**Chapter 4 – Final Carbaryl Effects Determinations**

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# Introduction

For 1,805 listed species, including endangered, threatened, candidate, proposed species, including experimental populations, and 791 designated critical habitats, a “No Effect” (NE), “Not Likely to Adversely Affect” (NLAA), or a “Likely to Adversely Affect” (LAA) determination is made. For each species and designated critical habitat, the effects determination is based on the methodology previously described in **Chapter 1** and the Revised Methods[[1]](#footnote-2). These determinations are described further below according to the Steps of the methodology in which a determination was made (*e.g.*, Step 1b, Step 2c, etc.), although some steps are combined as appropriate. Summary tables are provided within the chapter with more detailed tables and individual species determinations provided in appendices.

# Summary of Effects Determinations

**Tables 4-1** and **4-2** below summarize the effects determinations for all species and designated critical habitats, including a count of the number of species determinations by taxon. In addition, **Table 4-3** summarizes the step of the analysis in which each effects determination was made for the species and designated critical habitat while **Table 4-4** includes a summary of the strength of evidence associated with each LAA determination (discussed in more detail in **Section 3**). Effects determinations are summarized for each individual species and critical habitat in **APPENDIX 4-1**. **APPENDIX 4-1 (“Summary Table All Calls” tab)** is organized into 8 major taxa: birds, mammals, amphibians, reptiles, terrestrial invertebrates, fish, aquatic invertebrates, and plants. Species are listed by taxa, then alphabetically according to scientific name, then by species identification number. For each species, the table includes an effects determination for both the species and their critical habitat, if applicable, as well as an indication of how the effects determination was reached (*e.g.,* terrestrial weight-of-evidence analysis, qualitative).

**Table 4-1. Summary of Species Effects Determinations for Carbaryl (Counts by Taxon).**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Taxon** | **Step 1 Effects Determinations** | | **Step 2 Effects Determinations** | | **Totals** |
| **No Effect** | **May Affect** | **Not Likely to Adversely Affect** | **Likely to Adversely Affect** |
| Mammals | 1 | 101 | 27 | 74 | 102 |
| Birds | 0 | 107 | 26 | 81 | 107 |
| Amphibians | 0 | 38 | 0 | 38 | 38 |
| Reptiles | 0 | 46 | 14 | 32 | 46 |
| Fish | 0 | 192 | 11 | 181 | 192 |
| Plants | 0 | 950 | 38 | 912 | 950 |
| Aquatic Invertebrates | 0 | 209 | 24 | 185 | 209 |
| Terrestrial Invertebrates | 2 | 159 | 22 | 137 | 161 |
| Total | 3 | 1802 | 162 | 1640 | 1805 |
| Percent of total | 0% | 100% | 9% | 91% |  |

**Table 4-2. Summary of Critical Habitat Effects Determinations for Carbaryl (Counts by Taxon).**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Taxon** | **Step 1 Effects Determinations** | | **Step 2 Effects Determinations** | | **Totals** |
| **No Effect** | **May Affect** | **Not Likely to Adversely Affect** | **Likely to Adversely Affect** |
| Mammals | 0 | 33 | 6 | 27 | 33 |
| Birds | 0 | 31 | 1 | 30 | 31 |
| Amphibians | 0 | 25 | 0 | 25 | 25 |
| Reptiles | 2 | 14 | 6 | 8 | 16 |
| Fish | 0 | 106 | 2 | 104 | 106 |
| Plants | 1 | 459 | 20 | 439 | 460 |
| Aquatic Invertebrates | 0 | 71 | 5 | 66 | 71 |
| Terrestrial Invertebrates | 0 | 49 | 12 | 37 | 49 |
| Total | 3 | 788 | 52 | 736 | 791 |
| Percent of total | 0% | 100% | 7% | 93% |  |

