California Department of Food and Agriculture
Statewide Plant Pest Prevention and Management Program
Environmental Impact Report, Addendum #5

Human Health Risk Assessment

Urban/Residential and Nursery Treatments, Pierce's Disease Control Program

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For a list of abbreviations and glossary terms, see the Dashboard Database 4.0 – *Glossary and Abbreviations*.

1 Executive Summary

This Human Health Risk Assessment (HHRA) was conducted as an addition to the HHRA performed as part of the Statewide Plant Pest Prevention and Management Program Environmental Impact Report (PEIR) (CDFA, 2014a). Six new alternative scenarios for foliar applications with Altus® insecticide for the control of glassy-winged sharpshooters, a vector for Pierce's Disease, were assessed:

(1) Applications to host plants in urban/residential settings using a mechanically pressurized handsprayer or backpack sprayer

(2) Applications to containerized host plants in production nursery loading docks using a backpack sprayer, mechanically pressurized handsprayer, or boom sprayer

(3) Applications in production nursery holds using a backpack sprayer, mechanically pressurized handsprayer, or boom sprayer

(4) Applications to large production nurseries using the mechanically pressurized handsprayer or boom sprayer

(5) Aerial applications via aircraft to large production nurseries

(6) Applications to containerized host plants in indoor production nursery loading docks using a mechanically pressurized handsprayer or backpack sprayer

The methods used in this risk assessment largely follow those methods used in the previous risk assessment in the Statewide PEIR (CDFA, 2014a) and Addenda (#1-3, 6) (CDFA, 2016a, 2017a, 2021a). Where methods differ, the new approaches, assumptions, and/or receptors are discussed.

CDFA and the Blankinship & Associates/Ardea Consulting team determined the appropriate scenarios to assess, models to evaluate exposure, default data assumptions, and appropriate toxic effects based on available scientific literature. Staff from the California Department of Pesticide Regulation (DPR) and the Office of Environmental Health Hazard Assessment (OEHHA) were briefed on the HHRA and provided review of project documents.

Acute, subchronic, and chronic dermal, inhalation, and oral exposures were considered for residents present after pesticide application (i.e., Post Application Resident, or PAR) and those present downwind during an application (i.e., Downwind Bystander, or DWB). The lifestages considered included the <2 year-old, 2-<16 year-old, and 16< year-old. In addition to resident receptors, the personnel responsible for handling and applying pesticides and treated vegetation were evaluated: the Mixer-Loader-Applicator (MLA), Post-Application Loader (PAL), and the Combined-Nursery Worker (CNW). Environmental media considered to contain pesticide residue included inedible vegetation, edible vegetation, drinking water, turf, soil and air.

The risk characterization phase provided conclusions on the potential for adverse effects to occur to human receptors, using the Margin of Exposure (MOE) technique. For this HHRA, the target MOE value, also referred to as the level of concern (LOC), that indicates an unlikely adverse impact to human health was 300. MOE values less than the LOC indicate the potential for adverse impacts to health; MOE values greater than the LOC indicate that adverse health impacts are unlikely. MOE values calculated for this HHRA ranged from approximately 283 to greater than $>10^{30}$. This indicates that exposure to pesticides during the Proposed Program is unlikely to result in adverse impacts to human health, with the exception of one scenario that required minor modifications as discussed in Section 7.1.

The magnitude of an MOE is indicative of the general safety of exposure, with larger MOEs generally indicating smaller potential health risk. Comparatively large MOEs should not, however, be interpreted as encouraging a receptor to unnecessarily come into contact with environmental media containing pesticides.

2 Introduction

This Human Health Risk Assessment (HHRA) evaluates six pesticide application scenarios within the California Department of Food and Agriculture's (CDFA) Pierce's Disease Control Program (PDCP, herein referred to as the "Proposed Program") for the control of glassy-winged sharpshooter (GWSS) in urban/residential and nursery settings. This document is an additional to the CDFA Statewide Plant Pest Prevention and Management Program Environmental Impact Report SCH # 2011062057 (Statewide PEIR) (CDFA, 2014a).

The primary goal of the PDCP is to minimize the statewide impacts of Pierce's disease and its vectors in California. Pierce's disease is a deadly disease of grapevines, caused by the bacterium *Xylella fastidiosa*. The bacterium is spread by xylem-feeding insects, most notably the GWSS. The GWSS is an invasive insect pest which was established and subsequently spread in southern California in the 1980s and 1990s. It caused serious outbreaks of Pierce's disease, leading to the establishment of the PDCP in 2000 to protect California's vineyards and other resources from further damage. The five major components of the PDCP are: contain the spread, statewide survey and detection, rapid response, outreach, and research.

2.1 Purpose of the Human Health Risk Assessment (HHRA)

The HHRA assesses potential future activities to be conducted under CDFA's Proposed Program. Specifically, the HHRA focuses on pesticide applications that would be available for use to control the glassy-winged sharpshooter. The HHRA evaluates the potential risk to human health following such pesticide applications.

2.2 Approach

A detailed discussion of the approach for the HHRA process is provided in the Statewide PEIR, Volume 3, Appendix B, Human Health Risk Assessment (CDFA, 2014a). For the purpose of this HHRA, the term "pesticide" refers to both active and inert ingredients in the formulated pesticide product.

This HHRA was conducted by using models and exposure data developed primarily by the United States Environmental Protection Agency (USEPA) in the context of typical pesticide application methods and settings in California. The HHRA depended on these USEPA exposure models to estimate environmental concentrations (EECs) in lieu of measured monitoring data. Many of these models, described in detail in the applicable sections of the Statewide PEIR (CDFA, 2014a), are Microsoft® Excel®-based user interface packages that allow for input of information specific to the Proposed Program, as well as default data when site-specific data are not available. Since multiple models were required for this HHRA, and some models required the output of other models as input, it was convenient to integrate several models into one Excel workbook so that information from all models could be combined into a single risk estimate as the final output for each pesticide application scenario. This Excel workbook, developed by Blankinship and Ardea Consulting under contract with CDFA, is referred to as the Comprehensive Risk ANalysis Kalculator (CRANK). The CRANK provides a consolidated tool to simultaneously estimate risk for the HHRA and the associated Ecological Risk Assessment (ERA).

To readily enter, store, retrieve, update and review information that serves as inputs for the various models used in the HHRA and addenda, a Microsoft® Access® database with a custom user interface was created. This Microsoft Access database is referred to as the Dashboard Database. Data used previously and as part of this analysis can be found in the newest version of the Dashboard Database (4.0). It is a supplement to this report and no conclusions should be based solely on the Dashboard Database or HHRA independently. To request a downloadable copy of the Dashboard Database, please email permits@cdfa.ca.gov.

The Dashboard Database specifically contains the following information:

- Specific details of each chemical application scenario, including application rates, maximum number of applications per year, application intervals, method of application, application area, etc.
- Pesticide product information, including formulation and concentration of active and, to the extent information is available and applicable, inert and adjuvant ingredients
- Physical, chemical, and fate properties of the chemicals considered in the HHRA, including degradation rate, vapor pressure, solubility, molecular weight, octanol-water coefficient (Log K_{OW}), and soil adsorption coefficient (K_{OC})
- Toxicological properties of the chemicals considered in the HHRA
- Summary of environmental effects based on published literature
- Model-specific inputs and outputs
- Soil concentration estimation results
- Water concentration estimation results
- Margins of Exposure (MOE) for each receptor under various conditions
- References, glossary terms, and abbreviations used throughout the report and Dashboard

Staff from the California Department of Pesticide Regulation (DPR) and Office of Environmental Health Hazard Assessment (OEHHA) reviewed and commented on the Proposed Program's HHRA. The purpose of this involvement was to allow for peer review, facilitate the exchange of information, collaborate on methods to assess and protect human health and the environment, and clearly communicate these methods and results to the public.

3 Hazard Identification

The first step in conducting the HHRA was a planning process called Hazard Identification (OEHHA, 2001a). This included identification of the ingredients of the pesticide products and adjuvants and the use scenarios that are anticipated under the Proposed Program. Pesticide and adjuvant ingredients were determined from pesticide manufacturers' label and safety data sheet (SDS). Details regarding the application of chemicals that impact the estimation of potential risk are:

3.1 Application Scenarios

Details regarding the application of the pesticides that impact the estimation of potential risk are:

- Type of chemical
- Concentration of chemical
- Application method (e.g., soil injection, fumigation, spraying)
- Duration and frequency of applications
- Rate of application
- Area of application
- Setting in which activity would occur (e.g., nursery, residential)
- Restricted Entry Interval (REI) requirements

As part of the Statewide PEIR (CDFA, 2014a), 59 application scenarios were analyzed in the PDCP. An additional nine scenarios were assessed in Addendum 3 (CDFA, 2020a) to the PEIR. The scenarios analyzed in this HHRA were compared to past work to determine if they could be considered a Substantially Similar Scenario (i.e., one in which products and application details are identical or substantially similar to one or more previously analyzed scenario or differs only in ways that would not significantly increase the risk of unreasonable adverse effects on the environment).

None of the scenarios described were considered substantially similar to the scenarios analyzed in the Statewide PEIR (CDFA, 2014a) or subsequent addenda (CDFA, 2016a, 2017a, 2020a, 2021b). Therefore, PDCP-79, PDCP-80, PDCP-81, PDCP-82, PDCP-83, and PDCP-84 were directly analyzed in this HHRA, as found in Table 1.

No application scenarios in the 2014 Statewide PEIR or its addenda assessed pesticide products containing flupyradifurone. In this assessment, Altus (active ingredient- flupyradifurone, inerts- propylene carbonate; oxirane, methyl-, polymer with oxirane, monobutyl ether) was analyzed as foliar spray applications targeting ornamentals and fruit trees in an urban/residential setting when applied using mechanically pressurized sprayer or a backpack sprayer (PDCP-79). Under the Proposed Program, Altus could be applied on an outdoor loading dock (PDCP-80) or in the production areas (PDCP-81) as a foliar spray to containerized nursery stock plants using a mechanically pressurized sprayer, backpack sprayer, or boom sprayer. Additionally, Altus may be applied to all nursery stock throughout the entire nursery using a mechanically pressurized sprayer or boom sprayer (PDCP-82), or as an aerial application (PDCP-83). Altus may also be applied to an indoor nursery loading dock (PDCP-84) using a backpack sprayer (PDCP-84a) or a mechanically pressurized handsprayer (PDCP-84b). In no scenario was an adjuvant used.

Consistent with the PEIR, CDFA defined the product application rate and other application details for each of the specific scenarios in the Program Material Data Sheet (PMDS) found in **Appendix A: PMDS** and summarized in **Table 1** at the end of this section. The defined application rate for all scenarios is 0.137 lbs flupyradifurone per acre. The following scenarios were assessed:

- **PDCP-79** consists of a single foliar application per year of Altus to a 17.5-acre area within an urban/residential setting.

- **PDCP-80** consists of 150 foliar applications made approximately every other day (2-day application interval) to 3750 ft^2 on the nursery loading dock.

- **PDCP-81** consists of two foliar applications made approximately 90 days apart each year to a 0.75-acre block of plants within the nursery production area.

- **PDCP-82** consists of a ground application.

- **PDCP-83** consists of an aerial application, with each scenario consisting of foliar applications made twice per year at a 6-month interval to a 130-acre nursery.

- **PDCP-84** consists of up to 24 foliar applications made every 15 days to a 3750 ft^2 area on an indoor nursery loading dock.

For urban/residential application scenarios, the application area was defined as a 17.5-acre area representing the entire area within the prescribed 150-meter (m) radius distance from a GWSS find. Treatments will be applied to host plants only. Within an application area, many features would not be treated, such as pavement, buildings, and lawns. Following the approach used in PEIR Addenda 1, 2, and 3 (CDFA, 2016a, 2017a, 2020a), it was assumed approximately one-third of the entire area was treated.

For nursery scenarios involving applications to containerized plants, it was assumed that treated containers were arranged such that approximately 80% and 60% of the pesticide from ground and aerial applications, respectively, was contained within the pot or deposited on foliage directly above the pot for ground applications, while approximately 20% and 40% of the pesticide from ground and aerial applications, respectively, was assumed to be subject to transport to water. Because the arrangement and density of treated containers may vary, making this assumption adds uncertainty as exposure estimates may be over- or under-estimated based on site-specific conditions.

Table 1: Foliar Application Scenarios of Altus Use for Pierce's Disease Control Program

Application Scenario	Application Method*	Setting	Application Rate (AR)	AR Active Ingredient (lb a.i./Ac)	Application Area	Area Treated/ Applicator/ Day (ATPD)	Max Apps/ year	Retreatment Interval (RTI)
PDCP-79	Backpack sprayer, mechanically pressurized handsprayer	Residential	10.5 fl. oz/ac	0.137	17.5 ac	17.5 ac	1	Per year
PDCP-80	Backpack sprayer, mechanically pressurized handsprayer, boom sprayer	Production Nursery Loading Dock	10.5 fl. oz/ac	0.137	3750 ft^2	3750 ft^2	150	2 days
PDCP-81	Backpack sprayer, mechanically pressurized handsprayer, boom sprayer	Production Nursery Hold	10.5 fl. oz/ac	0.137	0.75 ac	0.75 ac	2	90 days
PDCP-82	Mechanically pressurized handsprayer, boom sprayer	Large Production Nursery	10.5 fl. oz/ac	0.137	130 ac	50 ac	2	6 months
PDCP-83	Aerial	Large Production Nursery	10.5 fl. oz/ac	0.137	130 ac	130 ac	2	6 months
PDCP-84	Backpack, mechanically pressurized handsprayer	Production Nursery Indoor Loading Dock	10.5 fl. oz/ac	0.137	3750 ft^2	3750 ft^2	24	15 days

*When multiple application equipment were permitted for use under an application scenario, the ground equipment with the greatest unit exposure (UE) was selected as a health protective representative for exposure assessment. For PDCP-79, PDCP-80, and PDCP-81 the backpack sprayer yielded the greatest UE for both dermal and inhalation exposure. For PDCP-82, the mechanically pressurized handsprayer had the greater UE for both dermal and inhalation exposure. For PDCP-84, the backpack sprayer was associated with the greatest UE for dermal exposure while the mechanically pressurized sprayer had a greater UE for inhalation. Therefore, PDCP-84 was divided into PDCP-84a and PDCP-84b, respectively. Refer to Appendix B.

3.2 Active and Inert Ingredients

For the purpose of this HHRA, the term "pesticide" includes pesticide active and inert ingredients. The risk assessment team investigated the Altus label and Safety and Data Sheet (SDS) to determine the list of active and inert ingredients.

Two inert ingredients, propylene carbonate (42.8%) and oxirane, methyl-, polymer with oxirane, monobutyl ether (40.0%) were identified in Altus. Altus contains 17.09% flupyradifurone. No human toxicity data were identified for oxirane, methyl-, polymer with oxirane, monobutyl ether, and insufficient chemical property data were available to model environmental fate for oxirane, methyl-, polymer with oxirane, monobutyl ether. Therefore, potential impacts from oxirane, methyl-, polymer with oxirane, monobutyl ether could not be estimated. For Altus, the SDS lists all ingredients and no inert ingredients are unknown.

The ingredients were researched for chemical characteristics, including toxicity, as well as their environmental fate properties. Applicable environmental fate characteristics for the chemicals evaluated in this HHRA can found in the relevant sections of the Dashboard Database associated with the Statewide PEIR and updated with data from this assessment. The summary below for oxirane, methyl-, polymer with oxirane, monobutyl ether describes why it was not considered in the analyses.

Table 2: Altus Composition by Chemical

Product Application Rate (fl oz/ac)	Ingredient	% Ingredient Composition of Product	Ingredient Application Rate (lb/ac)
10.5	Flupyradifurone	17.19%	0.137
10.5	Propylene Carbonate	42.8%	0.343
10.5	Oxirane, methyl-, polymer w/oxirane monobutyl ether	40.40%	0.320

3.2.1 Flupyradifurone

Flupyradifurone is a butenolide insecticide (Subgroup 4D) that is applied through foliar and soil drench treatments to a broad spectrum of ornamental and agricultural crops, such as pome fruit and corn. It may also be used for seed treatment on soybeans (USEPA, 2014e). It is a systemic insecticide (when applied as a soil treatment) and translaminar when applied through foliar treatment and acts as a nicotinic acetylcholine receptor agonist (Health Canada, 2015a; FAO, 2017a; USEPA, 2016d)

A chemical summary for the active ingredient flupyradifurone may be found in the Dashboard Database 4.0, *Chemical Details* section.

3.2.2 Difluoroacetic Acid (DFA)

Difluoroacetic acid (DFA) is one of four major degradants of flupyradifurone that has been observed in aerobic environments in fate studies of flupyradifurone (USEPA, 2014e). Generally speaking, most degradants are less toxic than the parent compound to humans. However, DFA was considered for inclusion in the current assessment because DFA is reported to have similar toxicity to flupyradifurone.

In a 90-day feeding study with DFA in rats, reduced body weight and decreased food consumption were observed in males at the Lowest Observed Adverse Effect Level, or LOAEL, of 1000 ppm (66.2 mg/kg/day for males and 78.7 mg/kg/day for females), resulting in an established No Observed Adverse Effect Level, or NOAEL, of 200 ppm or 12.7 mg/kg/day for males and 15.6 mg/kg/day for females (USEPA, 2014e). Black foci were also observed in the stomach gland of both sexes at the 1000 ppm dose level. Although this effect was not statistically significant, it is considered to be toxicologically adverse due to its association with focal glandular erosion and/or necrosis in the stomach (USEPA, 2014e).

For flupyradifurone, a similar 90-day oral study in dogs established a NOAEL of 38 mg/kg/day based on observations of reductions in body weight and associated decreases in body weight gains at higher concentrations (USEPA, 2014e). Despite differences in the effects exhibited by DFA and flupyradifurone, the NOAELs established for flupyradifurone (289 g/mol) and DFA (97 g/mol) are comparable on a molar basis (USEPA, 2014e). Therefore, the flupyradifurone NOAEL was considered applicable to DFA. It should be noted that, because it is considered more health protective for the purposes of risk assessment, the subchronic human endpoint selected for the current analysis was a flupyradifurone NOAEL of 12 mg/kg/day established based on a 90-day oral toxicity study in dogs during which skeletal muscle atrophy was observed at the LOAEL (USEPA, 2016d). Critical endpoints selected for risk assessment are presented in Section 4.3.

An acute study of DFA reported an estimated LD50 of 6.957 g/kg in an oral gavage study in rats, based by the (Q)SAR toolbox, version 3.1 (European Union, 2020c). In a subacute (14-day repeated dose) oral range finding study in Wistar Rj: WI (IOPS HAN) rats exposed to DFA via the diet, statistically significant decreases in glucose concentrations were reported in both sexes at the 2000 ppm dose level, or 187 mg/kg/day in males and 201 mg/kg/day in females (USEPA, 2014f). The associated NOAEL in males and females was 48 mg/kg/day and 51 mg/kg/day, respectively. No treatment-related effects on survival, clinical signs, feed consumption, hematological parameters, or macroscopic or microscopic findings were reported (JMPR, 2015a). Because an acute study of rats orally exposed to flupyradifurone established a NOAEL of 35 mg/kg/day based on increased incidence of piloerection in both sexes and pupil dilation in females at higher dose levels (USEPA, 2016d), the acute oral NOAEL for flupyradifurone was considered to be protective of the subacute oral NOAEL for DFA and was selected for risk assessment.

In a bacterial reverse mutation test (*Salmonella typhimurium* strains TA98, TA100, TA102, TA1535, and TA1537), mammalian cell gene mutation test (Chinese hamster V79 cell/HPRT), and in vitro cytogenetics (chromosome aberration assay in Chinese hamster V79 cells) submitted to USEPA (2014f) in support of the registration of flupyradifurone, exposure to DFA did not result in mutagenic or genotoxic effects.

Based on these findings, DFA is of similar but not greater toxicity than flupyradifurone. Therefore, in lieu of conducting individual assessments of each chemical, flupyradifurone toxicity values were considered applicable to or protective of those associated with DFA in this HHRA. Consistent with the approach used or recommended by organizations such as USEPA, the Australian Pesticides and Veterinary Medicines Authority (APVMA), and the European Food Safety Authority (EFSA) (APVMA, 2018a; EFSA, 2015a; USEPA, 2016d), flupyradifurone residues were defined as the sum of flupyradifurone and DFA. Environmental fate data selected for exposure assessment was representative of the combination of flupyradifurone and its degradation products, including DFA, where applicable. Although degradants other than DFA may or may not constitute residues of concern, they were conservatively assumed to consist of solely DFA in the current analysis.

Information presented here on DFA is included in the flupyradifurone chemical summary within the *Chemical Details* section of the Dashboard Database 4.0.

3.2.3 Propylene Carbonate

Propylene carbonate is a carbonate ester derived from propylene glycol that is used in the production of a wide variety of products as a polar aprotic solvent (USEPA, 1998i). It is often used as an inert ingredient in pesticide formulations, but also as a plasticizer and chemical intermediate. It is not expected to have prolonged environmental persistence, as it is susceptible to both direct photolysis and hydrolysis (HSDB, 2003d).

A chemical summary for the inert ingredient propylene carbonate may be found in the Dashboard Database 4.0, *Chemical Details* section.

3.2.4 Oxirane, methyl-, polymer with oxirane, monobutyl ether

Because inert ingredients are often considered confidential business information, their identity is not disclosed and as a result cannot always be assessed. In the case of oxirane, methyl-, polymer with oxirane, monobutyl ether, no discrete human toxicity data were identified for the species known to be in Altus and insufficient chemical property data were available to model environmental fate for this class of chemicals.

Oxirane, methyl-, polymer with oxirane, monobutyl ether is a copolymer of ethylene and propylene oxide and falls under a large class of chemicals that share the CAS# 9038-95-3, with molecular weights ranging from 176.254 to >4,000 (CIR, 2017a; NIEHS, 2020a). Chemicals under the CAS# 9038-95-3 may be used in personal care products, such as shampoo, eye makeup remover, and fragrance ingredients, as a surfactant/emulsifying agent, as a chemical intermediate, and may be formulated as specialized lubricants (CIR, 2017a; DOW, 2015a; USDA, 2013a). However, due to the lack of distinct identification of what form(s) of oxirane, methyl-, polymer with oxirane, monobutyl ether are present in Altus, and a lack of environmental fate data to properly characterize the vast properties of this group, the, potential impacts from oxirane, methyl-, polymer with oxirane, monobutyl ether could not be estimated.

Information presented here on oxirane polymer is summarized within the *Chemical Details* section of the Dashboard Database 4.0.

4 Toxicity Dose-Response Assessment

The second step in the HHRA process was the assessment of toxicity (OEHHA, 2001a). All chemicals have some degree of toxicity and no substances are completely non-toxic. This fundamental concept of toxicology is expressed by Philippus Von Hohenheim (also known as Paracelsus), a 16th century physician and scientist (Pachter, 1951), in his famous maxim: "All things are poison, and nothing is without poison: only the dose permits something not to be poisonous." Accordingly, understanding the toxicity of pesticide active and inert ingredients and adjuvants, and the potential dose that human receptors might receive as part of Proposed Program, is critical. Two fundamentally different toxicological responses may transpire following exposure depending on the end response: cancerous and non-cancerous health effects. Toxicity values are quantitative values that describe the relationship between an estimated dose and the probability of developing cancer or the likelihood of producing non-cancerous health effects.

Non-cancerous health effects (e.g., difficulty breathing, neurological effects) were evaluated using no observable adverse effect levels (NOAELs). A NOAEL is the highest exposure level at which there are no statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its control (USEPA, 1993q).

