportion of the field treated, installing a downwind hedgerow/windbreak or downwind riparian/forest/shrubland/woodlot, adjusting boom height, investing in an over-the-top hooded sprayer or row-middle hooded sprayer, or spraying below crop canopy. Please check the **Mitigation Menu website** (https://www.epa.gov/pesticides/mitigation-menu) for a full list of options and more details. Most of these options have an additional cost, but these options also give growers and/or applicators the flexibility of weighing a reduction in impacts from a spray drift buffer against the cost of a buffer distance reduction mitigation measure.

To characterize the effect that buffers may have on growers, **Table 7.4.1** shows how different sizes of no-spray buffers can impact growers and/or applicators who want to use a pesticide with mandatory buffers required on approved labeling on different sized fields. As an example of the potential impacts of a required buffer, consider a rectangular field with length equal to twice its width, with the buffer on the long side of the field. In this scenario, the field is immediately adjacent to the sensitive area and the buffer is on the side of the field downwind from the application. A 30-foot buffer results in the loss of 3% of a 50-acre field, but 6% of a 10-acre field. A 100-foot buffer results in the loss of 10% of the 50-acre field, and 21% of the 10-acre field. If the buffer were to fall on the short side, the affected area would be substantially less. Irregularly shaped fields could be affected substantially more.

Table 7.4.1. Percent of fields of various sizes lost to in-field buffers of various sizes.

Field Size (Acres)	**1**	**10**	**50**	**100**
Buffer Size	Percent of Field Impacted by Buffer			
30 Feet	20%	6%	3%	2%
100 Feet	68%	21%	10%	7%
150 Feet	100%	32%	14%	10%

Calculations based on a rectangular field with length equal to twice its width, with the in-field buffer on the long side of the field.

7.4.2 Structural Mitigations

The following structural mitigation measures cannot be adopted without first undertaking substantial investment. Local consultants working with USDA Natural Resources Conservation Service (NRCS) have estimated establishment costs for many of these conservation practices on a regional basis. USDA OPMP (2023) aggregated these regional estimates into national average establishment costs for structural conservation practices in a public comment on the Herbicide Strategy, which are included below where applicable[13]. These practices could also require a substantial period of time to implement and could be very difficult to remove once implemented. Approximately 40% of U.S. cropland is leased (USDA NASS, 2014) and growers and/or applicators using land they do not own may find it especially difficult to adopt these mitigations if the landowner does not want to make the investment to make permanent structural measures that address runoff (Burnett et al, 2024). However, some growers and/or applicators may already be utilizing these practices due to the other agronomic benefits they provide and will achieve the points associated with those measures without any additional cost.

Vegetative Filter Strips

Vegetative filter strips (VFS) are strips of land in permanent vegetation designed to protect sensitive downslope areas from runoff from agricultural fields. VFS slow water movement and increase water infiltration, reduce runoff, and remove sediment and pesticides from runoff. However, employing in-field VFS can be costly for growers, especially those with small fields because they may remove land from production. VFS may also be costly to maintain.

Aside from taking land out of production, growers and/or applicators would incur costs to establish and maintain vegetated filter strips in fields. USDA OPMP previously provided cost estimates for a vegetated filter strip. Based on the USDA NRCS payment schedule for California USDA estimated the cost of establishing a vegetated filter strip to be $165 – $927 per acre of strip (USDA OPMP, 2018). Yearly maintenance costs were estimated to be $40 to $240 per acre of strip (for mowing or weed control applications). Costs, including labor costs, would differ across states and regions and also vary according to the size and shape of the field. Use of vegetative filter strips is likely feasible in all crops, assuming the cost and loss of production area does not outweigh the benefits growers receive from the use of the pesticide.

Field Border

A field border is a strip of permanent vegetation on one or more sides of a field. The border can be converted cropland but may also be created by removing large trees from a field border and leaving a transition zone of herbaceous plants. Field borders reduce the potential for sediment and pesticides leaving the field by controlling and filtering runoff. The establishment of field borders may take land out of production, similar to a VFS, and there are costs associated with establishing and maintaining field borders, including costs associated with tree removal, herbaceous cover establishment and weed control. USDA OPMP (2023) estimated the cost to install a 30-ft wide field border on two field edges to

[13] For additional details on these estimates and information on the costs of other mitigation measures, please see USDA OPMP's comment in the Draft Herbicide Strategy Docket, available at https://www.regulations.gov/comment/EPA-HQ-OPP-2023-0365-0176.

be $497 per acre. Similar to VFS, field borders are likely feasible in all crops, assuming the cost and loss of production area does not outweigh the benefits growers receive from the use of the pesticide.