**Table 4-3. Summary of Species Effects Determinations by Step (and part) in the Process.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Step 1A** | **Step 1B/C** | **Step 2A** | **Step 2B** | **Step 2C** | | **Step 2D** | | **Step 2E** | **Step 2F** | **Step 2G/H/I** | |
|  |
| **Outside of the action area** | **No toxicity effects** | **Incomplete exposure pathway** | **Extinct** | **Unreliable overlap based on range** | | **Exposure models unreliable** | | **<1% overlap** | **<1 exposed and pop. >100** | **Weight of evidence** | |  |
| **NE** | **NE** | **NLAA** | **NLAA** | **NLAA** | **LAA** | **NLAA** | **LAA** | **NLAA** | **NLAA** | **NLAA** | **LAA** |  |
| # of species in category | 3 | 0 | 47 | 15 | 9 | 6 | 47 | 2 | 3 | 1 | 40 | 1632 |  |
| # of critical habitats in category | 3 | 0 | 16 | 0 | 0 | 4 | 14 | 2 | 1 | 8 | 13 | 730 |  |

**Table 4-4. Classification of LAA Determinations by Strength of Evidence.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Strength of LAA call** | **Species range** | | **Critical Habitat** | |
| **Number** | **% of LAA determinations** | **Number** | **% of LAA determinations** |
| Strongest evidence of LAA | 131 | 8% | 70 | 10% |
| Moderate evidence of LAA | 1147 | 70% | 534 | 73% |
| Weakest evidence of LAA | 362 | 22% | 132 | 18% |

# Methodology for Making Effects Determinations

As discussed in **Chapter 1** and the Revised Method, effects determinations are made in a tiered manner, progressing from more conservative, screening level assumptions to more refinement as the analysis progresses. As discussed in the Revised Method, the MAGtool version 2.3 combines toxicological information, exposure analysis and results of the spatial analysis into one tool. The spatial footprint of the action area includes the pesticide footprint based on all labeled uses for the chemical and offsite transport due to spray drift, as described in the Revised Method. Additional information on how the action area was developed can also be found in **APPENDIX 1-6.**

For each species and critical habitat, the MAGtool provides output for each step of the method, proceeding from Step 1a to Step 2f. In Steps 2f-2g/h/i, output is provided as the number of individuals predicted to be impacted under the assumptions of the analysis. It is important to note that the output generated is the potential number of individuals that could be impacted (based on the assumptions of the simulation), not a prediction that they will be impacted. Throughout this analysis, the BE maintains conservative assumptions and may overstate the number of species exposed to and impacted by a pesticide. At Step 2g through 2i, EPA applies a weight of evidence analysis to make the final effects determinations as outlined in **Attachment 4-1**. Effects determinations utilized probabilistic methods for a subset of species, including the use of the Excel Add-In, Oracle Crystal Ball. The output from these final steps is either an NLAA or LAA determination, with all LAA determinations receiving a strongest, moderate, or weakest evidence of LAA designation (further described in **Section 5.7**). Additional technical information on the MAGtool, can be found in the Revised Methods and the model documentation[[2]](#footnote-3).

The basis of the inputs used in the MAGtool to make effects determinations, including spatial analyses, toxicity data and estimated environmental concentrations (EECs) are described in **Chapters 1-3.** Spreadsheets containing the inputs to the MAGtool are provided in **APPENDIX 4-2.** Additional details and output from the aquatic model parameter variation analyses (*i.e*., for curve number and application date) are provided in **APPENDICES 4-3** and **4-4.**

In addition to the information included in the MAGtool output, consideration was also given to any granular uses that may be relevant to a use site that has overlap with a species range or critical habitat. Carbaryl is registered for granular applications on a number of use sites including developed use sites (e.g., residential), corn and pasture. For all exposure pathways except ingestion of granules by birds, reptiles, amphibians, and mammals, the flowable applications analyses are expected to be protective of the granular/dust/bait formulation analyses. Therefore, the granular formulations are still considered when making effects determinations for species that may ingest granules. A discussion and analysis of the methods for assessing granular/bait uses for terrestrial species and the predicted impacts are described in **APPENDIX 4-5**.

In addition to the MAGtool analysis, after an aquatic species or a terrestrial species that relies on aquatic dietary items has been given a NE or NLAA determination, EPA conducted a final analysis to evaluate sources upstream of a species range or critical habitat that could affect the species. To do this, EPA evaluated monitoring data upstream and downstream of the species range/critical habitat to determine if any detections of the pesticide had occurred. Details of this analysis method are provided in **APPENDIX 4-6** and the analysis used to derive the results in **APPENDIX 4-7.**

# Step 1: No Effect/May Effect Determinations

In Step 1a, a “No Effect” determination is made if a listed species range or its designated critical habitat are outside of the action area. NE determinations were made in Step 1a for 3 species and 3 designated critical habitats due to no overlap of the action area and range/critical habitat. None of the species identified were aquatic with habitats in flowing bins, so an evaluation of monitoring data was not required, and the determinations remained as NE.

