Risks of Aldicarb Use to the Federally Threatened Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*) and the Federally Endangered San Joaquin Kit Fox (*Vulpes macrotis mutica*)

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Primary Authors:
N.E. Federoff, Wildlife Biologist
R. David Jones, PhD, Senior Agronomist

Secondary Review:
K. Garber, Senior Biologist
J. Lin, Environmental Engineer

Branch Chief, Environmental Risk Branch 2:
Brian Anderson

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List of Commonly Used Abbreviations and Nomenclature

µg/kg	Symbol for “micrograms per kilogram”
µg/L	Symbol for “micrograms per liter”
ºC	Symbol for “degrees Celsius”
AAPCO	Association of American Pesticide Control Officials
a.i.	Active Ingredient
AIMS	Avian Monitoring Information System
Acc#	Accession Number
amu	Atomic Mass Unit
BCB	Bay Checkerspot Butterfly
BCF	Bioconcentration Factor
BEAD	Biological and Economic Analysis Division
bw	Body Weight
CAM	Chemical Application Method
CARB	California Air Resources Board
AW	Alameda Whipsnake
CBD	Center for Biological Diversity
CCR	California Clapper Rail
CDPR	California Department of Pesticide Regulation
CDPR-PUR	California Department of Pesticide Regulation Pesticide Use Reporting Database
CFWS	California Freshwater Shrimp
CI	Confidence Interval
CL	Confidence Limit
CTS	California Tiger Salamander
CTS-CC	California Tiger Salamander Central California Distinct Population Segment
CTS-SB	California Tiger Salamander Santa Barbara County Distinct Population Segment
CTS-SC	California Tiger Salamander Sonoma County Distinct Population Segment
DS	Delta Smelt
EC	Emulsifiable Concentrate
EC_{05}	5% Effect Concentration
EC_{25}	25% Effect Concentration
EC_{50}	50% (or Median) Effect Concentration

ECOTOX	EPA managed database of Ecotoxicology data
EEC	Estimated Environmental Concentration
EFED	Environmental Fate and Effects Division
e.g.	Latin *exempli gratia* ("for example")
EIM	Environmental Information Management System
EPI	Estimation Programs Interface
ESU	Evolutionarily significant unit
et al.	Latin *et alii* ("and others")
etc.	Latin *et cetera* ("and the rest" or "and so forth")
EXAMS	Exposure Analysis Modeling System
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
FQPA	Food Quality Protection Act
ft	Feet
GENEEC	Generic Estimated Exposure Concentration model
HPLC	High Pressure Liquid Chromatography
IC_{05}	5% Inhibition Concentration
IC_{50}	50% (or median) Inhibition Concentration
i.e.	Latin for *id est* ("that is")
IECV1.1	Individual Effect Chance Model Version 1.1
KABAM	K_{OW} (based) Aquatic BioAccumulation Model
kg	Kilogram(s)
kJ/mole	Kilojoules per mole
km	Kilometer(s)
K_{AW}	Air-water Partition Coefficient
Kd	Solid-water Distribution Coefficient
KF	Freundlich Solid-Water Distribution Coefficient
K_{OC}	Organic-carbon Partition Coefficient
K_{OW}	Octanol–water Partition Coefficient
LAA	Likely to Adversely Affect
lb a.i./A	Pound(s) of active ingredient per acre
LC_{50}	50% (or Median) Lethal Concentration
LD_{50}	50% (or Median) Lethal Dose
LOAEC	Lowest Observable Adverse Effect Concentration
LOAEL	Lowest Observable Adverse Effect Level
LOC	Level of Concern
LOD	Level of Detection

LOEC	Lowest Observable Effect Concentration
LOQ	Level of Quantitation
m	Meter(s)
MA	May Affect
MATC	Maximum Acceptable Toxicant Concentration
m^2/day	Square Meters per Days
ME	Microencapsulated
mg	Milligram(s)
mg/kg	Milligrams per kilogram (equivalent to ppm)
mg/L	Milligrams per liter (equivalent to ppm)
mi	Mile(s)
MRID	Master Record Identification Number
MW	Molecular Weight
n/a	Not applicable
NASS	National Agricultural Statistics Service
NAWQA	National Water Quality Assessment
NCOD	National Contaminant Occurrence Database
NE	No Effect
NLAA	Not Likely to Adversely Affect
NLCD	National Land Cover Dataset
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAEC	No Observable Adverse Effect Concentration
NOAEL	No Observable Adverse Effect Level
NOEC	No Observable Effect Concentration
NRCS	Natural Resources Conservation Service
OPP	Office of Pesticide Programs
OPPTS	Office of Prevention, Pesticides and Toxic Substances
ORD	Office of Research and Development
PCE	Primary Constituent Element
pH	Symbol for the negative logarithm of the hydrogen ion activity in an aqueous solution, dimensionless
pKa	Symbol for the negative logarithm of the acid dissociation constant, dimensionless
pptr	Parts per Trillion (equivalent to ng/L or ng/kg)
ppb	Parts per Billion (equivalent to µg/L or µg/kg)

ppm	Parts per Million (equivalent to mg/L or mg/kg)
PRD	Pesticide Re-Evaluation Division
PRZM	Pesticide Root Zone Model
ROW	Right of Way
RQ	Risk Quotient
SFGS	San Francisco Garter Snake
SJKF	San Joaquin Kit Fox
SLN	Special Local Need
SMHM	Salt Marsh Harvest Mouse
TG	Tidewater Goby
T-HERPS	Terrestrial Herpetofaunal Exposure Residue Program Simulation
T-REX	Terrestrial Residue Exposure Model
UCL	Upper Confidence Limit
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VELB	Valley Elderberry Longhorn Beetle
WDG	Water Dispersible Granule
WP	Wettable Powder
wt	Weight

1. Executive Summary

1.1. Purpose of Assessment

The purpose of this assessment is to evaluate potential direct and indirect effects on the Valley Elderberry Longhorn Beetle (VELB) and the San Joaquin Kit Fox (SJKF) arising from FIFRA regulatory actions regarding use of aldicarb on agricultural and non-agricultural sites. In addition, this assessment evaluates whether these actions can be expected to result in modification of designated critical habitat for the VELB. This assessment was completed in accordance with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998), procedures outlined in the Agency's Overview Document (USEPA, 2004), and consistent with a suit in which aldicarb was alleged to be of concern to the VELB and the SJKF (*Center for Biological Diversity (CBD) vs. EPA et al*. (Case No. 07-2794-JCS).

Valley Elderberry Longhorn Beetle (VELB): The VELB was listed as threatened in 1980 by the USFWS. The species is found in areas with elderberry shrubs throughout California's Central Valley and associated foothills on the east and the watershed of the Central Valley on the west. This species has a designated critical habitat.

San Joaquin Kit Fox (SJKF): The SJKF was listed as endangered in 1967 by the USFWS. The species is found in a variety of habitats in the Central Valley area of California. This species does not have a designated critical habitat.

1.2. Scope of Assessment

1.2.1. Uses Assessed

Aldicarb is a systemic carbamate insecticide. There are two end use product labels for aldicarb – Temik 15G (Reg. No. 263-330) and Meymik 15G (Reg. No. 87895-1), both of which are granular formulations. Temik 15G is being voluntarily cancelled as of December 14, 2014 and the product cannot be used after December 31, 2018. The second product has an essentially identical label to Temik. The registration for this product was approved in December, 2011. There are 6 crops listed for use of aldicarb on these labels: cotton, dry beans, peanuts, soybeans, sugar beets, and sweet potatoes. In addition there is a Special Local Needs registration for cotton in California (Reg. No. CA110003). Of the currently registered labeled use patterns for aldicarb, only cotton, peanuts, and sugar beets can be used in California; therefore, only these three uses are considered in this assessment.

1.2.2. Environmental Fate Properties of Aldicarb

Aldicarb is mobile (K_{oc}: 0.33 $L \cdot kg^{-1}$) and moderately persistent in the environment with a mean half-life of 64 days in aerobic soil. Aldicarb forms two primary degradates, aldicarb sulfoxide and aldicarb sulfone which are also mobile and are of toxicological concern with a mode of action similar to the parent – acetylcholinerase inhibition. In acidic soils, aldicarb and these two degradates can persist for many years in ground water. Aldicarb degrades by aqueous photolysis with a half-life of 4 days, and this route can be important in clear shallow surface waters.

Aldicarb is not volatile (vapor pressure: 6.25 x 10^{-5} torr; Henry's Law constant: 3.0 x 10^{-10} atm·m^3/mol) and is not expected to move through the atmosphere.

1.2.3. Assessment Procedures

1.2.3a Aquatic Exposures

Since neither the VELB nor the SJKF live in aquatic habitats or consume aquatic organisms as a principle part of their diet, no aquatic exposure is necessary to support the risk assessment for these two species.

1.2.3b Terrestrial Exposures

i. San Joaquin Kit Fox

Exposures to terrestrial species resulting from application of aldicarb granules were evaluated by assuming the SJKF was exposed to aldicarb through 1) ingesting prey that had consumed aldicarb granules or 2) drinking water with aldicarb. In addition, LD_{50}/sq ft calculations are used to assess risk to prey species that would indirectly affect the SJKF through a reduction of prey availability.

The level of incorporation of aldicarb granules into the soil following application has the strongest effect on subsequent environmental exposure, especially to birds and mammals. Ingestion of granules left exposed in treated fields represents the most significant exposure pathway for these animals. Different application methods result in variable incorporation efficiency, as shown in **Table 1.1**. Additionally, aldicarb granules may be left exposed on the soil surface when 1) machinery is being loaded, 2) planter shoes are lifted out of the furrows to permit turning, 3) planter shoes rise out of the soils of irregularly contoured fields, and 4) machinery is worn or is not operating correctly (EPA, 1992).

Table 1.1. Aldicarb application methods and assumed incorporation efficiency

Application Method	Incorporation efficiency
Banded covered with a specific amount of soil	99%
In-furrow, drilled, or shanked-in	99%
Side-dress, banded mixed or lightly incorporated into soil	85%
Broadcast mixed or lightly incorporated into soil	85%

The SJKF obtains all of its necessary water requirements through food intake, although to do so, it must consume approximately 150% (or 175g of prey daily) of its daily energy requirements (Golightly and Ohmart 1984). While the fox can fulfill its water requirements on food alone, if

water is available, the fox will likely consume it.
A calculation was made to estimate the dose of aldicarb that a San Joaquin kit fox might receive from drinking water from a contaminated puddle on a field based on the fraction of aldicarb that may be near the surface and available to be dissolved in a puddle. A simple partition model was used estimate the concentration of aldicarb in the puddle. This was converted to a dose based on the amount of water typically consumed by the kit fox. The estimated dose was compared to dose-based (LD_{50}) toxicity data. Resulting risk quotients exceeded direct risk thresholds or levels of concern (LOC) for endangered species (RQ $\geq$ 0.1) (See **Table 1.2)**. A more complete description of the calculation of the drinking water exposure estimates is in Section 3.2.1.b and the risk assessment for drinking water is in Section 5.1.2.

Table 1.2. Estimated risk to the San Joaquin kit fox from drinking water from puddles in treated fields.

Crop	Dose ($mg \cdot kg^{-1}$)	LD_{50} ($mg \cdot kg^{-1}$)	Acute Risk Quotient
peanuts	0.069	0.56	**0.12**
sugar beets	0.396	0.56	**0.71**

ii. Valley Elderberry Longhorn Beetle

The VELB lives in a habitat (in elderberry trees) that can be found around the borders of riparian zone. Because all aldicarb uses are an incorporated granular, there is no drift expected. In addition, the beetles are not expected to be in the treated field as they spend their entire life cycle in and on elderberry bushes. Even though aldicarb is incorporated, small amounts from granules which are near the surface can be extracted into runoff and this runoff can run through habitat where elderberry bushes grow. A fraction of this material can infiltrate into the root extraction zone of the elderberry and some fraction of that can be absorbed and translocated into the elderberry bush in which the larval elderberry beetle lives in cavities bore into the trunk and stems. Since only small fractions are expected to be transmitted at each step in this process, the amount available to the VELB is expected to be negligible. It is worth noting that in a 5 year study, aldicarb was judged not to cause jeopardy to the VELB or adversely modify its critical habitat. However, the study did conclude that aldicarb may affect and was likely to adversely affect the beetle (Talley *et al*., 2006).

1.2.4 Toxicity Assessment

The assessment endpoints include direct toxic effects on survival, reproduction, and growth of individuals, as well as indirect effects, such as reduction of the food source and/or modification of habitat. The Agency evaluated registrant-submitted studies and data from the open literature to characterize aldicarb toxicity relevant to the species in the current assessment. The assessment used the most sensitive toxicity value available from acceptable or supplemental studies for each taxon relevant for estimating potential risks to the assessed species and/or their designated critical habitat.

Aldicarb is very highly toxic to essentially all animals tested to date. **Section 4** summarizes the ecotoxicity data available on aldicarb. Because aldicarb is a granular, and single granules can

cause toxic effects, and most granules will be buried and the remainder on or near the surface will not persist past the first rainfall or irrigation event, chronic effects were not expected to be an important part of the risk profile for aldicarb and chronic effects were not considered in this assessment.

1.2.5 Measures of Risk

Acute risk quotients (RQs) are compared to the Agency's Levels of Concern (LOCs) to identify instances where aldicarb use has the potential to adversely affect the assessed species or adversely modify their designated critical habitat. When RQs for a particular type of effect are below LOCs, the pesticide is considered to have "no effect" on the species and its designated critical habitat. Where RQs exceed LOCs, a potential to cause adverse effects or habitat modification is identified, leading to a conclusion of "may affect". If use "may affect" the assessed species, and/or may cause effects to designated critical habitat, the best available additional information is considered to refine the potential for exposure and effects, and distinguish actions that are Not Likely to Adversely Affect (NLAA) from those that are Likely to Adversely Affect (LAA).

1.3. Summary of Conclusions

The labeled uses of aldicarb may indirectly affect the SJKF by reducing or changing the composition of the food supply (mostly small mammals and birds). It may also directly affect the SJKF by direct mortality through ingestion of exposed prey or through the consumption of contaminated drinking water from puddles on treated fields.

Based on the best available information, the Agency makes a Likely to Adversely Affect determination for the SJKF from the use of aldicarb. Additional details are provided in

Table 1.3. Use specific adverse effects determinations are in **Table 1.4.** Critical habitat has not been designated for the SJKF. Given the LAA determination for the SJKF, a description of the baseline status and cumulative effects is provided in **Attachment III**.

Because the VELB lives in a habitat that would limit exposure from an incorporated granular pesticide, exposure was expected to be extremely small and therefore discountable for all uses and not likely to adversely affect the VELB. In a 5 year study, aldicarb was judged to not cause jeopardy to the VELB or adversely modify its critical habitat (**Table 1.5**). However, the study did conclude that aldicarb may affect and was likely to adversely affect the beetle (Talley *et al*., 2006).

Table 1.3. Effects Determination Summary for Effects of Aldicarb on the VELB and SJKF.

Species	Effects Determination	Basis for Determination
Valley Elderberry Longhorn Beetle	*May Affect* but *Not likely to Adversely Affect* (NLAA)	**Potential for Direct Effects** Elderberry beetles reside solely in elderberry trees and are not expected to be directly exposed to aldicarb. Aldicarb is applied as a granule; therefore, spray drift is assumed to be negligible. It is possible that elderberry trees could uptake aldicarb that is present in runoff if the chemical is applied up-gradient from an elderberry tree resulting in possible exposure to the beetle. However, this exposure potential is assumed to be discountable given that aldicarb is incorporated at planting, the amount of aldicarb that would infiltrate in the elderberry root zone is small and only a fraction of this would be taken into the plant. **Potential for Indirect Effects** ***Terrestrial prey items*** The limited exposure indicates use of aldicarb will likely not reduce the abundance of food. Because the VELB directly feeds on only the elderberry bush, and risk concerns for the elderberry bush are below concern levels, it is unlikely that the bush would be affected through use of granular incorporated aldicarb. ***Habitat Modifications*** The lack of exposure indicates use of aldicarb will likely not adversely modify the habitat of this species by reducing the availability of food or habitat. Because the VELB directly feeds on only the elderberry bush and low risk is assumed, it is unlikely that the bush would be affected through use of granular incorporated aldicarb.
San Joaquin Kit Fox (*Vulpes macrotis mutica*)	*May Affect* and *Likely to Adversely Affect* (LAA)	**Potential for Direct Effects** The risk assessment indicates use of aldicarb may result in direct effects to the SJKF from acute toxicity through ingestion of drinking water. Dietary exposure estimates and data on acute toxicity to small mammals such as the SJKF result in acute RQs that exceed the LOC for primary exposure. Secondary exposure may also occur from consumption of contaminated prey animals. **Potential for Indirect Effects** ***Terrestrial prey items*** The use of aldicarb has the potential to reduce the abundance of food. As little as one granule can kill a small bird or mammal, which are primary food items of the SJKF. ***Habitat Modifications*** The risk assessment indicates use of aldicarb may adversely modify the habitat of this species by reducing the availability of prey items. This conclusion is based on acute risks for birds and mammals.

Table 1.4. Use specific summary of the potential for adverse effects to terrestrial taxa .

Uses	Potential for Effects to Identified Taxa Found in the Terrestrial Environment:					
	Small Mammals[1]	SJKF and Large Mammals[2]	Small Birds[3]	VELB [4]	Dicots[5]	Monocots[5]
	Acute	Acute	Acute	Acute		
Cotton	Yes	Yes	Yes	No	No	No
Peanuts	Yes	Yes	Yes	No	No	No
Sugar Beets	Yes	Yes	Yes	No	No	No

1) A yes in this column indicates a potential for indirect effects to SJKF.
2) A yes in this column indicates a potential for direct and indirect effects to SJKF.
3) A yes in this column indicates a potential for indirect effects to the SJKF.
4) A yes in this column indicates a potential for direct effect to VELB.
5) A yes in this column indicates a potential for indirect effects to VELB. This is based on the listed species LOC because of the obligate relationship with terrestrial monocots and dicots.

