APPROVED

Lake Elsinore and Canyon Lake Nutrient TMDL Monitoring Plan

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Prepared for:
California Regional Water Quality Control Board, Santa Ana Region

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1.0 Introduction

In 1994, 1998 and again in 2002, Lake Elsinore and Canyon Lake were identified by the California Regional Water Quality Control Board, Santa Ana Region (Regional Board) on its Clean Water Act Section 303(d) list of impaired waters. Impairments identified for these waters included excessive levels of nutrients in both lakes, as well as, organic enrichment/low dissolved oxygen, sedimentation/siltation, and unknown toxicity in Lake Elsinore and high bacteria in Canyon Lake. As required by the Clean Water Act Section 303(d), waters that do not or are not expected to meet water quality standards (beneficial uses, water quality objectives) must implement a total maximum daily load[1] (TMDL). As a result, the Regional Board initiated the development of TMDLs for nutrients for Lake Elsinore and Canyon Lake.

Since 2000, local stakeholders, in cooperation with the Regional Board, have been working to identify the sources of nutrients causing impairment and evaluate their impacts to water quality and beneficial uses. Stakeholders have actively participated in annual watershed-wide stormwater quality and flow monitoring, as well as, water quality monitoring of Lake Elsinore and Canyon Lake. Grant funding has enabled stakeholders to develop models of the lakes to better understand the lake characteristics, as well as, a San Jacinto River Watershed model to simulate the wash off and transport of nutrients to the lakes. In addition, the Lake Elsinore & San Jacinto Watersheds Authority (LESJWA) has preformed numerous studies of the lakes and begun the implementation of projects to bring about improvements to in-lake water quality.

In 2004, the Regional Board prepared the Lake Elsinore and Canyon Lake Nutrient TMDL Report. This report framed the stakeholders monitoring and modeling efforts to characterize in-lake water quality and thus provide the basis for recommendations that the Regional Board consider revisions to the Implementation Plan (Chapter 5 of the Basin Plan) to incorporate the nutrient TMDLs for Canyon Lake and Lake Elsinore. These recommendations outlined in Resolution No. RB8-2004-0037 were adopted by the Regional Board in December 2004 and subsequently approved by the U.S. Environmental Protection Agency (US EPA) on September 30, 2005.

[1] Total maximum daily load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

2.0 Nutrient TMDL Monitoring Requirement

This report addresses the obligation of stakeholders to submit to the Regional Board and implement a Nutrient Monitoring Program, Task 4 of Resolution No. RB8-2004-0037 for the Canyon Lake and Lake Elsinore nutrient TMDLs. As detailed in Task 4, the stakeholders[2] have prepared for review and approval by the Regional Board a nutrient monitoring plan. This plan addresses the requirements to implement nutrient monitoring program providing the data necessary to review and update the Lake Elsinore and Canyon Lake Nutrient TMDL including:

1. A watershed-wide monitoring program to determine compliance with interim and/or final nitrogen and phosphorus allocations; and compliance with the nitrogen and phosphorus TMDL, including the waste load allocations (WLAs) and load allocations (LAs).
2. A Lake Elsinore nutrient monitoring program to determine compliance with interim and final nitrogen, phosphorus, chlorophyll a, and dissolved oxygen numeric targets. In addition, this program will evaluate and determine the relationship between ammonia toxicity and the total nitrogen allocation to ensure that the total nitrogen allocation will prevent ammonia toxicity in Lake Elsinore.
3. Canyon Lake nutrient monitoring program to determine compliance with interim and final nitrogen, phosphorus, chlorophyll a, and dissolved oxygen numeric targets. In addition, the monitoring program will evaluate and determine the relationship between ammonia toxicity and the total nitrogen allocation to ensure that the total nitrogen allocation will prevent ammonia toxicity in Canyon Lake.

[2] Stakeholders include all signatory members, Task Force Members of the Lake Elsinore and Canyon Lake TMDL Task Force.

3.0 Nutrient TMDL Monitoring Program

The nutrient monitoring program described here within is consistent with Basin Plan requirements and considers monitoring recommendations presented by the Regional Board to track compliance with the TMDL's and associated load allocations, as well as, measuring compliance to in-lake numeric water quality targets. However, due to budgetary and staffing considerations, as well as, significant gaps in information required to understand in-lake and watershed processes this monitoring program considers a phased approach. This approach will enable stakeholders to focus resources on the most prominent data gaps and limitations to the nutrient TMDL calculation, while maintaining an agreed minimum level of compliance monitoring.

The program is proposed to be conducted in three general phases. Phase 1 of this program focuses on data issues regarding in-lake processes and the "linkage analysis" relating external pollutant loading to in-lake response and the associated predicted nutrient concentrations compared to numeric water quality targets. This key point in the TMDL calculation is not well understood and has a direct influence on the assessment of the required external load reductions to the lake. Additionally, in consideration of the possibility of an extreme wet event during this phase of TMDL implementation, stakeholders will be prepared to perform full-scale watershed monitoring. Phase 2 follows, focusing on intensive study in the watershed to address compliance monitoring, as well as addressing key data gaps in understanding external nutrient source contributions from the watershed. A Phase 3 or the compliance monitoring phase is proposed to begin upon completion of the intensive data collection efforts of Phases 1 and 2. It is proposed that this monitoring phase consists of an agreed upon base level of in-lake and watershed compliance monitoring determined after many of the data gaps have been addressed.

The duration of Phase 1 is anticipated to be approximately 2-3 years depending on the completion of in-lake studies and the amount of data collected under Phase 1. Since the implementation schedule of the Lake Elsinore and Canyon Lake Nutrient TMDL allows reevaluation of the TMDL once every three years, it is envisioned that the results of the Phase 1 monitoring program will be used for the possible review and revision of the Nutrient TMDL. The process of conducting the more intensive in-lake monitoring program before proceeding with the Phase 2 intensive watershed monitoring program is reflective of the adaptive management approach in addressing the Lake Elsinore and Canyon Lake Nutrient TMDL.

3.1 Phase 1: Intensive Lake Study

Phase 1 monitoring of Lake Elsinore and Canyon Lake extends the previous data collection effort for trend analysis, and also focuses on collecting key information to address identified data gaps. Phase 1 monitoring stations within Canyon Lake and Lake Elsinore are consistent with those recommended by the Regional Board in the nutrient TMDL. Sampling methods at the lake stations will be consistent with existing Quality Assurance Performance Plans (QAPPs). Frequency of sampling is also consistent with previous lake monitoring plans, with monthly sampling from October through May, and bi-weekly from June through September.