Downwind Windbreak/Hedgerow/Riparian/Forest/Shrubland

Hedgerows and windbreaks are structures adjacent to the treated area that are effective at reducing spray drift transport downwind of the application. Riparian, forest, and shrubland are landscapes with similar vegetation and may have similar levels of spray drift reduction available, for more details see **Ecological Mitigation Support Document to Support Endangered Species Strategies**. The establishment of hedgerows, windbreaks, riparian, and shrubland may take land out of production, similar to a VFS, and there are costs associated with establishing these buffers, including costs associated with tree planting or herbaceous cover establishment. Similar to field borders, the establishment of hedgerows, windbreaks, riparian, forest, or shrubland buffers are likely feasible in all crops, assuming the cost and loss of production area does not outweigh the benefits growers receive from the use of the pesticide.

Grassed Waterways

A grassed waterway is a shaped or graded channel that is established within a field to convey water in a non-erosive way off the field. Grassed waterways are usually planted with perennial grass species but can contain other suitable plant species as well. Similar to VFS, land is removed from production and there are costs associated with establishing and maintaining them, including costs associated with herbaceous cover establishment and weed control. USDA OPMP (2023) estimated these costs to be $81 per acre of field where the waterway is approximately 2% of the acreage of the field or $3,247 per fully installed acre. Because these grass waterways may involve land grading within the field, this measure can involve substantial planning and may affect cropping on the land in future years.

Similar to VFS, grassed waterways are likely feasible in all crops, assuming the cost and loss of production area does not outweigh the benefits growers receive from the use of the pesticide. However, in fields that are flat and have limited slope, there may not be specific waterways to leave vegetated, meaning that grassed waterways may not be suitable for all fields.

Contour Buffer Strips and Terracing

Contour buffers are permanent established strips of perennial grasses alternating between wider cultivated strips that follow the contours of sloped land. Terraces are similar to contour buffers but involve the creation of semi-permanent earthen embankments or ridges built across the slope of a field and, depending on the type, are established in permanent cover. Contour buffers and terraces slow runoff water allowing for increased infiltration and filtering of sediment and pesticides within the runoff water. Contour buffers are generally easier to establish and cost less to implement than terraces, which require the building of embankments. USDA OPMP (2023) estimated contour buffer strips to range from $499 to $1,677 per acre depending on the size of the buffer and value of the crop being taken out of production. The cost of terraces vary greatly depending on desired slope and horizontal interval of terraces. USDA OPMP (2023) estimated that terraces cost a minimum of $2 per linear foot. Both measures take land out of crop production, similar to vegetative filter strips, with the impacts varying by field shape and size. Both require significant planning and investment to implement, and there are maintenance costs associated with both measures. Because these measures involve establishing embankments and/or semi-permanent vegetated strips within the field, this measure may affect cropping on the land in future years. Contour farming and terracing measures are designed to reduce runoff on sloped fields. Generally, terraces would likely be utilized on significantly steep slopes, while contour buffers would generally be utilized on more moderately sloped fields and would be unlikely to be used together.

Contour Farming and Strip Cropping

Contour farming is generally used for production of annual crops like corn, soybean, and cotton on sloping land. The tillage furrows are designed to follow the contours and be perpendicular to the slopes of the field. This orientation of the rows allows the crop rows to intercept runoff increasing water infiltration into the soil and reducing runoff water and pesticides leaving the field. Use of contour farming requires detailed planning by the grower but once implemented can be readily utilized annually. USDA OPMP (2023) estimated that the initial implementation costs, including increased labor, are $11 per acre.

Strip cropping involves the use of preplanned rotations of crops planted in equal width strips across a field with the rows of crops oriented perpendicular to the slope, similar to contour farming. At least 50% of the strips in the field consist of a grass or close growing crop which are alternated with a crop with less protected cover. Strip cropping works better in some rotational systems, especially ones that contain a forage crop, than rotations that include only row crops. Strip cropping requires greater managerial effort than other production systems. USDA OPMP (2023) estimated that the initial implementation costs, including increased labor, are $2 per acre.

Vegetated Ditches

Establishing and maintaining vegetated ditches near fields slow movement of water in ditches and reduces runoff. Similar to other measures discussed above that involve strips of perennial vegetation, there are costs associated with establishing and maintaining the vegetated ditch banks. Additionally, vegetated ditches may require weed control to prevent spread into neighboring crop fields, which would require the use of additional herbicide applications to these areas.

7.5 References for Appendices

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