When multiple, suitable NOAELs were available in the literature, the most sensitive effect level was selected. All NOAELs used in this assessment are reported in units of milligrams of chemical per kilogram body weight (BW) per day (mg/kg-day). Extrapolations were made and uncertainty factors applied to NOAELs selected from the literature for use in estimating risk. Extrapolation and uncertainty included using animal studies and/or surrogate chemicals. Use of the most sensitive effect level along with conservative extrapolation and uncertainty factors is generally considered health-protective of a representative cross section of the general population.

Consistent with the methods described in the Statewide PEIR, NOAELs were obtained for each assessed chemical for the available and relevant routes of exposure. Refer to the Dashboard Database 4.0*, Chemical Details* for a description of critical NOAELs selected for risk assessment.

Cancer risk was not characterized in this risk assessment because none of the active or inert ingredients are considered likely to be carcinogenic (USEPA, 2018a).

Data sources reviewed in the toxicity assessment are presented in Section 4.2 below.

4.1 Mechanism of Action and Target Organs and Systems

Toxicity studies are often conducted using single chemicals rather than a combination of chemicals that may be found in a specific pesticide formulation. An HHRA typically evaluates each chemical individually, and then combines the risks from multiple chemicals with the same effects to get a final, combined representation of risk.

As a health-protective and conservative approach, the cumulative risk of pesticide active and inert ingredients was estimated regardless of their mechanism of action (e.g., acetylcholinesterase inhibition), target organ (e.g., liver), or target system (e.g., nervous system).

The most sensitive adverse effect, as reported in studies typically described and accepted by the authoritative agencies described in Section 4.2, was selected for risk characterization purposes. By assuming exposure to each chemical contributed to cumulative adverse health effects, the potential risk to human health was likely overestimated, and, as a result, health protective and conservative in nature. This methodology is consistent with the approaches described in the USEPA (2004i) *Risk Assessment Guide to Superfund (RAGS)* and USEPA (2001e) *General Principles for Performing Aggregate Exposure and Risk Assessment* which provides guidance on assessing aggregate chemical risk and aggregate exposure pathway risk.

4.2 Data Sources

The toxicity assessment reviewed the following data sources. In the event that no conflicting or suspect data were found, other sources were used to corroborate the initial data found. The most conservative and health-protective data were used when two or more suitable data points existed. Any sources utilized during previous Statewide PEIR analyses were also considered.

- USEPA Pesticide Chemical Search: Reregistration Eligibility Decision (RED) and Human Health Risk Assessment (HHRA) documents (USEPA, 2020b)
- DPR Risk Characterization Documents (RCD) (DPR, 2020a)
- Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles (ATSDR, 2020a)
- OEHHA Toxicity Criteria Database (OEHHA, 2020a)
- United Nations Environmental Programme (UNEP) Screening Information Dataset System (SIDS) Initial Assessment Profiles (UNEP, 2020a)
- United States Department of Agriculture (USDA) Human Health Risk Assessments (USDA, 2020a)
- National Center for Biotechnology Information, National Library of Medicine PubChem (PubChem, 2021a)

4.3 Toxicity Endpoints Selected for Risk Characterization

Critical NOAELs used for risk characterization were identified and selected from the literature in a manner consistent with the methods described in the Statewide PEIR. Each pesticide or adjuvant ingredient was categorized into one of three categories for each evaluated exposure route (oral, inhalation, dermal) depending on the toxicity information available. These categories of classification included: Not of Concern (NOC), Potential Toxicological Concern (PTC), and No Data Available (NDA). Chemicals evaluated as NOC are not of toxicological concern for an exposure route based on the criteria described previously in the Statewide PEIR. Chemicals evaluated to be of potential toxicological concern for specific exposure routes were deemed PTC and available NOAELs were used to characterize risk quantitatively using the methods described in Section 6. A chemical was designated as NDA when endpoint data suitable for assessing risk was not available for this chemical and endpoint category. The risk for chemicals designated NDA could not be evaluated.

The critical NOAELs selected for risk characterization of flupyradifurone and propylene carbonate are presented in **Table 3** and **Table 4**, respectively. Additional notes about endpoint selection may be found in the *Chemical Details (Human Endpoints)* section of the Dashboard Database 4.0.

Table 3: NOAELs Selected for Risk Characterization of Flupyradifurone

Exposure Duration	Value (mg/kg-d)	Adverse Effect	Source
Acute	35	Piloerection and pupil dilation in females	USEPA, 2016d
SC	12	Skeletal muscle atrophy/degeneration	USEPA, 2016d
Chronic	7.8	Focal/Multifocal areas of skeletal muscle degeneration in gastrocnemius and/or biceps femoris muscle.	USEPA, 2016d

Table 4: NOAELs Selected for Risk Characterization of Propylene Carbonate

Exposure Duration	Pathway	Value (mg/kg-d)	Adverse Effect	Source
Acute	Oral	1000	Mortality, salivation, decreased activity, abnormal gait, dyspnea, cyanosis	USEPA, 2002n
	Dermal	1000	Mortality, salivation, decreased activity, abnormal gait, dyspnea, cyanosis	USEPA, 2002n
	Adult Inhalation	13.187	Inflammation of ocular tissues	USEPA, 2002n
	Child Inhalation	20.236	Inflammation of ocular tissues	USEPA, 2002n
Subchronic	Oral	100	Mortality, salivation, decreased activity, abnormal gait, dyspnea, cyanosis	USEPA, 2002n
	Dermal	100	Mortality, salivation, decreased activity, abnormal gait, dyspnea, cyanosis	USEPA, 2002n
	Adult Inhalation	13.187	Inflammation of ocular tissues	USEPA, 2002n
	Child Inhalation	20.236	Inflammation of ocular tissues	USEPA, 2002n
Chronic	Oral	100	Mortality, salivation, decreased activity, abnormal gait, dyspnea, cyanosis	USEPA, 2002n
	Dermal	100	Mortality, salivation, decreased activity, abnormal gait, dyspnea, cyanosis	USEPA, 2002n
	Adult Inhalation	13.187	Inflammation of ocular tissues	USEPA, 2002n
	Child Inhalation	20.236	Inflammation of ocular tissues	USEPA, 2002n

5 Exposure Assessment

The third step in the HHRA was to estimate how much pesticide or adjuvant exposure an individual (herein referred to as a "receptor") would receive (OEHHA, 2001a). Exposure is commonly defined as contact of visible external physical boundaries (i.e., external boundaries such as the mouth, nostrils, and skin) with a chemical. In an exposure assessment, factors related to human behavior and characteristics that affect their exposure are often utilized for both qualitative and quantitative purposes. These parameters that influence the extent to which a receptor is exposed to a chemical are referred to as exposure factors (USEPA, 2011p). Exposure is dependent upon the intensity, frequency, and duration of contact. The intensity of contact is typically expressed in terms of the concentration of chemical per unit mass or volume (i.e., µg/g, µg/L, mg/m^3, ppm, etc.) in the media (i.e., soil, air, water, etc.) to which the receptor is exposed. Dose refers to the amount of chemical to which receptors are exposed that crosses the external boundary. Dose is dependent upon chemical concentration and the rate of intake (i.e., inhalation or ingestion) or uptake (e.g., dermal absorption) and may be normalized to receptor body weight as a function of time (i.e., mg/kg-day). The receptor average daily dose (ADD) rate is estimated in the generalized equation shown below:

$$ADD = \frac{C * CR * ED * EF * DAF}{BW * AT}$$

Where:

ADD = average daily dose (mg/kg-day);
C = chemical concentration (mg/L, mg/m^3; mg/cm^2, mg-medium/day);
CR = contact rate (L/day; m^3/day; cm^2/day, mg/day);
ED = exposure duration (years);
EF = frequency of exposure events (days/year);
DAF = dermal absorption factor (unitless)
*only applied for dermal exposure when endpoint was derived from an oral or inhalation study
BW = body weight (kg); and
AT = averaging time (days).

The chemical concentration (C), also expressed as an estimated environmental concentration (EEC), refers to the amount of pesticide residue in the media of interest, and contact rate (CR) refers to the rate of ingestion, inhalation, or dermal deposition per day. Exposure duration (ED) refers to the length of time that contact occurs and is affected by activity patterns. Exposure frequency (EF) is the number of exposure events over a specified time period. Absorbed doses may be estimated by applying an absorption factor. Body weight (BW) and averaging time (AT) are specific to the receptor and exposure scenarios being evaluated. For the average daily dose (ADD), a single-day exposure to a receptor was calculated using an acute exposure duration and averaging time of 1 day. The averaging time represents the number of days over which the exposure is averaged. For subchronic exposure, the subchronic average daily dose (SADD) was calculated using an averaging time of 30 days, which is consistent with the exposure duration. For chronic exposure, the annual average daily dose (AADD) is calculated using an averaging time which is receptor-specific and consistent with methods used in the Statewide PEIR, unless otherwise specified.

The exposure assessment portion of the HHRA was divided into two parts. The first part was to estimate the concentration of pesticides in the environment through fate and transport processes. This included estimating the concentration of pesticide residues that may be found in the air, water, soil, and contained in/on the plant. This methodology took into account the total amount of pesticide applied, along with chemical-specific mechanisms of dispersal or degradation that may occur during or shortly after application. The next part in determining human exposure (i.e., ADD, SADD, and AADD) was to estimate how much of the EEC would be absorbed by the receptor. The three main uptake pathways addressed in the HHRA were inhalation, ingestion, and dermal absorption. Receptor exposure and EECs are each discussed in further detail below.

5.1 Conceptual Site Model

A conceptual site model (CSM) is a written and graphical presentation of predicted exposure pathways (i.e., inhalation, dermal contact, or ingestion) between the pesticide application and receptor. It includes a description of the complete exposure pathways and outlines the primary release mediums, impacted media, and potential routes of exposure for each receptor. A complete exposure pathway exists when pesticide or adjuvant can be traced, or expected to travel, from the point of application to plants, soil, or air and eventually to a receptor. An exposure pathway that is not complete means that it is unlikely for that receptor to be exposed to a pesticide or adjuvant through that exposure pathway. The CSM identifies multiple pathways through which receptors can be exposed to pesticides as part of the Proposed Program.

Receptors that were considered for exposure included the Mixer-Loader-Applicator (MLA), Post-Application Loader (PAL), Combined-Nursery Worker (CNW), Downwind Bystander (DWB), Post-Application Resident (PAR), and the During and Post-Application Resident (DPAR). The MLA is the occupational worker who mixes, loads, and applies pesticide and adjuvant products. The PAL is a nursery employee that transports treated, containerized plants after the REI has passed. The CNW is an occupational worker who is assumed to both handle pesticides and loads treated plants (i.e., a combination of the MLA and the PAL). The DWB is any human receptor 25 feet away from an application in a residential or nursey setting who may be exposed to off-site drift. The PAR is an individual living in an urban/residential area who has the potential to come into contact with active, inert, or adjuvant residues following residential treatments. The DPAR is a person present 25 feet downwind of a residential application and also has the potential to be exposed to pesticide or adjuvant residues after the treatment (i.e., a combination of the DWB and PAR). The receptors considered will be discussed in greater detail in Section 5.4.

The starting point of the CSM is the application technique which considers the release of pesticide and/or inert into the environment. The next exposure step following an application depends on the environmental media that pesticide and/or inert reaches after application. Pesticide and/or inert residues may be found in the soil, air, water, turf, and vegetation, and receptors present at the time of the application. Turf or other plants present within the treated area may be exposed to pesticide via direct application, overspray, and uptake from the soil.

Following an application, the potential exists for off-site movement via aerial drift (hereinafter referred to as “drift”), runoff, and leaching such that pesticide residues may be present in surface water, groundwater, and/or adjacent untreated areas.

Once a pesticide is present in an environmental media, three routes of exposure exist for a receptor to become exposed: ingestion, dermal, and inhalation.

The CSMs for applications in residential, outdoor nursery, and indoor nursery settings in the Proposed Program are presented in **Figure 1**, **Figure 2**, and **Figure 3**, respectively.

Figure 1: Pierce's Disease Control Program Activities Residential CSM

Primary Source	Primary Release	Secondary Source	Impacted Media	Exposure Routes	Mixer/Loader/ Applicator (MLA)	Adult, 2<16 Child, 0<2 Child Downwind Bystander (DWB)	Adult Post-Application Resident (PAR)	2<16 Child Post-Application Resident (PAR)	0<2 Child Post-Application Residents (PAR)	Adult During & Post-Application Residents (DPAR)	2<16 Child During & Post-Application Residents (DPAR)	0<2 Child During & Post-Application Residents (DPAR)
Foliar Sprayers (Backpack Sprayer, Mechanically Pressurized Sprayer)			Air	Dermal	X	X	O	O	O	X	X	X
				Inhalation	X	X	O	O	O	X	X	X
	Droplets, Vapor, or Mist		Turf/ Groundcover	Dermal	O	O	X	X	X	X	X	X
				Hand-to-Mouth	O	O	O	X	X	O	X	X
				Object-to-Mouth	O	O	O	X	X	O	X	X
			Soil	Dermal	O	O	X	X	X	X	X	X
				Pica Ingestion	O	O	O	X	X	O	X	X
		Treated Vegetation	Ornamental and Edible Vegetation	Dermal	X	O	X	X	X	X	X	X
				Hand-to-Mouth	O	O	O	X	X	O	X	X
				Ingestion Edible Vegetation	O	O	X	X	X	X	X	X
		Water	Surface Water	Ingestion	O	O	X	X	X	X	X	X
			Groundwater	Ingestion	O	O	X	X	X	X	X	X

Key:
X - Complete Exposure Pathway
O - Incomplete, Inconsequential, or *De Minimis* Exposure Pathway

Notes:
Worker exposure scenarios assume that all appropriate personal protective equipment (PPE) is worn according to the product label and California law.
The MLA is not evaluated for pesticide ingestion because it is assumed this receptor is properly trained not to consume pesticide
Exposure pathways for incidental soil ingestion is expected to be *de minimis* compared to pica soil ingestion.
For exposure via hand-to-mouth, object-to-mouth, and soil ingestion, the Child PARs are assumed to be health protective of the adult PAR.

Figure 2: Pierce's Disease Control Program Activities Outdoor Nursery CSM

Primary Source	Primary Release	Secondary Source	Impacted Media	Exposure Routes	Mixer/Loader/ Applicator (MLA)	Post-Application Loader (PAL)	Combined Nursery Worker (CNW)(b)	Adult, 2<16 Child, 0<2 Child Downwind Bystander (DWB)	Adult, 2<16 Child, 0<2 Child Post-Application Resident (PAR)	Adult, 2<16 Child, 0<2 Child During & Post-Application Resident (DPAR)
Foliar Application (Backpack Sprayer, Mechanically Pressurized Sprayer, Boom Sprayer, Aerial)			Air	Dermal	X	O	X	X	O	X
				Inhalation	X	O	X	X	O	X
	Droplets, Vapor or Mist		Soil	Dermal	O	X	X	O	O	O
				Incidental Ingestion	O	O	O	O	O	O
		Treated Vegetation	Ornamental and Edible Vegetation	Dermal	X (a)	X	X	O	O	O
				Hand-to-Mouth	O	O	O	O	O	O
				Intentional Ingestion	O	O	O	O	O	O
		Water	Surface Water	Ingestion	O	O	O	O	X	X
			Groundwater	Ingestion	O	O	O	O	X	X

Key:
X - Complete Exposure Pathway
O - Incomplete, Inconsequential, or *De Minimis* Exposure Pathway

Notes:
(a) The MLA is only expected to have dermal exposure through mixing, loading, and applying pesticide, and not expected to come into dermal contact with treated plants
(b) The CNW is an occupational worker who is assumed to both handle pesticides and loads treated plants (i.e., a combination of the MLA and the PAL).
Worker exposure scenarios assume that all appropriate personal protective equipment (PPE) is worn according to the product label and California law.
MLA, PAL, and CNW are not evaluated for pesticide ingestion because it is assumed these receptors are properly trained not to consume pesticide.
Exposure for the post-purchase consumer to treated plants in nursery was not evaluated.

Figure 3: Pierce's Disease Control Program Activities Indoor Nursery CSM

Primary Source	Primary Release	Secondary Source	Impacted Media	Exposure Routes	Mixer/Loader/ Applicator (MLA)	Post-Application Loader (PAL)	Combined Nursery Worker (CNW)(b)
Foliar Application (Backpack Sprayer, Mechanically Pressurized Sprayer, Boom Sprayer)			Air	Dermal	X	O	X
				Inhalation	X	O	X
	Droplets, Vapor or Mist		Soil	Dermal	O	X	X
				Incidental Ingestion	O	O	O
		Treated Vegetation	Ornamental and Edible Vegetation	Dermal	X (a)	X	X
				Hand-to-Mouth	O	O	O
				Intentional Ingestion	O	O	O
		Water	Surface Water	Ingestion	O	O	O
			Groundwater	Ingestion	O	O	O

Key:
X - Complete Exposure Pathway
O - Incomplete, Inconsequential, or *De Minimis* Exposure Pathway

Notes:
(a) The MLA is only expected to have dermal exposure through mixing, loading, and applying pesticide, and not expected to come into dermal contact with treated plants
(b) The CNW is an occupational worker who is assumed to both handle pesticides and loads treated plants (i.e., a combination of the MLA and the PAL).
Worker exposure scenarios assume that all appropriate personal protective equipment (PPE) is worn according to the product label and California law.
MLA, PAL, and CNW are not evaluated for pesticide ingestion because it is assumed these receptors are properly trained not to consume pesticide.
Exposure for the post-purchase consumer to treated plants in nursery was not evaluated.
The non-occupational receptors are not assumed to come into contact with pesticide residues from indoor applications.

5.2 Physical, Chemical, and Environmental Fate Properties

Consistent with the methods described in the Statewide PEIR, data on physical, chemical, and environmental fate (PCF) properties were reviewed from the sources below. Any sources utilized during previous Statewide PEIR analyses were also considered.

- USEPA Reregistration Eligibility Decision (RED) documents (USEPA, 2020b)
- DPR Risk Characterization Documents (RCD) (DPR, 2020a)
- ATSDR Toxicological Profiles (ATSDR, 2020a)
- National Center for Biotechnology Information (NCBI) PubChem Database (PubChem, 2021a)
- United Nations Environmental Programme (UNEP) Screening Information Dataset System (SIDS) Initial Assessment Profiles (UNEP, 2017a)

When multiple suitable values were available, final PCF values utilized in the risk analysis were calculated consistent with the methods described in the Statewide PEIR. The PCF data selected and estimated final values selected for risk assessment are available in the *Chemical Details* section of the Dashboard Database 4.0. If PCF data were not available for a given chemical, a suitable surrogate was selected, when possible, based on its similarity in chemical structure and physical properties.

5.3 Estimating Pesticide Environmental Concentrations

The EEC is defined as the predicted concentration of pesticide within an environmental compartment (i.e., soil, water, plant tissue, or a specific organism) based on estimates of quantities applied, application methods, chemical-specific fate and transport properties, and the nature and characteristics of the application and surrounding area.

Because no empirical data were available for the Proposed Program, EECs were estimated using various models that have been developed for use in risk assessments. These models are designed to use conservative assumptions and in many cases are not capable of modeling all of the complex fate and transport processes that can occur once a pesticide and/or adjuvant is released into the environment. Typical fate properties that tend to decrease the concentration of pesticide chemicals include aerobic degradation, anaerobic degradation, photodegradation, absorption, solubilization, and volatilization. Key transport properties that may not be accounted for are dilution and partial transfer between media such as plants, soil, water, and air. Therefore, most of the EECs represented an upper-bound, conservatively high value since not all fate and transport properties have been modeled.

Most procedures for estimating EECs for the Proposed Program were consistent with those used in the Statewide PEIR (CDFA, 2014a). The assumptions that differ between the Proposed Program and the Statewide PEIR are presented below.

See Section 3.1 for specific details about the Program scenarios assessed. Estimated environmental concentrations are presented in the *Pest Programs* section of Dashboard Database 4.0.

5.3.1 Occupational Exposure Values

For occupation exposure assessments (e.g., mixer-loader-applicator), unit exposures (UEs) from USEPA's (2020a) *Occupational Pesticide Handler Exposure Database* (OPHED) were selected in accordance with methods described in USEPA's (2007k) *Review of Worker Exposure Assessment Methods*. Selection of unit exposures was generally completed in a similar manner as presented in the Statewide PEIR (CDFA, 2014a). Refer to Section 4.2.1.6.1 Mixer-Loader-Applicator of the Statewide PEIR (CDFA, 2014a) for additional details.

Some unit exposures selected for risk assessment in this addendum were adjusted based on the empirical data those unit exposures were derived from and anticipated treatment activities using Altus. See **Appendix B** for details.

Occupational unit exposures selected are presented in the *Pest Programs* section of the Dashboard 3.0.

5.3.2 Pesticide Off-target Drift

Off-target drift of pesticide residues was estimated in a similar manner as presented in the Statewide PEIR (CDFA, 2014a). Methods for assessing ground applications in AgDRIFT (USEPA, 2017d) were followed, and in accordance with USEPA's (1999f) *Overview of Issues Related to the Standard Operating Procedures for Residential Exposure Assessment*, a "Flagger" UE from USEPA's (2020a) OPHED was used to assess exposure to off-target drift to the DWB. Refer to Section 4.2.1.4.3 Pesticide Off-target Drift and Section 4.2.1.6.5 Downwind-Bystander of the Statewide PEIR (CDFA, 2014a) for additional details.

Flagger unit exposures and AgDRIFT estimated percent deposition are presented in the *Pest Programs* section of the Dashboard 3.0.

5.3.2.1 Residential

Concentrations in soil beneath treated ornamental plants or fruit trees in residential settings were used to estimate exposure from dermal contact and ingestion of soil. The soil was assumed to receive 20% of the applied Altus from drift in foliar applications (Linders *et al.*, 2000). Flupyradifurone and propylene carbonate were assumed to be available for potential exposure directly through soil and through uptake into plant tissue.

Soil concentrations for acute exposure in residential settings were represented by the peak residue concentrations in soils immediately following an application. Soil concentrations for subchronic exposure in residential settings represented the maximum 30-day daily average concentration that could occur over one year. Soil concentrations for chronic exposure in residential settings represented the daily concentration averaged over a 365-day period. Despite signage posted at the treatment area instructing residents not to enter until the spray has dried, environmental concentrations were modeling assuming no REI.

For additional details on estimation methods, refer to the Acelepryn Residential Foliar and Turf Japanese Beetle Human Health Risk Assessment, Section 5.2.1 (CDFA, 2017a).

5.3.2.2 Nursery

Concentrations in the soil of potted plants were used to estimate worker exposure from dermal contact with soil in nursery settings. The soil was assumed to receive 20% of the applied Altus via drift from foliar applications (Linders *et al*., 2000). Both active and inert ingredients in the soil were assumed to be available for potential exposure directly through soil.

To assess acute, subchronic, and chronic exposure in nursery settings, the initial soil concentration following an application was utilized. It was assumed that workers would follow the REI in accordance with label language and California law, which for Altus is 12 hours. It was also assumed workers in nursery settings would come in contact with treated soil following an application prior to transportation of the containerized plant.

5.3.3 Surface Residues on Non-Edible Vegetation

5.3.3.1 Residential

Flupyradifurone and propylene carbonate EECs on foliage were used to estimate exposure from dermal contact with plant surfaces. The surface of non-edible vegetation in residential settings was assumed to receive 100% of the applied ingredients despite 20% assumed to deposit on soil (Linders *et al.*, 2000). This method was a conservative approach as it assumed 120% of the applied pesticide is available for exposure.