To focus resources on intensive study of the lakes, the amount of watershed monitoring for Alterative 2 is reduced to the minimum required for determination of lake inputs and monitoring of compliance to load allocations reported in the nutrient TMDL's, as well as potentially quantifying loading from Mystic Lake in the event it overflows to the lower San Jacinto River. Figure 3-1 shows the location of the four TMDL stations recommended for watershed monitoring in Phase 1. Monitoring locations proposed for Lake Elsinore and Canyon Lake are presented in Figures 3-2 and 3-3 respectively. Consistent with Regional Board recommendations, sampling for Phase 1 includes multiple samples (8 samples for general water quality including nutrients) throughout the hydrograph of three storms per year.

In place of the more-intensive watershed monitoring, Phase 1 includes a focused number of parameters monitored in the lake, as well as special studies that can be added modularly as additional resources become available. Table 3-1 includes a summary of the lake and watershed monitoring and special studies included in Phase 1. Sections 3.1.1 and 3.1.2 provide additional discussion of the monitoring components, including the specific parameters to be measured, and summarize the investment required for implementation of each of the components of the monitoring plan. Section 3.1.3 provides discussion of special studies listed in Table 3-1.

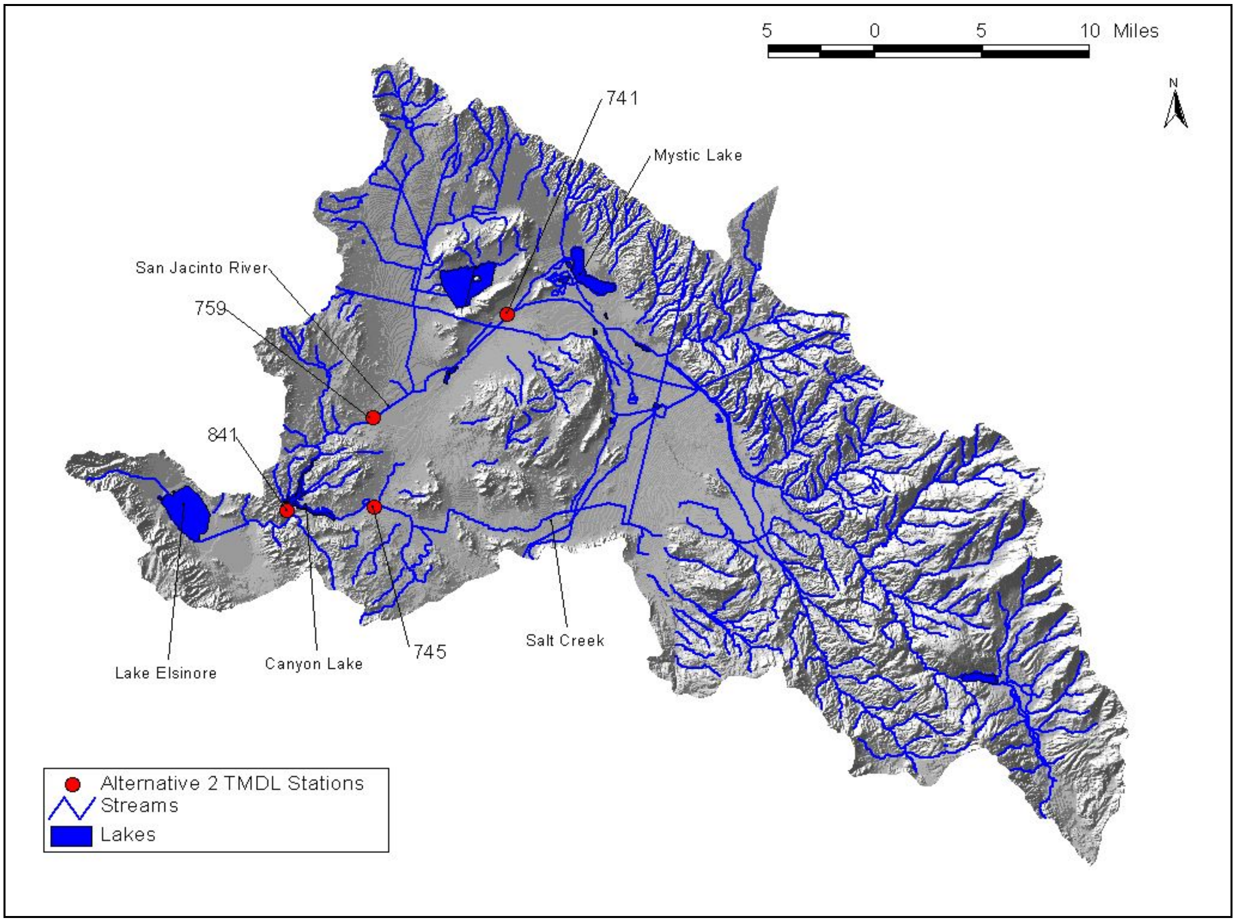

Figure 3-1. TMDL Stations for Phase 1Watershed Monitoring

Table 3-1. Summary of Phase 1

DESCRIPTION	NUMBER OF STATIONS	DATA COLLECTED
Watershed Water Quality	4	12 water quality constituents sampled through hydrograph of 3 storm events per year[b]
Watershed Flow	4	Continuous flow at TMDL stations
Canyon Lake Water Quality	4[a]	20 water quality constituents (monthly Oct - May; biweekly June – Sept)
Lake Elsinore Water Quality	3	17 water quality constituents (monthly Oct - May; biweekly June – Sept)
SPECIAL STUDIES		
1. Sediment nutrient flux and SOD studies of both lakes		
2. Monitoring of dry-urban runoff flows and water quality at both lakes		
3. Study to evaluate benefits from in-lake projects (based on data collection above)		
4. Study to re-evaluate site-specific nutrient targets used for TMDL development (based on data collection above)		
5. Study to assess benefits of carp removal from Lake Elsinore		

[a] At least 3 stations with multiple vertical samples assumed based on depths at station locations.
[b] Eight samples collected for general water quality constituents including nutrients (9)

