**APPENDIX 4-5. Analysis of Granular and Bait Uses**

Most carbaryl use sites have registered flowable uses (*e.g*., emulsifiable concentrate, wettable powder). Therefore, the methods developed for analyzing terrestrial exposures in this BE focus on flowable uses; however, carbaryl products also have other formulation types, including dust, bait, and granular uses. For the purpose of this assessment, it is assumed that exposures from flowable uses are protective of dust formulations, though dust applications may involve more focused treatment areas (*i.e*., spot treatment) than broadcast flowable applications. Therefore, effects determinations associated with these uses are incorporated into the analyses presented in **APPENDIX 4-1** based on the analysis for flowable formulations. Additional characterization is provided here for terrestrial exposure and risks associated with granular and pelleted bait uses, which may involve contact with or consumption of a more concentrated dose even when the application rate per unit area (*i.e.*, lb a.i./A) is comparable to flowable uses.

Because exposures related to granular and bait uses are readily modeled using our current aquatic modeling approaches, these types of uses are incorporated into the aquatic exposure analysis used to help make effects determinations for listed aquatic species (and those that rely on aquatic species). However, due to differences in estimating potential exposures from granular/bait uses and flowable uses, these (granular/bait) uses are not as easily incorporated into the current modeling approach for assessing terrestrial exposures to listed terrestrial species. As such exposure from these uses (flowable) are incorporated into the current version of the MAGtool (v2.3) that are used to help make effects determinations for listed terrestrial species (and those that rely on terrestrial species). While the granular/bait uses are not built into the tool, they will still be considered when making effects determinations. In the individual effects determinations output sheets from the MAGtool (**Appendix 4.9**), if a terrestrial animal range or critical habitat has overlap with a use site where granular uses are permitted, as shown in **Table 1** below, it is specified that this use should be given additional consideration by the assessor. Consideration of this additional use outside of the flowable uses already captured in the MAGtool did not result in the alteration of any effects determinations. A discussion of the methods for assessing exposure concentrations resulting from granular and bait uses for terrestrial species is described below.

**Granule & Bait Uses**

For terrestrial organisms, the primary route of exposure to granules/baits is assumed to be via ingestion by vertebrates, and via ingestion and contact by invertebrates. Spray drift is not expected from these types of uses; therefore, potential terrestrial exposures are assumed to be limited to the sites of application. **Table 1** shows registered granular uses of carbaryl. **Table 2** shows registered bait uses of carbaryl (wettable powder/pellets). More detailed information on specific use sites is in **APPENDIX 1-3**. Carbaryl also has dust and other flowable registrations for these use sites with the exception of horseradish, leaves or roots and tuber vegetables (crop group 2), parsnips, salsify, and paths/patios. Furthermore, household/domestic, nuisance pests, and tick uses have granular application rates that are higher than their associated flowable uses. Therefore, for most uses of carbaryl the granular and bait uses do not represent a different use footprint than the one being captured by the flowable uses; however, for those crops that do not have a registered flowable use with a higher application rate, the estimated exposures from a flowable use from the same use layer are used as a protective proxy from the granular uses. For the agricultural uses (horseradish, parsnips, salsify, and leave or roots and tuber vegetables) a use for root and tuber crops with six possible annual applications of 2.04 lb ai/A was identified as a proxy foliar use. For residential uses (paths/patios, household/domestic, nuisance pests, residential lawns, and ticks) a use for residential lawns with two possible annual application of 8.33 lb ai/A was identified as a proxy use.

