**CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY**

# California Regional Water Quality Control Board
# Central Coast Region

# Total Maximum Daily Loads for Chlorpyrifos in San Antonio Creek Watershed in Santa Barbara County, California

## Final Project Report

***Prepared March 26, 2012***
***For the May 3, 2012 Water Board Meeting***

Adopted by the
California Regional Water Quality Control Board
Central Coast Region
on May 3, 2012

Approved by the
United States Environmental Protection Agency
on June 4, 2012

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http://www.waterboards.ca.gov/centralcoast/TMDL/303dandTMDLprojects.htm

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| CDPR | California Department of Pesticide Regulation |
| CDFG | California Department of Fish and Game |
| CCAMP | Central Coast Ambient Monitoring Program |
| CMP | Cooperative Monitoring Program |
| GC/MS | Gas Chromatography/Mass Spectrometry |
| CCAMP | Central Coast Ambient Monitoring Program |
| CCC | Criterion Continuous Concentration |
| CMC | Criterion Maximum Concentration |
| ELISA | Enzyme-linked immunosorbant assays |
| GIS | Geographic Information System |
| MAA | Management Agency Agreement |
| NPDES | National Pollutant Discharge Elimination System |
| OP | Organophosphate |
| PUR | Pesticide Use Report |
| TIEs | Toxicity Identification Evaluations |
| TMDL | Total Maximum Daily Load |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geologic Survey |
| Water Board | Regional Water Quality Control Board, Central Coast Region |
| WDR | Waste Discharge Requirements |

# EXECUTIVE SUMMARY

The following Chlorpyrifos Total Maximum Daily Load (TMDL) Report (TMDL Report) evaluates chlorpyrifos loading to San Antonio Creek in Santa Barbara County.

**Total Maximum Daily Load**

This TMDL Report presents a TMDL for chlorpyrifos in the San Antonio Creek Watershed. TMDL is a term used to describe the maximum amount of pollutants, in this case, chlorpyrifos, that a waterbody can receive and still meet water quality standards. A TMDL study identifies the probable sources of pollution, establishes the maximum amount of pollution a waterbody can receive and still meet water quality standards, and allocates that amount to all probable contributing sources. By "allocating" an amount to a contributing source, we are assigning responsibility to someone, an agency, group, or individuals, to reduce their contribution in order to meet water quality standards.

The federal Clean Water Act requires every state to evaluate its waterbodies and maintain a list of waters that are considered "impaired" either because the water exceeds water quality standards or does not achieve its designated use. For each waterbody on the Central Coast's 303(d) Impaired Waters List, the Central Coast Regional Water Quality Control Board (Central Coast Water Board) must develop and implement a plan to reduce pollutants so that the waterbody is no longer impaired and can be de-listed.

San Antonio Creek was listed as impaired on the 2008-2010 303(d) list because two out of seven samples exceeded the of water quality standards for chlorpyrifos.

Chlorpyrifos is a man-made organophosphate (OP) pesticide used almost exclusively for the control of agricultural pests.

**Impaired Waterbody**

The geographic scope of this project includes the San Antonio Creek Watershed, which encompasses approximately 153 square miles in Santa Barbara County.

The watershed is primarily composed of forest/grassland/shrubs (78%), cropland (11%), and developed open space (6%).

**Numeric Targets and Allocations**

Numeric targets are water quality targets developed to ascertain when and where water quality objectives are achieved, and hence, when beneficial uses are protected. The numeric targets for these TMDLs are identical to numeric water quality criteria that were derived by the California Department of Fish and Game and the Central Valley Regional Water Quality Control Board for chlorpyrifos, which were subsequently approved by U.S. EPA. Numeric targets for the TMDLs include acute and chronic water column numeric targets for chlorpyrifos.

Discharges of chlorpyrifos from irrigated agriculture caused exceedance of the water quality objectives for toxicity and pesticides. Owners and operators of irrigated lands are assigned allocations for chlorpyrifos to achieve the TMDL. Responsible parties are assigned allocations for chlorpyrifos equal to the numeric targets as represented in the table below.

These TMDLs are concentration-based TMDLs equal to the numeric targets.

The table below identifies the allocations assigned to responsible parties and the affected waterbodies.

**LOAD ALLOCATIONS**

| Waterbodies Assigned TMDLs | Responsible Party Assigned Allocation (Source) | Receiving Water Allocation |
|---|---|---|
| • San Antonio Creek | Owners/operators of irrigated agricultural lands in the San Antonio Creek Watershed<br><br>(Discharges from irrigated lands) | Allocation-1 |

Allocation 1: For chlorpyrifos

| Compound | CMC [A] (ppb) | CCC [B] (ppb) |
|---|---|---|
| Chlorpyrifos | 0.025 | 0.015 |

[A] CMC – Criterion Maximum Concentration or acute (1- hour average). Not to be exceeded more than once in a three year period

[B] CCC – Criterion Continuous Concentration or chronic (4-day (96-hour) average). Not to be exceeded more than once in a three year period.

**TMDL Implementation, Monitoring, and TMDL Timeline**

Owners and operators of irrigated lands in the project area are required to comply with the conditions and requirements of the *Conditional Waiver of Waste Discharge Requirements For Discharges from Irrigated Lands* (Agricultural Order) and any renewals thereof. Owners and operators are required to comply with the requirements described in this TMDL, Section 6, including:

- Implement proper handling, storage, application, disposal and management of pesticides to prevent or control discharge into surface waters to the extent that the TMDL numeric targets are achieved.
- Develop or update and implement Farm Plans to include specific measures aimed at preventing or controlling the discharge of pesticides into surface waters to the extent that the TMDL numeric targets are achieved.
- Develop and implement a monitoring plan aimed at assessing the effectiveness of management measures in place to prevent or control the discharge of chlorpyrifos into surface waters to the extent that the TMDL numeric targets are achieved. Monitoring efforts can be implemented individually, as a group effort with other interested parties, or a combination thereof. Note that current monitoring efforts, e.g., through the Cooperative Monitoring Program and anticipated monitoring efforts of the Central Coast Ambient Monitoring Program may be used to help demonstrate compliance and progress.

The timeline to achieve this TMDL is by March 2016.

# 1 INTRODUCTION

## 1.1 Clean Water Act Section 303(d)

Section 303(d) of the federal Clean Water Act requires every state to evaluate its waterbodies and maintain a list of waters that are considered "impaired" either because the water exceeds water quality standards or does not achieve its designated use. For each water on the Central Coast's "303(d) Impaired Waters List," the California Central Coast Water Board must develop and implement a plan to reduce pollutants so that the waterbody is no longer impaired and can be de-listed. Section 303(d) of the Clean Water Act states:

*Each State shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 1314(a)(2) of this title as suitable for such calculation. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.*

The State complies with this requirement by periodically assessing the conditions of the rivers, lakes and bays and identifying them as "impaired" if they do not meet water quality standards. These waters, and the pollutant or condition causing the impairment, are placed on the 303(d) List of Impaired Waters. In addition to creating this list of waterbodies not meeting water quality standards, the Clean Water Act mandates each state to develop TMDLs for each waterbody listed. The Central Coast Water Board is the agency responsible for protecting water quality consistent with the Basin Plan, including developing TMDLs for waterbodies identified as not meeting water quality objectives.

## 1.2 Project Area

The geographic scope of this TMDL (the project area) encompasses approximately 153 square miles of the San Antonio Creek Watershed (CalWater hydrologic subarea 31300050) located in Santa Barbara County. The watershed is a westerly trending drainage that extends from southeast of the town of Los Alamos and discharges to the San Antonio lagoon at the Pacific Ocean.

## 1.3 Pollutants Addressed

This project addresses impairments due to chlorpyrifos, which is an organophosphate (OP) pesticide.

## 1.4 FIFRA/FQPA

Since 2001, the USEPA has mandated chlorpyrifos-use cancellations (phase-outs) and restrictions for urban and agricultural uses (USEPA Diazinon and Chlorpyrifos Interim Reregistration Eligibility Decisions (IREDs)). The USEPA has undertaken the reregistration process for chlorpyrifos to ensure that the pesticide meets the safety standards under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Food Quality Protection Act (FQPA) of 1996.

Under the chlorpyrifos IRED (USEPA, 2002), virtually all products labeled for homeowner use have been canceled effective December 31, 2001, except containerized ant and roach baits in child-resistant packaging, which have not been canceled because they present minimal exposure. Distribution and sale of products for all other residential uses were prohibited since December 31, 2001. The application rate for termite treatments was reduced as of December 1, 2000. Full-barrier (wholehouse) termite treatment products are no longer distributed or sold as of December 31, 2001. Spot and local post-construction use was canceled on December 31, 2002, and pre-construction termiticide uses were canceled on December 31, 2005, unless acceptable exposure data are submitted and demonstrate that post application risks to residents are not of concern.

Many additional chlorpyrifos-use restrictions and cancellations apply to agricultural uses. These substantial reductions of chlorpyrifos use are expected to facilitate chlorpyrifos concentration reductions in impaired waters of the San Antonio Creek Watershed.

# 2 PROBLEM IDENTIFICATION

## 2.1 Watershed Description

The geographic scope of this TMDL (the project area) encompasses approximately 153 square miles of the San Antonio Creek Watershed (CalWater hydrologic subarea 31300050) located in Santa Barbara County (please see Figure 1). The watershed is a westerly trending drainage that extends from southeast of the town of Los Alamos and discharges to the San Antonio lagoon at the Pacific Ocean. Elevations within the watershed range from sea level to 1,672 feet at an unnamed (“Joe’s”) peak in the Purisma Hills south of Los Alamos (CRMP 2003). A transverse consolidated rock barrier located near the base boundary forces groundwater to the surface and forms Barka Slough, the largest freshwater wetland in the County (ibid).

Other than public road corridors and Vandenberg Air Force Base, most of the land in the watershed is in private ownership, and except for the community of Los Alamos, is used for some form of agriculture (CRMP 2003). Agriculture, including cropland and grazing lands, is the current dominant land use in the watershed, aside from forest, grassland and shrubs. According to Farmland Mapping and Monitoring Program (FMMP 2008), vineyard, orchard, and vegetable crops are cultivated in the watershed.

Historically, oil mining was the most important non-farm industry; however, it is largely in decline. Most of the valley floor is used to raise annual vegetable crops year-round (CRMP 2003). Traditionally, almost all of the upland areas have been used for grazing beef cattle including the oil mining fields. In recent years, many of the best grazing sites have been converted to wine grape vineyards. All of the irrigated crops use groundwater resources (CRMP 2003). The few urban areas within the watershed include Los Alamos and housing within the Vandenberg Air Force Base. For more details on the land uses in the watershed, please see Table 1.

Table 1. Landcover in the San Antonio Watershed (NLCD 2001).

| Landcover | Percent of the watershed | Area in square miles |
|---|---|---|
| Open Water | 0.1% | 0.1 |
| Developed Open Space | 6.0% | 9.1 |
| Developed, Low Intensity | 0.8% | 1.2 |
| Developed, Medium Intensity | 0.1% | 0.1 |
| Developed, High Intensity | 0.0% | 0.0 |
| Barren Land (Rock/Sand/Clay) | 0.1% | 0.1 |
| Deciduous Forest | 0.0% | 0.0 |
| Evergreen Forest | 8.6% | 13.1 |
| Mixed Forest | 4.1% | 6.3 |
| Shrub/Scrub | 29.5% | 45.1 |
| Grassland/Herbaceous | 35.8% | 54.7 |
| Pasture/Hay | 1.7% | 2.5 |
| Cultivated Crops | 11.3% | 17.3 |
| Woody Wetlands | 1.1% | 1.7 |
| Emergent Herbaceous Wetlands | 0.8% | 1.2 |
| Total | 100% | 152.6 |

Rainfall pattern throughout the project area is uniform with an average annual accumulation of about 15 inches (CRMP 2003). Temperatures are generally mild ranging between $40^{o}$ F and $60^{o}$ F in the winter months and up to the 80s in summer months (CRMP 2003). Extreme temperatures occur periodically with temperatures reaching below freezing in the winter and up to the 100s in the summer.

With regards to the hydrology of the Project Area, there is little or no flow in San Antonio Creek except during the November to April wet season. Downstream of Barka Slough perennial flows are sustained by groundwater forced to the surface at the western end of the slough. Flows do not reach the ocean except during periods of high runoff because of wind-blown sand blocking the creek mouth (CRMP 2003).

Most of the main channel has a well-vegetated riparian corridor dominated by various willow species. The vegetation is very dense and provides stream bank protection from both overland and in stream flows. However, in some reaches it must be cleared periodically because of encroachment within the channel that reduces hydraulic capacity and causes flooding. This clearing is done under a permit granted to the Santa Barbara County Flood Control District and is accordance with CEQA approved

procedures. The adjacent landowners maintain the buffer and little change is expected to occur in the near term future (CRMP 2003).

