

Section 7
WATER QUALITY

| | |
|--|------|
| SOURCES OF DATA..... | 7-1 |
| HISTORICAL CONTEXT | 7-2 |
| WATER QUALITY STANDARDS | 7-3 |
| Drinking Water Standards, Maximum Contaminant Levels (MCLs)..... | 7-7 |
| Maximum Contaminant Level Goals (MCL Goals or MCLs)..... | 7-8 |
| California Public Health Goals (PHGs) | 7-8 |
| California State Action Levels..... | 7-8 |
| Drinking Water Health Advisories and Water Quality Advisories | 7-8 |
| Proposition 65 Safe Harbor Levels | 7-8 |
| California Toxics Rule (CTR) and National Toxics Rule (NTR) Criteria | 7-9 |
| National Ambient Water Quality Criteria..... | 7-9 |
| Agricultural Water Quality Limits | 7-9 |
| SURFACE WATER QUALITY | 7-9 |
| Department of Water Resources, (DWR)..... | 7-10 |
| US Geological Survey (USGS) | 7-10 |
| CSUC Sediment Budget | 7-11 |
| DWR 1982 | 7-12 |
| United States Forest Service (USFS) | 7-13 |
| Crane Mills Temperature Data | 7-13 |
| Surface Water Quality Summary | 7-13 |
| GROUNDWATER QUALITY | 7-21 |
| USGS Groundwater Data | 7-22 |
| DWR Groundwater Data | 7-22 |
| RWQCB GeoTracker | 7-22 |
| Groundwater Quality Summary..... | 7-24 |
| WATER QUALITY ISSUES..... | 7-24 |
| Ag Waivers..... | 7-24 |
| Landslides..... | 7-26 |
| Pesticide Use | 7-26 |
| Municipal Stormwater Runoff..... | 7-37 |
| CONCLUSIONS AND RECOMMENDATIONS..... | 7-30 |
| REFERENCES | 7-35 |

TABLES

| | | |
|-----|--|------|
| 7-1 | Beneficial Uses for Sacramento River and Thomas Creek..... | 7-4 |
| 7-2 | Water Quality Objectives for the Sacramento River Within the Watershed | 7-7 |
| 7-3 | Nine DWR Stations in Tehama West Watershed..... | 7-10 |
| 7-4 | Seven USGS Stations in Tehama West Watershed..... | 7-11 |
| 7-5 | DWR Station Information – Dissolved Analytes with Sample Results Exceeding the Reporting Limit (>RL) <u>OR</u> With Maximum Results >0..... | 7-14 |
| 7-6 | DWR Station Information – Non-Dissolved Analytes with Sample Results Exceeding the Reporting Limit (>RL) <u>OR</u> with Maximum Results >0 | 7-15 |

| | | |
|------|---|------|
| 7-7 | DWR Station Information – Analytes with Sample Results Exceeding the Reporting Limit (>RL) by Analyte | 7-16 |
| 7-8 | DWR Station Information – Analytes with Sample Results Exceeding the Reporting Limit (>RL) by Station | 7-17 |
| 7-9 | USGS Station Information – Analytes with Sample Results Exceeding the Reporting Limit (>RL) <u>OR</u> with Maximum Results >0..... | 7-18 |
| 7-10 | USGS Station Information – Parameters Exceeding the Reporting Limit (>RL)..... | 7-20 |
| 7-11 | USGS Station Information – Parameters Exceeding the Reporting Limit (>RL) by Station..... | 7-20 |
| 7-12 | Potential Sources and Causes of Water Quality Impairment..... | 7-21 |
| 7-13 | USGS Groundwater Quality Data, Multiple Locations | 7-23 |
| 7-14 | DWR Groundwater Quality Data, Multiple Locations..... | 7-23 |
| 7-15 | GeoTracker Site Summary | 7-24 |
| 7-16 | Exceedances for Toxicity Burch Creek at Woodson Ave | 7-26 |
| 7-17 | Trends in Shasta/Tehama Subwatersheds | 7-26 |
| 7-18 | Applicable Water Quality Objectives and Method Detection Limits for Analytes Monitored in the Agricultural Waiver Program at the Burch Creek Site | 7-28 |
| 7-19 | Pesticide Use by Sub-Unit | 7-29 |
| 7-20 | Irrigated Acres by Sub-Unit | 7-29 |
| 7-21 | Top 50 Crops and Sites for all Chemicals Used in Tehama County..... | 7-30 |
| 7-22 | Top 50 Pesticides Used on All Sites in Tehama County 2003..... | 7-33 |

FIGURES

| | |
|-----|--|
| 7-1 | DWR Stations |
| 7-2 | USGS Stations |
| 7-3 | Landslides – Mendocino National Forest |
| 7-4 | Pesticide Use |
| 7-5 | Irrigated Acres |
| 7-6 | 303(d) Listed Streams and Rivers |

APPENDICES

| | |
|-----|------------------------------|
| 7-1 | Crane Mills Temperature Data |
|-----|------------------------------|

Section 7

WATER QUALITY

Basic information on the surface water and groundwater quality of the Tehama West watersheds is presented in this section. Water rights and water use were discussed in section 6, “Hydrology.” Supporting information on surface and groundwater hydrology and geomorphology is summarized in Section 6. Supporting information on climate is summarized in Section 5, “Climate.”

Demographics and land use can have a pronounced effect on water quality; not only through the addition of contaminants to surface and groundwater, but through the use and management of soil and potential increases in sediment and nutrient loading over background levels. Sediment generation and the relationship between hydrology, geomorphology, and geology were discussed in Section 6. The eastern portions of these watersheds are underlain by rocks of the Great Valley Geomorphic Province. In general, this portion of the watershed is characterized by low elevations, low precipitation, relatively gentle topography, low erosion potential, and a significant groundwater reservoir. The western portion of the watershed is characterized by high elevations, high rainfall, and steep slopes with high erosion potential. Over time the transport of material from these rugged upland areas to the valley floor has resulted in the deposition of large alluvial fans and gravel reserves.

SOURCES OF DATA

Primary sources of data used in the preparation of this section are listed below. Additional information is provided in the references section.

- U.S. Geological Survey (USGS) stations for which water quality data was available
- Department of Water Resources, (DWR) stations for which water quality data was available
- Thomes Creek Watershed Study (DWR 1982)
- Thomes Creek Sediment Budget (CSUC 2004)
- Sacramento Valley Westside Tributary Watershed Erosion Study (DWR 1992)
- Coordinated AB3030 Groundwater Management Plan, Tehama County Flood Control and Water Conservation District (Law 1996)
- Water Inventory and Analysis Report, Tehama County Flood Control and Water Conservation District (CDM 2003)
- Tehama County: A Small Water Systems Drought Vulnerability Study (CDM 2005)
- Thomes Creek Watershed Assessment Analysis Report (USDA 1977)

- Data from the California Department of Pesticide Regulation
- Files from Crane Mills
- Water Quality Control Plan for the Central Valley/Sacramento River Basin.

HISTORICAL CONTEXT

Historical water quality in the watershed is unknown; however the primary constituents of concern would have likely been sedimentation and increases in temperature or dissolved oxygen resulting from drought or natural events.

Native Americans used fire as a tool to manage the landscape and the use of fire may have resulted in increased sedimentation or contribution of ash to watercourses. In the literature reviewed for the project, only the Thomes Creek Watershed Assessment prepared by the United States Forest Service (USFS) in 1997 provides any discussion of historical water quality and the discussion is limited to the impacts of land management on sediment. The USFS estimated that the frequent fires from Native American burning and natural causes “probably resulted in a significant volume of fine grained sediment eroding from the Watershed.” The following discussion was extracted from that document.

The first significant increase in erosion and sediment production in the watershed over the moderate levels, believed to have occurred at the time of California Indian use, probably occurred between the 1860s and 1917, with a peak around 1900, coincident with grazing in the watershed. The Thomes Creek Watershed is reported to have been one of the most heavily grazed watersheds in the Mendocino National Forest. Large bands of sheep were grazed on both private and public land by ranchers in the Paskenta and Newville areas (USDA 1977).

When the stockmen left the higher elevations and forested areas in the fall, they set fires to improve the browse for their livestock. The fires removed some of the grasses and herbaceous vegetation that protected the high-elevation soils. Many higher elevation soils lost their “A” horizon during this period, which changed the ability of the soil to support vegetation. The lack of surface vegetation resulted in rapid surface runoff, high soil erosion and sedimentation.

Control of grazing and effective fire suppression began in 1917, following the establishment of the Mendocino National Forest. Since the area of the Thomes Creek Watershed and the Tehama West Watershed as a whole within the forest is quite large, the increasing effectiveness of fire suppression likely had a major impact on total soil erosion and sediments leaving the watershed. Organic matter began to build up on the forest floor, resulting in soils with a higher organic component and lower pH. This change in soil structure and chemistry improved the water-holding capacity of the soil, and the increased organic duff slowed runoff, which helped reduce soil erosion. Currently, soils are believed to be more resistant to erosion than the soils in place when California Indians occupied the region, due to this build-up of organic matter (USDA 1977). The buildup of vegetation, however, also increased the potential for large wildfires in the watershed (USDA 1977).

The greatest and most rapid increase in erosion and sedimentation in the watershed likely occurred from 1950 through about 1970. This increase appears to be correlated with timber harvest and road building. Timber harvest began in the watershed during the 1950s and peaked in the 1960s and 1970s. By the 1960s soil disturbance was extensive over large areas of the watershed. A study conducted in 1982 calculated areas affected by timber harvest for four periods of time between 1952 and 1978 using aerial photographs. They found that while in 1952 only 7 percent of the watershed's area had been cut, by 1978, 38 percent of the watershed had been entered at least once for timber removal.

This was also a period of maximum road building. Roads remain major contributors of sediments in the watershed (USDA 1977). It was also during this time period that the largest recorded flood event in the watershed occurred. The effects of this naturally occurring event were exacerbated by the sharp increase in timber harvest and road building prior to its occurrence (USDA 1977).

The high levels of erosion and sediment production present in the 1960s began to decrease in the 1970s, and are now believed to be similar to those following the grazing period. This drop is due to decreased road construction, stabilization of the existing roadbeds, and decreased timber harvest. Other contributing factors are the partial recovery of streamside vegetation that had been wiped out by the 1964 flood, especially during the flood-free years of 1975 through 1978, and implementation of Best Management Practices (BMPs) and the California Forestry Practices Act during the 1970s and 1980s.

WATER QUALITY STANDARDS

California's water quality standards are based on the anticipated use of the water source. In addition, California has adopted a non-degradation policy (Resolution 68-16), which prohibits anyone from damaging or degrading water to a condition worse than its current status.

Section 303 of the Clean Water Act (CWA) (33 U.S.C. §1313) provides for promulgation of water quality standards by states. The standards consist of designating uses of water and then developing water quality criteria based on the designated uses (40 CFR §131.3(i)). The criteria are "elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use" (40 CFR §131.3(b)). Water quality standards for the watershed are presented in the *Water Quality Control Plan for the Sacramento and San Joaquin River Basin Plan* (RWQCB, 1998).

The CWA requires states to protect beneficial uses of waters in the United States within their jurisdictional boundaries. The CWA further requires states to adopt water quality criteria (referred to as "objectives" in California) that protect the designated "beneficial uses" of water bodies. The designated beneficial uses, the water quality criteria to protect those uses, and an anti-degradation policy constitute water quality standards. California adopts standards through the basin planning process. Basin Plans are adopted and amended by the Regional Water Quality Control Board (RWQCB) using a structured process involving peer review, public participation, state environmental review, and state and federal agency review and

approval. Designated beneficial uses are listed on Table II-1 of the Basin Plan. Only the Sacramento River and Thomas Creek have designated beneficial uses. If specific beneficial uses for a water body are not identified, the beneficial uses of the water body to which the water body is tributary apply. Beneficial uses applicable to the Tehama West Watershed are shown on Table 7-1.

| Table 7-1 BENEFICIAL USES FOR SACRAMENTO RIVER AND THOMES CREEK | | | | |
|--|---|--------------------------------|---------------------------------|--------------------------|
| Designation | Definition | Existing Beneficial Use | Potential Beneficial Use | No Beneficial Use |
| Municipal and Domestic Supply | MUN – Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply. | S | | T |
| Irrigation | AGR – Uses of water for farming, horticulture, or ranching including but not limited to, irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing. | S/T | | |
| Stock Watering | As defined for irrigation | S/T | | |
| Process | Proc – Uses of water for industrial activities that depend primarily on water quality. | | S | T |
| Service Supply | IND – Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization. | S | | T |
| Power | POW – Uses of water for hydropower generation. | S | T | |

**Table 7-1 (cont.)
BENEFICIAL USES FOR SACRAMENTO RIVER AND THOMES CREEK**

| Designation | Definition | Existing Beneficial Use | Potential Beneficial Use | No Beneficial Use |
|----------------------|--|--------------------------------|---------------------------------|--------------------------|
| Contact | 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. | S/T | | |
| Canoeing and Rafting | As defined for contact | S | | T |
| Other Noncontact | REC 2 – Uses of water for recreational activities involving proximity to water but where there is generally no body contact with water, nor any likelihood of ingestion of water. 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. | S/T | | |
| Warm | WARM – Uses of water that support warmwater ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife including invertebrates. | S/T | | |
| Cold | COLD – Uses of water that support coldwater ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates. | S/T | | |
| Warm (MIGR) | MIGR – Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as | | | T |

| Table 7-1 (cont.) BENEFICIAL USES FOR SACRAMENTO RIVER AND THOMES CREEK | | | | |
|--|--|-------------------------|--------------------------|-------------------|
| Designation | Definition | Existing Beneficial Use | Potential Beneficial Use | No Beneficial Use |
| | anadromous fish. | | | |
| Cold (MIGR) | As defined for Warm (MIGR) | S/T | | |
| Warm (MIGR) | SPWN – Uses of water that support high-quality aquatic habitats suitable for reproduction and early development of fish. | S/T | | |
| Cold (SPWN) | As defined for Warm (MIGR) | S/T | | |
| Wildlife Habitat | WILD – Uses of water that support terrestrial or wetland ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources. | S/T | | |
| | NAV – Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels. | S | | T |

The Basin Plan also establishes water quality objectives as required by the Porter-Cologne Water Quality Control Act. Under this act water quality objectives are defined as “...the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area” (Water Code Section 13050(h) as cited by RWQCB, 1998). Water quality objectives are set for a particular body of water, and include maximum and/or minimum allowable levels of several constituents. Water quality objectives are not established for specific tributaries in the watershed; however, certain constituents apply to the upper Sacramento River. These constituents, with their maximum and minimum allowable levels, relative time period, and applicable body of water, are shown in Table 7-2.