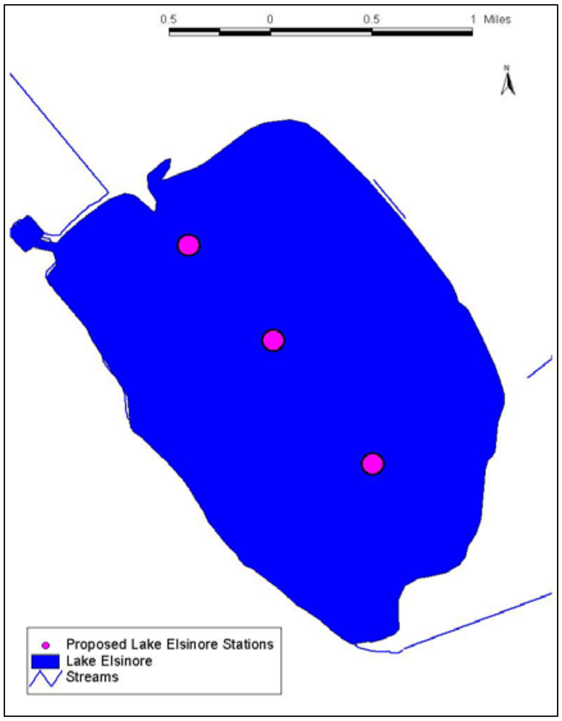

Figure 3-2. TMDL Stations for Monitoring Lake Elsinore

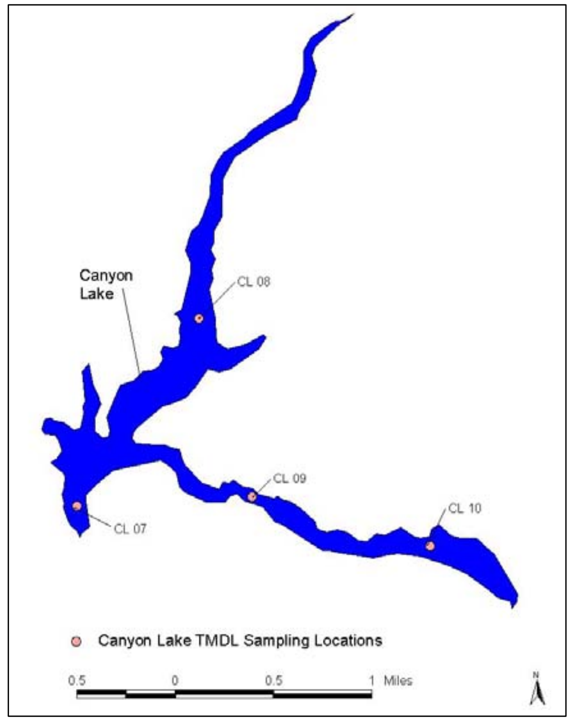

Figure 3-3. TMDL Stations for Monitoring Canyon Lake

3.1.1 Phase 1 - Laboratory Analyses

Separate laboratory analyses are required for lake and watershed samples. The following sections discuss parameters to be measured for each sample and the total cost of laboratory analyses.

3.1.1.1 Lake Samples

For all samples collected from the Canyon Lake and Lake Elsinore TMDL stations, the following parameters are recommended for laboratory analyses:

- Water temperature
- Dissolved oxygen
- Specific conductance
- Chlorophyll *a*
- Nitrate nitrogen
- Nitrite nitrogen
- Ammonia nitrogen
- Total organic nitrogen
- Dissolved organic nitrogen
- Ortho phosphate
- Total organic phosphorus
- Dissolved organic phosphorus
- Chemical oxygen demand (COD)
- Biological oxygen demand (BOD)
- Total suspended solids (TSS)
- Total organic carbon
- Dissolved organic carbon

3.1.1.2 Watershed Samples

For all samples collected from the watershed TMDL stations, the following parameters are recommended for laboratory analyses:

- Total organic nitrogen
- Nitrite nitrogen
- Nitrate nitrogen
- Ammonia nitrogen
- Total phosphorus
- Ortho phosphate
- Total suspended solids (TSS)
- Chemical oxygen demand (COD)
- Biological oxygen demand (BOD)

3.1.2 Phase 1 – Flow Measurement Stations

Four flow measurement stations are necessary for monitoring at the TMDL stations shown in Figure 3-1. These four stations include three existing USGS gages and one existing RCFC gage, as shown in Table 3-2.

Table 3-2. Flow Gages Operated and Maintained for Phase 1

TMDL GAGE ID	USGS GAGE ID	LOCATION	AFFILIATED AGENCY
745	11070465	Salt Creek at Murrieta Road	USGS
759	11070365	San Jacinto River at Goetz Road	USGS
741	11070210	San Jacinto River at Ramona Expressway	USGS
841	N/A	Canyon Lake Spillway	RCFC

3.1.3 Phase 1: Lake Special Studies

In addition to the studies identified in this section, additional special studies in the lakes to be considered to further address data gaps, advance understanding of nutrient cycling within the lakes, and refine assumptions and models for TMDL development. The ability to conduct these studies would be dependent on funding levels available. These studies are discussed in the following sections.

3.1.3.1 Extreme Wet Weather Monitoring Event

Stakeholders will be prepared to monitor an extreme wet weather event in which Mystic Lake is anticipated to overflow. Data collected during this event will provide information required to verify hydrologic and pollutant transport processes established within the watershed model for the Mystic Lake area, which separates the upper San Jacinto watershed from the downstream Canyon Lake and Lake Elsinore watersheds.

For all samples collected from the watershed TMDL stations during this event, the following parameters are recommended for laboratory analyses:

- Total organic nitrogen
- Nitrite nitrogen
- Nitrate nitrogen
- Ammonia nitrogen
- Total phosphorus
- Ortho phosphate
- Total suspended solids (TSS)
- Chemical oxygen demand (COD)
- Biological oxygen demand (BOD)

Four flow measurement stations are necessary for monitoring at the TMDL stations shown in Figure 3-2. These fifteen stations include 8 existing USGS gages and 7 existing RCFC gages, as shown in Table 3-3.