Table 1.5. Effects Determination Summary for the Critical Habitat Impact Analysis

Designated Critical Habitat for:	Effects Determination	Basis for Determination
VELB	No Habitat Modification	Exposure unlikely due to incorporated granular applications

Based on the conclusions of this assessment, a formal consultation with the U. S. Fish and Wildlife Service under Section 7 of the Endangered Species Act should be initiated.

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (*i.e.*, food and habitat) are not expected to be uniform across the action area. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available.

Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of the San Joaquin Kit Fox life stages within the action area and/or applicable designated critical habitat. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the assessed species.

- Quantitative information on prey base requirements for the assessed species. While existing information provides a preliminary picture of the types of food

sources utilized by the assessed species, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.

- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual species and potential modification to critical habitat.

2. Problem Formulation

Problem formulation provides a strategic framework for the risk assessment. By identifying the important components of the problem, it focuses the assessment on the most relevant life history stages, habitat components, chemical properties, exposure routes, and endpoints. The structure of this risk assessment is based on guidance contained in U.S. EPA's *Guidance for Ecological Risk Assessment* (USEPA, 1998), the Services' *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998) and is consistent with procedures and methodology outlined in the Overview Document (USEPA, 2004) and reviewed by the U.S. Fish and Wildlife Service and National Marine Fisheries Service (USFWS/NMFS/NOAA, 2004).

2.1. Purpose

The purpose of this endangered species assessment is to evaluate potential direct and indirect effects on individuals of the VELB and the SJKF arising from FIFRA regulatory actions regarding use of Aldicarb for pest control. This ecological risk assessment has been prepared consistent with a stipulated injunction settling the case *Center for Biological Diversity (CBD) vs. EPA et al*. (Case No. 07-2794-JCS).

In this assessment, direct and indirect effects to the VELB and the SJKF and potential modification to designated critical habitat for these species are evaluated in accordance with the methods described in the Agency's Overview Document (USEPA, 2004).

In accordance with the Overview Document, provisions of the ESA, and the Services' *Endangered Species Consultation Handbook*, the assessment of effects associated with registrations of Aldicarb is based on an action area. The action area is the area directly or indirectly affected by the federal action, as indicated by the exceedance of the Agency's Levels

of Concern (LOCs). It is acknowledged that the action area for a national-level FIFRA regulatory decision associated with a use of aldicarb may potentially involve numerous areas throughout the United States and its Territories. However, for the purposes of this assessment, attention will be focused on relevant sections of the action area including those geographic areas associated with locations of the VELB and the SJKF and their designated critical habitat within the state of California. As part of the "effects determination," one of the following three conclusions will be reached separately for each of the assessed species in the lawsuits regarding the potential use of aldicarb in accordance with current labels:

- "No effect";
- "May affect, but not likely to adversely affect"; or
- "May affect and likely to adversely affect".

Additionally, for habitat and PCEs, a "No Effect" or a "Habitat Modification" determination is made.

2.2. Scope

The end result of the EPA pesticide registration process (*i.e.*, the FIFRA regulatory action) is an approved product label. The label is a legal document that stipulates how and where a given pesticide may be used. Product labels (also known as end-use labels) describe the formulation type (*e.g.*, liquid or granular), acceptable methods of application, approved use sites, and any restrictions on how applications may be conducted. Thus, the use or potential use of aldicarb in accordance with the approved product labels for California is "the action" relevant to this ecological risk assessment.

Although current registrations of aldicarb allow for use nationwide (at use sites permitted by registered labels), this ecological risk assessment and effects determination addresses currently registered uses of Aldicarb in portions of the action area that are reasonably assumed to be biologically relevant to the VELB and the SJKF and their designated critical habitat. Further discussion of the action area for these species and their critical habitat is provided in Section 2.7.

2.3. Previous Assessments and Biological Opinions

2.3.1. USFWS Biological Opinions

In 1982, the U.S. Fish and Wildlife Service (USFWS) issued a case-by-case biological opinion (USFWS 1982) for aldicarb in response to the U. S. Environmental Protection Agency's request for consultation for use of Temik on tomatoes, sorghum, grapefruit, lemons and limes. In issuing its opinion, the USFWS considered the following factors in terms of potential exposure to endangered species: (1) direct ingestion of granules (2) indirect exposure through ingestion of invertebrates, birds, or other small mammals, which have died from exposure to Temik, (3) ingestion of earthworms that have granules adhering to their mucoid epidermis, and (4) because of the systemic action of the chemical to translocate via the root system-ingestion of vegetation.

Based on dietary habits, habitat requirements, crop use patterns and distributions of the species the USFWS concluded that…"with the exception of the San Joaquin kit fox (*Vulpes macrotis mutica*) and the Attwater's greater prairie chicken (*Tympanuchus cupido attwateri*), listed species would be precluded from adverse exposure". They further concluded that although there was a potential for secondary poisoning, the impact was..."not likely to jeopardize the continued existence of the San Joaquin kit fox." However, because of the extensive use of sorghum fields by the Attwater's greater prairie chicken and because just one granule of either the 10G or 15G formulation exceeded the LD_{50} for 2-week old chicks, the opinion concluded that the use of aldicarb on sorghum was likely to jeopardize the continued existence of the Attwater's greater prairie chicken.

2.3.2. Relevant Conclusions from Previous Assessments

In May 2005, the Agency issued a *Reregistration Eligibility Decision (RED) for Aldicarb.* A revised version was issued in September 2007[1]. Key conclusions on exposure and risks to terrestrial and aquatic wildlife as well as relevant data gaps as they relate to these two assessments are listed below. Risk conclusions were consistent and remained unchanged between the two assessments.

Exposure and Risk to Terrestrial Organisms:

- The cotton scenario (4.05 lbs ai/A; *banded side-dress, 1 application*) poses the highest use risk in the terrestrial environment to mammals and birds due to aldicarb levels in soil (highest acute RQ for small birds = 6400), followed by potato, sugar beet, peanuts and dry beans (RQ for small birds = 3000, 2800, 2800, 2600, respectively).

- The acute risk, acute restricted use, and acute endangered species LOCs for birds and mammals are exceeded for all target crops (cotton, dry beans, sorghum, peanuts, potatoes, soybeans, sugar beets, sweet potatoes, citrus, pecans, ornamentals) due to aldicarb levels in soil at both maximum allowed label rates (1.05 to 10.05 lbs ai/A) and average use rates (0.6 to 3.1 lbs ai/A).

- Acute levels of concern are consistently exceeded by a factor of greater than 100 and are frequently exceeded by more than 1000 for birds and mammals.

- Granules left exposed on the surface appear to be the main source of exposure, but other sources such as residues of aldicarb taken up by plants and soil invertebrates (e.g., earthworms) may also serve as a means of exposure.

- A single granule of TEMIK 15G can kill a small bird or mammal.

- Reproductive effects to birds at sub-lethal levels could not be assessed because of the lack of reproductive studies with aldicarb or its degradates, due in part to high acute toxicity. It has been difficult to design an experiment that utilizes a dose low enough not to acutely intoxicate adult birds.

[1] http://www.epa.gov/oppsrrd1/REDs/aldicarb_red.pdf

- Reduction in seedling emergence and vegetative vigor to non-target terrestrial plants from runoff could not be assessed because of the lack of toxicity data. Terrestrial plant studies have since been submitted.

2.4. Environmental Fate and Transport

2.4.1. Chemical and Physical Properties

Common Name:	aldicarb
Chemical Name:	2-methyl-2(methylthio)propionaldehyde O-(methylcarbamoyl)oxime
CAS No.	116-06-3
PC Code:	098301
SMILES code	C(C)(C)(C=NOC(=O)NC)SC
Molecular Formula:	$C_7H_{14}N_2O_2S$
Molecular Weight:	190.2 g/mol
Density:	0.565 g/cm^3
Melting Point:	96.5º C
Boiling Point:	decomposes above 100° C
Water Solubility:	5191 mg/L(pH 7, 20 °C)
Octanol/Water Partition Coefficient (K_{OW}):	14
Formulations:	granules (*e.g.* active ingredient 15.0%, Inert ingredients 85.0%)

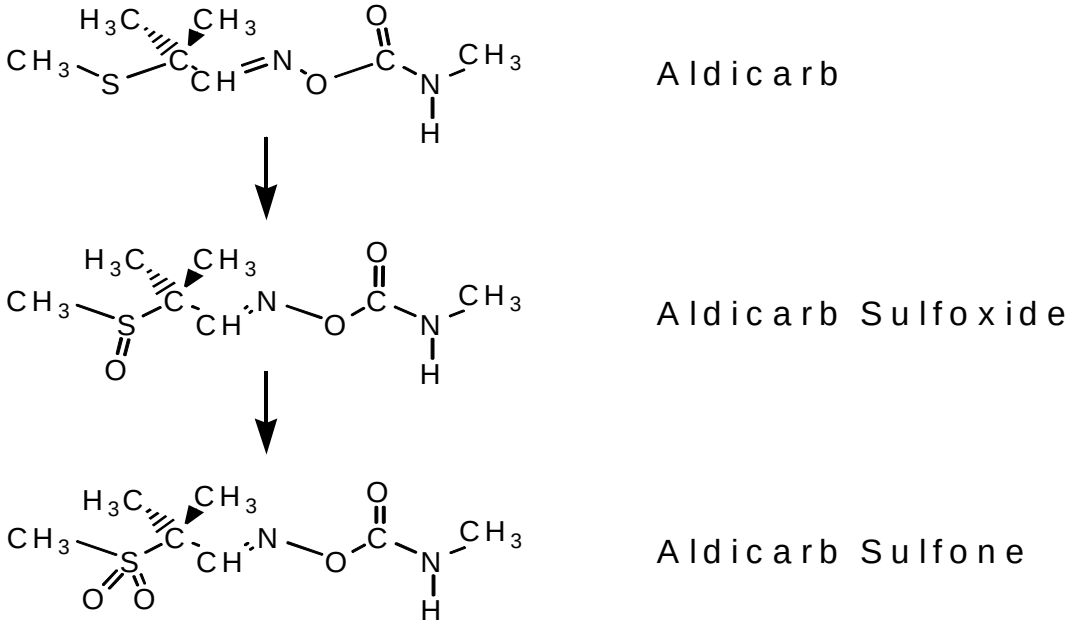

Figure 2.1. Chemical structure of aldicarb and its oxidative transformation products.

2.4.2. Degradation

Aldicarb rapidly degrades to aldicarb sulfoxide and aldicarb sulfone – both of which are as toxic or nearly as toxic as, and are more persistent than, the parent compound (**Figure 2.1**). Other aldicarb degradates may form as well, but are substantially less toxic and/or produced only in small amounts (<5%) and so are not included in this evaluation. Aerobic soil metabolism is the primary dissipation route for parent aldicarb in unsaturated soil. Half-lives for parent aldicarb range from 1 to 28 days (MRIDs 00102051, 00093642, 00080820, 00093640, 00053366, 00101934, 00035365, and 00102071). Currently, insufficient data are available to accurately estimate the formation and dissipation rates of the sulfoxide and sulfone degradates. However, the rapid oxidation of parent aldicarb to these forms, and their substantially greater persistence than the parent, has been well documented in the published literature (*e.g*. Bull *et al*., 1970; Smelt *et al.*, 1979).

Laboratory studies suggest that degradation of all three aldicarb forms (parent, sulfoxide, and sulfone) to relatively non-toxic, non-carbamate residues (oximes and nitriles) occurs slowly ($t_{1/2}$ up to 3 months) in aerobic soils, as a result of soil-catalyzed hydrolysis rather than aerobic metabolism (Lightfoot *et al.*, 1987; Bank and Tyrrell, 1984). Parent aldicarb is generally stable to hydrolysis, slowly hydrolyzing only at a pH of 9 (MRID 00102065). Aldicarb sulfoxide hydrolyzed more quickly ($t_{1/2}$ = 2.3 days) at pH 9 than at pH 7 (about 6% at 28 days) (MRID 00102066). Aqueous photolysis rapidly degraded aldicarb to oxime and nitrile forms (*i.e*. with a $t_{1/2}$ of four days: MRID 42498201). However, this process will only be dominant in clear, shallow waters, and will not affect residues in the subsurface.

In published field studies, dissipation half-lives for total carbamate residues (including aldicarb and its sulfoxide and sulfone degradates) in soil have ranged from approximately 0.3 to 5 months in the unsaturated zone, and 1 to 36 months in the saturated zone (Jones and Estes, 1995), in apparent contradiction to the observation of faster degradation under anaerobic (saturated) conditions. The reasons for the extreme variability in reported transformation rates (3 hours to 36 months) for aldicarb residues under anaerobic/saturated conditions are not known, but may be related to temperature, pH, and the presence of soils for surface catalysis (Lightfoot, *et al.*, 1987). Also, not all saturated zones are necessarily anoxic; if they are shallow, there can be sufficient interaction with the unsaturated zone such that the ground water may be sub-oxic or even atmosphere-equilibrated (oxic). Monitoring data in areas with historical aldicarb contamination confirm the high persistence of total aldicarb residues in some ground water. For example, twenty years after cessation of aldicarb use on Long Island, New York, aldicarb sulfone and sulfoxide were the most frequently detected pesticide compounds in ground water there in year 2000 (Suffolk County Dept. of Health Services, 2000).

The sulfoxide and sulfone degradates are nearly as toxic as the parent and are more mobile and persistent. For aquatic exposures, the parent aldicarb may undergo some transformation to the sulfoxide and sulfone residues between the time of application to the soil and a runoff event. A summary of environmental fate and transport properties of aldicarb are provided in **Table 4.2**.

Table 2.1. General Physical/Chemical Properties and Environmental Fate Parameters of Aldicarb.

Parameter	**Value**	**Reference** [A]

Parameter	Value	Reference [A]
Physical/Chemical Parameters		
Molecular mass	190.26 g/mol	calculated
Vapor pressure (23°C)	6.25 x 10^{-6} torr	MRID 4822504
Henry's Law constant (23°C)	3.0 x 10^{-10} atm·m^3/mol	calculated
Water solubility (20°C)	5.191g/L	MRID 4822504
Octanol-water partition coefficient (K_{OW})	11.48	MRID 4822504
Persistence in Water		
Hydrolysis half-life	pH 5: no significant degradation @ 30 d pH 7: no significant degradation @ 30 d pH 9: < 10% degradation of parent @ 30 d $T_{1/2}$ < 197 d	MRID 00102065
Aqueous photolysis half-life	4 d	MRID 42498201
Persistence in Soil		
Aerobic soil metabolism half-life	*parent only*: NJ sandy loam: 2.3 d Houston clay: 11 d Lakeland sandy loam: 17 d Norwood silty clay: 12 d unspecified: 1 d Illinois silt: 6 d NC loamy sand: 10 d *total toxic residues:* Houston clay: 28 d Lakeland sandy loam: 47 d Norwood silty clay: 136 d unspecified: 44 d	 MRID 44005001 MRID 00093642 MRID 45602904 MRID 45739801 MRID 00093642 MRID 45602904
Mobility		
Fruendlich Adsorption Coefficients (K_f)	*parent* sandy loam: 0.18 6 L·kg^{-1} silt: 0.36 L·kg^{-1} clay: 0.6 L·kg^{-1} sand: 0.2 L·kg^{-1} *aldicarb sulfoxide:* Tujunga loamy sand: 0.22 L·kg^{-1} Wedowee sandy loam: 0.17 L·kg^{-1} Hunting silt loam: 0.26 L·kg^{-1} Huntington sandy clay loam: 0.26 L·kg^{-1} *aldicarb sulfone:* Tujunga loamy sand: 0.09 L·kg^{-1} Wedowee sandy loam: 0.12 L·kg^{-1} Hunting silt loam: 0.22 L·kg^{-1} Huntington sandy clay loam: 0.22 L·kg^{-1}	MRID 42498202 MRID 43560301 MRID 43560302

2.4.3. Mobility

Parent aldicarb is most likely to be transported away from treatment sites as a component of field runoff. Following a rain event, aldicarb may reach aquatic environments as sheet and channel flow from areas of application, since aldicarb is moderately persistent in terrestrial environments and soluble in water. It is unlikely, though, that undissolved granules will reach surface water bodies. The toxic degradates (aldicarb sulfoxide and aldicarb sulfone) are more prone to move vertically down through the soil profile, and potentially into ground water, as they form primarily in the shallow subsurface. Ground water that contains aldicarb residues may then be discharged into surface waters as base flow. If the receiving ground water is cool, acidic, and oxic, the sulfoxide and sulfone degradates will be very persistent and capable of long-distance subsurface transport.

Aldicarb and its oxidation products are all highly mobile in soil. Aldicarb itself has Freundlich K_{ads} values ranging between 0.19 ml/g (for sandy loam) and 0.60 ml/g (for clay) (MRID 42498202). Aldicarb sulfoxide has Freundlich K_{ads} values between 0.17 ml/g (sandy loam soil) and 0.26 ml/g (sandy clay loam) (MRID 43560301). Aldicarb sulfone had slightly lower values, ranging between 0.09 ml/g and 0.22 ml/g for the same set of soils as the sulfoxide (MRID 43560302). Aldicarb is not expected to be mobile into or through the atmosphere because aldicarb is applied as a granule, and because its potential to enter the air from water or soil is considered insignificant based on its Henry's Law constant (3.0×10^{-10} atm·m^3/mol) and vapor pressure (6.25×10^{-6} torr).

2.5. Mechanism of Action

Aldicarb is a systemic insecticide, acaricide, and nematicide. Aldicarb is a carbamate that acts as a potent cholinesterase (ChE) inhibitor causing inhibition of erythrocyte acetylcholinesterase (RBC ChE) as well as plasma butyryl ChE by binding to the active site of the enzyme. Acetylcholinesterase is an enzyme necessary for the degradation of the neurotransmitter acetylcholine (ACh) and subsequent cessation of synaptic transmission. Inhibition of these enzymes in animals (*i.e.*, terrestrial and aquatic invertebrates, fish, birds, amphibians, reptiles, mammals) results in the accumulation of acetylcholine at cholinergic nerve endings and continual nerve stimulation leading to death.

