CENTRAL VALLEY REGIONAL
WATER QUALITY CONTROL BOARD

A Compilation of Selected Water Bodies and Aquatic Life Indicators for the Central Valley Pesticide Basin Plan Amendment Project

Final Staff Report

July 2010

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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Executive Summary

The purpose of this report is to provide a list of readily identifiable water bodies within the Sacramento and San Joaquin River Basins for which pesticide water quality objectives and implementation provisions can be proposed as Basin Plan amendment(s).This report documents the compilation of a list of nearly 1,300 readily identifiable water bodies within the Sacramento and San Joaquin River Basins below major dams. The aquatic life beneficial uses of water are generally the beneficial uses most sensitive to pesticides of concern in surface waters in the Central Valley Region. Therefore, in support of the development of the waterbody list in this report, readily available information was compiled to document the presence of aquatic life in water bodies in the Sacramento and San Joaquin River Basis. Based on the information compiled for this report, it is reasonable to conclude that aquatic life likely occurs within each of the nearly 1,300 named water bodies.

Abbreviations and Terms Used

Basin Plan	The Water Quality Control Plan for the California Regional Water Quality Control Board, Central Valley Region – The Sacramento River Basin and the San Joaquin River Basin, Fourth Edition, revised September 2009
benthic macroinvertebrate [BMI]	"animal[s] inhabiting the substratum [bottom] of lakes, streams, estuaries, and marine waters" (Eaton *et al.*, 2001), generally large enough to be seen with the naked eye
benthos	The bottom substrate of a water body
BMI	Benthic macroinvertebrate
Chinook	Central Valley spring-run Chinook salmon
DFG	Department of Fish and Game
DPR	Department of Pesticide Regulation
ESA	Endangered Species Act 0of 1973, administered by the FWS and NOAA
ESU	Evolutionary Significant Unit - Under the Endangered Species Act (ESA), an ESU is a distinct population segment that is substantially reproductively isolated from other nonspecific population units; and represents an important component in the evolutionary legacy of the species.
FWS	United States Fish and Wildlife Service
GIS	Geographic Information System (computer-based mapping hardware and software, maps, and data files)
NHD	National Hydrography Dataset, a GIS file from the USGS
NMFS	National Marine Fisheries Service, a branch of the NOAA
NOAA	National Oceanic and Atmospheric Administration
periphyton	Algae, bacteria, microbes, microinvertebrates, or detritus attached to submerged surfaces
Project Area	Central Valley Pesticide Basin Plan Amendment Project Area
Regional Water Board	California Regional Water Quality Control Board, Central Valley Region
Reach File 3 [RF3]	A GIS file created by the USEPA of mapped water bodies
Steelhead	Central Valley steelhead
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
UC Davis	University of California, Davis
UM	University of Maryland
USGS	United States Geological Survey

1. Introduction

The purpose of this report is to provide a list of readily identifiable water bodies within the Sacramento and San Joaquin River Basins for which pesticide water quality objectives and implementation provisions can be considered in Basin Plan amendment(s) addressing pesticide discharges. The beneficial uses of water most sensitive to pesticides of concern in surface waters in the Central Valley Region are the aquatic life beneficial uses (WARM and COLD.) Currently, the Basin Plan designates beneficial uses (including aquatic life uses) for specific water bodies listed in Table II-1 and for other water bodies through a tributary statement that generally assigns the beneficial uses of Table II-1 water bodies to their tributaries (CRWQCB-CVR, 2009), but states that beneficial uses of these waterbodies will be evaluated on a case by case basis. Therefore, in support of the development of the waterbody list in this report, readily available information was compiled to document the presence of aquatic life in water bodies in the Sacramento and San Joaquin River Basis.

Staff prepared an earlier, draft version of this report, titled "Natural Streams and Aquatic Life Within the Central Valley Pesticide Basin Plan Amendment Project Area" (Report). The draft Report described how a list of 738 named water bodies within the Project Area was compiled into "Table 1 - Named Water Bodies Within the Central Valley Pesticide Basin Plan Amendment Project Area" (draft Table 1) of that report.

The draft Report was released in July 2007 for public review and comments. Staff received, and prepared written responses to, four sets of comments (see Appendix A). In response to the public comments, staff utilized several additional sources of information (see Section 3) to identify approximately 650 additional named water bodies. As a result, draft Table 1 was expanded to a total of approximately 1,300 named water bodies. Since this was a substantial change from the original draft Table 1, a revised version titled, "Table 1 - Selected Water Bodies Within the Central Valley Pesticide Basin Plan Amendment Area, Proposed Final" (revised Table 1), was released for public review and comment in August 2009.

Staff received twelve sets of written comments to revised Table 1. Staff prepared written responses to this set of comments (Appendix A). Based on the comments received, and the substantially lengthened list of named water bodies, staff prepared this final Report. The compiled list of named water bodies is now Appendix B located at the very end of this Report.

This report presents:

- A description of the Project Area (Section 2);
- A description of how the list of 1,289 named water bodies within the Project Area (Appendix B) was compiled (Section 3);
- A description and summaries of the information that documents aquatic life indicators in a subset (130) of the list of named water bodies (Section 4 and Tables 1 and 2);

- Results and Conclusions (Section 5);
- References (Section 6);
- Responses to Public Comments (Appendix A); and
- A list of 1,289 named water bodies that occur within the Project Area (Appendix B).

2. Description of the Project Area

The Project Area is the area downstream of major dams and their reservoirs and within the Sacramento and San Joaquin River Basins (Figure 1). The Project Area was designed to focus on the areas of known pesticide surface water impairments and was defined using Geographic Information System (GIS) software and coverages.

To provide further geographic breakdown consistent with the hydrology of the Central Valley and existing pesticide control provisions in the Basin Plan, the Project Area was divided into three watersheds, described below and shown on Figures 2 through 5.

The lower Sacramento watershed contains the lower Sacramento and the lower Feather rivers and their tributaries that normally drain into the Sacramento-San Joaquin Delta at the northern border of the lower Delta watershed via the Sacramento River. This watershed is similar to, but expanded around the northern end of, the project area for the Sacramento and Feather River diazinon ands chlorpyrifos Total Maximum Daily Load (TMDL) (Hann et al, 2007).

The lower San Joaquin watershed contains the lower San Joaquin River and its tributaries that normally drain into the Sacramento-San Joaquin Delta at the southern border of the lower Delta watershed via the San Joaquin River. This watershed is similar to, but expanded around its western and eastern margins of, the project area for the lower San Joaquin River diazinon ands chlorpyrifos TMDL (Beaulaurier et al, 2005).

The lower Delta watershed includes the legal Sacramento-San Joaquin Delta and a much broader area that includes the headwaters and drainage area of the Cosumnes River and other peripheral areas that drain directly into the legal Delta. This watershed is similar to the project area for the Sacramento-Joaquin Delta diazinon ands chlorpyrifos TMDL (Delta Waterways OP TMDL; McClure et al, 2006), but excludes the Colusa Basin subwatershed, which is assigned to the lower Sacramento watershed for the purposes of this Report.

3. Compilation of Named Water Bodies List

Staff compiled a list of 1,289 named water bodies (Appendix B) from GIS coverages, several Regional Water Board TMDL documents, and a limited literature search. The structure and content of Appendix B are described in Section 3.8.

It should be noted that several thousands of water bodies occur within the Project Area but most were not included in Appendix B because they are not named. In particular, only approximately 20% of the water bodies mapped in the RF3 and NHD GIS shapefiles (the two largest sources for named water bodies used in compiling Appendix B) have names in their associated attribute tables. Similarly, the USGS 1:24,000-scale topographic maps (and many other general maps that are readily available, but not digitized nor summarized by water body name), show many additional water bodies, including many that are named. However, the level of effort required to extract these additional water bodies would extend far beyond the available scope and resources for this Report.

Basin Plan

Table II-1 (and its accompanying map, Figure II-1) of the Basin Plan lists 98 specific water bodies or water body segments and an indeterminate number of "other lakes and reservoirs". Forty three of these water bodies occur within the Project Area and were included in Appendix B. The "Primary Source of Water Body Name" in Appendix B for these water bodies is indicated as "Basin Plan".

The "Sacramento Hydrologic Basin Planning Area" and "San Joaquin Hydrologic Basin Planning Area" maps (Basin Plan maps) (SWRCB, 1986) that supplement the Basin Plan are available in hardcopy (paper) format and as Digital Raster Graphic (DRG) GIS files. Two hundred forty five water bodies shown on these maps and that occur within the Project Area (those not already included from Table II-1 of the Basin Plan) were included in Appendix B. The "Primary Source of Water Body Name" in Appendix B for these water bodies is indicated as "Basin Plan Map".

Appendix 42 of the Basin Plan lists 146 Delta Waterways within the Legal Delta to which sites specific pesticide objectives apply. One hundred seven of these Delta Waterways water bodies (those not already included from the previous two sources) were added to Appendix B. Therefore, all 146 Delta Waterways are included in Appendix B of this Report. The "Primary Source of Water Body Name" in Appendix B for these one hundred seven water bodies not previously added from the previous sources is indicated as "Basin Plan, Appendix 42."

Harley Gulch has site-specific water quality objectives for mercury in the Basin Plan but it was not already included in Appendix B from previously described sources. Therefore, Harley Gulch was included in Appendix B. The "Primary Source of Water Body Name" in Appendix B for this water body is indicated as "Basin Plan."

2008/2010 Proposed Integrated Report

While this report was being prepared, the proposed 2008/2010 Integrated Report (IR) for the Regional Water Board was approved by the Regional Water Board and is pending approval by the State Water Board. Thirty one water bodies already on, or proposed for addition to, the Clean Water Act (CWA) Section 303(d) list of impaired water bodies (but not already included from the previously described sources) occur within the Project Area and were included in Appendix B. The "Primary Source of Water

Body Name" in Appendix B for the 303(d) water bodies is indicated as "2008/2010 303(d)/305(b) Integrated Report".

Seven other water bodies assessed for the proposed CWA Section 305(b) portion of the 2008/2010 IR (not proposed for the 303(d) list nor already added from the previously described sources) occur within the Project Area and were included in Appendix B. The "Primary Source of Water Body Name" in Appendix B for the 305(b) water bodies is indicated as "2008/2010 303(d)/305(b) Integrated Report."

Reach File 3 (RF3)
A GIS shapefile of water bodies (a national hydrologic database known as Reach File 3 or RF3 was created by the USEPA based on United States Geological Survey (USGS) Digital Line Graph mapping at a scale of 1:100,000 (USEPA, 1998). RF3 consists of linear features (e.g., rivers, streams, and some sloughs and canals). Within the attribute tables associated with the RF3 shapefile, approximately 20 percent of the water body segments are named. Sixteen RF3-named water bodies that occur within the Project Area (those not already included from the previously described sources) were included in Appendix B. The "Primary Source of Water Body Name" in Appendix B for these water bodies is indicated as "RF3".

National Hydrography Dataset (NHD)
The USGS has produced a National Hydrography Set (NHD) GIS coverage of water bodies based on the RF3 and additional feature digitization from mapping at two levels of resolution: 1:100,000-scale (nominally "medium resolution") and 1:24,000-scale (nominally "high resolution"). The NHD includes GIS shapefiles for linear features (e.g., rivers, streams, and some sloughs and canals) and for polygonal features (e.g., lakes, reservoirs, ponds, and some broader sloughs and river segments).