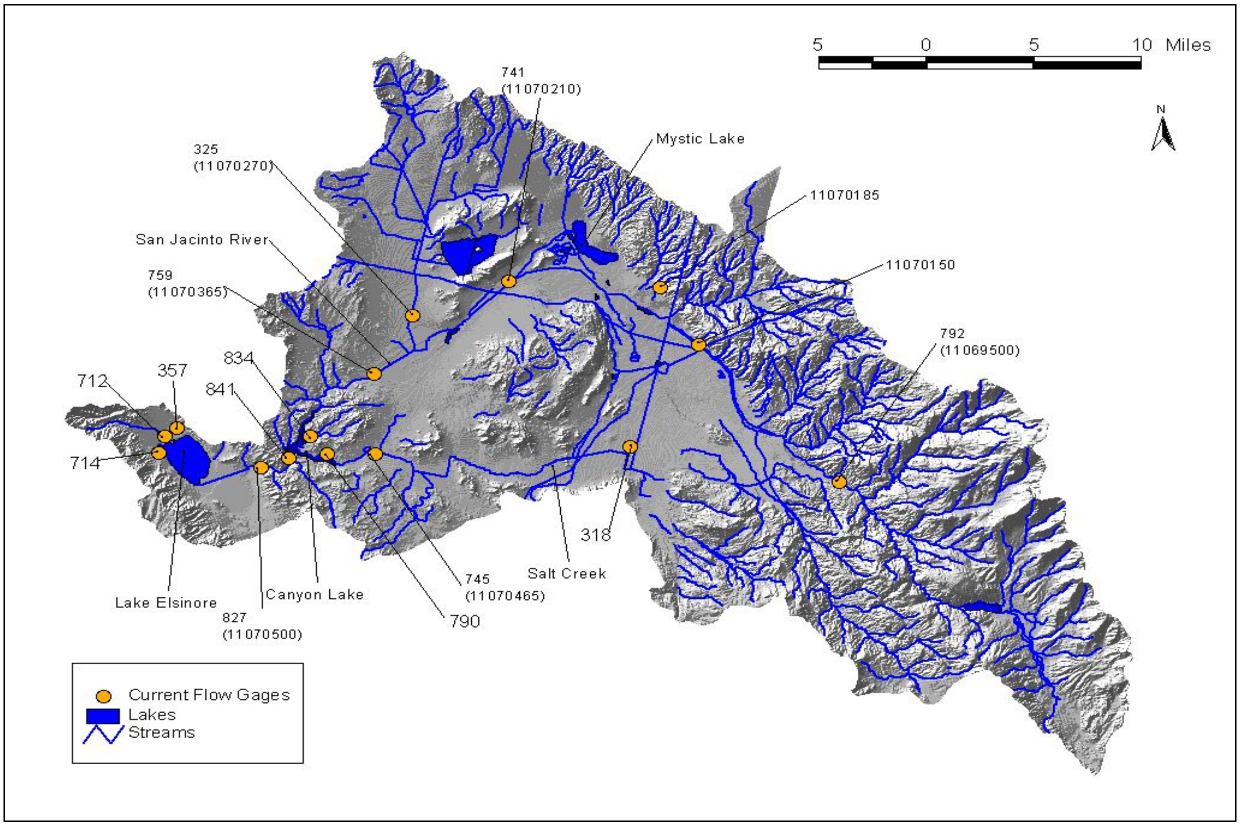

Figure 3-4. TMDL Stations Included for the Extreme Wet Weather Event

Table 3-3. Monitoring Locations and Flow Gages used for the Extreme Wet Weather Event

TMDL GAGE ID	USGS GAGE ID	LOCATION	AFFILIATED AGENCY
357	N/A	Four Corners Storm Drain in Elsinore	RCFC
714	N/A	Ortega Flood Channel in Elsinore	RCFC
712	N/A	Leach Canyon Channel in Elsinore	RCFC
792	11069500	San Jacinto River at Cranston Guard Station	USGS
745	11070465	Salt Creek at Murrieta Road	USGS
759	11070365	San Jacinto River at Goetz Road	USGS
325	11070270	Perris Valley Storm Drain at Nuevo Road	USGS
741	11070210	San Jacinto River at Ramona Expressway	USGS
827	11070500	San Jacinto River Upstream of Lake Elsinore	USGS
834	N/A	Sierra Park Drain in Canyon Lake	RCFC, City of Canyon Lake
790	N/A	Fair Weather Drive Storm Drain in Canyon Lake	RCFC, City of Canyon Lake
318	N/A	Hemet Channel at Sanderson Ave	RCFC
841	N/A	Canyon Lake Spillway	RCFC
N/A	11070150	San Jacinto River at State St.	USGS, EMWD, RCFC
N/A	11070185	Lamb Canyon Victory Ranch near San Jacinto	USGS, EMWD

3.1.3.2 Sediment Nutrient Flux and Oxygen Demand Studies

Previous studies have demonstrated that flux of nutrients from the sediments is a critical process in Lake Elsinore and Canyon Lake (Anderson, 2001; Anderson and Oza, 2003; SAWPA 2003). However, previous nutrient flux studies of the lakes were performed during particularly dry years. As in-lake processes are expected to vary based upon environmental conditions, the lake levels and nutrient inputs related to wet- and dry-weather flows are expected to play a significant role in the rate of nutrient flux from Lake Elsinore sediments. The anticipated differences in nutrient flux rate will illustrate the varying flux rates and nutrient cycling patterns under different hydrologic conditions. Such an understanding will be valuable to the development of more precise models for use in predicting in-lake conditions and processes.

This proposed special study includes continuation of nutrient flux studies conducted by University of California, Riverside for both lakes (Anderson, 2001; Anderson and Oza, 2003). However, in order to reduce costs and maximize the environmental realism of flux estimates, all flux studies will be performed *in situ*. As with the previous study, this will use equilibrium dialyzers that are placed and allowed to equilibrate in the field. The chemical gradients in the sediments are then measured after a 28-day exposure period. Four quarterly measurements are recommended for representation of seasonal variations of fluxes during one year. Four stations are recommended for sampling in Canyon Lake; three stations are recommended for Lake Elsinore.

In addition, corresponding measurements of sediment oxygen demand (SOD) are recommended for measurement at all seven lake stations mentioned above. These data will assist greatly in analysis of dissolved oxygen levels in the lake and effects of multiple influences.