For constituents not included in the Basin Plan, water quality limits from other sources may apply. To be defensive, water quality limits should be chosen to implement all predictable water quality objectives and promulgated criteria. Water quality limits are found in many sources. Other sources of water quality limits applicable to the ground and surface water in the Tehama West Watershed follow as summarized from *A Compilation of Water Quality Goals* (RWQCB 2003a).

**Table 7-2
WATER QUALITY OBJECTIVES FOR THE SACRAMENTO RIVER
WITHIN THE WATERSHED**

| Constituent | Maximum Concentration /Level | Minimum Concentration /Level | Time Period | Applicable Water Body |
|---|-------------------------------------|-------------------------------------|---------------------|---|
| Arsenic | 0.01 (mg/l) | | | Sacramento River from Keswick Dam to I Street Bridge at City of Sacramento |
| Barium | 0.1 (mg/l) | | | As noted for Arsenic |
| Cadmium | 0.00022 (mg/l) | | | Sacramento River and its tributaries above State Highway 32 bridge at Hamilton City |
| Cyanide | 0.01 (mg/l) | | | As noted for Arsenic |
| Iron | 0.3 (mg/l) | | | As noted for Arsenic |
| Manganese | 0.05 (mg/l) | | | As noted for Arsenic |
| Silver | 0.01 (mg/l) | | | As noted for Arsenic |
| Dissolved Oxygen | | 9.0 mg/l | June 1 to August 31 | Sacramento River from Keswick Dam to Hamilton City |
| PH | 8.5 | 6.5 | | All |
| Electrical Conductivity (at 25°C) | 230 Micromhos/centimeter (µmhos/cm) | | | Sacramento River |
| Temperature | 56°F | | | Sacramento River from Shasta Dam to I Street Bridge |
| *See the Water Quality Control Plan for the Sacramento River and San Joaquin River Basin for a complete listing of all constituents, applicable water bodies, and minimum and maximum levels. | | | | |

Drinking Water Standards, Maximum Contaminant Levels (MCLs)

Drinking water MCLs are directly applicable to water supply systems and at the tap and are enforceable by the Department of Health Services (DHS) and local health departments. MCLs are components of the drinking water standards adopted by the Department of Health Services (DHS) pursuant to the California Safe Drinking Water Act. California MCLs may be found in Title 22 of the California Code of Regulations (CCR).

Primary MCLs are derived from health-based criteria. MCLs also include technologic and economic considerations based on the feasibility of achieving and monitoring for these concentrations in drinking water supply systems and at the tap.

Secondary MCLs are derived from human welfare considerations (e.g., taste, odor, laundry staining) in the same manner as Primary MCLs. California MCLs, both Primary and Secondary, are directly applicable to groundwater and surface water resources when they are specifically referenced as water quality objectives.

Maximum Contaminant Level Goals (MCL Goals or MCLGs)

MCL Goals are promulgated by the United States Environmental Protection Agency (USEPA) as part of the National Primary Drinking Water Regulations. MCL Goals represent the first step in establishing federal Primary MCLs and are required by federal statute to be set at levels that represent no adverse health risks. They are set at “zero” for known and probable human carcinogens, since theoretically a single molecule of such a chemical could present some degree of cancer risk. Threshold levels posing no risk of health effects are used for non-carcinogens and for possible human carcinogens. Because they are purely health-based, non-zero MCL Goals may be useful to interpret narrative water quality objectives which prohibit toxicity to human consumers.

California Public Health Goals (PHGs)

The California Safe Drinking Water Act of 1996 requires the California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA) to perform risk assessments and to adopt Public health goals for contaminants in drinking water based exclusively on public health considerations. PHGs represent levels of contaminants in drinking water that would pose no significant health risk to individuals consuming the water on a daily basis over a lifetime. For carcinogens, PHGs are based on 10^{-6} incremental cancer risk estimates.

California State Action Levels

Action levels are published by DHS for chemicals for which there is no drinking water MCL. State Action Levels are based mainly on health effects – an incremental cancer risk estimate of 10^{-6} for carcinogens and a threshold toxicity limit for other constituents. As with MCLs, the ability to quantify the amount of the constituent in a water sample using readily available analytical methods may cause action levels to be set at somewhat higher concentrations than purely health-based values.

Drinking Water Health Advisories and Water Quality Advisories

Health Advisories are published by USEPA for short-term (1-day exposure or less or 10-day exposure or less), long-term (7-year exposure or less), and lifetime human exposures through drinking water. Health advisories for non-carcinogens and for possible human carcinogens are calculated for chemicals where sufficient toxicologic data exist. Incremental cancer risk estimates for known and probably human carcinogens are also presented.

Proposition 65 Safe Harbor Levels

Safe harbor levels are established pursuant to the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) for known human carcinogens and reproductive toxins. Proposition 65, an initiative statute, made it illegal to expose persons to significant amounts of these chemicals without prior notification or to discharge significant amounts of these chemicals to sources of drinking water. These “significant amounts” are adopted by the OEHHA in regulations contained in Title 22 of the CCR, Division 2, Chapter 3. For

carcinogens, No Significant Risk Levels (NSRLs) are set at concentrations associated with a 1-in-100,000 (10^{-5}) incremental risk of cancer. These are the only California health-based limits derived from risk levels greater than 10^{-6} .

California Toxics Rule (CTR) and National Toxics Rule (NTR) Criteria

The CWA requires all states to have enforceable numerical water quality criteria applicable to priority toxic pollutants in surface waters. USEPA promulgated water quality criteria for priority toxic pollutants for California's inland surface waters and enclosed bays and estuaries in federal regulations called the "California Toxics Rule." Included are criteria to protect both human health and aquatic life, similar to those published in the *National Ambient Water Quality Criteria*, discussed below. The CTR criteria, along with the beneficial use designations in the Basin Plans, are directly applicable water quality standards for toxic pollutants in these waters under Section 304(c) of the federal Clean Water Act. Implementation provisions for these standards may be found in the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (SWRCB Resolution No. 2000-015), adopted by the State Water Board in March 2000. The policy includes time schedules for compliance, provisions for mixing zones, analytical methods and reporting levels.

National Ambient Water Quality Criteria

These criteria, also called the national Recommended Water Quality Criteria, are developed by USEPA under Section 304(a) of the federal Clean Water Act to provide guidance to the states in developing water quality standards under Section 304(c) of the Act and to interpret narrative toxicity standards. These criteria are designed to protect human health and welfare and aquatic life from pollutants in freshwater and marine surface waters. In April 1999 and November 2002, USEPA published tables of *National Recommended Water Quality Criteria*, which summarize criteria from the sources discussed above and more recent updates. Due to their age and changes in methods used to derive the criteria, Blue Book criteria no longer appear in these summary tables.

Agricultural Water Quality Limits

Water Quality for Agriculture, Published by the Food and Agriculture Organization of the United Nations in 1985, contains limits protective of various agricultural uses of water, including irrigation of various types of crops and stock watering. Above these limits, specific agricultural uses of water may be adversely affected. These limits may be used to translate narrative water quality objectives that prohibit chemical constituents in concentrations that would impair agricultural uses of water.

SURFACE WATER QUALITY

The primary sources of surface water data in the watershed are from DWR and USGS monitoring stations. Other data is available on specific tributaries such as the Thames Creek Sediment Budget (CSUC 2004), Sacramento Valley Watershed Coalition sampling at Burch Creek, and Crane Mills temperature data in Thames Creek.

Department of Water Resources (DWR)

DWR monitored nine stations on four streams: Elder, Red Bank, Reeds, and Thomes Creeks. Station locations are shown on Figure 7-1. Downloaded data includes over 2,500 individual samples of nearly 200 analytes over a seven-year period from 1998 to 2005 (DWR data downloaded from <http://wdl.water.ca.gov/wq-gst/>). Of the nearly 200 analytes sampled only 50 have results that exceed the Reporting Limit (RL) or whose maximum result is greater than zero. Where possible, limits for each analyte were established using the Basin Plan, the Environmental Protection Agency's (EPA) Water Quality criteria, and the CTR. The minimum, maximum, average, and standard deviation of the sample results of each of these analytes was calculated and then compared to the RLs determined by DWR. These limits were exceeded on five analytes at six stations. These included dissolved aluminum, dissolved iron, pH, total dissolved solids, and water temperature. Station information is included in Table 7-3. Results are shown on Tables 7-5 and 7-6 and summarized on Tables 7-7 and 7-8.

US Geological Survey (USGS)

USGS monitored seven stations on three streams including Red Bank, Elder, and Thomes Creeks at different periods from 1958 to 2000. The downloaded data includes over 10,000 individual samples of 94 parameters over the 22-year period (USGS data downloaded from <http://nwis.waterdata.usgs.gov/usa/nwis/qwdata>). USGS stations are included on Figure 7-2. Of the 94 parameters sampled 88 have results that are greater than the RL. Again, where possible, limits for each parameter were established using the Basin Plan, EPA's Water Quality Criteria, and the CTR. The minimum, maximum, average, and standard deviation of each parameter were calculated and then compared to these limits. These limits were exceeded on five parameters at five USGS stations. These included temperature, turbidity, specific conductance, pH, and chloride. Station information is included as Table 7-4. Results are shown on Tables 7-9 and summarized on Tables 7-10 and 7-11.

| Station Number | Station Name | Lat. | Long. | Period of Sampling | Number of Samples |
|-----------------------|--|-------------|--------------|---------------------------|--------------------------|
| A0332000 | Elder Creek at Gerber | 40.0511 | -122.1514 | 3/7/2001-7/26/2005 | 574 |
| A0335000 | Elder Creek near Henleyville | 40.0322 | -122.2900 | 5/29/1998-5/8/2001 | 54 |
| A0340500 | Red Bank Creek at Rawson | 40.1403 | -122.2383 | 3/6/2001-6/28/2005 | 475 |
| A0346000 | Red Bank Creek near Red Bluff | 40.0900 | -122.4125 | 5/28/1998-2/7/2001 | 26 |
| A3471000 | Red Bank Creek North Fork at Bell Road | 40.1350 | -122.5200 | 5/29/1998-5/29/1998 | 11 |
| A0025700 | Reeds Creek at Red Bluff | 40.1686 | -122.2369 | 3/6/2001-6/28/2005 | 516 |
| A0321800 | Thomes Creek at Hall Road | 39.9853 | -122.1233 | 3/7/2001-6/28/2005 | 514 |
| A0325500 | Thomes Creek at Henleyville | 39.9564 | -122.3292 | 5/19/2004-5/19/2004 | 31 |
| A0350000 | Thomes Creek at Paskenta | 39.8878 | -122.5281 | 5/28/1998-4/10/2002 | 336 |

| Table 7-4 SEVEN USGS STATIONS IN TEHAMA WEST WATERSHED | | |
|---|--|----------------------|
| Station Number | Station Number | Sampling Period |
| 11378800 | Red Bank Creek near Red Bluff | 12/5/1960-5/4/1966 |
| 11378860 | Red Bank Creek at Rawson Rd. Bridge near Red Bluff | 12/26/196-34/15/1969 |
| 11380500 | Elder Creek at Gerber | 12/6/1960-3/28/1979 |
| 11379500 | Elder Creek near Paskenta | 10/2/1958-1/19/2000 |
| 11382090 | Thomes Creek at Rawson Rd. Bridge near Richfield | 1/31/1977-4/8/1980 |
| 11382100 | Thomes Creek near Mouth near Corning | 12/6/1960-7/6/1966 |
| 11382000 | Thomes Creek at Paskenta | 10/2/1958-5/4/1983 |

Note: Table includes stations with > 1 sampling event

CSUC Sediment Budget

A study completed by California State University, Chico proclaimed the Thomes Creek watershed as “one of the highest sediment-producing streams in the western Sacramento Valley.” The objective of the study was to develop a sediment budget for Thomes Creek to determine if gravel extraction operations in the lower reaches of the creek below the I-5 Bridge were depleting the resource. The following four paragraphs were extracted from the executive summary of the report.

The Thomes Creek watershed is one of the highest sediment-producing streams in the western Sacramento Valley of Northern California. Consequently, sand and gravel mining is one of the major land uses in the lower watershed. Mining from the creekbed may not be without impacts, however. According to the California Department of Fish and Game (1993), mining, especially in the reach between the I-5 Bridge and Sacramento River confluence has resulted in local changes in channel cross-section as well as changes in stream stability. These alterations are postulated to have impaired migration of adult salmonids, diminished the availability of suitable spawning sites, altered the movement of spawning gravel, and increased the volume of suspended solids present in the water. In light of these concerns, and to develop effective management strategies for sustainable mining practices of sand and gravel in Thomes Creek, we have constructed a quantitative sediment budget for the Thomes Creek watershed. Our analysis indicates that although average annual bedload discharges are insufficient to replace the volume of sediments either permitted to be or historically mined annually, sediment stored in the channel during high-flow events may be sufficient to maintain mining operations in subsequent years under current permitted volumes and practices.

In the current analysis, we have identified two sources of sediment in the Thomes Creek channel: mass wasting in the upper watershed, especially in the steeply sloped area between the Gorge and the Slab, and remobilization of sediment previously stored in the channel. Slope failures as debris slides, block slides, rotational/translational slides, debris avalanches and rock slides/rock falls are common and widespread. Most of the sediment entering the channel is derived from debris slides fed by large, deep-seated rotational/translational slides located upslope; examination of sequential aerial photographs reveal that the same locations

tend to fail year after year. Debris slides deliver all sizes of sediment to the channel, from clay to boulders. Much of the sediment that moves out of the upper watershed during high flow events is trapped in the lower watershed as channel lag, bars and terraces. We estimate that over 309,000,000 yd³ [cubic yards] of sediment currently reside in the active portion of the Thames Creek channel. Sedimentologic analysis of modern channel deposits indicate unsystematic downstream fining in pebbles, cobbles and boulders coupled with an increase in the relative proportions of sand, silt and clay in the downstream direction, ranging from approximately 30% in the vicinity of the Slab crossing and Paskenta to 43% at Flournoy and up to 60% at Henleyville and Rawson Road. Flanking the active channel are terraces of various ages whose relative stability is indicated by the presence of soil development.

To construct a sediment budget for the watershed, the estimated 89,700 yd³/yr of sediment delivered to the Thames Creek channel in the upper watershed was routed downstream on a reach-by-reach basis utilizing the bedload rating curves derived for each measured cross-section in conjunction with yearly flood flows. Results of our calculations indicate that bedload transport rates are highly variable, both as a function of location and time, and the use of average annual bedload transport rates calculated from yearly estimates tend to disguise the wide variability inherent in the Thames Creek system. Of the sediment delivered to the channel in the upper watershed, approximately 75,200 yd³/yr is transported at the Slab, 45,000 yd³/yr [cubic yards per year] is transported at Paskenta, 24,300 yd³/yr moves through the Flournoy, 25,300 yd³/yr moves past Henleyville and about 44,000 yd³/yr passes under the Rawson Road bridge.