NHD has many more named water bodies than RF3. However, similar to RF3, only approximately 20 percent of the linear NHD features are named. A total of 830 named NHD water bodies that occur within the Project Area (those not already included from previously described sources) were included in Appendix B. The "Primary Source of Water Body Name" in Appendix B for these water bodies is indicated as "100K" for the 654 water bodies based on "medium resolution" mapping, and as "24K" for the 176 water bodies based on "high resolution" mapping. New, "medium resolution" waterbodies ("100K") were included in Appendix B before new "high resolution" ("24K") water bodies.

Limited Literature Search
While assembling literature documenting the presence of aquatic life indicators in water bodies within the Project Area (see Section 4), seven water bodies not already identified in any of the information sources previously described were included in Appendix B. These water bodies include Clear Creek (central Butte County), Union School Slough, Doty Creek, Linden Creek, Rock Gulch Creek, Snake Creek (southwestern Tehama County), and Soap Creek.

Of six creeks identified in a TMDL report for diazinon and chlorpyrifos in Sacramento area urban creeks (Spector et al, 2004), only one (Elk Grove Creek) was not included from the previously described sources. Therefore, Elk Grove Creek was included in Appendix B. The "Primary Source of Water Body Name" in Appendix B for this water body is indicated as "Sac urban creek OP TMDL."

Water Body List (Appendix B) Description

Based on information from the sources described above, and subsequent review to remove duplicate entries, the list of 1,289 named water bodies within the Project Area was augmented with information about each water body. Generally, this information is intended to help readers locate water bodies with additional geographical features. In particular, additional information for water bodies that share the same name (e.g., there are more than 20 instances of "Dry Creek") was included in Appendix B to distinguish the individual water bodies.

Appendix B is a table with eight informational columns, consisting of:

1. **Water Body Name** – Water body names are listed alphabetically. County names are included with some water body names.
2. **Location** – Nearby geographical features (typically a town or city name).
3. **Hydrologic Unit** – Corresponds to the first three digits of the "Hydro Unit Number" column of Basin Plan Table II-1 and to Hydrologic Units shown on the Basin Plan maps.
4. **Primary Source of Water Body Name** – Many water bodies listed in Appendix B were identifiable from more than one of the information sources listed above (Sections 3.1 through 3.7). Therefore, an information-source hierarchy was implemented for identifying the sources of water body names listed in Appendix B. The hierarchy follows the order of information sources presented in Sections 3.1 through 3.7. For example, the "Primary Source of Water Body Name" for "Water Body Name" = "American River, Lower" is" Basin Plan", although this water body was also identifiable from a Basin Plan map, the proposed 2008/2010 Integrated Report, RF3, NHD, and Site-Specific Data and Critical Habitat Data sources. The "Primary Source of Water Body Name" column entries for NHD water bodies are prioritized "100K" over "24K".
5. **BMI/Fish** – Water bodies for which the limited literature search (described in Section 4, below) found studies that document the presence of benthic macroinvertebrates (BMIs) or fish are indicated with "B" or "F", respectively.
6. **Critical Habitat Criteria** – Water bodies for which the limited literature search (described in Section 4, below) found studies that document critical habitat for Chinook salmon or steelhead are indicated with a "C" or "S", respectively. For many water bodies, both apply.
7. **CVP BPA Project Watershed** – This column indicates in which watershed (lower Sacramento, lower Delta, or lower San Joaquin) the water body occurs (see Section 2).
8. **Notes** – This column may contain location information, such as alternate water body names (e.g., the names used in the proposed 2008/2010 IR), general geographical information (e.g., the Delta Waterways OP TMDL subarea in which

a water body occurs), or specific hydrographical information (e.g., the names of water bodies to which the listed water body is a tributary).

The general geographical distribution of the compiled list of water bodies within the lower Sacramento, lower Delta, and lower San Joaquin watersheds, are displayed in Figures 3, 4, and 5, respectively.

4. Compilation of Aquatic Life Indicators

Information documenting the occurrence, or possible occurrence, of aquatic organisms in Project Area water bodies was gleaned from a limited search of readily available literature. The information documents the presence of benthic macroinvertebrate (BMI) communities, fish species, or critical habitat for two threatened fish species in 130 of the 1,289 water bodies compiled into Appendix B).

Studies that documented BMI communities or fish species for specific sites typically included a description of the data and, in a few cases, provided the raw data in the report. For several studies, the authors did not include the specific locations of the sites where the data were collected. In these cases, one of the study's authors was contacted to obtain the site location information.

GIS shapefiles that documented water bodies associated with critical habitat for Central Valley steelhead and Central Valley spring-run Chinook salmon (species listed as threatened under the federal Endangered Species Act) were obtained from the National Marine Fisheries Service (NMFS) branch of the National Oceanic and Atmospheric Administration's (NOAA).

General descriptions of the types of possible aquatic life indicator studies and shapefiles, and summaries of the specific studies, are presented in Section 4.1 for BMI and fish studies and in Section 4.2 for critical habitat studies.

BMI and Fish Studies

The readily available literature included 10 benthic macroinvertebrate (BMI) bioassessment studies and two fish studies. BMIs are "animals inhabiting the substratum [bottom] of lakes, streams, estuaries, and marine water" (Eaton *et al.*, 2001). Biological communities have been sampled by the University of California, Davis (UC Davis), the Department of Fish and Game (DFG), the Regional Water Board, the University of Maryland (UM), the United States Geological Survey (USGS), and the Department of Pesticide Regulation (DPR). The sites associated with the 10 studies are listed in Table 1 and are shown on Figure 6. Table 1 also indicates: the data type ("Macroinvertebrate" or "Fish"); the "Water body" (name); "Site Name"; "Latitude" and "Longitude" coordinates; and the "Study" (reference number) for each site.

Regional Water Board staff summarized the information in each of the 10 BMI or fish studies, including: who collected the data; the type of study (BMI or fish); how, when, and where the data were collected; and whether metrics were calculated or other analyses were performed. These summaries are presented, alphabetically by author, below.

Additional general information gleaned from the 10 studies is provided in Table 2 and includes: the complete "Study Citation"; "Year(s) Studied"; "Organisms Sampled"; "# of Sites" (number of sites studied); whether a "Physical Habitat Assessment" was made; and a brief list of "Other Parameters Studied" (e.g., temperature, dissolved oxygen, alkalinity, etc.). The Study numbers used in the summaries, below, correspond with the "Study" numbers in Tables 1 and 2.

Summaries of BMI Studies

1. Bacey and Spurlock, 2005

From 2002-2004, the DPR collected BMIs in four creeks in the greater Sacramento area and concurrently collected water and sediment samples from these locations. The BMI samples were collected using modified USEPA methods. BMI populations were identified and classified by metrics that included taxa, abundance, feeding habits, etc. Macroinvertebrates were found at every location that was sampled.

This study also discussed the relationship of the BMI metrics to water and sediment quality measurements and analytical parameters, including organophosphate and pyrethroid pesticides, temperature, and physical habitat assessments.

2. Brown and May, 2000

From 1993 through 1997, the USGS collected macroinvertebrates from riffles or large woody debris at sites within the San Joaquin River and Sacramento River drainages. Although information for only 53 (of a total of 63) sites sampled was presented in the study report, USGS staff confirmed that aquatic organisms (a total of 83 taxa) was found at all 63 sites sampled (personal communication with May, 2006.).

3. Brown and May, 2004

In June and September of 2001, the USGS collected macroinvertebrates and periphyton from pieces of submerged woody debris at five sites within the San Joaquin River Basin. USGS taxonomists identified a total of 126 macroinvertebrate taxa and 161 periphyton taxa. The USGS also collected basic water quality data and physical habitat observations at each site. The USGS analyzed the data to define existing conditions and to find relationships between the macroinvertebrate and periphyton community conditions and environmental conditions. BMI and periphyton communities were present at every site.

4. CRWQCB-CVR, 2003

Between 2001 and 2003, Regional Water Board staff collected macroinvertebrates, and made basic water quality and flow measurements, at 16 sites

throughout the Cow Creek watershed. Macroinvertebrates were sampled according to the California Stream Bioassessment Procedure (CBSP) developed by the DFG (Harrington, 1999). DFG Aquatic Bioassessment Laboratory taxonomists analyzed macroinvertebrate populations. BMI communities were present at every site.

5. de Vlaming *et al.*, 2004

Between 2000 and 2002, University of California, Davis Aquatic Toxicology Laboratory (UC Davis ATL) staff collected BMI samples and made physical habitat assessments at several locations along each of five agriculture-dominated and three effluent-dominated tributaries within the lower Sacramento River Watershed. UC Davis ATL taxonomists analyzed the resident BMI populations and community compositions. BMI communities were found in all eight water bodies.

6. de Vlaming *et al.*, 2005

In June and September 2001, UC Davis ATL staff collected and analyzed BMI samples from a total of 11 effluent-dominated and agriculture-dominated water bodies within the San Joaquin River watershed. Macroinvertebrates were sampled according to the CSBP.

The UC Davis ATL field crews made physical habitat observations and basic water quality measurements at each site and collected water samples for analysis of metals, nutrients, total organic carbon, and biological oxygen demand. Taxonomists identified a sub-sampling of 300 BMIs and several metrics were analyzed to explore the relationships between BMI populations, water quality, and physical habitat. BMI communities were present at every sampling site.

7. Hall and Killen, 2005

From 2000 to 2002, University of Maryland (UM) Agricultural Experiment Station staff collected BMI samples at 10 riffle sites along Orestimba Creek in Stanislaus County. One site was situated upstream of agricultural activity and the other nine sites were located downstream, within the area of agricultural activity. UM staff also made physical habitat observations and basic water quality measurements and observations in the field and analyzed BMI communities in the laboratory. BMI populations were found at every sampling site.

8. Markiewicz *et al.*, 2005

In 2002, UC Davis ATL staff collected 22 BMI samples from tributaries of the San Joaquin River to ascertain the “community structure” of the macroinvertebrates and to assess the physical habitat conditions of the water bodies. Field teams collected samples using the USEPA’s multi-habitat sampling method from their rapid bioassessment protocol (Barbour *et al.*, 1999) and the CSBP. The UC Davis ATL identified a sub-sample of the organisms and performed multivariate and multimetric analyses of the BMI populations. Macroinvertebrate communities were present at every site sampled.

9. Ode *et al.*, 2000

Between September and November 2000, DFG staff collected macroinvertebrate samples for the Sacramento River Watershed Project at 37 sites within the Sacramento River watershed. Field teams collected samples using either the CSBP or the USGS snag sampling method (described in Brown and May, 2000). The DFG Aquatic Bioassessment Laboratory identified macroinvertebrate populations and analyzed macroinvertebrate community metrics. Macroinvertebrate communities were present at every sampling site.

10. Ode *et al.*, 2005

In 2004, DFG staff collected BMI samples from 30 sites in streams and sloughs within the Central Valley using the USEPA's Environmental Monitoring and Assessment Program (EMAP) 11-transect, reach-wide, benthos method (Peck *et al.* 2003). In addition to BMI collection, DFG staff concurrently made physical habitat measurements and observations and measured basic water quality parameters. The DFG Aquatic Biology Laboratory identified BMI populations in the samples and analyzed the data using several metrics. The goal of this research was to assist the Regional Water Board in developing a method of bioassessment that could be used to measure water quality. DFG staff found BMI communities at every sampling site.