3.1.3.3 Monitoring of Dry-weather Runoff Flows and Water Quality

In order to develop the best understanding of the influences of dry-weather runoff on Lake Elsinore and Canyon Lake water quality, it is necessary to quantify the dry-weather inputs from surrounding communities and major tributaries. Stormwater drains and flowing tributaries should be sampled on a monthly basis during the dry weather season (June – September). These samples should be analyzed for nutrients (organic nitrogen, nitrite, nitrate, ammonia, total phosphorus, and orthophosphate) at both lakes. Also, the flow should be measured at the time of sample collection.

Such monitoring of the dry weather flows will help identify major inputs of nutrients contaminants to the lakes during the warmer growing season. Further, a more complete description of inputs to the lakes during the dry season will complement an existing body of knowledge of wet-weather inputs to this system. Together, these data will allow the most complete understanding of influences on the lakes to be addressed. This knowledge will then facilitate the most efficient use of limited resources in mitigation of these impacts through best management practices and use of other available technologies.

3.1.3.4 Study to Evaluate Benefits from In-lake Projects

Based on data collected from both lakes during the monitoring outlined above, analyses can be performed to evaluate benefits observed from in-lake projects. Such projects include aeration of Lake Elsinore and dredging of Canyon Lake. Similar studies are recommended in the implementation plan of the *Lake Elsinore and Canyon Lake Nutrient TMDL* (Tasks 9 and 10).

3.1.3.5 Study to Re-evaluate Site-specific Nutrient Targets

For nutrient TMDL development of both lakes, site-specific numeric targets were established based on reference conditions when beneficial uses of the lake were not considered significantly impacted by nutrients. Further study of these impacts can further refine the cause-and-effect relationship between nutrient levels and impairments to beneficial uses, including assessment of nuisance algae levels and dissolved oxygen variability that can be influenced by nutrient levels and biological activity. Also, the implementation plan of the *Lake Elsinore and Canyon Lake Nutrient TMDL* (Task 13) includes a review and potential revision of total inorganic nitrogen number targets for the lakes, as well as an evaluation of the appropriateness of establishing total phosphorus and un-ionized ammonia numeric water quality objectives for both lakes.

Analysis of previous and current monitoring data can provide sufficient data for assessment. In addition, development of dynamic models that provide full simulation of eutrophic processes can assist in understanding cause-and-effect relationships. However, if model results are to assist in analysis, associated model development is assumed performed in separate studies.

3.1.3.6 Study to Assess Benefits of Carp Removal from Lake Elsinore

Since 2002, carp removal projects have been implemented in Lake Elsinore to reduce populations that potentially re-suspend sediment and associated nutrients, as well as create additional nutrients through waste production. To date, about 1.1 million pounds of carp have been removed as a result of this project (per communication with David Ruhl, SAWPA). For the nutrient TMDL, the Regional Board made assumptions regarding rates of nutrient re-suspension that can be refined or updated based on new data regarding reduced carp populations and impacts on re-suspension. The Regional Board has recommended further study of these water quality benefits (per communication with Cindy Li, Regional Board). Continued water quality monitoring at the lake should provide information for assessment of trends in water quality that can potentially correlate with carp removal. Additional studies of sediment re-suspension or settling, such as in-situ sediment traps, can further assist in refining assumptions for sediment/nutrient re-suspension. Development of cost estimates for this study is dependent upon the amount of water quality data available for trend analysis, and preferences by stakeholders and the Regional Board regarding necessary data to support development of acceptable assumptions for sediment/nutrient re-suspension.

3.2 Phase 2: Intensive Watershed Study

This data collection strategy, outlined in Phase 2 is a combination of watershed monitoring and previous and new TMDL stations, as well as special studies to be pursued when adequate resources become available. This phase of the monitoring program focuses intensive study in the watershed to address compliance monitoring as well as addressing key data gaps in the watershed. Monitoring in both lakes is maintained to provide assessment of compliance to numeric water quality targets and continue to provide information for future model testing.

Watershed TMDL stations recommended for Phase 2 are shown in Figure 3-2. These include nine previous TMDL stations that included flow gages, one previously investigative TMDL station on the San Jacinto River at Bridge St. (Station 835) that currently does not include flow measurements, and three new TMDL stations. Phase 2 monitoring locations for Lake Elsinore and Canyon Lake are the same as proposed previously in Figures 3-2 and 3-3 respectively. Discussion of locations and rationale for these stations are provided below.

- A new TMDL station is recommended on a small tributary of the San Jacinto River above Canyon Lake known as Meadowbrook, which is likely to regularly contribute flows and associated pollutant loadings to Canyon Lake during various storm magnitudes. Monitoring in the Meadowbrook watershed can also provide information for this area regarding representation of potential impacts of septic failures that can have substantial impact on nutrient runoff. Potential locations of monitoring stations are shown in Figure A-1 of Appendix A and corresponding photos Figures A-1a, A-1b and A-1c.
- A new TMDL station is recommended in Moreno Valley on the Kitching St. Channel at Iris Ave., as shown in Figure A-2 of Appendix A and corresponding photo Figure A-2a. This location drains a small watershed that is primarily developed (residential). Currently, only the Hemet Channel station (318) provides representation of urban stormwater runoff in the watershed. To test transferability of urban modeling parameters to other areas and to provide characterization of urban runoff from the northwest portion of the watershed, the Kitching St. Channel provides an ideal location for monitoring.
- Conversion of TMDL Station 835, located on the San Jacinto River at Bridge St., to a complete water quality and flow measurement station will provide insight into loadings to Mystic Lake and sources from upstream croplands and dairies. Although the flows at this station may not represent all flows to Mystic Lake during specific storm magnitudes due to the multiple pathways of storm flows, this key location can continue to provide a record of pollutant loads and flows to assist in understanding this complexity. Figure A-3 of Appendix A shows the location of the Station 835.
- A new station is recommended at an existing USGS gage on San Jacinto River at State St. (USGS 11070150), as shown in Figure A-4 of Appendix A. This station can provide improved understanding of pollutant loadings to Mystic Lake. Also, substantial reduction of San Jacinto River flows have been observed upstream of the State St. gage, likely resulting from high infiltration capacity of the streambed. To address this infiltration loss, new model refinements may be required.