In general, the tributary streams have intermittent flows throughout most of their drainage; however, some relatively short reaches within certain streams have perennial flows that are sustained by springs during the dry season. The San Antonio Creek mainstem is defined by the USGS as an intermittent stream from its headwaters to Barka Slough, and as a perennial stream from the slough westerly to the ocean. Consolidated sub-surface rocks form a barrier on the west end of the slough. That condition and a narrowing of San Antonio Valley at that point forces groundwater to the surface resulting in the year-round flows. All of the agricultural irrigation systems in this project area are drip or sprinkler systems and there is no runoff into the creeks during the dry season (CRMP 2003).

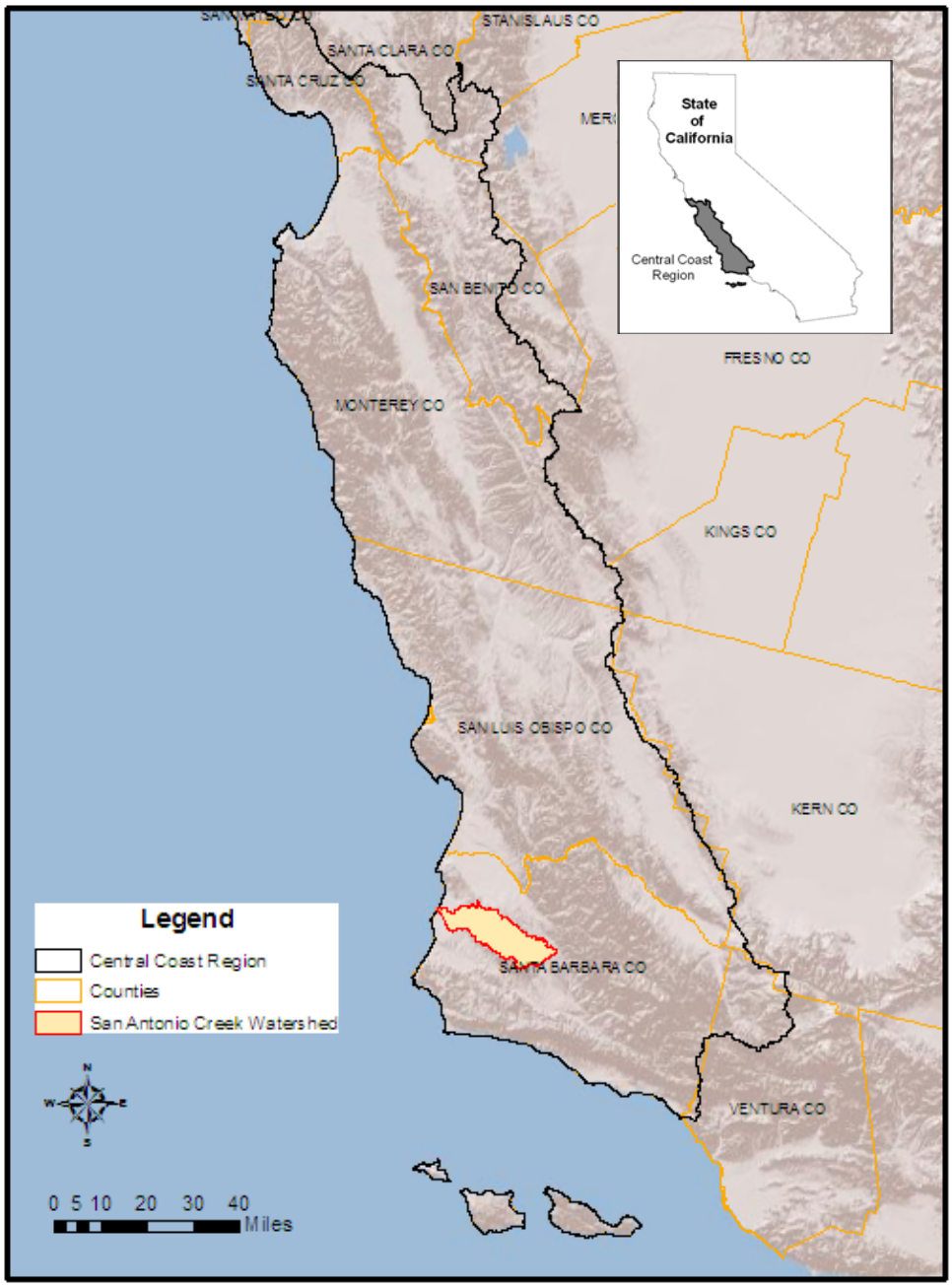


Figure 1. Location of the San Antonio Creek Watershed

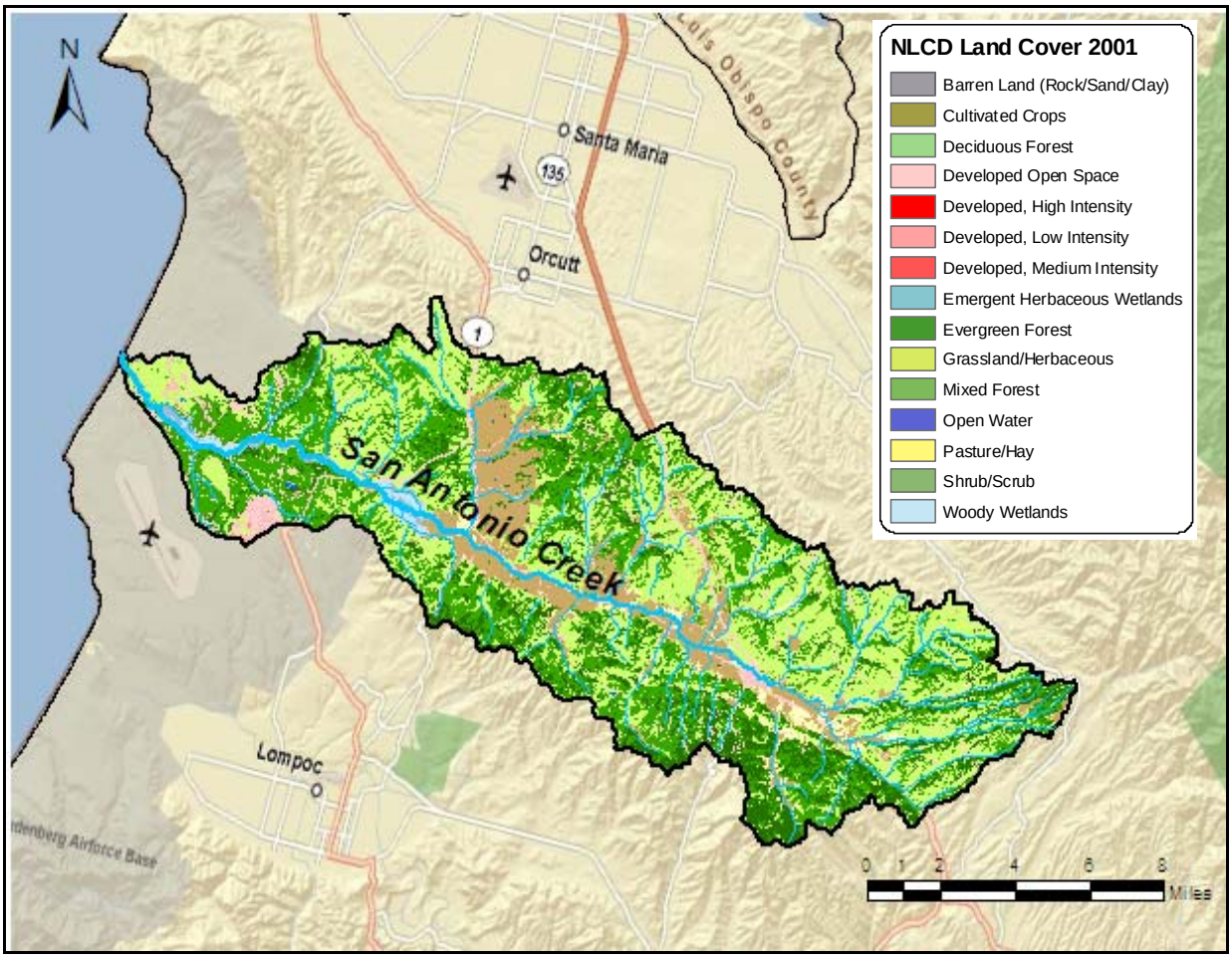

Figure 2. The San Antonio Creek Watershed shown with landcover (NCLD 2001)

## 2.2 Beneficial Uses

The designated beneficial uses identified in the Basin Plan for the San Antonio Creek are shown in Table 2.

Table 2. Basin Plan designated beneficial uses

| Waterbody Names | MUN | AGR | PRO | IND | GWR | REC1 | REC2 | WILD | COLD | WARM | MIGR | SPWN | BIOL | RARE | EST | FRESH | COMM | SHELL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| San Antonio Creek | X | X | | | X | X | X | X | X | X | X | X | | X | | X | X | |

Beneficial uses are regarded as existing whether the water body is perennial or ephemeral, or the flow is intermittent or continuous.

Municipal and Domestic Supply (MUN) - Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply. According to State Board Resolution No. 88-63, "Sources of Drinking Water Policy" all surface waters are considered suitable, or potentially suitable, for municipal or domestic water supply except where:

a. TDS exceeds 3000 mg/l (5000 uS/cm electrical conductivity);
b. Contamination exists, that cannot reasonably be treated for domestic use;
c. The source is not sufficient to supply an average sustained yield of 200 gallons per day;
d. The water is in collection or treatment systems of municipal or industrial wastewaters, process waters, mining wastewaters, or storm water runoff; and
e. The water is in systems for conveying or holding agricultural drainage waters.

Agricultural Supply (AGR) - Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Ground Water Recharge (GWR) - Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers. Ground water recharge includes recharge of surface water underflow.

Water Contact Recreation (REC-1) - Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-Contact Water Recreation (REC-2) - Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

*Wildlife Habitat (WILD) - Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

*Cold Fresh Water Habitat (COLD) - Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.

*Warm Fresh Water Habitat (WARM) - Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

*Migration of Aquatic Organisms (MIGR) - Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

*Spawning, Reproduction, and/or Early Development (SPWN) - Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

*Rare, Threatened, or Endangered Species (RARE) - Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

Freshwater Replenishment (FRESH) - Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity) which includes a water body that supplies water to a different type of water body, such as, streams that supply reservoirs and lakes, or estuaries; or reservoirs and lakes that supply streams. This includes only immediate upstream water bodies and not their tributaries.

Commercial and Sport Fishing (COMM) - Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

* = Aquatic habitat beneficial use.

## 2.3 Water Quality Objectives

The Central Coast Region's Water Quality Control Plan (Basin Plan) contains specific water quality objectives that apply to all inland surface waters, enclosed bays and estuaries (CCRWQCB, 1994, pg. III-4). Relevant water quality objectives for this project include:

### *2.3.1 Toxicity*

*All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, toxicity bioassays of appropriate duration, or other appropriate methods as specified by the Regional Board.*

*Survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality conditions, shall not be less than that for the same water body in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with the requirements for "experimental water" as described in Standard Methods for the Examination of Water and Wastewater, latest edition. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay.*

*In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants*

*will be established as sufficient data become available, and source control of toxic substances is encouraged.*

### *2.3.2 Pesticides*

*No individual pesticide or combination of pesticides shall reach concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.*

### *2.3.3 Prohibitions*

Section IV.B. Inland Waters (V-8) of the Basin Plan states that, "Wastes discharged to surface waters shall be essentially free of toxic substances, grease, oil, and phenolic compounds. Waste discharges to the following inland waters are prohibited:

1. All surface freshwater impoundments and their immediate tributaries.
2. All surface waters within the San Lorenzo River, Aptos-Soquel, and ***San Antonio Creek*** (emphasis added) Subbasins and all water contact recreation areas except where benefits can be realized form direct discharge of reclaimed water.

### *2.3.4 Water Quality Criteria (USEPA recommended)*

In 2000, CDFG published freshwater water quality criteria for chlorpyrifos (CDFG, 2000) using USEPA methodology (USEPA, 1985). Water Board staff used the criterion maximum concentration (CMC) or acute 1-hour average of 0.025 µg/L to compare the water quality standards to. Please see Table 3.

Table 3. USEPA recommended water quality criteria for chlorpyrifos

| Compound | CMC [A] (ppb) | CCC [B] (ppb) |
|---|---|---|
| Chlorpyrifos | 0.025 | 0.015 |

[A] CMC – Criterion Maximum Concentration or acute (1- hour average). Not to be exceeded more than once in a three year period

[B] CCC – Criterion Continuous Concentration or chronic (4-day (96-hour) average). Not to be exceeded more than once in a three year period

## 2.4 Pollutants Addressed

San Antonio Creek was listed on the 2008-2010 303(d) List for chlorpyrifos in accordance with the State Water Resources Control Board Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List, September 2004 (Listing Policy, SWRCB, 2004). Table 3.1 of the Listing Policy specifies the minimum number of measured exceedances needed to place a water segment on the Section 303(d) list for toxicants (SWRCB, 2004, pg. 9). San Antonio Creek exceeded the water quality criteria for chlorpyrifos 2/7 times (see appendix A for water quality data), which met the minimum number of measured exceedances needed to place San Antonio Creek on the 303(d) list.