Post-application flupyradifurone and propylene carbonate on vegetation that are available for dermal transfer to a receptor's skin are referred to as dislodgeable foliar residue (DFR_t). The method for estimating the residential DFR_t was derived from a modification of the USEPA's (2012l) *Standard Operating Procedures for Residential Pesticide Exposure Assessment* (SOP) as follows:

$$DFR_t = AR * F_{AR} * (1 - F_D)^t * CF_1 * CF_2 * CIF$$

Where:

DFR_t = Dislodgeable foliar residue (t) days after application (µg/cm^2)
AR = Application rate (lb a.i./acre)
F_{AR} = Fraction of transferable a.i.
F_D = Fraction of residue that dissipates per day
t = Time after application (days)
CF_1 = Weight conversion factor (µg/lb)
CF_2 = Area unit conversion factor (acre/cm^2)
CIF = Canopy Interception Factor (%)

The F_{AR} was left unchanged from the default USEPA SOP value of 0.25, and the F_D was modified to reflect the rate at which flupyradifurone or propylene carbonate dissipates per day. The F_D was calculated by determining the percent of flupyradifurone or propylene carbonate remaining 1 day after application, using a foliar half-life of 87.25 days for flupyradifurone and 1.08 days for propylene carbonate and the equation for first-order rate kinetics (Juraske *et al.*, 2008; USEPA, 2012l, 2014e). Using this method, the residue concentration remaining after 1 day for flupyradifurone was estimated to be 99.21%; therefore, the percent of flupyradifurone residue assumed to dissipate per day was 0.79%. The residue concentration remaining after 1 day was estimated to be 52.63% for propylene carbonate; therefore, the percent of propylene carbonate residue assumed to dissipate per day was 47.37%. The equation of first-order rate kinetics is given below:

$$C_t = C_0 e^{-kt}$$

Where:

C_t = Concentration on Day t following the application
C_0 = Concentration on Day 0 (immediately following application)
e = 2.718
k = 0.693/half life
t = time (days)

A summary of the exposure factors used in estimating residential DFR_t is given in **Table 5**.

Table 5: Exposure Factors Used in Estimating Residential DFR_t

Chemical	F_{AR}	F_D	t (days)	CIF (unitless)	Foliar Half Life (days)
Flupyradifurone	0.25	0.0079	0-365	1	87.5
Propylene Carbonate		0.4737			1.08

For estimating residue concentrations for acute exposures, dermal contact was assumed to occur immediately after application without any degradation, and the DFR_t value represents the peak concentration. No REI was accounted for in estimating exposure in residential settings.

For subchronic exposures, dermal contact was assumed to occur every day over 30 days. The subchronic DFR_t value represents the maximum 30-day average concentration on foliage that could occur over a 365-day period.

For chronic exposures, dermal contact was assumed to occur every day for 365 days, so the estimated daily foliar concentration was averaged over a 365-day period. The chronic DFR_t value represents the 365-day average concentration on foliage assessed over the course of a year.

Residential DFR_t concentration results are presented in the *Pest Programs* section of the Dashboard Database 4.0.

5.3.3.2 Nursery

The surface of non-edible vegetation in nursery settings was assumed to receive 100% of the applied ingredients despite 20% assumed to deposit onto soil (Linders *et al.*, 2000). This method was likely an overestimation of environmental concentration as it assumed 120% of the applied pesticide was available for exposure. The equation for estimating the occupational DFR_t is the same as the residential DFR_t, which can be found in Section 5.3.3.1

DFR_t concentrations for acute, subchronic, and chronic duration exposure in nursery settings represent the concentration following a single application. The fraction dissipated after the REI of 12 hours (F_{REI}) was accounted for without consideration of environmental degradation, as it was assumed workers in nursery settings would come into contact with treated foliage following an application prior to transportation of the containerized plant.

A summary of the exposure factors used in estimating occupational DFR_t is given in **Table 6**.

Table 6: Exposure Factors Used in Estimating Occupational DFR_t

Chemical	CIF	t (days)	F_{REI}
Flupyradifurone	1	0.5	0.004
Propylene Carbonate			0.27

Occupational DFR_t concentration results are presented in the *Pest Programs* section of the Dashboard Database 4.0.

5.3.4 Edible Vegetation Residue

Uptake by plants from soil in residential settings was estimated in a similar manner to that used in the ERA of the Statewide PEIR (CDFA, 2014a) with the exception that a revised Briggs equation was used based on the updated version in USEPA's (2014a) *Guidance for Assessing Pesticide Risk to Bees*. Complete details regarding how the Briggs equation is used appear in the

Statewide PEIR (CDFA, 2014a). Consistent with guidance provided by USEPA (2014a), if the octanol/water partition coefficient (Log K_{ow}) was greater than 5.0, no uptake was assumed. When the Log K_{ow} was negative, the Transpiration Stream Concentration Factor (TSCF) was assumed to be 1.0 (Collins *et al*., 2006).

No exposure was evaluated for the post-purchase consumption of treated plants in nursery settings.

For estimating residue concentrations for acute exposures, the EEC value taken up by plants represents the peak concentration.

For subchronic exposures, ingestion of treated edible vegetation was assumed to occur every day over 30 days. The subchronic EEC represents the maximum 30-day average concentration in foliage that could occur over a 365-day period.

For chronic exposures, ingestion of treated edible vegetation was assumed to occur every day for 365 days, so the estimated EEC in plants was averaged over a 365-day period. The chronic EEC value represents the 365-day average concentration in edible plants assessed over the course of a year.

For assessing the concentration of flupyradifurone and propylene carbonate in the tissue of edible vegetation due to soil deposition following a foliar application, it was assumed 20% of pesticide was available for uptake in soil (Linders *et al.*, 2000).

First, the K_{ow}-specific Transpiration Stream Concentration Factor (TSCF) was calculated to estimate the relative potential for the translocation of a chemical within a plant, based on the following equation:

$$TSCF = [-0.0648 \times (\text{Log } K_{ow})^2 + 0.241 \times \text{Log } K_{ow} + 0.5822]$$

Where:

TSCF = Transpiration Stream Concentration Factor

K_{ow} = Octanol/Water Partition Coefficient (unitless)

Using the TSCF and other inputs as described below, the Briggs equation (USEPA, 2014a) was utilized to yield the Terrestrial Vegetation Uptake Factor (VUF) in wet weight:

$$\text{Terrestrial VUF} = ([10^{(0.95 \times \text{Log } K_{ow} - 2.05)} + 0.82] \times \text{TSCF} \times \left[\frac{\rho}{\theta + \rho \times K_{oc} \times f_{oc}}\right])$$

Where:

VUF = Vegetation uptake factor
K_{ow} = Octanol/Water Partition Coefficient (unitless)
ρ = soil bulk density (g/cm^3)
θ = soil-water content by volume (cm^3/cm^3)
K_{oc} = soil organic carbon-water partitioning coefficient (cm^3/g-organic carbon or L/kg-organic carbon)
f_{oc} = fraction of organic carbon in the soil

The values of ρ, θ, and f_{oc} were obtained from USEPA (2006y) data associated with its Pesticide Root Zone Model (PRZM) inputs for Exeter fine sandy loam. Please see Section 4.4.2 of the ERA for more details. The total concentration of flupyradifurone and propylene carbonate in plant tissue was estimated by multiplying the Terrestrial VUF and the concentration of flupyradifurone and propylene carbonate available in the soil, as shown in the equation below:

$$EEC_{Briggs} = \text{VUF} * \text{Soil Concentration}$$

For foliar applications, it was assumed that 100% of applied pesticide was retained on edible vegetation surface.

To estimate surface residues on edible foliage, the USEPA's (2012l) Terrestrial Residue EXposure (T-REX) model (Version 1.5) was used. Using chemical-specific data, T-REX estimated the flupyradifurone and propylene carbonate concentrations on terrestrial vegetation using the peak value (acute), 30-day maximum concentration (subchronic), and 365 day average concentration (chronic). Receptors were assumed to consume vegetation from the fruits and seeds category. For more details, please see the Statewide PEIR (CDFA, 2014a).

In this risk assessment, it was assumed that consumption of edible vegetation would occur without external precautionary measures, like washing to reduce pesticide residue. However, under the Proposed Program, notices are posted that instruct residents to wash exposed edible vegetation prior to consumption. Therefore, the pesticide concentration on edible vegetation estimated in this HHRA was likely an overestimation.

The exposure factors used in estimating flupyradifurone and propylene carbonate concentrations in and on edible vegetation are summarized in **Table 7**.

Table 7: Exposure Factors Used in Estimating Edible Vegetation Residues

Chemical	Log K_{ow}	ρ (g/cm3)	θ (cm^3/cm^3)	K_{oc} (cm3/g)	f_{oc}	Soil EEC (mg/kg)
Flupyradifurone	0.08	1.7	0.218	109	0.0058	See the Dashboard Database 4.0
Propylene Carbonate	-0.41			5		

Edible vegetation residue concentration results are presented in the *Pest Programs* section of the Dashboard Database 4.0.

5.3.5 Transferable Turf Residue

In residential foliar application scenarios, 20% of the pesticide applied to foliage was assumed to deposit onto turf (DtT) and groundcover (Linders *et al.*, 2000). Flupyradifurone and propylene carbonate EECs on turf surfaces were used to estimate exposure from dermal contact with turf and incidental hand-to-mouth ingestion of pesticide residues.

Post-application flupyradifurone and propylene carbonate on turf surfaces that are available for dermal transfer to a receptor's skin and hand-to-mouth ingestion are referred to as transferable turf residues (TTRs). The method for estimating the TTR_t was selected from USEPA's (2012l) SOP. The following equation was used to estimate the TTR_t:

$$TTR_t = AR * F_{AR} * (1 - F_D)^t * CF_1 * CF_2 * DtT$$

Where:

TTR_t = Transferable turf residue (t) days after application (µg/cm^2)
AR = Application rate (lb a.i./acre)
F_{AR} = Fraction of transferable a.i.
F_D = Fraction of residue that dissipates per day
t = Time after application (days)
CF_1 = Weight conversion factor (µg/lb)
CF_2 = Area unit conversion factor (acre/cm^2)
DtT = Deposition to Turf (%)

The F_{AR} was left unchanged from the default USEPA SOP value of 0.01, and the F_D was modified to reflect the rate at which flupyradifurone or propylene carbonate dissipates per day. The F_D was calculated by determining the percent of flupyradifurone or propylene carbonate remaining 1 day after application, using a foliar half-life of 87.25 days for flupyradifurone and 1.08 days for propylene carbonate and the equation for first-order rate kinetics (Juraske *et al.*, 2008; USEPA, 2012l, 2014e). Using this method, the residue concentration remaining after 1 day for flupyradifurone was estimated to be 99.21%; therefore, the percent of flupyradifurone residue assumed to dissipate per day was 0.79%. The residue concentration remaining after 1 day was estimated to be 52.63% for propylene carbonate; therefore, the percent of propylene carbonate residue assumed to dissipate per day was 47.37%. The equation of first-order rate kinetics is given below:

$$C_t = C_0 e^{-kt}$$

Where:
- C_t = Concentration on Day t following the application
- C_0 = Concentration on Day 0 (immediately following application)
- e = 2.718
- k = 0.693/half life
- t = time (days)

A summary of the exposure factors used in estimating TTR_t is given in **Table 8**.

Table 8: Exposure Factors Used in Estimating TTR_t

Chemical	F_{AR}	F_D	t (days)	DtT (unitless)	Foliar Half Life (days)
Flupyradifurone	0.01	0.79	0-365	0.2	87.5
Propylene Carbonate		0.4737			1.08

For estimating flupyradifurone and propylene carbonate concentrations for acute exposures, dermal contact with turf was assumed to occur immediately after an application. The acute TTR_t value represents the peak concentration on turf over the course of a year.

For estimating flupyradifurone and propylene carbonate concentrations in subchronic exposures, dermal contact was assumed to occur every day for 30 days. The subchronic TTR_t value represents the maximum 30-day average on turf over the course of a year.

For chronic exposures, dermal contact was assumed to occur every day for 365 days, so the estimated daily TTR_t was averaged over a 365-day period. The chronic TTR_t value represents the 365-day average concentration on turf assessed over the course of a year.

For all exposure durations, the TTR_t took into account the possibility of flupyradifurone and propylene carbonate accumulation when multiple applications would be made under the Proposed Program. Contact of pesticide residue with turf was not considered for nursery settings.

TTR_t concentration results are presented in the *Pest Programs* section of the Dashboard Database 4.0.

5.3.6 Surface water

The concentration of pesticides in surface water was estimated using the Pesticide in Water Calculator (PWC) Version 1.52 for the active and inert ingredients utilized in the Proposed Program. The PWC is a model designed by the USEPA (2016f) to estimate the concentration of pesticide ingredients in surface waters resulting from drift, runoff, and/or erosion during and after pesticide applications. Model details and run parameters were the same as those discussed and presented in the ERA except as noted below.

The Pesticide Root Zone Model version 5.0+ (PRZM) standard scenario used for surface water assessment is a 172.8-hectare (427-acre) watershed, releasing pesticide-containing runoff into a 5.26-hectare (13-acre) drinking water reservoir, 2.74 meters (9 feet) deep equaling 144,124 cubic meters. The water volume in the reservoir was assumed to remain constant and no outflow was modeled.

To simulate application efficiency and spray drift loadings to waterbodies resulting from foliar and aerial applications, the application efficiency and spray drift percentages used were 99% and 6.3%, respectively, for ground applications and 95% and 16%, respectively, for aerial applications. Although previous analyses in the Statewide PEIR (CDFA, 2014a) estimated application efficiency and spray drift percentages using USEPA's AgDRIFT model and EXPRESS (EXAMS-PRZM Exposure Simulation Shell), a precursor water model to the PWC with additional USEPA approved default parameters, suggested values from the PWC User Manual (USEPA, 2017c) were selected for the current analysis.

The PWC estimates multiple EECs, including the peak concentration and the 1-day, 4-day, 21-day, 60-day, 90-day, and 365-day average. Upper 90th ranked peak concentrations were used to assess acute and subchronic exposure to surface water potentially used as drinking water, while upper 90th ranked 90-day average concentrations were used to assess chronic exposure.

5.3.7 Groundwater

Groundwater simulations were conducted consistent with surface water simulations, described in Section 5.3.6 above and in the ERA, except as noted below.

Although previous analyses (CDFA, 2020a) relied on empirical groundwater monitoring data to draw conclusions on potential human health risks associated with groundwater contamination, scenario-specific groundwater EECs in the current assessment were estimated using PWC in the current analysis. Groundwater assessment was based on an aquifer with a recommended vertical thickness of 1 meter (3.3 feet) (D. F. Young, USEPA, personal communication, June 11, 2020).

As described in the ERA, primary PRZM Scenario Files were selected based on similarities between application location and setting and the environment modeled by the scenario file. For the current groundwater assessment, however, the depth to groundwater was adjusted to better reflect California conditions and soil profiles were conservatively assumed to be more porous than scenario defaults. While the default depth to groundwater was 10 cm (3.9 inches) for nursery applications and 26 cm (10.2 inches) for residential scenarios, an adjusted depth to groundwater was estimated for scenarios that may take place throughout the state and for scenarios geographically limited to Southern California. CDFA's (2020b) Directory of Licensed Nurseries was used to identify the Northern, Central, and Southern California counties most densely populated with production nurseries. Five counties were selected from each region. Combined, the production nurseries located within the fifteen selected counties made up 70% of all licensed production nurseries in the State at the time of assessment.

The California Department of Water Resources' (DWR's) California Statewide Groundwater Elevation Monitoring (CASGEM) database was used to characterize the depth to groundwater in the fifteen selected counties from 2015 to 2019 (DWR, 2020a). Drinkable groundwater was conservatively assumed to occur at a minimum depth of 0.01 feet. The depth to groundwater for scenarios that may take place throughout the state was determined by calculating the geometric mean of groundwater depth data for each county, then calculating the arithmetic mean of all fifteen counties (average depth: 85.33 feet). For scenarios that are geographically limited to Southern California, only groundwater depth data for the five Southern California counties was included (average depth: 88.65 feet).

Through collaboration with Dirk F. Young, senior scientist at the USEPA and developer of the PWC, soil profiles were modified to be more amenable to modified groundwater depths (D. F. Young, USEPA, personal communication, June 11, 2020). Soil parameters for Tifton loamy sand were obtained from the USEPA-developed Pesticide Root Zone Model for Groundwater (PRZM-GW) scenario GACOASTAL_STD. This scenario was one of six available groundwater scenarios and selected based on relative similarity of the associated soil profile to those associated with the PRZM Scenario Files used for surface water assessment. According to the *Georgia Southern Coastal Plain (Peanuts) Ground Water* description file provided by USEPA (2013j), "Tifton is a very deep, well drained soil on uplands. The subsoil is loamy and extends to a depth greater than 5 feet. Plinthite occurs below a depth of 30 to 50 inches and ironstone nodules are present throughout the soil. Permeability is moderate in the upper part of the subsoil and moderately slow in the lower part. Available water capacity is moderate. This soil falls into the Hydrologic Group B." Note that soils in Hydrologic Group B, including Tifton loamy sand, typically contain 10-20% clay and 50-90% sand, while soils in Hydrologic Group C, including the Cieneba sandy loam and Exeter loam soils used for surface water assessment, typically contain 20-40% clay and less than 50% sand (NRCS, 2009a). Because of their coarse texture and porous nature, sandier soils have greater infiltration capacity than finer, more compacted soils and may therefore render local groundwater aquifers more vulnerable to contamination.

The PWC limits the number of applications to 50 applications per year. Through collaboration with Houbao Li of USEPA, this limitation was overcome through expanding the PRZM input files generated by the PWC for 50 applications out to 150 applications and feeding those input files manually into the PRZM to generate results (H. Li, USEPA, personal communication, July 30 and August 5, 2020).

The 100-year peak groundwater concentration was used to assess acute, subchronic, and chronic exposure to groundwater potentially used as drinking water.

5.4 Estimating Human Receptor Exposure

The exposure assessment estimated the dose, or amount of pesticide that different receptors may be exposed to, under different application scenarios that would be a part of the Proposed Program. The exposure to pesticide or adjuvant ingredients varied for different types of receptors depending on the activities of a particular receptor and proximity to the application site. The following six types of receptors were assessed in this HHRA:

- Mixer-Loader-Applicator (MLA): Pesticide handlers
- Downwind Bystander (DWB): Residents or workers near the application site during application
- Post-Application Resident (PAR): Residents in the yard after pesticide application
- During and Post-Application Residents (DPAR): Residents near the application site during application and in the yard after application
- Post-Application Loader (PAL): Nursery employee that transports containerized plants after application
- Combined-Nursery Worker (CNW): Nursery pesticide handler that also transports containerized plants

The potential health impacts, if any, to receptors were estimated by comparing estimated exposure doses with the measures of toxicity. Descriptions of the methodology used to characterize risk are described in Section 6.

5.4.1 Exposure Routes

Depending on the activities and location of a particular receptor, twelve exposure routes could potentially occur under acute, subchronic, and chronic duration exposure scenarios. The exposure routes considered in this HHRA are the following:

- Inhalation: Aerosols and vapors
- Dermal Exposure to Airborne Residues: Deposition onto skin
- Ingestion of Edible Vegetation Residues: Eating home-grown edible vegetation (e.g., fruit)
- Dermal Exposure to Residues on Vegetation: Contact to skin due to working or playing in treated areas
- Hand-to-Mouth Ingestion of Vegetation Residues: Unintentional ingestion of residue from vegetation through hand-to-mouth transfer
- Dermal Exposure to Residues on Turf: Contact to skin due to activities in treated areas
- Hand-to-Mouth Ingestion of Turf Residues: Unintentional ingestion of residue from activities on turf through hand-to-mouth transfer
- Object-to-Mouth Ingestion of Turf Residues: Unintentional ingestion of residue from activities on turf through object-to-mouth transfer

- Pica and Incidental Ingestion of Soil Residues: Deliberate and unintentional soil consumption
- Dermal Exposure to Residues in Soil: Skin contact due to working or playing in treated areas
- Ingestion of Surface Water: Consumption of residues potentially in surface water
- Ingestion of Groundwater: Consumption of residues potentially in groundwater

A description of each of the six receptors identified in Section 5.4.1 is provided below. These receptor groups represent the groups with reasonable potential for exposure during the Proposed Program.

5.4.1.1 Mixer-Loader-Applicator

The mixer-loader-applicator (MLA) represents the combination exposure of a worker who may be occupationally exposed to pesticide active and inert ingredients or adjuvants while mixing, loading, and applying pesticides. The MLA was assumed to be exposed through dermal and inhalation routes. Ingestion was not evaluated for this receptor because the MLA is properly trained to minimize any hand-to-mouth transfers.

5.4.1.1.1 Acute Exposure Assessment

Acute exposure for the MLA was evaluated in the same manner as in the Statewide PEIR (CDFA, 2014a). Refer to the Statewide PEIR Appendix B Section 2.3 for more details about exposure assessment methodology for the MLA. USEPA's (2020a) Occupational Pesticide Handler Exposure Database (OPHED) was most recently updated in March 2020, and unit exposure values were derived from the updated version.

The following equation was used to estimate the ADD:

$$ADD = \frac{AR * ATPD * UE * DAF}{BW * CF_1}$$

Where:

ADD = Average daily dose (mg/kg-day)
AR =Application rate (lb/ac)
ATPD = Acres treated per day (ac/day)
UE = Unit exposure (µg/lb)
DAF = Dermal absorption factor*
*Only applied for dermal exposure when acute endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)
CF_1 = Conversion factor (µg/mg)

A summary of the exposure factors used in estimating acute exposure to residues through dermal contact and inhalation to the MLA is given in **Table 9**.

Table 9: Exposure Factors Used in Estimating Acute Exposures to Residues to the MLA

Receptor	DAF	Body Weight[1] (kg)
Adult MLA	See the Dashboard Database 4.0 for Chemical-Specific DAFs	80

1. USEPA, 2011p

Refer to the Dashboard Database 4.0, *Pest Programs* section for the OPHED unit exposures used for estimating exposure to the MLA.

5.4.1.1.2 Subchronic Exposure Assessment

Subchronic exposure for the MLA was evaluated in a similar manner as the chronic in the Statewide PEIR (CDFA, 2014a), except the exposure frequency was limited to the number of applications that could occur over 30 days and a DAF was only applied in the dermal exposure assessment if the subchronic NOAEL was extrapolated from an oral or inhalation endpoint. Additionally, the averaging time reflected the intermediate period of 30 days instead of the chronic exposure duration. Unit exposure values were derived from USEPA's (2020a) OPHED.

The following equation was used to estimate the SADD:

$$SADD = \frac{AR * ATPD * UE * DAF * EF * ED}{BW * AT * CF_1 * CF_2}$$

Where:

SADD = Subchronic average daily dose (mg/kg-day)
AR =Application rate (lb/ac)
ATPD = Acres treated per day (ac/day)
UE = Unit exposure (µg/lb)
DAF = Dermal absorption factor*
*Only applied for dermal exposure when subchronic endpoint was derived from an oral or inhalation study
EF = Exposure frequency (days/year)
ED = Exposure duration (days)
BW = Body weight (kg)
AT = Averaging time (days)
CF_1 = Conversion factor (µg/mg)
CF_2 = Conversion factor (days/years)

A summary of the exposure factors used in estimating subchronic exposure to residues through dermal contact and inhalation to the MLA are given in **Table 10**.

Table 10: Exposure Factors Used in Estimating Subchronic Exposures to Residues to the MLA

Receptor	DAF	Exposure Duration (days)	Averaging Time (days)	Body Weight[1] (kg)
Adult MLA	See the Dashboard Database 4.0 Chemical-Specific DAFs	30	30	80

a. EFH (USEPA, 2011p)

Refer to the *Pest Programs* section of the Dashboard Database 4.0 for the OPHED unit exposures used for estimating exposure to the MLA.

5.4.1.1.3 Chronic Non-Cancer Exposure Assessment

Chronic exposure for the MLA was evaluated in the same manner as in the Statewide PEIR (CDFA, 2014a), except unit exposure values were selected from an updated version of the USEPA's (2020a) OPHED. Refer to the Statewide PEIR Appendix B Section 2.3 for exposure assessment methodology.