The greatest amounts of sand and gravel are transported downstream during high discharge events, which typically have fairly low recurrence intervals. Exceedence probabilities and return periods for Thames Creek flows recently calculated using 75 years of annual discharge data indicate that discharges of about 10,000 cfs have an average return period of between two and five years. The 10-year flood has an associated discharge of 19,500 cfs, while the 25-year and 50-year floods have discharges of approximately 27,000 cfs and 33,000 cfs, respectively. At 20,000 cfs the Thames Creek channel on average is capable of transporting nearly 100,000 yd³ of sediment per day. Because of the proportionate increase in sand in the downstream reaches, much of the sediment that will be transported to the mining sites under higher flood flows will be sand-sized or finer. We estimated the relative sizes of particles transported in each reach as the fraction available, rescaled to preclude the sizes not transported, times the total yearly average bedload discharge. Transport of sand and finer sediment as bedload at Rawson Road may average 30,500 yd³/yr or more, comprising nearly 70% of the total sediment load (CSUC 2004).

DWR 1982

The most complete assessment of sources and causes of high sediment yield in the Thames Creek upper watershed was from the two-year study by Howard and Varnum (1982). The authors found that most sediment entering the creek channel in the upper watershed comes from landslides along the main channel and tributaries. The authors identified that the landslides are caused by a combination of unstable geology, (particularly within the South Fork Mountain Schist and Valentine Spring formations), steep slopes, intense precipitation, (including large storm events), snowmelt, or small, late spring storms; and human activities

such as timber harvesting and road construction. Movement of unconsolidated material is exacerbated by high flows, generally in excess of 17,600 cfs as gauged at Paskenta. These flows carry high volumes of sediment that aggrade the channel and lead to undercutting of the streambanks, thus initiating sliding. Minor amounts of sediment are delivered to the Thomes Creek channel by rock slides within the gorge, by large, deep-seated translation-rotational slides in the middle watershed, which probably date from the late Pliocene to mid-Quaternary, from gutted stream channels scoured by debris torrents in long, straight, steep tributaries to Thomes Creek, and by soil mantle creep in the upper watershed, especially on south-facing slopes.

United States Forest Service (USFS)

The USFS conducted a landslide inventory in the Mendocino National Forest. Active results of the inventory are shown on Figure 7-3. The inventory identified 16,970 acres of active or dormant slides in the Thomes Creek Drainage and 3,221 acres of active or dormant landslides in the Elder Creek drainage.

Crane Mills Temperature Data

Crane Mills has monitored water temperature at two locations in Thomes Creek (Upper Thomes Creek at the bridge and Lower Thomes Creek at the Slab). Data was collected from 1995 through 2002 from approximately June 15 to November 15 of each year. The Data sheets supplied as records of this work are included in an appendix to this section. In general the data reflects seasonal snowmelt in June with average temperatures near 50°F in both upper and lower locations. As the summer progresses and base flow conditions occur, the temperatures rise consistently with average air temperature such that the lower Thomes Creek location temperatures increases from 5° to 10° over the temperature at the upper location.

Surface Water Quality Summary

DWR and USGS monitoring have recorded analytes that have exceeded their limits on Elder, Red Bank, Reeds, and Thomes Creeks for dissolved aluminum, dissolved iron, pH, total dissolved solids, water temperature, turbidity, specific conductance, and chloride. However, overall water quality in the watershed is good.

Sediment loading in Thomes Creek continues to be a problem. Studies conducted by CSUC and DWR attribute sediment loading to landslides and remobilization of sediment. Concerns caused by sediment include changes in channel cross-section, changes in stream stability, impaired salmonid migration and spawning sites, and increased volume of suspended solids.

The potential sources and causes of water quality impairment vary from subwatershed to subwatershed. Table 7-12 lists potential sources and causes of water quality impairment.

**Table 7-5
DWR STATION INFORMATION – DISSOLVED ANALYTES WITH SAMPLE RESULTS EXCEEDING
THE REPORTING LIMIT (>RL) OR WITH MAXIMUM RESULTS > 0**

| Constituent | Number of Samples | Result | | | | Basin Plan Limit (ug/l) | CTR (l) (ug/l) | | Federal MCL (ug/l) | | CA MCL (ug/l) | |
|-------------------------------|-------------------|---------|---------|---------|--------------------|-------------------------|----------------|---------------|--------------------|-----------|---------------|-----------|
| | | Minimum | Maximum | Average | Standard Deviation | | Contin. Acute | 4 Day Chronic | Primary | Secondary | Primary | Secondary |
| Ammonia (mg/l as N) | 54 | 0 | 0.04 | 0.00 | 0.01 | | | | | | | |
| Arsenic (µg/l) | 28 | 0.349 | 1.54 | 0.67 | 0.30 | 10 | 340 | 150 | 10 | | 50 | |
| Boron (mg/l) | 62 | 0 | 0.6 | 0.01 | 0.08 | | | | | | | |
| Calcium (mg/l) | 62 | 2 | 52 | 26.68 | 10.05 | | | | | | | |
| Chloride (mg/l) | 62 | 0 | 74 | 7.18 | 10.90 | | | | | 250,000 | | 250,000 |
| Chromium (µg/l) | 28 | 0.37 | 7.12 | 1.85 | 1.37 | | 550 | 180 | 100 | | | 50 |
| Copper (µg/l) | 28 | 0.46 | 5.22 | 1.08 | 0.93 | 5.6 | 13 | 9 | 1300 | 1000 | 1300 | 1000 |
| Iron (µg/l) | 28 | 0 | 1525 | 97.42 | 291.60 | 300 | | | | 300 | | 300 |
| Lead (µg/l) | 28 | 0 | 0.647 | 0.04 | 0.12 | | 65 | 2.5 | 15 | | 15 | |
| Magnesium (mg/l) | 62 | 1 | 38 | 14.06 | 7.99 | | | | | | | |
| Manganese (µg/l) | 28 | 0.21 | 21.4 | 2.05 | 3.96 | 50 | | | | 50 | | 50 |
| Nitrate (mg/l) | 9 | 0 | 2 | 0.64 | 0.61 | | | | 10,000 | | 45,000 | |
| Nitrite + Nitrate (mg/l as N) | 62 | 0 | 1.1 | 0.11 | 0.20 | | | | 1000 | | 1000 | |
| Organic Nitrogen (mg/l as N) | 3 | 0.1 | 0.6 | 0.30 | 0.26 | | | | | | | |
| Ortho-phosphate (mg/l as P) | 48 | 0 | 0.14 | 0.02 | 0.03 | | | | | | | |
| Potassium (mg/l) | 62 | 0.5 | 1.9 | 0.92 | 0.33 | | | | | | | |
| Sodium (mg/l) | 62 | 2 | 35 | 9.39 | 6.61 | | | | | | | |
| Sulfate (mg/l) | 62 | 2 | 46 | 14.34 | 10.39 | | | | 500,000 | 250,000 | | 250,000 |
| Zinc (µg/l) | 28 | 0 | 3.37 | 0.38 | 0.63 | 16 | 120 | 180 | | 5000 | | 5000 |

Notes: (1) CTR values vary by hardness for freshwater life or lowest shown.
Blank spaces denote no current State or Federal value available.

**Table 7-6
DWR STATION INFORMATION – NON- DISSOLVED ANALYTES WITH SAMPLE RESULTS EXCEEDING
THE REPORTING LIMIT (>RL) OR WITH MAXIMUM RESULTS > 0**

| Constituent | Number of Samples | Result | | | | Basin Plan Limit (ug/l) | CTR (ug/l) | | Federal MCL (ug/l) | | CA MCL (ug/l) | |
|-----------------------------|-------------------|---------|---------|---------|--------------------|-------------------------|---------------|---------------|--------------------|-----------|---------------|-----------|
| | | Minimum | Maximum | Average | Standard Deviation | | Contin. Acute | 4 Day Chronic | Primary | Secondary | Primary | Secondary |
| Hardness (mg/l as CaCO3) | 58 | 11 | 262 | 133.93 | 53.53 | | | | | | | |
| Ortho-phosphate (mg/l as P) | 14 | 0 | 0.23 | 0.05 | 0.06 | | | | | | | |
| pH (units) | 40 | 6.4 | 8.8 | 7.57 | 0.61 | 6.5 | | | | 6.5-8.5 | | |
| Alkalinity (mg/l as CaCO3) | 30 | 56 | 225 | 136.73 | 40.77 | | | | | | | |
| Arsenic (µg/l) | 30 | 0.431 | 2.97 | 0.81 | 0.49 | 10 | 340 | 150 | 10 | | 50 | |
| Cadmium (µg/l) | 30 | 0 | 0.138 | 0.01 | 0.03 | 0.22 | 2 | 0.25 | 5 | | 5 | |
| Calcium (mg/l) | 38 | 15 | 50 | 29.66 | 9.44 | | | | | | | |
| Chromium (µg/l) | 30 | 0.66 | 36.4 | 4.09 | 7.14 | | 550 | 180 | 100 | | 50 | |
| Copper (µg/l) | 30 | 0.47 | 31.2 | 2.63 | 5.74 | 5.6 | 13 | 9 | 1300 | 1000 | 1300 | 1000 |
| Dissolved Solids (mg/l) | 63 | 38 | 317 | 172.49 | 64.56 | 125 | | | 500 | | 500 | |
| Hardness (mg/l as CaCO3) | 8 | 54 | 222 | 108.00 | 57.45 | | | | | | | |
| Iron (µg/l) | 30 | 0 | 17775 | 1169.35 | 3468.98 | 300 | | | | 300 | | 300 |
| Lead (µg/l) | 30 | 0 | 6.34 | 0.37 | 1.18 | | 65 | 2.5 | | 15 | | 15 |
| Magnesium (mg/l) | 38 | 4 | 37 | 15.82 | 7.48 | | | | | | | |
| Manganese (µg/l) | 30 | 0.23 | 443 | 31.11 | 86.83 | 50 | | | | 50 | | 50 |
| Suspended Solids (mg/l) | 58 | 0 | 680 | 40.75 | 111.64 | | | | | | | |
| Zinc (µg/l) | 30 | 0 | 45 | 3.11 | 8.61 | 16 | 120 | 120 | | 5000 | | 5000 |
| Temperature °C | 8 | 6 | 26 | 13.58 | 7.43 | 21.1 | | | | | | |

Notes: (1) CTR values vary by hardness for freshwater life or lowest shown.
Blank spaces denote no current State or Federal value available.

**Table 7-7
DWR STATION INFORMATION – ANALYTES WITH SAMPLE RESULTS EXCEEDING
THE REPORTING LIMIT (>RL) BY ANALYTE**

| Constituent | Number of Samples | Result | | | | Basin Plan Limit (ug/l) | Federal MCL (ug/l) | | CA MCL (ug/l) | |
|-------------------------------|-------------------|---------|---------|---------|--------------------|-------------------------|--------------------|-----------|---------------|-----------|
| | | Minimum | Maximum | Average | Standard Deviation | Acute | Primary | Secondary | Primary | Secondary |
| Dissolved Aluminum (µg/L) | 28 | 0.94 | 2572 | 151.87 | 484.78 | | | 50 – 200 | 1000 | 200 |
| Dissolved Iron (µg/L) | 28 | 0 | 1525 | 97.42 | 291.60 | 300 | | 300 | | 300 |
| pH(units) | 40 | 6.4 | 8.8 | 7.57 | 0.61 | 6.5 | | 6.5-8.5 | | |
| Total Dissolved Solids (mg/l) | 63 | 38 | 317 | 172.49 | 64.56 | 125 | | 500,000 | | 500,000 |
| Temperature °C | 8 | 6 | 26 | 13.58 | 7.43 | 21.1 | | | | |

Blank spaces denote no current State or Federal value available.

**Table 7-8
DWR STATION INFORMATION – ANALYTES WITH SAMPLE RESULTS
EXCEEDING THE REPORTING LIMIT (>RL) BY STATION**

| Station Name | Parameter | Number of Samples | Minimum | Maximum | Average | Standard Deviation |
|----------------------------|-------------------------------|--------------------------|----------------|----------------|----------------|---------------------------|
| Elder Creek at Gerber | Dissolved Iron (µg/l) | 8 | 0 | 398 | 60.50 | 137.10 |
| | pH (units) | 9 | 6.6 | 8.8 | 7.66 | 0.73 |
| | Total Dissolved Solids | 12 | 110 | 317 | 186.58 | 52.08 |
| Elder Creek at Henleyville | Total Dissolved Solids (mg/l) | 3 | 148 | 239 | 179.67 | 51.42 |
| Red Bank Creek at Rawson | Total Dissolved Solids (mg/l) | 14 | 165 | 284 | 245.57 | 37.36 |
| Reeds Creek at Red Bluff | Total Dissolved Solids (mg/l) | 12 | 107 | 210 | 166.92 | 36.42 |
| Thomes Creek at Hall Road | Dissolved Aluminus (µg/l) | 7 | 30.5 | 2572 | 415.76 | 951.05 |
| | Dissolved Iron (µg/l) | 7 | 0 | 1525 | 246.93 | 563.91 |
| | pH (Units) | 7 | 6.4 | 8.1 | 7.06 | .052 |
| | Total Dissolved Solids (mg/l) | 11 | 99 | 199 | 134.45 | 31.39 |
| Thomes Creek at Paskenta | Total Dissolved Solids (mg/l) | 9 | 65 | 276 | 112.00 | 64.82 |
| | Temperature °C | 8 | 6 | 26 | 13.58 | 7.43 |