2.6. Use Characterization

2.6.1. Labeled Uses

Analysis of labeled use information is the critical first step in evaluating the federal action. The current labels for Aldicarb represent the FIFRA regulatory action; therefore, labeled use and application rates specified on the label form the basis of this assessment. The assessment of use information is critical to the development of the action area and selection of appropriate modeling scenarios and inputs. In California, aldicarb can currently be applied to cotton, peanuts and sugar beets. Details related to the use of aldicarb for each of these crops is provided below and in **Table 2.2**. It is important to note that all three uses employ some degree of incorporation

and that the incorporation affects the amount of aldicarb which is available for terrestrial exposure. Discussion of how incorporation effects were handled in the exposure assessment is provided in **Sections 3.2** and **5.1**.

Table 2.2. Labeled aldicarb uses of maximum exposure assessed for California.

Use	Max. Single App. Rate (lbs a.i./A)	Max. No. of App. per Year	Min. Reapp. Interval	Max. Annual App. Rate (lbs a.i./A)	Application Method
Cotton[1]	2.1	2	21 d	3.15	at plant: in furrow and T-band post-emergent: in furrow
Peanuts[2]	1.05	1	NA[3]	1.05	at plant: incorporated band or T-band
Sugar Beets[4]	2.1	3	NS[5]	4.2	at plant: incorporated band post-emergent: incorporated side band

1) Second application is restricted to 0.75 lb and must be placed in furrow at least 2 inches deep. Applications must be between March 1 and September 1 in California.
2) Post-emergent applications may not be made in California. At plant applications are restricted to 1.05 lb-ai/acre.
3) NA: not applicable
4) Use on sugar beets is restricted to California, Colorado, Idaho, Montana, Nebraska, Oregon, Washington, and Wyoming. Applications must be made within 60 d of planting.
5) NS: not specified on labels

Cotton. There is a special local needs registration (24c) for aldicarb use on cotton in the state of California that allows up to 2.1 lb·acre^{-1} for a second side dress application and 3.15 lb·acre^{-1} total to be applied per year. Two applications can be made per season to cotton with the first application made at-plant, in-furrow with the requirement that the granules in the furrow be immediately covered 'with soil by mechanical means'. Side dress applications are to be made 3 weeks after planting to first bloom. Side dress applications are to be to a depth of 2 to 3 inches in a furrow 6 to 10 inches on one or both sides of the row. The label restrictions include a note to deep-disk any spills at row ends or elsewhere to ensure the granules are covered with a layer of soil. Applications are restricted to between March 1 and September 1.

Peanuts. Only one application of aldicarb can be made to peanuts in California at planting. There is no restriction on application timing for peanuts in California as there is for cotton and sugar beets. At-plant applications can be made either in-furrow or in a T-band over the open seed furrow. The label states to cover immediately with soil by mechanical means. At-plant applications can also be made as a 6 to 12 inch band which is mechanically incorporated from 2 to 4 inches in depth into which the peanuts are subsequently planted. Applications can be made at up to 1.05 lb·acre^{-1}. The label restrictions include a note to 'immediately deep-disk any spills at row ends or elsewhere to ensure the granules are covered with a layer of soil.

Sugar Beets. Applications of aldicarb to sugar beets in California can only be made between March 1 and September 1. The maximum annual application rate is 4.2 lb·acre^{-1}. No more than three applications can be made per year, one application at planting, and two post-emergent applications. The maximum single application rate at plant is 2.1 lb·acre^{-1}. For control of

nematodes, applications can be made up to a week before planting in a band 4 to 6 inches wide which is immediately incorporated. Planting is then done into the incorporated band. Alternatively, the granules can be drilled in a row 3 to 4 inches deep and three inches to the side of the seed row if furrow irrigation is employed for seed germination. For aphid control, granules can be placed in the seed line if the application does not exceed 1.05 $lb \cdot acre^{-1}$. Otherwise, the granules should be drilled 1 to 3 inches below the seed line. For sugar beet root maggot control, granules can be applied in a band 2 to 3 inches wide over the seed row and immediately incorporated, or, if furrow irrigation is employed for seed germination, granules can be drilled in a row 2 inches deep 2 inches from the seed furrow. Post-emergent applications are to be made on both sides of the plant row and immediately covered with soil or, if furrow irrigation is present, 4 to 8 inches on the water side of the plants at furrow depth. Post-emergent applications must be made with 30 days of planting in California and within 60 days of planting elsewhere.

General use restrictions: Aldicarb cannot be applied in Del Norte and Humboldt Counties in California. Aldicarb can only be applied between March 1 and September 1 in California. There are also restrictions on the use of aldicarb around drinking water wells. In all cases, application cannot be made with 50 ft of a drinking water well, but more stringent conditions often apply. In most cases, these restrictions are based on the presence of a 'vulnerable soil' and the nature of the well. A vulnerable soil is defined on the label as having a loamy sand or sand texture and a subsoil with less than 2% organic matter on average in the upper 12 inches. Restrictions around the well are necessary if the water table is less than 25 ft deep, unless the well is cased to less than 100 ft or to 30 feet below the top of the water table. If the user does not know that the water table is greater than 25 feet, then one should assume that the water table is greater than 25 feet deep. For all uses, applications cannot be made within 50 ft of any drinking water well. **Table 2.2** presents the uses and corresponding application rates considered in this assessment.

2.6.2. Estimated Use of Aldicarb in the US and California

During 1998-2010, national usage of aldicarb (excluding sweet potatoes because usage data are not available) was relatively stable (See Appendix G). In 1999, there was a notable increase in use which was largely driven by use in citrus. During the most recent years of 2006-2010, on average, approximately 3.7 million pounds of aldicarb was used to treat 3.6 million acres (*ibid*).

Usage data specific to California from 2007 to 2009 is in **Table 2.3**. Of these uses, alfalfa, green house cut flowers and greens and pecans are no longer legal uses while dry beans are no longer a legal use in California (it is allowed in other states however). There does not appear to be any use of aldicarb on peanuts during this time period, and only 32 pounds of aldicarb was applied to sugar beets in California in 2007 and none in 2008. The dominant use in the state is cotton, which has decreased from 109 thousand pounds in 2007 to 30 thousand pounds in 2009.

Table 2.3. Aldicarb used in California over the three most recent years available (2007 - 2009).

Commodity	2007 Pounds Applied	2008 Pounds Applied	2009 Pounds Applied
alfalfa (forage - fodder) (alfalfa hay)	32		121
beans, dried-type	907	224	964
cotton, general	109186	74760	30192
greenhouse grown cut flowers or greens	1		
pecan	5318	837	252
sugar beet, general	32		
Chemical Total	**115476**	**75821**	**31529**
Date Prepared: **09/02/2011**			
Cal DPR Data: http://www.cdpr.ca.gov/docs/pur/purmain.htm			

2.7. Assessed Species

The following section provides a summary of the current distribution, habitat requirements, and life history parameters for the listed species being assessed (**Table 2.4**).

Valley Elderberry Longhorn Beetle (VELB): The VELB was listed as threatened in 1980 by the USFWS. The species is found in areas with elderberry shrubs throughout California's Central Valley and associated foothills on the east and the watershed of the Central Valley on the west. See **Figure 2.2** for a map of the current range and designated critical habitat of the VELB.

San Joaquin Kit Fox (SJKF): The SJKF was listed as endangered in 1967 by the USFWS. The species is found in a variety of habitats in the Central Valley area of California. See **Figure 2.3** for a map of the current range of the San Joaquin kit fox.

Table 2.4. Summary of Current Distribution, Habitat Requirements, and Life History Information for the Assessed Listed Species.[1]

Assessed Species	Size	Current Range	Habitat Type	Designated Critical Habitat?	Reproductive Cycle	Diet
Valley Elderberry Longhorn Beetle (VELB) (*Desmocerus californicus dimorphus*)	Males: 1.25–2.5 cm length Females: 1.9–2.5 cm length	Central Valley of California (from Shasta County to Fresno County in the San Joaquin Valley)	Completely dependent on its host plant, elderberry (*Sambucus species*), which is a common component of the remaining riparian forests and adjacent upland habitats of California's Central Valley	Yes	The larval stage may last 2 years living within the stems of an elderberry plant. Then larvae enter the pupal stage and transform into adults. Adults emerge and are active from March to June feeding and mating, when the elderberry produces flowers.	Obligates with elderberry trees. Adults eat the foliage until about June when they mate. Upon hatching, the larvae tunnel into the tree where they will spend 1-2 years eating the interior wood which is their sole food source.

Assessed Species	Size	Current Range	Habitat Type	Designated Critical Habitat?	Reproductive Cycle	Diet
San Joaquin Kit Fox (SJKF) (*Vulpes macrotis mutica*)	Adult ~2 kg *Ave adult male = 2.3 kg *Ave adult female = 2.1 kg	Alameda, Contra Costa, Fresno, Kern, Kings, Madera, Merced, Monterey, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Stanislaus, Tulare and Ventura counties	A variety of habitats, including grasslands, scrublands (*e.g*., chenopod scrub and sub-shrub scrub), vernal pool areas, oak woodland, alkali meadows and playas, and an agricultural matrix of row crops, irrigated pastures, orchards, vineyards, and grazed annual grasslands. Kit foxes dig their own dens, modify and use those already constructed by other animals (ground squirrels, badgers, and coyotes), or use human-made structures (culverts, abandoned pipelines, or banks in sumps or roadbeds). They move to new dens within their home range often (likely to avoid predation by coyotes)	No, but has designated core areas	Mating and conception: late December - March. Gestation period: 48 to 52 days. Litters born: February - late March Pups emerge from their dens at about 1-month of age and may begin to disperse after 4 – 5 months usually in Aug. or Sept.	Small animals, including blacktailed hares, desert cottontails, mice, kangaroo rats, squirrels, birds, lizards, insects and grass. It can fully satisfy its moisture requirements from prey but will need freshwater sources if daily prey requirements are not met.

[1] For more detailed information on the distribution, habitat requirements, and life history information of the assessed listed species, see Attachment II.
*Morell, 1972.

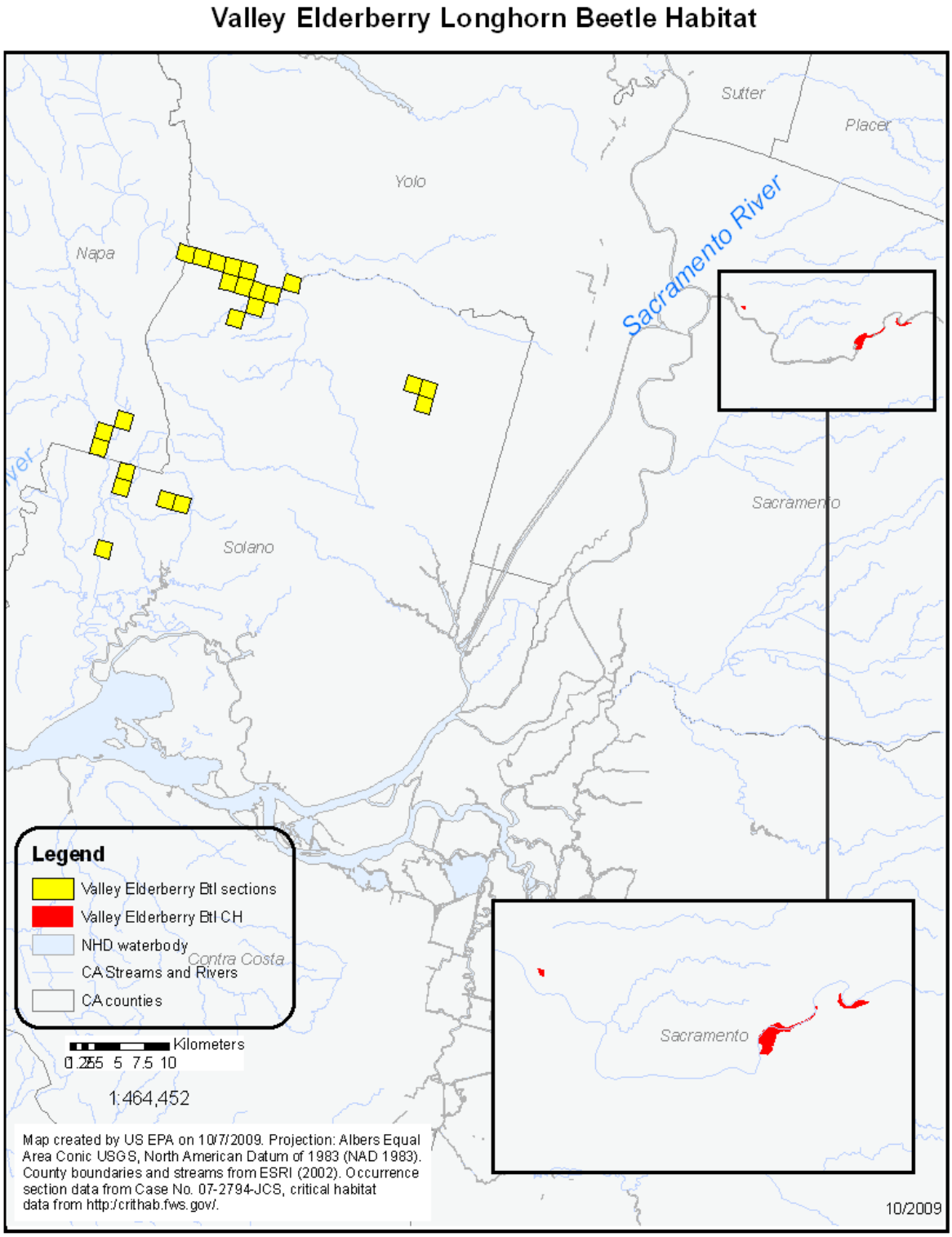

Figure 2.2. Critical habitat and occurrence sections of the Valley Elderberry Longhorn Beetle, as identified in Case No. 07-2794-JCS

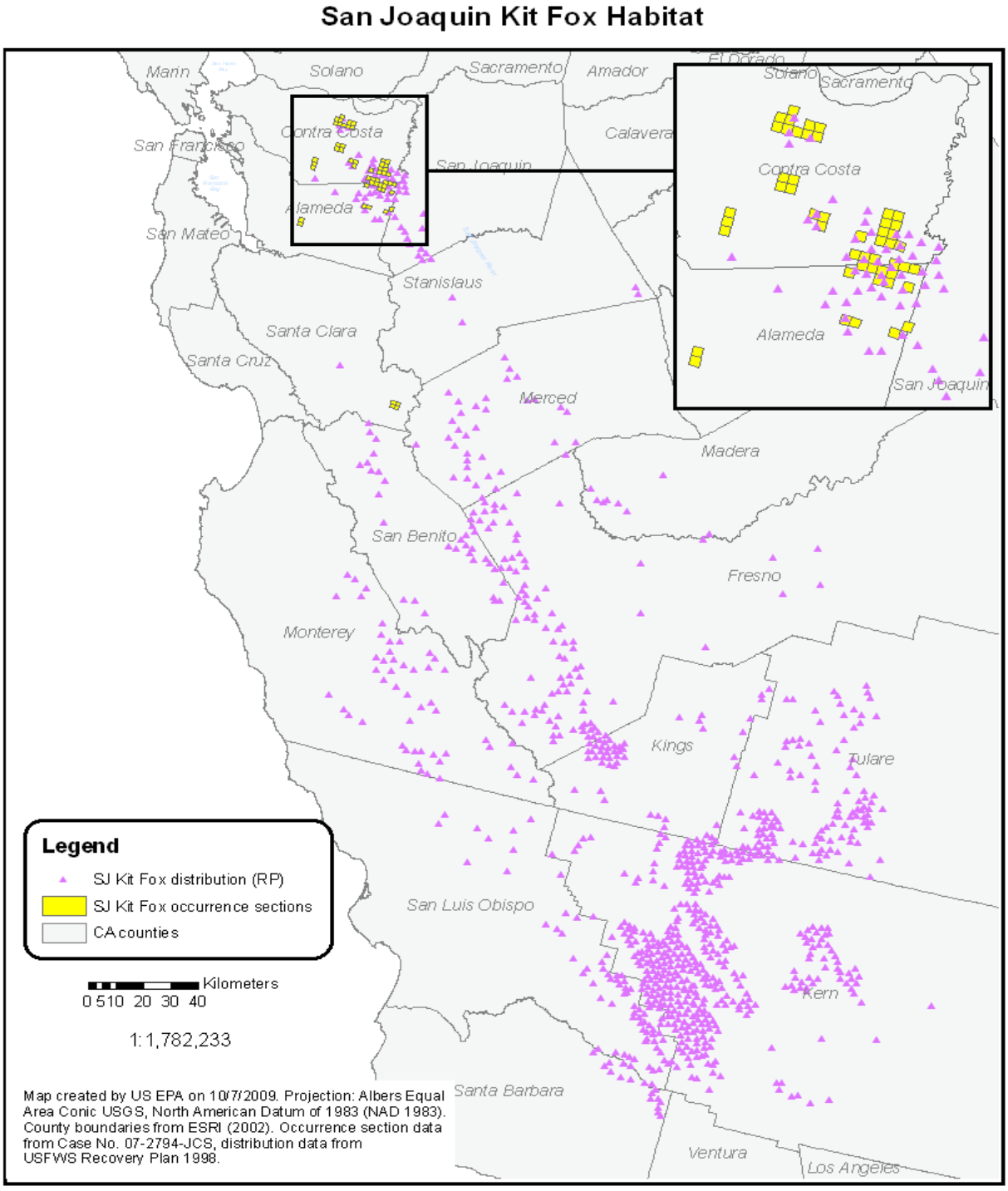

Figure 2.3. Occurrences and occurrence sections of the San Joaquin Kit Fox, as identified in Case No. 07-2794-JCS.