The following equation was used to estimate the AADD:

$$AADD = \frac{AR * ATPD * UE * DAF * ED * EF}{BW * AT * CF_1 * CF_2}$$

Where:

AADD = Annual average daily dose (mg/kg-day)
AR =Application rate (lb/ac)
ATPD = Acres treated per day (ac/day)
UE = Unit exposure (µg/lb)
DAF = Dermal absorption factor*
*Only applied for dermal exposure when chronic endpoint was derived from an oral or inhalation study
ED = Exposure duration (years)
EF = Exposure frequency (days/year)
BW = Body weight (kg)
AT = Averaging time (years)
CF_1 = Conversion factor (µg/mg)
CF_2 = Conversion factor (days/year)

A summary of the exposure factors used in estimating chronic exposure to residues through dermal contact and inhalation to the MLA is given in **Table 11**.

Table 11: Exposure Factors Used in Estimating Chronic Exposures to Residues to the MLA

Receptor	DAF	Exposure Duration (years)	Averaging Time (years)	Body Weight[1] (kg)
Adult MLA	See the Dashboard Database 4.0 Chemical-Specific DAFs	20	20	80

1. EFH (USEPA, 2011p)

Refer to the *Pest Programs* section of the Dashboard Database 3.0 for the OPHED unit exposures used for estimating exposure to the MLA.

5.4.1.1.4 Cancer Exposure Assessment

Cancer exposure was not characterized in this risk assessment because none of the active or inert ingredients are suspected carcinogens (USEPA, 2018a).

5.4.1.2 Downwind-Bystander

The downwind bystander (DWB) represents any adult or child that is downwind from a residential or nursery application site and has the potential to be exposed to off-site drift. In accordance with USEPA's (1999f) *Overview of Issues Related to the Standard Operating Procedures for Residential Exposure Assessment*, the DWB was assumed to be 25 feet away from the application site.

The DWB was subcategorized into a <2 year-old child, a 2-<16 year-old child, and a 16< year-old (i.e., adult). The DWB was assumed to be exposed to pesticide residue through dermal and inhalation off-target drift for foliar and aerial applications.

5.4.1.2.1 Acute Exposure Assessment

Acute exposure for the DWB was evaluated in the same manner as in the Statewide PEIR (CDFA, 2014a), except as described here. Refer to the Statewide PEIR Appendix B Section 2.3 for exposure assessment methodology. Unit exposure values were derived from USEPA's (2020a) OPHED. DWB exposure was estimated identically for the three age-groups, except the body weights selected were 11.4 kg for the <2 year-old child DWB (data for 1<2 year-olds), 13.8 kg for the 2-<16 year-old child DWB (data for 2<3 year-olds), and 80 kg for the adult DWB (USEPA, 2011p).

The following equation was used to estimate the ADD:

$$ADD = \frac{AR * OSD * ATPD * UE * DAF}{BW * CF_1}$$

Where:

ADD = Average daily dose (mg/kg-day)
AR =Application rate (lb/ac)
OSD = Off-site drift (%)
ATPD = Acres treated per day (ac/day)
UE = Unit exposure (µg/lb)
DAF = Dermal absorption factor*
*Only applied for dermal exposure when acute endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)
CF_1 = Conversion factor (µg/mg)

A summary of the exposure factors used in estimating acute exposure to residues through dermal contact and inhalation to the DWB is given in **Table 12**.

Table 12: Exposure Factors Used in Estimating Acute Exposures to Residues to the DWB

Receptor	Index Lifestage	DAF	Body Weight[1] (kg)
0<2 DWB	1-<2 years	See the Dashboard Database 4.0 for Chemical-Specific DAFs	11.4
2-<16 DWB	2-<3 years		13.8
Adult DWB	Adult		80

1. EFH (USEPA, 2011p)

Refer to the Dashboard Database 4.0 *Pest Programs* section for the OPHED "Flagger" unit exposures and off-site drift used for estimating exposure to the DWB.

5.4.1.2.2 Subchronic Exposure Assessment

Subchronic exposure for the DWB to active and inert ingredients was evaluated in the same manner as the chronic exposure in the Statewide PEIR (CDFA, 2014a), except the number of applications per year (exposure frequency) was limited to the number of applications that could occur over 30 days. Unit exposure values were derived from USEPA's (2020a) OPHED.

The following equation was used to estimate the SADD:

$$SADD = \frac{AR * OSD * ATPD * UE * EF * ED * DAF}{BW * AT * CF_1 * CF_2}$$

Where:

SADD = Subchronic average daily dose (mg/kg-day)
AR =Application rate (lb/ac)
OSD = Off-site drift (%)
ATPD = Acres treated per day (ac/day)
UE = Unit exposure (µg/lb)
EF = Exposure frequency (days/year)
ED = Exposure duration (days)
DAF = Dermal absorption factor*
*Only applied for dermal exposure when subchronic endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)
AT = Averaging time (days)
CF_1 = Conversion factor (µg/mg)
CF_2 = Conversion factor (days/year)

A summary of the exposure factors used in estimating subchronic exposure to residues through dermal contact and inhalation to the DWB is given in **Table 13**.

Table 13: Exposure Factors Used in Estimating Subchronic Exposures to Residues to the DWB

Receptor	Index Lifestage	ED (days)	AT (days)	DAF	Body Weight[a] (kg)
<2 DWB	1-<2 years	30	30	See the Dashboard Database 4.0 for Chemical-Specific DAFs	11.4
2-<16 DWB	2-<3 years				13.8
Adult DWB	Adult				80

a. EFH (USEPA, 2011p)

Refer to the Dashboard Database 4.0 *Pest Programs* section for the OPHED "Flagger" unit exposures and off-site drift used for estimating exposure to the DWB.

5.4.1.2.3 Chronic Exposure Assessment

Chronic exposure for the DWB was evaluated in the same manner as in the Statewide PEIR (CDFA, 2014a), with exception to changes described in this subsection. Refer to the Statewide PEIR Appendix B Section 2.3 for exposure assessment methodology.

For applications in residential and urban settings, the maximum number of consecutive years the program was anticipated to occur at a single residence was 10 years (C. Hanes, CDFA, personal communication, May 26, 2020). Therefore, the exposure duration for the adult and 2-<16 year-old DWB was assumed to be 10 years for applications in residential and urban settings. The exposure duration for the 0-<2 year-old DWB was assumed to be the entirety of that lifestage (i.e., 2 years).

For applications in nursery settings, an exposure duration of 20 years was selected for the adult DWB based on an updated version of the Department of Toxic Substances Control (DTSC) Default Exposure Factors for Human Risk Assessment (DTSC, 2019a). Consistent with the Statewide PEIR and Statewide Japanese Beetle Eradication Program Human Health Risk Assessments (CDFA, 2014a, 2016a, 2017a), the 2-<16 year-old DWB and 0-<2 year-old DWB were assumed to be exposed to for the entire duration of that lifestage (i.e., 14 years and 2 years, respectively).

Unit exposure values for the DWB were selected from an updated version of the USEPA's (2020a) OPHED.

The following equation was used to estimate the AADD:

$$AADD = \frac{AR * OSD * ATPD * UE * EF * ED * DAF}{BW * AT * CF_1 * CF_2}$$

Where:

AADD = Average daily dose (mg/kg-day)
AR =Application rate (lb/ac)
OSD = Off-site Drift (%)
ATPD = Acres treated per day (ac/day)
UE = Unit exposure (µg/lb)
DAF = Dermal absorption factor*
*Only applied for dermal exposure when chronic endpoint was derived from an oral or inhalation NO(A)EL
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body weight (kg)
AT = Averaging Time (years)
CF_1 = Conversion factor (µg/mg)
CF_2 = Conversion factor (days/year)

A summary of the exposure factors used in estimating chronic exposure to residues through dermal contact and inhalation to the DWB is given in **Table 14**.

Table 14: Exposure Factors Used in Estimating Chronic Exposures to Residues to the DWB

Receptor	Index Lifestage	Application Setting	Exposure Duration (years)	Averaging Time (years)	Dermal Absorption Factor	Body Weight[1] (kg)
<2 DWB	1-<2 years	Residential	2	2	See the Dashboard Database 4.0 for Chemical-Specific DAFs	11.4
		Nursery				
2-<16 DWB	2-<3 years	Residential	10	10		13.8
		Nursery	14	14		
Adult DWB	Adult	Residential	10	10		80
		Nursery	20	20		

1. EFH (USEPA, 2011p)

Refer to the Dashboard Database 4.0 *Pest Programs* section for the OPHED "Flagger" unit exposures and off-site drift used for estimating exposure to the DWB.

5.4.1.2.4 Cancer Exposure Assessment

Cancer exposure was not characterized in this risk assessment because none of the active or inert ingredients are suspected carcinogens (USEPA, 2018a).

5.4.1.3 Post-Application Resident

The post-application resident (PAR) represents a typical receptor living in an urban or residential environment who has the potential to be exposed after treatments have been conducted under the Proposed Program. The PAR was conservatively assumed to be active in the gardens and lawns on his/her property and to consume home-grown edible vegetation (e.g., fruits). An adult resident was assumed to be exposed to residues on foliage, turf, and soil through dermal contact and through ingestion of home-grown edible vegetation and drinking of surface water and groundwater. Child residents, ages <2 years old and 2-<16 years old, were assumed to be exposed to residues on foliage, turf, and soil through dermal contact, incidental ingestion of residues on turf from hand-to-mouth and object-to-mouth activity, incidental ingestion of residues on foliage from hand-to-mouth activity, ingestion of soil, home-grown edible vegetation, and the drinking of groundwater and surface water. Post-application inhalation exposure to flupyradifurone and propylene carbonate was not considered because of their low vapor pressure (1.30E-08 mmHg and 4.50E-02 mmHg, respectively) (HSDB, 2017b; USEPA, 2014e).

For the purposes of this risk assessment, the resident was analyzed over three lifestages: <2 year-old child, 2-<16 year-old child, and adults 16 years of age and older. To estimate potential exposure for these three age-groups, guidance and exposure factors from sources including, but not limited to, USEPA's (2012l) Standard Operating Procedures for Residential Pesticide Exposure Assessment (SOP), USEPA's (1989e, 2004i, 2014d) Risk Assessment Guidance for Superfund (RAGS), and USEPA's (2011p) Exposure Factors Handbook (EFH) and subsequent chapter releases were selected. If exposure factors from multiple age-ranges (e.g., 3-<6 year-old, 6-<11 year-old, etc.) within each lifestage (e.g., 2-<16 year-old child) were available, the exposure factor from the age-range that resulted in the highest exposure was selected for each lifestage. The SOP designates "index lifestages" for specific exposure assessments. An index lifestage (ILS) represents "the lifestage of highest concern due to unique behavioral characteristics that may lead to higher levels of exposure." The USEPA (2012l) determined these index lifestages through both "quantitative (e.g., exposure assessments) and qualitative (e.g., exposure and activity data) considerations," and assessment of the ILS is expected to "protect for the exposures and risks for all potentially exposed lifestages." For estimating potential exposure in this risk assessment, the SOP ILS was assessed using the SOP guidance when available.

Unless otherwise specified, exposure factors for the adult are drawn from the EFH (USEPA, 2011p) were based on data from a 21-<80+ year-old. Similarly, exposure factors from the SOP (USEPA, 2012l) were based on data from a 16-<80 year-old.

5.4.1.3.1 Acute Exposure Assessment

Dermal Exposure to Residues in Soil

The <2 year-old child PAR, 2-<16 year-old child PAR, and the adult PAR were assumed to be dermally exposed to flupyradifurone and propylene carbonate residues in garden soil or bare spots on lawns. Methods and exposure factors from USEPA's (2004i, 2014d) RAGS, USEPA's (2011p) EFH, and USEPA's (2012l) SOP were used in this assessment. Exposure factors for a 1-<2 year-old and a 2-<3 year-old were selected to represent the <2 year-old child and 2-<16 year-old child PARs, respectively. For certain exposure factors, data were not available for the 2-<3 year-old lifestage index. In those instances, values from other lifestages were selected as surrogates.

To estimate the ADD, the peak flupyradifurone and propylene carbonate residue estimated to be in soil, as described in Section 5.3.2, was multiplied by the resident's skin surface area that typically contacts soil, a soil-to-skin adherence factor, the number of times the resident is expected to come into contact with treated soil per hour, the number of hours per day the receptor was anticipated to spend in a treated area, a dermal absorption factor, and divided by the resident's body weight. A surface area of 6,032 cm^2/event was selected for an adult PAR, based on the mean surface area of an adult (USEPA, 2014d). A surface area of 2,373 cm^2/event was selected for a 2-<16 year-old child PAR based on the weighted average of a 0-<6 year-old (USEPA, 2014d). A surface area of 610 cm^2/event was used for a <2 year-old child PAR, based on the 95^{th} percentile for total body surface area of a 1-<2 year-old child (USEPA, 2011p). The soil adherence factor (AF) used for an adult was 0.07 mg/cm^2, based on the 50^{th} percentile of a gardener in a high activity setting (DTSC, 2019a; USEPA, 2004i, 2014d). A soil adherence factor of 0.2 mg/cm^2 was used for both child PARs, based on the 95^{th} percentile of a 1-<6 year-old child (USEPA, 2004i, 2014d). The adult PAR was assumed to spend 2.2 hours per day outside in treated areas and the two child PARs were assumed to spend 1.1 hours per day outside in treated areas, based on the arithmetic mean of adults and for 6-<11 year-old activity in gardens, respectively (USEPA, 2012l). The adult and both child PARs were assumed to contact soil 71 times per hour, based on the 90^{th} percentile soil contact rate of both hands of a 1 to 5-year-old child (USEPA, 2011p). The mean body weights for a 1-<2 year-old, 2-<3 year-old, and adult were used for the <2 year-old PAR, 2-<16 year-old PAR, and adult PAR, respectively (USEPA, 2011p).

The following equation was used to estimate the ADD:

$$ADD = \frac{EEC * CF * SA * AF * ET * CR * DAF}{BW}$$

Where:

ADD = Average daily dose (mg/kg-day)
EEC = Estimated environmental concentration (mg/kg)
CF = Conversion factor (kg/mg)
SA = Surface area exposed per event (cm^2/event)
AF = Soil adherence factor (mg/cm^2)
ET = Exposure time (hours/day)
CR = Contact rate (events/hour)
DAF = Dermal absorption factor
*Only applied for dermal exposure when acute endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)

A summary of the exposure factors used in estimating acute dermal exposure to residues in soil is given in **Table 15**.

Table 15: Exposure Factors Used in Estimating Acute Dermal Exposure to the PAR in Soil

Receptor	EEC (mg/kg)	SA (cm^2/event)	AF[b,d] (mg/cm^2)	ET[c] (hours/day)	CR[a] (events/hour)	DAF	BW (kg)[a]
<2 PAR	Refer to Dashboard Database 4.0	610[a]	0.2	1.1	71	See Dashboard Database 4.0 for chemical-specific DAFs	11.4
2-<16 PAR		2,373[b]					13.8
Adult PAR		6,032[b]	0.07	2.2			80

a. USEPA, 2011p
b. USEPA, 2014d
c. USEPA, 2012l
d. USEPA, 2004i

Pica and Incidental Ingestion of Soil

Both the <2 year-old and 2-<16 year-old child PARs were assumed to be exposed to flupyradifurone and propylene carbonate through ingestion of treated soils underneath garden plants or bare spots on lawns. The two child PARs were assumed to exhibit soil pica behavior, which is the recurrent ingestion of unusually high amounts of soil of between 1,000 – 5,000 mg/day (USEPA, 2017g). USEPA's (2011p) EFH states, "soil-pica should not be limited to intentional soil ingestion, primarily because children can consume large amounts of soil from their typical behaviors and because differentiating intentional and unintentional behavior in young children is difficult." Therefore, the soil ingestion rate was based on a total mg soil per day, and accounts for both intentional and incidental soil ingestion (OEHHA, 2012d). Due to the higher likelihood of children to consume soil, estimations of soil ingestion of the two child PARs were considered health protective of the adult PAR.

Methods and exposure factors from the USEPA's (1989e) RAGS, USEPA's (2011p, 2017g) EFH, and ATSDR's (2001a) Soil-Pica Workshop were used in this assessment. The ILSs for the <2 year-old child PAR and 2-<16 year-old child PAR were the 1-<2 year-old and 2-<3 year-old, respectively.

To estimate the ADD, the peak flupyradifurone and propylene carbonate concentration estimated to be in soil was multiplied by a soil ingestion rate, the fraction of soil ingested that had been treated, and then divided by the child's body weight. A soil ingestion rate of 5,000 mg soil/day was selected based on suggested value from the ATSDR (2001a) Soil-Pica Workshop Summary Report. The fraction of soil ingested from a treated site was assumed to be 100%.

The following equation was used to estimate the ADD:

$$ADD = \frac{EEC * CF * IR_s * FI}{BW}$$

Where:

ADD = Average daily dose (mg/kg-day)
EEC = Estimated environmental concentration (mg/kg)
CF = Conversion factor (kg/mg)
IR_s = Soil ingestion rate (mg/day)
FI = Fraction ingested from Contaminated Source (unitless)
BW = Body weight (kg)

A summary of the exposure factors used in estimating acute pica and incidental soil ingestion is given in **Table 16**.

Table 16: Exposure Factors Used in Estimating Acute Pica and Incidental Soil Ingestion

Receptor	Index Lifestage	EEC (mg/kg)	IR_s[a] (mg/day)	FI[b]	BW[c] (kg)
<2 PAR	1-<2 years	Refer to the Dashboard Database 4.0	5,000	1	11.4
2-<16 PAR	2-<3 years				13.8

a. USEPA, 2017g; ATSDR, 2001a
b. Professional judgment
c. USEPA, 2011p

Dermal Exposure to Residues on Non-Edible Vegetation

The <2 year-old child PAR, 2-<16 year-old child PAR, and the adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate through dermal contact with residues on ornamental plants and non-citrus fruit trees. Methods and exposure factors from the 'Gardens' section of the USEPA (2012l) SOP were selected for assessment of dermal exposure to non-edible vegetation. Because the exposure factors and methods from the 'Gardens' section of the SOP result in a greater estimated exposure than those of the 'Trees' section, use of the 'Gardens' SOP was considered health-protective of contact with treated trees. Exposure factors for a 6-<11 year-old were selected to represent the 2-<16 year-old because it was assumed younger children will not utilize these areas for playing nor engage in activities associated with these areas to the extent older children will (USEPA, 2012l). Although <2 year-old children are not expected to spend a substantial amount of time in garden/tree settings, the 1-<2 year-old child was selected to represent the <2 year-old child PAR for the sake of completeness.

The first step of the Gardens and Trees SOP equation was to estimate the DFR_t of the pesticide active or inert ingredient. The DFR_t represents the amount of material on the surface of a plant that is available for dermal transfer to a receptor's skin after an application has occurred (USEPA, 2012l). For additional details of the methods for estimating the surface residue on foliage, refer to Section 5.3.3. The SOP makes use of transfer coefficients (TCs) to estimate the transfer of residue from leaf surface to skin. The TCs recommended by the SOP for use in garden settings were 8,400 cm^2/hr for an adult and 4,600 cm^2/hr for a child 6-<11 years old (USEPA, 2012l). No TC was available in the SOP for the 1-<2 year-old in garden/tree settings. However, the Lawns and Turf section of the SOP adjusts the adult TC by a reduction factor of 73% for the purposes of evaluating 1-<2 year-olds on lawns/turf. For this HHRA, the same reduction factor was applied to result in a TC of 2,268 cm^2/hr for the 1-<2 year-old PAR in residential/urban settings (USEPA, 2012l).

To estimate the PAR's exposure, the DFR_t was multiplied by the surface-to-skin TC and the number of hours per day the resident was expected to be exposed (ET). The SOP assumed the adult was exposed for 2.2 hour per day and weighed 80 kg (USEPA, 2011p, 2012l). The exposure time recommended by the SOP for the 6-< 11 year-old in garden settings was 1.1 hours/day with a body weight of 31.8 kg (USEPA, 2012l). Because no ET was available for 1-<2 year-olds in garden settings, the 6-<11 year-old value of 1.1 hours/day was used. A body weight of 11.4 kg was used for the 1-<2 year-old child PAR (USEPA, 2012l).

The following equation was used to estimate the Vegetation Dermal Exposure (VDE):

$$VDE = DFR_t * CF * TC * ET$$

Where:

VDE = Vegetation Dermal Exposure (mg/day)
DFR_t = Dislodgeable Foliar Residue (μg/cm^2)
CF= Weight unit conversion factor (mg/μg)
TC = Transfer coefficient (cm^2/hour)
ET = Exposure time (hours/day)

To estimate the PAR's Average Daily Dose (ADD), the VDE was multiplied by the DAF and then divided by the resident's body weight. The following equation was used to estimate the ADD:

$$ADD = \frac{VDE * DAF}{BW}$$

Where:

ADD = Average daily dose (mg/kg-day)
VDE = Vegetation Dermal Exposure (mg/day)
DAF = Dermal Absorption Factor (unitless)
*Only applied for dermal exposure when acute endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)

A summary of the exposure factors used in estimating acute exposure to residues through dermal exposure to vegetation is given in **Table 17**.

Table 17: Exposure Factors Used in Estimating Acute Dermal Exposure to Vegetation

Receptor	Index Lifestage	TC[b] (cm^2/hour)	ET[a] (hours/day)	DAF	BW[a] (kg)
<2 PAR	1-<2 years	2,268	1.1	See Dashboard Database 4.0 for Chemical-Specific DAFs	11.4
2-<16 PAR	6-<11 years	4,600	1.1		31.8
Adult PAR	Adult	8,400	2.2		80

a. USEPA, 2011p
b. USEPA, 2012l

Hand-to-Mouth Ingestion of Vegetation Residues

The <2 year-old child and 2-<16 year-old child PARs were assumed to be exposed to flupyradifurone and propylene carbonate by contacting residues on vegetation and then transferring that residue from his/her hand to mouth (HtM). The USEPA's (2012l) SOP for Lawns/Turf was the method used to evaluate hand-to-mouth ingestion of vegetation residues. Although an SOP for Gardens and Trees is available, it does not include a hand-to-mouth analysis; therefore, the Lawns/Turf SOP was chosen as a surrogate. In accordance with the USEPA (2012l) SOP, the adult PAR was not assessed for hand-to-mouth incidental ingestion of residues because it is assumed adults would not place pesticide-contaminated hands in their mouth. See the Statewide PEIR (CDFA, 2014a) for more details.

In accordance with the SOP, the Vegetation Dermal Exposure (VDE) estimated in the Dermal Exposure to Residues on Non-Edible Vegetation section was multiplied by the fraction of residue on the child's hands (Fai_{Hands}) compared to total surface residue. The result was then divided by the typical surface area of a child's hands to estimate the potential amount of residue available on the PAR child's hands (HR) (USEPA, 2012l).

The following equation was used to estimate the HR:

$$HR = \frac{Fai_{Hands} * VDE}{2 * SA_H}$$

Where:

HR = Residue available on hand (mg/cm^2)
Fai_{Hands}= Fraction of total residue on hands
VDE = Vegetation Dermal Exposure (mg)
SA_H = Hand surface area (cm^2)

To estimate the ADD, the SOP then factored in the fraction of hand surface area mouthed during each event, the typical surface area of one hand, the number of hours per day the child may be exposed, the number of times the child contacts treated vegetation per hour, the fraction of residue removed from saliva, the frequency of hand-to-mouth contacts per hour, and the child PAR's body weight (USEPA, 2012l). The exposure factors for a 1-<2 year old and 3-<6 year old were selected from the Lawns/Turf SOP to represent the <2 year-old child and 2-<16 year-old child PARs, respectively, for analysis of hand-to-mouth ingestion of vegetation residues.