Staff used the evaluation guideline of 0.025 micrograms per liter (µg/L) for chlorpyrifos (CDFG, 2000; CDFG, 2004) for the development of the 2008-2010 Clean Water Act section 303(d) List. This concentration is protective of aquatic life beneficial uses (see section 2.2. Beneficial Uses for the aquatic life beneficial uses assigned to this waterbody) and other beneficial uses in the watershed.

## 2.5 Data Analysis

This section provides information pertaining to data sources and an analysis of water quality data used to assess water quality conditions and impairment.

To assess water quality conditions and impairment, staff used evaluation guidelines of 0.025 micrograms per liter (µg/L) for chlorpyrifos (CDFG, 2000; CDFG, 2004) to protect aquatic life beneficial uses. The CDFG concentrations are criterion maximum concentrations (CMC) expressed as 1-hour averages (acute); however, because water quality data was only available on a daily interval (e.g., not hourly), staff conducted the impairment assessment by treating the daily instantaneous water quality results as a 1-hour average. In addition to the CMCs, CDFG published criterion continuous concentrations (CCC) for chlorpyrifos (CDFG, 2000; CDFG, 2004), which are expressed as a 4-day average (chronic). Staff was not able to assess chronic toxicity conditions because water quality data for comparison to the 4-day average was not available. Additional information pertaining to numeric targets and their derivation are contained in Section 3.

Staff used the following data for the development of these TMDLs:

- Central Coast Ambient Monitoring Program Sediment Chemistry Data from Region 3 Harbors, 2004
- California Department of Pesticide Regulation's (CDPR) Surface Water Database, Pesticide Use Reports that report pesticide usage

### *2.5.1 Central Coast Ambient Monitoring Program*

The Central Coast Ambient Monitoring Program (CCAMP) conducted a sediment toxicity study between 2001 and 2007 throughout Region 3. As part of that study, CCAMP collected samples from three sites within the San Antonio Creek Watershed.

CCAMP collected seven samples between December 2001 and March 2004 (please see Table 4 and Figure 3). Two out of seven samples exceeded the water quality standard for chlorpyrifos of 0.025 µg/L. The two samples that exceeded were collected March 17, 2002 (site 313SAB) and March 31, 2004 (site 313SAI).

Staff is not aware of any other organophosphate sampling efforts that have occurred in this watershed since March of 2004.

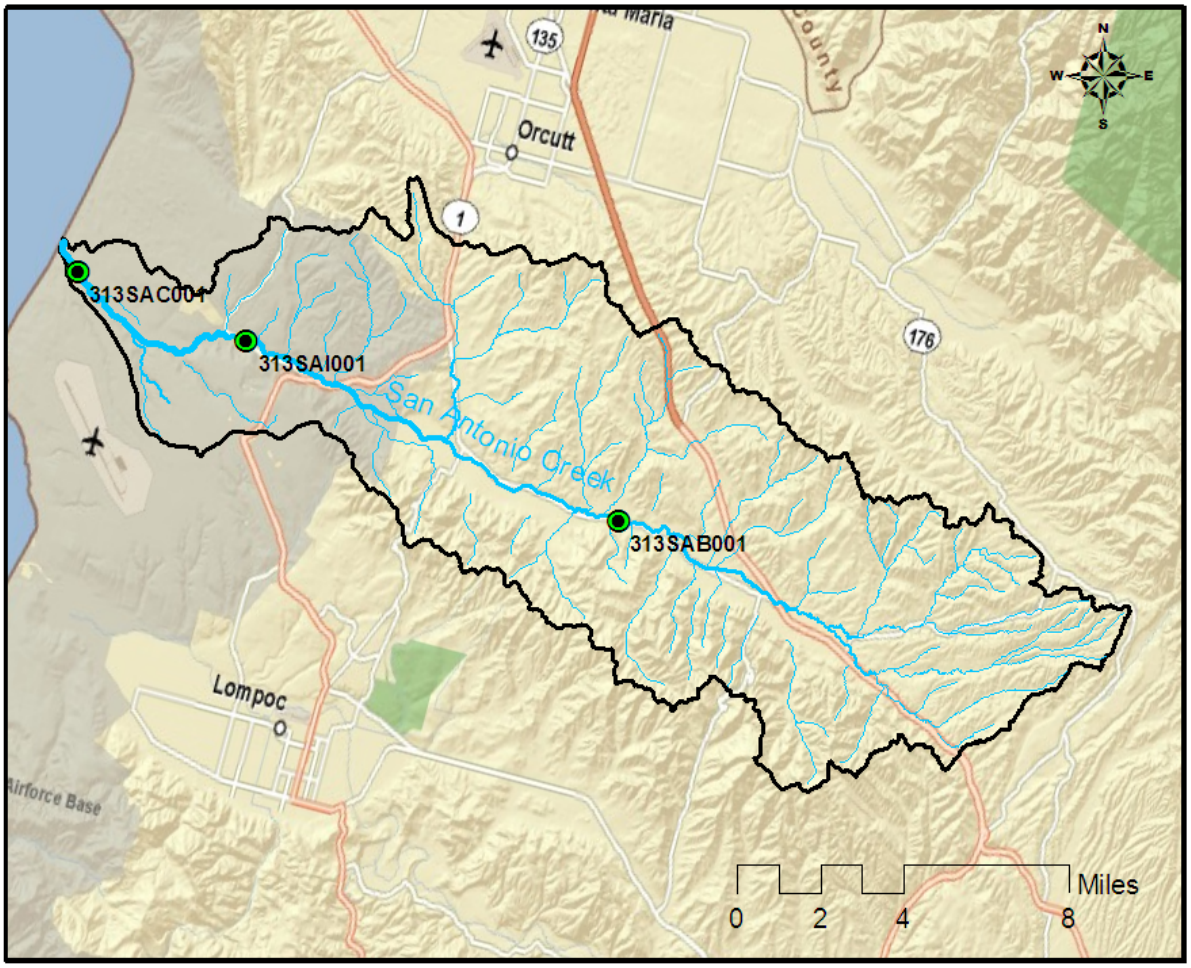


Figure 3. The San Antonio Creek Watershed showing sampling sites. Exceedances occurred at site 313SAB (2002) and 313SAI (2004).

Table 4. Sample stations, dates, and results of chlorpyrifos sampling in San Antonio Creek

| Station Code | Sample Date | Matrix Name | MethodName | Analyte Name | Unit | Result |
|---|---|---|---|---|---|---|
| 313SAB001 | 10-Dec-01 | samplewater | ELISA SOP 3.3 | Chlorpyrifos | µg/L | ND |
| 313SAC001 | 10-Dec-01 | samplewater | ELISA SOP 3.3 | Chlorpyrifos | µg/L | ND |
| 313SAI001 | 10-Dec-01 | samplewater | ELISA SOP 3.3 | Chlorpyrifos | µg/L | ND |
| 313SAB001 | 17-Mar-02 | samplewater | ELISA SOP 3.3 | Chlorpyrifos | µg/L | 0.052 |
| 313SAC001 | 17-Mar-02 | samplewater | ELISA SOP 3.3 | Chlorpyrifos | µg/L | ND |
| 313SAI001 | 17-Mar-02 | samplewater | ELISA SOP 3.3 | Chlorpyrifos | µg/L | ND |
| 313SAI001 | 31-Mar-04 | Interstitial water | ELISA SOP 3.3 | Chlorpyrifos | µg/L | 0.102 |

ND = nondetect

### *2.5.2 Department of Pesticide Regulations Pesticide Use Reports*

The California Department of Pesticide Regulation develops pesticide use reports. Water Board staff was able to evaluate pesticide use, specifically chlorpyrifos, in the

San Antonio Watershed. Staff looked at the pounds of chlorpyrifos applied between 2000 and 2010. Staff determined that chlorpyrifos has been applied in certain areas of the San Antonio Watershed between 2000 and 2010.

Between 2000 and 2003, application of chlorpyrifos was approximately 100 pounds per year. Usage of chlorpyrifos spiked between 2004 and 2008, with anywhere between 1,000 and 3,000 pounds being applied per year. Usage of chlorpyrifos has declined in 2009 and 2010 with the pounds applied being 332 and 196 respectively.

Staff reviewed when chlorpyrifos was applied and compared this information to when the March 17, 2002 and March 31, 2004 water quality standards were exceeded. Based on application dates, staff determined that the March 17, 2002 exceedance was likely caused by a July or August 2001 application of chlorpyrifos on broccoli (either Lorsban 4E-HF or Lorsban 15G Granular insecticide) and the March 31, 2004 exceedance was likely caused by a chlorpyrifos application to broccoli or brussel sprouts between March 2003 through August 2003 or a broccoli or cauliflower application in January or February of 2004 (DPR PUR 2000-2010).

Staff used these pesticide use reports to confirm that chlorpyrifos was being applied to various crops in the watershed. Staff was also able to confirm that the exceedances of water quality standard were due to application of chlorpyrifos in the watershed.

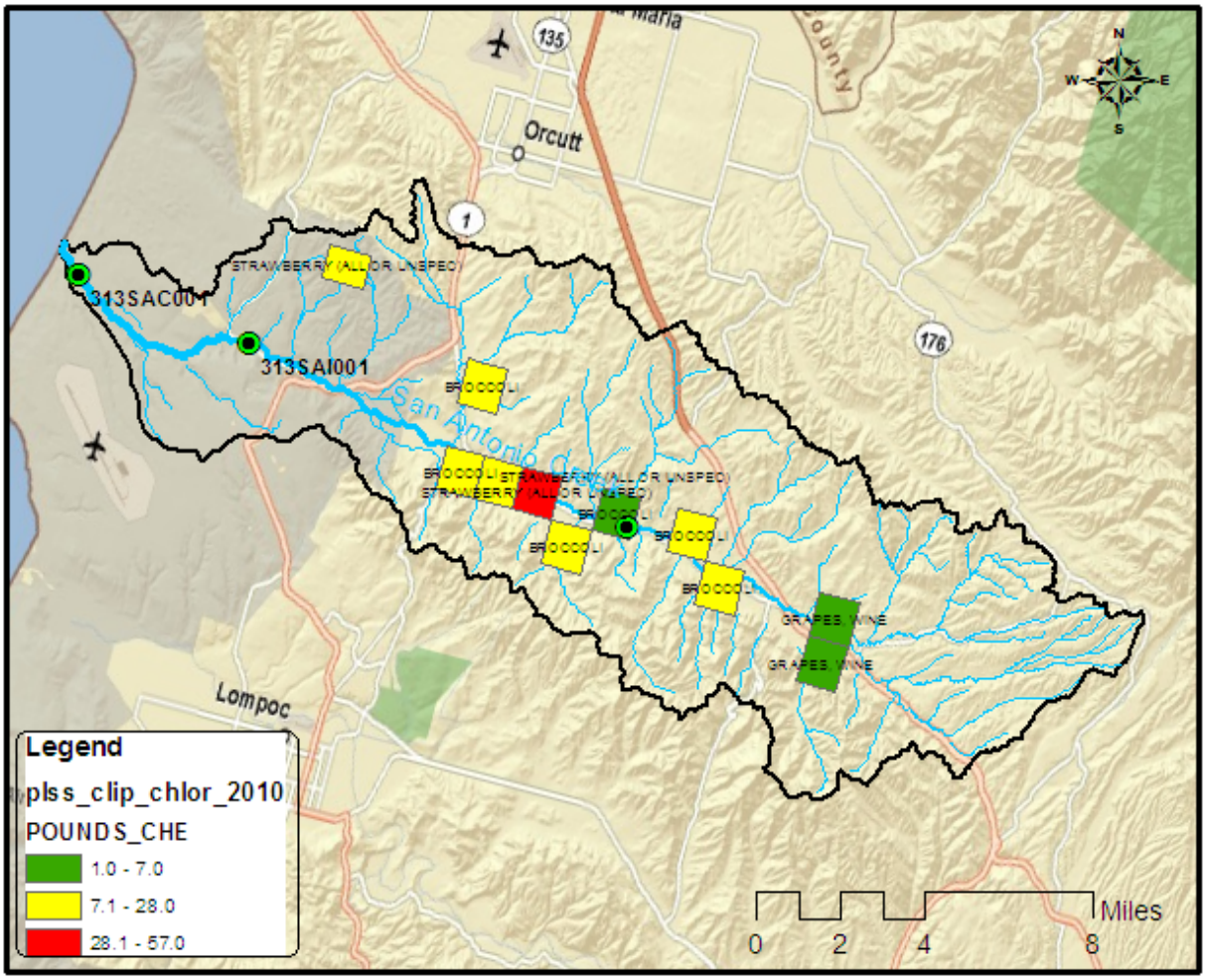


Figure 4. Pounds of chlorpyrifos applied in the San Antonio Creek Watershed in 2010.

Please see appendix C for maps of chlorpyrifos usage per year (2000 – 2009).

### *2.5.3 Problem statement*

The San Antonio Creek is impaired due to exceedance of the water quality criteria for pesticides and toxicity. The pesticide chlorpyrifos is present in San Antonio Creek at levels not protective of beneficial uses associated with aquatic life. This project identifies the causes of impairment and describes solutions to achieve water quality objectives and protection of beneficial uses.

## 3 NUMERIC TARGETS

This section describes the numeric targets used to develop the TMDL. Numeric targets are water quality targets developed to ascertain when and where water quality objectives are achieved, and hence, when beneficial uses are protected. Recall that the toxicity and pesticide objectives are narrative objectives (see Section 2.3).