Special studies can be performed to address other data gaps not answered through typical watershed monitoring. One important data gap is the storage and in-lake nutrient cycling within Mystic Lake. Continued monitoring downstream of Mystic Lake on the San Jacinto River and Ramona Expressway (TMDL Station 741) can provide information in the case that the lake overflows, however data collection within the lake can also provide a great deal of information for modeling assumptions, such as storage volume and overflow hydraulics. Other special studies of agricultural management practices and changes in land use are also recommended in Phase 2.

Table 3-3 includes a summary of the lake and watershed monitoring and special studies included in Phase 2. Sections 3.2.1 through 3.2.2 provide additional discussion of the monitoring components, including the specific parameters to be measured, and summarize the investment required for implementation. Section 3.2.3 provides discussion of special studies listed in Table 3-3.

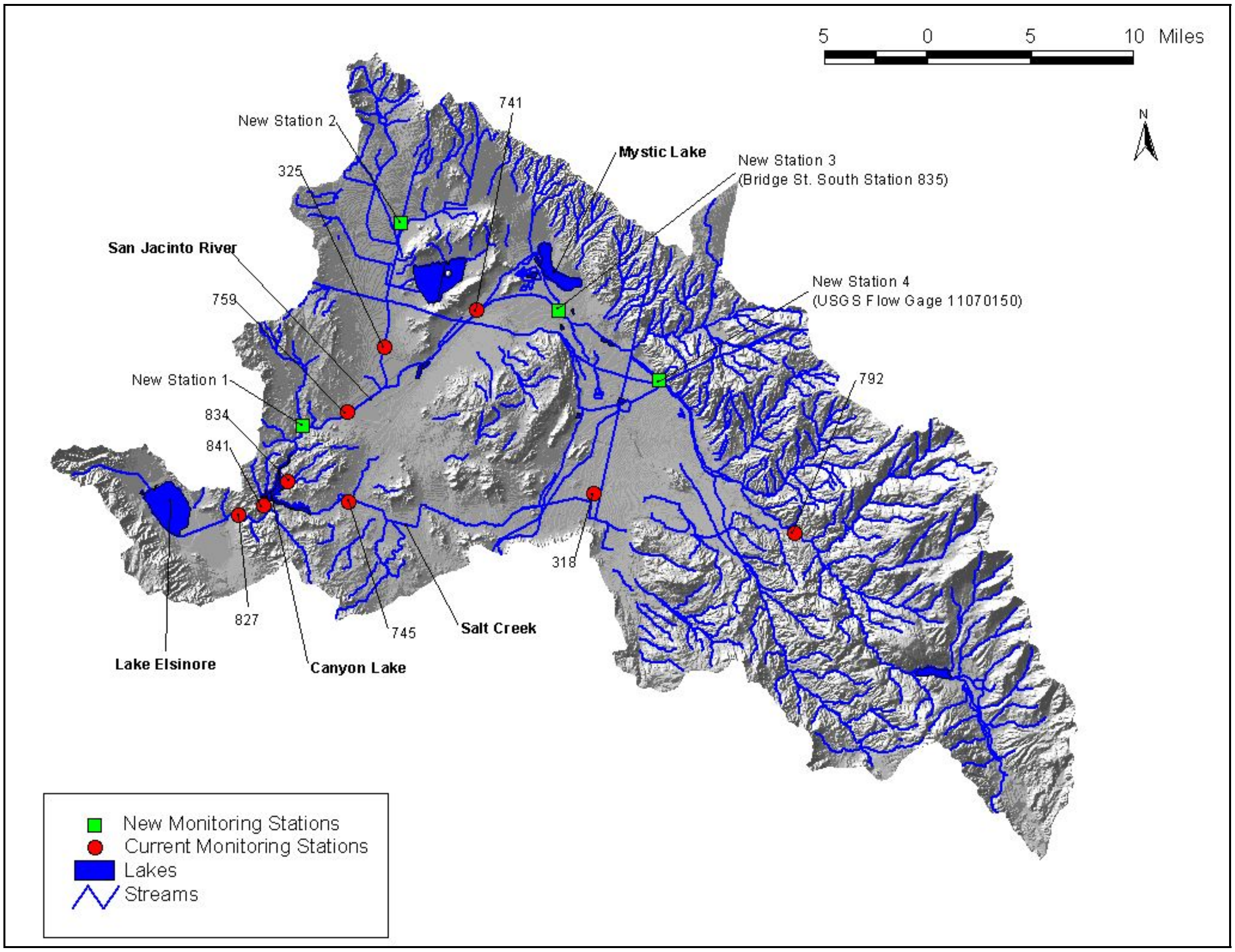

Figure 3-5. TMDL Stations for Phase 2Watershed Monitoring

Table 3-4. Summary of Phase 2

DESCRIPTION	NUMBER OF STATIONS	DATA COLLECTED
Watershed Water Quality	13	10 water quality constituents sampled through hydrograph of 3 storm events per year[b]
Watershed Flow	13	Continuous flow at TMDL stations
Canyon Lake Water Quality	4[a]	15 water quality constituents (monthly Oct - May; biweekly June – Sept)
Lake Elsinore Water Quality	3	12 water quality constituents (monthly Oct - May; biweekly June – Sept)

SPECIAL STUDIES
1. Bathymetric survey of Mystic Lake and development of inflow and stage-outflow relationships
2. Mystic Lake in-lake water quality monitoring
3. Assessment of agricultural manure/fertilizer application and spatial variability of crop types in the watershed
4. Update of land use dataset

[a] At least 3 stations with multiple vertical samples assumed based on depths at station locations.
[b] Eight samples collected for general water quality constituents including nutrients (7)

3.2.1 Phase 2 - Laboratory Analyses

Separate laboratory analyses are required for lake and watershed samples. The following sections discuss parameters to be measured for each sample and the total cost of laboratory analyses.

3.2.1.1 Lake Samples

For all samples collected from the Canyon Lake and Lake Elsinore TMDL stations, the following parameters are recommended for laboratory analyses:

- Water temperature
- Dissolved oxygen
- Chlorophyll *a*
- Nitrate nitrogen
- Nitrite nitrogen
- Ammonia nitrogen
- Total organic nitrogen
- Ortho phosphate
- Total organic phosphorus
- Chemical oxygen demand (COD)
- Biological oxygen demand (BOD)
- Total suspended solids (TSS)

In addition, samples collected from the Canyon Lake *surface* should include laboratory analysis of fecal coliform, total coliform, and *E. coli*.