2.8. Designated Critical Habitat

Critical habitat has been designated for the VELB. Risk to critical habitat is evaluated separately from risk to effects on the species. Critical habitat is defined in the ESA as the geographic area occupied by the species at the time of the listing where the physical and biological features necessary for the conservation of the species exist, and there is a need for special management to protect the listed species. It may also include areas outside the occupied area at the time of listing if such areas are essential to the conservation of the species. Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species or areas that contain certain primary constituent elements (PCEs) (as defined in 50 CFR 414.12(b)). **Table 2.5** describes the PCEs for the critical habitats designated for the VELB.

Table 2.5. Designated critical habitat PCEs for the valley elderberry longhorn beetle[1]**.**

Species	PCEs	Reference
Valley Elderberry Longhorn Beetle	Areas that contain the host plant of this species [*i.e*., elderberry trees (*Sambucus* sp.)] (a dicot)	43 FR 35636 35643, 1978

[1] These PCEs are in addition to more general requirements for habitat areas that provide essential life cycle needs of the species such as, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

Activities that may destroy or adversely modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the species. Evaluation of actions related to use of Aldicarb that may alter the PCEs of the designated critical habitat for the VELB form the basis of the critical habitat impact analysis.

As previously noted in Section 2.1, the Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because Aldicarb is expected to directly impact living organisms within the action area, critical habitat analysis for aldicarb is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes.

2.9. Action Area and LAA Effects Determination Area

2.9.1. Action Area

The action area is used to identify areas that could be affected by the Federal action. The Federal action is the authorization or registration of pesticide use or uses as described on the label(s) of pesticide products containing a particular active ingredient. The action area is defined by the Endangered Species Act as, "all areas to be affected directly or indirectly by the Federal action and not merely the immediate are involved in the action" (50 CFR §402.2). Based on an analysis of the Federal action, the action area is defined by the actual and potential use of the pesticide and areas where that use could result in effects. Specific measures of ecological effect for the assessed species that define the action area include any direct and indirect toxic effect to the assessed species and any

potential modification of its critical habitat, including reduction in survival, growth, and fecundity as well as the full suite of sublethal effects available in the effects literature. It is recognized that the overall action area for the national registration of aldicarb is likely to encompass considerable portions of the United States based on the six agricultural use patterns, some of which are extensive (*e.g.* cotton). However, the scope of this assessment limits consideration of the overall action area to those portions that may be applicable to the protection of the VELB and SJKF and their designated critical habitat within the state of California. For this assessment, the entire state of California is considered the action area given the extent of potential use sites. The purpose of defining the action area as the entire state of California is to ensure that the initial area of consideration encompasses all areas where the pesticide may be used now and in the future. Additionally, the concept of a state-wide action area takes into account the potential for direct and indirect effects and any potential modification to critical habitat based on ecological effect measures associated with reduction in survival, growth, and reproduction, as well as the full suite of sublethal effects available in the effects literature.

It is important to note that the state-wide action area does not imply that direct and/or indirect effects and/or critical habitat modification are expected to or are likely to occur over the full extent of the action area, but rather to identify all areas that may potentially be affected by the action. The Agency uses more rigorous analysis including consideration of available land cover data, toxicity data, and exposure information to determine areas where the VELB and SJKF designated critical habitat may be affected or modified via endpoints associated with reduced survival, growth, or reproduction.

2.9.2. LAA Effects Determination Area

A stepwise approach is used to define the Likely to Adversely Affect (LAA) Effects Determination Area. An LAA effects determination applies to those areas where it is expected that the pesticide's use will directly or indirectly affect the species and/or modify its designated critical habitat using EFED's standard assessment procedures (see **Attachment 1**) and effects endpoints related to survival, growth, and reproduction. This is the area where the "Potential Area of LAA Effects" overlaps with the range and/or designated critical habitat for the species being assessed. If there is no overlap between the potential area of LAA effects and the habitat or occurrence areas, a No Effect determination is made. The first step in defining the LAA Effects Determination Area is to understand the federal action. The federal action is defined by the currently labeled uses for Aldicarb. An analysis of labeled uses and review of available product labels was completed. Some of the currently labeled uses are special local needs (SLN) uses not specified for use in California or are restricted to specific states and are excluded from this assessment. In addition, a distinction has been made between food use crops and those that are non-food/non-agricultural uses. For those uses relevant to the assessed species, the analysis indicates that, for aldicarb, the following agricultural uses are considered as part of the federal action evaluated in this assessment:

- cotton
- peanuts
- sugar beet

Following a determination of the assessed uses, an evaluation of the potential "footprint" of aldicarb

use patterns (*i.e*., the area where pesticide application may occur) is determined. This "footprint" represents the initial area of concern, based on an analysis of available land cover data for the state of California. The initial area of concern is defined as all land cover types and the stream reaches within the land cover areas that represent the labeled uses described above. For aldicarb, the land cover types include only cultivated crops.

2.10. Assessment Endpoints and Measures of Ecological Effect

2.10.1. Assessment Endpoints

A complete discussion of all the toxicity data needed for this risk assessment, including resulting measures of ecological effect selected for each taxonomic group of concern, is included in Section 4 of this document. Table 2.6identifies the taxa used to assess the potential for direct and indirect effects from the uses of aldicarb for each listed species assessed here. The specific assessment endpoints used to assess the potential for direct and indirect effects to each listed species are provided in Table 2.7**.**

Table 2.6. Taxa used in the analyses of direct and indirect effects for the assessed listed species.

Listed Species	Birds	Mammals	Terr. Plants	Terr. Inverts.	FW Fish	FW Inverts.	Estuarine /Marine Fish	Estuarine /Marine Inverts.	Aquatic Plants
San Joaquin kit fox	Indirect (prey)	Direct Indirect (prey)	Indirect (food/ habitat)	Indirect (prey)	n/a	n/a	n/a	n/a	n/a
Valley Elderberry longhorn beetle	n/a	n/a	Indirect (food/ habitat) *	Direct	n/a	n/a	n/a	n/a	n/a

Abbreviations: n/a = Not applicable; Terr. = Terrestrial; Invert. = Invertebrate; FW = Freshwater
* obligate relationship

Table 2.7. Taxa and assessment endpoints used to evaluate the potential for use of aldicarb to result in direct and indirect effects to the assessed listed species or modification of critical habitat.

Taxa Used to Assess Effects	Assessed Listed Species	Assessment Endpoints	Measures of Ecological Effects
1. Birds **	Indirect Effect (prey/rearing sites) - San Joaquin Kit Fox	Survival, growth, and reproduction of individuals or modification of critical habitat/habitat via indirect effects on terrestrial prey (birds)	Avian acute LD_{50} = 1.0 mg/kg
2. Mammals	Direct Effect -San Joaquin Kit Fox	Survival, growth, and reproduction of individuals via direct effects	Mammalian acute LD_{50} = 0.9 mg/kg
	Indirect Effect (prey/habitat from burrows/rearing sites) -San Joaquin Kit Fox	Survival, growth, and reproduction of individuals or modification of critical habitat/habitat via indirect effects on terrestrial prey (mammals) and/or burrows/rearing sites	
3. Terrestrial Invertebrates	Direct Effect -Valley elderberry longhorn beetle	Survival, growth, and reproduction of individuals via direct effects	No data
	Indirect Effect (prey) -San Joaquin Kit Fox	Survival, growth, and reproduction of individuals or modification of critical habitat/habitat via indirect effects on terrestrial prey (terrestrial invertebrates)	
4. Terrestrial Plants	Indirect Effect (food/habitat) (non-obligate relationship) -San Joaquin Kit Fox	Survival, growth, and reproduction of individuals or modification of critical habitat/habitat via indirect effects on food and habitat (*i.e.*, riparian and upland vegetation)	Seedling Emergence: >25% effects observed in ryegrass (shoot weight) and tomato (shoot length and weight).
	Indirect Effect (food/habitat) (obligate relationship) -Valley Elderberry Longhorn Beetle		

Abbreviations: SF=San Francisco
** Birds are used as a surrogate for terrestrial-phase amphibians and reptiles.

2.10.2. Assessment Endpoints for Designated Critical Habitat

As previously discussed, designated critical habitat is assessed to evaluate actions related to the use of aldicarb that may alter the PCEs of the assessed species' designated critical habitat. PCEs for the assessed species were previously described in **Section 2.8**. Actions that may modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the assessed species. Therefore, these actions are identified as assessment endpoints. It should be noted that evaluation of PCEs as assessment endpoints is limited to those of a biological nature (*i.e.*, the biological resource requirements for the listed species associated with the critical habitat) and those for which aldicarb

effects data are available.

Assessment endpoints used to evaluate potential for direct and indirect effects are equivalent to the assessment endpoints used to evaluate potential effects to designated critical habitat. If a potential for direct or indirect effects is found, then there is also a potential for effects to critical habitat. Some components of these PCEs are associated with physical abiotic features (*e.g.*, presence and/or depth of a water body, or distance between two sites), which are not expected to be measurably altered by use of pesticides.

2.11. Conceptual Model

For a pesticide to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a pesticide moves in the environment from a source to an ecological receptor. For an ecological pathway to be complete, it must have a source, a release mechanism, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure.

The conceptual model for aldicarb provides a written description and visual representation of the predicted relationships between aldicarb, potential routes of exposure, and the predicted effects for the assessment endpoint. A conceptual model consists of two major components: risk hypothesis and a conceptual diagram (USEPA, 1998).

Based on an examination of the physical/chemical properties of aldicarb, its fate and disposition in the environment, and its mode of application, a conceptual model was developed that represents the possible relationships between this pesticide as a stressor, ecological receptors, and the assessment endpoints. The conceptual model depicts the potential pathways for ecological risk associated with aldicarb use. The conceptual model provides an overview of the expected exposure pathways and effects of aldicarb on terrestrial and aquatic environments. Solid arrows depict the most likely routes of exposure and effects; dashed lines depict potential routes of exposure that are not considered likely for aldicarb.

2.11.1. Risk Hypotheses

Risk hypotheses are specific assumptions about potential adverse effects (*i.e.,* changes in assessment endpoints) and may be based on theory and logic, empirical data, mathematical models, or probability models (USEPA, 1998). For this assessment, the risk is stressor-linked, where the stressor is the release of Aldicarb to the environment. The following risk hypotheses are presumed in this assessment:

The labeled use of aldicarb within the action area may:

- directly affect the SJKF by causing mortality or by adversely affecting growth or fecundity;
- indirectly affect the SJKF;
- directly affect the VELB by causing mortality
- indirectly affect the VELB and/or modify their designated critical habitat by reducing or changing the composition its food supply the elderberry bush.
-

2.11.2. Diagram

The conceptual model is a graphic representation of the structure of the risk assessment. It specifies the aldicarb release mechanisms, biological receptor types, and effects endpoints of potential concern. The conceptual model for the VELB and SJKF including terrestrial PCE components of critical habitat for the VELB are shown in Figure 2-5**.** Although the conceptual model for direct/indirect effects and modification of designated critical habitat PCEs are shown on the same diagram, the potential for direct/indirect effects and modification of PCEs will be evaluated separately in this assessment. Exposure routes shown in dashed lines are not quantitatively considered because the contribution of those potential exposure routes is expected to be negligible.

Terrestrial species may ingest Aldicarb by eating contaminated prey and/or by drinking contaminated water. Aldicarb is applied as a granule and is expected to partition into drinking water sources (*e.g.* puddles). Dermal and inhalation routes of exposure occur for some pesticides (*e.g*., foliar sprays). However, these are not expected to be important routes of exposure for granular pesticides because Aldicarb is not volatile and is not expected to absorb appreciably through the skin.

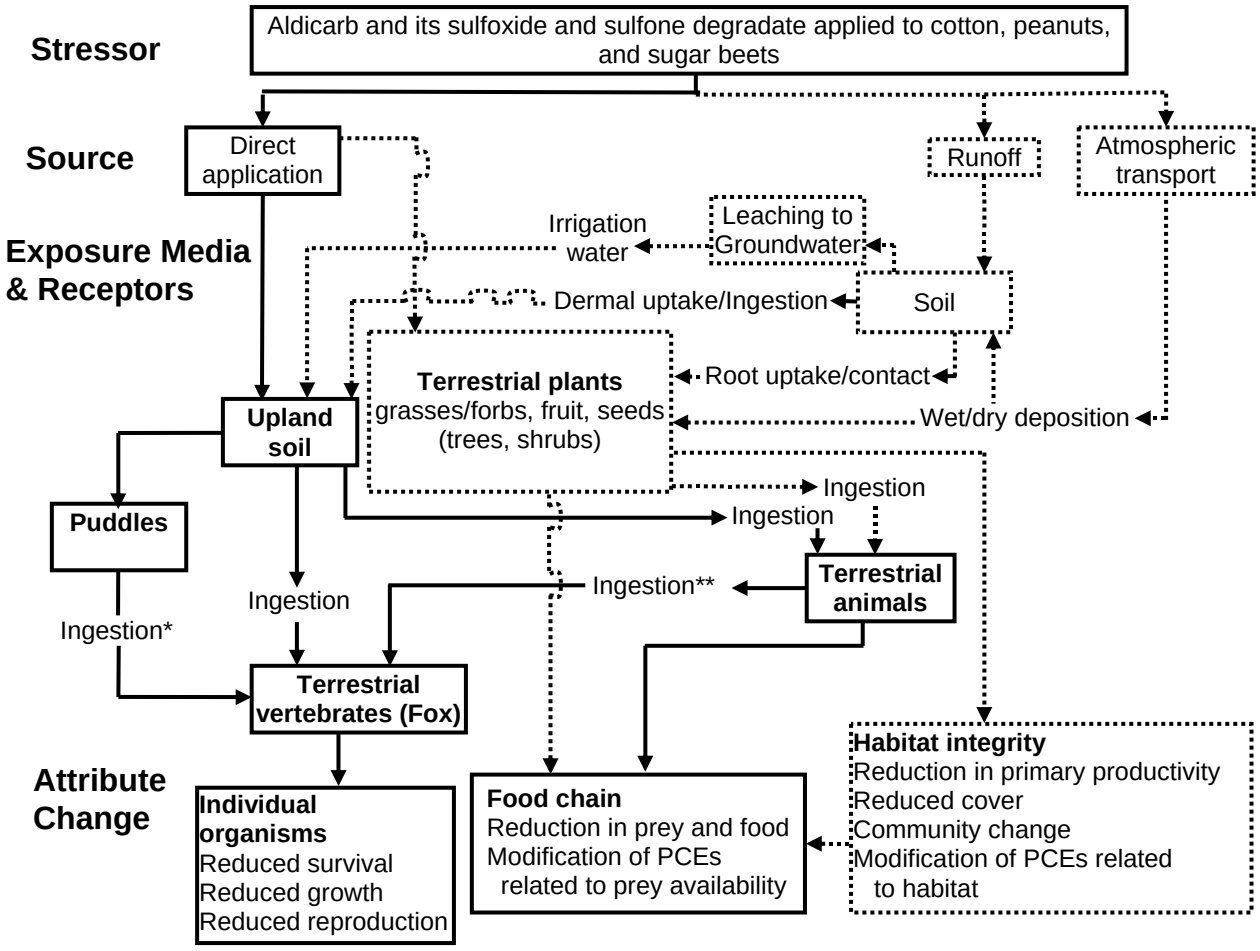

Figure 2-5. Conceptual model depicting stressors, exposure pathways, and potential effects to terrestrial organisms from the use of aldicarb.

Dotted lines indicate exposure pathways that have a low likelihood of contributing to ecological risk.

*Represents primary exposure to the kit fox (through drinking water)

**Represents secondary exposure to the kit fox (through consumption of contaminated prey).

2.12. Analysis Plan

In order to address the risk hypothesis, the potential for direct and indirect effects to the assessed species, prey items, and habitat is estimated based on a taxon-level approach. In the following sections, the use, environmental fate, and ecological effects of aldicarb are characterized and integrated to assess the risks. This is accomplished using a risk quotient (ratio of exposure concentration to effects concentration) approach. Although risk is often defined as the likelihood and magnitude of adverse ecological effects, the risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of an adverse effect. However, as outlined in the Overview Document (USEPA, 2004), the likelihood of effects to individual organisms from particular uses of aldicarb is estimated using the probit dose-response slope and either the level of concern (discussed below) or actual calculated risk quotient value.

2.12.1. Measures of Exposure

For terrestrial exposure, the primary pathways of terrestrial animals to aldicarb are through direct ingestion of exposed dead or dying prey species (birds and mammals) and/or through contaminated drinking water. Because the terrestrial organisms being considered in this assessment are not dependent on aquatic organisms and associated habitat, an aquatic exposure assessment is not included.

Measures of exposure are based on terrestrial models that predict estimated environmental concentrations (EECs) of aldicarb using maximum labeled application rates and methods of application.

2.12.2. Estimating Exposure in the Terrestrial Environment

For this assessment, applications of aldicarb granules are considered. Terrestrial EECs were derived for birds and mammals consuming granules (as an indirect effect to the prey base of the SJKF) as well as for the SJKF consuming contaminated prey and water. Exposure estimates generated are for the parent alone. For primary risk to prey, LD_{50}/sq. ft. calculations are calculated using the T-REX[2] model. For secondary toxicity risk to the SJKF, the concentrations of aldicarb in puddle drinking water from on-field puddles and primary consumers (*i.e.*, the dose) are used to estimate potential exposure.

2.12.3. Measures of Effect

Data identified in **Section 2.10** are used as measures of effect for direct and indirect effects. Data were obtained from registrant submitted studies or from literature studies identified by ECOTOX. More information on the ECOTOXicology (ECOTOX) database and how toxicological data are used in assessments is available in **Attachment I**.

[2] http://www.epa.gov/oppefed1/models/terrestrial/index.htm

2.12.3.a. Integration of Exposure and Effects

Risk characterization is the integration of exposure and ecological effects characterization to determine the potential ecological risk from agricultural and non-agricultural uses of aldicarb, and the likelihood of direct and indirect effects to the assessed species in terrestrial habitats. The exposure and toxicity effects data are integrated in order to evaluate the risks of adverse ecological effects on non-target species. The risk quotient (RQ) method is used to compare exposure and measured toxicity values. EECs are divided by acute and chronic toxicity values. The resulting RQs are then compared to the Agency's endangered levels of concern (LOC of 0.1) (USEPA, 2004).