Note that the targets presented below are consistent with the numeric targets approved by the Central Coast Water Board on May 5, 2011, for chlorpyrifos TMDLs for Salinas River Watershed Chlorpyrifos and Diazinon TMDLs[1]. These targets are also consistent with other USEPA approved TMDLs for chlorpyrifos in California.

## 3.1 Water Column Numeric Targets

Staff selected water column numeric target values for chlorpyrifos as a direct measure of water quality conditions for the protection of aquatic life that are consistent with the toxicity and pesticide objectives described in Section 2.3.

In 2000, CDFG published freshwater water quality criteria for chlorpyrifos (CDFG, 2000) using USEPA methodology (USEPA, 1985). Staff selected the CDFG water quality criteria as numeric targets for these TMDLs. The numeric targets are presented in Table 5.

Table 5. Water column numeric targets

| Compound | CMC [A] (ppb) | CCC [B] (ppb) |
|---|---|---|
| Chlorpyrifos | 0.025 | 0.015 |

[A] CMC – Criterion Maximum Concentration or acute (1- hour average). Not to be exceeded more than once in a three year period

[B] CCC – Criterion Continuous Concentration or chronic (4-day (96-hour) average). Not to be exceeded more than once in a three year period

# 4 SOURCE ANALYSIS

## 4.1 Introduction

Chlorpyrifos is a man-made pesticide. Therefore, there is not a natural background level of chlorpyrifos contributing to the impairment. Agricultural sources of chlorpyrifos found in the San Antonio Creek watershed have caused exceedances of water quality objectives.

### *4.1.1 Agricultural Sources*

Chlorpyrifos is actively applied in the Project Area and was found in the water column and bottom sediments. Staff tracked agricultural application location and the amount applied using the Pesticide Use Report (PUR) provided by the Department of Pesticide

[1] http://www.waterboards.ca.gov/centralcoast/water_issues/programs/tmdl/docs/salinas/pesticide/index.shtml

Regulation. Staff evaluated application of chlorpyrifos between 2000 and 2010. Applications of currently registered pesticides are reported at the section, or square mile, level. The PUR allows for fairly accurate identification of sources in time and space.

### *4.1.2 Urban Storm Water Sources*

USEPA has severely restricted non-agricultural use of chlorpyrifos. Chlorpyrifos was restricted for general public use in Dec. 31, 2001. Additionally, chlorpyrifos was restricted for structural application in 2005 (see section 1.4). Based on the restriction of chlorpyrifos by the general public and based on the small amount of urban land use in the watershed (approximately 1%), staff does not consider urban storm water sources to be a current source of chlorpyrifos in the San Antonio Creek watershed.

## 4.2 Chlorpyrifos Use in the San Antonio Creek Watershed

Chlorpyrifos has been actively applied within the San Antonio Creek watersheds. This pesticide can be found both in the water column (including suspended material) and in bottom sediments (interstial water). The source analysis is based on application data from 2000 through 2010 contained in the Pesticide Use Reports (PUR) provided by the Department of Pesticide Regulation (CDPR).

### *4.2.1 Approach and Methods*

Staff queried how much chlorpyrifos was applied in the San Antonio Creek watershed using PUR provided by the CDPR.

#### 4.2.1.1 Agricultural Sources

The PUR data for agricultural pesticide use is reported at the section (square mile) level in pounds of chemical applied. Staff used GIS to assign sections, and portions of sections, to specific watersheds. This allowed the application data to be summed at the watershed level. Please see Figure 5 for a graphical display of how much chlorpyrifos was applied in the watershed per year. PUR data confirmed that chlorpyrifos was being applied within the watershed.

Staff then reviewed the month in which chlorpyrifos was applied and compared this information to when the March 17, 2002 and March 31, 2004 water quality standards were exceeded. Based on application dates, staff determined that the March 17, 2002 exceedance was likely caused by a July or August 2001 application of chlorpyrifos on broccoli (either Lorsban 4E-HF or Lorsban 15G Granular insecticide) and the March 31, 2004 exceedance was likely caused by a chlorpyrifos application to broccoli or brussel sprouts between March 2003 through August 2003 or a broccoli or cauliflower application in January or February of 2004 (DPR PUR 2000-2010).

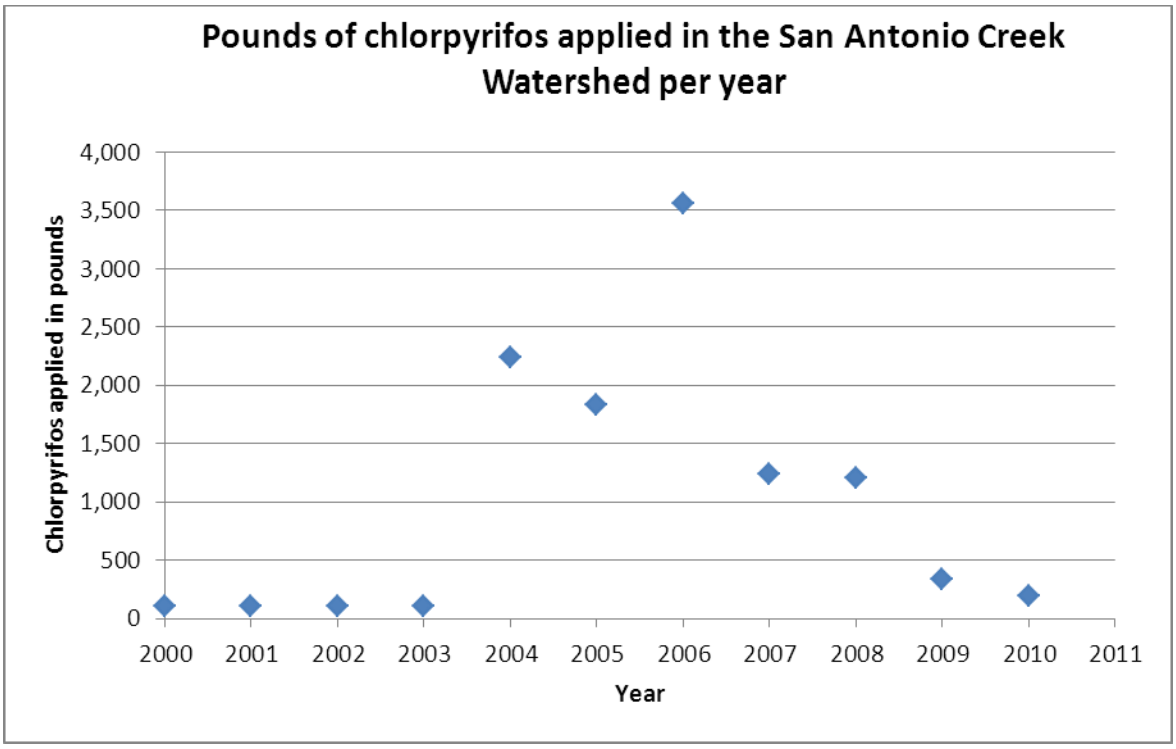


Figure 5. Pounds of chlorpyrifos applied per year in the San Antonio Creek Watershed.

Staff concludes that discharges from agricultural lands are the primary source of chlorpyrifos in San Antonio Creek. This conclusion is based on the following:

- Agricultural lands are adjacent to San Antonio Creek and have applied chlorpyrifos.
- Domestic usage of chlorpyrifos was canceled by USEPA in 2001.

Staff concludes that urban stormwater discharges of chlorpyrifos are not causing exceedances of water quality criteria within the project area. This conclusion is based on the following:

- No application rates for structural pest control and landscape maintenance relative to agricultural applications since 2000.
- Low estimates for unreported residential use relative to agricultural applications, especially because urban areas make up approximately 1% of the watershed.

### *4.2.2 Natural Background Sources*

USEPA requires states to assign an allocation to natural background sources of pollutant stressors and identification of sources of the pollutants for which allocations are assigned.

USEPA describes background levels as representing pollutant loading from natural geomorphological processes, e.g. weathering.

Chlorpyrifos is not a natural pollutant; therefore there are no background levels. Because natural background sources of this chemical does not exist, staff has assigned an allocation to background equal to zero.

## 4.3 Conclusions from Source Analysis

Staff concludes that discharges of chlorpyrifos from agricultural lands are the sole source of chlorpyrifos causing impairment.

# 5 LOADING CAPACITY AND ALLOCATIONS

## 5.1 Introduction

TMDLs are "[t]he sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure" in accordance with Code of Federal Regulations, Title 40, §130.2[i].

Staff proposes the establishment of concentration-based TMDLs in accordance with this provision of the Clean Water Act.

## 5.2 Loading Capacity (TMDL)

The TMDLs are set equal to the loading capacity. The loading capacity for the San Antonio Creek watershed is the amount of chlorpyrifos that can be assimilated without exceeding the water quality objectives. The allowable water column concentration of chlorpyrifos that will achieve the objectives for toxicity and pesticides is equal to the numeric targets.

The loading capacity, or Total Maximum Daily Load, for chlorpyrifos is a water column concentration-based Total Maximum Daily Load and is applicable to each day of all seasons as indicated in Table 6.

Table 6. Concentration-based TMDL for chlorpyrifos

| Impaired Waterbody Assigned TMDL | TMDL | |
|---|---|---|
| | Chlorpyrifos | |
| | CMC[A] (ppb) | CCC[B] (ppb) |
| San Antonio Creek | 0.025 | 0.015 |

[A] CMC – Criterion Maximum Concentration or acute (1- hour average). Not to be exceeded more than once in a three year period

[B] CCC – Criterion Continuous Concentration or chronic (4-day (96-hour) average). Not to be exceeded more than once in a three year period

## 5.3 Linkage Analysis

The goal of the linkage analysis is to establish a link between pollutant loads and desired water quality. This, in turn, ensures that the loading capacity specified in the TMDLs will result in attaining the desired water quality. For these TMDLs, this link is established because the load allocations are equal to the numeric targets, which are the same as the TMDLs. Therefore, reductions in chlorpyrifos loading will result in achieving the water quality standards.

## 5.4 Load Allocations

Table 7 shows load allocations assigned to responsible parties. The allocations are equal to the TMDLs. The allocations are receiving water allocations.

Table 7. Load allocations

**LOAD ALLOCATIONS**

| Waterbody Assigned TMDLs | Responsible Party Assigned Allocation (Source) | Receiving Water Allocation |
|---|---|---|
| • San Antonio Creek | Owners/operators of irrigated agricultural lands in the San Antonio Creek Watershed<br><br>(Discharges from irrigated lands) | Allocation-1 |

Allocation 1:

| Compound | CMC [A] (ppb) | CCC [B] (ppb) |
|---|---|---|
| Chlorpyrifos | 0.025 | 0.015 |

[A] CMC – Criterion Maximum Concentration or acute (1- hour average). Not to be exceeded more than once in a three year period

[B] CCC – Criterion Continuous Concentration or chronic (4-day (96-hour) average). Not to be exceeded more than once in a three year period.

Available samples collected within the applicable averaging period (e.g., 1-hour CMC and 4-day CCC) for the numeric targets will be used to determine compliance with the allocations and loading capacity.

## 5.5 Margin of Safety

This TMDL uses an implicit margin of safety. The margin of safety for this TMDL is implicit in the water column numeric targets selected for chlorpyrifos.

The assigned TMDL assumes no significant reductions in chlorpyrifos loading due to removal from the water column by degradation and/or adsorption to sediment particles and subsequent sediment deposition. Since these processes are likely to take place, this assumption contributes to the implicit margin of safety in the proposed allocation methodology. This is a conservative assumption resulting in an implicit margin of safety.

Staff used water column numeric criteria for chlorpyrifos, developed by the California Department of Fish and Game (CDFG, 2000: CDFG, 2004) following USEPA protocols (USEPA 1985), to establish the loading capacity. Therefore, the loading capacity has the same conservative assumptions used in those procedures.

## 5.6 Critical Conditions, Seasonal Variation

A critical condition is the combination of environmental factors resulting in the water quality standard being achieved by a narrow margin, i.e., that a slight change in one of the environmental factors could result in exceedance of the water quality standard. Such a phenomenon could be significant if the TMDL were expressed in terms of load, and the allowed load was determined on achieving the water quality standard by a narrow margin. However, this TMDL is expressed as a concentration, which is equal to the desired water quality condition. Consequently, there are no critical conditions.

Exceedance of the water quality criteria occurred in March of 2002 and March of 2004. Much of the impaired water is dry during the summer months. The TMDL and allocations are expressed in terms of concentration and applicable when water is present to protect aquatic life, regardless of season. Therefore, the TMDL is applicable all during all seasons.

# 6 IMPLEMENTATION AND MONITORING

## 6.1 Introduction

This TMDL is being implemented by the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Order); *this includes the order currently in effect and renewals thereof*. Central Coast Water Board staff will conduct a review of implementation activities when monitoring and reporting data is submitted as required by the Agricultural Order. Central Coast Water Board staff will pursue modification of Agricultural Order conditions or other regulatory means (e.g. waste discharge requirements), as necessary, to address remaining impairments from chlorpyrifos during the TMDL implementation phase.