**Table 7-9
USGS STATION INFORMATION –ANALYTES WITH SAMPLE RESULTS EXCEEDING
THE REPORTING LIMIT (>RL) OR WITH MAXIMUM RESULTS > 0**

| Constituent | Number of Samples | Result | | | |
|---|-------------------|---------|---------|---------|--------------------|
| | | Minimum | Maximum | Average | Standard Deviation |
| Acid neutralizing capacity (mg/l as CaCO ₃) | 112 | 40 | 210 | 99.38 | 39.59 |
| Ammonia (mg/l as N) | 1 | 0.8 | 0.8 | 0.80 | |
| Bicarbonate (mg/l) | 399 | 49 | 286 | 143.47 | 53.57 |
| Boron (mg/l) | 399 | 0 | 400 | 62.53 | 74.98 |
| Carbonate (mg/l) | 356 | 0 | 19 | 3.13 | 3.85 |
| Carbon dioxide (mg/l) | 20 | 1.2 | 3.4 | 2.07 | 0.73 |
| Calcium (mg/l) | 95 | 4.6 | 99 | 33.45 | 15.26 |
| Chloride (mg/l) | 399 | 0 | 660 | 30.21 | 73.14 |
| Dissolved oxygen (mg/l) | 143 | 7.3 | 15 | 10.91 | 1.60 |
| Hardness (mg/l as CaCO ₃) | 400 | 44 | 540 | 152.56 | 70.78 |
| Iron (µg/l) | 5 | 0 | 30 | 6.00 | 13.42 |
| Magnesium (mg/l) | 95 | 2 | 70 | 16.11 | 12.81 |
| Nitrate (mg/l) | 1 | 0.8 | 0.8 | 0.80 | |
| Nitrate, NO ₃ (mg/l) | 131 | 0 | 4.9 | 0.58 | 0.75 |
| Manganese (µg/l) | 30 | 0.23 | 443 | 31.11 | 86.83 |
| Orthophosphate (mg/l as P) | 23 | 0 | 0.02 | 0.01 | 0.01 |
| pH (units) | 439 | 7.4 | 8.8 | 8.22 | 0.26 |
| Phosphorus (mg/l) | 1 | 2.5 | 2.5 | 2.50 | |
| Phosphate (mg/l) | 21 | 0 | 3.5 | 0.40 | 0.94 |
| Potassium (mg/l) | 94 | 0.2 | 4.4 | 1.02 | 0.68 |
| Sodium (mg/l) | 401 | 2 | 232 | 17.33 | 28.52 |
| Sulfate (mg/l) | 89 | 1.9 | 95 | 21.87 | 19.92 |
| Fluoride (mg/l) | 29 | 0 | 0.2 | 0.10 | 0.08 |

**Table 7-9 (cont.)
USGS STATION INFORMATION –ANALYTES WITH SAMPLE RESULTS EXCEEDING
THE REPORTING LIMIT (>RL) OR WITH MAXIMUM RESULTS > 0**

| Constituent | Number of Samples | Result | | | |
|--|-------------------|---------|---------|----------|--------------------|
| | | Minimum | Maximum | Average | Standard Deviation |
| Silica (mg/l) | 76 | 8.2 | 40 | 14.13 | 4.67 |
| Specific conductance (ms/cm) | 474 | 96 | 2420 | 352.00 | 250.98 |
| Strontium (mg/l) | 1 | 20 | 20 | 20.00 | |
| Suspended sediment (<0.063 mm) sieve | 120 | 15 | 100 | 75.37 | 17.38 |
| Suspended sediment (<0.125 mm) sieve | 113 | 18 | 100 | 80.99 | 15.41 |
| Suspended sediment (<0.25 mm) sieve | 105 | 27 | 100 | 87.51 | 12.96 |
| Suspended sediment (<0.5 mm) sieve diameter | 94 | 66 | 100 | 94.37 | 7.42 |
| Suspended sediment (<1 mm) sieve diameter | 73 | 79 | 100 | 97.58 | 4.18 |
| Suspended sediment (<2 mm) sieve diameter | 37 | 94 | 100 | 99.49 | 1.37 |
| Suspended sediment (<0.002 mm) fall diameter | 138 | 1 | 65 | 22.75 | 10.50 |
| Suspended sediment (<0.004 mm) fall diameter | 175 | 5 | 84 | 30.06 | 12.61 |
| Suspended sediment (<0.008 mm) fall diameter | 161 | 8 | 94 | 40.29 | 14.61 |
| Suspended sediment (<0.016 mm) fall diameter | 175 | 10 | 99 | 51.09 | 15.02 |
| Suspended sediment (<0.031 mm) fall diameter | 161 | 11 | 99 | 61.01 | 14.66 |
| Suspended sediment (<0.063 mm) fall diameter | 136 | 42 | 100 | 70.29 | 14.17 |
| Suspended sediment (<0.125 mm) fall diameter | 133 | 46 | 100 | 79.47 | 12.20 |
| Suspended sediment (<0.25 mm) fall diameter | 131 | 57 | 100 | 89.14 | 8.90 |
| Suspended sediment (<0.5 mm) fall diameter | 119 | 80 | 100 | 96.65 | 4.21 |
| Suspended sediment (<2 mm) fall diameter | 93 | 97 | 100 | 99.67 | 0.74 |
| Suspended sediment concentration (mg/l) | 634 | 0 | 44100 | 1218.62 | 3332.33 |
| Suspended sediment discharge (tpd) | 625 | 0 | 1520000 | 15910.75 | 79134.68 |
| Temperature °C | 816 | 0 | 55 | 11.14 | 6.35 |
| Turbidity (JTU) | 70 | 0 | 200 | 13.76 | 33.28 |
| Turbidity (mg/l as SiO ₂) | 37 | 0 | 500 | 59.47 | 110.31 |
| Turbidity (NTU) | 24 | 0 | 800 | 40.54 | 162.91 |

Notes: CTR values vary by hardness

Table 7-10
USGS STATION INFORMATION – PARAMETERS EXCEEDING THE REPORTING LIMIT (>RL)

| Constituent | Number of Samples | Result | | | | |
|------------------------------|-------------------|---------|---------|---------|--------------------|-------------|
| | | Minimum | Maximum | Average | Standard Deviation | Basin Limit |
| Temperature °C | 816 | 0 | 55 | 11.14 | 6.35 | 21.1 |
| Turbidity (NTU) | 24 | 0 | 800 | 40.54 | 162.91 | 150 |
| Specific conductance (mS/cm) | 474 | 96 | 2420 | 352.00 | 250.98 | |
| pH (units) | 439 | 7.4 | 8.8 | 8.22 | 0.26 | 8.5 |
| Chloride (mg/l) | 399 | 0 | 660 | 30.21 | 73.14 | |

Table 7-11
USGS STATION INFORMATION – PARAMETERS EXCEEDING THE REPORTING LIMIT (>RL) BY STATION

| Station Name | Parameter | Number of Samples | Minimum | Maximum | Average | Standard Deviation |
|--|---------------------------------------|-------------------|---------|---------|---------|--------------------|
| Red Bank Creek near Red Bluff | pH (units) | 39 | 8.1 | 8.6 | 8.36 | 0.13 |
| Red Bank Creek at Rawson Rd. Bridge near Red Bluff | Temperature °C | 286 | 1.7 | 31.1 | 10.36 | 3.09 |
| Elder Creek near Paskenta | Temperature °C | 113 | 1.1 | 31.1 | 11.96 | 6.21 |
| | Specific conductance (mS/cm at 25 °C) | 85 | 166 | 2420 | 613.09 | 444.53 |
| | pH (units) | 70 | 8 | 8.8 | 8.44 | 0.18 |
| | Chloride (mg/l) | 85 | 1.8 | 660 | 99.97 | 136.40 |
| Elder Creek at Gerber | pH (units) | 49 | 7.6 | 8.8 | 8.41 | 0.22 |
| Thomes Creek at Paskenta | Temperature °C | 303 | 0 | 55 | 12.07 | 8.99 |
| | Turbidity (NTU) | 24 | 0 | 800 | 40.54 | 162.91 |
| | pH (units) | 227 | 7.5 | 8.6 | 8.09 | 0.24 |

Notes: CTR values vary by hardness
Blank spaces indicate no current state or federal value available.

| Source of Contamination | Pollutant or Stressor | Possible Sources |
|-------------------------|---|---|
| General | Dissolved minerals | Mineral deposits, mineralized waters, hot springs, seawater intrusion |
| | Asbestos | Mine tailings, serpentinite formations |
| | Hydrogen sulfide | Subsurface organic deposits, such as peat soils in Delta islands |
| | Metals | Mine tailings |
| | Microbial agents | Wildlife |
| | Radon | Geologic formations |
| Commercial businesses | Gasoline | Service stations' underground storage tanks |
| | Solvents | Dry cleaners, machine shops |
| | Metals | Photo processors, laboratories, metal planting works |
| Municipal | Microbial agents | Sewage discharges, storm water runoff |
| | Pesticides | Storm water runoff; golf courses |
| | Nutrients | Storm water runoff |
| Industrial | SOCs industrial solvents, metals, acids | Electronics manufacturing, metal fabricating and planting, transformers, storage facilities, hazardous waste disposal |
| | Pesticides | Chemical formulating plants |
| | Wood preservatives | Plants that pressure treat power poles, wood pilings, railroad ties |
| Solid waste disposal | Solvents, pesticides, metals, organics, petroleum wastes, microbial agents, household waste | Disposal sites receive waste from a variety of industries, municipal solid wastes, petroleum products |
| Agricultural | Pesticides, fertilizers, concentrated mineral salts, microbial agents, sediment, nutrients | Tailwater runoff, agricultural chemical applications, fertilizer usage, chemical storage at farms and applicators; air strips, packing sheds and processing plants, dairies, feed lots, pastures |
| Disasters | Solvents petroleum products, microbial agents, other hazardous materials | Earthquake-caused pipeline and storage tank failures and damage to sewage treatment and containment facilities, major spills of hazardous materials, floodwater contamination of storage reservoirs and groundwater sources |

Source: DWR 1998

GROUNDWATER QUALITY

The primary sources of groundwater data in the watershed are from the RWQCB, DWR and USGS monitoring stations, and various reports compiled by DWR.

The Sacramento River Basinwide Water Management Plan was developed by DWR in 2003 as a comprehensive assessment of the occurrence, movement, and chemistry of groundwater in portions of the Sacramento Valley. The report contains an analysis of groundwater quality in the Sacramento Valley based primarily on existing data collected from DWR's groundwater quality monitoring wells and a generalized characterization by USGS.

In 1993, USGS evaluated the general water quality of the Redding Groundwater Basin. Approximately one-third of the Tehama West Watershed is located within this basin. The report concluded that for the majority of the basin groundwater quality was considered good to excellent for most uses. Areas of poor water quality are largely limited to the margins of the basin. In these areas, shallow wells within marine sedimentary rock of the Great Valley Sequence tend to have high salinity levels. For the central portions of the basin, the groundwater geochemistry is characterized as magnesium-calcium bicarbonate (DWR 2003).

In the Sacramento Valley Groundwater Basin water quality is generally characterized as calcium-magnesium bicarbonate. Isolated areas may contain sodium bicarbonate, calcium bicarbonate, and magnesium bicarbonate water types.

USGS Groundwater Data

Groundwater samples were collected sporadically in the study area from 1957 to 1997. Table 7-13 summarizes the analytical results obtained from these groundwater sampling events, presenting minimum, maximum, and average values for each constituent, as well as EPA, RWQCB, and California domestic limits for these constituents, where applicable. No constituents exceeded the California maximum contamination for drinking water.

DWR Groundwater Data

The groundwater chemistry in the watershed shows little variability. Groundwater samples were collected over a two month period in late 2000. Table 7-14 summarizes the analytical results obtained from these groundwater sampling events, presenting minimum, maximum, and average values for each constituent.

Due to the short time period of the sampling conducted by DWR, it is difficult to determine any water quality trends in the watershed. More studies are recommended so that water quality trends can be established.

RWQCB GeoTracker

GeoTracker is a geographic information system (GIS) maintained by the RWQCB that provides online access to environmental data. GeoTracker is the interface to the Geographic Environmental Information Management System (GEIMS), a data warehouse which tracks regulatory data about underground fuel tanks, fuel pipelines, and public drinking water supplies. GeoTracker and GEIMS were developed pursuant to a mandate by the California State Legislature to investigate the feasibility of establishing a statewide GIS for leaking underground fuel tank (LUFT) sites where groundwater contamination had occurred. GeoTracker contains well, tank, pipeline, and contamination site data from all of California. This makes it an important resource to both regulators and the public (SWRCB 2006). Table 7-15 shows the GeoTracker sites by contamination source located in the watershed.

**Table 7-13
USGS GROUNDWATER QUALITY DATA, MULTIPLE LOCATIONS**

| Constituent | Number of Samples | Minimum | Maximum | Average | California Primary MCL (ug/l) (c) | California Secondary MCL (ug/l) (d) |
|---|-------------------|---------|---------|---------|-----------------------------------|-------------------------------------|
| Metals (measured in ug/l) | | | | | | |
| Aluminum | 51 | 1 | 250 | 50 | 1000 | 200 |
| Arsenic | 70 | 0 | 10 | 1.2 | 50 | |
| Boron | 243 | 1 | 2100 | 163.3 | | |
| Chromium (total) | 27 | 1 | 10 | 1.2 | 50 | |
| Copper | 39 | 1 | 60 | 11.6 | 1300 | 1000 |
| Iron | 120 | 0 | 610 | 75.7 | | 300 |
| Manganese | 43 | 0 | 190 | 11.1 | | 50 |
| Zinc | 38 | 0 | 750 | 78.7 | | 5000 |
| Other Constituents (measured in mg/l unless otherwise noted) | | | | | | |
| Bicarbonate | 228 | 74 | 550 | 181.1 | | |
| Calcium | 322 | 2.5 | 99 | 26.3 | | |
| Carbon dioxide | 228 | 0.3 | 152 | 14.1 | | |
| Carbonate | 191 | 1 | 10 | 0.6 | | |
| Chloride | 360 | 1.1 | 100 | 15.4 | | 250,000 |
| Fluoride | 162 | 0 | 10 | 0.2 | 2000 | |
| Hardness (a) | 284 | 36 | 540 | 149.1 | | |
| Magnesium | 321 | 1.6 | 106 | 17.5 | | |
| Nitrate | 224 | 0 | 50 | 9.6 | 45,000 | |
| pH (b) | 84 | 6.4 | 8.3 | 7.5 | | 6.5 – 8.5 |
| Potassium | 272 | 0.3 | 8 | 1.4 | | |
| Silica | 185 | 12 | 74 | 38 | | |
| Sodium | 344 | 4.4 | 98 | 18.5 | | |
| Sulfate | 301 | 0.2 | 66 | 11.9 | | 250,000 |
| Source: USGS 2005 | | | | | | |
| Notes: (a) Hardness is in mg/L CaCO ₃ | | | | | | |
| (b) pH is measured in pH units | | | | | | |
| (c) Taste and odor | | | | | | |
| (d) If not shown, no number or limit available. | | | | | | |