2.12.4. Data Gaps

Environmental Fate
There are no significant fate environmental data gaps which affect this assessment.

Ecological Effects
Under the parameters of the current assessment, toxicity data for terrestrial plants are needed to assess risk to elderberry trees for possible indirect effects to the VELB. A seedling emergence study was submitted (MRID 47904401) but was classified as supplemental. The most sensitive monocot species was ryegrass, with a 12 and 44% difference in shoot length and weight, respectively, compared to the control. The most sensitive dicotyledonous species (the elderberry tree is a dicot) was tomato, with a 28 and 25% difference in shoot length and weight, respectively, compared to the control. This study used 10.3 lb ai/A to test for effects which is over 2 times the current maximum annual application rate. Phytotoxic effects, including stunting and necrosis, were observed in ryegrass and tomatoes. A vegetative vigor study was not available. Also not available were valid avian chronic data as well as toxicity data for terrestrial invertebrates.

3. Exposure Assessment

Aldicarb is formulated as a granular product only. The potential for spray drift is minimal and, spray drift analysis was not conducted for this assessment. Therefore, potential for exposure to aldicarb granules is limited to treated fields.

3.1. Label Application Rates and Intervals

Currently registered uses of aldicarb include only agricultural areas. Labeled uses sites for agriculture in California include cotton, peanuts and sugar beets as summarized in **Section 2.6.** All of these uses are considered as part of the federal action evaluated in this assessment.

3.2. Terrestrial Animal Exposure

3.2.1. Exposure to Residues in Terrestrial Food Items

3.2.1.a. Primary Exposure From Consumption of Granules

Immediately following granular application of aldicarb and prior to soil incorporation, granules are

expected to be available at the soil surface on agriculture sites. Wildlife exposure could result from mistakenly ingesting granules as seeds or ingesting them as part of incidental soil ingestion while foraging for food. Soil incorporation of the granules is expected to result in the movement of aldicarb down into the soil column, but some granules will still remain available on the surface (*i.e.* soil incorporation methods result in <100% incorporation). However, as a carnivorous mammal, the SJKF is not a capable consumer of granules. Thus, it would incidentally ingest them only when consuming exposed prey.

3.2.1.b. Primary Exposure Through the Consumption of Contaminated Drinking Water

Aldicarb is highly soluble in water with a solubility of 5191 $mg \cdot L^{-1}$. Aldicarb in granules which are at or near the surface can dissolve in puddles which form on a treated field from rainfall or irrigation events. Puddles are often used by wildlife as a source of drinking water. Concentrations of aldicarb from granules which may be in the top 1 cm of soil and estimates of the concentrations that could be in puddles that form on the field are compared to acute dietary endpoints for direct exposure the SJKF from drinking contaminated water.

The calculation has three steps. First, the portion of the application to each crop which is near enough to the surface (top centimeter) to dissolve in a puddle is estimated for each crop. Secondly, the concentration in a puddle which is 5 cm and in contact with aldicarb in the top 1 cm of soil is calculated using equilibrium partitioning between the soil and water. The top centimeter of soil is the part of the soil which would be expected to be mixing with the water in the puddle. Water below this level is not likely to be mixed back to the surface, and thus unlikely to affect the concentration in the puddle. The rationale for using the top centimeter of soil is similar to that used for mixing between soil and paddy water; a more complete description can be found in the Tier 1 Rice Model Manual. [3] A 5 cm depth was used as this puddle would be likely to persist for at least a few days, increasing the probability that it would be used for wildlife as a drinking water source. Thirdly, a dose of aldicarb is calculated based on the potential consumption of water by the fox. The areal dimensions of the puddle have been removed from consideration by setting up the calculation so that it is based on the puddle and soil depths only. It is important to note that this calculation is not standard tool used in OPP risk assessments. However, the equation is a direct extension of the equation used to describe equilibrium partitioning of a pesticide between soil/sediment and water and is the same equation used for this process in other aquatic exposure such as EXAMS and the Tier 1 rice model.

i. Aldicarb available to dissolve in a puddle

Descriptions of application practices for each of the three crops are provided below as well as a description of how the fraction of each application in the top centimeter is estimated. The results for each crop are summarized in **Table 3.1**. Note that the effective rates estimated here are not the same as those used for the other terrestrial exposure assessments because availability of granules to an organism searching a field for food or grit is different than the availability for extraction into water.

[3] http://www.epa.gov/oppefed1/models/water/rice_tier_i.pdf

Cotton. The minimum planting depth for cotton is 0.5 in or ~1.25 cm and side dress applications are to be placed in a furrow at least 2 inches deep. This depth is below the part of the soil which is in contact with the puddle; therefore, drinking water exposure is not expected from this use.

Peanuts. Applications to peanuts at-planting can be made in a 6 inch T-band over an open furrow, or as a 6 to 12 inch band which is then mechanically incorporated to a depth of at least 2 inches. In the case of the T-band, the application must immediately be covered with soil by mechanical means, but a depth is not specified. If the width of the open furrow is 2 inches, then the other 4 inches of a 6 inch band is available near the surface. Since the depth of coverage is not specified, all of the aldicarb which is not in the furrow ise considered to be at less than 1 cm depth and available for extraction into a puddle. For the banded, incorporated application, if the incorporation results in aldicarb being well mixed through 2 inches, it can be assumed that only the top 1 cm is available for extraction into a puddle, so 1 cm / 2.54 cm/in x 2 in) = 19.6% the applied application can be extracted into the puddle. Since the banded, incorporated application results in lower exposure than the T-band application, only exposure for the T-band application is assessed. Post-emergence applications to peanuts are not allowed in California.

Sugar beets. Three applications per year can be made to sugar beets. However, only two applications can be made at the maximum application rate as the maximum seasonal rate is twice the single rate. Applications can be made pre-plant by applying granules in 4 to 6 inch band and immediately covering with soil. Planting is then made into the treated band. Since the depth of incorporation is not specified, it is assumed that all the aldicarb is in the top centimeter and available for extraction into a puddle. Applications can also be made by drilling granules at least 2 inches deep in a furrow 2 inches from the seed row. Since this application would be made below the extraction zone for the puddle, it is not expected that significant aldicarb will be occur in puddles that may be used for drinking water.

At plant, application can be made 1 to 3 inches below the seed line in furrow or at the bottom of the furrow if the application rate is below 7 lb·acre^{-1}. As sugar beets are usually planted at least ½ inch below the surface, extraction into puddles is not expected for this application method. For treatment of sugar beet root maggot, applications can be made in a 2 to 3 inch band over the seed row and then incorporated by mechanical means. The depth of incorporation is not specified, but must be less than the planting depth. Therefore, it is reasonable to assume that this application will be made at 1 cm or less and is wholly extractable into a puddle. However, this application method cannot be used in conjunction with a post-emergence application

For post-emergence applications, applications can be made on either side of the plant row and immediately incorporated, since the incorporation depth is not specified; therefore, it is assumed that all the aldicarb in the application is available for extraction into the puddle. Application can also be made by placing the granules at furrow depth 4 to 8 inches from the plants on the water furrow side. This method can only be used when irrigation is present. Since this method places the aldicarb below the expected extraction zone for the puddle, it is not expected to be available in puddle-based drinking water for wildlife.

Based on this analysis of the application methods for sugar beets, the maximum exposure through drinking water is based on two applications at the maximum rate of 2.1 lb·acre^{-1}, one made at plant,

and one made two weeks last after emergence. Both applications are made as bands on the surface and lightly incorporated to less than 1 cm. The concentration of aldicarb in the soil from the first application which is still present when the second application is made can be estimated by assuming first order decay with a half-life of 83.8 d for 14 days. The 83.8 d half-life is the upper 90% confidence bound on the mean half-life of aldicarb plus the aldicarb sulfoxide and aldicarb sulfone degradates as estimated using the total toxic residues method. This concentration is 1.87 lb·acre^{-1}. The concentration after the second application is then 3.96 lb·acre^{-1}.

Table 3.1. Application practices used for assessment of drinking water exposure for the San Joaquin kit fox.

Crop	Application Rate (lb·acre^{-1})	Number of Applications	Application Method	Incorporation Depth (cm)	Rate in Top cm (lb·acre^{-1})
peanuts	1.05	1	T-band	< 1 cm	0.69
sugar beets	1st: 2.1 2nd: 2.1	2	banded banded	< 1cm < 1 cm	1.05 1.05

ii. Estimation of puddle concentration

The concentration of aldicarb in drinking water was estimated by assuming aldicarb is dissolved in a puddle on the field 5 cm deep and that aldicarb in the top 1 cm of soil could dissolve into the puddle. The aldicarb was partitioned between the soil and the water using the mean K_d 0f 0.33 L·kg^{-1}. The storm event causing the puddles was assumed to be immediately after application of peanuts and after the second application for sugar beets. The first application to sugar beets was allowed to degrade with a half-life of 83.8 days for 14 days prior to making the second application. The concentration used for sugar beets was then the sum of the remaining aldicarb from the first application plus the second application. The calculation used to estimate the concentration is the same used for the Tier 1 rice model (EFED, 2007), except that the depth of the water used was 5 cm rather than 10 cm for the rice paddy. The equation used is:

$$C_w = \frac{AR\left(\frac{4.536\ x\ 10^5\ mg}{lb}\right)\left(\frac{2.471\ x\ 10^{-4}\ acre}{m^2}\right)}{d_w + d_{sed}(\theta_{sed} + \rho_b K_d)}\left(\frac{m^3}{1000\ L}\right)$$

where

AR: Application rate ((lb a.i.)·acre^{-1})
C_w: concentration in the puddle in mg·L^{-1}
d_w: depth of the puddle = 0.05 m (5 cm)
d_{sed}: depth of sediment in equilibrium with the water column = 0.01 m (1 cm)
θ_{sed}: sediment porosity = 0.509 (dimensionless)
ρ_b: soil bulk density = 1.3 kg·L^{-1}

The three constants in the equation are conversion factors so that the resulting units are mg·L^{-1}. The equation can be simplified to:

$$C_w = \frac{8.622xAR}{4.238 + K_d}$$

Descriptions and justifications for the values used for soil bulk density, sediment porosity, and

depth of sediment are provided in the manual for the Tier 1 rice model. Estimated puddle concentrations for the three uses are in provided in **Table 3.2**.

iii. Estimation of dose

In order to estimate the acute dietary risk based on a dose-toxicity endpoint, the amount of water that the SJKF consumes is needed. Direct estimates of the amount of water needed by the San Joaquin kit fox are not available. However, SJKFs need to consume 175 g of prey a day in order to meet their water needs (Golightly and Ohmart, 1984); therefore, this information is used to estimate the daily water requirement of the fox. Typically the water content of mammals that would serve as prey items for the San Joaquin kit fox is 70% (USEPA, 2003). Based on this, about 122 g, or 0.122 L of water are needed daily by the kit fox. The dose was calculated by multiplying the EEC in the puddle used as drinking water by this volume of water and dividing by the typical mass of the SJKF (2.3 kg).The estimated doses for each use are in **Table 3.2**.

Table 3.2. Drinking water EECs for the San Joaquin kit fox for the use of aldicarb in California.

Crop	Available Application Rate* ($lb \cdot acre^{-1}$)	EEC ($mg \cdot L^{-1}$)	Dose ($mg \cdot kg^{-1}$)
peanuts	0.69	1.30	0.069
sugar beets	3.96	7.47	0.396
* Available amount of aldicarb in the top cm of soil after the last application which is available after the last application of the season. Applications prior to the last application are degraded with an 83.8 d half-life.			

3.2.1.c. Secondary Exposure from Consumption of Treated Prey

Aldicarb granules are assumed to be consumed by prey species, which are then consumed by the SJKF. If a 2.3 kg fox consumes a rat (with a mass of 200 g or 0.2 kg) that has died from ingested aldicarb. The dose in the rat is 0.9 x 0.2 kg = 0.18 mg. The dose in the fox is then 0.18 mg/2.3 kg fox = 0.414 mg/kg fox. This dose (eaten by the SJKF) is compared to the most toxic mammalian (for the SJKF) LD_{50}. Using a similar calculation, the dose from eating a bird or birds which weigh a total of 200 g and with the concentration in the bird at the LD_{50} of 1.0 $mg \cdot kg^{-1}$ is 0.2 mg/kg fox. See **Section 5.1.2** for further details.

3.3. Exposure to Aldicarb for the Valley Elderberry Longhorn Beetle

As aldicarb is applied as a granule and label instructions for all crops grown in California require incorporation of the granules, there will be no off-site spray drift. Incorporation substantially decreases, but may not eliminate aldicarb in runoff from treated fields. The VELB spends most of its life in the larval stage inside the branches and stems of elderberry trees, so direct contact with runoff water will not occur. A small fraction of runoff from a treated field may infiltrate in the root zone of an elderberry tree and a small fraction of this can be taken up into the tree through the roots. Some portion of this could then be available for exposure to the larval VELB. Adult VELB can also be exposed through the consumption of leaves which have aldicarb by the same route. While this

route exposure is potentially complete, tools are not available to quantitatively assess the exposure to the VELB. However, given that only a small fraction of the applied aldicarb moves on through each step of the route, the amounts which actually are exposed to the VELB would be small enough to be considered negligible.

4. Effects Assessment

This assessment evaluates the potential for aldicarb to directly or indirectly affect the VELB and the SJKF or modify designated critical habitat for the VELB. Assessment endpoints for the effects determination for each assessed species include direct toxic effects on the survival, reproduction, and growth, as well as indirect effects, such as reduction of the prey base or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating effects to the PCEs, which are components of the critical habitat areas that provide essential life cycle needs of the VELB.

As described in the Agency's Overview Document (USEPA, 2004), the most sensitive endpoint for each taxon is used for risk estimation. For this assessment, evaluated taxa include only mammals. Acute (short-term) and chronic (long-term) toxicity information is characterized based on registrant-submitted studies and a comprehensive review of the open literature on aldicarb. Toxicity for the aldicarb sulfone and aldicarb sulfoxide degradates is also described.

4.1. Ecotoxicity Study Data Sources

Toxicity endpoints are established based on data generated from guideline studies submitted by the registrant, and from open literature studies that meet the criteria for inclusion into the ECOTOX database maintained by EPA/Office of Research and Development (ORD) (USEPA, 2004). Open literature data presented in this assessment were obtained from ECOTOX information obtained on 11/1/2011. In order to be included in the ECOTOX database, papers must meet the following minimum criteria:

(1) the toxic effects are related to single chemical exposure;
(2) the toxic effects are on an aquatic or terrestrial plant or animal species;
(3) there is a biological effect on live, whole organisms;
(4) a concurrent environmental chemical concentration/dose or application rate is reported; and
(5) there is an explicit duration of exposure.

Open literature toxicity data for other 'target' insect species (not including bees, butterflies, beetles, and non-insect invertebrates including soil arthropods and worms), which include efficacy studies, are not currently considered in deriving the most sensitive endpoint for terrestrial insects. Efficacy studies do not typically provide endpoint values that are useful for risk assessment (*e.g.*, NOAEC, EC50, *etc.*), but rather are intended to identify a dose that maximizes a particular effect (*e.g.*, EC100). Therefore, efficacy data and non-efficacy toxicological target insect data are not included in the ECOTOX open literature. For the purposes of this assessment, 'target' insect species are defined as all terrestrial insects with the exception of bees, butterflies, beetles, and non-insect invertebrates (*i.e.*, soil arthropods, worms, *etc.*).

Data that pass the ECOTOX screen are evaluated along with the registrant-submitted data, and may be incorporated qualitatively or quantitatively into this endangered species assessment. In general, effects data in the open literature that are more conservative than the registrant-submitted data are considered. The degree to which open literature data are quantitatively or qualitatively characterized for the effects determination is dependent on whether the information is relevant to the assessment endpoints (*i.e.*, survival, reproduction, and growth) identified in **Section 2.10**. For example, endpoints such as behavior modifications are likely to be qualitatively evaluated, because quantitative relationships between modifications and reduction in species survival, reproduction, and/or growth are not available. Although the effects determination relies on endpoints that are relevant to the assessment endpoints of survival, growth, or reproduction, it is important to note that the full suite of sublethal endpoints potentially available in the effects literature (regardless of their significance to the assessment endpoints) are considered, as they are relevant to the understanding of the area with potential effects, as defined for the action area.

Citations of all open literature not considered as part of this assessment because they were either rejected by the ECOTOX screen or accepted by ECOTOX but not used (*e.g.*, the endpoint is less sensitive) are included in **Appendix D.** This appendix also includes a rationale for rejection of those studies that did not pass the ECOTOX screen and those that were not evaluated as part of this endangered species risk assessment.

A detailed spreadsheet of the available ECOTOX open literature data, including the full suite of lethal and sublethal endpoints is presented in **Appendix E**.

In addition to registrant-submitted and open literature toxicity information, other sources of information, including use of the acute probit dose response relationship to establish the probability of an individual effect and reviews of ecological incident data, are considered to further refine the characterization of potential ecological effects associated with exposure to aldicarb. A summary of the available terrestrial ecotoxicity information and the incident information for aldicarb are provided in **Sections 4.2** through **4.4**.

Available toxicity of degradates and other stressors of concern are summarized for each taxa in the appropriate sections for the taxa.

4.2. Toxicity of Aldicarb to Terrestrial Organisms

Table 4.1 summarizes the most sensitive terrestrial toxicity endpoints, based on an evaluation of both the submitted studies and the open literature. A brief summary of submitted and open literature data considered relevant to this ecological risk assessment is presented below.