The following equation was used to estimate the ADD:

$$ADD = \frac{HR * F_M * SA_H * N_{Rep} * ET * \left(1 - (1 - SE)^{\frac{EV_{HtM}}{N_{Rep}}}\right)}{BW}$$

Where:

ADD = Average daily dose (mg/kg-day)
HR = Residue available on hand (mg/cm^2)
F_M = Fraction of hand surface area mouthed per event
SA_H = Hand surface area (cm^2)
ET = Exposure time (hours/day)
N_{Rep} = Number of replenishment intervals per hour (intervals/hour)
SE = Extraction by saliva
EV_{HtM} = Frequency of hand-to-mouth events per hour (events/hour)
BW = Body weight (kg)

A summary of the exposure factors used in estimating acute hand-to-mouth ingestion to vegetation residue is given in **Table 18**.

Table 18: Exposure Factors Used in Estimating Acute Hand-to-Mouth Ingestion to Vegetation Residues

Receptor	ILS	Fai_{hands}[a]	SA_H[a,b] (cm^2)	F_M[a]	ET[a] (hours/day)	N_{Rep}[a] (intervals/hour)	SE[a]	EV_{HtM}[a] (events/hour)	BW[b] (kg)
0 -<2 PAR	1-<2 years	0.06	150	0.127	1.5	4	0.48	13.9	11.4
2 -<16 PAR	3-<6 years		225					8.5	18.6

a. USEPA, 2012l
b. USEPA, 2011p

Ingestion of Edible Vegetation Residues

The <2 year-old child, 2-<16 year-old child, and the adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues through consumption of edible vegetation (i.e., home-grown fruit). Methods for estimating pesticide residue concentrations in plants are described in Section 5.3.4. When evaluating foliar applications, it was assumed that direct treatment of vegetation resulted in 100% of the applied material being available on the surface of fruit-bearing plants. It was assumed that an additional 20% of the application rate drifted to soil below fruit-bearing plants and was available for uptake through the roots.

Methods and exposure factors from the USEPA's (1989e) RAGS and USEPA's (2011p) EFH were used in this assessment. Exposure factors for a 1-<2 year old and a 3-<5 year old were selected to represent the ILSs for the <2 year-old child and 2-<16 year-old child PARs, respectively. Exposure factors for a 40-<69 year-old were selected to represent the adult PAR (USEPA, 2011p).

To estimate the ADD, the maximum EEC of flupyradifurone and propylene carbonate in edible vegetation, found in the Dashboard Database 4.0, was multiplied by the amount of vegetation a resident was expected to consume per day relative to his/her body weight. For the <2 year-old child PAR assessment, a vegetation ingestion rate of 8.7 g/kg-day, based on mean intake of home-produced fruits for a 1-2 years old. For the 2-<16 year-old child PAR assessment, a vegetation ingestion rate of 4.1 g/kg-day, based on mean intake of home-produced fruits for a 3-5 years old. For the adult PAR assessment, a vegetation ingestion rate of 2.7 g/kg-day, based on mean intake of home-produced fruits for a 40-69 year-old. Each of the aforementioned ingestion rates was selected from USEPA's (2011p) EFH.

The following equation was used to estimate the ADD:

$$ADD = EEC * CF * IR_v$$

Where:

ADD = Average daily dose (mg/kg-day)
EEC = Estimated environmental concentration (mg/kg)
CF = Conversion factor (kg/g)
IR_v = Vegetation ingestion rate (g/kg-day)

A summary of the exposure factors used in estimating acute exposure to residues through ingestion of edible vegetation is given in **Table 19**.

Table 19: Exposure Factors Used in Estimating Acute Exposures to Residues through Ingestion of Edible Vegetation

Receptor	Index Lifestage	EEC (mg/kg)	IR_v[a] (g/kg day)
<2 PAR	1-<2 years	Refer to the Dashboard Database 4.0 *Pest Programs* Section	8.7
2-<16 PAR	3-<5 years		4.1
Adult PAR	40-<69 years		2.7

a. USEPA, 2011p

Dermal Exposure to Residues on Turf

The <2 year-old child, 2-<16 year-old child, and adult PARs dermal exposure to flupyradifurone and propylene carbonate residues on turf were assessed using USEPA's (2012l) SOP guidance for "Lawns/Turf - High Contact Lawn Activities." In accordance with the SOP, the 1-<2 year-old PAR served as the ILS for the <2 year-old. The 2-<3 year-old child represented the 2-<16 year-old PAR. The first step of the Lawns/Turf SOP equation was to estimate the Transferable Turf Residue (TTR_t) of flupyradifurone and propylene carbonate. Refer to Section 5.3.4 for the TTR_t equation and additional details.

The SOP-recommended TCs were used to estimate the transfer of residue from turf-surface to skin. The recommended TCs were 49,000 cm^2/hour for a 1-<2 year old, 56,000 cm^2/hour for a 2-<3 year-old, and 180,000 cm^2/hour for an adult (USEPA, 2012l). For the definition of TCs, refer to the Glossary and Abbreviations section of the Dashboard Database 4.0. It was assumed the adult, 1-<2 year-old child, and 3-<6 year-old child PARs spent 1.5 hours in turf settings. The default exposure factors used in the SOP for a child 1-<2 year old, a child 2-<3 year old, and an adult were left unchanged for the assessment of the <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR, respectively.

To estimate the Turf Dermal Exposure (TDE), the TTR_t was multiplied by the TC, and the number of hours per day the resident was expected to be exposed (ET).

The following equation was used to estimate the TDE:

$$TDE = TTR_t * CF * TC * ET$$

Where:

TDE = Turf Dermal Exposure (mg/d)
TTR_t = Transferable turf residue (t) days after application (µg/cm^2)
CF= Weight unit conversion factor (mg/µg)
TC = Transfer coefficient (cm^2/hour)
ET = Exposure time (hours/day)

To estimate the PAR's Average Daily Dose (ADD), the TDE was multiplied by the DAF and then divided by the resident's body weight:

$$ADD = \frac{TDE * DAF}{BW}$$

Where:

ADD = Average daily dose (mg/kg-day)
TDE = Turf Dermal Exposure (mg/d)
DAF = Dermal absorption factor
*Only applied for dermal exposure when acute endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)

A summary of the exposure factors used in estimating acute dermal exposure to turf is given in **Table 20**.

Table 20: Exposure Factors Used in Estimating Acute Dermal Exposure to Turf

Receptor	Index Lifestage	TC[a] (cm^2/hour)	ET[a] (hours/d)	DAF	BW[b] (kg)
<2 PAR	1-<2 years	49,000	1.5	See the Dashboard Database 4.0 for chemical-specific DAFs	11.4
2-<16 PAR	2-<3 years	56,000			13.8
Adult PAR	Adult	180,000			80

a. USEPA, 2012l
b. USEPA, 2011p

Hand-to-Mouth Ingestion of Turf Residues

The <2 year-old child PAR and 2-<16 year-old child PAR were assumed to come into contact with flupyradifurone and propylene carbonate by contacting residues on turf and then transferring that residue from his/her hand to mouth. Due to the higher likelihood of children placing their hands in their mouths, estimations of incidental ingestion for the two child PARs were considered health protective of the adult PAR. The USEPA's (2012l) SOP guidance for Lawns/Turf was used as a source of exposure factors and methods. Exposure factors for the ILS of 1-<2 year-old and a 3-<6 year-old were selected to represent the <2 year-old child PAR and the 2-<16 year-old child PAR, respectively.

In accordance with the SOP, the TDE, which was estimated in the Dermal Exposure to Residues on Turf Section, was multiplied by the fraction of total residue on the child's hands. The result was then divided by the surface area of the child's hands to estimate the potential amount of residue available on the PAR child's hands. The following equation was used to estimate the HR:

$$HR = \frac{Fai_{hands} * TDE}{SA_H * 2}$$

Where:

HR = Residue available on hand (mg/cm^2)
Fai_{hands} = Fraction of total residue on hands
TDE = Turf dermal exposure (mg)
SA_H = Hand surface area (cm^2)

To estimate the ADD, the SOP accounted for the residue available on the receptor's hands, the fraction of hand surface area mouthed each event, the typical surface area of one hand, the number of hours per day the child may be exposed, the number of times the child contacts treated turf per hour, the fraction of residue removed from saliva, the frequency of hand-to-mouth contacts per hour, and the child PAR's body weight (USEPA, 2012l). The following equation was used to estimate the ADD:

$$ADD = \frac{HR * F_M * SA_H * ET * N_{Rep} * (1 - (1 - SE)^{EV_{HtM} / N_{Rep}})}{BW}$$

Where:

ADD = Average daily dose (mg/kg-day)
HR = Residue available on hand (mg/cm^2)
F_M = Fraction of hand surface area mouthed per event (unitless/event)
SA_H = Hand surface area (cm^2)
ET = Exposure time (hours/day)
N_{Rep} = Number of replenishment intervals per hour (intervals/hour)
SE = Extraction by saliva
EV_{HtM} = Frequency of hand-to-mouth (events/hour)
BW = Body weight (kg)

A summary of the exposure factors used in estimating acute hand-to-mouth ingestion of turf residues is given in **Table 21**.

Table 21: Exposure Factors Used in Estimating Acute Hand-to-Mouth Ingestion of Turf Residues

<table>
<tr><th>Receptor</th><th>Index Lifestage</th><th>Fai_{hands}[a]</th><th>SA_H (cm^2)</th><th>F_M[a]</th><th>ET [a] (hours /day)</th><th>N_{Rep}[a] (intervals/ hr)</th><th>SE[a]</th><th>EV_{HtM} (events/ hour)[a]</th><th>BW (kg)[b]</th></tr>
<tr><td><2 PAR</td><td>1-<2 years</td><td rowspan="2">0.06</td><td>150[b]</td><td rowspan="2">0.127</td><td rowspan="2">1.5</td><td rowspan="2">4</td><td rowspan="2">0.48</td><td>13.9</td><td>11.4</td></tr>
<tr><td>2-<16 PAR</td><td>3-<6 years</td><td>225[a]</td><td>8.5</td><td>18.6</td></tr>
</table>

a. USEPA, 2012l
b. USEPA, 2011p

Object-to-Mouth Ingestion of Turf Residues

Both the <2 year-old and 2-<16 year-old child PARs were assumed to come into contact with flupyradifurone and propylene carbonate through turf-to-object contact that subsequently transferred to his/her mouth from the object. Due to the higher likelihood of children placing objects in their mouth, estimations of incidental ingestion of the two child PARs were considered health protective of the adult PAR. The USEPA's (2012l) SOP guidance for Lawns/Turf was used as a source of exposure factors and methods. Exposure factors for a 1-<2 year-old and a 2-<3 year-old were selected to represent the <2 year-old child and 2-<16 year-old child PARs, respectively.

To estimate the potential amount of residue available on an object (OR_t), a variation of the equation found in the USEPA SOP was used. Consistent with a personal communication with Jeff Dawson of the USEPA, the application rate was multiplied by the fraction of total residue on the object and the dissipation rate (J. Dawson, USEPA, personal communication, July 20, 2016). For acute exposure, the OR_t was the peak value possible considering environmental degradation. It was assumed the dissipation of pesticide residue on an object was comparable to the degradation on foliage. As such, the foliar half-lives of 87.5 days and 1.08 days were used to estimate the concentration of flupyradifurone and propylene carbonate on the object over time, respectively. See Section 5.3 for more details on the use of first-order rate kinetics to estimate environmental degradation. A 20% Deposition to Object (DtO) was applied for foliar applications to account for residues blocked by foliage.

The following equation was used to estimate the OR_t:

$$OR_t = AR * F_O * (1 - FD)^t * CF_1 * CF_2 * DtO$$

Where:

OR_t = Residue available on object (μg/cm^2)
AR = Application rate (lb a.i./acre)
F_O = Fraction of total residue on object
F_D = Fraction of residue that dissipates per day
t = Time after application (days)
CF_1 = Weight unit conversion factor (μg/lb)
CF_2 = Area unit conversion factor (acre/cm^2)
DtO = Drift to Object

To estimate the ADD due to object-to-mouth (OtM) exposure, the SOP accounted for the residue available on the object, the object surface area mouthed for each event, the number of hours per day the child is assumed to be exposed (i.e., exposure time), the number of times the object contacts treated turf per hour, the fraction of residue removed by saliva, the frequency of object-to-mouth contacts per hour, and the child PAR's body weight (USEPA, 2012l).

The following equation was used to estimate the ADD:

$$ADD = \frac{OR_t * CF_3 * SAM_O * ET * N_{Rep} * (1 - (1 - SE)^{(EV_{OtM} / N_{Rep})})}{BW}$$

Where:

ADD = Average daily dose (mg/kg-day)
OR_t = Residue available on object (μg/cm^2)
CF_3 = Weight unit conversion factor (mg/ug)
SAM_O = Object surface area mouthed per event (cm^2/event)
ET = Exposure time (hours/day)
N_{Rep} = Number of replenishment intervals per hour (intervals/hour)
SE = Extraction by saliva
EV_{OtM} = Frequency of OtM events per hour (events/hour)
BW = Body weight (kg)

A summary of the exposure factors used in estimating acute object-to-mouth ingestion of turf residues is given in **Table 22**.

Table 22: Exposure Factors Used in Estimating Acute Object-to-Mouth Ingestion of Turf Residue

Receptor	Index Lifestage	t (days)	EV_{OtM}[a] (events /hr)	BW[b] (kg)	Fo[a]	DtO	SAM_O[a] (cm^2/ event)	ET[a] (hrs/ day)	N_{Rep}[a] (intervals/ hr)	SE[a]
0<2 PAR	1-<2 years	0-365	8.8	11.4	0.01	0.2	10	1.5	4	0.48
2-<16 PAR	2-<3 years		8.1	13.8						

a. USEPA, 2012l
b. USEPA, 2011p

Ingestion of Surface Water Residues

The <2 year-old child, 2-<16 year-old child, and the adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues through drinking water sourced from surface water. Methods for estimating pesticide residue concentrations in surface water are described in Section 5.3.6.

In addition to PWC estimated EECs, exposure factors and guidance from the USEPA's (1989e) RAGS and OEHHA's (2012e) Technical Support Document for Exposure Assessment and Stochastic Analysis were used to estimate exposure. Exposure factors for a 16-70 year-old were selected to represent the adult PAR (USEPA, 2011p). Exposure factors for a 0<2 year-old and a 2<9 year-old were selected to represent the ILSs for the <2 year-old child and 2-<16 year-old child PARs, respectively. To estimate the ADD, the peak EEC of flupyradifurone and propylene carbonate in surface water was multiplied by the amount of water a resident was expected to consume per day relative to his/her body weight. The water ingestion rates for these receptors, as seen in **Table 23**, represent the 95^{th} percentile recommended point estimate and was used for both surface and groundwater ingestion (i.e., it is assumed a person drinks twice as much as the 95^{th} percentile water ingestion rate). It was assumed residents consumed drinking water only from contaminated sources (i.e., there was no reduction in water consumption based on other potential sources).

The following equation was used to estimate the Drinking Water Exposure (DWE):

$$DWE = IRw * EEC * CF1$$

Where:
DWE = Drinking water exposure (mg/kg-day)
IR_w =Water intake rate (L/kg-d)
EEC = Estimated environmental concentration (µg/L)
BW = Body weight (kg)
CF1 = Conversion factor (mg/µg)

A summary of the exposure factors used in estimating DWE are presented in **Table 23**.

Table 23: Exposure Factors Used to Estimate Drinking Water Exposure from Surfacewater

Receptor	Index Lifestage	IR_w (L/kg d)[1]	EEC (ug/L)
0-<2 year old	0-<2	0.196	See Dashboard Database 4.0 Section *Pest Programs*
2-<16 year old	2<9	0.066	
Adult	16-70	0.045	

1. OEHHA, 2012e

Ingestion of Groundwater Residues

Methods and exposure factors for estimating exposure to residues from drinking groundwater were the same as those described in the Ingestion of Surface Water Residues, except the peak groundwater EEC was used. See 5.3.7 for discussion of groundwater EEC calculations.

5.4.1.4 Subchronic Exposure Assessment

The subchronic duration was defined as repeated daily exposure over multiple days up to 10 percent of a life span in humans or 30 to 90 days in laboratory animal species (USEPA, 1996g). For this assessment, the subchronic exposure was assumed to be 30 days, based on the USEPA (2011w) Integrated Risk Information System (IRIS) Glossary definition of ‘subchronic exposure.’

To assess the subchronic exposure to the PAR, an average daily dose (ADD_{SC}) was estimated using a similar method and equation as the acute exposure, except a subchronic EEC was used instead of the peak EEC. See Section 5.3 for more details about the methods used to calculate subchronic EECs.

To estimate the Subchronic Average Daily Dose (SADD), the ADD_{SC} was multiplied by the number of days the resident had the potential to be exposed per year, and the time frame the resident was expected to be exposed. A chemical-specific DAF was also included when evaluating dermal exposure if the associated subchronic endpoint was derived from an oral or inhalation NOAEL. This value was then divided by the total duration of time assessed. The exposure frequency, exposure duration, and averaging time reflected the assumed 30-day exposure.

The general equation for calculating the SADD was as follows:

$$SADD = \frac{ADD_{SC} * EF * ED * DAF}{CF * AT}$$

Where:

SADD = Subchronic average daily dose (mg/kg-day)
ADD_{SC} = Average daily dose (mg/kg-day)
EF = Exposure frequency (days/year)
ED = Exposure duration (days)
DAF = Dermal absorption factor (unitless)
*Only applied for dermal exposure when subchronic endpoint was derived from an oral or inhalation NO(A)EL
CF = Conversion factor (days/year)
AT = Averaging time (days)

A summary of the exposure factors used in estimating the SADD is given in **Table 24**.

Table 24: Exposure Factors Used in Estimating the SADD

PAR Lifestage	EF (days/year)	ED (days)	AT (days)
<2 year-old	30	30	30
2-<16 year-old			
Adult			

Dermal Exposure to Residues in Soil

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from dermal contact with treated soil daily for 30 days. An adjusted ADD (ADD_{SC}) was estimated by the same process as the acute ADD, except a subchronic soil EEC was used, considering first-order environmental degradation. See Section 5.3 for more details about how subchronic EECs were estimated.

To calculate the SADD, the ADD_{SC} was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), and a chemical-specific DAF when appropriate, then divided by the total duration of time assessed (AT).

Pica and Incidental Soil Ingestion

The <2 year-old child PAR and 2-<16 year-old child PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from ingestion of treated soil daily for 30 days. An adjusted ADD (ADD_{SC}) was estimated through the same process as the acute ADD, except a subchronic soil EEC was used, considering first-order environmental degradation over 30 days. See Section 5.3 for more details about how subchronic EECs were estimated.

To calculate the SADD, the ADD_{SC} was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT).

Dermal Exposure to Residues on Vegetation

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues on non-edible vegetation daily for 30 days. An adjusted ADD (ADD_{SC}) was estimated through the same process as the acute ADD, except a subchronic DFR_t was used, considering first-order environmental degradation over 30 days. See Section 5.3 for more details about how subchronic EECs were estimated.

To calculate the SADD, the ADD_{SC} was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), and a chemical-specific DAF when appropriate, then divided by the total duration of time assessed (AT).

Hand-to-Mouth Ingestion of Vegetation Residues

The <2 year-old child PAR and 2-<16 year-old child PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from hand-to-mouth activity daily for 30 days. An adjusted ADD (ADD_{SC}) was estimated through the same process as the acute ADD, except a subchronic DFR_t was used, considering first-order environmental degradation over 30 days. See Section 5.3 for more details about how subchronic EECs were estimated.

To calculate the SADD, the ADD_{SC} was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT).

Ingestion of Edible Vegetation

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues in edible vegetation daily for 30 days. An adjusted ADD (ADD_{SC}) was estimated through the same process as the acute ADD, except a subchronic EEC was used, considering first-order environmental degradation over 30 days.

To calculate the SADD, the acute ADD_{SC} was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT). Refer to Section 5.3 for additional details regarding the estimation of edible vegetation EECs.

Dermal Exposure to Residues on Turf

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from dermal contact with turf for 30 days. An adjusted ADD (ADD_{SC}) was estimated through the same process as the acute ADD, except a subchronic TTR_t was used, considering first-order environmental degradation over 30 days. See Section 5.3 for more details about how subchronic EECs were estimated.

To calculate the SADD, the ADD_{SC} was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), a chemical-specific dermal absorption factor (DAF) when appropriate, and then divided by the total duration of time assessed (AT).

Hand-to-Mouth Ingestion of Turf Residues

The <2 year-old child PAR and 2-<16 year-old child PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from hand-to-mouth activity daily for 30 days. An adjusted ADD (ADD_{SC}) was estimated through the same process as the acute ADD, except a subchronic TTR_t was used, considering first-order environmental degradation and the possibility of accumulation from multiple applications over 30 days. Refer to Section 5.3 for more details about how subchronic EECs were estimated.

To calculate the SADD, the ADD_{SC} was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT).

Object-to-Mouth Ingestion of Turf Residues

The <2 year-old child PAR and 2-<16 year-old child PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from object-to-mouth contact daily for 30 days. An adjusted ADD (ADD_{SC}) was estimated through the same process as the acute ADD, except a subchronic OR_t was used, considering first-order environmental over 30 days. Refer to the acute object-to-mouth exposure section Object-to-Mouth Ingestion of Turf Residues for details about how OR_ts were estimated.

To calculate the SADD, the ADD_{SC} was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT).

Ingestion of Surface Water Residues

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from ingestion of surface water for 30 days. The ADD was estimated through the same process as the acute ADD. See Section 5.3 for more details about how EECs were estimated.

To calculate the SADD, the ADD was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), and then divided by the total duration of time assessed (AT).

Ingestion of Groundwater Residues

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from ingestion of groundwater for 30 days. The ADD was estimated through the same process as the acute ADD. See Section 5.3 for more details about how EECs were estimated.

To calculate the SADD, the acute ADD was multiplied by the number of days the resident had the potential to be exposed per year (EF), the duration the resident was expected to be exposed (ED), and then divided by the total duration of time assessed (AT).

5.4.1.5 Chronic Exposure Assessment

To assess the chronic exposure to the PAR, an average daily dose (ADD_C) was estimated using a similar method and equation as the acute exposure, except a chronic EEC was used instead of the peak EEC. See Section 5.3 for more details about how chronic EECs were estimated.

To estimate the Annual Average Daily Dose (AADD), the ADD_C was multiplied by the number of days the resident had the potential to be exposed per year, the time frame the resident was expected to be exposed, and a chemical-specific DAF when the chronic endpoint was derived from an oral or inhalation NOAEL. This value was then divided by the total duration of time assessed. The duration of Proposed Program treatments at a single residence was assumed to be 10 years (C. Hanes, CDFA, personal communication, May 26, 2020). Because the <2 year-old child PAR lifestage is limited to two years, a two year exposure duration was assumed for this subgroup.

The following equation was used to calculate the AADD:

$$AADD = \frac{ADD_c * EF * ED * DAF}{AT * CF}$$

Where:

AADD = Annual average daily dose (mg/kg-day)
ADD_c = Average daily dose (mg/kg-day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
DAF = Dermal Absorption Factor (unitless)
*Only applied for dermal exposure when chronic endpoint was derived from an oral or inhalation NO(A)EL
AT = Averaging time (years)
CF = Conversion factor (days/year)

A summary of the exposure factors used in estimating the AADD is given in **Table 25**.

Table 25: Exposure Factors Used in Estimating the AADD

PAR Lifestage	EF (days/year)	ED (years)	AT (years)
<2 year-old	365	2	2
2-<16 year-old		10	10
Adult		10	10

Dermal Exposure to Residues in Soil

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues in soil daily for the entire year. An adjusted ADD (ADD_C) was estimated through the same process as the acute ADD, except a chronic soil EEC was used, considering first-order rate environmental degradation over 365 days. See Section 5.3 for more details about how chronic EECs were estimated.