<u>Summaries of Fish Studies</u>

11. Brown, 2000

Between 1993 and 1995, USGS staff collected fish at 20 sites within the San Joaquin River drainage. Fish species metrics were determined and compared with water quality and habitat quality. Of the 31 fish taxa collected, only 10 are native to the lower San Joaquin River drainage.

12. May and Brown, 2002

Between 1996 and 1998, USGS staff collected fish at 22 sites within the Sacramento River Basin and made water quality measurements and assessed habitat conditions at each site. Of the 36 taxa of fish collected, only 13 are native to the Sacramento River Basin. The USGS performed several analyses on the data and calculated several metrics to determine whether an Index of Biotic Integrity (IBI) could be developed for the Sacramento River Basin. Fish were present at every site sampled for these two studies.

Central Valley Steelhead and Spring-Run Chinook Salmon Critical Habitat

The federal government is required to designate "critical habitat" for species listed by the Endangered Species Act (ESA). "Critical habitat" is defined in the ESA, section 3(5)(A) as:

> (i) the specific areas within the geographical area occupied by the species, at the time it is listed… on which are found those physical or biological features (I) essential to the conservation of the species

and (II) which may require special management considerations or protections; and

(ii) specific areas outside the geographical area occupied by the species at the time it is listed… upon a determination by the Secretary that such areas are essential for the conservation of the species.

NMFS reviewed and collected data for several fish groups. Within the Project Area, NMFS has identified two distinct population segments, which they described as Evolutionary Significant Units (ESUs). NMFS designated critical habitat for the ESUs rather than for species and identified two ESUs in the Central Valley: the Central Valley spring-run Chinook salmon ESU and the Central Valley steelhead ESU (NOAA, 2005).

NMFS provided GIS shapefiles that show where Central Valley steelhead (steelhead) and Central Valley spring-run Chinook salmon (Chinook) critical habitat ESUs occur. Germane to this report, and significant to the Project, NMFS biologists determined that Chinook and steelhead may be present during one, or more, life stages, including adult migration and spawning, and juvenile rearing and migration in those areas (NOAA, 2005; Gavette, 2005a; Gavette, 2005b).

The Central Valley spring-run Chinook salmon critical habitat ESU includes between 1,000 and 1,500 miles of water bodies, and about 250 square miles of estuary. Water body segments within the Project Area that Chinook may use occur from Redding, in the north, to east of Stockton, in the south. Chinook may use these water bodies for adult spawning, holding and migration, juvenile rearing and migration, and non-natal rearing (NOAA, 2005; Gavette, 2005b). A map of the critical habitat ESU for Central Valley spring-run Chinook salmon is shown in Figure 7.

The Central Valley steelhead critical habitat includes approximately 2,300 miles of water bodies and about 250 square miles of estuary. Water body segments within the Project Area that steelhead may use occur from Redding, in the north, to the Merced River, in the south. Steelhead may use these water bodies for adult migration and spawning, and juvenile rearing and migration (NOAA, 2005; Gavette 2005a). A map of the critical habitat ESU water bodies for Central Valley steelhead is shown in Figure 8.

5. Results and Conclusions

A list of 1,289 named water bodies located within the Project Area was compiled from readily available sources (Appendix B). Indicators of the actual, or possible, presence of aquatic organisms (BMI populations, fish species occurrences, and critical habitat for Central Valley steelhead and/or Chinook salmon) were identified for 130 water bodies (10% of the Appendix B-listed water bodies). Since each of the 130 water bodies are documented as being associated with one, or more, aquatic life indicators, it is reasonable to conclude that one, or more, aquatic life beneficial uses, as defined in the Basin Plan, may be appropriate for these 130 water bodies. Further, it is not inappropriate to consider that one, or more, aquatic life beneficial uses apply to all of the

1,289 water bodies compiled in Appendix B (and, indeed, to many more tributary water bodies not listed in Appendix B).

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Figure 1 - Central Valley Pesticide Basin Plan Amendment Project Area