Table 4.1. Terrestrial Toxicity Profile for Aldicarb

Species	Acute/ Chronic	Species	Toxicity Value Used in Risk Assessment	Citation MRID/ECOTOX reference No.	Classification
Birds	Acute oral LD50	Mallard Duck	1.0 mg/kg	00107398	Very Highly Toxic

Species	Acute/ Chronic	Species	Toxicity Value Used in Risk Assessment	Citation MRID/ECOTOX reference No.	Classification
	Acute Dietary LC50	Bobwhite Quail	71 ppm	00102132	Highly Toxic
	Chronic	Mallard Duck	1.8 ppm (NOAEC)	48156905	Not applicable
Mammals	Acute oral LD50	Rat	0.9 mg/kg	00057333	Very highly Toxic
	Chronic	Rat	0.4 ppm (NOAEL)	42148401	Not applicable

Acute toxicity to terrestrial animals is categorized using the classification system shown in **Table** 4.2**.**

Table 4.2. Categories of Acute Toxicity for Avian and Mammalian Studies

Toxicity Category	Oral LD_{50}	Dietary LC_{50}
Very highly toxic	< 10 mg/kg	< 50 mg/kg-diet
Highly toxic	10 - 50 mg/kg	50 - 500 mg/kg-diet
Moderately toxic	51 - 500 mg/kg	501 - 1000 mg/kg-diet
Slightly toxic	501 - 2000 mg/kg	1001 - 5000 mg/kg-diet
Practically non-toxic	> 2000 mg/kg	> 5000 mg/kg-diet

4.2.1. Toxicity to Terrestrial Organisms

As specified in the Overview Document, the Agency uses birds as a surrogate for reptiles and terrestrial-phase amphibians when toxicity data for each specific taxon are not available (USEPA, 2004). A summary of toxicity data used for this assessment are provided below.

4.2.1.a. Birds

The acute avian oral LD_{50} is 1.0 mg/kg-bw for aldicarb and 33.5 mg/kg-bw for aldicarb sulfone. The most sensitive species tested for both aldicarb and aldicarb sulfone is the mallard duck. Aldicarb and aldicarb sulfone are categorized as very highly toxic and highly toxic to avian species on an acute oral basis, respectively (MRID 107398). Supplemental avian reproduction data suggest that aldicarb has reproductive effects at 8.3 ppm with a NOAEL of 1.8 ppm (MRID 48156905). Although none of the endpoints in the treated groups displayed statistically significant differences compared to controls, several of the endpoints had 10-25% difference in the two highest treatments. These endpoints include: number of eggs laid/pen, number of eggs set/pen, number of viable embryos/pen, number of live embryos/pen, number of hatchlings/pen, hatchling survival/pen. In addition, adult body weight gain was also decreased in these treatments. The reviewer believed that these differences may be biologically significant.

The most sensitive avian species tested on a subacute 5-d dietary basis for both aldicarb and aldicarb sulfone is the bobwhite quail. The LC_{50} is 71 ppm for aldicarb and 5706 ppm for aldicarb sulfone (or sulfocarb). Aldicarb and aldicarb sulfone are categorized as very highly toxic and practically nontoxic to avian species, respectively (MRID 00102132 & 1096727).

4.2.1.b. Mammals

Acute oral LD_{50} and reproduction data for laboratory rats reviewed by the Health Effects Division (HED) for evaluation of human toxicity were used to assess the mammalian acute and chronic toxicity of Aldicarb. The LD_{50} for rats is 0.9 mg ai/kg (MRID 00057333). These results classify Aldicarb as very highly toxic to mammals on an acute basis.

In a 2-generation reproduction study (MRID 42148401), rats were exposed to aldicarb in their diet at concentrations of 0, 2, 5, 10, and 20 ppm. Exposure consistently led to decreased dam body weight gain (parental LOAEL = 0.7 - 0.9 mg/kg-bw; NOAEL = 0.4 mg/kg-bw). Aldicarb treatment also caused lower survivability and pup weights in offspring of all litters (reproductive LOAEL = 1.4 - 1.7 mg/kg-bw; NOAEL = 0.7 - 0.9 mg/kg-bw). These toxicity values are similar to the acute oral LD_{50} mammalian values and suggest that mammals that survive acute aldicarb exposure may suffer adverse reproductive effects from chronic exposure. Data on the toxicity of the sulfone and sulfoxide degradates of aldicarb on mammals was not available.

4.2.1.c. Terrestrial plants

A Tier I seedling emergence study was submitted (MRID 47904401) but was classified as supplemental. The most sensitive monocot species was ryegrass, with a 12 and 44% difference in shoot length and weight, respectively, compared to the control. The most sensitive dicot species was tomato, with a 28 and 25% difference in shoot length and weight, respectively, compared to the control. The application rate was 10.3 lbs ai/A, which is considerably higher than currently labeled application rates. Phytotoxic effects, including stunting and necrosis, were observed in ryegrass and tomatoes. A vegetative vigor study was not available.

4.3. Incident Database Review

A search was made on October 27th, 2011 of the Ecological Incident Information System (EIIS, version 2.1), which is maintained by the Agency's Office of Pesticide Programs, and the Avian Incident Monitoring System (AIMS), which is maintained by the American Bird Conservancy. A total of 36 incidents for aldicarb were reported to the Agency. There were 17 (47%) incidents (most using WDG bait applications) classified as "highly probable" of which 15 were classified as "intentional misuse", 1 was classified as "accidental misuse" and another was classified as "unknown". There were 9 (25%) incidents classified as "probable", 10 (28%) classified as "possible" and 0 classified as "unlikely". The following table summarizes these incidents. Six of the incidents were on plants and, in all cases, the effected organisms were on the treated crop.
These were all classified as 'possible'.

Table 4.3. Summary of Aldicarb Incidents

Incident #	Date	County	State	Certainty	Legality	Formulation	Appl Method	Total Magnitude
AQUATIC								
Agricultural Area								
I000165-052	6/12/92		NC	2	RU	WDG	Soil Incorp.	Sm Number of bluegill
N/R								
I003826-002	6/12/95	Johnston	NC	2	UN	N/R	N/R	Unknown
PLANTS								
Cotton								
I010837-012	5/18/00	Williamsburg	SC	2	UN			655 acres of 690
Peanut								
I011838-085		Caddo	OK	2	UN			106 acres
I011838-010	5/27/00	Houston	GA	2	UN	N/R	N/R	All 141 acres
I011838-061	5/21/01	Caddo	OK	2	UN			217 acres
I011838-059	5/21/01	Caddo	OK	2	UN			78 acrea
Potato								
I012089-009	8/7/2001	Bingham	ID	2	RU	N/R	Pre-Broadcast	All 1050 acres
TERRESTRIAL								
Agricultural Area								
I001267-001	10/3/94			4	MI	WDG	Unknown	1 Hawk
I010439-001	6/1/2000	Pearl River	MS	4	MI	N/R	Bait	1 Coyote & 1 Opossum
I013168-001	7/25/02	Carroll	TN	4	MI		Bait	9 birds
I021411-012	10/29/08	Eastland	TX	3	M	WDG	Animal control Device	1 Hawk & 1 Buzzard
Bait								
I002352-001	4/9/92	Edgefield	SC	4	MI	WDG	Bait	3 Hawks, 1 Raccoon, 1 Opossum, 1 Grey Fox & a number of Rabbits
I008694-001	2/10/98	Marengo	AL	2	MI	WDG	Bait	1 Golden Eagle
I007595-001	7/15/98	Evangeline	LA	3	MA	WDG	Bait	1 Raccoon
I011213-007	2/28/01		VA	3	MI	WDG	Bait	1 Great horned owl
I016407-062	5/15/05		ID	4	MI		Bait	1 Gray Wolf
I017085-001	3/1/06	Floyd	GA	4	MI		Bait	1 Dog & 2 Opossum
I019925-001	2/23/08	Hancock	GA	4	MI	WDG	Bait	1 Coyote, 1 Red-tailed Hawk & 23 other unknown
Bait, carcass/meat								
B000178-001	12/1/88		NE	4	UN			3 Magpie & 1 Eagle
I010439-002	7/1/00	Hancock	MS	3	MI	N/R	Bait	1 Dog, 1 Raccoon & 1 Buzzard
I013928-001	2/7/03	Columbia	GA	4	MI		Bait	1 Coyote, 1 Red Fox & 1 Yellow-rumped Warbler
I017141-001	1/3/06	Floyd	GA	2	MI			2 Dogs & 2 Opossum
I019363-003	1/29/08	Pike	AL	3	MI	WDG	Bait	2 Dogs & 3 Opossum
I019647-014	2/12/08		MS	4	MI	WDG	Bait	10 Hawks & some Vultures
I019647-015	2/27/08	Montgomery	AR	4	MI	WDG	Bait	30-35 Hawks and other unknown birds
I019647-016	3/24/08	McDuffie	GA	4	MI		Bait	1 Coyote, 1 Gray Fox, 3 Raccoons, 2 Opossum, 3 Red-tailed hawks

Cotton								
I005364-001		Mississippi	AR	4	MA		Soil incorp	2 Dogs & 1 Raccoon
N/R								
I011300-001	2/7/01	Putnum	GA	4	MI		Bait	2 Hawks
I014343-001	7/9/03	Effingham	GA	3	UN			2 Vultures
I017462-001	3/27/06	Troup	GA	4	MI			2 Vultures & 1 Rabitt
Potato								
B0000-400-7	3/17/91	Hertford	NC	4	MI		Unincorp Broadcast	24 Gulls, 2 Finches & 7 Blackbirds
I000799-005	3/18/91	Hertford	NC	3	MI	WDG	N/R	37 birds, mostly Gulls
Quarry								
I015916-001	1/1/99			3	MI		Bait	3 Peregrine Falcons
Rangeland								
I000637-001	1/1/93	Uvalde	TX	3	MI		N/R	N/R
Woodlands								
I007372-003	1/27/97	Kent	DE	4	MI	N/R	N/R	1 Dog, 1 Red Fox & 1 Red-tailed hawk

Certainty Code: 0=Unrelated, 1=Unlikely, 2=Possible, 3=Probable and 4=Highly Probable
Legality Code: RU=Registered Use, M=Misuse, MA=Misuse Accidental, MI=Misuse Intentional, U=Unknown

4.4. Use of Probit Slope Response Relationship to Provide Information on the Endangered Species Levels of Concern

The Agency uses the probit dose response relationship as a tool for providing additional information on the potential for acute direct effects to individual listed species and aquatic animals that may indirectly affect the listed species of concern (USEPA, 2004). As part of the risk characterization, an interpretation of acute RQs for listed species is discussed. This interpretation is presented in terms of the chance of an individual event (*i.e.*, mortality or immobilization) should exposure at the EEC actually occur for a species with sensitivity to aldicarb on par with the acute toxicity endpoint selected for RQ calculation. To accomplish this interpretation, the Agency uses the slope of the dose response relationship available from the toxicity study used to establish the acute toxicity measures of effect for each taxonomic group that is relevant to this assessment. The individual effects probability associated with the acute RQ is based on the mean estimate of the slope and an assumption of a probit dose response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available.

Individual effect probabilities are calculated based on an Excel spreadsheet tool IECV1.1 (Individual Effect Chance Model Version 1.1) developed by the U.S. EPA, OPP, Environmental Fate and Effects Division (June 22, 2004). The model allows for such calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. In addition, the acute RQ is entered as the desired threshold.

5. Risk Characterization

5.1. Risk Estimation

Risk is estimated by calculating the ratio of exposure to toxicity. This ratio is the risk quotient (RQ), which is then compared to pre-established acute and chronic levels of concern (LOCs) for each category evaluated. For acute exposures to endangered mammals and birds, the LOC is 0.1. The LOC for chronic exposures to animals is 1.0.

5.1.1. Granule ingestion by prey species

Terrestrial wildlife exposure estimates are typically calculated for birds and mammals, emphasizing a dietary exposure route for uptake of the pesticide. In the case of aldicarb, which is applied only in a granular form, the method used in calculating terrestrial EECs took into account this granular formulation and its soil incorporation. The current T-REX model (v. 1.4.1) assumes that only 1% (in-furrow application) or 15% (banded application) of the applied granules remain on the surface and have the potential for terrestrial animal exposure. EECs were calculated based on application method, application rate, band width (where appropriate), and percent incorporation of the granules into the soil. Terrestrial EECs were calculated using T-REX and are shown in the table below**.** Terrestrial EECs were calculated using the following equations:

Banded applications

$$EEC\,(mg\ ai/sq.ft.) = \frac{(Applicatio\ n\ rate\,(oz\ ai)\ /1000\ (ft))(0.0625\,(lbs/oz))(\%\,Unincorpor\ ated\ )}{(Bandwidth\ \ (ft))(1000\ (ft))}$$

Broadcast applications

$$EEC(mg\ ai/sq.ft.) = \frac{(Application\ rate\,(lb\,ai/Acre))(453{,}950\,(mg/lb))}{(\#\,of\ rows/Acre)(Bandwidth\,(ft))(Row\,length\,(ft))}$$

Table 5.1. Terrestrial EECs for aldicarb were calculated based on application method, application rate (maximum and average), and % unincorporation of granules

Crop	Application method	Max Application rate (lbs ai/A)	% Unincorporated	Max EEC (mg ai/ft^2)	Exposed EEC (mg ai/ft^2)
Cotton (single application)	Banded[(a)] (2" band width) (40" row spacing)	2.1 4.95	15 15	437.35	65.6
Peanut (single application)	Banded[(a)] (4" band width) (36" row spacing)	1.05	15	98.40	14.76
Sugar Beets (single application)	Banded (4" band width) (22" row spacing)	2.1	15	120.27	18.04

[(a)]EEC = oz. ai per 1000 ft.* 28349 mg/oz * % Unincorporated / (bandwidth (ft) * 1000 ft)
80

The LD_{50} values entered into T-REX are adjusted for animal class (20, 80, and 1000g birds and 15, 35, and 1000g mammals) using the following equations:

Avian LD_{50}: Adjusted $LD_{50} = LD_{50}$ x $(AW/TW)^{(1.15-1)}$
Mammal LD_{50}: Adjusted $LD_{50} = LD_{50}$ x $(TW/AW)^{(0.25)}$

Where TW = test weight (specific to animal size) and AW = adjusted weight (adjusted for animal class). As shown in **Tables 5.2** and **5.3**, the risk assessment indicates that aldicarb poses acute risk to birds and mammals. As previously stated, the method used in calculating terrestrial EECs took into account the granular formulation of the product and its soil incorporation. The model assumes that only 1% (in-furrow application) or 15% (banded application) of the applied granules remain on the surface and have the potential for terrestrial animal exposure. Quantitative chronic risk assessments are not currently performed for granular pesticides on terrestrial organisms.

The following tables provide risk quotients that were calculated based on maximum labeled application rates as well as label-indicated band widths and row spacing. These rates could be considered more typical of the application rates applied under some use conditions. Based on this information, it is evident that risk levels of concern are exceeded even at rates that are less than the application rates allowed by the product labels.

Table 5.2. Avian acute risk quotients for aldicarb (maximum use rates).

Crop Scenario	Bird Type	Maximum Application		
		Rate (lbs ai/A)	Exposed EEC (mg ai/ft^2)	RQ (LD50/sq ft)
Cotton Banded/Sidedress 2" band width 40" row spacing 15% unincorporated	Small Bird (20g)	2.1	65.6	**6317**
	Medium Bird (80g)	2.1	65.6	**992**
	Large Bird (1000g)	2.1	65.6	**70**
Peanuts Banded/Sidedress 4" band width 36" row spacing 15% unincorporated	Small Bird (20g)	1.05	14.76	**421**
	Medium Bird (80g)	1.05	14.76	**233**
	Large Bird (1000g)	1.05	14.76	**16**
Sugar Beets Banded 4" band width 22" row spacing 15% unincorporated	Small Bird (20g)	2.1	18.04	**1737**
	Medium Bird (80g)	2.1	18.04	**273**
	Large Bird (1000g)	2.1	18.04	**19**

Based on unadjusted Mallard Duck LD_{50} of 1.0 mg/kg[1]
Bold type indicates exceedance of both listed and non-listed LOCs

Table 5.3. Mammalian acute risk quotients for aldicarb (maximum use rates).

Crop Scenario	Mammal Size	Maximum Application		
		Rate (lbs ai/A)	Exposed EEC (mg ai/ft^2)	RQ (LD_{50}/sq ft)
Cotton Banded/Side dress 2" band width 40" row spacing 15% unincorporated	15g	2.1	65.6	**2211**
	35g	2.1	65.6	**1171**
	2300g fox	2.1	65.6	**51**
Peanuts Banded/Side dress 4" band width 36" row spacing 15% unincorporated	15g	1.05	14.76	**497**
	35g	1.05	14.76	**264**
	2300g fox	1.05	14.76	**11**
Sugar Beets Banded 6" band width 22" row spacing 15% unincorporated	15g	2.1	18.04	**608**
	35g	2.1	18.04	**322**
	2300g Fox	2.1	18.04	**14**

Based on Rat LD_{50} of 0.9 mg/kg.
Bold type indicates exceedance of both listed and non-listed LOCs

Risk quotients for birds and mammals all exceed the acute risk levels of concern by up to four orders of magnitude for small animals. Birds and mammals that serve as prey of the SJKF can be killed through ingestion of aldicarb granules.

5.1.2. SJKF Drinking Water Risk Assessment

In order to estimate the risk posed to SJKF in drinking water from puddles on treated fields, the acute dietary toxicity must be adjusted to account for the differences in the weight of the test organism, the laboratory rat and the SJKF. This can be done using an allometric equation developed by USEPA (1995) which is the same allometric adjustment used in the standard model for evaluating risks to terrestrial wildlife to pesticides, T-REX. The typical weight of the laboratory rat is 350 g while the typical weight of the San Joaquin kit fox is 2300 g (Morrell, 1972). The acute dietary toxicity for the rat is 0.9 $mg \cdot kg^{-1}$. The allometric equation is:

$$adj.\, LD_{50} = LD_{50}\left(\frac{TW}{AW}\right)^{.25}$$

Where

Adj. LD_{50}: the LD_{50} for the species to be assessed
LD_{50}: the LD_{50} for the test species, the laboratory rat
TW: the weight of the test species
AW: the weight of the assessed species

The resulting adjusted toxicity is 0.56 $mg \cdot kg^{-1}$. RQs based on the doses presented in **Table 3.2** are provided in **Table 5.4**. Levels of concern for endangered species are exceeded for both peanuts and sugar beets. The sugar beet LOC also exceeds the non-listed LOC.