The Porter-Cologne Water Quality Control Act grants the Water Boards the authority to implement and enforce water quality laws. Water Board staff ensures compliance with the Agricultural Order using the authority and regulatory mechanisms granted through the California Water Code, including application of enforcement actions described in the Water Quality Enforcement Policy. Therefore, the Central Coast Water Board does not need an additional regulatory program (e.g., a new plan or policy adopted through a Basin Plan Amendment) to address impairments caused by chlorpyrifos in the project area, because the Agricultural Order is the regulatory mechanism in place to address these impairments.

In 1997, the State Water Resources Control Board (State Water Board) and the Department of Pesticide Regulation (DPR) approved the California Pesticide Management Plan for Water Quality (Plan) as a joint effort to protect water quality from the adverse effects of pesticides. The Pesticide Management Plan is an implementation plan of the Management Agency Agreement (MAA) between the agencies and describes how the Water Board, DPR, and the County Agricultural Commissioners (Commissioners) will work together to address water quality problems associated with pesticides. Water Board staff recently wrote a letter (January 13, 2012) to DPR and Commissioners to request that DPR and Commissioners initiate Step 3 of the Plan to implement reduced-risk practices through necessary restricted material use permit requirements, regulations and other regulatory authority used by DPR and the Commissioners. In Stage 3, reduced risk practices will be implemented by restricted material use permits, regulations and other regulatory authority used by DPR and the Commissioners. The Water Board requested a meeting with the agencies to discuss their request and mutual goals. Staff anticipates, but does not rely upon for this TMDL, reduced risk practice implementation by growers in compliance with DPR requirements.

An additional regulatory tool of DPR is the reevaluation of pesticide products (DPR 2010). DPR is required to evaluate pesticides prior to permitting use in California. Once a pesticide is in use, California regulations require DPR to investigate possible adverse effects to people and the environment. If the effects are significant, DPR is required to reevaluate the registration of the pesticide. Chlorpyrifos is linked to significant adverse effects to surface water quality. This pesticide is currently in reevaluation and the registrants are required to evaluate the extent of the water quality problem and identify appropriate mitigation measures. Reevaluation is a lengthy scientific review process where the registrant is required to provide information to DPR. If the adverse effects cannot be mitigated, DPR can cancel or suspend the registration of the pesticide.

DPR placed chlorpyrifos into reevaluation in 2004 and the registrant, DOW AgroSciences, began investigating the problem. Dow submitted a report to DPR entitled, “Surface Water Monitoring and Use Investigations for determining Effectiveness of Chlorpyrifos Mitigation Measures” (DOW AgroSciences 2008). In the report, DOW AgroSciences concluded that chlorpyrifos applications on the Central Coast are primarily on grapes and cole crops. DOW AgroSciences further concluded that grapes were not grown in the watersheds with chlorpyrifos surface water detections and that the applications to cole crops were the likely source of chlorpyrifos in surface water[2]. Chlorpyrifos is applied on cole crops to control soil maggots. DOW AgroSciences assessed chlorpyrifos use on cole crops, product formulations and cropping practices. DOW AgroSciences found that chlorpyrifos applications on cole crops were primarily pre-plant granular applications and that irrigation runoff was the most likely transport mechanism to surface waters. Recall that the two data (data from

[2] Staff noted in this Project Report that even though growers applied chlorpyrifos to wine grapes, the exceedances in 2002 and 2004 were likely due to cole crops. DOW’s study did not include the San Antonio Watershed.

March 17, 2002 and March 31, 2004) used to determine impairment in San Antonio Creek were following granular applications of chlorpyrifos to either broccoli, brussel sprouts or cauliflower, which are cole crops.

DOW AgroScience identified methods that could eliminate organophosphate in surface waters, including: use of drip irrigation to eliminate runoff, improvement of granular application methods to eliminate spills, use of treatment enzymes that degrade the pesticides, and the use of vegetative treatment systems (DOW AgroSciences 2009). DOW AgroScience noted that multiple crops on a field, sometimes three crop rotations in a year, may lead to an increase in crop residue left behind in a field that provides a host for adult and larval root maggots. Rotating non-host crops and fallow periods would reduce soil infestations.

The parties with allocations for this TMDL include any agricultural operation that uses chlorpyrifos on their crops. Please see section 6.5, Timelines and Milestones for the timeline and milestones associated with complying with this TMDL.

## 6.2 Implementation Requirements

Owner and operators of irrigated lands in the project area are required to comply with the conditions and requirements of the current *Conditional Waiver of Waste Discharge Requirements For Discharges from Irrigated Lands* (Agricultural Order) and any renewals thereof. Requirements outlined in the Agricultural Order will prioritize implementation efforts in the San Antonio Creek watershed aimed at addressing discharges of chlorpyrifos. Implementing parties shall:

- Implement proper handling, storage, application, disposal and management of pesticides to prevent or control discharge into surface waters to the extent that the TMDL numeric targets are achieved.
- Develop or update and implement Farm Plans to include specific measures aimed at preventing or controlling the discharge of pesticides into surface waters to the extent that the TMDL numeric targets are achieved.
- For growers who have applied chlorpyrifos in the past year (from May 2011 or any time thereafter) or may apply chlorpyrifos between May 2012 and October 2014: Develop and implement a monitoring plan aimed at assessing the effectiveness of management measures in place to prevent or control the discharge of chlorpyrifos into surface waters to the extent that the TMDL numeric targets for chlorpyrifos are achieved. Monitoring efforts can be implemented individually, cooperatively with other interested parties, or a combination thereof. Note that current monitoring efforts, e.g. through the Cooperative Monitoring Program and anticipated monitoring efforts of the Central Coast Ambient Monitoring Program may be used to help demonstrate compliance and progress. Monitoring plans shall be developed and implemented by October 2012. Monitoring plans and results shall be made available to the Water Board within 30-days, upon request.

## 6.3 Monitoring and Reporting Requirements

If a grower has not applied chlorpyrifos within the last year (since May 2011), they are not required to conduct chlorpyrifos monitoring per this TMDL. Growers required to monitor must meet the monitoring requirements of the *Conditional Waiver of Waste Discharge Requirements For Discharges from Irrigated Lands* (Agricultural Order).

The Agricultural Order includes monitoring and reporting requirements that assess progress toward achieving these TMDLs. To achieve this goal, the monitoring requirements should include the following, or other monitoring as consistent with the Agricultural Order:

1. Water column chlorpyrifos monitoring consistent with numeric targets outlined in Section 3.1. There should be a minimum of one sample during the wet season when there is flow in the San Antonio Creek (approximately November – April). Water column sampling will be performed after chlorpyrifos application, ideally within 30-60 days after application. If chlorpyrifos is applied a second time to the field, a second sampling event is encouraged. Dry season monitoring is not required because there is typically no flow during the dry season (CRMP 2003).
2. Laboratory analytical methods rigorous enough for data comparison with the numeric targets.
3. Results submitted to the Water Board, upon request.

Table 8. Recommended receiving water monitoring sites for TMDL progress assessment.

| Impaired Waterbody | Recommended Monitoring Sites |
|---|---|
| San Antonio Creek | 313SAI001 (CCAMP coastal confluences site)<br>313SAB001 |

The CMP (Cooperative Monitoring Program) is currently scheduled to sample for toxicity in 2013 (four toxicity samples in water) as well as collect four samples that will analyze for OP pesticides, which will include chlorpyrifos. CMP's plans also include sediment sampling in 2013 or 2014 which may include OP sampling. CCAMP is currently scheduled to conduct rotational sampling in the San Antonio Watershed in 2015. If needed, their sampling may include quarterly sampling for chlorpyrifos. These monitoring efforts may supplement other monitoring growers/third parties may collect as well as help inform ambient conditions in the watershed.

## 6.4 Timeline and Milestones

Discharge of pesticides at levels toxic to the environment affects a spectrum of beneficial uses and is, therefore, a serious water quality problem. As such, implementation should occur at an accelerated pace to achieve the allocations and TMDL in the shortest time-frame feasible.

The target date to achieve the allocations, numeric targets, and TMDLs in the impaired waterbodies addressed in this TMDL is March 2016. This date coincides with planned monitoring efforts to help defray costs to implementing parties and reflects the apparent decrease in chlorpyrifos use in the San Antonio Watershed and associated ease with which the TMDL can likely be achieved (please see Section 6.6 Existing Implementation Efforts). The Agricultural Order should establish timeframes for individual dischargers to achieve water quality standards; achieving water quality standards will result in achieving TMDL allocations.

Water Board staff will reevaluate impairments caused by chlorpyrifos when monitoring data is submitted and during renewals of the Agricultural Order. Water Board staff will modify the conditions of the Agricultural Order, if necessary, to address remaining impairments.

## 6.5 Cost Estimate

Existing regulatory requirements are sufficient to attain water quality standards for chlorpyrifos in the project area. The Regional Board is not approving any new activity, but merely finding that ongoing activities and regulatory requirements are sufficient. Therefore, this TMDL is not a "project" that requires compliance with the California Environmental Quality Act (California Public Resources Code § 21000 et seq.) and the Central Coast Water Board is not directly undertaking an activity, funding an activity or issuing a permit or other entitlement for use by this action (Public Resources Code § 21065; 14 Cal. Code of Regs. §15378).

## 6.6 Existing Implementation Efforts

Staff learned at a December 2011 outreach meeting that many growers are no longer applying chlorpyrifos. This is especially notable for vineyards. Vineyards used between 1,000 and 3,000 pounds of chlorpyrifos each year between 2004 and 2008. Per 2010 PUR reports, vineyards have reduced their application to less than 10 pounds per year. This reduction in chlorpyrifos application is significant. In conversations with a vineyard grower, it is likely that there was no chlorpyrifos application in 2011 (data unavailable through DPR for 2011 at the time of writing this report). Staff does not anticipate that vineyards will be a contributing source of chlorpyrifos in the future.

In February 2012, staff spoke with a vegetable grower in the area about chlorpyrifos application. The grower informed staff that most pesticide application on farms in the area is overseen by a pest control advisor. In other words, the growers themselves do not apply the chemical. Staff subsequently had a conversation with a pest control advisor who works in the area. This person indicated that the individuals who apply chlorpyrifos are advised to use best management practices in applying the chlorpyrifos to the farm. That is, they are advised to use caution and stop at the end of the row to prevent the spillage of granular chlorpyrifos as well as other management measures in order to maintain the pesticide onsite. Additionally, this pest control advisor is working with growers to stop using chlorpyrifos in the future.

In March 2012, staff spoke with a pest control advisor who stated that after the Central Coast Water Board adopted the agricultural order (March 15, 2012), growers in this watershed will no longer be applying chlorpyrifos.

Based on the above information, staff finds it likely that the risk of chlorpyrifos entering San Antonio Creek is much less than it was in the early 2000s. Staff will follow up with outreach and monitoring.

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# APPENDIX A – WATER QUALITY DATA

All of the following data were taken from ProjectID 00SW3001 which is SWAMP data

| Station Code | Event Type | Sample Date | Sample Type Code | Depth Sample Collec-tion | Depth Unit | Preparation | Matrix Name | MethodName | Analyte Name | Unit | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 313SAB001 | WaterTox_Chem | 10-Dec-01 | Grab | 0.1 | m | None | sample-water | ELISA SOP 3.3 | Chlorpyrifos | µg/L | -0.05 |
| 313SAC001 | WaterTox_Chem | 10-Dec-01 | Grab | 0.1 | m | None | sample- | ELISA SOP 3.3 | Chlorpyrifos | µg/L | -0.05 |
| 313SAI001 | WaterTox_Chem | 10-Dec-01 | Grab | 0.1 | m | None | water | ELISA SOP 3.3 | Chlorpyrifos | µg/L | -0.05 |
| 313SAB001 | WaterTox_Chem | 17-Mar-02 | Grab | 0.1 | m | None | sample- | ELISA SOP 3.3 | Chlorpyrifos | µg/L | 0.052 |
| 313SAC001 | WaterTox_Chem | 17-Mar-02 | Grab | 0.1 | m | None | water | ELISA SOP 3.3 | Chlorpyrifos | µg/L | -0.05 |
| 313SAI001 | WaterTox_Chem | 17-Mar-02 | Grab | 0.1 | m | None | sample- | ELISA SOP 3.3 | Chlorpyrifos | µg/L | -0.05 |
| 313SAI001 | SedTox_Chem | 31-Mar-04 | Inte-grated | 2 | cm | Centrifuged | Inter-stitial-water | ELISA SOP 3.3 | Chlorpyrifos | µg/L | 0.102 |

# APPENDIX B - DERIVATION OF WATER COLUMN NUMERIC TARGETS

Staff used water column numeric target values that were derived from the California Department of Fish and Game's (CDFG) *Water Quality Criteria for Diazinon and Chlorpyrifos* (CDFG, 2000) and later modified based on information provided by staff of the Central Valley Regional Water Quality Control Board. A description of this modification is contained in the following paragraphs.