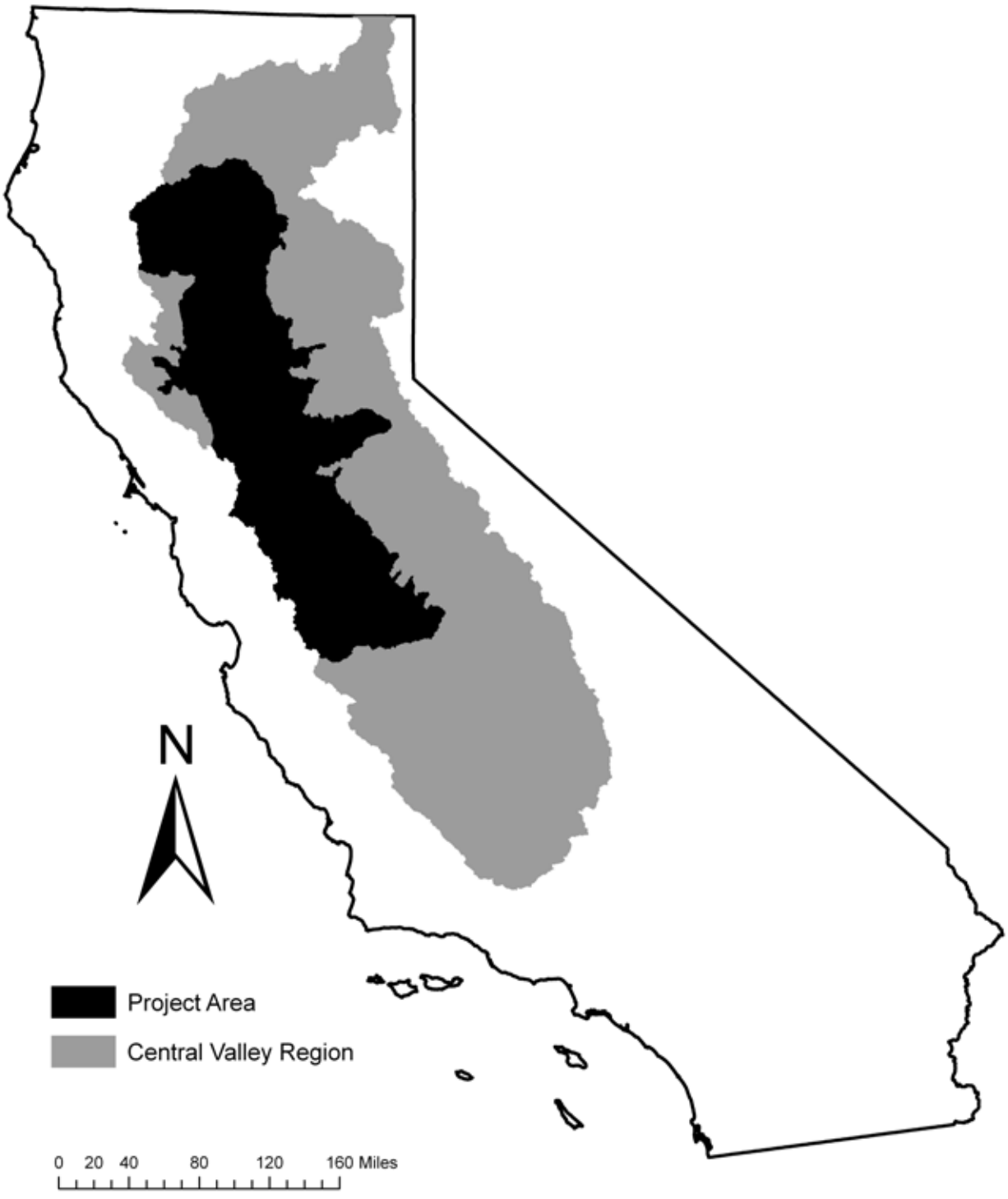

Figure 2 – Project Area Watersheds

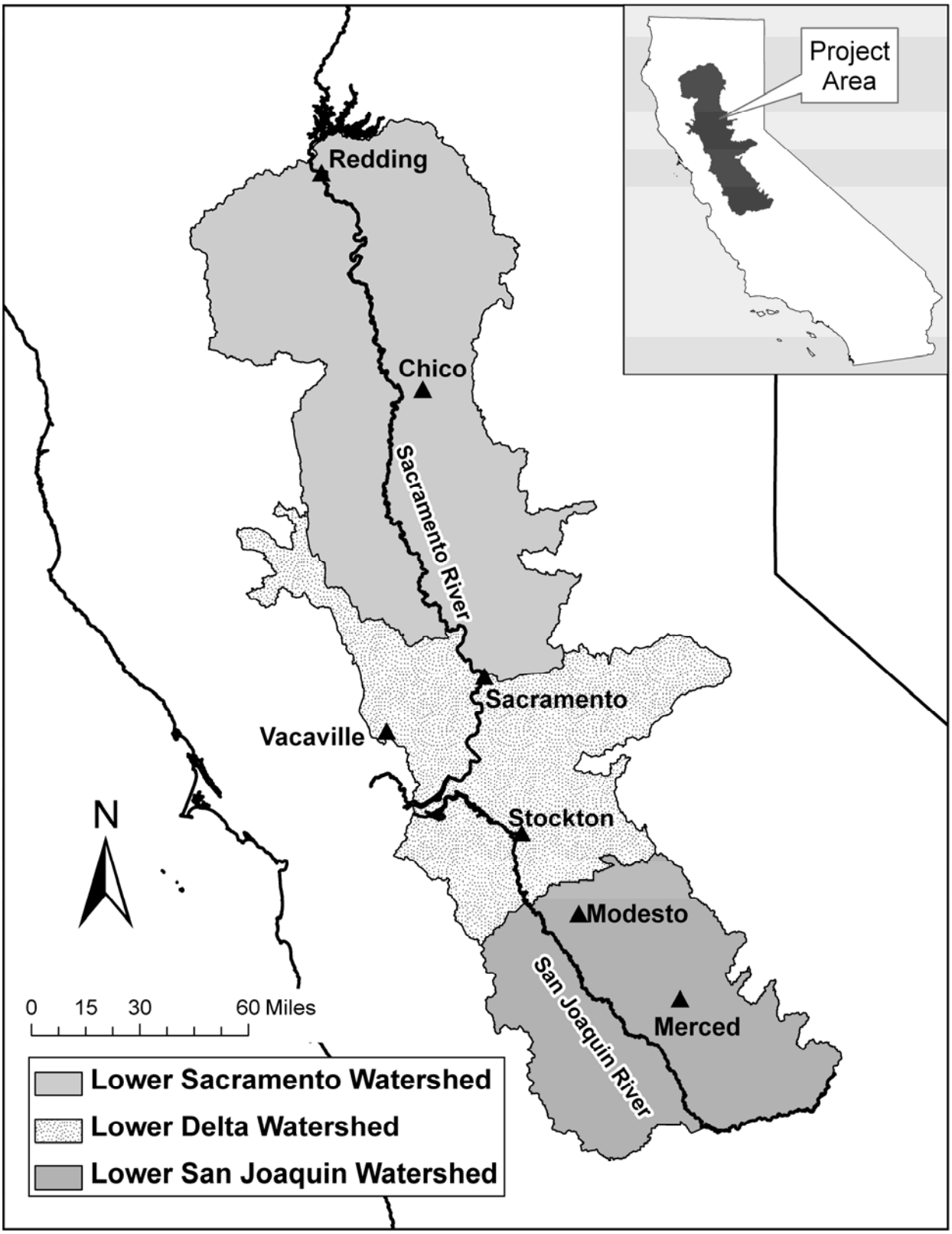

Figure 3 - Compiled Water Bodies - Lower Sacramento Watershed

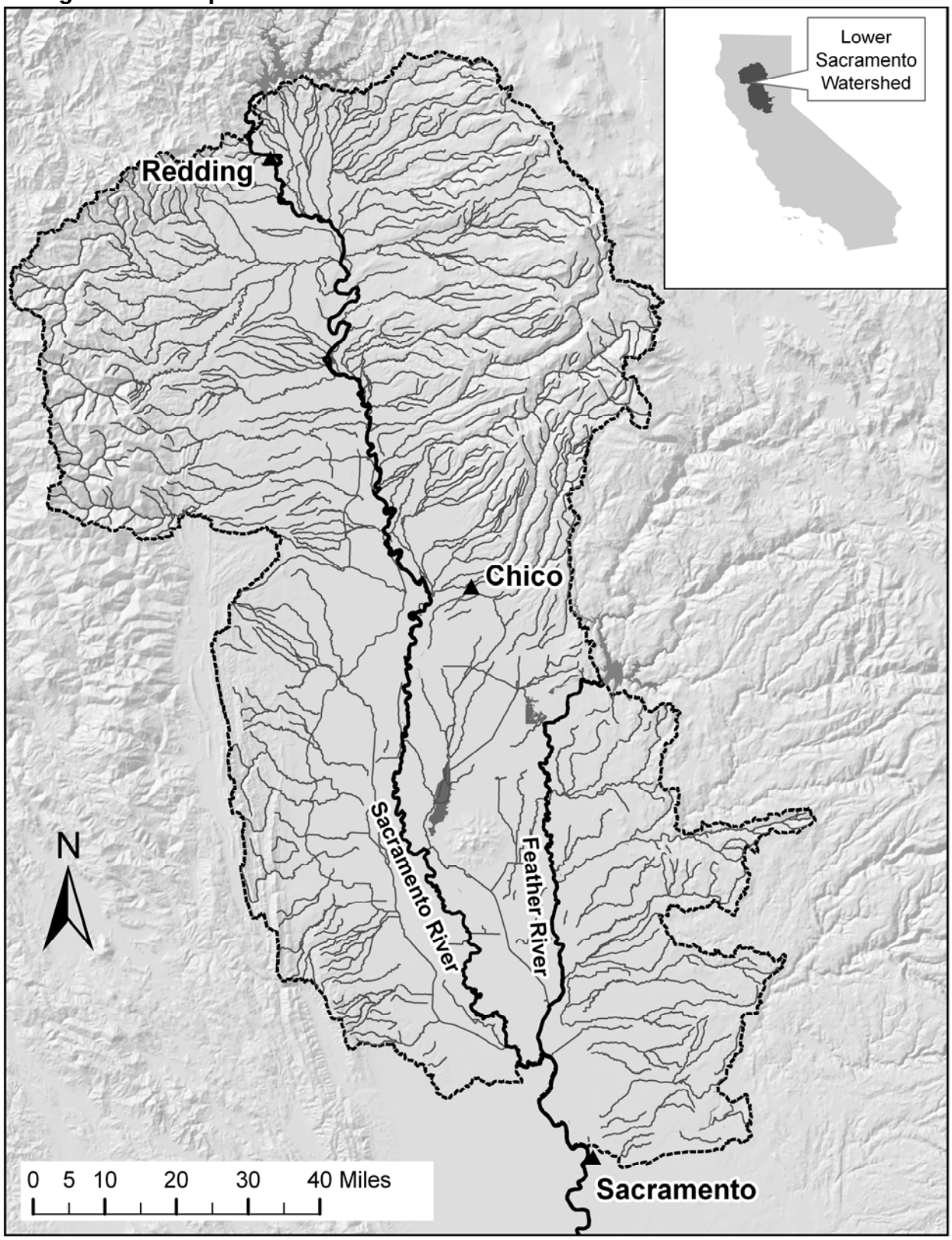

Figure 4 - Compiled Water Bodies - Lower Delta Watershed

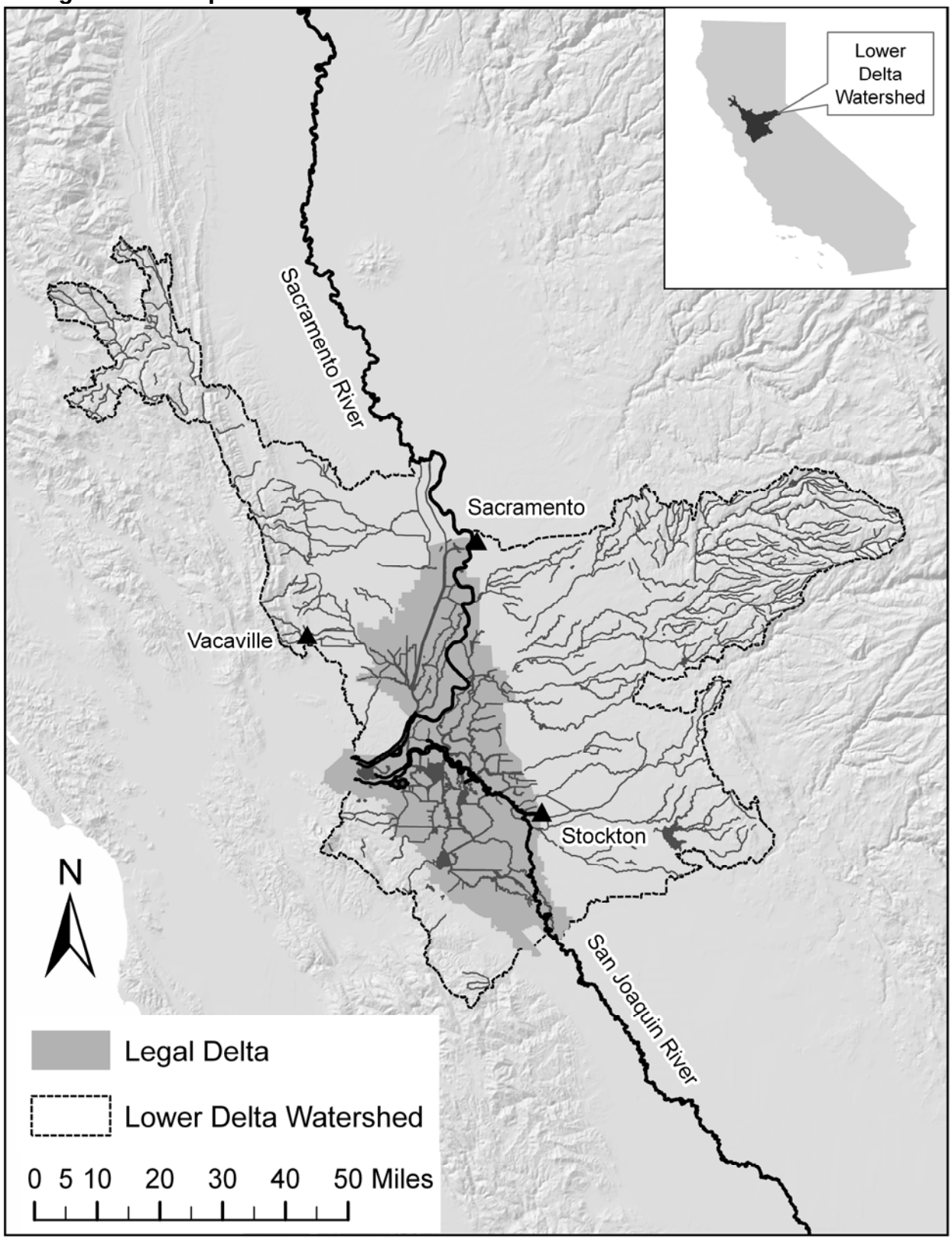

Figure 5 - Compiled Water Bodies - Lower San Joaquin Watershed

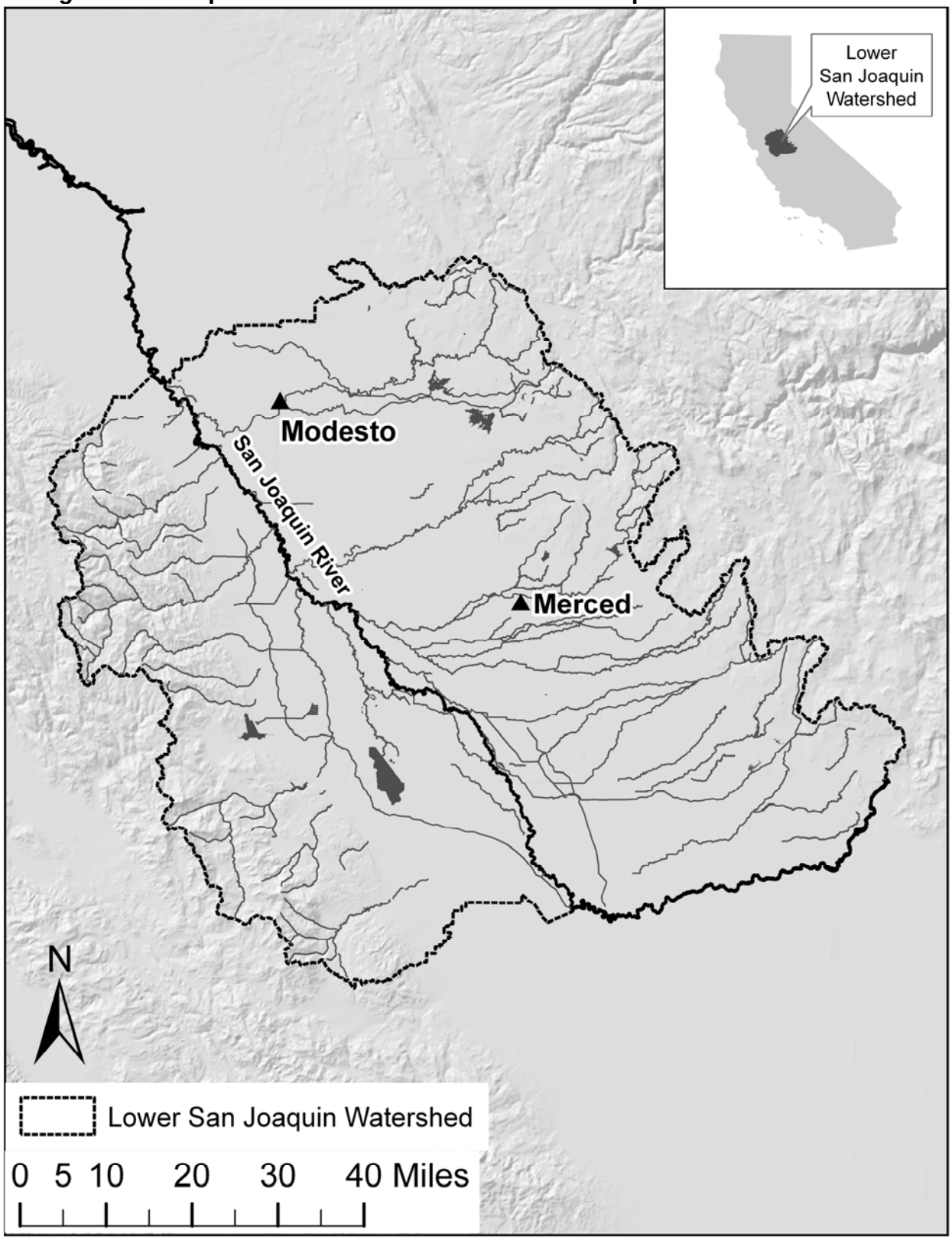