Table 5.4. Estimated risk to the San Joaquin kit fox from drinking water from puddles in treated fields.

Crop	Dose ($mg \cdot kg^{-1}$)	LD_{50} ($mg \cdot kg^{-1}$)	Acute Risk Quotient
peanuts	0.069	0.56	**0.12**[1]
sugar beets	0.396	0.56	**0.71**[2]

1 exceeds listed species LOCs
2 exceeds of both listed and non-listed species LOCs

5.1.3. SJKF Risk Assessment for Consumption of Exposed Prey

As above, RQs can be calculated for the SJKF through ingestion prey which have consumed aldicarb. The dietary exposure values for the consumption of exposed mammals and bird are in Section 3.2.1.c. In order to estimate the risk posed to San Joaquin kit foxes from exposed prey, the acute dietary toxicity must be adjusted to account for the differences in the weight of the test organism, the laboratory rat and the San Joaquin kit fox as in Section 5.1.2 above. The resulting risk quotients are in **Table 5.5**. The LOC for listed species of 0.1 is exceeded for both mammalian and avian prey items for the SJKF.

Table 5.5. Estimated risk to the San Joaquin kit fox from ingestion of exposed prey

Prey Item	Dose ($mg \cdot kg^{-1}$)	LD_{50} ($mg \cdot kg^{-1}$)	Acute Risk Quotient
mammal	0.078	0.56	**0.14**[1]
bird	0.087	0.56	**0.15**[1]

1 exceeds listed species LOCs

5.1.4. Risk Estimation for the VELB

As noted in exposure assessment for the VELB (Section 3.3), the amount of aldicarb which is expected to available to the beetle is expected to be negligible based on a qualitative exposure assessment. Therefore risks above the level of concern are not expected for the VELB.

The VELB could also be impacted if the beetle's host plant, the elderberry bush, was impacted by aldicarb. As noted in the Incidents Database Review (Section 4.3), aldicarb can possibly cause incidents on the treated crops and effects were seen in both dicots and monocots in Tier 1 seedling emergence studies at application rates that exceed the current application rates to crops. However, using similar logic to that for the direct exposure to the VELB, exposure to the elderberry bush should be considerably below levels which would impact the plant, so secondary effects on the VELB through effects on the host species is not expected.

5.1.5. Use of Probit Slope Response Relationship to Provide Information on the Endangered Species Levels of Concern

The Agency uses the probit dose response relationship as a tool for providing additional information on the potential for acute direct effects to individual listed species and aquatic animals that may indirectly affect the listed species of concern (USEPA, 2004). As part of the risk characterization, an interpretation of acute RQs for listed species is discussed. This interpretation is presented in terms of the chance of an individual event (*i.e.*, mortality or immobilization) should exposure at the EEC actually occur for a species with sensitivity to aldicarb on par with the acute toxicity endpoint selected for RQ calculation. To accomplish this interpretation, the Agency uses the slope of the dose response relationship available from the toxicity study used to establish the acute toxicity measures of effect for each taxonomic group that is relevant to this assessment. The individual effects probability associated with the acute RQ is based on the mean estimate of the slope and an assumption of a probit dose response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available. If no dose response information is available to estimate a slope for this analysis, a default slope assumption of 4.5 (with lower and upper bounds of 2 to 9) (Urban and Cook, 1986) is used.

Individual effect probabilities are calculated based on an Excel spreadsheet tool IECv1.1 (Individual Effect Chance Model Version 1.1) developed by the U.S. EPA (OPP, Environmental Fate and Effects Division, June 22, 2004). The spreadsheet performs these calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. The desired threshold for the probability of an individual effect is entered as the listed species LOC.

Birds

Analysis of raw data from the mallard duck acute toxicity study (MRID 107398) provides a slope of 8.49 (95% C.I. 3.73 - 13.26). Based on this slope and the endangered species avian acute LOC of 0.1, the corresponding estimate chance of individual mortality of avian species following aldicarb application is 1 in 10,000,000,000. To explore possible bounds to such estimates, the upper and lower values for the mean slope estimate (3.73 - 13.26) can be used to calculate upper and lower estimates of the effects probability associated with the listed species LOC. These values are 1 in 10,400 and 1 in $1x10^{16}$. An assessment at the risk quotient is not available because risk to birds for granules is based on an LD_{50}/sq ft assessment.

Mammals

Raw data are not provided in the rat acute LD_{50} study (MRID 00057333) to calculate a slope. Therefore, the event probability was calculated for mammalian LOC based on a default slope of 4.5 (with a range from 2 - 9). Based on an assumption of a probit dose response relationship with a mean estimated slope of 4.5, the corresponding estimated chance of individual mortality associated with the mammalian listed species LOC of 0.1 is 1 in 294,000. The estimated chance of individual mortality associated with drinking water in sugar beet field which has an RQ of 0.71 is 1 in 3.97, indicating there is a significant risk of mortality. To explore possible bounds to such estimates, the upper and lower values for the mean slope estimate can be used to calculate upper and lower estimates of the effects probability associated with the listed species LOC. However, since slope is based on a default assumption of 4.5, the 95 percent confidence intervals for the slopes are unavailable.

5.1.1 Primary Constituent Elements of Designated Critical Habitat

The assessment endpoints for designated critical habitat PCEs involve the same endpoints as those being assessed relative to the potential for direct and indirect effects to the listed species assessed here. Therefore, the effects determinations for direct and indirect effects are used as the basis of the effects determination for potential modification to designated critical habitat.

5.2 Risk Description

The risk description synthesizes overall conclusions regarding the likelihood of adverse impacts leading to a preliminary effects determination (*i.e.*, "no effect," "may affect, but not likely to adversely affect," or "likely to adversely affect") for the assessed species and the potential for modification of their designated critical habitat based on analysis of risk quotients and a comparison to the Level of Concern. The final No Effect/May Affect determination is made after the spatial analysis is completed at the end of the risk description in **Section 5.2.3**. In **Section 5.2.3**, a discussion of any potential overlap between areas where potential usage may result in LAA effects and areas where species are expected to occur (including any designated critical habitat) is presented. If there is no overlap of the species habitat and occurrence sections with the Potential Area of LAA Effects a No Effect determination is made.

Table 5.6 Risk Estimation Summary for Aldicarb - Direct and Indirect Effects

Taxa	LOC Exceedances (Yes/No)	Description of Results of Risk Estimation	Assessed Species Potentially Affected
Birds, Reptiles, and Terrestrial-Phase Amphibians	Non-listed Species	LOC exceeded	Indirect Effects: SJKF
Mammals	Non-listed Species (Yes)	LOC exceeded	Indirect Effects: SJKF
	Listed Species (Yes)	LOC exceeded	Direct Effects: SJKF
Terrestrial Insects	No	LOC not exceeded	None
Plants	No	LOC not exceeded	None

Following a preliminary "may affect" determination, additional information is considered to refine the potential for exposure at the predicted levels based on the life history characteristics (*i.e.*, habitat range, feeding preferences, *etc*.) of the assessed species. Based on the best available information, the Agency uses the refined evaluation to distinguish those actions that "may affect, but are not likely to adversely affect" from those actions that are "likely to adversely affect" the assessed species and its designated critical habitat.

The criteria used to make determinations that the effects of an action are "not likely to adversely affect" the assessed species or modify its designated critical habitat include the following:

- Significance of Effect: Insignificant effects are those that cannot be meaningfully measured, detected, or evaluated in the context of a level of effect where "take" occurs for even a single individual. "Take" in this context means to harass or harm, defined as the following:
    - Harm includes significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering.
    - Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.
- Likelihood of the Effect Occurring: Discountable effects are those that are extremely unlikely to occur.
- Adverse Nature of Effect: Effects that are wholly beneficial without any adverse effects are not considered adverse.

A description of the risk and effects determination for each of the established assessment endpoints for the assessed species and their designated critical habitat is provided in the following sections. Each section will start with a discussion of the potential for direct effects, followed by a discussion of the potential for indirect effects. These discussions do not consider the spatial analysis. For those listed species that have designated critical habitat, the section will end with a discussion on the potential for modification to the critical habitat from the use of aldicarb. Finally a discussion of any potential overlap between areas of concern and the species

(including any designated critical habitat) is presented. If there is no overlap of the species habitat and occurrence sections with the Potential Area of LAA Effects a No Effect determination is made.

5.2.1 San Joaquin Kit Fox

5.2.1.1 Direct Effects

Direct effects to SJKF are assessed based on exposure via its consumption of drinking water and prey items contaminated with aldicarb. Results from the current assessment suggest that consumption of aldicarb contaminated prey and/or water may adversely affect the SJKF. Acute RQs for mammals were exceeded for potential direct effects to the SJKF. Secondary acute RQs for the SJKF were also exceeded by consuming prey that has eaten granules. Based on the weight-of-evidence, there is a potential for direct effects to SJKF. The effects determination is LAA for this species for direct effects potential.

5.2.1.2 Indirect Effects

5.2.1.2.1 Potential Loss of Prey

Indirect effects to SJKF are assessed based on potential reduction of prey species. For indirect effects, aldicarb is likely to indirectly affect the SJKF. The acute risk LOCs for listed terrestrial prey taxa (*i.e*., birds and mammals) were exceeded. Many mortality incidents for mammals and birds have been reported (although most were reported as intentional misuse of aldicarb). Small mammals and birds are important prey items for the SJKF. Loss of prey density can decrease reproductive success in the SJKF (Cypher *et al*., 2000). Birds and mammals may utilize fields that have been treated with aldicarb and therefore may be exposed. Birds are well known to be in fields during planting. This may be due to the invertebrates and seeds brought to the surface by tillage. Also, birds and mammals foraging for seeds, insects, and annelids (*e.g*., earthworms) may be unable to avoid ingesting granular aldicarb. Birds may also ingest granules in treated areas when foraging for grit.

5.2.1.3 Spatial Extent of Potential Effects

LAA determinations have been made for the SJKF. Aldicarb can be used in agricultural areas. Therefore, the spatial extent of potential effects could be substantial, depending on where the chemical is actually applied and the crops it is applied to occur. Maps showing the overlap of) SJKF occurrence (**Figure 5.2**) with cultivated land have been developed to show where there is potential for agriculture including the crops on which aldicarb can be applied, cotton, sugar beets, and peanuts to co-occur with the SJKF habitats.

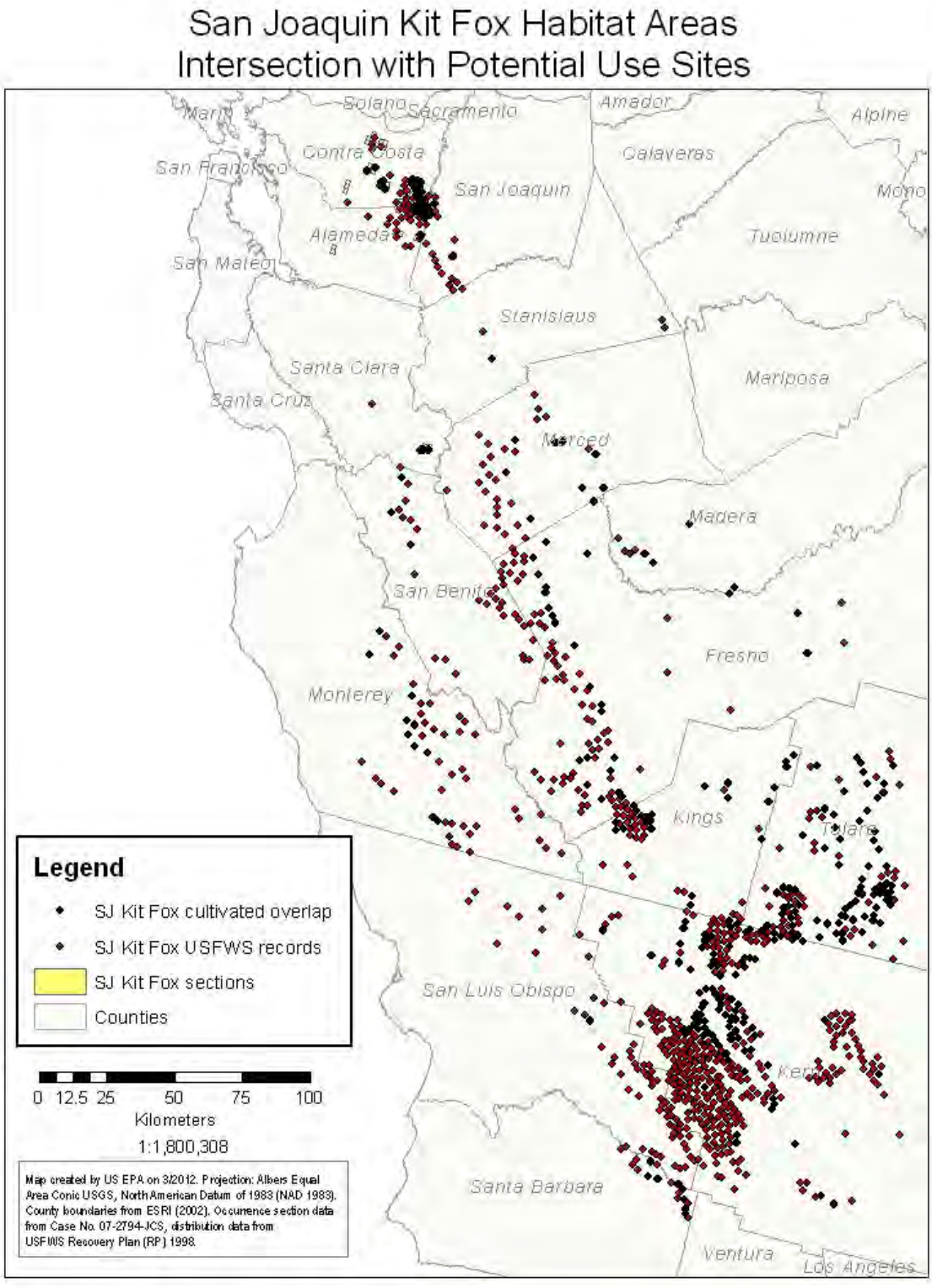

Figure 5.1. Intersection of sections with San Joaquin Kit Fox occurrence and cultivated land.

5.2.2 Valley Elderberry Longhorn Beetle

The effects determination for the VELB is "May Affect, Not Likely To Adversely Affect" for direct effects because the limited exposure that is expected to occur to the elderberry tree and animals that reside on the elderberry tree. Factors considered for this conclusion include: (1) limited to no spray drift due to granular formulation; and (2) the small amount of aldicarb expected to be available for uptake to the elderberry tree due to incorporation of granules at planting and the resulting limited amount of aldicarb that could be taken up into the tree due to infiltration of runoff into the root zone of the tree.

Valley elderberry longhorn beetles spend most of their lifetime living in the trunk and branches of the elderberry tree. Collinge *et al*. (2001) found that it is rare for valley elderberry longhorn beetles to colonize new sites, even if occupied sites occur within the same drainage, and that they probably never colonize new sites if the nearest occupied sites are in different drainages. This pattern implies that even when an individual VELB disperses from its host plant to colonize new habitat, it only travels along the riparian corridor within its home drainage. Most remaining elderberry habitat and riparian vegetation exist in small isolated patches; the distance between VELB populations and unoccupied VELB habitat limits the species' ability to successfully colonize new sites. Dispersal may be limited by the fact that adults are short-lived and must remain close to elderberry plants for food and to lay eggs (Halstead and Oldham, 1990; Collinge *et al*. 2001). Any activity that damages the host elderberry plant could result in VELB mortality. The majority of a valley elderberry longhorn beetle's life span is spent within the stem of the host plant (Collinge *et al*. 2001). Exposure can only occur through the uptake of aldicarb through the roots. Based on these factors, potential effects to the elderberry beetle are considered to be discountable.

A January 6, 1999 memorandum from Acting Field Supervisor Michael Thabault to the Regional Section 7 Coordinator stated that registered uses of acephate, bendiocarb, chlorpyrifos, fenthion, naled, permethrin, and S-fenvalerate (also called esfenvalerate) would jeopardize VELB, and that all these except chlorpyrifos and S-fenvalerate were likely to adversely modify designated critical habitat of the VELB (file 1-1-99-I-464). Aldicarb was judged to adversely affect the species but not cause jeopardy or adversely modify critical habitat (Talley *et al*., 2006).

Lastly, USFWS (on 8/11/11 in the Federal Register) announced a 90-day finding that delisting the VELB. They are initiating a status review of the species to determine if delisting is warranted[4].

5.2.1.3 Spatial Extent of Potential Effects

NLAA determinations have been made for the SJKF. Aldicarb can be used in agricultural areas. Therefore, the spatial extent of potential effects could be substantial, depending on where the chemical is actually applied and the crops it is applied to occur. Maps showing the overlap of) VELB occurrence (**Figure 5.2**) with cultivated land have been developed to show where there is potential for agriculture including the crops on which aldicarb can be applied, cotton, sugar beets, and peanuts to co-occur with the SJKF habitats.