For the chlorpyrifos section of the CDFG criteria derivation (CDFG, 2000) forty-three acceptable acute toxicity values were available to calculate freshwater criteria. Acceptable acute toxicity tests were available for thirteen invertebrate and seven fish species. Eight acute to chronic ratios for seven species (both freshwater and saltwater) were available to calculate a chronic criterion for chlorpyrifos. CDFG calculated an acute criterion for chlorpyrifos of 20 ng/L and a chronic freshwater criterion of 14 ng/L. The calculations that are part of the USEPA methodology (EPA, 1985) can include interim calculations before the final criterion is calculated. The USEPA methodology states that interim calculations should be rounded to four significant figures and the final criterion should be rounded to two significant figures. When the freshwater chlorpyrifos criteria are rounded to two significant figures using the data set that CDFG found acceptable, the acute criterion is 25 ng/L, rather than 20 ng/L, and the chronic criterion is 15 ng/L, rather than 14 ng/L.

# APPENDIX C – CHLORPYRIFOS APPLICATION IN THE SAN ANTONIO WATERSHED BY YEAR, DISPLAYED GEOGRAPHICALLY

This information was collected via the CDPR's website using pesticide use reports.

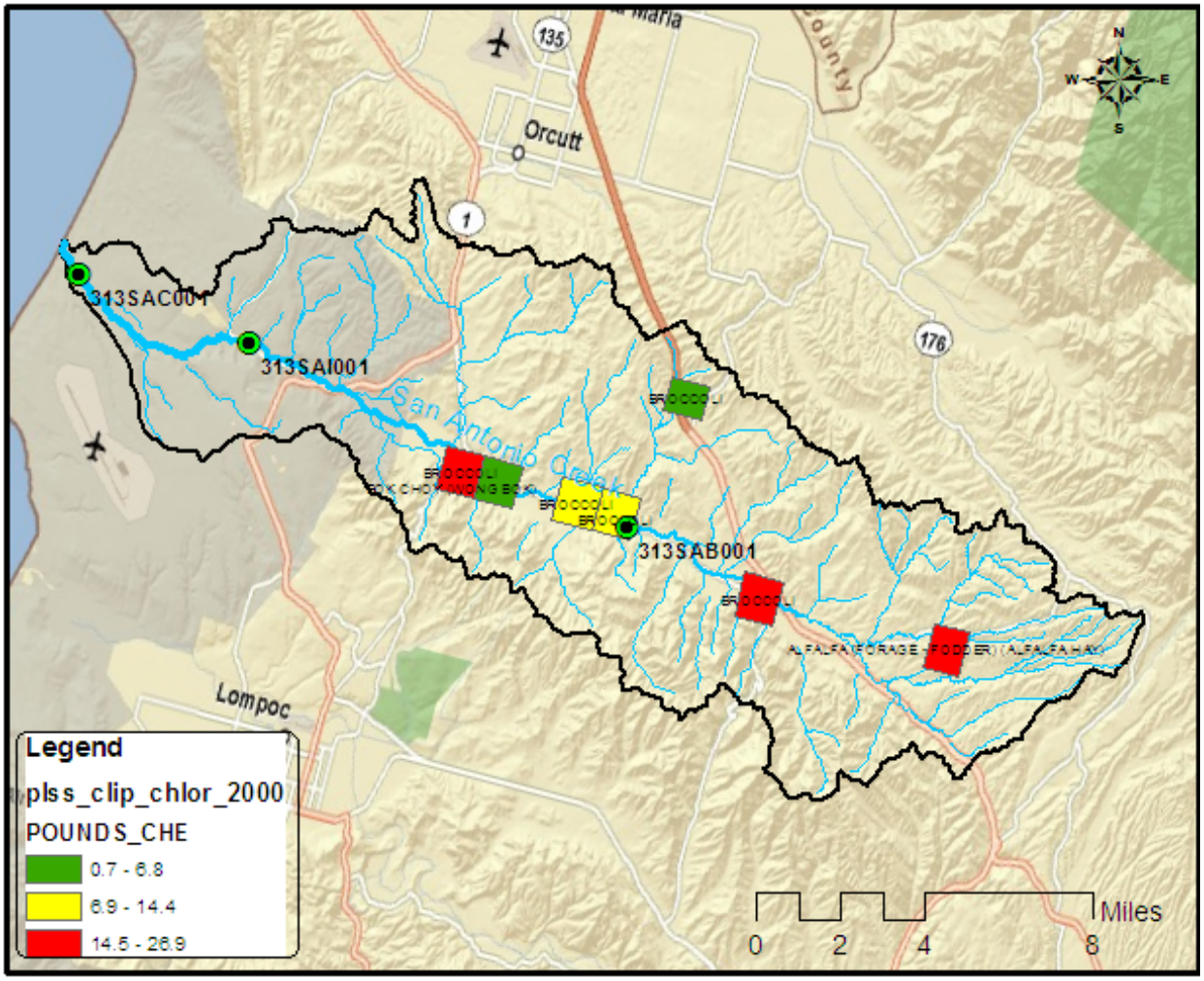


Figure 1. Chlorpyrifos application in 2000.

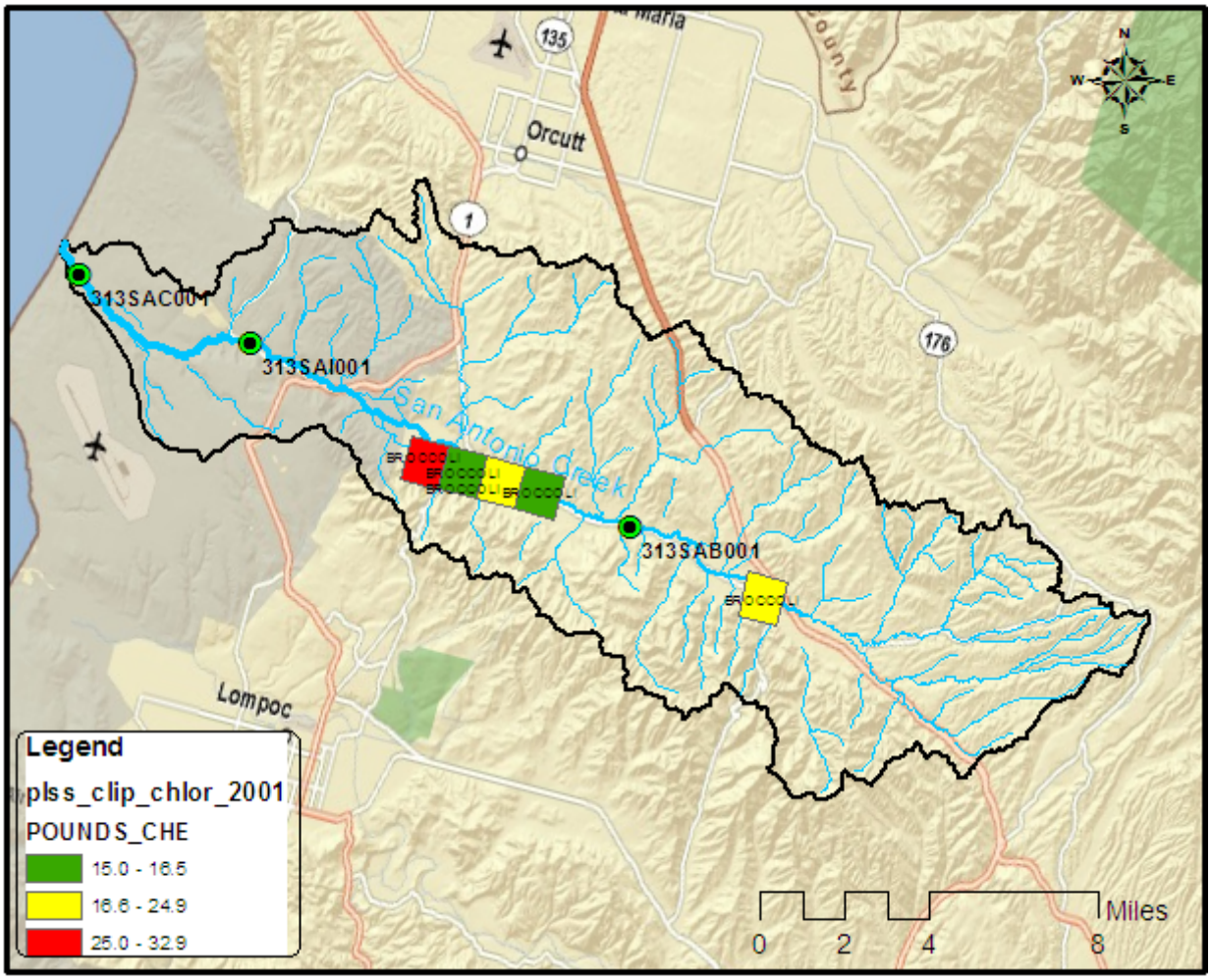


Figure 2. Chlorpyrifos application in 2001.

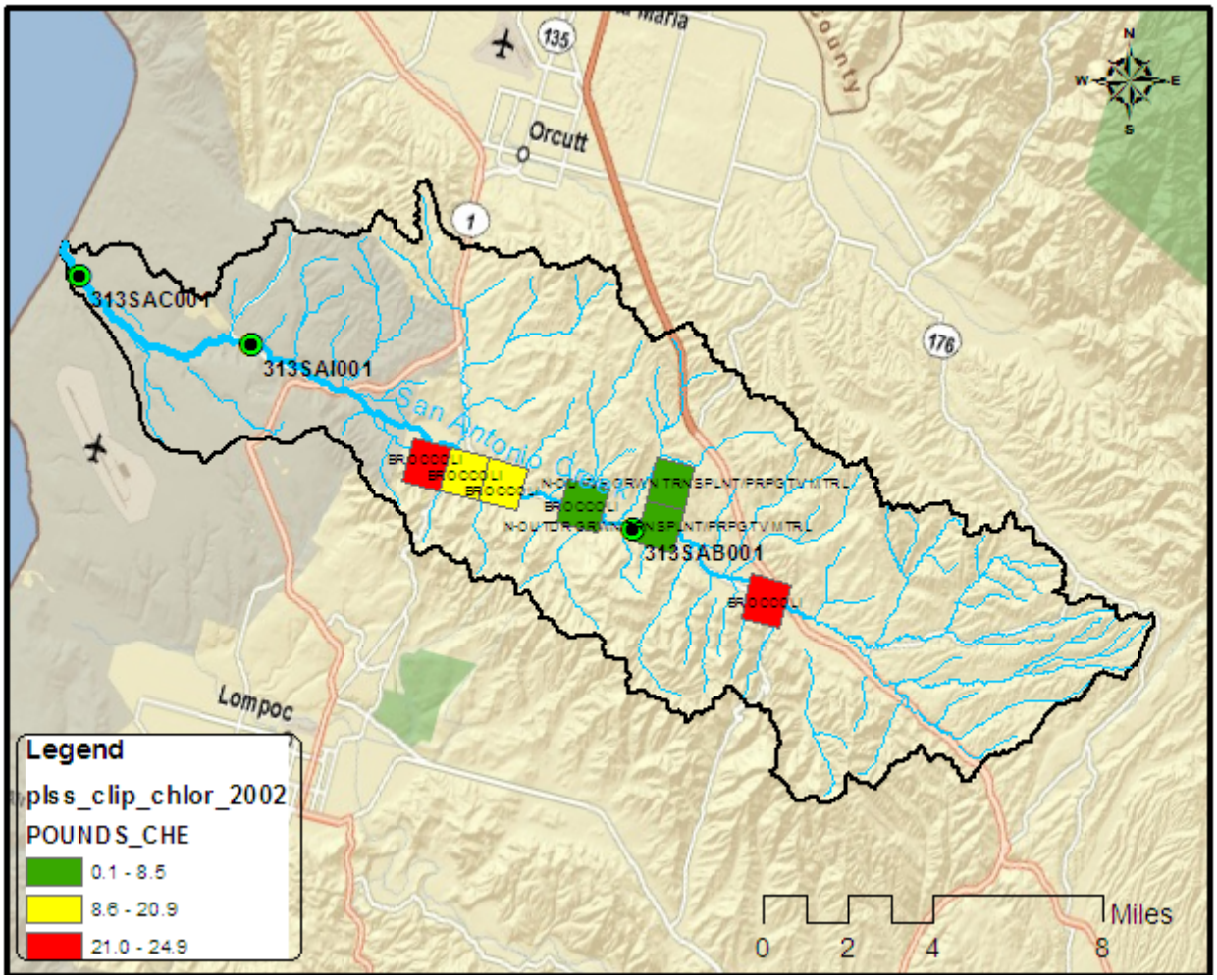


Figure 3: Chlorpyrifos application in 2002.