In Steps 1b and 1c, a “No Effect” determination is made for a species and its critical habitat if no effect to a listed species or its PPHD is anticipated based on screening conservative toxicity endpoints against the highest EEC predicted. No species met these criteria for carbaryl.

Overall, “May Affect” (MA) determinations were made for 1,802 species and 788 critical habitats. Specific species determinations are provided in **APPENDIX 4-1.** All species given a May Affect determination at Step 1 progressed to the Step 2 analysis where an NLAA or LAA determination is made.

# Step 2: NLAA/LAA Determinations

## Step 2a: Is the species exposure pathway incomplete?

In Step 2a, the assessor considers whether the pathway to pesticide exposure is complete for an individual of a listed species or the taxa upon which it depends (*i.e.,* PPHD). In general, exposures to non-target animals and plants may occur through contact, consumption or inhalation. The pathways of exposure that are relevant to a given pesticide are dependent upon the application parameters and fate properties of a pesticide. An exposure pathway is considered incomplete when there is no reasonable expectation of continuity between the source of pesticide exposure and an individual organism of a listed species. In other words, the exposure pathway is considered incomplete if an individual of a listed species or organisms upon which it depends are not expected to be exposed through contact, consumption or inhalation. When the exposure pathway is incomplete, effects are not reasonably expected to occur. Therefore, a NLAA determination is made for species for which exposure pathways are incomplete.

For carbaryl, three types of species characteristics lead to a conclusion that the exposure pathway is incomplete: species that only occur on uninhabited islands, species that predominantly occur in the open ocean and terrestrial species that only occur in caves. Additional explanation of why the exposure pathway is incomplete for these three types of species habitats is provided in **APPENDIX 4-8**.

When considering the complete list of species, NLAA determinations were made for 47 species because they have incomplete exposure pathways for carbaryl. **APPENDIX 4-1** includes the species for which NLAA determinations are made because of incomplete exposure pathways. These species include those with ranges that are only on uninhabited islands, species that are located in the open ocean and only rely on the ocean for PPHD, and terrestrial invertebrate species that are obligate to caves (see **APPENDICES 4-1 and 4-8**).

Of the 47 species with incomplete exposure pathways, 16 have designated critical habitats. NLAA determinations are made for the designated critical habitats of species with incomplete exposure pathways (see **APPENDIX 4-1**).

## Step 2b: Is the species most likely extinct?

Species recommended for delisting due to extinction by the Services are presumed extinct and receive a NLAA determination. NLAA determinations are made for these species as exposure from the action is not reasonably certain to occur, and, therefore, effects on the species are not anticipated. Species are only presumed extinct after a recommendation to delist is made by the Services in a review document (*e.g.*, Recovery plan, 5-year review).

The US Fish Wildlife Service has recommended 15 species for delisting due to extinction. NLAA determinations are made for these 15 species because they are presumed extinct (see **APPENDIX 4-1** for the list of species). None of these species have designated critical habitat.

## Step 2c: Is the range of species and resulting overlap considered unreliable?

As described in the Revised Method, in Step 2c, a review of the range data, provided by FWS, was completed for those that followed geopolitical boundaries (*e.g.,* counties or states), rather than natural ones. From that review, in cases where the ranges from Environmental Conservation Online System (ECOS) and the field offices’ documentation differ substantially, a quantitative overlap analysis was not conducted and an LAA or a NLAA determination was based on a qualitative weight of evidence analysis.

Nine species were determined to have range data that differed substantially from the data provided in ECOS and as a result the overlap results would be unreliable. The weight of evidence included consideration of the size and unique traits of species range and life history (*e.g.,* exists only in very remote location, etc.) as well as any information from FWS documents on stressors to species (*i.e.,* pesticides) or proximity to potential use sites for carbaryl. Based on this analysis, an NLAA determination was made for 5 species and an LAA determination was made for 4 species. Three of the species were designated as moderate evidence of LAA and one was designated as weakest evidence of LAA. The specific species are provided in **APPENDIX 4-1** (tab marked as Step 2c)as well as additional information on the review of the data for each species and the factors considered in making the determinations.