Figure 6 BMI and Fish Study Sites

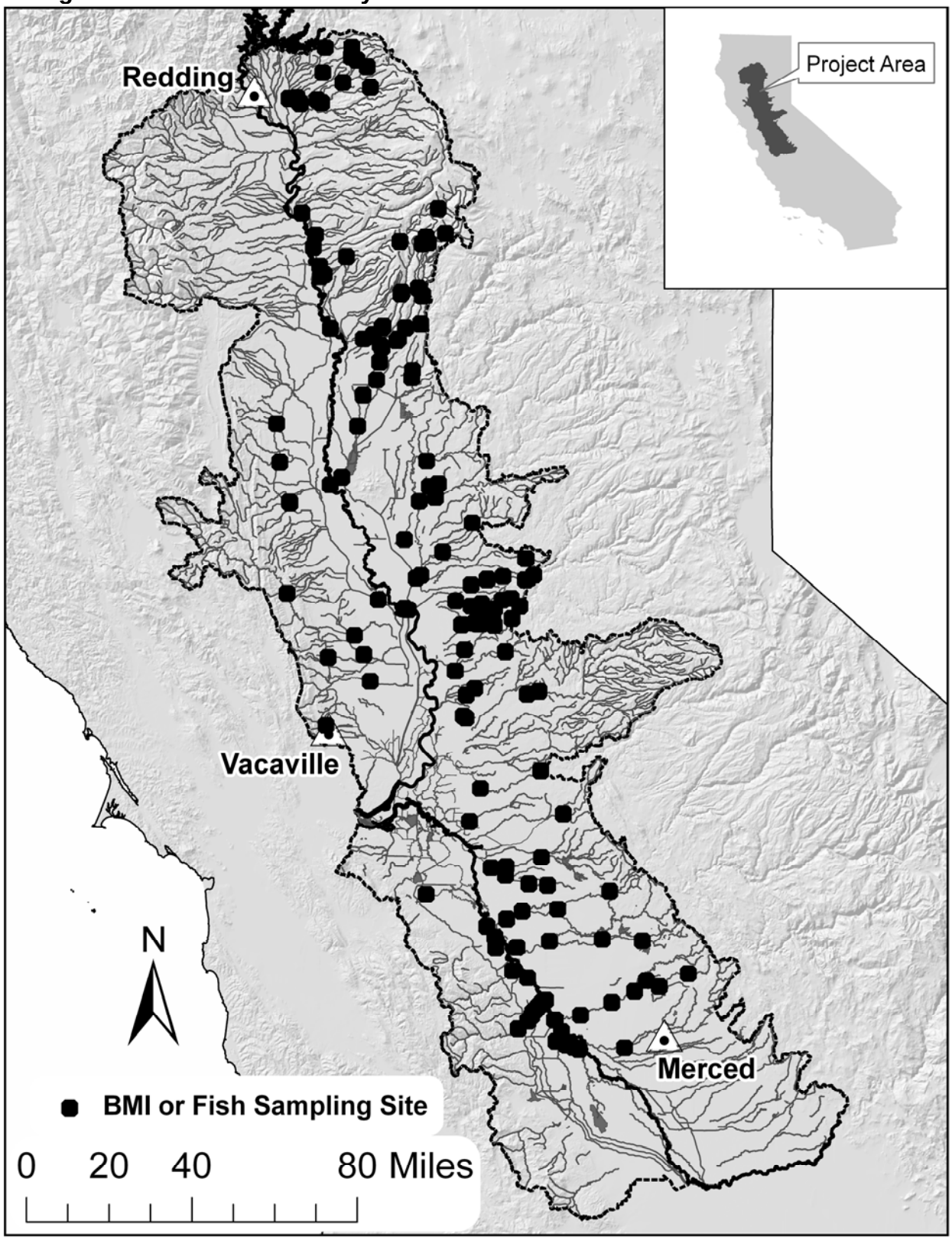

Figure 7 – Critical Habitat - Central Valley Spring-Run Chinook Salmon

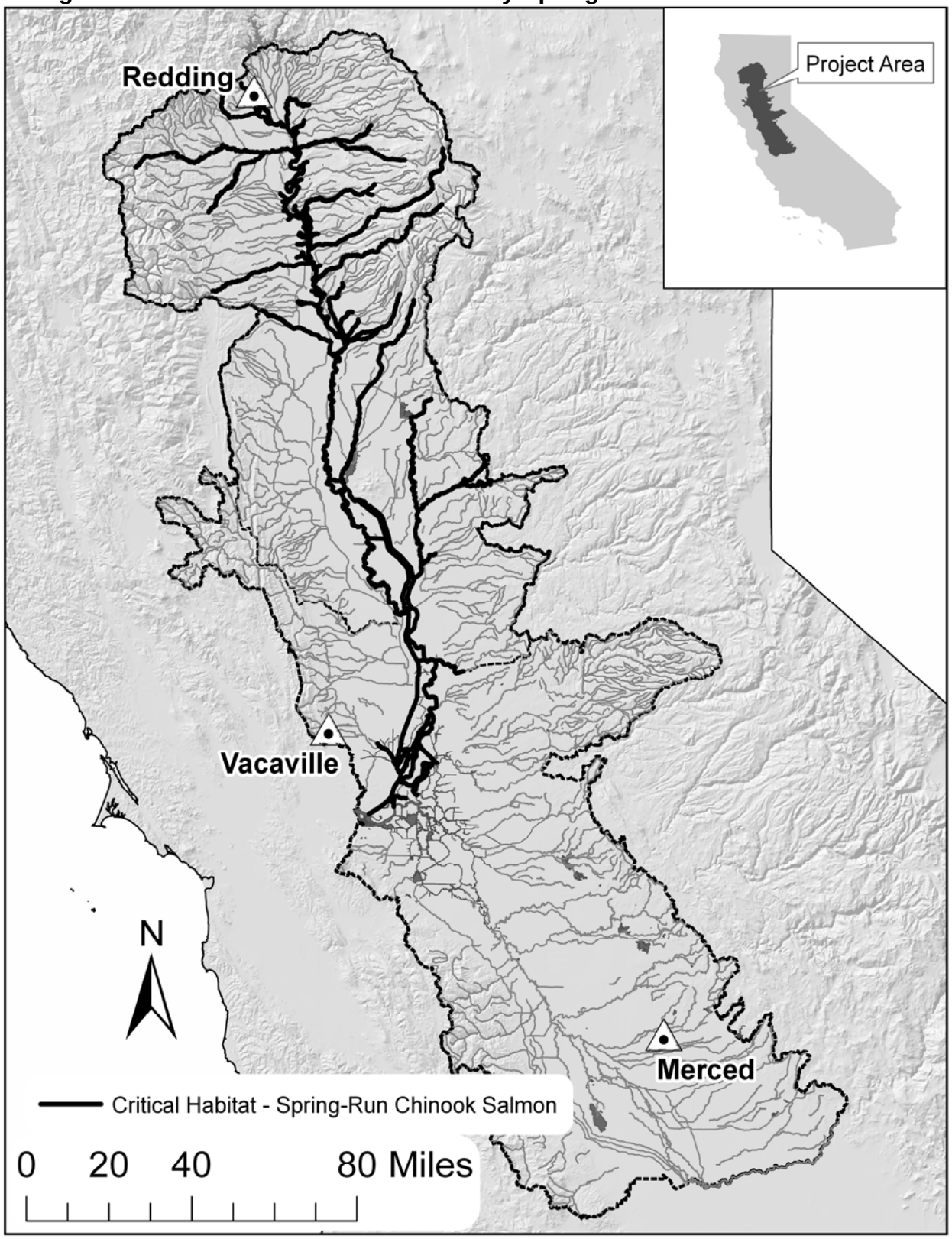

Figure 8 – Critical Habitat - Central Valley Steelhead

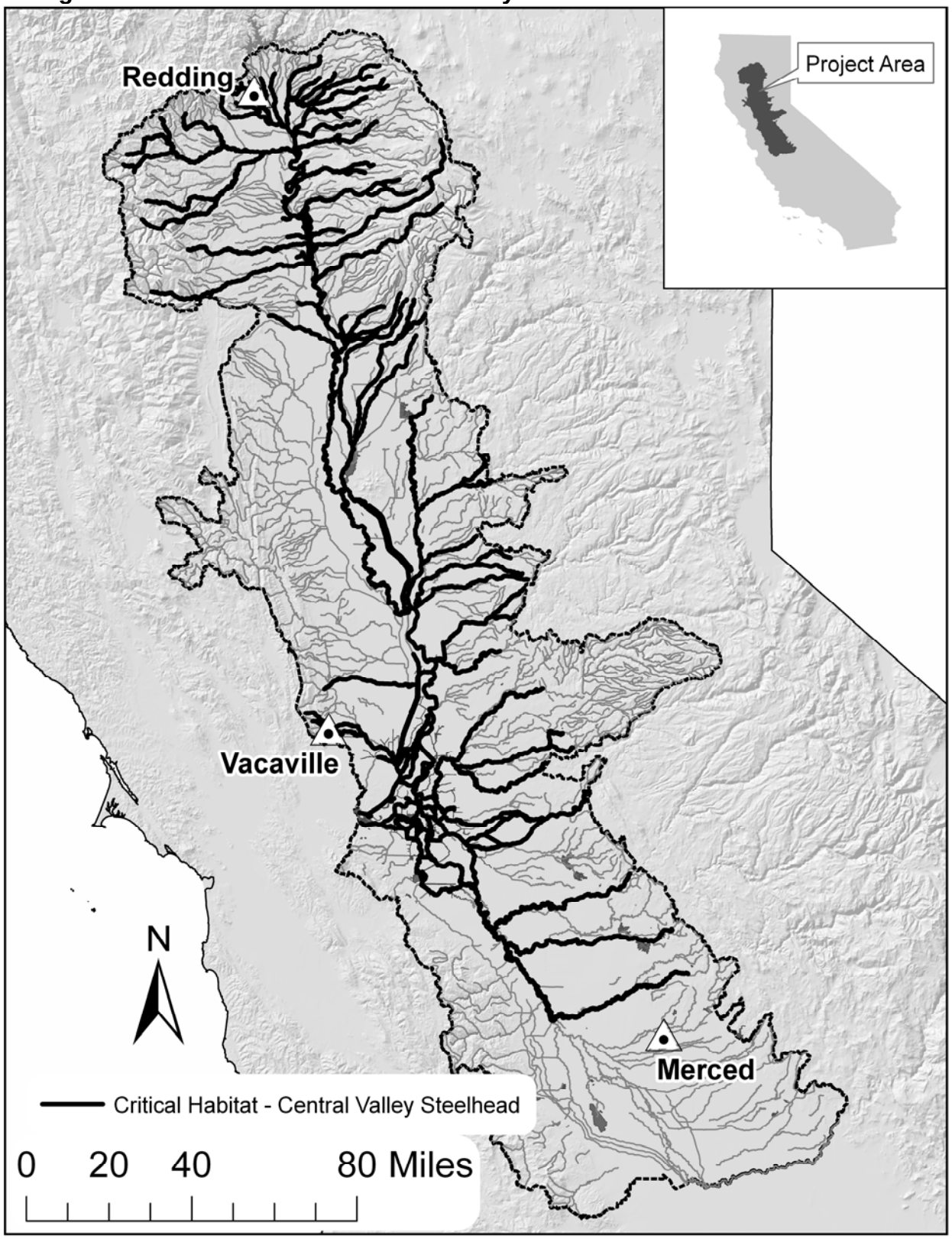

Table 1 - BMI and Fish Study Sites

Site names are from the associated studies (study numbers correspond to Table 2).