**Table 7-14
DWR GROUNDWATER QUALITY DATA, MULTIPLE LOCATIONS**

| Constituent (a) | Number of Samples | Minimum | Maximum | Average |
|---|-------------------|---------|---------|---------|
| Dissolved Calcium | 12 | 7 | 67 | 29.1 |
| Dissolved Chloride | 12 | 3 | 50 | 14.2 |
| Dissolved Magnesium | 12 | 7 | 63 | 21.3 |
| Dissolved Nitrate | 12 | 3.2 | 25.8 | 10.1 |
| Dissolved Potassium | 12 | 0.8 | 3.4 | 1.4 |
| Dissolved Sodium | 12 | 8 | 98 | 27.3 |
| Dissolved Sulfate | 12 | <1 | 54 | 15.7 |
| Electrical Conductivity (b) | 12 | 179 | 936 | 407.8 |
| pH (c) | 12 | 6.8 | 7.8 | 7.2 |
| Hardness (c) | 12 | 50 | 427 | 160.2 |
| Total Copper | 12 | 0.001 | 0.072 | 0.01 |
| Total Dissolved Solids | 13 | 112 | 520 | 248.5 |
| Total Iron | 12 | 0.01 | 0.36 | 0.08 |
| Total Phosphorus | 12 | 0.03 | 0.21 | 0.08 |
| Total Zinc | 12 | 0.007 | 3.15 | 0.37 |
| Source: DWR 2005 | | | | |
| Notes: (a) Most constituents measured in mg/l, unless otherwise noted | | | | |
| (b) EC measured in uS/cm at 25°C | | | | |
| (c) pH measured in pH units | | | | |
| (d) Hardness is in mg/l CaCO ₃ | | | | |

| Table 7-15 GEOTRACKER SITE SUMMARY | | | |
|--|-----------|--------|-----------------|
| Type | Town | Number | Status |
| LUFT (Leaking Underground Fuel Tank) | Paskenta | 1 | Open with RWQCB |
| | Corning | 6 | Open with RWQCB |
| | Red Bluff | 9 | Open with RWQCB |
| | Proberta | 1 | Open with RWQCB |
| | Gerber | 1 | Open with RWQCB |
| SLIC (Spills, Leaks, Investigation, and Cleanup) | Corning | 5 | Open with RWQCB |
| | Red Bluff | 7 | Open with RWQCB |
| | Richfield | 1 | Open with RWQCB |
| Landfill | Red Bluff | 8 | Open with RWQCB |
| | Corning | 4 | Open with RWQCB |
| | Paskenta | 1 | Open with RWQCB |
| Source: SWRCB 2006 Note: Open status implies active groundwater contamination without resolution. | | | |

Groundwater Quality Summary

DWR and USGS monitoring stations have recorded constituents that have exceeded their limits at several monitoring sites in the watershed. Overall, groundwater quality in the watershed is good. However, it is recommended that further studies be conducted to monitor groundwater quality.

WATER QUALITY ISSUES

Ag Waivers

The RWQCB regulates discharges of waste primarily through issuance of Waste Discharge Requirements (WDRs) and National Pollutant Discharge Elimination System (NPDES) permits.

The requirement for WDRs may be waived by a RWQCB for a specific discharge or type of discharge where such a waiver is not against the public interest. On March 26, 1982 the RWQCB adopted Resolution No. 82-036, *Waiving Waste Discharge Requirements for Specific Types of Discharge*. The resolution listed 23 categories of waste discharges, including irrigation return flows and stormwater runoff from agricultural lands, and the conditions required to comply with the waiver. In 1999, Senate Bill 390 was adopted and changed waiver authorizations. As a result of the changes, all waivers in place on January 1, 2000 would sunset January 1, 2003 if the Regional Board had not readopted them. This change in the law meant that the 1982 waiver, which included irrigation return flows and stormwater runoff from agricultural lands in the Central Valley, would sunset. Additionally, waivers could no longer exceed five years in duration. In November 2000, an environmental organization submitted a petition asking the RWQCB to rescind the waiver and use WDRs to control discharges of pesticides from irrigated lands (RWQCB 2003b). In December 2002 the RWQCB adopted a revised waiver. The waiver is based on a watershed approach that depends on coalition groups to evaluate risks and conduct surface water sampling. The Tehama West Watershed lies within the area of the Sacramento Valley Coalition Group headed up by Northern California Water User

Association (Coalition). The Coalition has completed the submittal of initial watershed information, and conducted sampling. Only one sampling location was located in the Tehama West Watershed. The sample was taken on Burch Creek at Woodson Avenue.

Coalition and subwatershed monitoring data collected from July 2004 through January 2005 were compared to applicable narrative and numeric water quality objectives in the Basin Plan and the California Toxics Rule. Statistically significant toxicity was observed in four water quality samples collected during the January 2005 sample event including Burch Creek at Woodson. The observations of toxicity to *Ceriodaphnia* and *Selenastrum* were considered exceedances of the Basin Plan narrative objective for toxicity. The results were reported to the RWQCB by the Coalition in two Communication Reports dated February 3 and February 9, 2005, as required by the Conditional Waiver and the Coalition's Monitoring and Reporting Program Plan (MRPP). Each of the three samples was retested to determine whether toxicity was persistent in the original sample, and new samples were collected from the same sites and retested to evaluate the duration of toxicity in the water body. The retested samples did not reveal significant or persistent toxicity. The results of the testing of the Burch Creek Samples are summarized in Table 7-16. Diazinon was detected at 0.316 µg/l in the Burch Creek January 26, 2005 sample. No other pesticides were detected in the Burch Creek sample.

Although the results for Burch Creek do not provide definitive proof that diazinon was the cause of toxicity to *Ceriodaphnia* in the initial Burch Creek sample, the data support diazinon as a likely cause of at least some portion of the toxicity. Application of dormant spray pesticides in this drainage in the dry period prior to sampling are a probable source of the diazinon detected in the Burch Creek sample collected January 26, 2006. The more rapid and complete mortality observed in the February 2, 2005 follow up sample, suggests that diazinon concentrations may have been higher in the later sample, although other causes of toxicity cannot be ruled out in this case. Other potential sources of toxicants (in addition to agricultural sources) in this drainage include runoff from a fairly dense area of rural housing, a solid waste management facility and truck stop facilities. These other sources complicate the process of identifying the primary source of toxicity in samples from the current Burch Creek site.

In response to Burch Creek toxicity, growers in the Burch Creek drainage were contacted and participated in reviewing drafts of the Coalition's initial reports. Growers in the subwatershed have surveyed the drainage area upstream of the Burch Creek monitoring site to better understand the nature of the current land uses. This survey revealed a mixed-use landscape, including rural residential housing, a waste management facility and a truck stop facility. The survey also identified a potential alternative upstream sampling site that may be used if needed to isolate potential sources of toxicity or exceedances of numeric objectives. The Tehama County Agricultural Commissioner's Department also performed a qualitative analysis of land and typical pesticide use trends in this drainage area.

Because pesticide usage is a likely source of the observed toxicity, the Coalition evaluated pesticide use trends in the subwatershed (including Tehama West). These are shown in Table 7-17.

| Table 7-16 EXCEEDANCES FOR TOXICITY BURCH CREEK AT WOODSON AVE | | | | |
|--|-------------|--------------|-----------------------|----------------------|
| Site and Sample Description | Sample Date | Parameter | Result ⁽¹⁾ | Objective Exceeded |
| Initial sample | 01/26/05 | Ceriodaphnia | 20% survival* | Toxicity (Narrative) |
| Initial sample | 01/26/05 | Diazinon | 0.316 µg/l | Non-regulatory limit |
| Retest of initial sample at 5 days | 01/26/05 | Ceriodaphnia | 85% survival | Toxicity (Narrative) |
| Follow-up sample | 02/02/05 | Ceriodaphnia | 0% survival | Toxicity (Narrative) |

Note: An asterisk indicates that the result is statistically significant at the 95% confidence level.

| Table 7-17 TRENDS IN SHASTA/TEHAMA SUBWATERSHEDS 2000-2003 | | | | | |
|--|---------------------|--------|--------|--------|----------|
| Applied Pesticide | 2000 ⁽¹⁾ | 2001 | 2002 | 2003 | Trend |
| Azinphos-methyl | 1,580 | 1,182 | 167 | 350 | Down |
| Carbofuran | 0 | 0 | 0 | 0 | No trend |
| Chlorpyrifos | 11,820 | 11,640 | 15,301 | 12,099 | No trend |
| Diazinon | 3,233 | 3,864 | 5,006 | 5,051 | Up |
| Malathion | 3,420 | 3,332 | 10,561 | 5,390 | No trend |
| Methyl Parathion | 0 | 262 | 0 | 0 | No trend |

Note: Tabled values are total annual pounds of active ingredient applied per Coalition Subwatershed, as reported in the California Department of Pesticide Regulation PUR Database (2004).

Landslides

Although BMP and general land use practices have improved significantly, sediment continues to be generated for the upland areas and from bank instability in the transition zones. USFS landslide mapping was included as Figure 7-3.

Pesticide Use

Based on the increasing interest in pesticide use and potential for water quality impacts, the Department of Pesticide regulation databases were queried for the Tehama West Watershed. The pesticide data is available on a county and section basis. Actual field tracking is not yet implemented in Tehama County. Pesticide use by watershed sub-unit for the year 2003 is included on Table 7-19 and shown on Figure 7-4. The purported source of contaminated stormwater runoff under the Ag Waiver program is dormant spray from orchard croplands. A summary of cropland acres (irrigated acres) by watershed sub-unit from 2004 Tehama County parcel records is included as Table 7-20 and shown on Figure 7-5.

The top 50 crops by pesticide use, in gross pounds and acres treated, from the DPR PAN data set for Tehama County in 2003 are shown in Table 7-20. Non-agricultural uses are included and marked as (non-ag). The top 50 pesticides in Tehama County are included in Table 7-21 in order of amount used (gross pounds) from a DPR PAN data set for Tehama County, 2003. Both data sets are for the County of Tehama, not just the Tehama West Watershed area.

Municipal Stormwater Runoff

Municipal runoff from roads, parking facilities, sidewalks, buildings, rooftops, and other impervious surfaces can transport trash, debris, metals, hydrocarbons, and fecal matter that pollute receiving streams. Lawns and other landscaped areas may also contaminate runoff with nutrients, fertilizers, and suspended solids. Agricultural runoff may carry nutrients, animal wastes, sediment, salts, pesticides, fertilizers, and other ingredients that may be harmful in high concentrations. High concentrations of nutrients, for example, can stimulate excessive or undesirable forms of aquatic growth such as algae and noxious weeds. These plants may consume oxygen faster than natural processes can produce it, and as a result, fish and lower species in the food chain may be destroyed. Nutrient enrichment can also drive up the pH levels in water through increased photosynthetic activity. Animal wastes can accelerate the production of algae and contaminate water used for fishing, swimming, and drinking with related microorganism pathogens (Office of Infrastructure 2006).

The most common contaminants in runoff are heavy metals, inorganic salts, aromatic hydrocarbons and suspended solids that accumulate on the road surface as a result of regular highway operation and maintenance activities. Salting and sanding practices, for example, may leave concentrations of chloride, sodium, and calcium on the roadway surface. Ordinary operations and the wear and tear of our vehicles also result in the dropping of oil, grease, rust, hydrocarbons, rubber particles, and other solid materials on the highway surface. These materials are often washed off the highway during rain or snow storm events.

Receiving surface and groundwaters are susceptible to contamination from all these sources. Contamination of groundwater tends to occur gradually because contaminants percolate downward through the soil at slow rates. Highway runoff that soaks into soil with or without the presence of any type of vegetation, channel, or basin is usually harmless to the environment. Surface waters (streams, rivers, ponds, and lakes) are particularly vulnerable because they are directly exposed to contaminants released into the air and to direct discharges from point or non-point sources. Excessive concentrations of these microorganisms can prevent receiving waters from being used for certain water supply and/or recreational activities.

**Table 7-18
 APPLICABLE WATER QUALITY OBJECTIVES AND METHOD DETECTION LIMITS FOR ANALYTES MONITORED IN
 THE AGRICULTURAL WAIVER PROGRAM AT THE BURCH CREEK SITE**

| Basin Plan Objectives | | | | | |
|-------------------------------|-----------------------|-----|-------------------|--|--|
| Analyte | Units | MDL | WQO | WQO Basis | Application |
| Temperature | °F | NA | narr. | <°F increase above natural | All waters designated WARM or COLD |
| Dissolved Oxygen | mg/l | NA | 7.0 5.0 7.0 | Minimum Minimum Minimum | Sacramento River below the I Street Bridge waters designated WARM waters designated COLD |
| PH | -log[H ⁺] | NA | 6.5-8.5 | “appropriate averaging period” protective of beneficial uses | All waters |
| Conductivity | µmhos/cm | NA | 230 | 50 th percentile | Sacramento River above Colusa Basin Drain |
| | | | 235 | 95 th percentile | |
| | | | 240 340 | 50 th percentile 95 th percentile | Sacramento River at I Street Bridge |
| | | | 150 | 90 th percentile | Feather River Basin |
| Color | CU | 2 | narr. | NA | All waters |
| Hardness as CaCO ₃ | mg/l | 3 | none | NA | NA |
| Nitrate | mg/l as N | | 10 | Maximum | All waters designated MUN |
| Turbidity | NTU | 0.1 | narr. | NA | All waters |
| Total Dissolved Solids (TDS) | mg/l | 6 | 125 | 90 th percentile | American River basin |
| Total Suspended Solids (TSS) | mg/l | 2 | narr. | NA | All waters |
| E. Coli bacteria | MPN/100ml | 2 | 126 | 5-sample geo. Mean; Single sample max | Waters designated REC-1 |
| | | | 235 | | Waters designated REC-1 |