**Table 1. Registered granular uses of carbaryl**

| **Use** | **Use Data Layer (UDL)** | **Max Single App rate****(lb AI/a)** | **Max #Apps/ Year** | **Max App rate/Year (lb AI/A/Yr)** | **MRI (days)** | **Labels** |
| --- | --- | --- | --- | --- | --- | --- |
| ASPARAGUS | Vegetable/ Ground Fruit | 1 | 3 | 5 | 3 d | 19713-627 |
| 2 | 2 | 5 | 3 d | 19713-627 |
| 2 | 3 | 6 | 3 d | 432-1212 |
| 2 | 2 | 10 - pre & post | 7 d | 432-1212 |
| 1 | 3 | 3 | 3 d | 34704-289 |
| 2 | 5 - pre & post | 5.0 - pre & post | 3 d | 34704-289 |
| BEANS  | Vegetable/ Ground Fruit | 1.4 | 4 | 6 | 7 d | 9198-146 |
| 1.5 | 4 | 6 | 7 d | 432-1212 |
| BRASSICA | Vegetable/ Ground Fruit | 2 | 3 | 6 | 7 d | 19713-627 |
| 2 | 4\* | 6 | 7 d | 432-1212 |
| 1.96 | 3 | 5.88**1** | 7 d | 829-285 |
| 2 | 4 | 6 | 7 | 34704-289 |
| CORN (FIELD & POP) | Corn | 2 | 4 | 8 | 14 d | 19713-627 |
| CORN (SWEET) | Vegetable/ Ground Fruit | 2 | 8 | 16 | 3 d | 19713-627 |
| 2 | 4 | 8 | 7 d | 34704-289 |
| CUCURBITS | Vegetable/ Ground Fruit | 1 | 6 | 6 | 7 d | 19713-627 |
| 0.98 | 6 | 5.88**1** | 7 d | 829-285 |
| 1 | 6 | 6 | 7 d | 432-1212 |
| FRUITING VEGETABLES | Vegetable/ Ground Fruit | 2 | 4 | 8 | 7 d | 19713-627 |
| 2 | 4 | 8 | 7 d | 9198-146 |
| 2 | 4 | 8 | 7 d | 432-1212 |
| 1.96 | 4 | 7.84**1** | 7 d | 829-285 |
| 2 | 4 | 8 | 7 d | 34704-289 |
| HOUSEHOLD/ DOMESTIC DWELLINGS OUTDOOR PREMISES | Developed | 7.842 | 3 | 23.52**1** | 7 d | 432-1212 |
| 1.87 | 3 | 5.61**1** | 7 d | 8378-36 |
| 8.362 | 4 | 33.44**1** | 7 d | 9198-146 |
| LEAFY BRASSICA - Sub-Group 5 B | Vegetable/Ground Fruit | 2 | 4 | 6 | 7 d | 34704-289 |
| LEAFY VEGETABLES - garden beets (tops), turnip (tops) | Vegetable/Ground Fruit | 2 | 3 | 6 | 7 d | 19713-627 |
| 2 | 3 | 6 | 7 d | 432-1212 |
| LEAVES of ROOT & TUBER VEGETABLES: covering beet, garden (tops) and turnip (tops) | Vegetable/Ground Fruit | 2 | 3 | 6 | 7 d | 34704-289 |
| ORNAMENTAL LAWNS & TURF | Open Spaced Developed | 8.362 | 4 | 33.44**1** | 7 d | 9198-146 |
| ORNAMENTAL PLANTINGS | Open Spaced Developed | 7.842 | 3 | 23.52**1** | 7 d | 432-1212 |
| 1.96 | 3 | 5.88**1** | 7 d | 829-285 |
| 42 | 3 | 12**1** | 7 d | 8378-36 |
| 8.362 | 4 | 33.44**1** | 7 d | 9198-146 |
| PASTURES, grasses grown for hay and/or seed | Pasture | 1.5 | 2 | 3 | 14 d | 19713-627 |
| PISTACHIOS - nonbearing | Other Orchards | 2 | 5**1** | 10 | 7 d | 19713-627 |
| POTATO | Vegetable/Ground Fruit | 2 | 3 | 6 | 7 d | 19713-627 |
| 2 | 3 | 6 | 7 d | 432-1212 |
| RANGELAND | Rangeland | 1 | 1 | 1 | NA | 19713-630, 19713-627 |
| 1 | 1 | 1**1** | NA | 19713-627 |
| RESIDENTIAL LAWNS | Developed | 7.842 | 4 | 31.36**1** | 7 d | 432-1212 |
| 1.96 | 4 | 7.84**1** | 7 d | 829-285 |
| 8.12 | 4 | 32.4**1** | 7 d | 8378-36 |
| 8.362 | 4 | 33.44**1** | 7 d | 9198-146 |
| 2.4 | 4 | 9.6**1** | 7 d | 9198-234 |
| ROOT CROP VEGETABLES | Vegetable/Ground Fruit | 2 | 3 | 6 | 7 d | 19713-627 |
| 2 | 3 | 6 | 7 d | 19713-627 |
| 2 | 6 | 6 | 7 d | 432-1212 |
| 1.96 | 3 | 5.881 | 2 d | 829-285 |
| ROOT & TUBOR VEGETABLES | Vegetable/Ground Fruit | 2 | 3 | 6.0 | 7 d | 34704-289 |
| STRAWBERRIES | Vegetable/Ground Fruit | 2 | 5 | 12 | 7 d | 9198-146 |
| 2 | 5 | 10 | 7 d | 432-1212 |
| 2 | 4 | 8.0 | 7 d | 34704-289 |
| SUGAR BEET | Other row crops | 1.5 | 2 | 3 | 14 d | 19713-627 |
| SWEET POTATO | Vegetable/Ground Fruit | 2 | 3 | 6.0 | 7 d | 34704-289 |