Six additional species and four critical habitats were also included in this Step of the analysis as either no spatial data were available and/or these species are considered extirpated based on communication with FWS. LAA determinations are made for 2 of these species and 4 critical habitats, and NLAA determinations were made for 4 of these species, (see **APPENDIX 4-1** for the list of species).

## Step 2d: Are exposure models considered unreliable for assessed species?

At this time, the current exposure models used in this assessment cannot estimate exposures for all types of pesticide applications, all habitat types, or for all potential exposure routes relevant to listed species. Therefore, there may be uncertainty in the exposure values being used for a particular species based on what potential uses its range or critical habitat may overlap with, what type of habitat the species is found in, or what the main potential exposure route(s) might be. For species and critical habitats that have not been determined to be NE or NLAA based on the above analyses, consideration is given to how well the conceptual model of the relevant exposure model(s) matches up with the specific species being assessed. If the model estimates are not considered representative of the exposure of the species (due to an inconsistency in the exposure model and assessed species’ habitat), a qualitative analysis is conducted.

The qualitative analysis considered whether exposures to carbaryl are reasonably certain to occur given the habitat of the listed species (e.g., ocean, beach, and/or freshwater habitats) and, if exposures are expected to occur, are impacts to an individual likely. The analysis also considered the potential for effects to the PPHD of the species and whether those effects would rise to the level of impacting an individual of a listed species. Circumstances that led to an LAA determination include species with an obligate relationship to a prey item that has an LAA determination with high confidence (*e.g.*, the Orca is a listed species that is obligate to listed salmon species) and species that utilize both saltwater and freshwater habitats and may be exposed to carbaryl (*e.g.*, the Western manatee may be exposed in freshwater environments). Circumstances that led to an NLAA determination include:

* marine species that do not have an obligate relationship and whose exposures to carbaryl are reasonably expected to be *de minimus (e.g., whales that utilize open ocean)*;
* marine species that also utilize terrestrial environments (on a limited basis), because exposure to carbaryl is not reasonably expected to occur at levels that will impact an individual (*e.g.,* sea turtles and pinnipeds);
* marine species that rely on multiple dietary items because exposure to carbaryl is not reasonably expected to decrease prey populations (*e.g.*, Beluga whale); and
* terrestrial species that are predominantly located outside of the United States (e.g., the wood bison) because use of carbaryl in the US is unlikely to result in exposure.

When considering the species information and potential for exposures, LAA determinations were made for 2 species and 2 critical habitats and NLAA determinations were made for 47 species and 14 critical habitats. Additional discussion on these determinations is provided in **APPENDIX 4-8**.

## Step 2e: Is the percent of species range/critical habitat that overlaps with the action area less than 1%?

As described in the Revised Method, the effects determination for any listed species or designated critical habitat whose range overlaps <1% with the area of effects, after considering the quantitative analyses, will be an NLAA determination. The cutoff of 1% is based on the precision of the available data. Three species met this criterion for carbaryl for the species range as well as one critical habitat.

## Step 2f: Based on conservative assumptions, is it likely that less than 1 individual exposed?

Step 2f applies a more refined approach and considers available usage data when identifying the likely portion of a species range where pesticide exposure may occur; different approaches were employed for crop and non-crop uses due to differences in the nature of the available usage data. At this step in the method, the percent overlap analysis becomes a surrogate for the percentage of the population exposed; further description of the methodology is available in the Revised Method. In Step 2, the number of individuals exposed and impacted is considered using the likely exposure area. Additionally, the designation of a species likely being on or off a use site, based on the species life history, is applied at this step. In Step 2f, the maximum PCT and upper distribution of acres in the species range is used to represent the percent overlap with the range and the number of individuals likely exposed. This approach is also applied to the critical habitat.

Based on this analysis, an NLAA determination was made for 1 species and 8 species’ critical habitat (**Table 4-3 and Table 4-4**). The specific species with NLAA determinations are provided in **APPENDIX 4-1**.