**Table 7-18 (cont.)
 APPLICABLE WATER QUALITY OBJECTIVES AND METHOD DETECTION LIMITS FOR ANALYTES MONITORED IN
 THE AGRICULTURAL WAIVER PROGRAM AT THE BURCH CREEK SITE**

| Other Objectives | | | | | |
|--|------------------|------------|--|--|------------------------------------|
| Analyte | Units | MDL | WQO | WQO Basis | Application |
| Ammonia | mg/l | | | PH and temperature dependent; 30-day avg., 4-day avg., and 1-hour avg. | USEPA 1999 |
| Azinphos-methyl | µg/l | 0.01 | 0.01 | Instantaneous max | USEPA 1976 |
| Carbofuran | µg/l | 0.25 | 0.5 | Instantaneous max | Menconi and Gray 1992 (CDFG) |
| Chlorpyrifos | µg/l | 0.005 | 0.014 0.02 | 4-day average 1-hour maximum | Siepmann and Finlayson 2000 (CDFG) |
| Diazinon | µg/l | 0.005 | 0.05 ⁽¹⁾ 0.08 ⁽¹⁾ | 4-day average 1-hour maximum | Siepmann and Finlayson 2000 (CDFG) |
| Malathion | µg/l | 0.005 | 0.1 | Instantaneous max | USEPA 1999 |
| Parathion, Methyl | µg/l | 0.01 | 0.08 | Instantaneous max | Menconi and Harrington 1992 (CDFG) |
| Monitored Analytes Without Objectives | | | | | |
| Analyte | Units | MDL | WQO | WQO Basis | Application |
| Total Organic Carbon (TOC) | mg/l | 0.3 | none | NA | NA |
| Dissolved Organic Carbon (DOC) | mg/l | 0.3 | none | NA | NA |
| Ultraviolet Absorbance at 254nm | cm ⁻¹ | NA | none | NA | NA |
| Notes: MDL – Method Detection Limit WQO – Water Quality Objective | | | | | |

| Table 7-19 PESTICIDE USE BY SUB-UNIT | |
|---|---|
| Watershed Sub-unit | Pesticide Use (pounds/acre/year) |
| Burch | 78,567 |
| Dibble | 237 |
| Elder | 31,643 |
| Jewett | 67,853 |
| Oat | 122,428 |
| Red Bank | 11,949 |
| Reeds | 30 |
| Spring | 17,863 |
| Thomes | 56,595 |

| Table 7-20 IRRIGATED ACRES BY SUB-UNIT | |
|---|--------------|
| Watershed Sub-unit | Acres |
| Burch | 11,414 |
| Dibble | 139 |
| Elder | 15,410 |
| Jewett | 12,978 |
| Oat | 40 |
| Red Bank | 6,146 |
| Reeds | 10,685 |
| Spring | 650 |
| Thomes | 12,654 |

CONCLUSIONS AND RECOMMENDATIONS

- Encourage voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations, participation in citizen monitoring program activities, and distribution of water quality “fact sheets.”
- Develop a strong road design and management element to assist landowner recognition of road erosion problems and their solutions
- Pursue grant funding or cost-share payments for landowners to inventory, prepare plans, and implement best-management practices that reduce water quality impacts.
- Evaluate the effectiveness of vegetation management alternatives to manage seasonal surface runoff and underflow. Evaluate the effectiveness of reducing brush to increase flows in springs and creeks.
- Offer livestock and small animal operators increased opportunities to participate in voluntary cooperative water quality short courses to help livestock operators understand the possible sources of livestock impacts to water quality.

**Table 7-21
TOP 50 CROPS AND SITES FOR ALL CHEMICALS USED IN TEHAMA COUNTY**

| Crop or Site | Gross Pounds¹ | Application Rate (lbs/acre treated) | Acres Planted | Acres Treated | Number of Applications |
|---|---------------------------------|--|----------------------|----------------------|-------------------------------|
| All Sites | 630,900 | 2.27 | 80,919 | 245,292 | 10,807 |
| Walnuts | 253,764 | 2.45 | 16,066 | 97,341 | 4,214 |
| Prunes | 122,475 | 2.96 | 8,744 | 41,312 | 1,096 |
| Almonds | 89,030 | 1.74 | 7,755 | 51,308 | 1,062 |
| Outdoor Propagation Nursery | 31,155 | 49.2 | 256.7 | 632.8 | 100 |
| Right of Way (non-ag) | 27,038 | 0.86 | 180.0 | 290.0 | 455 |
| Wine Grapes | 21,621 | 13.1 | 191.1 | 1,645 | 68 |
| Aquatic Area (non-ag) | 17,997 | 8.76 | 1.50 | 273.8 | 20 |
| Olives | 17,502 | 0.98 | 4,930 | 17,908 | 743 |
| Commodity Fumigation (non-ag) | 8,235 | - | - | - | 28 |
| Alfalfa for Forage | 7,752 | 0.71 | 3,688 | 10,963 | 204 |
| Public health pest Control (non-ag) | 5,634 | - | - | - | 61 |
| Forests | 4,970 | 1.70 | 24,675 | 2,881 | 70 |
| Rice | 3,366 | 11.1 | 358.1 | 304.1 | 6 |
| Beans | 3,102 | 1.10 | 1,160 | 2,828 | 53 |
| Figs | 3,038 | 20.2 | 150.0 | 150.0 | 2 |
| Wheat | 2,332 | 0.55 | 2,282 | 4,203 | 59 |
| Oats | 1,941 | 0.66 | 3,122 | 2,954 | 71 |
| Structural Pest Control (non-ag) | 1,160 | - | - | - | 1,864 |
| Uncultivated Agricultural Area (non-ag) | 1,133 | 0.77 | 803.0 | 1,475 | 105 |
| Other Fumigation (non-ag) | 1,021 | - | - | - | 6 |
| Sunflowers | 1,003 | 2.45 | 245.0 | 409.0 | 7 |
| Landscape (non-ag) | 947.5 | - | - | - | 234 |
| Peaches | 732.1 | 4.50 | 50.5 | 162.8 | 39 |
| Oranges | 708.5 | 7.09 | 25.0 | 100.0 | 10 |
| Corn for Forage | 705.4 | 0.55 | 790.5 | 1,286 | 34 |
| Barley | 536.5 | 0.73 | 796.0 | 738.0 | 8 |
| Pistachios | 382.5 | 0.59 | 138.5 | 645.0 | 31 |

**Table 7-21
TOP 50 CROPS AND SITES FOR ALL CHEMICALS USED IN TEHAMA COUNTY**

| Crop or Site | Gross Pounds¹ | Application Rate (lbs/acre treated) | Acres Planted | Acres Treated | Number of Applications |
|------------------------|---------------------------------|--|----------------------|----------------------|-------------------------------|
| Squash | 302.8 | 4.92 | 31.0 | 61.5 | 6 |
| Rangeland | 286.9 | 0.07 | 2,951 | 4,006 | 16 |
| Pasture | 283.7 | 0.75 | 796.0 | 376.0 | 13 |
| Dried Beans | 143.8 | 0.55 | 123.0 | 261.0 | 6 |
| Pecans | 142.2 | 0.81 | 136.0 | 176.0 | 10 |
| Nectarines | 135.8 | 5.22 | 4.00 | 26.0 | 10 |
| Apples | 97.6 | 3.88 | 11.9 | 25.2 | 14 |
| Plums | 70.7 | 0.42 | 187.6 | 170.1 | 9 |
| Grains | 46.9 | 0.47 | 60.0 | 100.0 | 5 |
| Sudangrass for Forage | 38.4 | 1.92 | 20.0 | 20.0 | 1 |
| Non-Agricultural Areas | 31.1 | 0.70 | 8.00 | 44.5 | 10 |
| Apricots | 21.2 | 2.65 | 4.00 | 8.00 | 2 |
| Greenhouse Propagation | 18.4 | - | - | - | 17 |
| Irrigation Systems | 16.3 | - | - | - | 2 |
| Melons | 10.9 | 0.23 | 30.0 | 48.0 | 3 |
| Outdoor Flower Nursery | 8.91 | 1.75 | 7.50 | 5.10 | 4 |
| Watermelons | 6.15 | 0.09 | 66.0 | 66.0 | 2 |
| Strawberries | 5.86 | 0.41 | 9.10 | 14.2 | 7 |
| Cucumbers | 5.12 | 0.09 | 56.0 | 55.0 | 1 |
| Blueberries | 5.01 | 1.25 | 4.90 | 4.00 | 1 |
| Pumpkins | 1.58 | 0.26 | 3.00 | 6.00 | 1 |
| Cherries | 0.75 | 0.75 | 1.00 | 1.00 | 1 |

¹ Includes: herbicides, pesticides, rodenticides and fungicides

**Table 7-22
TOP 50 PESTICIDES USED ON ALL SITES IN TEHAMA COUNTY 2003**

| Chemical Name | Chemical Class | Gross Pounds | Application Rate (lbs/acre treated) | Acres Planted | Acres Treated |
|--|------------------------------------|---------------------|--|----------------------|----------------------|
| All Chemicals | | 630,900 | 2.27 | 80,919 | 245,292 |
| Copper hydroxide Uses: Fungicide, Microbiocide, Nematicide | Inorganic-Copper | 140,006 | 4.83 | 15,501 | 28,962 |
| Mineral oil Uses: Insecticide, Adjuvant | Petroleum derivative | 88,081 | 20.7 | 4,390 | 4,265 |
| Glyphosate, isopropylamine salt Uses: Herbicide | Phosphonoglycine | 47,602 | 0.84 | 46,021 | 49,475 |
| Sulfur Uses: Fungicide, Insecticide | Inorganic | 46,981 | 11.1 | 3,102 | 4,230 |
| Maneb Uses: Fungicide | Dithiocarbamate | 45,664 | 1.76 | 13,503 | 25,937 |
| Methyl bromide Uses: Fumigant, Insecticide, Herbicide, Nematicide | Halogenated organic | 39,026 | 34.1 | 2,476 | 648.3 |
| Petroleum oil, unclassified Uses: Insecticide, Herbicide, Fungicide, Adjuvant | Petroleum derivative | 28,357 | 10.1 | 3,851 | 2,797 |
| Copper sulfate (pentahydrate) Uses: Algacide, Fungicide, Insecticide, Water Treatment, Molluscicide | Inorganic-Copper | 27,002 | 16.0 | 401.1 | 347.1 |
| 1,3-dichloropropene Uses: Fumigant, nematicide | Halogenated organic | 18,757 | 319.5 | 194.0 | 58.7 |
| Diuron Uses: Herbicide | Urea | 14,198 | 1.56 | 5,911 | 2,866 |
| Chloropicrin Uses: Fumigant, Nematicide | Unclassified | 11,619 | 20.2 | 1,204 | 573.9 |
| Chlorpyrifos Uses: Insecticide, Nematicide | Organophosphorus | 11,497 | 1.30 | 10,622 | 8,863 |
| Propargite Uses: Insecticide | Unclassified | 9,982 | 1.57 | 9,482 | 6,370 |
| Ziram Uses: Fungicide, Microbiocide, Dog and Cat Repellent | Dithiocarbamate, Inorganic-Zinc | 9,312 | 5.26 | 2,152 | 1,769 |
| 2,4-D, dimethylamine salt Uses: Herbicide | Chlorophenoxy | 8,494 | 0.70 | 12,924 | 10,830 |
| Captan Uses: Fungicide | Thiophthalimide | 7,607 | 2.47 | 4,223 | 3,076 |
| Propylene oxide Uses: Fumigant | Alcohol/Ether | 7,240 | - | - | - |
| Paraquat dichloride Uses: Herbicide | Bipyridylum | 6,372 | 0.91 | 9,726 | 7,002 |
| Malathion Uses: Insecticide | Organophosphorus | 5,564 | 2.19 | 3,330 | 2,452 |

**Table 7-22
TOP 50 PESTICIDES USED ON ALL SITES IN TEHAMA COUNTY 2003**

| Chemical Name | Chemical Class | Gross Pounds | Application Rate (lbs/acre treated) | Acres Planted | Acres Treated |
|---|-------------------------------|---------------------|--|----------------------|----------------------|
| Petroleum distillates Uses: Insecticide, Adjuvant, Solvent | Petroleum derivative | 5,371 | - | - | - |
| Diazinon Uses: Insecticide | Organophosphorus | 5,331 | 1.44 | 4,652 | 3,602 |
| Simazine Uses: Herbicide | Triazine | 4,805 | 1.68 | 5,651 | 2,605 |
| Phosmet Uses: Insecticide | Organophosphorus | 3,448 | 1.97 | 3,473 | 1,747 |
| Hexazinone Uses: Herbicide | Triazinone | 3,289 | 1.37 | 10,982 | 2,402 |
| Solvent naphtha (petroleum), light aromatic Uses: Solvent, Insecticide | Petroleum derivative | 3,284 | 1.20 | 3,589 | 2,729 |
| Lime-sulfur Uses: Insecticide, Fungicide | Inorganic | 3,060 | 25.5 | 144.2 | 120.2 |
| Dicofol Uses: Insecticide | Organochlorine | 2,159 | 1.22 | 2,826 | 1,767 |
| Oryzalin Uses: Herbicide | 2,6-Dinitroaniline | 1,747 | 2.16 | 1,587 | 620.5 |
| Ethephon Uses: Plant Growth Regulator | Organophosphorus | 1,738 | 1.01 | 2,480 | 1,709 |
| Cyrodinil Uses: Fungicide | | 1,597 | 0.23 | 8,333 | 7,070 |
| Oxyfluorfen Uses: Herbicide | Diphenyl ether | 1,538 | 0.10 | 17,442 | 14,315 |
| Acrolein Uses: Algacide | Aldehyde | 1,397 | - | - | - |
| Pendimethalin Uses: Herbicide | 2,6-Dinitroaniline | 1,289 | 1.74 | 1,721 | 668.6 |
| Methidathion Uses: Insecticide | Organophosphorus | 1,077 | 1.53 | 905.9 | 705.9 |
| Sodium chlorate Uses: Defoliant, Herbicide, Micorbiocide | Inorganic | 996.5 | 3.57 | 279.0 | 279.0 |
| MCPA, dimethylamine salt Uses: Herbicide | Chlorophenoxy acid or ester | 870.1 | 0.82 | 1,231 | 1,055 |
| Iprodione Uses: Fungicide | Dicarboximide | 844.6 | 0.49 | 1,951 | 1,714.7 |
| Norflurazon Uses: Herbicide | Pyridazinone | 737.6 | 0.93 | 963.1 | 783.8 |
| Triclopyr, butoxyethyl ester Uses: Herbicide | Chloropyridinyl, Glycol Ether | 716.6 | 0.18 | 2,715 | 885.0 |
| Thiophanate-methyl Uses: Fungicide | Benzimidazole precursor | 646.7 | 0.85 | 765.9 | 745.0 |
| Azoxystrobin Uses: Fungicide | Strobin | 611.2 | 0.15 | 3,911 | 4,170 |

**Table 7-22
TOP 50 PESTICIDES USED ON ALL SITES IN TEHAMA COUNTY 2003**

| Chemical Name | Chemical Class | Gross Pounds | Application Rate (lbs/acre treated) | Acres Planted | Acres Treated |
|--|-----------------------------|---------------------|--|----------------------|----------------------|
| Carbon dioxide Uses: Fumigant, Insecticide, Rodenticides | Inorganic | 583.1 | - | - | - |
| Trifluralin Uses: Herbicide | 2,6-Dinitroaniline | 571.7 | 1.87 | 653.7 | 306.0 |
| Permethrin Uses: Insecticide | Pyrethroid | 551.6 | 0.18 | 3,230 | 2,518 |
| Aluminum phosphide Uses: Fumigant, Fungicide | Inorganic | 495.1 | 0.06 | 2,206 | 451.6 |
| EPTC Uses: Herbicide | Thiocarbamate | 476.0 | 2.60 | 183.0 | 183.0 |
| Methomyl Uses: Insecticide, Breakdown product | N-Methyl Carbamate | 475.1 | 0.47 | 1,605 | 1,010 |
| Metam-sodium Uses: Fumigant, Herbicide, Fungicide, Microbiocide, Algacide | Dithiocarbamate | 414.6 | - | - | - |
| 2,4-D,2-ethylhexyl ester Uses: Herbicide | Chlorophenoxy acid or ester | 394.5 | 1.85 | 3,239 | 213.0 |

REFERENCES

CSUC (California State University Chico). 2004. *Thomes Creek Sediment Budget*.