[4] http://www.endangeredspecieslawandpolicy.com/uploads/file/90%20day%20VELB.pdf

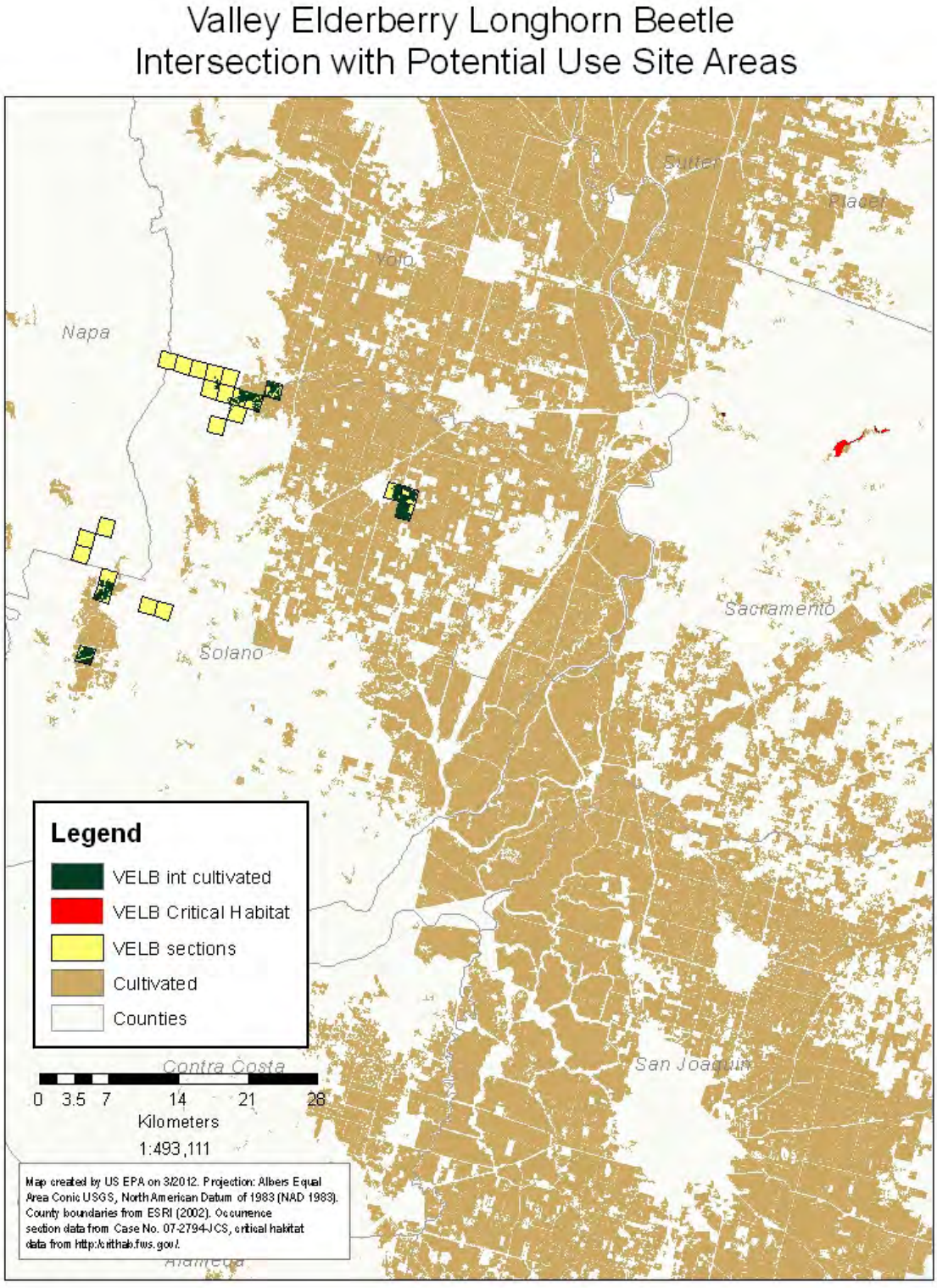

Figure 5.2. Intersection of Valley Elderberry Longhorn Beetle habitat and cultivated land.

5.2.2.1 Modification of Designated Critical Habitat

Critical habitat has been designated for the VELB. Based on the weight-of-evidence, there is a low potential for the modification of designated critical habitat. If direct and/or indirect effects are expected, then modification to critical habitat may occur. As described in the exposure assessment for the VELB, aldicarb uses do not cause drift and because all aldicarb uses in California are incorporated which limits the amount that is extracted into runoff, and only a small portion of runoff could potentially infiltrate into the root zone of the elderberry plant, exposure to VELBs habited in very small. Given the limited potential for aldicarb to move off of a treated field, designated critical habitat is not expected to be impacted.

5.2.3 Effects Determinations

5.2.3.1 Assessed Species

LOCs were exceeded for the SJKF for direct (consumption of contaminated prey and/or water) and indirect effects (prey reductions primarily from reductions in mammals and birds). Therefore, the Agency makes a "may affect, and likely to adversely affect" determination for the SJKF based on the potential for direct and indirect effects. The effects determination for the VELB is "not likely to adversely affect" for direct effects and there is not expected to be modification of critical habitat due to the limited exposure potential as previously discussed.

5.2.3.2 Addressing the Risk Hypotheses

In order to conclude this risk assessment, it is necessary to address the risk hypotheses. Based on the conclusions of this assessment, for the SJKF none of the hypotheses can be rejected, meaning that the stated hypotheses represent concerns in terms of direct and indirect effects of aldicarb on the SJKF. For the VELB, all the risk hypotheses have been rejected because our determination is NLAA and there is no modification of habitat for the species.

The labeled use of aldicarb may:

- indirectly affect the SJKF and/or affect their habitat by reducing or changing the composition of the food supply (mostly small mammals and birds).
- …directly affect the SJKF by direct mortality through ingestion of exposed prey and/or drinking water.

6.0 Uncertainties

6.1 Exposure Assessment Uncertainties

Generic uncertainties which apply across all assessments are described in Attachment 1. Uncertainties which are specific to this assessment are described below.

6.1.1 Terrestrial Exposure Assessment Uncertainties

Uncertainty in the exposure assessment stems mainly from assumptions related to the consumption of granules by various types of animals. Animals were assumed to consume granules. Incidents have shown that individuals have been killed due to aldicarb poisoning, although this was mostly due to misuse of the product through the consumption of treated baits.

A major assumption for all assessments is the fraction of the granules which are not incorporated or otherwise near enough the surface that exposure can occur. With the exception of a foliar use on peanuts that cannot be used in California, both aldicarb end use product labels clearly indicate that granules must be incorporated. However, at least some of the use practices which are used to apply aldicarb do not assure that is buried deeply enough to prevent surface exposure. To the extent that granules are buried at least a centimeter below the surface, exposure from aldicarb for both species in greatly reduced.

The assessment of secondary exposure to the SJKF involves additional uncertainties. A conservative assumption was made that the entire amount of active ingredient consumed by the prey is present in the prey animal when it is consumed by the fox. In reality, the amount of active ingredient in the prey may decrease between the time it consumes the granule and the prey is consumed by the fox as the result of elimination and detoxification. Also, the amount of and rate of assimilation of aldicarb from the consumed prey into the fox is uncertain. Assimilation efficiency may be considerably less than the assumed 100%.

The drinking water assessment assumes that rainfall occurs shortly after application. Rainfall events that occur sometime after application will have reduced risk as aldicarb will dissipate from the application zone by degradation and leaching and the calculation does not consider degradation after the last application. (It does consider degradation between the two applicaition for the sugar beet use.) In most cases, puddles will persist for a few days, and this route of exposure is limited to the length of time that exposure can occur. The assessment also assumes that all the water for one day comes from drinking water when in most cases, drinking water at least in part come from the diet and for the SJKF, may come completely from the diet on some occasions.

Lastly, chronic risk is an uncertainty to the SJKF in part because sublethal adverse effects to reproduction are not known. It is assumed that ingestion of aldicarb would induce mortality where reproduction would not be an issue. However, non-lethal effects to reproduction in these species are unknown. The female kit fox is rarely seen hunting during the time she is lactating. During this period, the male provides most of the food for her and the pups. In this case, the female may be killed if the prey brought by the male had ingested prey containing aldicarb. In addition, aldicarb may be excreted in mammalian milk, thus exposing whelping young. Aldicarb is readily absorbed through both the gut and the skin, but is rapidly metabolized and excreted in the urine almost completely within 24 hrs. However, in desert species such as the SJKF, conservation of metabolic water is important and excretion may be slowed. Williams *et al* 2004 found species of desert and mesic foxes showed no significant differences in basal metabolic rates (BMR), nor did desert foxes have a significantly lower BMR than other carnivores. However, the total evaporative water loss (TEWL) of desert foxes was lower than other more mesic carnivores. Although desert foxes have a BMR comparable to other more mesic species, it appears that desert foxes do have a smaller body mass, lowering overall energy requirements.

Overall, the reported incidents data includes mortalities of foxes, domestic dogs, coyotes and a gray wolf. However, these mortality events were mostly from misuse of aldicarb. They do however, suggest that aldicarb in the environment is capable of causing direct mortality in the SJKF.

Uncertainties Associated with the LD_{50}/sq. ft. Index

Risk quotients based on the LD_{50}/sq.ft. hazard index have been criticized as being too conservative and overestimating "real world" risk. It has been argued that the method greatly oversimplifies the exposure component to hazard assessment by not specifically addressing the temporal and spatial situations that non-target wildlife species experience under field conditions. Although this is somewhat correct, there are still many other exposure related and toxicological factors that are not accounted for by the index which may actually underestimate risk from this method.

For example, the LD_{50}/sq.ft. index is based solely on acute mortality as derived from acute oral exposure from laboratory tests. It does not address subacute behavioral or physiological effects that may occur prior to mortality and yet can still have a profound sub-lethal effect on an organism's ability to survive and reproduce. As such, this index may underestimate ecological hazard from sub-lethal exposures. For instance, it is common in clinical observations, conducted during acute tests, to observe such symptoms as wing droop, goose-stepping ataxia, dyspnea (labored breathing), diarrhea, apnea, weight loss, salivation, convulsions and hyperactivity prior to mortality occurring. Even if an organism survives this exposure to the toxicant, these symptoms indicate the organism is under extreme stress that could greatly affect both its survival (susceptibility to disease and parasites, ability to avoid predation, nest desertion and abandonment) and ability to reproduce under actual field conditions. Necropsy data also indicate that many organisms are experiencing extreme physiological changes even though they may not die from exposure to the toxicant. Liver damage, renal failure, lesions, hemorrhage and other tissue damage are indications of severe physiological impairment that could adversely affect both the survival and reproductive capability of the organisms. These sub-lethal effects are not really addressed by the LD_{50}/sq. ft. index. Basing ecological hazard assessments solely on direct effects, as determined by acute indices, may be under protective for predicting indirect effects from sub-lethal exposures.

The systemic nature of aldicarb, especially the major degradates which are also highly toxic to non-target wildlife, is another exposure factor that is not accounted for by the LD_{50}/sq.ft. hazard index. For instance, to be efficacious, aldicarb must translocate via the root system to those portions of the plant that are likely to be attacked by the pest species. Non-target organisms feeding on these plant parts (and/or other non-crop plant species that have been exposed to treatment) are now exposed to subacute dietary concentrations of the pesticide, as well as acute exposure from feeding directly on the granules. Whether or not this will result in an increase in total body burden residues is unknown but it definitely increases the routes of exposure.

Although it is presumed that the LD_{50}/sq.ft. index accounts for acute exposure from oral, dermal and inhalation exposure, it was not intended to address exposure from drinking water where runoff, from either rain events or irrigation, to low areas may create puddles that contain very high concentrations of the pesticide. The contribution of this route of exposure to overall body

burden residues is unknown but it will clearly be additive to exposure from direct consumption of the granules, ingestion of exposed prey and/or exposure from eating contaminated vegetation.

6.1.2 Aquatic Exposure Modeling of Aldicarb

Aquatic routes of exposure are not predicted to make significant contributions to the total exposure of the SJKF or VELB and thus were not modeled.

6.2 Effects Assessment Uncertainties

6.2.1 Data Gaps and Uncertainties

Toxicity data are lacking on the effects of aldicarb on terrestrial plants. In the study submitted, the most sensitive monocot species was ryegrass, with a 12 and 44% difference in shoot length and weight, respectively, compared to the control. The most sensitive dicot species was tomato, with a 28 and 25% difference in shoot length and weight, respectively, compared to the control. Phytotoxic effects, including stunting and necrosis, were observed in ryegrass and tomatoes. Based on the observance of >25% effects in ryegrass and tomato, a tier II study with these two species is necessary to fulfill the guideline requirement for 850.4100. While, toxicity data for terrestrial plants are needed for a quantitative assessment of risk to plants, under the parameters of the current assessment, risk to elderberry trees for possible indirect effects to the VELB were found to be discountable based on minimal exposure in the absence of this data. Other uncertainties that should be noted are lack of terrestrial invertebrate data especially given that aldicarb is an insecticide and systemic and lack of chronic avian reproduction data.

6.2.2 Use of Surrogate Species Effects Data

Efforts are made to select the organisms most likely to be affected by the type of compound and usage pattern; however, there is an inherent uncertainty in extrapolating across phyla. In addition, the Agency's LOCs are intentionally set very low, and conservative estimates are made in the screening level risk assessment to account for these uncertainties.

6.2.3 Sublethal Effects

When assessing acute risk, the screening risk assessment relies on the acute mortality endpoint as well as a suite of sublethal responses to the pesticide, as determined by the testing of species response to chronic exposure conditions and subsequent chronic risk assessment. Consideration of additional sublethal data in the effects determination is exercised on a case-by-case basis and only after careful consideration of the nature of the sublethal effect measured and the extent and quality of available data to support establishing a plausible relationship between the measure of effect (sublethal endpoint) and the assessment endpoints. However, the full suite of sublethal effects from valid open literature studies is considered for the characterization purposes.

6.2.3 Exposure Uncertainties

There are no significant fate and transport data affecting this assessment which are not available.

7.0 Risk Conclusions

In fulfilling its obligations under Section 7(a)(2) of the Endangered Species Act, the information presented in this endangered species risk assessment represents the best data currently available to assess the potential risks of Aldicarb to the SJKF and the VELB and its designated critical habitat.

Based on the best available information, the Agency makes a Likely to Adversely Affect determination for the SJKF. Based on the best available information, the Agency makes a *May Affect* but *Not likely to Adversely Affect* (NLAA) determination for the VELB. Given the LAA determination for the SJKF, a description of the baseline status and cumulative effects is provided in Attachment III.

A summary of the risk conclusions and effects determinations for the species assessed and their critical habitat, given the uncertainties discussed in Section 6.0 and Attachment I, is presented in Table 7-1 and 7-2.

Table 7.1. Effects determination summary for effects of aldicarb on the VELB and SJKF.

Species	Effects Determination	Basis for Determination
Valley Elderberry Longhorn Beetle	*May Affect* but *Not likely to Adversely Affect* (NLAA)	**Potential for Direct Effects**
		Elderberry beetles reside solely in elderberry trees and are not expected to be directly exposed to aldicarb. Aldicarb is applied as a granule; therefore, spray drift is assumed to be negligible. It is possible that elderberry trees could uptake aldicarb that is present in runoff if the chemical is applied up-gradient from an elderberry tree resulting in possible exposure to the beetle. However, this exposure potential is assumed to be discountable given that aldicarb is incorporated at planting, only small amounts are available for transport by runoff, of this only a small portion will infiltrate into the root zone of the elderberry bush and only a fraction of this will be taken up by the roots and allow exposure to the VELB living within the plant.
		Potential for Indirect Effects
		Terrestrial prey items The limited exposure indicates use of Aldicarb will likely not reduce the abundance of food. Because the VELB directly feeds on only the Elderberry bush, and risk concerns for the elderberry bush are below concern levels, it is unlikely that the bush would be affected through use of granular incorporated aldicarb. ***Habitat Modifications*** The lack of exposure indicates use of aldicarb will likely not adversely modify the habitat of this species by reducing the availability of food or habitat. Because the VELB directly feeds on only the Elderberry bush and low risk is assumed, it is unlikely that the bush would be affected through use of granular incorporated aldicarb.

Species	Effects Determination	Basis for Determination
San Joaquin Kit Fox (*Vulpes macrotis mutica*)	*May Affect* and *Likely to Adversely Affect* (LAA)	**Potential for Direct Effects** The risk assessment indicates use of aldicarb may result in direct effects to the SJKF from acute toxicity through ingestion of drinking water. Dietary exposure estimates and data on acute toxicity to small mammals results in acute RQs that exceed the LOC for primary exposure. Secondary exposure may also occur from consumption of contaminated prey animals.
		Potential for Indirect Effects ***Terrestrial prey items*** The use of aldicarb has the potential to reduce the abundance of food. As little as one granule can kill a small bird or mammal, which are primary food items of the SJKF. ***Habitat Modifications*** The risk assessment indicates use of Aldicarb may adversely modify the habitat of this species by reducing the availability of prey items. This conclusion is based on acute risks for birds and mammals.

Table 7.2. Effects determination summary for the critical habitat impact analysis.

Designated Critical Habitat for:	Effects Determination	Basis for Determination
VELB	NLAA: Direct Effects	Aldicarb is applied as a granule; therefore, spray drift is assumed to be negligible. It is possible that elderberry trees could uptake aldicarb that is present in runoff if the chemical is applied up-gradient from an elderberry tree resulting in possible exposure to the beetle. However, this exposure potential is assumed to be discountable given that aldicarb is incorporated at planting, only small amounts are available for transport by runoff, of this only a small portion will infiltrate into the root zone of the elderberry bush and only a fraction of this will be taken up by the roots and allow exposure to the VELB living within the plant.
VELB	NLAA Indirect Effects	Aldicarb is applied as a granule; therefore, spray drift is assumed to be negligible. It is possible that elderberry trees could uptake aldicarb that is present in runoff if the chemical is applied up-gradient from an elderberry tree resulting in possible exposure to the beetle. However, this exposure potential is assumed to be discountable given that aldicarb is incorporated at planting, only small amounts are available for transport by runoff, of this only a small portion will infiltrate into the root zone of the elderberry bush and only a fraction of this will be taken up by the roots. This small amount is unlikely to impact the elderberry tree.

Based on the conclusions of this assessment, a formal consultation with the U. S. Fish and Wildlife Service under Section 7 of the Endangered Species Act should be initiated.

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the listed species and its resources (*i.e.*, food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (*i.e.*, attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of

application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available.

Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of life stages within the action area and/or applicable designated critical habitat. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the assessed species.
- Quantitative information on prey base requirements for the assessed species. While existing information provides a preliminary picture of the types of food sources utilized by the assessed species, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.
- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual species and potential modification to critical habitat.

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