## Step 2g/h/i: Weight of Evidence Analysis for final effects determinations

As described in the Revised Method, a weight of evidence analysis was used for any species reaching Step 2 parts g, h and i of the analysis. This included 1,672 species and 743 critical habitats. The purpose of the weight of evidence was to consider multiple factors and scenarios in making the effects determination, including various percent crop treated (PCT)/acres distribution scenarios, alternative assumptions for species populations, potential alternative toxicity endpoints as well as typical application rates. Additionally, probabilistic components were introduced into the analysis at this step for a subset of species to allow for the use of distributions of potential EECs and toxicological responses.

In addition to making an NLAA/LAA determination for a species and critical habitat from the analyses, as part of the effects determination a degree of confidence was assigned to each LAA determination. This was denoted as “evidence in the LAA” determination and each species or critical habitat was assigned a weak, moderate or strong evidence in the LAA determination based on multiple factors, including: the impact of using less conservative assumptions in the analysis, the quality of the species range or usage data, impacts to both the species and PPHD as opposed to only one, the presence of reported incidents involving the species taxa or PPHD taxa, the presence of monitoring data that exceeds endpoints, exposure only due to spray drift and the likelihood of drift into a species habitat (*e.g.*, if the species inhabits forests). This is described in more detail in the Revised Method document and in **ATTACHMENT 4-1**. The three strength of evidence categories applied to LAA determinations are not used for NE or NLAA determinations. Given the conservative nature of the Step 1 and Step 2 analysis, EPA is confident that when a NE or NLAA determination is made, there will be no effects to an individual of the assessed species or an individual of a species is not likely to be adversely affected.

One uncertainty noted for some species is that the best available species range data does not accurately reflect where the species is expected to be located. An overlap scenario is considered in the weight of evidence for species likely found on specific habitats. The habitats are spatially defined using GAP/Landfire layer[[3]](#footnote-4). This map layer defines specific habitats has defined by the U.S National Vegetation Classification[[4]](#footnote-5) and NatureServe Ecological System classification[[5]](#footnote-6). For species identified in the draft BE as coastal beach, a review of all habitat layers was completed. For the purposes of this BE, this habitat scenario was considered for 39 species, including plants, mammals, birds and terrestrial invertebrates. Under this scenario, the exposure area within the species range is assumed to be limited to habitat identified as suitable habitat (*i.e.*, where individuals are expected to be located). NLAA determinations are made for species if the overlap of the action area and the suitable habitat is less than 1%.

The MAGtool technical documentation describes the algorithm used to assign an automated NLAA or LAA determination and the strength of evidence in the LAA and it is also provided for reference in **ATTACHMENT 4-1**. Lines of evidence were considered for each LAA determination in the weight of evidence. These lines of evidence were also reviewed by an assessor when appropriate to allow for individual refinement of the determination, if needed. Additionally, in the output, the contribution of each specific use site to the total number of individuals potentially impacted (assuming the species population is evenly distributed over the critical habitat or range) is provided, as well as other characterization of the effects determinations.

Based on the WoE analysis, an NLAA determination was made for 40 species and 13 species’ critical habitat and an LAA determination was made for 1632 species and 730 critical habitats (**Table 4-3 and Table 4-4**). Thirty-nine of these species were evaluated based on the application of the habitat layers as described above. NLAA determinations were made for 3 of these species after the weight of evidence analysis. The remaining 36 species were found to be LAA predominantly with moderate evidence of risk. The overall determination or strength of evidence did not change for most of these species when compared to the analysis without the habitat layers, but the number of individuals predicted to be impacted tended to decrease and the contribution of drift to the determinations tended to increase, due to the lower direct overlap of the preferred habitat with use sites. However, with the application of the refined habitat layers, although the number of individuals that could be impacted may be reduced, there is greater confidence in the effects determination due to the restriction of the range to the habitat layers. It is notable that EPA received public comments on the effects determinations for many of the species for which an NLAA determination was made based on the application of the coastal habitat layers. The determinations based on the application of the habitat layers herein for the final BE are based on the reevaluation of GAP/Landfire layers associated with the species habitat and applied in the overlap analysis. This has increased the confidence in the determinations and resulted in a change in effects determinations for some of the species. The application of habitat layers and evaluating their impact on the confidence in LAA calls will be further developed in the future.