CDM in association with the California Department of Water Resources, Northern District. 2003. Tehama County Flood Control and Water Conservation District. *Water Inventory and Analysis Report*. September 2003.

CDM. 2005. *Tehama County: A Small Water Systems Drought Vulnerability Study*.

Crane Mills. 2005. Stream temperature data.

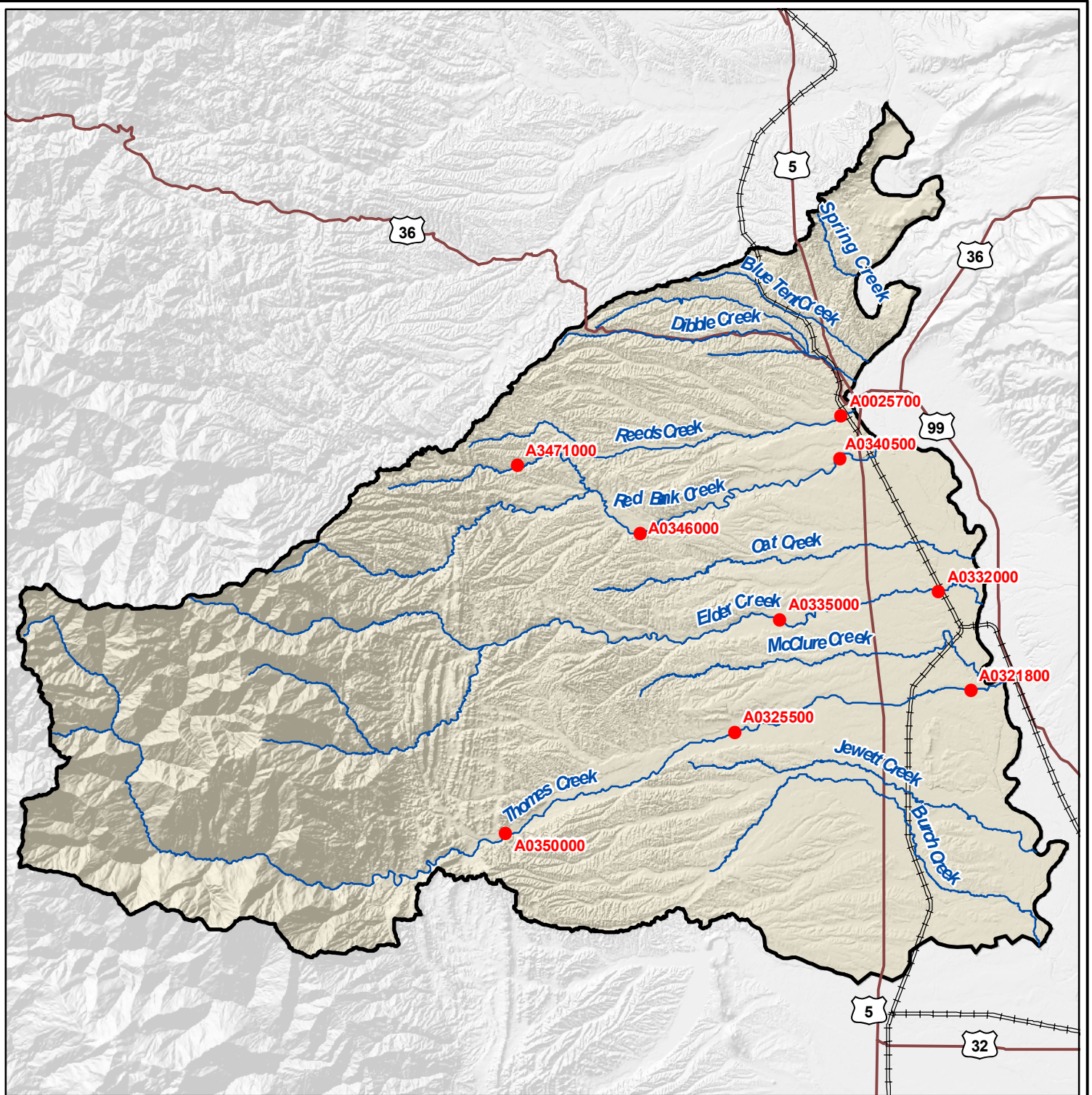
DWR (California Department of Water Resources). 1982. *Thomes Creek Watershed Study*.

----- . 1992. *Sacramento Valley Westside Tributary Watershed Erosion Study*.

----- . 1993. *Groundwater levels in the Sacramento Valley ground water basin: Tehama County*. Sacramento: Department of Water Resources.

----- . 1998. *California water plan update: bulletin 160-98*. Sacramento: Department of Water Resources.

- , 2003. *Sacramento River basinwide water management plan*. Sacramento: Department of Water Resources.
- , 2005. *Department of Water Resources*. [Cited February 2006]. Available from the World Wide Web: <http://wdl.water.ca.gov/wq-gst/>.
- Federal Highway Administration. 1999. *Is Highway Runoff a Serious Problem?* Turner-Fairbank Highway Research Center, <http://www.tfhrc.gov/hnr20/runoff.htm>.
- Law. 1996. *Coordinated AB3030 Groundwater Management Plan, Tehama County Flood Control and Water Conservation District*.
- Office of Infrastructure R&D and Office of Environment and Planning. 1999. *Is highway runoff a serious problem?* In Turner-Fairbank Highway Research Center. Cited February 8, 2006. Available on the World Wide Web at <<http://www.tfhrc.gov/hnr20/runoff/runoff.htm>>.
- PAN Pesticides Database – California Pesticide Use. *Pesticide Use in Tehama in 2003, Sacramento Valley Region*. Available from the World Wide Web: <http://www.pesticideinfo.org>.
- RWQCB. Regional Water Quality Control Board. 1998. *Water Quality Control Plan for the Sacramento and San Joaquin River Basin Plan*.
- RWQCB. (California Environmental Protection Agency, Regional Water Quality Control Board, Central Valley Region). 2003a. *A Compilation of Water Quality Goals*. August 2003.
- RWQCB. Regional Water Quality Control Board. 2003b. *Irrigated Lands Fact Sheet: History of the Conditional Waivers of Waste Discharge Requirements for Discharges from Irrigated Lands*.
- Sacramento Valley Water Quality Coalition. *Monitoring and Reporting Program Plan, Annual Monitoring Report 2004-2005*. Water Quality Control Plan for the Central Valley/Sacramento River Basin. April 1, 2005.
- SWRCB (State Water Resources Control Board). 2006. *Geotracker*. In State Water Resources Control Board. [Cited February 2006]. Available from the World Wide Web: <http://geotracker.swrcb.ca.gov/>
- Tehama County 2004 Parcel Records.
- USDA (United States Department of Agriculture). 1977. *Thomes Creek Watershed Assessment Analysis Report*.
- USGS (United States Geological Survey). 2005. *USGS*. [Cited November 2005]. Available from the World Wide Web: <http://nwis.waterdata.usgs.gov/usa/nwis/qwdata>



Legend

-  Railroad
-  Major Highway
-  Major Tributary
-  DWR Station
-  Tehama West Watershed

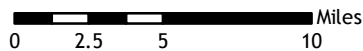
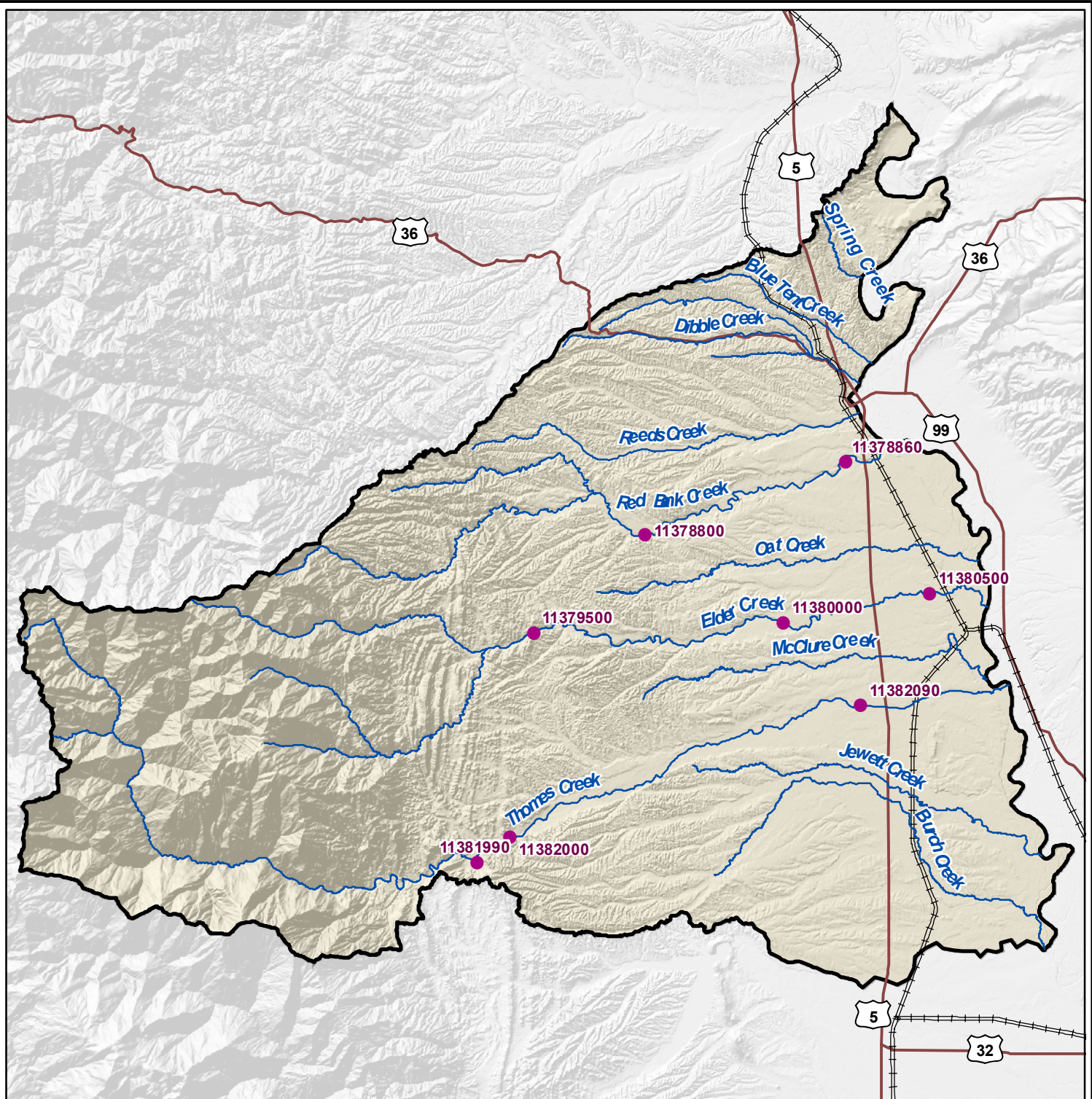


FIGURE 7-1
DWR STATIONS
TEHAMA WEST WATERSHED ASSESSMENT

VESTRA





Legend

-  Railroad
-  Major Highway
-  Major Tributary
-  USGS Station
-  Tehama West Watershed

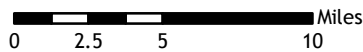
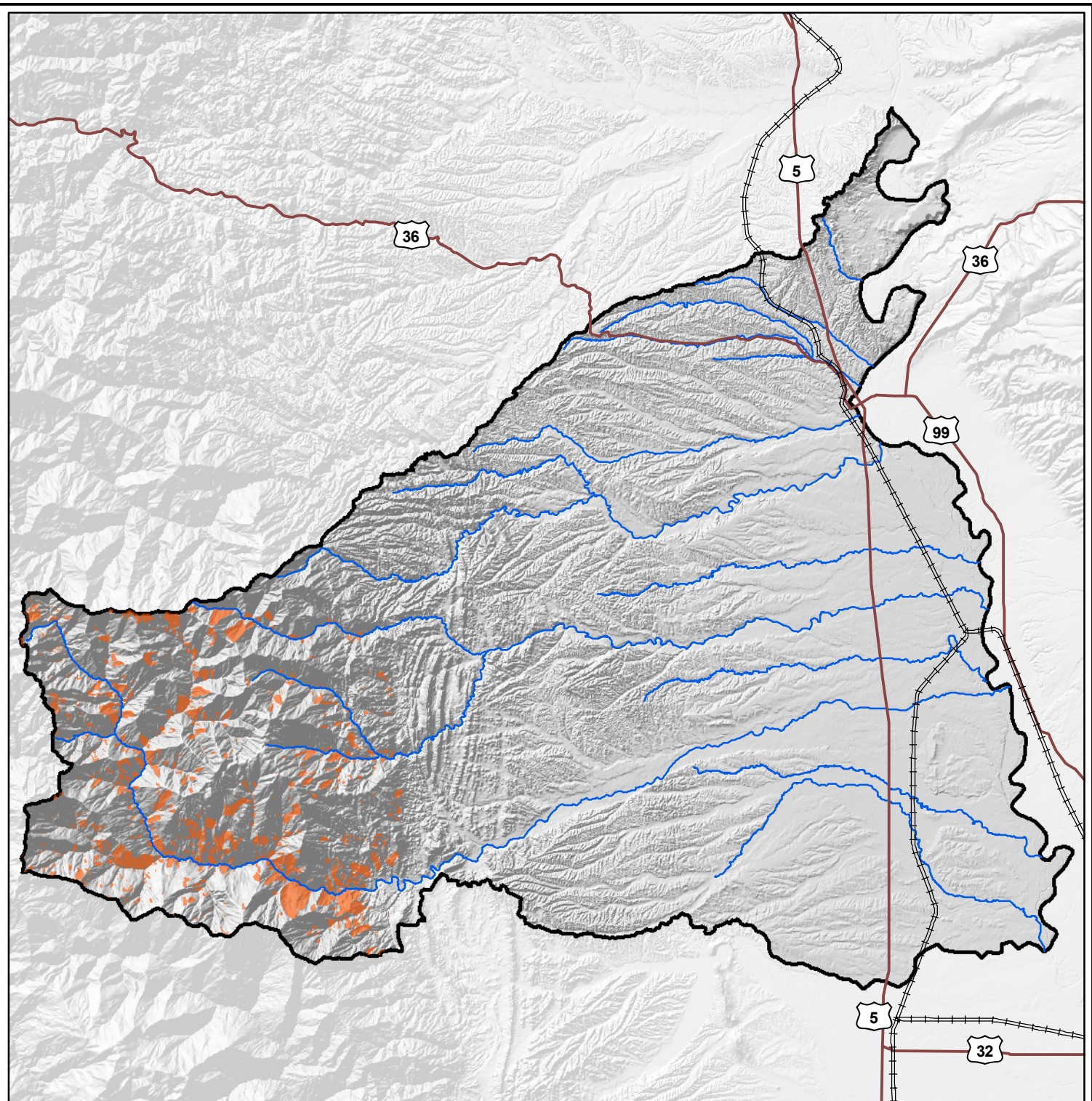