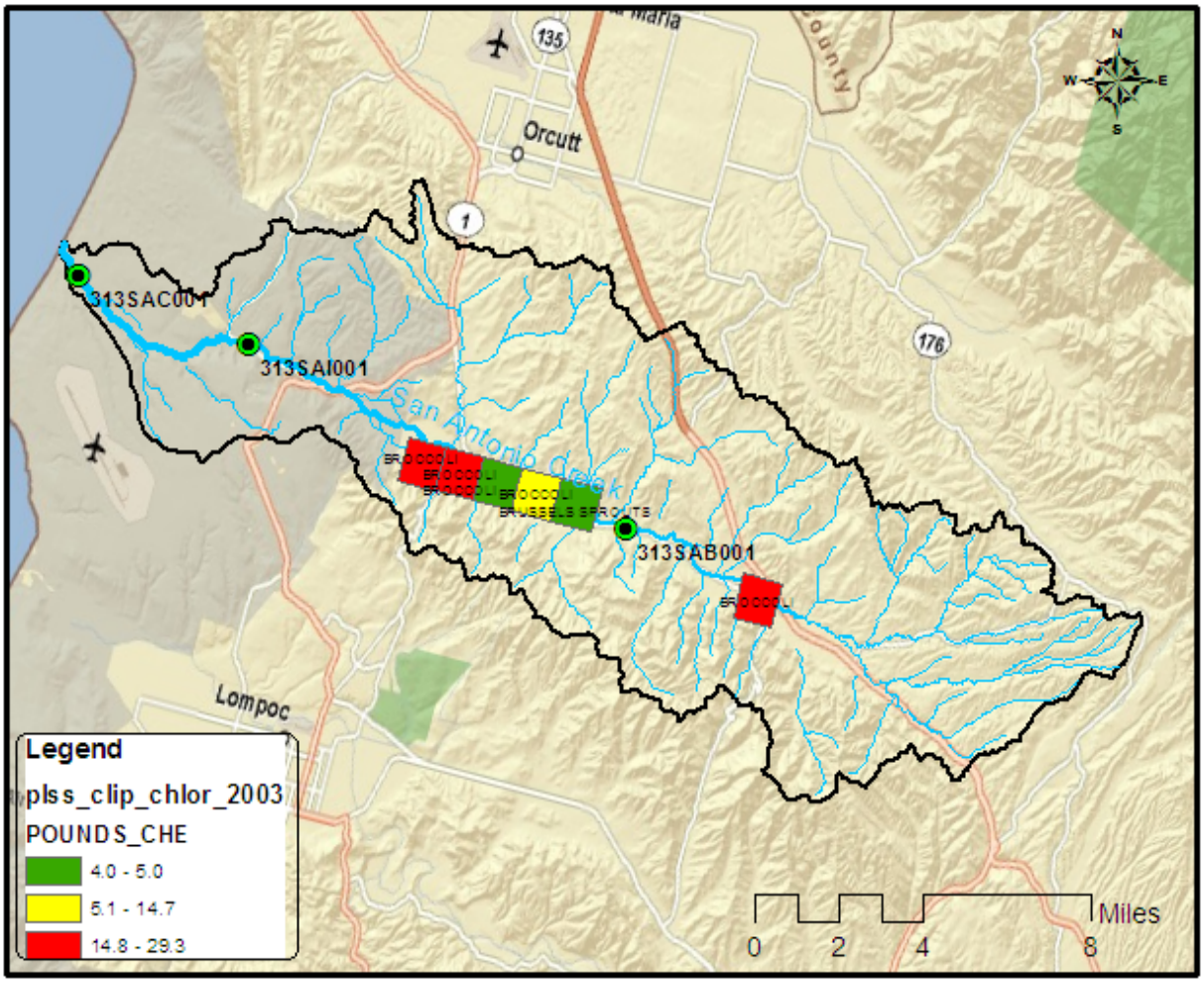


Figure 4. Chlorpyrifos application in 2003.

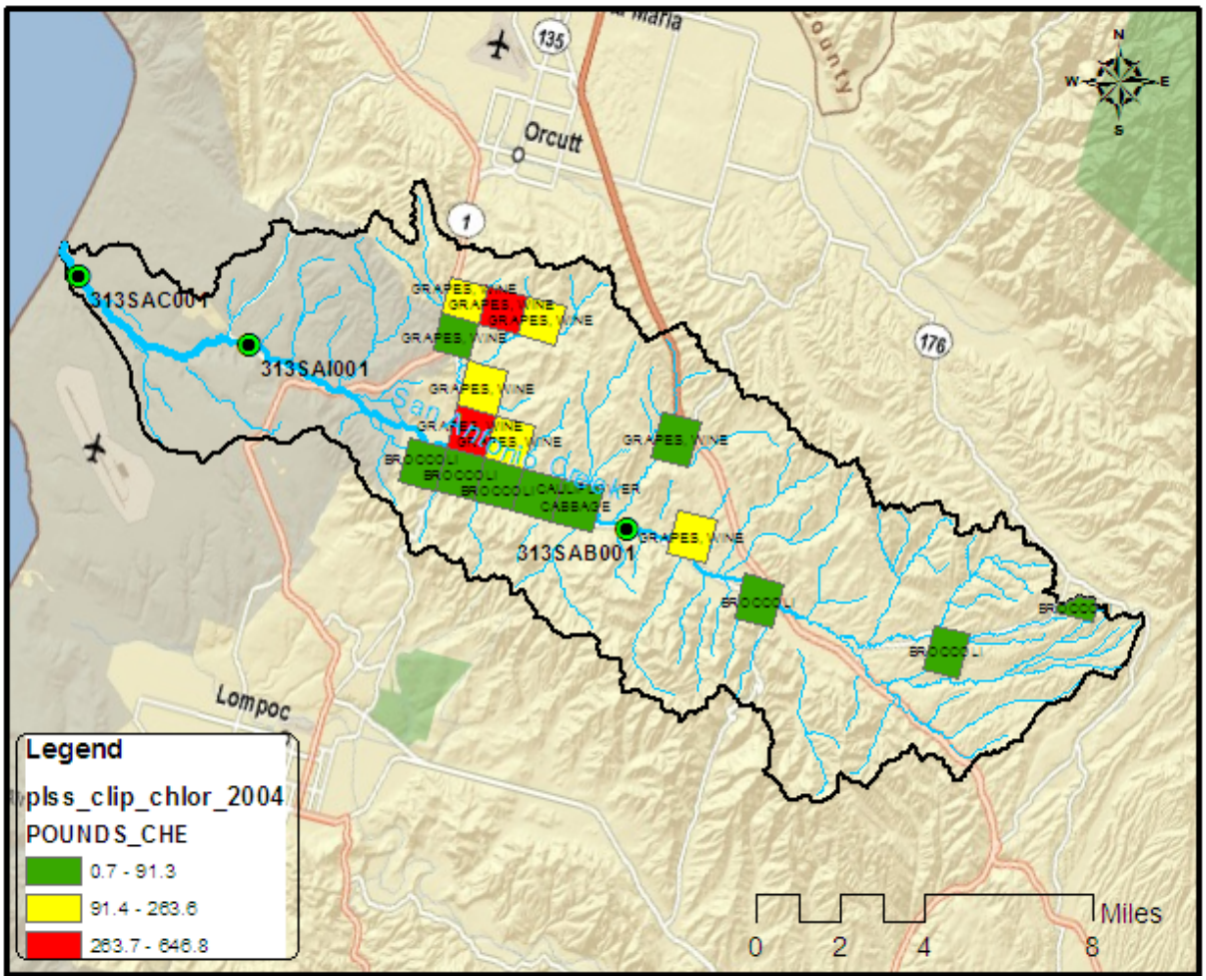


Figure 5. Chlorpyrifos application 2004.

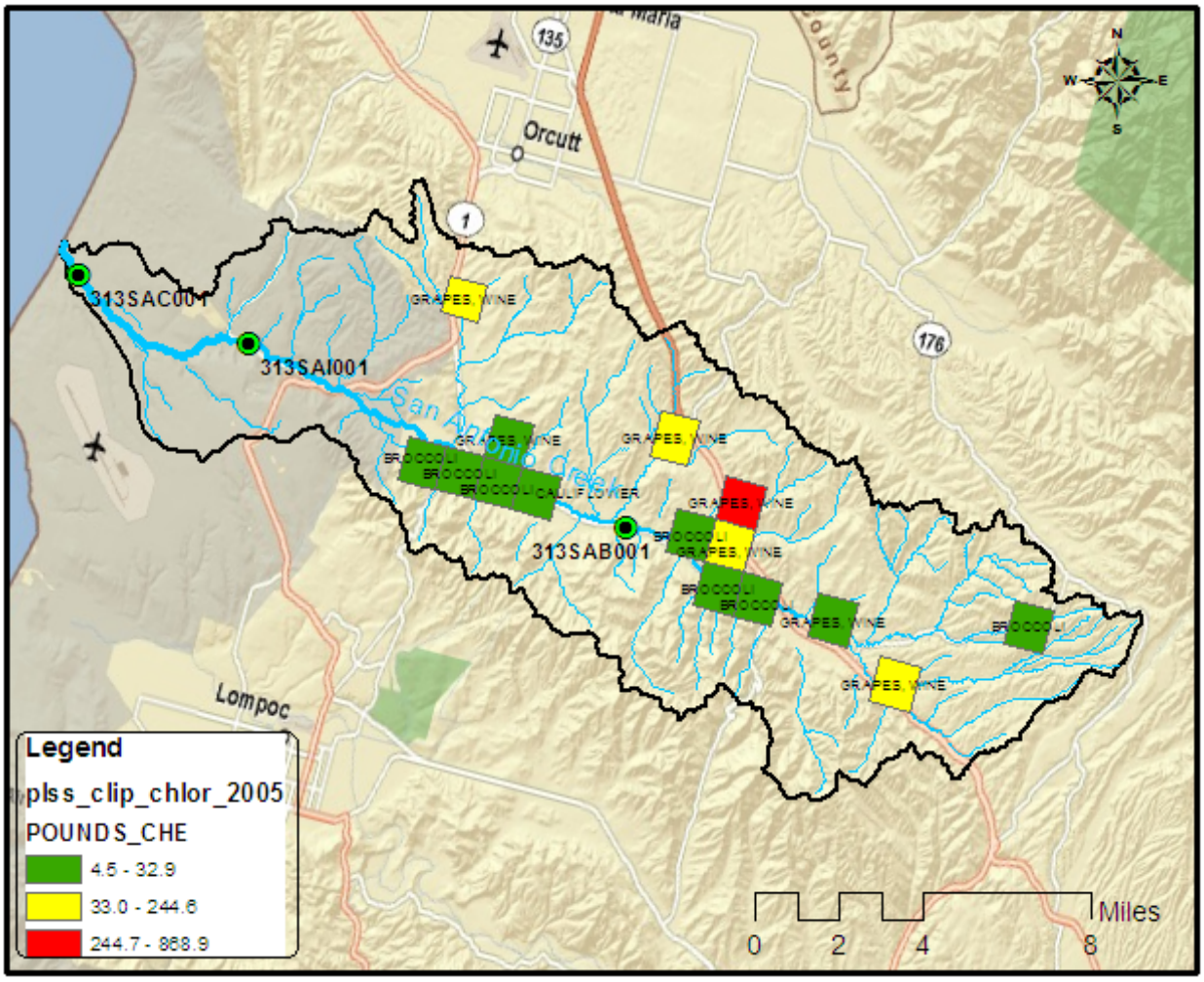


Figure 6. Chlorpyrifos application 2005.