Specific species results are provided in **APPENDIX 4-1.** As described in **Chapter 1 (Section 7)**, regarding updates to the analysis plan, effects determinations were revised for the final assessment to be based both on deterministic calculations using the upper and lower bounds of the exposure assumptions, as well as probabilistic analysis, to determine impacts to a species based on mortality effects, sublethal effect or effects to PPHD. This was done to provide more transparency to the calculations and also to provide a faster, streamlined manner of analysis. For a subset of species, selected based on the potential to refine the effects analysis, probabilistic analysis was used in making effects determinations. For the majority of species, as impacts are predicted even at the minimum or lower bound of exposure assumptions, the probabilistic analysis does not change the effects determination. However, the probabilistic analysis provides insight into the magnitude of effect when variability in input parameters is considered, which could be relevant in the Step 3 population analysis, if needed.

For the strength of evidence of each LAA determination, the majority of species were found to be in the moderate evidence of LAA. LAA determinations were distributed across all taxa and were found in both the ConUS and non-contiguous state and territories. Additional details on the distribution of the strength of determinations as well as additional characterization of the effects determinations is provided in **Tables 4-5** thru **4-8** below.

**Table 4-5. Distribution of LAA Determinations Across Evidence Classes for Species Range and Critical Habitat.**

| **Strength of LAA call** | **Species range** | | **Critical Habitat** | |
| --- | --- | --- | --- | --- |
| **Number** | **% of LAA determinations** | **Number** | **% of LAA determinations** |
| Strongest evidence of LAA | 131 | 8% | 70 | 10% |
| Moderate evidence of LAA | 1147 | 70% | 534 | 73% |
| Weakest evidence of LAA | 362 | 22% | 132 | 18% |

**Table 4-6. Distribution of LAA Determinations Across Taxonomic Groups for Species Range.**

| **Taxa** | **Strength of evidence of LAA (counts)** | | | | **Strength of evidence of LAA (%)** | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Strong** | **Moderate** | **Weak** | **Total** | **Strong** | **Moderate** | **Weak** |
| Mammals | 27 | 44 | 3 | 74 | 36% | 59% | 4% |
| Birds | 3 | 72 | 6 | 81 | 4% | 89% | 7% |
| Amphibians | 8 | 30 | 0 | 38 | 21% | 79% | 0% |
| Reptiles | 3 | 28 | 1 | 32 | 9% | 88% | 3% |
| Fish | 33 | 145 | 3 | 181 | 18% | 80% | 2% |
| Plants | 1 | 571 | 340 | 912 | 0% | 63% | 37% |
| Aquatic Invertebrates | 47 | 132 | 6 | 185 | 25% | 71% | 3% |
| Terrestrial Invertebrates | 9 | 125 | 3 | 137 | 7% | 91% | 2% |

**Table 4-7. Additional characterization of LAA and NLAA determinations.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **LAA call based on Max Upper only?** | **LAA call with no impacts by alternative analysis?** | **LAA call based on drift only?** | **LAA call based on indirect effects only?** | **LAA call based on one use only?** | **NLAA call with low population (<100)?** |
|
| 0 | 215 | 19 | 817 | 164 | 35 |

**Table 4-8. Impact of all UDLs on LAA effects determinations.**

| **UDL1** | **Number of times UDL predicted to impact a species** | **Rank** |
| --- | --- | --- |
|
| **CONUS** | | |
| CONUS\_Open Space Developed | 1027 | 1 |
| CONUS\_Right of Way | 1005 | 2 |
| CONUS\_Developed | 930 | 3 |
| CONUS\_Forest Trees | 909 | 4 |
| CONUS\_Rangeland | 891 | 5 |
| CONUS\_Corn | 500 | 6 |
| CONUS\_Vegetables and Ground Fruit | 454 | 7 |
| CONUS\_Alfalfa | 434 | 8 |
| CONUS\_Nurseries | 431 | 9 |
| CONUS\_Other Orchards | 407 | 10 |
| CONUS\_Other Crops | 403 | 11 |
| CONUS\_Other Grains | 383 | 12 |
| CONUS\_Soybeans | 296 | 13 |
| CONUS\_OtherRow Crops | 281 | 14 |
| CONUS\_Grapes | 198 | 15 |
| CONUS\_Citrus | 119 | 16 |
| CONUS\_Rice | 84 | 17 |
| **NL48 Layers** | | |
| NL48\_Forest Trees | 498 | 1 |
| NL48\_Right of Way | 411 | 2 |
| NL48\_Developed | 379 | 3 |
| NL48\_Open Space Developed | 256 | 4 |
| NL48\_Rangeland | 130 | 5 |
| NL48\_Ag | 113 | 6 |
| NL48 Nurseries | 3 | 7 |
| 1 Counts terrestrial and aquatic impacts separately, one species could be impacted twice by same use in both terrestrial and aquatic environment | | |