To calculate the AADD, the ADD_C was multiplied by the number of days the resident had the potential to be exposed per year (EF), the number of years the resident was expected to be exposed (ED), a chemical-specific DAF when appropriate, then divided by the total duration of time assessed (AT).

Pica and Incidental Soil Ingestion

The <2 year-old child PAR and 2-<16 year-old child PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from ingestion of treated soil every day of the year. An adjusted ADD (ADD_C) was estimated through the same process as the acute ADD, except a chronic soil EEC was used, considering first-order rate environmental degradation over 365 days. See Section 5.3 for more details about how chronic EECs were estimated.

To calculate the AADD, the ADD_C was multiplied by the number of days the resident had the potential to be exposed per year (EF), the number of years the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT).

Dermal Exposure to Residues on Vegetation

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from dermal contact with vegetation daily for the entire year. An adjusted ADD (ADD_C) was estimated using the same process as the acute ADD, except a chronic DFR_t was used, considering first-order environmental degradation over 365 days. See Section 5.3 for more details about how chronic EECs were estimated.

To calculate the AADD, the ADD_C was multiplied by the number of days the resident had the potential to be exposed per year (EF), the number of years the resident was expected to be exposed (ED) and a chemical-specific DAF when appropriate, then divided by the total duration of time assessed (AT).

Hand-to-Mouth Ingestion of Vegetation Residues

The <2 year-old child PAR and 2-<16 year-old child PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from hand-to-mouth activity every day of the year. An adjusted ADD (ADD_C) was estimated using the same process as the acute ADD, except a chronic Vegetation Dermal Exposure was used, considering first-order environmental degradation over 365 days. See the Dermal Exposure to Residues on Non-Edible Vegetation section for more details about how chronic dermal exposure to vegetation was estimated.

To calculate the AADD for hand-to-mouth ingestion of vegetation residues, the ADD_C was multiplied by the number of days the resident had the potential to be exposed per year (EF) and the number of years the resident was expected to be exposed (ED), and subsequently divided by the total duration of time assessed (AT).

Ingestion of Edible Vegetation

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues in edible vegetation daily for an entire year. Because fruits have seasonal limits of availability, consumption of residues on treated fruit over an entire year is not anticipated. However, to complete this extrapolation, the ADD_c was multiplied by the number of potential exposure days and the number of years the resident was expected to be exposed, and then divided by the total duration of time assessed. The AADD was then compared to the chronic NOAEL. Refer to Section 5.3 for additional details regarding estimating edible vegetation residue concentrations.

Dermal Exposure to Residues on Turf

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from dermal contact with turf every day of the year. An adjusted ADD (ADD_C) was estimated using the same process as the acute ADD, except a chronic TTR_t was used, considering first-order environmental degradation over 365 days. See Section 5.3 for more details on how chronic EECs were estimated.

To calculate the AADD, the ADD_C was multiplied by the number of days the resident had the potential to be exposed per year (EF), the number of years the resident was expected to be exposed (ED), and a chemical-specific DAF when appropriate, then divided by the total duration of time assessed (AT).

Hand-to-Mouth Ingestion of Turf Residues

The <2 year-old child PAR and 2-<16 year-old child PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from hand-to-mouth activity every day of the year. An adjusted ADD (ADD_C) was estimated through the same process as the acute ADD, except a chronic TTR_t was used, considering first-order rate environmental degradation and the possibility of accumulation from multiple applications over 365 days. See Section 5.3 for more details about how chronic EECs were estimated.

To calculate the AADD, the ADD_C was multiplied by the number of days the resident had the potential to be exposed per year (EF), the number of years the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT).

Object-to-Mouth Ingestion of Turf Residues

The <2 year-old child PAR and 2-<16 year-old child PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from object-to-mouth activity daily for the entire year. An adjusted ADD (ADD_C) was estimated through the same process as the acute ADD, except a chronic OR_t was used, considering first-order rate environmental degradation and the possibility of accumulation from multiple applications over 365 days. Refer to the acute object-to-mouth exposure (Section 5.4.1.1.1) for details about how OR_ts were estimated.

To calculate the AADD, the ADD_C was multiplied by the number of days the resident had the potential to be exposed per year (EF), the number of years the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT).

Ingestion of Surface Water Residues

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from ingestion of surface water every day of the year. An adjusted ADD (ADD_C) was estimated using the same process as the acute ADD, except a 90-day average EEC was used. See Section 5.3 for more details on how chronic EECs were estimated.

To calculate the AADD, the ADD_C was multiplied by the number of days the resident had the potential to be exposed per year (EF), the number of years the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT).

Ingestion of Groundwater Residues

The <2 year-old child PAR, 2-<16 year-old child PAR, and adult PAR were assumed to be exposed to flupyradifurone and propylene carbonate residues from ingestion of groundwater every day of the year. The ADD, estimated using the 100-year peak groundwater EEC, was used for chronic ingestion. See Section 5.3 for more details on how chronic EECs were estimated.

To calculate the AADD, the ADD was multiplied by the number of days the resident had the potential to be exposed per year (EF), the number of years the resident was expected to be exposed (ED), then divided by the total duration of time assessed (AT).

5.4.1.5.1 Cancer Exposure Assessment

Cancer exposure was not characterized in this risk assessment because no chemicals evaluated in this HHRA are suspected carcinogens (USEPA, 2018a).

5.4.1.6 During and Post-Application Resident

The during and post-application resident (DPAR) represents a combination exposure of a resident who is downwind at the time his/her property is being treated, and who has the potential to be exposed to flupyradifurone and propylene carbonate residues on the treated vegetation, turf, and soil after the application. A <2 year-old child, a 2-<16 year-old child, and a ≥16 year-old adult were analyzed in the DPAR exposure assessment.

To estimate the DPAR's exposure, the DWB's and the PAR's risk values were summed. For additional details about the DWB and PAR individual exposures, refer to Sections 5.4.1.2 and 5.4.1.3, respectively. Further details of methods and equations to combine risk values can be found in Section 6.1.

5.4.1.7 Post-Application Loader

The post-application loader (PAL) represents a worker at a nursery who may be occupationally exposed to pesticide active and inert ingredient or adjuvant residues while loading plants that have been treated under the Proposed Program onto trucks or for transport. Loading was assumed to occur after the REI had passed. The PAL was assumed to have the potential to be exposed through dermal contact with vegetation after foliar treatments and soil while handling pots.

5.4.1.7.1 Acute Exposure Assessment

Dermal Exposure to Vegetation

The PAL was assumed to come into contact with treated foliage while picking up or brushing against leaves of potted plants. The method for estimating the PAL's dermal ADD for vegetation was based on USEPA's (2012l) SOP. The first step of the SOP methodology was to estimate the DFR_t of the specific pesticide active or inert ingredient. See Section 5.3 for more details about the methods used to calculate the DFR_t in nursery settings. To estimate the amount of dermal transfer of residue from leaf surface to the skin, a transfer coefficient (TC) of 100 cm^2/hour for "orchard maintenance" was selected from the USEPA (2013g) Science Advisory Council for Exposure (ExpoSAC) Policy. The DFR_t and TC were multiplied by an exposure time of 1 hour, a chemical-specific DAF, then divided by the average body weight of an adult (80 kg) (USEPA, 2011p). The ADD was calculated using the following equation:

$$ADD = \frac{DFR_t * TC * ET * CF_1 * DAF}{BW}$$

Where:

ADD = Average daily dose (mg/kg-day)
DFRt = Dislodgeable Foliar Residue (µg/cm^2)
TC = Transfer coefficient (cm^2/hr)
ET = Exposure time (hrs/day)
CF_1 = Conversion factor (mg/µg)
DAF = Dermal Absorption Factor
*Only applied for dermal exposure when acute endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)

A summary of the exposure factors used in estimating the acute ADD is given in **Table 26**.

Table 26: Exposure Factors Used in Estimating Acute Dermal Exposure to Vegetation

Receptor	TC[a] (cm^2/hr)	ET (hrs/day)	DFR_t (ug/cm^2)	DAF	BW (kg)[b]
Adult PAL	100	1	See the Dashboard Database 4.0	See the Dashboard Database 4.0	80

a. USEPA, 2013g
b. EFH (USEPA, 2011p)

Dermal Exposure to Soil

The PAL was assumed to come into contact with soil while picking up potted plants. The method for estimating the PAL's dermal ADD for soil was based on USEPA's (1989e) RAGS. The acute dermal exposure to soil was calculated using the acute concentration of chemical estimated to be in soil, the estimated surface area of the PAL's hand that comes into contact with treated soil, a soil-to-skin adherence factor, and the number of times the loader was expected to come into contact with treated soil. For more details about the methods used to calculate soil EECs, refer to Section 5.3. For the purposes of this risk assessment, a fifth of the 95th percentile adult male hand surface area of 0.131 m^2 (USEPA, 2011p) was used to represent the portion of the loader's hand (i.e., the thumb) that contacts the inside of a pot. A Department of Toxic Substances Control (DTSC) soil adherence factor (AF) of 0.2 mg/cm^2 was chosen (DTSC, 2019a), and the PAL was conservatively assumed to contact soil once every second for a 1 hour loading shift (i.e., 3,600 times per hour). The exposure was normalized by the loader's body weight, assumed to be 80 kg (USEPA, 2011p), to estimate the ADD. The ADD was calculated using the following equation:

$$ADD = \frac{EEC * CF_1 * SA_H * AF * EV * DAF}{BW}$$

Where:

ADD = Average daily dose (mg/kg-day)
EEC = Estimated environmental concentration (mg/kg)
CF = Conversion factor (kg/mg)
SA_H = Hand surface area exposed per event (cm^2/event)
AF = Soil adherence factor (mg/cm^2)
EV = Event frequency (events/day)
DAF = Dermal absorption Factor
*Only applied for dermal exposure when acute endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)

A summary of the exposure factors used in estimating acute dermal exposure to soil is given in **Table 27**.

Table 27: Exposure Factors Used in Estimating PAL Dermal Soil Exposure to Pesticide Residues

Receptor	EEC	SA_H[b]	AF[a]	EV	EF	ED	DAF	BW[b]	AT
Adult PAL	See the Dashboard Database 4.0	262	0.2	3,600	1	1	See the Dashboard Database 4.0 for chemical-specific DAFs	80	1

a. DTSC, 2019a
b. USEPA, 2011p

5.4.1.7.2 Subchronic Exposure Assessment

Dermal Exposure to Vegetation

Subchronic exposure for the PAL was evaluated in a similar manner as the chronic in the Statewide PEIR (CDFA, 2014a), except the frequency of exposure was limited to the number of applications that could occur over 30 days. A chemical-specific DAF was only applied if the subchronic dermal NOAEL was extrapolated from an oral or inhalation endpoint. Additionally, the exposure duration and averaging time reflected the intermediate period of 30 days instead of the chronic exposure duration.

The following equation was used to estimate the SADD:

$$SADD = \frac{DFR_t * CF_1 * TC * ET * EF * ED * DAF}{BW * AT * CF_2}$$

Where:

SADD = Subchronic average daily dose (mg/kg-day)
DFRt = Dislodgeable Foliar Residue (µg/cm^2)
CF_1 = Conversion factor (mg/µg)
TC = Transfer coefficient (cm^2/hr)
ET = Exposure time (hr/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (days)
DAF = Dermal Absorption Factor
*Only applied for dermal exposure when subchronic endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)
AT = Averaging time (days)
CF_2 = Conversion factor (days/year)

A summary of the exposure factors used in estimating the subchronic dermal exposure to vegetation is given in **Table 28**.

Table 28: Exposure Factors Used in Estimating Subchronic Dermal Exposure to Vegetation

Receptor	TC[a] (cm^2/hr)	ET (hrs/day)	ED (days)	AT (days)	DAF	Body Weight[b] (kg)
Adult PAL	100	1	30	30	See the Dashboard Database 4.0 for Chemical-Specific DAFs	80

a. USEPA, 2013g
b. USEPA, 2011p

Dermal Exposure to Soil

Subchronic exposure for the PAL was evaluated in a similar manner as the chronic in the Statewide PEIR, except the number of applications was limited to the number of applications that could occur over 30 days and a DAF was only applied if the subchronic dermal NOAEL was extrapolated from an oral or inhalation endpoint. Additionally, the exposure duration and averaging time reflected the intermediate period of 30 days instead of the chronic exposure duration.

The following equation was used to estimate the SADD:

$$SADD = \frac{EEC * CF_1 * SA_H * AF * EV * EF * ED * DAF}{CF_2 * BW * AT}$$

Where:

SADD = Subchronic average daily dose (mg/kg-day)
EEC = Estimated Environmental Concentration in Soil (mg/kg)
CF_1 = Conversion factor (kg/mg)
SA_H = Surface area of hand (cm^2/event)
AF = Adherence factor (mg/cm^2)
EV = Event frequency (events/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (days)
DAF = Dermal absorption factor*
*Only applied for dermal exposure when subchronic endpoint was derived from an oral or inhalation study
CF_2 = Conversion factor (days/year)
BW = Body weight (kg)
AT = Averaging time (days)

A summary of the exposure factors used in estimating subchronic exposure to the PAL through treated soil is given in **Table 29**.

Table 29: Exposure Factors Used in Estimating Subchronic Dermal Soil Exposure to Pesticide Residues

Receptor	EEC (mg/kg)	SA_H[a] (cm^2/event)	AF[b] (mg/cm^2)	EV (events/day)	ED (days)	DAF	BW (kg)[a]	AT (days)
Adult PAL	See the Dashboard Database 4.0	262	0.2	3600	30	See the Dashboard Database 4.0 for chemical-specific DAFs	80	30

a. EFH (USEPA, 2011p)
b. DTSC, 2019a

5.4.1.7.3 Chronic Exposure Assessment

Dermal Exposure to Vegetation

Chronic exposure for the PAL was evaluated in the same manner as in the Statewide PEIR (CDFA, 2014a). Refer to the Statewide PEIR for additional details of chronic exposure methodology.

The following equation was used to estimate the AADD:

$$AADD = \frac{DFR_t * CF_1 * TC * ET * EF * ED * DAF}{BW * AT * CF_2}$$

Where:

AADD = Annual average daily dose (mg/kg-day)
DFR_t = Dislodgeable foliar residue (µg/cm^2)
CF_1 = Conversion factor (mg/µg)
TC = Transfer coefficient (cm^2/hr)
ET = Exposure time (hrs/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
DAF = Dermal Absorption Factor
*Only applied for dermal exposure when chronic endpoint was derived from an oral or inhalation NO(A)EL
BW = Body weight (kg)
AT = Averaging time (years)
CF_2 = Conversion Factor (days/year)

A summary of the exposure factors used in estimating the AADD is given in **Table 30**.

Table 30: Exposure Factors Used in Estimating Chronic Dermal Exposure to Vegetation

Receptor	TC[a] (cm2/hr)	ET (hrs/day)	ED (years)	DAF	AT (years)	Body Weight[b] (kg)
Adult PAL	100	1	20	See the Dashboard Database 4.0 for chemical-specific DAFs	20	80

a. USEPA, 2013g
b. EFH (USEPA, 2011p)

Dermal Exposure to Soil

Chronic dermal exposure to soil for the PAL was evaluated in the same manner as the chronic in the Statewide PEIR. Refer to the Statewide PEIR for more details about the methods used to estimate dermal soil exposure.

The following equation was used to estimate the AADD:

$$AADD = \frac{EEC * CF_1 * SA_H * AF * EV * EF * ED * DAF}{BW * AT * CF_2}$$

Where:

AADD = Annual average daily dose (mg/kg-day)
EEC = Estimated Environmental Concentration in Soil (mg/kg)
CF_1 = Conversion factor (kg/mg)
SA_H = Surface area of hand (cm^2/event)
AF = Adherence factor (mg/cm^2)
EV = Event frequency (events/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
DAF = Dermal absorption factor*
*Only applied for dermal exposure when chronic endpoint was derived from an oral or inhalation study
BW = Body weight (kg)
AT = Averaging time (years)
CF_2 = Conversion Factor (days/year)

The exposure factors used in estimating chronic exposure to the PAL through treated soil are given in **Table 31**.

Table 31: Exposure Factors Used in Estimating PAL Dermal Soil Exposure to Pesticide Residues

Receptor	EEC (mg/kg)	SA_H[a] (cm^2/event)	AF[b] (mg/cm^2)	EV (events/day)	ED (year)	DAF	BW (kg)[a]	AT (years)
Adult PAL	See the Dashboard Database 4.0	262	0.2	3600	20	See the Dashboard Database 4.0 for Chemical-Specific DAF	80	20

a. USEPA, 2011p
b. DTSC, 2019a

5.4.1.7.4 Post-Application Loader Cancer Exposure Assessment

Cancer exposure was not characterized in this risk assessment because none of the chemicals evaluated are suspected carcinogens (EPA 2018a).

5.4.1.7.5 Combined-Nursery-Worker

The combined-nursery-worker (CNW) represents a worker employed at a nursery that may be occupationally exposed to Proposed Program chemicals while preparing pesticide solutions and applying them, as well as loading the treated plants into a truck for transport. To estimate the CNW's exposure, the MLA and the PAL exposure values were combined using the aggregate risk approach. See Section 6.1 for methods used to estimate aggregate exposure. For additional details about MLA and PAL exposure, refer to Sections 5.4.1.1 and 5.4.1.7, respectively.

6 Risk Characterization

The risk characterization phase compared estimates of pesticide active or inert ingredient and adjuvant receptor exposure (i.e., ADD, SADD, AADD) to relevant toxicity endpoints (i.e., NOAELs) to characterize the potential risk for each receptor (OEHHA, 2001a).

6.1 Non-Cancer Effects

The method used to quantify non-cancer risk due to estimated pesticide exposure was the Margin of Exposure (MOE) approach. The MOE represents how close the receptor's daily intake is to the NOAEL (i.e., how close a pesticide active or inert ingredient or adjuvant exposure is to the level of concern). The target MOE accounted for uncertainty in inter-species extrapolation and intra-species variation through the use of two 10x uncertainty factors for a target MOE of 100. An additional uncertainty factor of 3 was applied to the target MOE for child receptors, who may be more sensitive to adverse effects (OEHHA, 2001c, 2008a, 2016a; USEPA, 2005q). Calculated MOEs for the receptor's exposures greater than the target MOE are typically not considered to be of concern (USEPA, 2007k). It should be noted that MOEs estimated in this analysis are not probabilistic statements of risk, but instead represent a threshold model.

The generic formula used for estimating an MOE is:

MOE = Toxicity (mg/kg-day) / ADD (mg/kg-day)*

Where:

MOE = Margin of Exposure (unitless)

ADD = Average Daily Dose

* For subchronic or chronic assessments, the ADD is replaced by the SADD or AADD, respectively

In situations where multiple pathways are present, multiple exposures occur. An MOE was estimated for each active or inert ingredient individually for each exposure route and the MOEs were summed regardless of mode of action or target organs and systems to conservatively estimate the hazard that may be associated with the combined exposure. This methodology is consistent with the approaches described in the USEPA (1989e) *Risk Assessment Guide to Superfunds (RAGS*) and USEPA (2001e) *General Principles for Performing Aggregate Exposure and Risk Assessment* which provide guidance on assessing aggregate chemical risk and aggregate exposure pathway risk. Consistent with the evaluation of individual MOEs in this HHRA, summed MOEs greater than 300 were not considered to be of concern (OEHHA, 2016a; USEPA, 2007k).

The generic formula used for summing MOEs is:

$$MOE_{total} = 1 / ((1/MOE_1) + (1/MOE_2) + \ldots + (1/MOE_n))$$

Where:

MOE = Margin of Exposure (unitless)

6.2 Cancer Effects

Cancer risk was not estimated in this HHRA because there is no evidence suggesting any of the pesticide active or inert ingredients analyzed are carcinogenic (USEPA, 2018a).

6.3 Numeric Data Presentation

Some numeric data presented in the risk characterization section (as found in the Dashboard Database 4.0) were very large numbers. To present these numbers in an easily readable format, scientific notation is used. For example, the value of 1,290,000 is expressed as 1.29E+06. Note that the “E” represents “exponent” or the number 10 raised to a power. The positive (“+”) sign following the “E” indicates the number of places the decimal point was moved to the left from the original number.

7 Risk Assessment Results

Risk results, expressed as MOEs, are presented in the Dashboard Database 4.0 *Risk Results* section. To view the EECs and unit exposure values used to estimate risk for the Proposed Program, refer to the *Pest Programs* section of the Dashboard Database 4.0.

An overview of the minimum summed MOEs for each application scenario is presented in **Table 32**.

Table 32: Minimum Summed MOEs per Application Scenario

Scenario	Minimum MOE	
	Occupational	Non Occupational
PDCP-79	2.83E+02	7.88E+02
PDCP-80	1.32E+04	4.63E+02
PDCP-81	4.77E+03	3.08E+04
PDCP-82	6.08E+02	3.69E+04
PDCP-83	1.01+04	1.52E+04
PDCP-84a	1.32E+04	Not Applicable
PDCP-84b	1.55E+04	

Minimum summed MOEs were higher than the target MOE for all scenarios except PDCP-79. When a minimum summed MOE was lower than the target MOE based on the "baseline" run assumptions described earlier in this report, a reduced exposure and/or variant run was evaluated. Reduced exposure and variant scenarios are further discussed below.

7.1 Analysis of Reduced Exposure and Variant Scenarios

For each application scenario, a "baseline" run was completed to reflect the application scenarios proposed in Section 3.1 without modifications that may influence risk outcomes (e.g., changes in application area treated per day, technique, PPE, equipment). When the baseline scenario analysis suggested there was potential for an MOE below the target MOE, a reduced exposure (RedEx) and/or variant run was evaluated. Both RedEx and variant run scenarios reflect modifications to the baseline scenario such that the calculated MOE is greater than the threshold of unacceptable risk. The reduced exposure and/or variant runs evaluated are described below.

7.1.1.1 Baseline Analysis of PDCP-79

PDCP-79 is a foliar application of Altus, once per year, in a residential setting to 17.5 acres using a backpack sprayer or mechanically pressurized handsprayer. Baseline acute risk values to the MLA, assuming use of a backpack sprayer, resulted in an estimated MOE of 283, which is less than the target MOE of 300. Contribution of each chemical/pathway to the aggregate acute MLA MOE is presented in **Table 33**.

Table 33: PDCP-79 Baseline Acute MLA MOEs

Chemical	Run Description	MLA Dermal	MLA Inhalation	MLA Summed Risk
Flupyradifurone	Baseline	5.16E+02	1.69E+04	5.01E+02
Propylene Carbonate	Baseline	8.74E+02	2.54E+03	6.50E+02
Summed:	Baseline	**3.24E+02**	**2.21E+03**	**2.83E+02**

7.1.1.2 Variant/RedEx Analysis of PDCP-79

Because risk through the inhalation pathway had relatively low contribution to the summed MOE, modification to factors influencing dermal exposure was the primary focus for developing alterations to the baseline run.

A summary of the variant and RedEx is provided below. Under either Option 1 or Option 2, PDCP-79 is not anticipated to result in unacceptable risk to the MLA.

Option 1: Use of Mechanically Pressurized Handsprayer in lieu of Backpack Sprayer

In the baseline assessment, the backpack sprayer was evaluated as health protective of the mechanically pressurized handsprayer, based on the higher dermal and inhalation UEs reported in the USEPA (2020a) OPHED Surrogate Table. Limiting the application equipment to only the mechanically pressurized handsprayer resulted in reduction of the dermal unit exposure (from 30,500 to 2,050 ug a.i./lb handled for the backpack sprayer to the mechanically pressurized handsprayer, respectively), permits application to all 17.5 acres without additional PPE beyond the single-layer clothing and gloves.