**1** Application rate was not specified on the label; calculated by using known information from the label such as max single app rate and max # apps per year.

2 Labels were reviewed for use patterns that were limited to spot treatments; this use pattern is not a spot treatment.

**Table 2. Registered bait uses of carbaryl (wettable powder/pellets).** More detailed information on specific use sites is in **APPENDIX 1-3**.

| **Uses** | **Use Data Layer (UDL)** | **Max Single App rate (lb AI/A)** | **Max #Apps/ Year** | **Max App rate/Year (lb ai /A/Yr)1** | **MRI (days)** | **Labels** |
| --- | --- | --- | --- | --- | --- | --- |
| BLUEBERRIES | Vegetable/Ground Fruit | 0.415 | 3 | 1.2451 | 14 d | 8119-5 |
| BRASSICA / COLE CROPS | Vegetable/Ground Fruit | 0.415 | 3 | 1.2451 | 14 d | 8119-5 |
| CANEBERRIES & OTHER BERRIES | Vegetable/Ground Fruit | 0.415 | 3 | 1.2451 | 14 d | 8119-5 |
| ORNAMENTAL PLANTINGS | Open Spaced Developed | 0.415 | 6 | 2.491 | 21 d | 8119-5 |
| STRAWBERRIES | Vegetable/Ground Fruit | 0.415 | 3 | 1.2451 | 14 d | 8119-5 |
| TOMATOES | Vegetable/Ground Fruit | 0.415 | 3 | 1.2451 | 14 d | 8119-5 |

**1** Application rate was not specified on the label; calculated by using known information from the label such as max single app rate and max # apps per year.

Overall, the granular and bait use rates for carbaryl are comparable to the application rates for dust and other flowable uses on these sites. The maximum single granular application use rate is 8.36 lb a.i./acre per application for residential lawns, with up to four applications annually; the maximum annual application rate is not specified on this label. The maximum, annual, label-specified application rate for granular uses of carbaryl is 16 lb a.i./A for use on sweet corn. This compares to a maximum single flowable application rate of 8.33 lbs a.i./A and annual maximum of 16.3 lbs a.i./A for residential lawns, ornamental lawns, and turf, and 2.04 lbs a.i./A per application or 16.3 lbs a.i./A per year for sweet corn. (see **APPENDIX 1-3**).