3.2.1.2 Watershed Samples

For all samples collected from the watershed TMDL stations, the following parameters are recommended for laboratory analyses:

- Total organic nitrogen
- Nitrite nitrogen
- Nitrate nitrogen
- Ammonia nitrogen
- Total phosphorus
- Ortho phosphate
- Total suspended solids (TSS)

3.2.2 Phase 2 – Flow Measurement Stations

Thirteen flow measurement stations are necessary for monitoring at the TMDL stations shown in Figure 3-2. These thirteen stations include seven existing USGS gages, three existing RCFC gages, and three new flow gages requiring installation. Table 3-4 lists all flow gages included in Phase 2 (new flow gages are highlighted).

Table 3-5. Flow Gages Operated and Maintained for Phase 2

TMDL GAGE ID	USGS GAGE ID	LOCATION	AFFILIATED AGENCY
792	11069500	San Jacinto River at Cranston Guard Station	USGS
745	11070465	Salt Creek at Murrieta Road	USGS
759	11070365	San Jacinto River at Goetz Road	USGS
325	11070270	Perris Valley Storm Drain at Nuevo Road	USGS
741	11070210	San Jacinto River at Ramona Expressway	USGS
827	11070500	San Jacinto River Upstream of Lake Elsinore	USGS
834	N/A	Sierra Park Drain in Canyon Lake	RCFC, City of Canyon Lake
318	N/A	Hemet Channel at Sanderson Ave	RCFC
841	N/A	Canyon Lake Spillway	RCFC
NEW	11070150	San Jacinto River at State St.	USGS, EMWD, RCFC
835	N/A	San Jacinto River @ Bridge St.	?
NEW	N/A	Meadowbrook	?
NEW	N/A	Kitching St. Channel @ Iris Ave.	?

3.2.3 Phase 2: Watershed Special Studies

The reduced cost of Phase 2 monitoring allows opportunity for allocation of resources to pursue special studies in the watershed to further address data gaps, and advance understanding of hydrology and pollutant sources and transport from the watershed. Furthermore, these studies can provide essential information for update of models and re-evaluation of the source assessments performed for development of TMDL's and associated load allocations. These studies are discussed in the following sections.

3.2.3.1 Bathymetric Survey of Mystic Lake and Development of Assumptions for Inflow and Outflow

The RCFC has recently performed a bathymetric survey of Mystic Lake to further understanding of the storage of the lake during high flows. This information can be used to develop stage-storage relationships and assumptions estimating outflow hydraulics. Based upon the bathymetric data, hydrologic modeling analysis of the lake can be performed to determine relationships between lake water surface elevation and outflow. In the absence of lake outflow data, assumptions will likely require development based on survey data of the lake outflow location. Once outflows are measured by the downstream flow gage on San Jacinto River at Ramona Expressway, these data can be used to test modeling assumptions.

Additional study of the lake inflow hydraulics can improve understanding of the multiple pathways of flow from the San Jacinto River and the transport of pollutant loads from land use practices (e.g., croplands; dairies) in close proximity to each pathway. For instance, water quality and flows measured at the San Jacinto River at Bridge St. may be representative of most of the upstream watershed runoff during low flows, however at high flows the capacity of the channel at this location can be exceeded resulting in diversion of upper watershed flows through alternative channels in the floodplain. The uncertainty of the flooding of areas and multiple flow pathways can be determined based on high-resolution surveys (e.g., 1-2 ft. contours) and hydraulic modeling of the floodplain. (An example hydraulic model is HEC-RAS, which can provide simulation of flows and water depth based on detailed cross-sectional information). This information, combined with hydraulic modeling of Mystic Lake described above, can result in improved understanding of a segment of the San Jacinto River that is largely a mystery in terms of hydrology and influence on pollutant transport from the upper portion of the watershed through Mystic Lake to Canyon Lake.

This special study addresses a project identified in the *San Jacinto Nutrient Management Plan* (LESJWA, 2004) to address data gaps in the watershed (Project 18). Specifically, this project recommended data collection and study of lake bathymetry, inflow and outflow hydraulics, and in-lake water quality. A significant portion of this effort has already been completed by RCFC through collection of bathymetric data of Mystic Lake. The special study described above focuses on understanding the storage and inflow/outflow hydraulics of the lake.

3.2.3.2 Mystic Lake In-lake Water Quality Monitoring

Currently there are no known water quality data collected from Mystic Lake to assess conditions of the lake when storage occurs. This sampling will allow for a more precise understanding of the properties of Mystic Lake and the role it may potentially play in the storage and release of nutrients in the San Jacinto watershed. This understanding will facilitate the development of more precise models of the transport of nutrients and contaminants. This, in turn, will promote efficient use of limited resources in mitigation of nutrient inputs and related effects in the watershed. This special study recommends monthly sampling at a single site at the deepest part of the lake center. The following parameters presented in Table 3-5 should be measured at one-meter interval:

Table 3-6. Mystic Lake Monitoring – Phase 2 Special Study

DEPTH	PARAMETER	LOCATION OF ANALYSIS	SAMPLING FREQUENCY
N/A	Water depth, secchi depth	Field	Monthly
Ever 3 feet in depth	Dissolved oxygen, pH, conductivity, temperature	Field	Monthly
Photic zone	Chlorophyll a (composited from 3 samples), total coliform, fecal coliform, *E. coli*	Laboratory	Monthly
Sampled at 3-ft intervals and composited	Organic nitrogen, nitrite, nitrate, ammonia, total phosphorus, orthophosphate	Laboratory	Monthly

3.2.3.3 Assessment of Agricultural Manure/Fertilizer Application and Spatial Variability of Crop Types in the Watershed

The *San Jacinto Nutrient Management Plan* (LESJWA, 2004) identifies a needed study for determining crop-specific agronomic rates for guidance in fertilizer and manure application management in the watershed (Project 14). This project includes the following components:

- Spatial inventory (GIS) of crop distributions in the watershed; if crops are rotated throughout the year, each crop and associated season will be included in the inventory.
- Estimation of seasonal nutrient application rates for each crop type. For both fertilizer and manure, content will be assessed to determine quantities of nitrogen and phosphorus. If management of specific farms varies significantly for identical crop types, nutrient

application rates will be estimated and catalogued separately for each farm so that spatial variability in the watershed will be representative of such conditions.
- Estimation of agronomic rates associated with each crop type for both nitrogen and phosphorus.