Option 2: Reduction of Area Treated/Worker/Per Day

The worker may treat up to 16.5 acres daily exclusively with the backpack and standard, single-layer clothes and gloves; however, they would not be permitted to treat any additional area with any additional equipment or product in the same day.

The variant risk values based on changes in equipment are displayed in **Table 34** and reduced exposure run results, based on lower assumed area treated/worker/day (ATPD), in **Table 35**.

Table 34: PDCP-79 Variant Acute MLA MOE by Equipment

Chemical	Run Description	MLA Dermal	MLA Inhalation	MLA Summed Risk
Flupyradifurone	Baseline	5.16E+02	1.69E+04	5.01E+02
Propylene Carbonate	Baseline	8.74E+02	2.54E+03	6.50E+02
Summed:	Baseline	**3.24E+02**	**2.21E+03**	**2.83E+02**
Flupyradifurone	Variant- Mech-PH, Single-LCG, No resp	7.68E+03	1.35E+05	7.26E+03
Propylene Carbonate	Variant- Mech-PH, Single-LCG, No resp	1.30E+04	2.02E+04	7.92E+03
Summed:	Variant- Mech-PH, Single-LCG, No resp	**4.83E+03**	**1.76E+04**	**3.79E+03**

Table 35: PDCP-79 Reduced Exposure Acute MLA MOE by Area Treated/Worker/Day (ATPD)

Chemical	ATPD	MLA Dermal	MLA Inhalation	MLA Summed Risk
Flupyradifurone	17.5	5.16E+02	1.69E+04	5.01E+02
Propylene Carbonate		8.74E+02	2.54E+03	6.50E+02
Summed:		**3.24E+02**	**2.21E+03**	**2.83E+02**
Flupyradifurone	17	5.31E+02	1.74E+04	5.15E+02
Propylene Carbonate		9.00E+02	2.62E+03	6.70E+02
Summed:		**3.34E+02**	**2.28E+03**	**2.91E+02**
Flupyradifurone	16.5	5.47E+02	1.79E+04	5.31E+02
Propylene Carbonate		9.27E+02	2.70E+03	6.90E+02
Summed:		**3.44E+02**	**2.34E+03**	**3.00E+02**
Flupyradifurone	16	5.64E+02	1.85E+04	5.48E+02
Propylene Carbonate		9.56E+02	2.78E+03	7.11E+02
Summed:		**3.55E+02**	**2.42E+03**	**3.09E+02**

7.2 Uncertainty Analysis

In characterizing risks from exposure to pesticide active and inert ingredients, it is important to address the variability and uncertainty associated with the exposure/risk estimates. The risk characterization should provide information on: (1) potential measurement errors based on the precision and accuracy of the available data, (2) variability of the input data used in the exposure/risk estimates, and (3) uncertainty that results from data gaps or the assumptions used. The risk characterization also assesses the relative importance of these components on the estimates of exposure/dose and risk.

Uncertainty may be introduced into the exposure/risk calculations at various stages of the risk assessment process. Uncertainty may occur as a result of: (1) site-specific variations of chemical-specific fate and transport that could impact chemical partitioning, retention, and degradation, (2) the selection of exposure scenarios and exposure factors, (3) and the uncertainties associated with pesticide active and inert ingredient or adjuvant toxicity data that have been extrapolated from high doses in animals to low doses in humans, and that do not account for the interactions of exposures to multiple chemical substances over a lifetime. Variability can occur as a result of variations in individual day-to-day or event-to-event exposure factors or variations among the exposed population.

7.2.1 Exposure Assessment

To address the exposure assessment uncertainties, the following assumptions were made. In some cases, as noted below, conservative assumptions likely resulted in an overestimation of actual risk.

7.2.1.1 Inert Ingredient Information Quality

The HHRA evaluated information on inert ingredients to the extent that information was available. The quality and detail of information available on inert ingredients in pesticide products was highly variable. Disclosure of inert ingredients is generally limited. In instances where inert ingredients were not disclosed and/or no information was available to estimate risk, the extent of risk, if any, remains unknown.

7.2.1.2 Drinking Water

Pesticide EECs in drinking water were derived from USEPA's (2016f) PWC model. Assumptions used for modeling and regarding drinking water ingestion which resulted in uncertainty are discussed below. Refer to Section 7.2.1.3.6 for information on the noted limitations of PWC.

For nursery scenarios involving applications to containerized plants, it was assumed that treated containers were arranged such that approximately 80% and 60% of the pesticide from ground and aerial applications, respectively, was contained within the pot or deposited on foliage directly above the pot for ground applications, while approximately 20% and 40% of the pesticide from ground and aerial applications, respectively, was assumed to be subject to transport to water. Because the arrangement and density of treated containers may vary, making this assumption adds uncertainty as exposure estimates may be over- or under-estimated based on site-specific conditions.

For urban/residential application scenarios, the application area was defined as a 17.5-acre area representing the entire area within the prescribed 150-m distance from a GWSS find. Treatments would be applied to host plants only. Within an application area, many features would not be treated such as pavement, buildings, and lawns. Following the approach used in previous PEIR Addenda, it was assumed approximately one-third of the entire area was treated. Since it is not possible to know how many host plants would exist within the 17.5-acre application area, assuming one-third of the area is treated adds uncertainty.

For surface water-sourced drinking water, the upper 90th ranked peak EEC generated by PWC was used for acute and subchronic exposure assessment, while the upper 90th ranked 90-day average EEC was used for chronic exposure assessment. By using the peak EEC in lieu of the 21-day, 60-day, or 90-day average EEC for subchronic assessment and the 90-day average EEC in lieu of the 365-day average EEC for chronic assessment, exposures for these durations, and resulting risk estimates, were likely overestimated.

For groundwater-sourced drinking water, 100-year peak EECs generated by PWC were used to assess risk at all exposure durations (i.e., acute, subchronic, and chronic exposures). As a result, exposure and risk estimates for subchronic and/or chronic assessments may be exaggerated.

Individuals were conservatively assumed to consume exclusively from surface and groundwater sources impacted by the Proposed Program. Additionally, aggregated risk estimates included the MOE from both surface and groundwater with no reduction of the 95th percentile drinking water consumption each pathway assumes. Therefore, exposure estimates associated with ingestion of impacted drinking water are likely overestimated.

It is CDFA's practice to ensure measures are taken to prevent pesticide applications from directly reaching a waterbody. CDFA's protection measures for surface waters were presented in Section 2.11: Program Management Practices of the Main Body of the Statewide PEIR (CDFA, 2014a). Where necessary, site-specific conditions might need to be assessed and additional precautions applied to prevent drift or movement to water. Indirect pathways would likely have lower concentrations than predicted by the quantitative model. Therefore, the actual pesticide concentration in water, and corresponding risk, would be lower than predicted. Specific BMPs are required for specific applications conducted by CDFA under their Spray Applications National Pollutant Discharge Elimination System (NPDES) permit. Such BMPs for ground applications include a preapplication site assessment, proper calibration and maintenance of spray equipment, making applications only during favorable weather, using low pressure application equipment, and conducting spot applications (*i.e.*, limit application areas). For aerial applications, a standard 200-m buffer is maintained around water bodies.

7.2.1.3 Model Limitations

When empirical data were not available, models are often utilized to derive environmental media concentrations and exposure values in the HHRA. To overcome the innate limitations of environmental modeling, various assumptions were made based on professional judgment. When assumptions were necessary, conservative assumptions (i.e., ones that resulted in the highest exposure estimate) were made. For a description of the models discussed in this section, please refer to Section 5.

When modeling environmental exposure, key transport properties may not account for dilution and partial transfer between media such as plants, soil, water, and air. Therefore, most of the EECs represent an upper-bound, conservatively high value since not all fate and transport properties have been modeled.

Limitations of each model are presented below.

7.2.1.3.1 USEPA Occupational Pesticide Handler Exposure Data (OPHED)

OPHED required the user to select from the given combinations of application techniques, settings, and Personal Protective Equipment (PPE). When a requested application scenario did not match any of the OPHED choices, the most suitable surrogate was chosen based on professional judgment. Most studies used to derive the OPHED unit exposures were unavailable.

As a first-tier approach, unit exposures as presented in the OPHED surrogate table are used for the purposes of assessing risk to mixer-loader-applicators. The data found in this table are derived from studies that, in certain circumstances, are not readily comparable to application scenarios evaluated in this HHRA. When the studies and their details are available, the unit exposures may be refined to better represent CDFA activities under the Proposed Program. Methods associated with refinement of UEs as found in this report are discussed in Appendix B.

7.2.1.3.2 Briggs Equation

The Briggs equation was used to estimate active and inert ingredient and adjuvant concentration in vegetation. It allows for the calculation of expected tissue concentrations due to active and inert ingredient and adjuvant uptake from soil residues for plants. The Briggs equation utilizes the chemical K_{ow} and a simple soil model to estimate active and inert ingredient and adjuvant concentrations taken up in vegetation.

The soil properties selected for each application scenario are based on USEPA-generated PRZM inputs. The assumptions associated with specific soil properties are based on a soil profile that may not reflect all potential application site conditions.

7.2.1.3.3 AgDRIFT

For this HHRA, most of the default values in the AgDRIFT model were left unchanged from the Statewide PEIR. AgDRIFT makes assumptions for a variety of parameters associated with application methods and meteorological data that may not match site specific conditions and may lead to over- or under-estimation of actual off-site drift.

7.2.1.3.4 USEPA Standard Operating Procedures for Residential Exposure Assessments (SOP)

USEPA's Residential SOPs are more reliable for estimating acute exposure than continuous exposure. The user is limited to the application settings, exposure pathways, and activity patterns provided in the SOP so a surrogate had to be chosen if the requested application and exposure options were not available. Using conservative surrogates, such as USEPA's Exposure Factors Handbook (EFH), provided more confidence that the resulting exposure tended toward an over-estimate compared to actual exposure.

7.2.1.3.5 USEPA Risk Assessment Guidance for Superfunds (RAGS)

RAGS methodology is most commonly used to estimate continuous exposure, but in some cases (e.g., ingestion of vegetation, dermal exposure to soil), it was used for acute exposure assessments due to lack of appropriate alternative methodology.

7.2.1.3.6 Pesticide in Water Calculator (PWC)

The EECs used for estimating risk due to ingestion of drinking water from impacted surface and groundwater sources rely on modeling data from USEPA's (2016f) PWC model. There are inherent limitations associated with environmental modeling, including those discussed here. For more information on the limitations of PWC, see the ERA.

Surface water

PWC did not provide a means to appropriately estimate water concentrations in surface water that was not immediately adjacent to the application site. The inability to accurately model concentrations in waterbodies not immediately adjacent to application sites tended to produce an overestimate for water concentrations. The resulting risk estimates would therefore be exaggerated.

Water concentrations in PWC are based on what would occur in a 5.26-ha (13-acre) reservoir. In reality, a wide variety of waterbodies could be adjacent to application sites. Estimated concentrations from PWC for waterbodies that are smaller and shallower than the modeled waterbody would be low. However, where water bodies were larger, the estimates were likely greatly exaggerated.

Groundwater

No California-specific groundwater scenarios were available for use with PWC. The soil profile used for groundwater assessment (i.e., Tifton loamy sand) was based on soil data from Cook and Colquitt Counties in Georgia, where peanuts, cotton, and pecans are commonly grown (USEPA, 2013j). Because groundwater scenarios were designed to represent vulnerable groundwater sources and are more sand-dominant than the California-based soil profiles used for surface water assessment, impacts to groundwater quality and resulting human health risks are likely exaggerated and may not accurately reflect actual California conditions.

The modeled depth to groundwater of 85.33 feet for scenarios that may take place throughout the state and 88.65 feet for scenarios that are geographically limited to Southern California may result in over- or underestimated EECs in areas with groundwater-derived drinking water that occurs at increased or decreased depths, respectively. In addition, it is unlikely that drinkable groundwater occurs at a depth of 0.1 feet. Inclusion of all CASGEM groundwater depth data greater than or equal to 0.1 feet likely underestimates the actual depths of aquifers used for drinking water and overestimates the impact that pesticides have on water quality.

Groundwater concentrations were based on what would occur in an aquifer with a vertical thickness of 1 meter (3.3 feet). In reality, aquifers of a variety of sizes could occur beneath Program application sites. Therefore, groundwater EECs and associated risk estimates may be over- or underestimated based on site-specific conditions.

7.2.2 Toxicity Assessment

To address the toxicity assessment uncertainties, the following assumptions were made. In some cases, as noted below, conservative assumptions likely resulted in an over-estimate of actual risk.

7.2.2.1 Toxicological Endpoints

The toxicity assessment evaluated non-cancerous adverse effects that were derived from animal data observed in controlled experiments. Uncertainty associated with experimental animal NOAELs extrapolated for human exposure were addressed through use of the uncertainty factors which were used to determine the target MOE. The uncertainty factors for inter-species extrapolation and intra-species variation were accounted for through the use of two 10x uncertainty factors for a total target MOE of 100 (USEPA, 2007k). An additional uncertainty factor of 3 was applied to the target MOE for child receptors, who may be more sensitivity to adverse effects (OEHHA, 2001c, 2008a). Therefore, the higher target MOE of 300 for children was used to be consistent with a recent OEHHA (2016a) analysis.

There exists uncertainty in using a “freestanding NOAEL” (i.e., a point of departure that has no adverse effect associated with it, but instead is the maximum dose tested without adverse effects). Use of freestanding NOAELs is generally considered health protective as no adverse health effects are observed even at the typically high doses used in toxicity tests. There also exists uncertainty in the extrapolation of an oral endpoint to dermal and inhalation exposure pathways. Differences in metabolism and susceptibility at different sites influence the dose of a chemical that interacts at a receptor level, as well as whether the adverse effects are local or systemic.

7.2.2.2 Endocrine Disruptors

Endocrine disruptors are chemicals or mixtures of chemicals that may interfere with the body’s endocrine system and produce developmental, teratogenic, reproductive, neurological, and immune effects in both humans and wildlife (NIEHS, 2010a). Although endocrine disruptors are generally considered to have the potential to cause adverse effects, uncertainty exists regarding the relationship between endocrine disruptor exposure and adverse health outcomes. In many cases, only screening-level data are available, which may or may not address the potential for a chemical to interact with the endocrine system in a way that could produce an adverse effect (USEPA, 2011v). In general, these and other forms of endocrine disruptor data are not sufficient for conducting a risk assessment. Due to this uncertainty, endocrine disruption effects were not specifically evaluated in this risk assessment.

7.2.2.3 Synergism

Synergism is the effect caused when exposure to two or more chemicals concurrently or consecutively results in health effects that are greater than the sum of the effects of the individual chemicals (Health Canada, 2016c). Uncertainty exists as to whether any of the chemicals analyzed in this HHRA produce synergistic effects. Although methodologies were available for assessing synergism, no usable endpoints were available in the literature to evaluate synergistic relationships between and within active and inert ingredients analyzed in this HHRA. Therefore, synergistic effects could not be evaluated in this risk assessment.

7.2.3 Risk Characterization

In situations where multiple pathways are present, multiple exposures occur. An MOE was estimated for each active or inert ingredient individually for each individual exposure route and the MOEs were summed regardless of mode of action or target organs and systems to conservatively estimate the hazard that may be associated with the combined exposure.

7.3 Conclusions

This HHRA was conducted to assess the potential health risk to humans from implementation of Proposed Program. The HHRA was conducted using procedures and methodologies commonly accepted and used by government agencies such as USEPA, DPR, OEHHA, and CDPH as well as the wider risk assessment profession. The HHRA relied upon the four-stage process for risk assessments: hazard identification, toxicity dose response assessment, exposure assessment, and risk characterization. In the hazard identification phase, CDFA and its risk assessment team consulted with DPR and OEHHA to obtain feedback on a variety of topics including models used to evaluate exposure, default input parameters, and appropriate toxic effect representations. The toxicity dose-response assessment phase selected health-protective values for acute, subchronic, and chronic non-cancer health effects. Cancer slope factors (CSFs) do not exist because the available data indicate that the pesticide active and inert ingredients assessed are not likely to be carcinogenic. Therefore, cancer risk was not assessed. Non-cancer health effects were based on NOAELs obtained from toxicity studies. In the exposure assessment phase, the ADD, SADD, and AADD for potentially exposed populations were estimated using various models accounting for concentration of pesticide active and inert ingredients in various environmental media and subsequent exposure of human receptors. The risk characterization phase provided a quantitative assessment of the potential for adverse effects to receptors.

For each of the application scenarios analyzed for the Proposed Program, the calculated MOE was greater than the target MOE value of 300. Specifically, MOE values calculated for this HHRA ranged from approximately 283 to greater than 10^{30}. This indicates that exposure to pesticide active and inert ingredients as a result of Proposed Program activities is unlikely to result in adverse impacts to human health.

This HHRA, along with the Statewide PEIR, will be used to assist CDFA in assessing potential impacts to human health. This HHRA did not identify any new significant human health impacts or any substantial increase in the severity of the significant effects identified in the PEIR accruing to the use of these scenarios in addition to previously analyzed treatment scenarios. No alterations to scenarios presented in this HHRA were required.

8 References

References for this report may be found in the Dashboard Database 4.0.

NOTE: References match those previously listed in the Statewide PEIR (CDFA, 2014a). Therefore, lettering order following publication years may not always be in sequence in this report. Links to webpages were active as of the listed access date. Access to those web resources and information presented therein are subject to change.

Appendix A: Program Material Data Sheet (PMDS)

California Department of Food & Agriculture Program Material Data Sheet (PMDS)

INSTRUCTIONS:

1.) Please fill in this PMDS with specific application scenario details.
2.) In the "Application Description" section on Page 2, please describe the application in thorough detail.
3.) Please refer to the Example PMDS (attached) to ensure the template has been filled in properly.
4.) Please attach product label and Safety Data Sheet.
5.) Include units as needed.
6.) For PMDS revisions, do so in track changes and "save as" with the following file naming convention:
PMDS Program Name Pesticide Scenario App Method Author Initials Date
Ex.: PMDS JB Acelepryn Turf Spray Drench LP 4.2.16

PMDS Status Summary

Prepared by
(CDFA): **Craig Hanes** Date: 4/15/20

☒Reviewed, ☐ Revised, ☐ Approved by:
(Blankinship):J. Sullivan Date: 4/21/20

☐Reviewed, X Revised, ☐ Approved by:
(CDFA):**Craig Hanes** Date: **5/11/20**

☒ Reviewed, ☒ Revised, ☐ Approved by:
(Blankinship): **J. Sullivan** Date: **5/14/20**

☐Reviewed, x Revised, ☐ Approved by:

(CDFA): **Craig Hanes** Date: **5/19/2020**

☐Reviewed, X Revised, X Approved by:
(Blankinship): J. Sullivan Date: 6/3/20

Scenario Name: PDCP-79

Product Name	Specialty Label (e.g., Section 18, 24c) (Yes/No)	Active Ingredient(s)	Additional Product	Additional Active Ingredient
Altus	No	Flupyradifurone	None	None

General Scenario Setting (e.g., Large Production Nursery, Residential, etc.)	Specific Scenario Setting Description (e.g., containerized plants on loading dock)	Geographic Scenario Setting Description (Statewide or specific region)
Residential	Landscape host material	Statewide

Trapping Scenario (if yes, Describe on Page 2)	Anticipated Consecutive Years of Application	Target Pest(s)	Target Host(s) (e.g., citrus tree, ornamental, turf, etc.)
n/a	Minimum of 4 years	Various	Ornamentals/Fruit Trees

Non-target Areas Affected (e.g., potential overspray to turf)	Application Technique (e.g., broadcast, drench, spot spray, etc.)	Application Equipment (e.g., mechanically pressurized handgun, boom sprayer, etc.)
Potential overspray to turf, bare soil, or non-target plants	Foliar spray	Mechanically pressurized sprayer, backpack sprayer

Application(s) per year	Application Interval (If variable, explain on page 2)	Total Contiguous Application Area	Area Treated/Applicator/Day
Once per year per location	Once per year per location	17.5 acres	17.5 acres

Product Application Rate (Please include units)	Final Tank Mix Applied (Volume per Area)	Active Ingredient Application Rate (Provided by Consultant)	Inert Ingredient Application Rate(s) (Provided by Consultant)
10.5 fl. oz Per acre	100 gallons per acre	0.137 lbs. a.i./ac	Prop. carbonate-0.343 lb/ac[1] Oxirane-0.320 lb/ac[2]

Adjuvant(s) or Additive(s) Product:	Adjuvant Application Rate (Please include units)
None	NA

[1]Prop. Carbonate = Propylene carbonate
[2] Oxirane = Oxirane, methyl-, polymer with oxirane, monobutyl ether

Program Material Data Sheet (PMDS)

Application Descriptions and Assumptions (Please describe the application in as much detail as possible using a bullet point list).

- Applications made in a 150 m radius around a find.
- Applications made to ornamentals.
- Applications could be made to ground covers and fruit trees.
- No applications made to vegetables, but other fruit trees could be treated.
- No direct applications made to turf.
- Lawn furniture, lawn toys, are removed or covered.
- Water containers and features are tarped or covered.
- Application rate of 10.5 fl. oz. Altus/100 gal tank mix.
- Overspray to impervious surfaces avoided.
- Pre-treatment notification of at least 48 hours in advance provided to all properties.
- Residents are provided notices regarding re-entry period of "once the spray has dried."
- Notices will indicate any pre-harvest interval for fruit consumption as specified in the label.
- Minimize exposure to pollinators by applying outside of daily peak foraging periods.

California Department of Food & Agriculture Program Material Data Sheet (PMDS)

PMDS Status Summary
Prepared by (CDFA): **S. Oswalt** Date: 4/14/20
☒Reviewed, ☐ Revised, ☐ Approved by: (Blankinship):J. Sullivan Date: 4/21/20
☒Reviewed, ☒ Revised, ☐ Approved by: (CDFA): S. Oswalt Date: 5/6/20
☒ Reviewed, ☒ Revised, ☐ Approved by: (Blankinship): J. Sullivan Date: 5/14/20
☒Reviewed, ☒ Revised, ☐ Approved by: (CDFA): S. Oswalt Date: 5.15.20
☐Reviewed, ☐ Revised, X Approved by: (Blankinship): J. Sullivan Date: 5/28/20

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5.) Include units as needed.
6.) For PMDS revisions, do so in track changes and "save as" with the following file naming convention:
PMDS Program Name Pesticide Scenario App Method Author Initials Date
Ex.: PMDS JB Acelepryn Turf Spray Drench LP 4.2.16

Scenario Name: PDCP-80

Product Name	Specialty Label (e.g., Section 18, 24c) (Yes/No)	Active Ingredient(s)	Additional Product	Additional Active Ingredient
Altus	No	Flupyradifurone	None	None

General Scenario Setting (e.g., Large Production Nursery, Residential, etc.)	Specific Scenario Setting Description (e.g., containerized plants on loading dock)	Geographic Scenario Setting Description (Statewide or specific region)
Small, Medium and Most Large Production Nursery	Containerized nursery stock on loading dock	Statewide

Trapping Scenario (if yes, Describe on Page 2)	Anticipated Consecutive Years of Application	Target Pest(s)	Target Host(s) (e.g., citrus tree, ornamental, turf, etc.)
N/A	Minimum of 4 years	Various	Nursery Stock

Non-target Areas Affected (e.g., potential overspray to turf)	Application Technique (e.g., broadcast, drench, spot spray, etc.)	Application Equipment (e.g., mechanically pressurized handgun, boom sprayer, etc.)
Loading dock surface (concrete, soil)	Foliar spray	Mechanically pressurized handgun sprayer, boom sprayer, backpack sprayer

Application(s) per year	Application Interval (If variable, explain on page 2)	Total Contiguous Application Area	Area Treated/Applicator/Day
150	2 days	3750 sq. ft.	3750 sq. ft.