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Elder Creek	Elder Creek @ Bradshaw Road	38.5072	-121.3335	1
Macro-invertebrate	Elder Creek	Elder Creek @ Elk Grove-Florin Road	38.4840	-121.3710	1
Macro-invertebrate	Elk Grove Creek	Elk Grove Creek @ Elk Grove-Florin Road	38.4033	-121.3706	1
Macro-invertebrate	Elk Grove Creek	Elk Grove Creek @ Emerald Vista Drive	38.4110	-121.3832	1
Macro-invertebrate	Littlejohns Creek	Littlejohns Creek @ Austin Road	37.8861	-121.1826	1
Macro-invertebrate	Littlejohns Creek	Littlejohns Creek @ Stanley Road	37.9203	-121.0268	1
Macro-invertebrate	Lone Tree Creek	Lone Tree Creek @ Escalon-Bellota Road	37.8224	-120.9977	1
Macro-invertebrate	Lone Tree Creek	Lone Tree Creek @ Lone Tree Road	37.8272	-121.0805	1
Macro-invertebrate	American River	AMERICAN R A SACRAMENTO CA	38.5681	-121.4222	2
Macro-invertebrate	Arcade Creek	ARCADE C NR DEL PASO HEIGHTS CA	38.6419	-121.3817	2
Macro-invertebrate	Big Chico Creek	BIG CHICO C A CHICO CA	39.7272	-121.8622	2
Macro-invertebrate	Big Chico Creek	BIG CHICO C A SODA SPRGS CMPGRND	40.0878	-121.5844	2
Macro-invertebrate	Big Chico Creek	BIG CHICO C A UPPER PARK GOLF COU	39.7669	-121.7783	2
Macro-invertebrate	Big Chico Creek	BIG CHICO C NR FOREST RANCH CA	39.8933	-121.6922	2
Macro-invertebrate	Butte Creek	BUTTE C A BIGGS PRINCETON RD NR A	39.4200	-121.8800	2
Macro-invertebrate	Butte Creek	BUTTE C A CHERRY HILL CAMPGROUND	40.1025	-121.4964	2
Macro-invertebrate	Butte Creek	BUTTE C A DOE MILL RD NR STIRLING	39.9089	-121.6169	2
Macro-invertebrate	Butte Creek	BUTTE C A DURNEL RD NR NELSON CA	39.5842	-121.7989	2
Macro-invertebrate	Butte Creek	BUTTE C A HONEY RUN RD NR PARADIS	39.7289	-121.7025	2
Macro-invertebrate	Butte Creek	BUTTE C A LAUX RD NR MERIDIAN CA	39.2406	-121.9472	2

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Cache Creek	CACHE C A GUINDA CA	38.8283	-122.1822	2
Macro-invertebrate	Colusa Basin Drain	COLUSA BASIN DR A RD 99E NR KNIGH	38.8125	-121.7731	2
Macro-invertebrate	Deer Creek	DEER C A COHASSET RIDGE RD NR CAM	40.0706	-121.7036	2
Macro-invertebrate	Deer Creek	DEER C A POTATO PATCH CMPGRND NR	40.1878	-121.5311	2
Macro-invertebrate	Deer Creek	DEER C BL SP RR BRIDGE NR VINA CA	39.9408	-122.0636	2
Macro-invertebrate	Deer Creek	DEER C NR VINA CA	40.0141	-121.9472	2
Macro-invertebrate	Feather River	FEATHER R NR NICOLAUS	38.8906	-121.6033	2
Macro-invertebrate	Merced River	MERCED R A HAGAMAN CTY PARK NR IR	37.3683	-120.8464	2
Macro-invertebrate	Merced River	MERCED R A MCCONNELL STATE PARK N	37.4139	-120.7092	2
Macro-invertebrate	Merced River	MERCED R A RIVER ROAD BRIDGE NR N	37.3511	-120.9608	2
Macro-invertebrate	Merced River	MERCED R BL SNELLING DIV DAM NR S	37.5164	-120.3728	2
Macro-invertebrate	Mokelumne River	MOKELUMNE R A WOODBRIDGE CA	38.1586	-121.3025	2
Macro-invertebrate	Orestimba Creek	ORESTIMBA CR AT RIVER RD NR CROWS	37.4136	-121.0150	2
Macro-invertebrate	Sacramento River	SACRAMENTO R A COLUSA CA	39.2142	-121.9992	2
Macro-invertebrate	Sacramento Slough	SACRAMENTO SLOUGH NR KNIGHTS LAND	38.7850	-121.6533	2
Macro-invertebrate	Salt Slough	SALT SLOUGH A HWY 165 NR STEVINSO	37.2478	-120.8511	2
Macro-invertebrate	San Joaquin River	SAN JOAQUIN R A FREMONT FORD BRID	37.3100	-120.9300	2
Macro-invertebrate	San Joaquin River	SAN JOAQUIN R A PATTERSON BR NR P	37.4975	-121.0819	2
Macro-invertebrate	San Joaquin River	SAN JOAQUIN R AT MAZE RD BRIDGE N	37.6400	-121.2283	2
Macro-invertebrate	San Joaquin River	SAN JOAQUIN R NR VERNALIS CA	37.6761	-121.2642	2
Macro-invertebrate	Stanislaus River	STANISLAUS R A CASWELL STATE PARK	37.7025	-121.1772	2

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Stanislaus River	STANISLAUS R A MILE 50 NR KNIGHTS	37.8042	-120.7228	2
Macro-invertebrate	Stanislaus River	STANISLAUS R A RIPON CA	37.7297	-121.1094	2
Macro-invertebrate	Stanislaus River	STANISLAUS R A RIVERBANK CA	37.7386	-120.9519	2
Macro-invertebrate	Tuolumne River	TUOLUMNE R A HICKMAN NR WATERFORD	37.6356	-120.7539	2
Macro-invertebrate	Tuolumne River	TUOLUMNE R A MODESTO CA	37.6272	-120.9864	2
Macro-invertebrate	Tuolumne River	TUOLUMNE R A SHILOH RD BRIDGE NR	37.6033	-121.1303	2
Macro-invertebrate	Tuolumne River	TUOLUMNE R A TURLOCK LK STATE PK	37.6311	-120.5772	2
Macro-invertebrate	Yuba River	YUBA R NR MARYSVILLE CA	39.1758	-121.5239	2
Macro-invertebrate	Merced River	Merced River at River Road near Newman	37.3511	-120.9608	3
Macro-invertebrate	Orestimba Creek	Orestimba Creek at River Road near Crows Landing	37.4136	-121.0150	3
Macro-invertebrate	Salt Slough	Salt Slough at Highway 165 near Stevinson	37.2478	-120.8511	3
Macro-invertebrate	San Joaquin River	San Joaquin River near Vernalis	37.6761	-121.2653	3
Macro-invertebrate	Tuolumne River	Tuolumne River at Shiloh Road Bridge near Grayson	37.6034	-121.1303	3
Macro-invertebrate	Clover Creek	Lower Clover on Old 44. 1/2 mile west of Whitmore Road	40.5535	-122.1818	4
Macro-invertebrate	Old Cow Creek	Cow Creek at JS Ranch	40.5607	-122.0966	4
Macro-invertebrate	Cow Creek	Lower North Cow Creek near Swede Creek Road/Old 44	40.5637	-122.2251	4
Macro-invertebrate	Oak Run Creek	Lower Oak Run at bridge at Old 44 Drive near Winding Way	40.5668	-122.1895	4
Macro-invertebrate	Cow Creek	Lower Old/South Cow Creek 1/4 mile north of Highway 44 on Old 44 Drive	40.5457	-122.1732	4
Macro-invertebrate	South Cow Creek	Lower South Cow Creek at Dr. Farrell's, 1/4 mile north of South Cow Creek Road	40.5508	-122.0761	4

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Cow Creek	Mainstem Cow Creek at Highway 44 bridge, 1/3 mile east of Deschutes Road	40.5627	-122.2257	4
Macro-invertebrate	Little Cow Creek	Middle North Cow Creek on Highway 299 in Ingot	40.7439	-122.0639	4
Macro-invertebrate	Cow Creek	Middle Oak Run by Oak Run Road two miles south of Oak Run to Fern Road	40.6564	-122.0725	4
Macro-invertebrate	Cow Creek	Middle Old Cow Creek Bridge on Whitmore Road	40.6236	-121.9799	4
Macro-invertebrate	Cow Creek	Middle South Cow Creek at PG&E, South Cow Creek Road	40.5512	-122.0760	4
Macro-invertebrate	Cow Creek	Upper Clover near Oak Run to Fern road, 1/2 mile north of Clover Creek	40.7025	-121.9174	4
Macro-invertebrate	Little Cow Creek	Upper North Cow Creek by Phillips Road bridge near Buzzard Roost	40.7490	-121.9418	4
Macro-invertebrate	Cow Creek	Upper Oak Run by Phillips Road bridge near Oak Run to Fern Road	40.7139	-121.9435	4
Macro-invertebrate	Cow Creek	Upper Old Cow Creek at bridge on Fern Road	40.6801	-121.8693	4
Macro-invertebrate	Cow Creek	Upper South Cow Creek Bridge on Ponderosa Way	40.6071	-121.8524	4
Macro-invertebrate	Auburn Ravine	Downstream Auburn WWTF	38.8897	-121.1123	5
Macro-invertebrate	Auburn Ravine	Fowler Rd.	38.9011	-121.2125	5
Macro-invertebrate	Auburn Ravine	Hwy 65	38.8885	-121.2850	5
Macro-invertebrate	Auburn Ravine	Moore Rd.	38.8700	-121.3566	5
Macro-invertebrate	Auburn Ravine	Palm Avenue - Most Upstream	38.9064	-121.0751	5
Macro-invertebrate	Auburn Ravine	Upstream Auburn WWTF	38.8891	-121.1097	5
Macro-invertebrate	Butte Creek	Butte Creek - Aguas Frias Rd.	39.5301	-121.8584	5
Macro-invertebrate	Butte Creek	Butte Creek - Durham/Dayton HWY	39.6471	-121.7870	5