FIGURE 7-2
USGS STATIONS
TEHAMA WEST WATERSHED ASSESSMENT





Legend

-  Railroad
-  Major Highway
-  Major Tributary
-  Tehama West Watershed
-  Landslide Boundary (Mendocino National Forest only)

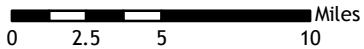
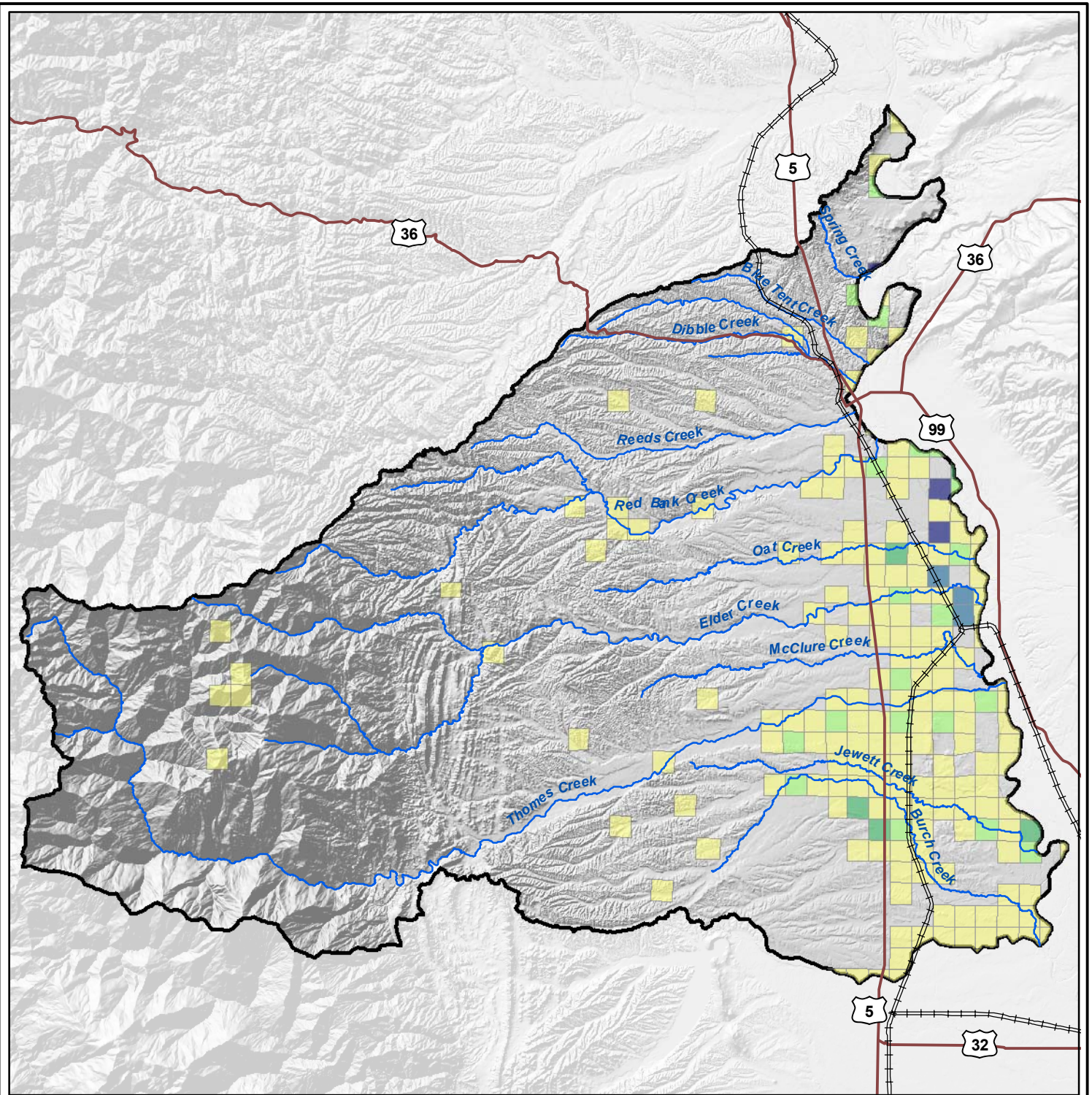


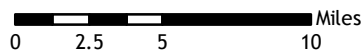
FIGURE 7-3
LANDSLIDES - MENDOCINO NATIONAL FOREST
TEHAMA WEST WATERSHED ASSESSMENT





Legend

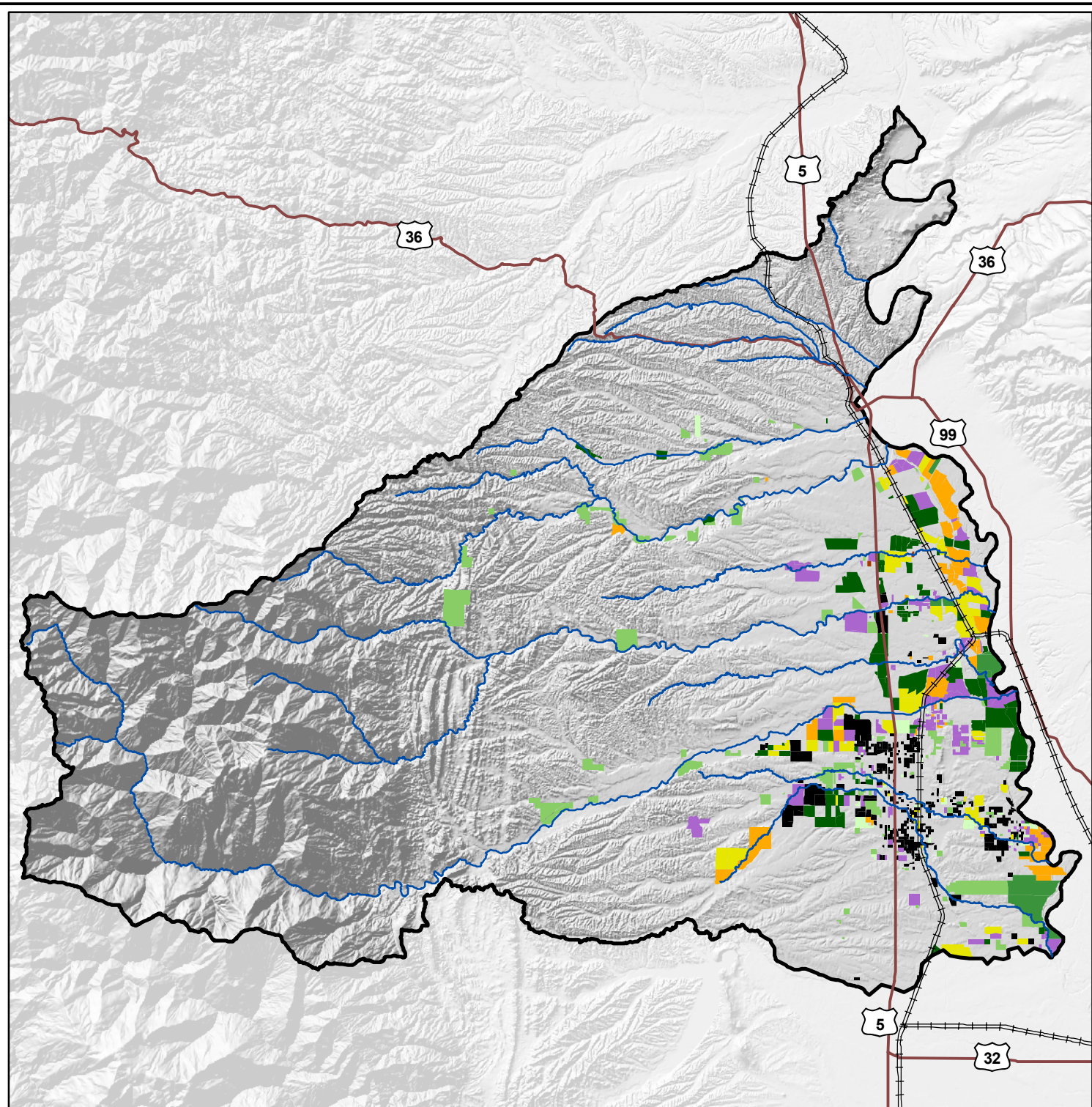
- | | | | |
|------|-----------------------|--|----------------------------------|
| ==== | Railroad | | 1 - 5,000 pounds/acre/year |
| — | Major Highway | | 5,001 - 10,000 pounds/acre/year |
| — | Major Tributary | | 10,001 - 15,000 pounds/acre/year |
| □ | Tehama West Watershed | | 15,001 - 20,000 pounds/acre/year |
| | | | 20,001 - 30,000 pounds/acre/year |



**FIGURE 7-4
PESTICIDE USE**

TEHAMA WEST WATERSHED ASSESSMENT





Legend

- | | | |
|-----------------|-------------------------|----------------------------------|
| Railroad | Field Crops - Irrigated | Irrigated Walnut Orchard |
| Major Highway | Row Crops - Irrigated | Irrigated Almond Orchard |
| Major Tributary | Irrigated Olive Orchard | Irrigated Misc. Orchard |
| Field Crops | Irrigated Prune Orchard | Vine and Bush Fruits - Irrigated |
| Orchard | | |

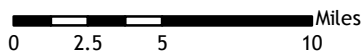
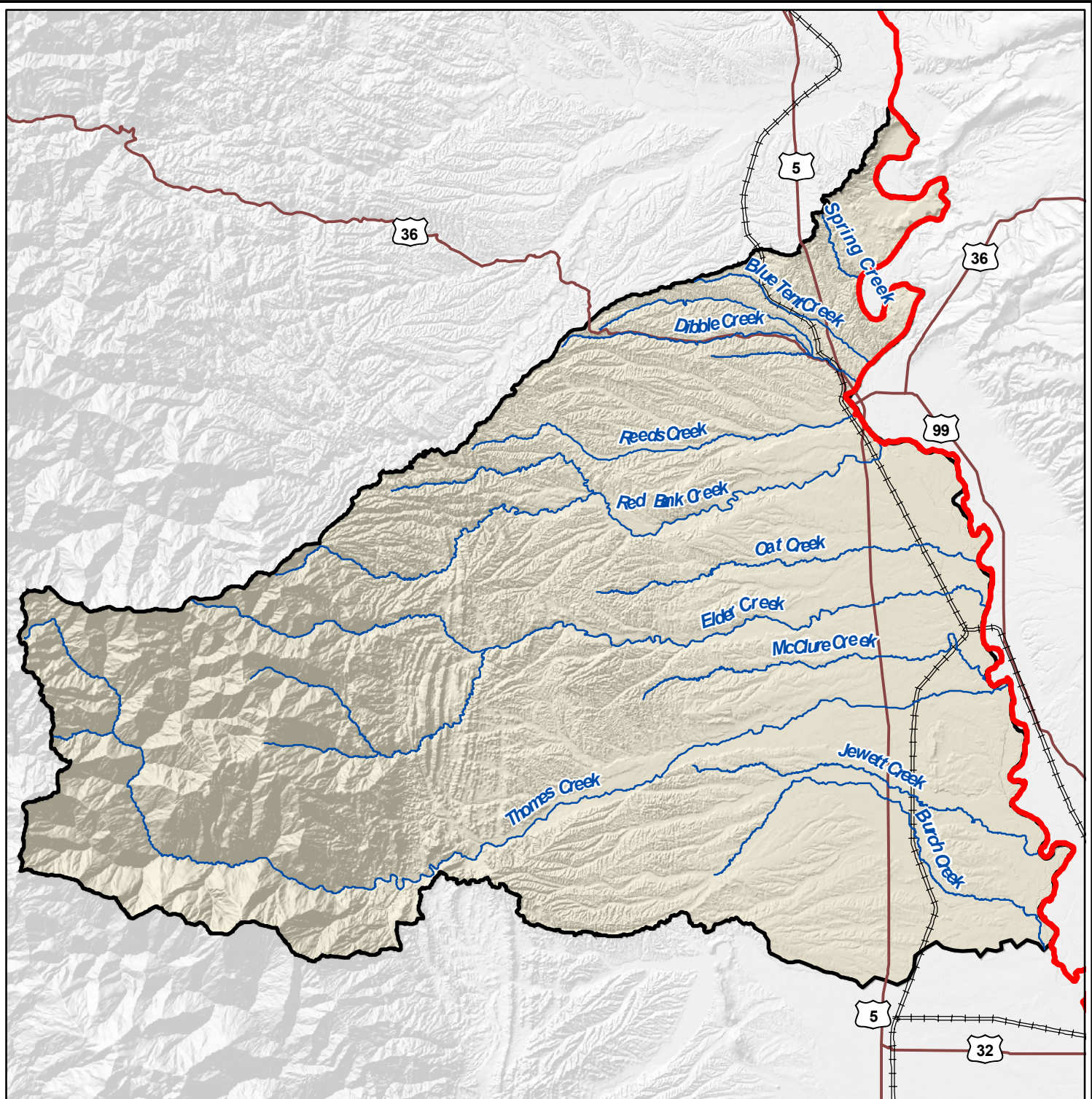


FIGURE 7-5
IRRIGATED ACRES
 TEHAMA WEST WATERSHED ASSESSMENT



Legend

-  Railroad
-  Major Highway
-  Major Tributary
-  Tehama West Watershed
-  303(d) Listing

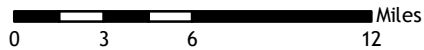


FIGURE 7-6
 303 (d) LISTED STREAMS AND RIVERS
 TEHAMA WEST WATERSHED ASSESSMENT