Product Application Rate (Please include units)	Final Tank Mix Applied (Volume per Area)	Active Ingredient Application Rate (Provided by Consultant)	Inert Ingredient Application Rate(s) (Provided by Consultant)
10.5 fl. oz / acre	100 gallons /acre	0.137 lbs. a.i./ac	Prop. carbonate-0.343 lb/ac[1] Oxirane-0.320 lb/ac[2]

Adjuvant(s) or Additive(s) Product:	Adjuvant Application Rate (Please include units)
None	NA

[1]Prop. Carbonate = Propylene carbonate
[2] Oxirane = Oxirane, methyl-, polymer with oxirane, monobutyl ether

Program Material Data Sheet (PMDS)

Application Descriptions and Assumptions (Please describe the application in as much detail as possible using a bullet point list).

- Each plant receives a single application on loading dock prior to shipment.
- Plants are not loaded onto shipping trucks until the REI period has elapsed.
- Loading consist of either palleted plants or individuals pots manually lifted.
- Treated host plants on loading docks are isolated from other nursery stock or other nontarget plants.
- Re-entry signs are posted around treated plants.
- The Restricted Entry Interval (REI) is 12 hours.
- Applying 10.5 fl oz of Altus / 100 gallons /acre
- Minimize exposure to pollinators by applying outside of daily peak foraging periods.

California Department of Food & Agriculture Program Material Data Sheet (PMDS)

PMDS Status Summary

Prepared by
(CDFA): **S. Oswalt** Date: 4/14/20

☒Reviewed, ☐ Revised, ☐ Approved by:
(Blankinship):J. Sullivan Date: 4/21/20

☒Reviewed, ☒ Revised, ☐ Approved by:
(CDFA): S.Oswalt Date: 5.6.20

☒ Reviewed, ☒ Revised, ☐ Approved by:
(Blankinship): J. Sullivan Date: 5.14.20

☒Reviewed, ☒ Revised, ☐ Approved by:
(CDFA): S.Oswalt Date: 5.15.20

☐Reviewed, ☐ Revised, x Approved by:
(Blankinship): J. Sullivan Date: 5/28/20

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PMDS Program Name Pesticide Scenario App Method Author Initials Date
Ex.: PMDS JB Acelepryn Turf Spray Drench LP 4.2.16

Scenario Name: PDCP-81

Product Name	Specialty Label (e.g., Section 18, 24c) (Yes/No)	Active Ingredient(s)	Additional Product	Additional Active Ingredient
Altus	No	Flupyradifurone	None	None

General Scenario Setting (e.g., Large Production Nursery, Residential, etc.)	Specific Scenario Setting Description (e.g., containerized plants on loading dock)	Geographic Scenario Setting Description (Statewide or specific region)
Small, Medium and Most Large Production Nursery	Containerized nursery stock	Statewide

Trapping Scenario (if yes, Describe on Page 2)	Anticipated Consecutive Years of Application	Target Pest(s)	Target Host(s) (e.g., citrus tree, ornamental, turf, etc.)
N/A	Minimum of 4 years	Various	Nursery Stock

Non-target Areas Affected (e.g., potential overspray to turf)	Application Technique (e.g., broadcast, drench, spot spray, etc.)	Application Equipment (e.g., mechanically pressurized handgun, boom sprayer, etc.)
Soil, drift to nontarget nursery plants	Foliar spray	Mechanically pressurized handgun sprayer, boom sprayer, backpack sprayer

Application(s) per year	Application Interval (If variable, explain on page 2)	Total Contiguous Application Area	Area Treated/Applicator/Day
2	90 days	0.75 acres	0.75 acres

Product Application Rate (Please include units)	Final Tank Mix Applied (Volume per Area)	Active Ingredient Application Rate (Provided by Consultant)	Inert Ingredient Application Rate(s) (Provided by Consultant)
10.5 fl. oz / acre	100 gallons /acre	0.137 lbs. a.i./ac	Prop. carbonate-0.343 lb/ac[1] Oxirane-0.320 lb/ac[2]

Adjuvant(s) or Additive(s) Product:	Adjuvant Application Rate (Please include units)
None	NA

[1]Prop. Carbonate = Propylene carbonate
[2]Oxirane = Oxirane, methyl-, polymer with oxirane, monobutyl ether

Program Material Data Sheet (PMDS)

Application Descriptions and Assumptions (Please describe the application in as much detail as possible using a bullet point list).

- Hold treatments are made when the nursery has a viable GWSS find in a shipment at destination. This would be a nursery with either an infested premise or a free-from premise compliance agreement. The second situation is a nursery in an infested county with trap finds that are over the maximum threshold for finds in the nursery. If either situation happens the nursery must treat all plants within 100 feet of the finds, or the block of plants where the GWSS-infested plant originated.
- Plants can be treated no more than twice per year.
- Re-entry signs are posted around treated plants.
- The Restricted Entry Interval (REI) is 12 hours.
- Applying 10.5 fl oz of Altus / 100 gallons /acre
- Minimize exposure to pollinators by applying outside of daily peak foraging periods.

California Department of Food & Agriculture Program Material Data Sheet (PMDS)

INSTRUCTIONS:

1.) Please fill in this PMDS with specific application scenario details.
2.) In the "Application Description" section on Page 2, please describe the application in thorough detail.
3.) Please refer to the Example PMDS (attached) to ensure the template has been filled in properly.
4.) Please attach product label and Safety Data Sheet.
5.) Include units as needed.
6.) For PMDS revisions, do so in track changes and "save as" with the following file naming convention:
PMDS Program Name Pesticide Scenario App Method Author Initials Date
Ex.: PMDS JB Acelepryn Turf Spray Drench LP 4.2.16

PMDS Status Summary

Prepared by
(CDFA): **S. Oswalt** Date: 4/14/20

☒Reviewed, ☐ Revised, ☐ Approved by:
(Blankinship):J. Sullivan Date: 4/21/20

☒Reviewed, ☒ Revised, ☐ Approved by:
(CDFA): S. Oswalt Date: 5/6/20

☒ Reviewed, ☒ Revised, ☐ Approved by:
(Blankinship): J. Sullivan Date: 5.14.20

☒Reviewed, ☒ Revised, ☐ Approved by:
(CDFA): S. Oswalt Date: 5.15.20

☐Reviewed, ☐ Revised, X Approved by:
(Blankinship): J. Sullivan Date: 5/28/20

Scenario Name: PDCP-82

Product Name	Specialty Label (e.g., Section 18, 24c) (Yes/No)	Active Ingredient(s)	Additional Product	Additional Active Ingredient
Altus	No	Flupyradifurone	None	None

General Scenario Setting (e.g., Large Production Nursery, Residential, etc.)	Specific Scenario Setting Description (e.g., containerized plants on loading dock)	Geographic Scenario Setting Description (Statewide or specific region)
Large Production Nursery	Containerized Nursery Stock	Southern California

Trapping Scenario (if yes, Describe on Page 2)	Anticipated Consecutive Years of Application	Target Pest(s)	Target Host(s) (e.g., citrus tree, ornamental, turf, etc.)
N/A	Minimum of 4 years	Various	Nursery Stock

Non-target Areas Affected (e.g., potential overspray to turf)	Application Technique (e.g., broadcast, drench, spot spray, etc.)	Application Equipment (e.g., mechanically pressurized handgun, boom sprayer, etc.)
Soil, drift to nontarget nursery plants	Foliar spray	Mechanically pressurized handgun sprayer, boom sprayer

Application(s) per year	Application Interval (If variable, explain on page 2)	Total Contiguous Application Area	Area Treated/Applicator/Day
2	6 months	130 acres	50 acres

Product Application Rate (Please include units)	Final Tank Mix Applied (Volume per Area)	Active Ingredient Application Rate (Provided by Consultant)	Inert Ingredient Application Rate(s) (Provided by Consultant)
10.5 fl. oz / acre	100 gallons /acre	0.137 lbs. a.i./ac	Prop. carbonate-0.343 lb/ac[1] Oxirane-0.320 lb/ac[2]

Adjuvant(s) or Additive(s) Product:	Adjuvant Application Rate (Please include units)
None	NA

[1]Prop. Carbonate = Propylene carbonate
[2] Oxirane = Oxirane, methyl-, polymer with oxirane, monobutyl ether

Program Material Data Sheet (PMDS)

Application Descriptions and Assumptions (Please describe the application in as much detail as possible using a bullet point list).

- Board treatments occur where nurseries, if they meet specific requirements, can receive a pesticide treatment that is reimbursed by the CDFA PD/GWSS Board. Quite often these treatments involve the aerial application of a pesticide having systemic or translaminar properties. The average size of these nurseries over the past few years has been about 130 acres. Treatments using Altus are done at most twice a year, with 12 nurseries qualifying. The products used for these treatments are those listed on the nursery PMDS as being applied using "aerial" or "foliar" methods.
- Plants can be treated no more than twice per year.
- Re-entry signs are posted around treated plants.
- The Restricted Entry Interval (REI) is 12 hours.
- Applying 10.5 fl oz of Altus / 100 gallons /acre
- Minimize exposure to pollinators by applying outside of daily peak foraging periods.

California Department of Food & Agriculture Program Material Data Sheet (PMDS)

INSTRUCTIONS:

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4.) Please attach product label and Safety Data Sheet.
5.) Include units as needed.
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PMDS Program Name Pesticide Scenario App Method Author Initials Date
Ex.: PMDS JB Acelepryn Turf Spray Drench LP 4.2.16

PMDS Status Summary

Prepared by
(CDFA): **S. Oswalt** Date: 4/14/20

☒Reviewed, ☐ Revised, ☐ Approved by:
(Blankinship):J. Sullivan Date: 4/21/20

☒Reviewed, ☒ Revised, ☐ Approved by:
(CDFA): S. Oswalt Date: 5/6/20

☒ Reviewed, ☒ Revised, ☐ Approved by:
(Blankinship): J. Sullivan Date: 5.14.20

☒Reviewed, ☒ Revised, ☐ Approved by:
(CDFA): S. Oswalt Date: 5/15/20

☐Reviewed, ☐ Revised, X Approved by:
(Blankinship): J. Sullivan Date: 5/28/20

Scenario Name: PDCP-83

Product Name	Specialty Label (e.g., Section 18, 24c) (Yes/No)	Active Ingredient(s)	Additional Product	Additional Active Ingredient
Altus	No	Flupyradifurone	None	None

General Scenario Setting (e.g., Large Production Nursery, Residential, etc.)	Specific Scenario Setting Description (e.g., containerized plants on loading dock)	Geographic Scenario Setting Description (Statewide or specific region)
Large Production Nursery	Containerized Nursery Stock	Southern California

Trapping Scenario (if yes, Describe on Page 2)	Anticipated Consecutive Years of Application	Target Pest(s)	Target Host(s) (e.g., citrus tree, ornamental, turf, etc.)
N/A	Minimum of 4 years	Various	Nursery Stock

Non-target Areas Affected (e.g., potential overspray to turf)	Application Technique (e.g., broadcast, drench, spot spray, etc.)	Application Equipment (e.g., mechanically pressurized handgun, boom sprayer, etc.)
Soil, drift to nontarget nursery plants	Foliar spray	Aerial

Application(s) per year	Application Interval (If variable, explain on page 2)	Total Contiguous Application Area	Area Treated/Applicator/Day
2	6 months	130 acres	50 acres *

Product Application Rate (Please include units)	Final Tank Mix Applied (Volume per Area)	Active Ingredient Application Rate (Provided by Consultant)	Inert Ingredient Application Rate(s) (Provided by Consultant)
10.5 fl. oz / acre	100 gallons /acre	0.137 lbs. a.i./ac	Prop. carbonate-0.343 lb/ac[1] Oxirane-0.320 lb/ac[2]

Adjuvant(s) or Additive(s) Product:	Adjuvant Application Rate (Please include units)
None	NA

[1]Prop. Carbonate = Propylene carbonate
[2] Oxirane = Oxirane, methyl-, polymer with oxirane, monobutyl ether

*As of September 29th, 2020, Stacie Oswalt of CDFA indicated via personal communication that the area treated/applicator/day is 130 acres

Program Material Data Sheet (PMDS)

Application Descriptions and Assumptions (Please describe the application in as much detail as possible using a bullet point list).

- Board treatments occur where nurseries, if they meet specific requirements, can receive a pesticide treatment that is reimbursed by the CDFA PD/GWSS Board. Quite often these treatments involve the aerial application of a pesticide having systemic or translaminar properties. The average size of these nurseries over the past few years has been about 130 acres. Treatments using Altus are done at most twice a year, with 12 nurseries qualifying. The products used for these treatments are those listed on the nursery PMDS as being applied using "aerial" or "foliar" methods.
- Plants can be treated no more than twice per year.
- Re-entry signs are posted around treated plants.
- The Restricted Entry Interval (REI) is 12 hours.
- Applying 10.5 fl oz of Altus / 100 gallons /acre.
- Minimize exposure to pollinators by applying outside of daily peak foraging periods.

California Department of Food & Agriculture Program Material Data Sheet (PMDS)

PMDS Status Summary

Prepared by
(CDFA): **S. Oswalt** Date: 5/22/20

☒Reviewed, ☒ Revised, ☐ Approved by:
Mike Blankinship
(Blankinship): Date: 6/1/20

☒Reviewed, ☐ Revised, ☒ Approved by:
(CDFA): Stacie Oswalt Date: 6/1/20

☒ Reviewed, ☐ Revised, ☒ Approved by:
Mike Blankinship: Date: 6/1/20

☐Reviewed, ☐ Revised, ☐ Approved by:
(CDFA): Date:

☐Reviewed, ☐ Revised, ☐ Approved by:
(Blankinship): Date:

INSTRUCTIONS:

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5.) Include units as needed.
6.) For PMDS revisions, do so in track changes and "save as" with the following file naming convention:
PMDS Program Name Pesticide Scenario App Method Author Initials Date
Ex.: PMDS JB Acelepryn Turf Spray Drench LP 4.2.16

Scenario Name: PDCP-84

Product Name	Specialty Label (e.g., Section 18, 24c) (Yes/No)	Active Ingredient(s)	Additional Product	Additional Active Ingredient
Altus	No	Flupyradifurone	None	None

General Scenario Setting (e.g., Large Production Nursery, Residential, etc.)	Specific Scenario Setting Description (e.g., containerized plants on loading dock)	Geographic Scenario Setting Description (Statewide or specific region)
Small, Medium and Most Large Production Nursery	Containerized nursery stock on indoor loading dock	Statewide

Trapping Scenario (if yes, Describe on Page 2)	Anticipated Consecutive Years of Application	Target Pest(s)	Target Host(s) (e.g., citrus tree, ornamental, turf, etc.)
N/A	Minimum of 4 years	Various	Nursery Stock

Non-target Areas Affected (e.g., potential overspray to turf)	Application Technique (e.g., broadcast, drench, spot spray, etc.)	Application Equipment (e.g., mechanically pressurized handgun, boom sprayer, etc.)
Loading dock surface (concrete, soil)	Foliar spray	Mechanically pressurized sprayer, backpack sprayer.

Application(s) per year	Application Interval (If variable, explain on page 2)	Total Contiguous Application Area	Area Treated/Applicator/Day
24	15 days	3750 sq. ft.	3750 sq. ft.

Product Application Rate (Please include units)	Final Tank Mix Applied (Volume per Area)	Active Ingredient Application Rate (Provided by Consultant)	Inert Ingredient Application Rate(s) (Provided by Consultant)
10.5 fl. oz / acre	100 gallons /acre	0.137 lbs. a.i./ac	Prop. carbonate-0.343 lb/ac[1] Oxirane-0.320 lb/ac[2]

Adjuvant(s) or Additive(s) Product:	Adjuvant Application Rate (Please include units)
None	NA

[1]Prop. Carbonate = Propylene carbonate
[2] Oxirane = Oxirane, methyl-, polymer with oxirane, monobutyl ether

Program Material Data Sheet (PMDS)

Application Descriptions and Assumptions (Please describe the application in as much detail as possible using a bullet point list).

- Each plant receives a single application on indoor loading dock prior to shipment.
- Plants are not loaded onto shipping trucks until the REI period has elapsed.
- Loading consist of either palleted plants or individuals pots manually lifted.
- Treated host plants on loading docks are isolated from other nursery stock or other nontarget plants.
- Re-entry signs are posted around treated plants.
- The Restricted Entry Interval (REI) is 12 hours.
- Applying 10.5 fl oz of Altus / 100 gallons /acre

Appendix B: Mechanically Pressurized Handsprayer Unit Exposure Derivation

Appendix B: Mechanically Pressurized Handsprayer Unit Exposure Derivation

Introduction

For this human health risk assessment, unit exposures (UEs) were selected from the USEPA 2020 Occupational Pesticide Handler Exposure Database (PHED) to evaluate the mixer-loader-applicator. When multiple equipment types under the same scenario could be used, the equipment with the greatest UE was selected as protective of equipment with lower UEs.

Since the previous release of the PHED Surrogate Table (2018b), several updates to the listed unit exposures have been made. A comparison of the UEs for the MPH and BP as listed in the USEPA (2018b, 2020a) PHED releases may be found in **Table 1**.

Table 1: Dermal and Inhalation PHED Unit Exposures by Equipment and Year Release

Equipment	Setting	Inhalation UE (ug/lb a.i.)	Dermal UE (ug/lb a.i.)	PHED Release Year
Mechanically-Pressurized Handgun Sprayer	Orchards, Vineyards, Specialty Agricultural Crops, Rights-of-way, **Nurseries**, Landscaping (non-turf), Industrial/Commercial areas, Aquatic areas, Wildlife management, Christmas Tree farms	8.68	2050	2018b
Mechanically-Pressurized Handgun Sprayer	Greenhouses, **Nurseries**, Mushroom houses	448	3610	2020a
Backpack Sprayer	**Nurseries,** Christmas Tree Farms, Wildlife management, Rights-of-way, Forestry, Conifer Plantations[1], Landscaping (turf/plants/bushes/trees)	69.1	30500	2018b, 2020a

1. Conifer Plantations were not included in USEPA (2018b)

A substantial update in USEPA 2020a was the increase of the inhalation UE associated with use of the MPH in nursery settings from 8.68 ug a.i./lb to 448 ug a.i./lb. Upon review of the USEPA 2019 *Memorandum: Draft Review of Agricultural Handler Exposure Task Force (AHETF) Monograph: "Mixing/Loading/Application using Powered Handgun Equipment in Managed Horticultural Facilities (i.e., greenhouses and nurseries)"*(USEPA, 2019c), it was determined that twenty-seven (27) datapoints associated with liquid and dry flowable formulations applied in enclosed greenhouses, shadehouses, hoop houses, and open and/or enclosed nurseries were used by the USEPA to develop a default UE for the MPH in nursery settings.

A summary of the MPH exposure data is displayed in **Table 2.**

Table 2: Empirical Data Points for Use of Mechanically Pressurized Handsprayer in Horticultural Facilities

Facility	Spray Orientation	Formulation	Inhal U.E. (ug/lb ai)	Derm U.E. (ug/lb ai)
Greenhouse (enclosed)	Horizontal and down	Liquid	101	36.6
Hoop house and Shadehouse (open and closed)	Horizontal and down	Liquid	0.065	1033
Greenhouse (enclosed)	Horizontal and down	Dry Flowable	54	18.5
Hoop house (enclosed) and Greenhouse (open)	Horizontal and down	Liquid	1.64	1047
Hoop house (open and closed)	Horizontal and down	Dry Flowable	1.26	33.1
Greenhouse (enclosed)	Horizontal and down	Liquid	96.4	225
Greenhouse (enclosed)	Horizontal and down	Dry Flowable	250	180
Greenhouse (enclosed)	Horizontal, down, and overhead	Dry Flowable	402	2428
Hoop house (enclosed)	Horizontal and down	Dry Flowable	57	77.3
Hoop house (enclosed)	Horizontal and down	Liquid	5.53	37.6
Greenhouse (enclosed)	Horizontal and down	Liquid	0.36	208
Nursery and shadehouse (open)	Horizontal, down, and overhead	Dry Flowable	2.58	145
Greenhouse and Nursery (open and closed)	Horizontal, down, and overhead	Liquid	284	9075
Shadehouse (enclosed)	Horizontal and down	Liquid	14.8	155
Greenhouse (enclosed)	Horizontal and down	Dry Flowable	65	60.1
Greenhouse (enclosed)	Down	Liquid	0.523	649
Nursery and Hoop house (open and enclosed areas)	Horizontal and down	Liquid	0.882	311
Hoop house (enclosed)	Horizontal and down	Liquid	368	925
Greenhouse (enclosed)	Horizontal and down	Dry Flowable	72	117
Nursery, Greenhouse, and Hoop house (open and enclosed areas)	Horizontal and down	Liquid	10.2	196
Greenhouse (enclosed)	Horizontal, down, and overhead	Liquid	508	2138
Greenhouse (enclosed)	Down	Liquid	112	4500
Nursery (open)	Horizontal and down	Liquid	12.7	1262
Greenhouse (enclosed)	Horizontal, down, and overhead	Liquid	14.4	8746
Greenhouse (enclosed)	Horizontal, down, and overhead	Liquid	447	21198
Greenhouse (enclosed)	Horizontal and down	Liquid	61.6	3200
Greenhouse (enclosed)	Horizontal and down	Dry Flowable	1.6	19.6

Method

To develop a UE that more accurately represented applications of Altus, a liquid formulation, datapoints derived from dry flowable formulations (n=9) as reported in **Table 2** were excluded from consideration. Additional considerations, discussed below, were made to select applicable datapoints for both indoor and outdoor treatments.

Outdoor Nursery Unit Exposure Derivation

To assess outdoor nursery application settings using an MPH, the UEs derived from facilities categorized as "enclosed" were removed from the dataset as described in **Table 2**. Because only two (2) datapoints remained for liquid application in "open" nurseries, data from hoop houses, shade houses, greenhouses, and nurseries categorized as "open and enclosed" were retained for a total sample size of six (6). The arithmetic mean of these values was used to derive dermal and inhalation UEs for outdoor nursery settings.

See **Table 3** for a comparison of unit exposures for the BP and MPH in outdoor nursery settings.

Indoor Nursery Unit Exposure Derivation

To assess indoor nursery application settings using ground equipment (i.e., PDCP-84), the arithmetic mean of UEs reported from "enclosed" greenhouses, shadehouses, and hoop houses (n=12) was used for estimating risk.

See **Table 3** for a comparison of unit exposures for the backpack and mechanically pressurized handsprayer in indoor nursery settings.

Results

Table 3: Unit Exposures for Backpack and Mechanically Pressurized Handsprayers in Outdoor and Indoor Nurseries

Setting	Equipment	Inhalation U.E. (ug a.i./lb)	Dermal U.E. (ug a.i./lb)
Outdoor	Mechanically Pressurized Handsprayer	51.58	2154
	Backpack Sprayer	**69.1**	**30500**
Indoor	Mechanically Pressurized Handsprayer	**144.13**	3501.52
	Backpack Sprayer	69.1	**30500**

***Bolded** numbers indicate value selected for this HHRA

Conclusions

Outdoor Nursery Application Equipment Selection

Based on this method of refining UE derivation that more accurately reflected CDFA activities, the new MPH dermal and inhalation UEs were both lower than those for the BP. Therefore, risk for scenarios that could use either equipment in outdoor nurseries (i.e., PDCP-80, 81) were analyzed using the BP UEs. This method was considered health protective of activities performed with the MPH.

Indoor Nursery Application Equipment Selection

Based on this method of refining UE derivation that more accurately reflected CDFA activities, the BP was calculated to have a greater dermal UE than the MPH. In contrast, the MPH was estimated to have a greater inhalation UE than the BP. Because neither equipment UE was considered adequately protective of both dermal and inhalation exposure, both types of equipment were assessed separately. Therefore, evaluation of risk for PDCP-84 was divided into PDCP-84a (backpack sprayer) and PDCP-84b (mechanically pressurized handsprayer).