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Butte Creek	Butte Creek - HWY 99	39.6994	-121.7771	5
Macro-invertebrate	Coon Creek	Coon Creek - d/s SMD1 WWTF	38.9657	-121.1130	5
Macro-invertebrate	Coon Creek	Coon Creek - u/s SMD1 WWTF	38.9663	-121.1096	5
Macro-invertebrate	Rock Creek	Rock Creek - u/s SMD1 WWTF	38.9643	-121.1101	5
Macro-invertebrate	Antelope Creek	Antelope Creek - Sunset Blvd.	38.7876	-121.2489	5
Macro-invertebrate	Dry Creek	Antelope Creek - Taylor Park	38.8183	-121.2164	5
Macro-invertebrate	Dry Creek	Dry Creek - Atkinson Rd.	38.7343	-121.3087	5
Macro-invertebrate	Dry Creek	Dry Creek - Cook Riolo Rd.	38.7368	-121.3383	5
Macro-invertebrate	Dry Creek	Dry Creek - d/s Roseville WWTF	38.7343	-121.3246	5
Macro-invertebrate	Dry Creek	Dry Creek - u/s Roseville WWTF	38.7339	-121.3187	5
Macro-invertebrate	Linda Creek	Linda Creek - Champion Oaks Blvd.	38.7300	-121.2493	5
Macro-invertebrate	Miners Ravine	Miners Ravine - Auburn Folsom Blvd.	38.7545	-121.1702	5
Macro-invertebrate	Miners Ravine	Miners Ravine - d/s SMD3 WWTF	38.7968	-121.1358	5
Macro-invertebrate	Miners Ravine	Miners Ravine - u/s SMD3 WWTF	38.7982	-121.1352	5
Macro-invertebrate	Secret Ravine	Secret Ravine - Loomis Park	38.8245	-121.1755	5
Macro-invertebrate	Gilsizer Slough	Gilsizer Slough - O'Banion Rd.	39.0260	-121.6592	5
Macro-invertebrate	Jack Slough	Jack Slough - Doc Adams Rd.	39.1623	-121.5959	5
Macro-invertebrate	Jack Slough	Jack Slough - Loma Rica Rd.	39.2253	-121.5116	5
Macro-invertebrate	Jack Slough	Jack Slough - Woodruff Rd.	39.2149	-121.5513	5
Macro-invertebrate	Pleasant Grove Creek	Pleasant Grove Creek - Fiddyment Rd.	38.7959	-121.3555	5
Macro-invertebrate	Pleasant Grove Creek	Pleasant Grove Creek - Industrial Blvd.	38.8055	-121.3087	5

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Pleasant Grove Creek	Pleasant Grove Creek - Pettigrew Rd.	38.8124	-121.4245	5
Macro-invertebrate	Pleasant Grove Creek	South Branch PGC - Pleasant Gr. Blvd.	38.7711	-121.3159	5
Macro-invertebrate	Cosumnes River	Cosumnes River @ Michigan Bar Road	38.5006	-121.0450	6
Macro-invertebrate	Lone Tree Creek	Lone Tree Creek @ Austin Road	37.8556	-121.1847	6
Macro-invertebrate	Mountain House Creek	Mtn. House Creek @ Byron Road	37.7856	-121.5356	6
Macro-invertebrate	Ingram Creek	Ingram Creek @ River Road	37.6003	-121.2242	6
Macro-invertebrate	Del Puerto Creek	Del Puerto Creek @ Vineyard Road	37.5214	-121.1486	6
Macro-invertebrate	Orestimba Creek	Orestimba Creek @ River Road	37.4139	-121.0142	6
Macro-invertebrate	Orestimba Creek	Orestimba Creek @ Bell Road	37.3458	-121.0792	6
Macro-invertebrate	Mud Slough	Mud Slough North: u/s San Luis Drain Inflow	37.2625	-120.9056	6
Macro-invertebrate	Salt Slough	Salt Slough @ Lander Ave. (Hwy. 165)	37.2486	-120.8511	6
Macro-invertebrate	Bear Creek	Bear Creek @ Bert Crane Road	37.2556	-120.6519	6
Macro-invertebrate	Orestimba Creek	Orestimba Creek 1	37.4195	-121.0015	7
Macro-invertebrate	Orestimba Creek	Orestimba Creek 2	37.4201	-121.0048	7
Macro-invertebrate	Orestimba Creek	Orestimba Creek 3	37.4131	-121.0154	7
Macro-invertebrate	Orestimba Creek	Orestimba Creek 4	37.4053	-121.0234	7
Macro-invertebrate	Orestimba Creek	Orestimba Creek 5	37.3984	-121.0329	7
Macro-invertebrate	Orestimba Creek	Orestimba Creek 6	37.3892	-121.0418	7
Macro-invertebrate	Orestimba Creek	Orestimba Creek 7	37.3831	-121.0490	7
Macro-invertebrate	Orestimba Creek	Orestimba Creek 8	37.3770	-121.0576	7
Macro-invertebrate	Orestimba Creek	Orestimba Creek 9	37.3648	-121.0615	7

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Orestimba Creek	Orestimba Creek 10	37.3189	-121.1206	7
Macro-invertebrate	Bear Creek	Bear Creek at Bert Crane Rd.	37.2556	-120.6519	8
Macro-invertebrate	Bear Creek	Bear Creek at Lower Sacramento Road	38.0431	-121.3486	8
Macro-invertebrate	Calaveras River	Calaveras River at Shelton Road	38.0727	-120.9310	8
Macro-invertebrate	Cosumnes River	Cosumnes River at Hwy 16	38.4904	-121.0978	8
Macro-invertebrate	Cosumnes River	Cosumnes River at Michigan Bar Road	38.5006	-121.0450	8
Macro-invertebrate	Del Puerto Creek	Del Puerto Creek at Vineyard	37.5214	-121.1486	8
Macro-invertebrate	French Camp Slough	French Camp Slough at Airport Road	37.8817	-121.2492	8
Macro-invertebrate	Ingalsbe Slough	Ingalsbe Slough at J17 Turlock	37.4918	-120.5578	8
Macro-invertebrate	Ingram Creek	Ingram Creek at River Road	37.6003	-121.2242	8
Macro-invertebrate	Lone Tree Creek	Lone Tree Creek at Austin Road	37.8556	-121.1847	8
Macro-invertebrate	Los Banos Creek	Los Banos Creek at Hwy 140	37.2764	-120.9539	8
Macro-invertebrate	Merced River	Merced River at Hatfield Park (River Road)	37.3497	-120.9578	8
Macro-invertebrate	Merced River	Merced River at Hwy 59	37.4702	-120.5005	8
Macro-invertebrate	Merced River	Merced River at J16 Oakdale Road	37.4540	-120.6092	8
Macro-invertebrate	Mokelumne River	Mokelumne River at Van Assen Co. Park	38.2225	-121.0344	8
Macro-invertebrate	Mountain House Creek	Mountain House Creek at Byron Road	37.7856	-121.5356	8
Macro-invertebrate	Mud Slough	Mud Slough downstream of SLD	37.2625	-120.9056	8
Macro-invertebrate	Mud Slough	Mud Slough upstream of SLD	37.2550	-120.8742	8
Macro-invertebrate	Orestimba Creek	Orestimba Creek at Bell Road	37.3458	-121.0792	8
Macro-invertebrate	Orestimba Creek	Orestimba Creek at River Road	37.4139	-121.0142	8

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Salt Slough	Salt Slough at Lander/Hwy 165	37.2486	-120.8511	8
Macro-invertebrate	American River	American River near Harrington Bar (AR-HB)	38.5681	-121.4212	9
Macro-invertebrate	Arcade Creek	Arcade Creek at Del Paso Park (AC-DPP)	38.6420	-121.3806	9
Macro-invertebrate	Big Chico Creek	Big Chico Creek downstream of Rose Avenue (BCC-RA)	39.7271	-121.8609	9
Macro-invertebrate	Big Chico Creek	Big Chico Creek near Forest Ranch (BCC-FR)	39.8877	-121.6952	9
Macro-invertebrate	Big Chico Creek	Big Chico Creek upstream of Highway 32 crossing (BCC-H32)	40.0639	-121.6026	9
Macro-invertebrate	Big Chico Creek	Big Chico Creek within Upper Bidwell Park (BCC-BP)	39.7724	-121.7732	9
Macro-invertebrate	Butte Creek	Butte Creek downstream of Honey Run Covered Bridge (BC-HR)	39.7222	-121.7100	9
Macro-invertebrate	Butte Creek	Butte Creek near Richbar Road crossing (BC-RR)	39.7676	-121.6717	9
Macro-invertebrate	Butte Creek	Butte Creek upstream of Cherry Hill Campground (BC-CHC)	40.1006	-121.4955	9
Macro-invertebrate	Butte Creek	Butte Creek upstream of Doe Mill Road (BC-DMR)	39.7834	-121.6023	9
Macro-invertebrate	Feather River	Feather River upstream of the Sacramento River confluence (FR-EN)	38.9004	-121.5823	9
Macro-invertebrate	Butte Creek	Little Butte Creek near Haut Coulteanc Road (LBC-HCR)	39.8800	-121.5972	9
Macro-invertebrate	Butte Creek	Little Butte Creek upstream of Skyway Road crossing (LBC-S)	39.8857	-121.5953	9
Macro-invertebrate	Sacramento River	Sacramento River downstream of Sacramento State Park near Colusa (SR-SSP)	38.8126	-121.7720	9
Macro-invertebrate	Sacramento River	Sacramento River upstream of Highway 32 (SR-HAM)	39.7612	-122.0134	9
Macro-invertebrate	Yuba River	Yuba River upstream of Marysville at Smartsville Road (YR-M)	39.1759	-121.5228	9

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Alder Creek	ALDER CREEK @ FOLSOM BLVD	38.6375	-121.1983	10
Macro-invertebrate	Auburn Ravine	AUBURN RAVINE @ HWY 193	38.8911	-121.2828	10
Macro-invertebrate	Baker Slough	BAKER SLOUGH @ MCDERMOTT	39.4231	-122.2475	10
Macro-invertebrate	Bear River	BEAR RIVER @ PLEASANT GROVE RD	38.9847	-121.4867	10
Macro-invertebrate	Big Chico Creek	BIG CHICO @ Bidwell Park	39.7439	-121.8164	10
Macro-invertebrate	Butte Creek	BUTTE CR @ Hwy 99	39.6964	-121.7764	10
Macro-invertebrate	Cache Creek	CACHE CR @ PRESERVE	38.6867	-121.8761	10
Macro-invertebrate	Clear Creek	CLEAR CREEK @ NELSON RD	39.5817	-121.6992	10
Macro-invertebrate	Comanche Creek	COMANCHE CK @ USFS LAB	39.7072	-121.7853	10
Macro-invertebrate	Deer Creek	DEER CREEK @ HWY 99	39.9492	-122.0464	10
Macro-invertebrate	Dry Creek	DRY CK @ GIBSON PARK RANCH	38.7297	-121.3969	10
Macro-invertebrate	Dry Creek	DRY CK D/S HWY 191	39.6197	-121.6364	10
Macro-invertebrate	Dry Creek	DRY CREEK @ BEALE AFB	39.0894	-121.3556	10
Macro-invertebrate	Dye Creek	DYE CREEK @ SHASTA BLVD	40.0883	-122.0903	10
Macro-invertebrate	Gold Run Creek	GOLD RUN CK @ OPENSHAW RD	39.5933	-121.6394	10
Macro-invertebrate	Jack Slough	JACK SLOUGH @ LOMA RICA RD.	39.2250	-121.5103	10
Macro-invertebrate	Mill Creek	MILL CREEK @ HWY 99	40.0439	-122.0986	10
Macro-invertebrate	Miners Ravine	MINERS RAVINE	38.7592	-121.2561	10
Macro-invertebrate	New Creek	NEW CREEK @ HWY 99	40.1631	-122.1542	10
Macro-invertebrate	Putah Creek	PUTAH CK @ UC DAVIS	38.5272	-121.8017	10
Macro-invertebrate	Salt Creek	SALT CREEK @ HWY 20	39.1508	-122.1811	10