The number of and strength of LAA determinations found for carbaryl is expected given the use footprint of the chemical and the toxicity profile. Carbaryl is an insecticide with a large number of uses and a high amount of usage (over 2.7 million lbs applied in the US annually), especially on non-agricultural use sites (over 1.3 million lbs applied to residential areas annually). Use sites associated with the Open Space Developed, Right of Way, and Developed Use Data Layers (UDLs), were often cited as one of the leading use sites associated with impacts to a species. When interpreting these rankings, it is important to remember the UDLs are not mutually exclusive from one another. Therefore, other influences related to this lack of independence may influence the high rankings of a given layers. However, due to the lack of availability and uncertainty in usage data associated with non-agricultural use sites, strength of evidence was moderate at best when these uses were the main contributors to risk. Part of the reason that the non-agricultural use layers are a driver for impacts to species is that these layers do not map label uses as specifically the agricultural UDLs. For example, the Developed UDL is used for a number of label uses range from lawns, to ornamental trees dwellings or other structures. The result of this is often non-agricultural UDLs often overestimates the label use compared to the agricultural UDLs. As detailed in **Appendix 4-1** in the compiled results, LAA determinations for a considerable number of species were based only on impacts from non-agricultural UDLs. Carbaryl also has toxicity across multiple taxa, including plants, which may contribute to it having toxic effects to a species as well as its PPHD; however, it also tends not to be as acutely toxic as some other carbamates and therefore may cause toxicity only at some of the predicted EECs. Other factors can have a greater or lesser influence on the strength of evidence depending on the species. For example, the location of the species (ConUS or non-contiguous state and territories) influences the confidence in the overlap analysis, with species in ConUS having an increase in the strength of evidence in the LAA determination. In addition, whether impacts were predicted only for the species *or* PPHD can decrease the strength of evidence in the LAA determination. Although each species analysis is unique, these factors may help to explain the general trend seen in the data of many species with moderate evidence of LAA.

Strong evidence of LAA was noted in 8% of species and 10% of critical habitat determinations. Factors contributing to the finding of strong evidence generally included effects predicted to the listed species and the PPHD, impacts being predicted at less conservative PCTs and distribution of acres assumptions in relation to the species range. Additionally, strong evidence of LAA was often associated with CONUS species with agricultural uses being the predominant risk driver.

Summary results for the species determinations are contained in **APPENDIX 4-1 (‘Summary’ tab)** and are denoted as either “TerrWoE”, “AquaWoE” or “TerrWoE and AquaWoE” as the source of the effects determination. Additional worksheets in **APPENDIX 4-1** include total determination counts for species and a key to file locations for each species. Detailed weight of evidence output for all species are located in **APPENDIX 4-9**, organized according to the file key in **APPENDIX 4-1**.

# Upstream Monitoring Data Analysis

As previously discussed, as part of the analysis any species that was classified as a No Effect or Not Likely to Adversely Affect was reviewed to ensure that no sources upstream of a species range or critical habitat would affect the species. To do this, EPA evaluated the monitoring data with regards to the location to the species range/critical habitat (e.g., upstream or downstream) to determine if any detections of the pesticide had occurred. Only monitoring sites upstream of or in the species range/critical habitat were considered relevant for the downstream transport analysis, as there is uncertainty in the downstream monitoring sites as to where the pesticide originated (*i.e.*, was pesticide used in the species range/critical habitat, or outside where the species would not be exposed).

Results of the analysis are described in **APPENDIX 4-6**. For species ranges, one species (with two separate entity IDs) had monitoring samples upstream of the range that were detectable. This species was the Roseate tern, which feeds on fish. However, this species has a relatively high threshold for effects to the species and impacts to PPHD vectors, such that effects were not predicted using modeled EECs. Therefore, this species will remain NLAA. No monitoring samples were collected in or upstream of any critical habitats with an NE or NLAA designation.