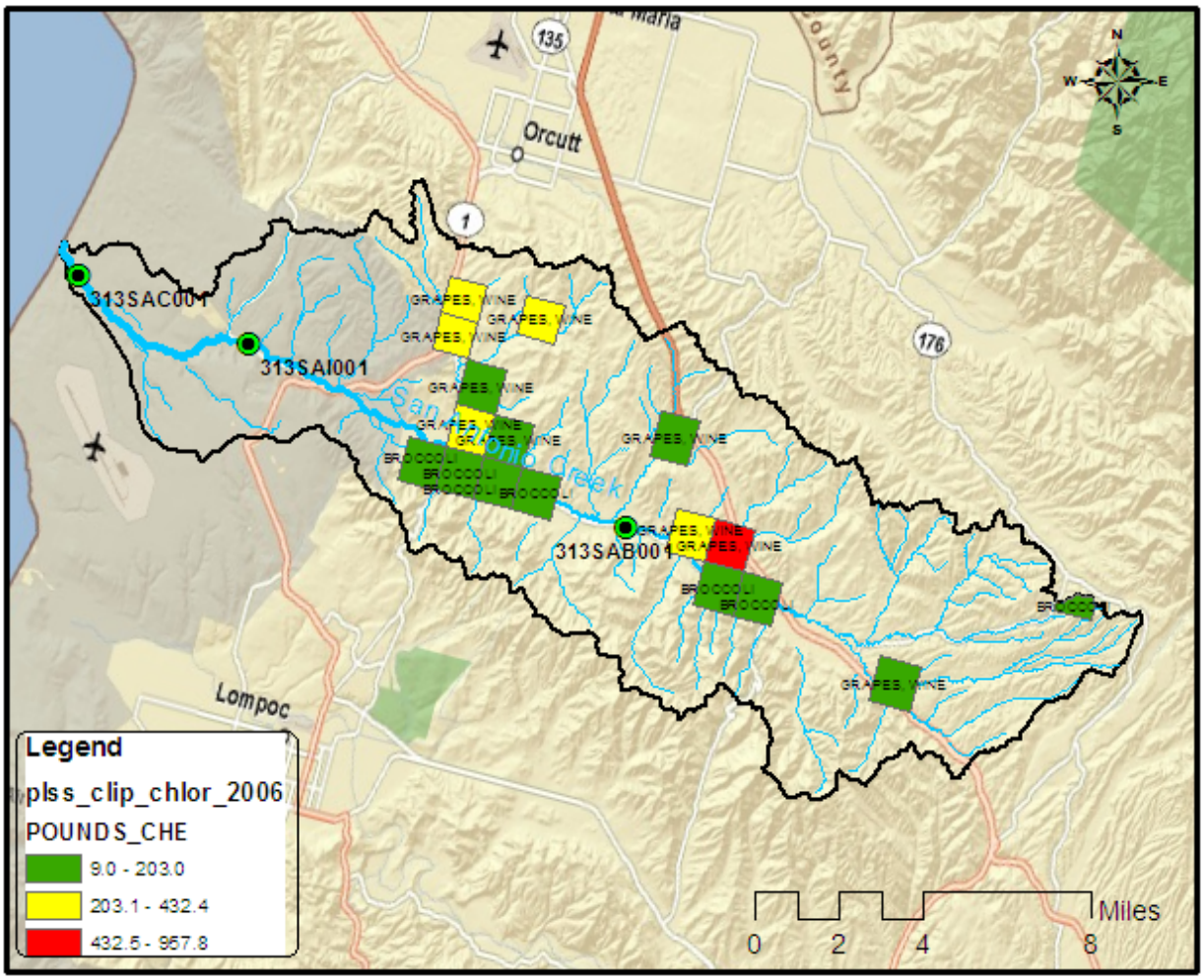


Figure 7. Chlorpyrifos application 2006

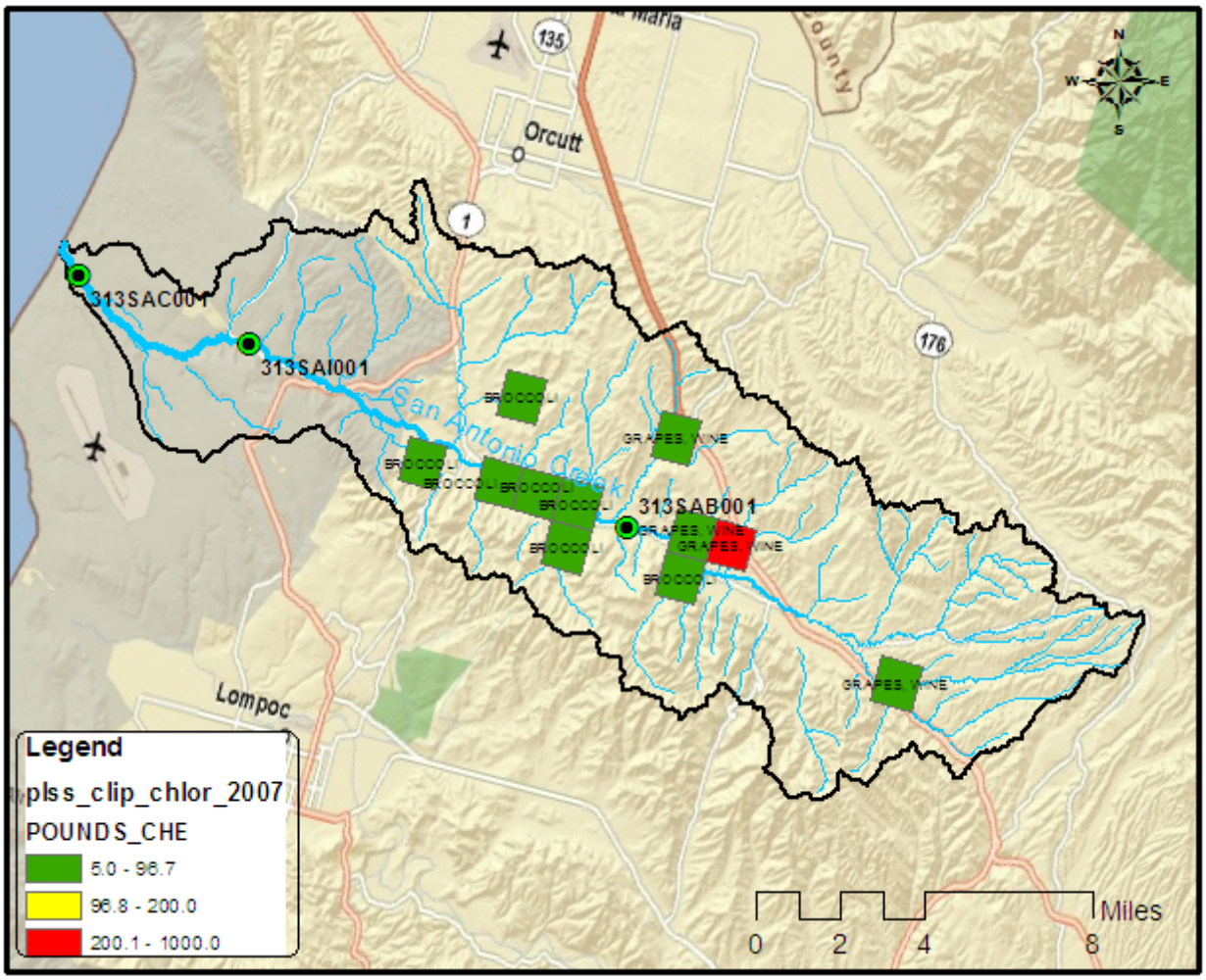


Figure 8. Chlorpyrifos application 2007.

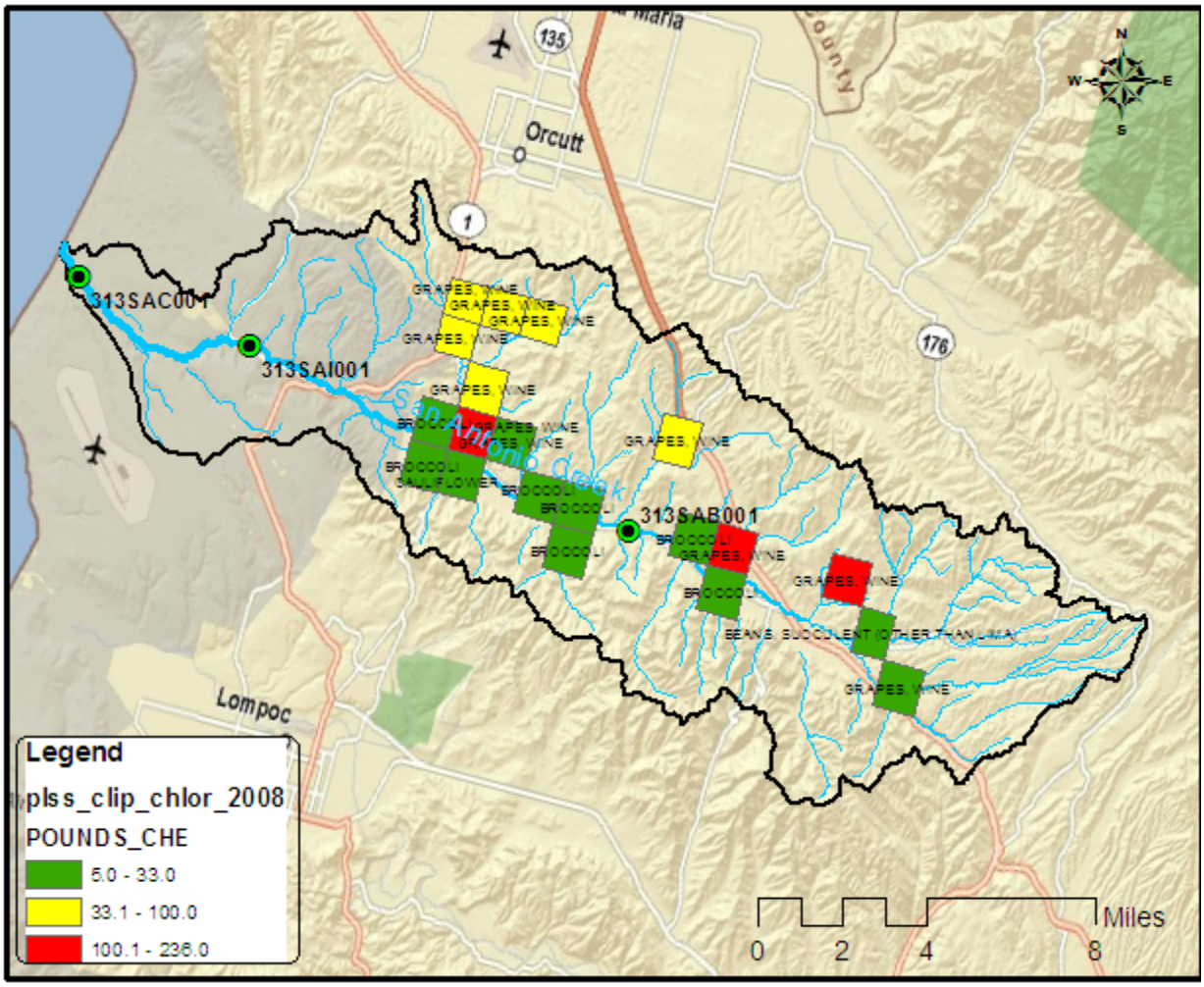


Figure 9. Chlorpyrifos application 2008.

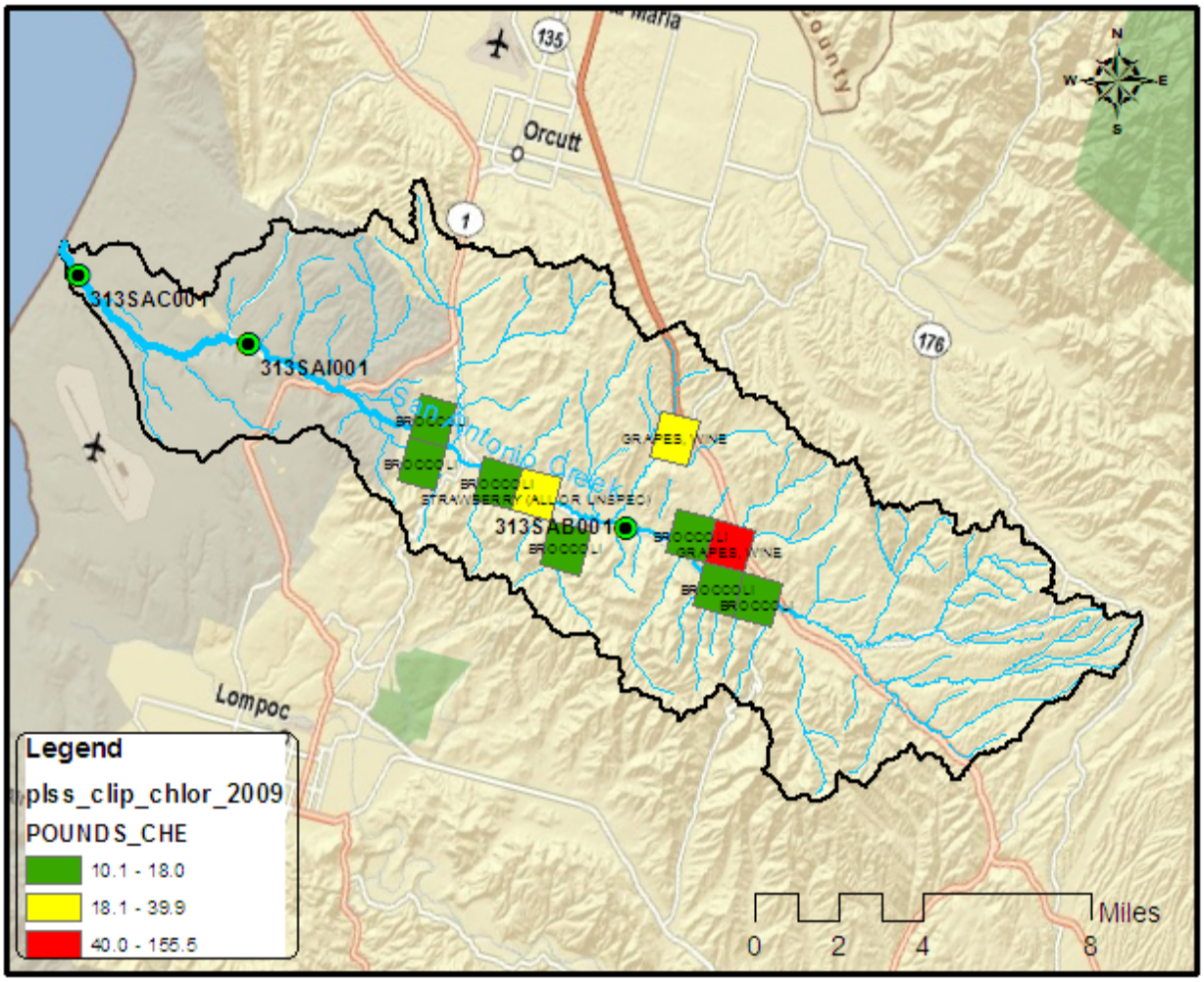


Figure 10. Chlorpyrifos application 2009.

(2010 chlorpyrifos application in the body of the Project Report.)