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Macro-invertebrate	Secret Ravine	SECRET RAVINE	38.7594	-121.2567	10
Macro-invertebrate	Honcut Creek South	SOUTH HONCUT @ SOUTH HONCUT RD.	39.3031	-121.5650	10
Macro-invertebrate	Spring Creek	SPRING CR @ HWY 20	39.1472	-122.1792	10
Macro-invertebrate	Stone Corral Creek	STONE CORRAL CR	39.2879	-122.2289	10
Macro-invertebrate	Toomes Creek	TOOMES CREEK @ TEHEMA VINA ROAD	39.9797	-122.0681	10
Macro-invertebrate	Ulatis Creek	ULATIS CK @ FERRELL RD	38.3694	-121.9947	10
Macro-invertebrate	Union School Slough	UNION SCHOOL SLOUGH @ RD 88	38.6069	-121.9919	10
Macro-invertebrate	Willow Slough	WILLOW SLOUGH @ RD 27	38.6197	-121.8325	10
Fish	Merced River	Merced River at Hagamann County Park	37.3683	-120.8464	11
Fish	Merced River	Merced River at McConnell State Park	37.4139	-120.7092	11
Fish	Merced River	Merced River at River Road	37.3511	-120.9608	11
Fish	Merced River	Merced River near Snelling Diversion Dam	37.5164	-120.3728	11
Fish	Mud Slough	Mud Slough near Gustine	37.2625	-120.9056	11
Fish	Orestimba Creek	Orestimba Creek at River Road	37.4136	-121.0150	11
Fish	Salt Slough	Salt Slough at Lander Avenue	37.2478	-120.8511	11
Fish	San Joaquin River	San Joaquin River at Fremont Ford	37.3100	-120.9300	11
Fish	San Joaquin River	San Joaquin River at Maze Road	37.6400	-121.2283	11
Fish	San Joaquin River	San Joaquin River near Patterson	37.4975	-121.0819	11
Fish	San Joaquin River	San Joaquin River near Vernalis	37.6761	-121.2653	11
Fish	Stanislaus River	Stanislaus River at Caswell State Park	37.7025	-121.1772	11
Fish	Stanislaus River	Stanislaus River near Knights Ferry	37.8042	-120.7228	11
Fish	Stanislaus River	Stanislaus River near Ripon	37.7297	-121.1094	11

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Fish	Stanislaus River	Stanislaus River near Riverbank	37.7386	-120.9519	11
Fish	Tuolumne River	Tuolumne River at Modesto	37.6269	-120.9869	11
Fish	Tuolumne River	Tuolumne River at Shiloh Road	37.6033	-121.1303	11
Fish	Tuolumne River	Tuolumne River at Turlock State Recreation Area	37.6311	-120.5772	11
Fish	Tuolumne River	Tuolumne River near Waterford	37.6356	-120.7539	11
Fish	American River	American River at Sacramento	38.5681	-121.4222	12
Fish	Big Chico Creek	Big Chico at Soda Springs Campground	40.0878	-121.5844	12
Fish	Big Chico Creek	Big Chico Creek above Chico	39.7669	-121.7783	12
Fish	Big Chico Creek	Big Chico Creek at Chico	39.7272	-121.8622	12
Fish	Big Chico Creek	Big Chico Creek near Forest Ranch	39.8933	-121.6922	12
Fish	Butte Creek	Butte Creek at Cherry Hill Campground	40.1025	-121.4964	12
Fish	Butte Creek	Butte Creek near Afton	39.4200	-121.8800	12
Fish	Butte Creek	Butte Creek near Butte Meadows	40.0683	-121.5736	12
Fish	Butte Creek	Butte Creek near Meridian	39.2406	-121.9472	12
Fish	Butte Creek	Butte Creek near Nelson	39.5842	-121.7989	12
Fish	Butte Creek	Butte Creek near Paradise	39.7289	-121.7025	12
Fish	Cache Creek	Cache Creek near Guinda	38.8283	-122.1822	12
Fish	Colusa Basin Drain	Colusa Basin Drain near Knights Landing	38.8125	-121.7731	12
Fish	Deer Creek	Deer Creek at Potato Patch Campground	40.1878	-121.5311	12
Fish	Deer Creek	Deer Creek below Hwy 99 Bridge	39.9408	-122.0636	12
Fish	Deer Creek	Deer Creek near Ishi Wilderness Area	40.0706	-121.7036	12
Fish	Deer Creek	Deer Creek near Vina	40.0141	-121.9472	12
Fish	Feather River	Feather River near Nicholas	38.8906	-121.6033	12
Fish	Sacramento River	Sacramento River near Colusa	39.2142	-121.9992	12

Table 1 – BMI and Fish Study Sites (continued)

Data Type	Water body	Site Name	Latitude	Longitude	Study
Fish	Sacramento Slough	Sacramento Slough near Karnak	38.7792	-121.6375	12
Fish	Yuba River	Yuba River near Marysville	39.1758	-121.5239	12

Table 2 - Summary of BMI and Fish Studies

Study	Study Citation	Year(s) Studied	Organisms Sampled	# of Sites	Physical Habitat Assess-ment	Other Parameters Measured
1	Bacey, J., F. Spurlock. 2005. Biological assessment of urban and agricultural streams in the California Central Valley (Fall 2002 through Spring 2004). California Department of Pesticide Regulation. http://www.cdpr.ca.gov/docs/empm/pubs/ehapreps/eh0501.pdf	2002-2003	macroinverte-brates	8	yes	Temperature, dissolved oxygen, specific conductance, pH, turbidity, pyrethroids, organophosphorus pesticides, herbicides, pyrethroid analysis of sediment
2	Brown, L.R. and J.T. May. 2000. Benthic macroinvertebrates assemblages and their relations with environmental variables in the Sacramento and San Joaquin River drainages, California, 1993-1997. US. Geological Survey Water-Resources Investigations Report 00-4125. 25 p.	1993-1997	macroinverte-brates	~53*	yes	Temperature, dissolved oxygen, specific conductance, pH, alkalinity
3	Brown, L.R., and May, J.T., 2004. Periphyton and macroinvertebrate communities at five sites in the San Joaquin River Basin, California, during June and September, 2001: U.S. Geological Survey Scientific Investigations Report 2004-5098, 43 p.	2001	macroinverte-brates & periphyton	5	yes	Temperature, specific conductance
4	CVRWQCB. 2003. Cow Creek water	2001-	macroinverte-	16	yes	Temperature, dissolved

Table 2 - Summary of BMI and Fish Studies (continued)

Study	Study Citation	Year(s) Studied	Organisms Sampled	# of Sites	Physical Habitat Assess-ment	Other Parameters Measured
	quality study, 2001-2003. Central Valley Regional Water Quality Control Board. Redding. 33 p.	2003	brates			oxygen, specific conductance, pH, turbidity, fecal coliform bacteria, *E. coli* bacteria
5	de Vlaming, V., D. Markiewicz, K. Goding, T. Kimball, and R. Holmes. 2004. Macroinvertebrate Assemblages in Agriculture- and Effluent-Dominated Water bodies of the Lower Sacramento River Watershed. University of California, Davis. http://www.waterboards.ca.gov/centralvalley/available_documents/waterqualitystudies/Sac_River_BioReport_Final.pdf	2000-2002	macroinverte-brates	44	yes	Temperature, dissolved oxygen, specific conductance, pH, turbidity, alkalinity, hardness, nutrients, color
6	de Vlaming, V. D. Markiewicz, K. Goding, A. Morrill, and J. Rowan. 2005. Macroinvertebrate Assemblages of the San Joaquin River Watershed. University of California, Davis. http://www.waterboards.ca.gov/centralvalley/available_documents/waterqualitystudies/SJR_Bioassessment_Final_Rpt.pdf	2001	macroinverte-brates	11	yes	Temperature, dissolved oxygen, specific conductance, pH, turbidity, alkalinity, hardness, metals, nutrients, total organic carbon, biological oxygen demand
7	Hall, Jr., L.W, and W.D. Killen. 2005.	2000-	macroinverte-	10	yes	Temperature, dissolved

Table 2 - Summary of BMI and Fish Studies (continued)

Study	Study Citation	Year(s) Studied	Organisms Sampled	# of Sites	Physical Habitat Assess-ment	Other Parameters Measured
	Temporal and spatial assessment of water quality, physical habitat, and benthic communities in an impaired agricultural stream in California's San Joaquin Valley. Journal of Environmental Science and Health, Part A. 40:959-989.	2002	brates			oxygen, specific conductance, pH, turbidity, salinity
8	Markiewicz, D., K. Goding, V. de Vlaming, and J. Rowan. 2005. Benthic macroinvertebrate bioassessment of San Joaquin River tributaries: spring and fall 2002. University of Davis. http://www.waterboards.ca.gov/centralvalley/available_documents/waterqualitystudies/SJR02_Bioassess_final_083005.pdf	2002	macroinverte-brates	22	yes	Temperature, dissolved oxygen, specific conductance, pH, alkalinity, hardness, metals, nutrients, total organic carbon, biochemical oxygen demand
9	Ode, P.R., A. Montalvo, D. Post, A. Rehn, and M. Dawson. 2000. A water quality inventory series, biological and physical habitat assessment of California Water Bodies. Sacramento River Watershed Project: 2000 biological assessment report. California Department of Fish and Game. 40 p.	2000	macroinverte-brates	37	yes	Temperature, dissolved oxygen, specific conductance, pH
10	Ode, P.R., D.P. Pickard, J.P. Slusark, and A.C. Rehn. 2005. Adaptation of a	2004	macroinverte-brates	30	yes	Temperature, dissolved oxygen, specific

Table 2 - Summary of BMI and Fish Studies (continued)

Study	Study Citation	Year(s) Studied	Organisms Sampled	# of Sites	Physical Habitat Assess-ment	Other Parameters Measured
	bioassessment reference site selection methodology to creeks and sloughs of California's Sacramento Valley and alternative strategies for applying bioassessment in the valley. Report to the Central Valley Regional Water Quality Control Board. California Department of Fish and Game Aquatic Bioassessment Laboratory, Rancho Cordova, California.					conductance, alkalinity, salinity
11	Brown, L.R., 2000. Fish communities and their associations with environmental variable, lower San Joaquin River drainage, California. Environmental Biology of Fishes 57: 251-269.	1993-1995	fish	20	yes	Temperature, dissolved oxygen, specific conductance, pH, alkalinity, nutrients
12	May, J.T., and L.R. Brown. 2002. Fish communities of the Sacramento River Basin: implication for conservation of native fishes in the Central Valley, California. Environmental Biology of Fishes. 63: 373-388.	1996-1998	fish	22	yes	Temperature, dissolved oxygen, specific conductance, pH, alkalinity, nutrients, major ions

Appendix A

Responses to Public Comments

Appendix B

List of Named Water Bodies