# Additional Characterization of Effects Determinations, Uncertainties and Refinements

These effects determinations were developed based on refinements to the methods for evaluating risks to listed species, such as inclusion of usage data and probabilistic modeling. However, there are several areas of the analysis that could be further refined to increase confidence in the effects determinations. See **Attachment 4-1** for details on how these uncertainties influence the confidence of the effects determinations.

* Resolution of spatial data. There are uncertainties in the spatial footprint associated with the non-agricultural uses (e.g., residential, forestry, rangeland) as it related to the specific label uses of carbaryl and there are limited data available to inform the extent of usage in any given area for these types of uses. Additionally, all agricultural uses are captured in one spatial footprint in the non-contiguous United States and territories. Another important uncertainty is that the available range data for some listed species include areas not occupied or habitats not used by the species, especially when following geopolitical or other man-made boundaries. Species with overly broad ranges that include habitats the species would not utilize lead to uncertainties in effects determinations.
* Resolution of usage data. Usage data are available at the state, region, or national level while species’ range or critical habitat information or at the sub-state level. To address the difference in scale, we made several assumptions with respect to where pesticide-treated acres could occur relative to a species’ habitat (e.g., all treated acres occur within the habitat, evenly dispersed throughout the state, or primarily outside of a species habitat). In the non-contiguous United States and territories usage data is extremely limited.
* Threshold for assessing impacts on prey, pollination, habitat, dispersal (PPHD) of a species. There are uncertainties associated with the magnitude of impact to a particular species’ prey base or habitat for a given pesticide that could result in a discernible effect to that listed species.

Any refinements in these areas would increase the EPA’s confidence in the LAA determinations.

# Conclusions

For 1,805 listed species, including endangered, threatened, candidate, proposed species, and experimental populations, and 791 designated critical habitats, an NE, NLAA or a LAA determination was made for carbaryl. The weight of evidence for each LAA determination was also characterized as either strongest, moderate, or weakest. All of Steps 1 (parts a-c) and 2 (parts a-i) were applied for the majority of listed species and critical habitats.

NE determinations were made for three species and designated critical habitats. NLAA determinations were made for 162 species and 52 species’ critical habitat and LAA determinations were made for 1,640 species and 736 critical habitats. Approximately 91% of all species and 93% of all critical habitats were given a LAA determination and these species were distributed across all taxa. Of those LAA determinations, 8% were considered to have strongest evidence, 70% were considered to have moderate evidence, and 22% were considered to have weakest evidence for species and 10% were considered to have strongest evidence, 73% were considered to have moderate evidence, and 18% were considered to have weakest evidence for critical habitat. Open Space Developed, Right of Way, and Developed UDLs were often cited as the top use sites associated with predicted impacts to species or critical habitats with LAA determinations.

1. USEPA. 2020. *Revised Method for National Level Listed Species Biological Evaluations of Conventional Pesticides*. March 12, 2020. Environmental Fate and Effects Division. Office of Pesticide Programs. U.S. Environmental Protection Agency. Available at <https://www.epa.gov/endangered-species/revised-method-national-level-listed-species-biological-evaluations-conventiona>l. [↑](#footnote-ref-2)
2. Available online at: <https://www.epa.gov/endangered-species/models-and-tools-endangered-species-pesticide-assessments> [↑](#footnote-ref-3)
3. U.S. Geological Survey Gap Analysis Program, 20160513, GAP/LANDFIRE National Terrestrial Ecosystems 2011: U.S. Geological Survey: Boise, ID, <https://www.sciencebase.gov/catalog/item/573cc51be4b0dae0d5e4b0c5>. This landcover dataset is based on standardize terrestrial ecological classifications grouped using multiple plant communities that tend to co-occur under similar environmental setting and ecological dynamics. [↑](#footnote-ref-4)
4. <https://www.natureserve.org/conservation-tools/projects/us-national-vegetation-classification> [↑](#footnote-ref-5)
5. <https://www.natureserve.org/conservation-tools/terrestrial-ecological-systems-united-states> [↑](#footnote-ref-6)