For terrestrial invertebrates, the primary routes of exposure from the granular uses of carbaryl are assumed to be via ingestion of contaminated plants that uptake carbaryl from the soil. This approach is consistent with EFED’s risk assessment method for bees[[1]](#footnote-2). For ground dwelling species, there may also be contact with or ingestion of soil or granules. For application rates that are lower for the granular use than the flowable uses, the soil concentrations from the granular use are expected to be lower than the concentrations from the flowable uses. There are currently no methods available for precisely assessing exposure and risk via contaminated plants (from uptake). It is anticipated that the residue concentrations in plants from the granular use will not be higher than the residues on plants from flowable uses (assuming similar application rates). Therefore, for terrestrial invertebrates, the estimated exposures from the flowable uses will be used to evaluate exposures from the granular uses where possible. Root and tuber crop estimated exposures from flowables will be used to assess agricultural granular uses where no flowable uses were registered. Residential lawn estimated exposure will be used to assess residential granular uses where no foliar uses were registered.

For terrestrial vertebrates, the primary route of exposure is expected to be to birds found on the site of application that may ingest the granules, which are clay-based, as grit. Other vertebrates are generally not expected to intentionally ingest the granules because they are not food-based and are only likely to be ingested by animals that require grit for normal digestion (*i.e*., birds). Other taxa may also eat soil or have incidental soil ingestion; however, the probability of incidental ingestion for other vertebrates is assumed to be lower. The risk exposure estimates calculated for direct bird consumption are used as a proxy for the exposure of other terrestrial vertebrates.

The carbaryl granular product currently registered for uses on turf and residential lawns at these maximum rates contains 8% a.i. (EPA Reg. No. 9198-146). The carbaryl bait products registered for various garden uses are restricted to a lower application rate (0.415 lbs ai/A) and have a lower percent a.i. (5%) carbaryl; therefore, maximum exposure and risk estimates for the granular use are expected to be protective of the bait uses.

To explore potential exposures to birds, the number of carbaryl granules (8% a.i. products) that birds of different sizes would need to ingest to exceed the acute, mortality threshold (LD50 = 2290 mg/kg-bw) is calculated using T-REX (see **Table 3**). Based on this analysis, which used an estimated single granule weight of 10 mg, 20 g, 100 g, and 1,000 g birds would need to ingest 41, 262, and 3708 granules, respectively, to exceed the mortality threshold.

**Table 3. T-REX In-put and Outputs for the Carbaryl Granular Exposure Estimates for Birds (8% a.i. products)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Input/Output** | **20 g Bird** | **100 g Bird** | **1,000 g Bird** |
| Weight of bird (kg) | 0.02 | 0.10 | 1.0 |
| Adjusted threshold, mg/kg-bw1, 2 | 1650 | 2100 | 2970 |
| mg a.i. needed to achieve the adjusted threshold for bird of assessed weight | 33.0 | 210 | 2970 |
| Fraction of a.i. in formulated product  | 0.08 |
| Weight of 1 granule (mg, estimation) | 10 |
| mg a.i./granule  | 0.8 |
| No. of granules needed to exceed mortality threshold (8% a.i.) | 41.3 | 263 | 3710 |

1 Based on the LD50 mortality of 2290 mg a.i./kg-bw (Hudson et al. 1984, MRID 00160000, E50386).

2 Values were adjusted in the T-REX tool’s LD50 ft2 tab.

For vertebrate animals that may ingest contaminated plants, it is anticipated that the residue concentrations in plants associated with the granular and bait uses will not be higher than the residues on plants from flowable uses (assuming similar application rates). Therefore, for terrestrial vertebrates that may ingest contaminated plant material, the estimated exposures from the flowable uses were used to estimate exposures from the granular and bait uses where possible. Root and tuber crop estimated exposures from the flowable applications were used to assess agricultural granular uses where no flowable formulations were registered. Residential lawn estimated exposure will be used to assess residential granular uses where no flowable formulations were registered for the use pattern.

1. USEPA, Health Canada PMRA, & California Department of Pesticide Regulation. 2014. *Guidance for Assessing Pesticide Risks to Bees*. June 23, 2014. U.S. Environmental Protection Agency. Health Canada Pest Management Regulatory Agency. California Department of Pesticide Regulation. Available at <http://www2.epa.gov/pollinator-protection/pollinator-risk-assessment-guidance>. [↑](#footnote-ref-2)