In addition, the implementation plan of the *Lake Elsinore and Canyon Lake Nutrient TMDL* (Task 5) requires development of a nutrient management plan by agricultural operators, in cooperation with the Riverside County Farm Bureau, the University of California Cooperative Extension, and the Western Riverside County Agricultural Coalition (WRCAC), to meet Regional Board approval (Regional Board, 2004). The Regional Board states that this plan must include the following:

- Implementation of nutrient controls, BMPs, and reduction strategies to meet load allocations;
- Evaluation of effectiveness of BMPs;
- Development and implementation of compliance monitoring; and
- Development and implementation of focused studies that will provide the following data and information:
    - Inventory of crops grown in the watershed;
    - Amount of manure and/or fertilizer applied to each crop with corresponding nitrogen and phosphorus amounts; and
    - Amount of nutrients discharged from croplands.

Ongoing and proposed studies performed by the SAWPA, EMWD, the University of California, Riverside, the WRCAC, the San Jacinto River Watershed Council, and various agricultural operators can address components of the projects outlined above.

3.2.3.4 Update of Land Use Dataset

The San Jacinto River watershed is currently undergoing major changes due to development of previous open space or agricultural lands. Previous model development of the watershed to support nutrient and TMDL development was based on a combination of land use data collected in 1993 by USGS and 1999 by EMWD (SAWPA, 2003). To assess the changes in hydrology and pollutant transport due to the rapidly changing land use, new land use data is required. To obtain a better understanding of current land us, EMWD plans to update their previous dataset to current conditions. Once collected, this data can be used to update the previously developed watershed model to assess changes in pollutant transport and impacts on Canyon Lake and Lake Elsinore.

References

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Anderson, M.A., and H. Oza. 2003. *Internal Loading and Nutrient Cycling in Canyon Lake*. Final Report to Santa Ana Regional Water Quality Control Board.

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Regional Board (California Regional Water Quality Control Board – Santa Ana Region). 2004a. Lake Elsinore and Canyon Lake Nutrient Total Maximum Daily Loads. Riverside, CA.

SAWPA (Santa Ana Water Project Authority). 2003. Lake Elsinore and Canyon Lake Nutrient Source Assessment - Final Report. Prepared by Tetra Tech, Inc.

Appendix A

Potential Locations of New Watershed Monitoring Stations for Phase 2

Figure A-1. Potential Locations for Monitoring Station at Meadowbrook

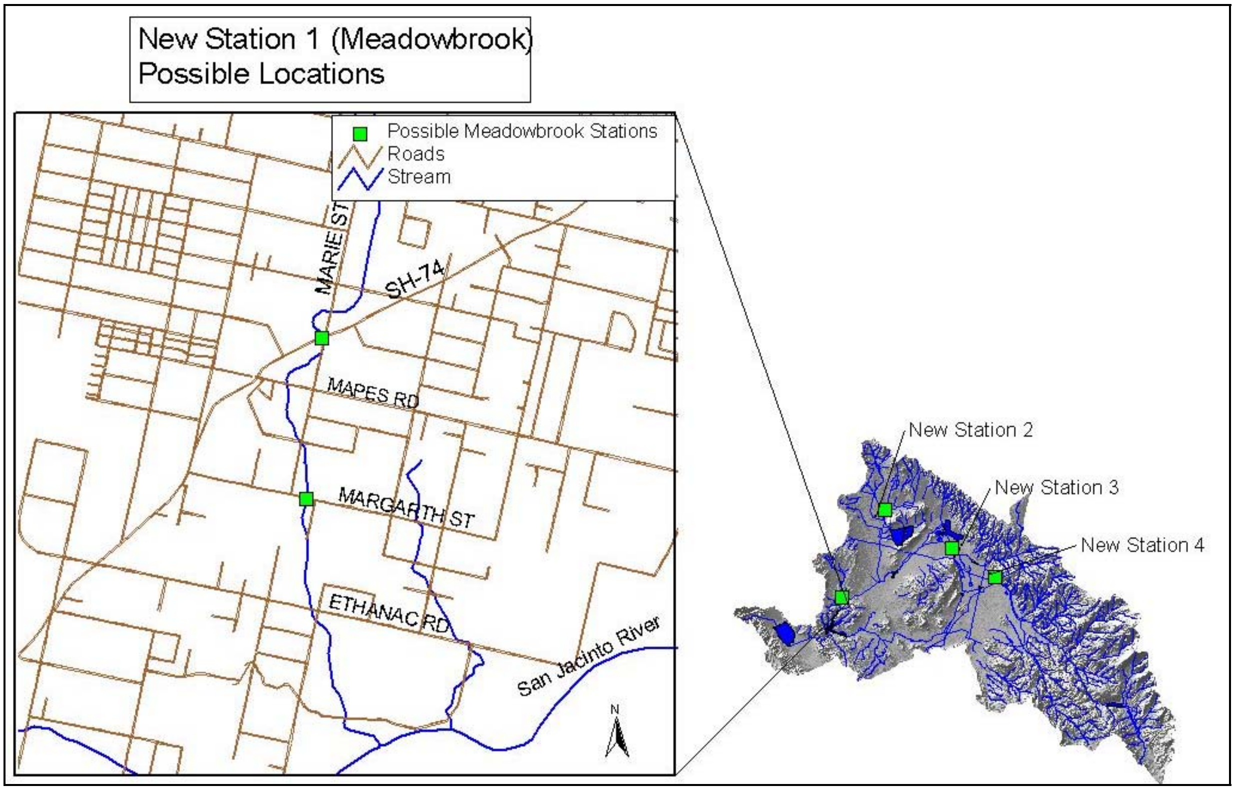

Figure A-1a. Candidate monitoring station #1 in Meadowbrook (Margarth Rd)

Figure A-1b. Candidate monitoring station #1 in Meadowbrook (Margarth Rd)

Figure A-1c. Candidate monitoring station #2 in Meadowbrook (Highway 74)

Figure A-2. Potential Location for Monitoring Station at Kitching St. at Iris Ave.

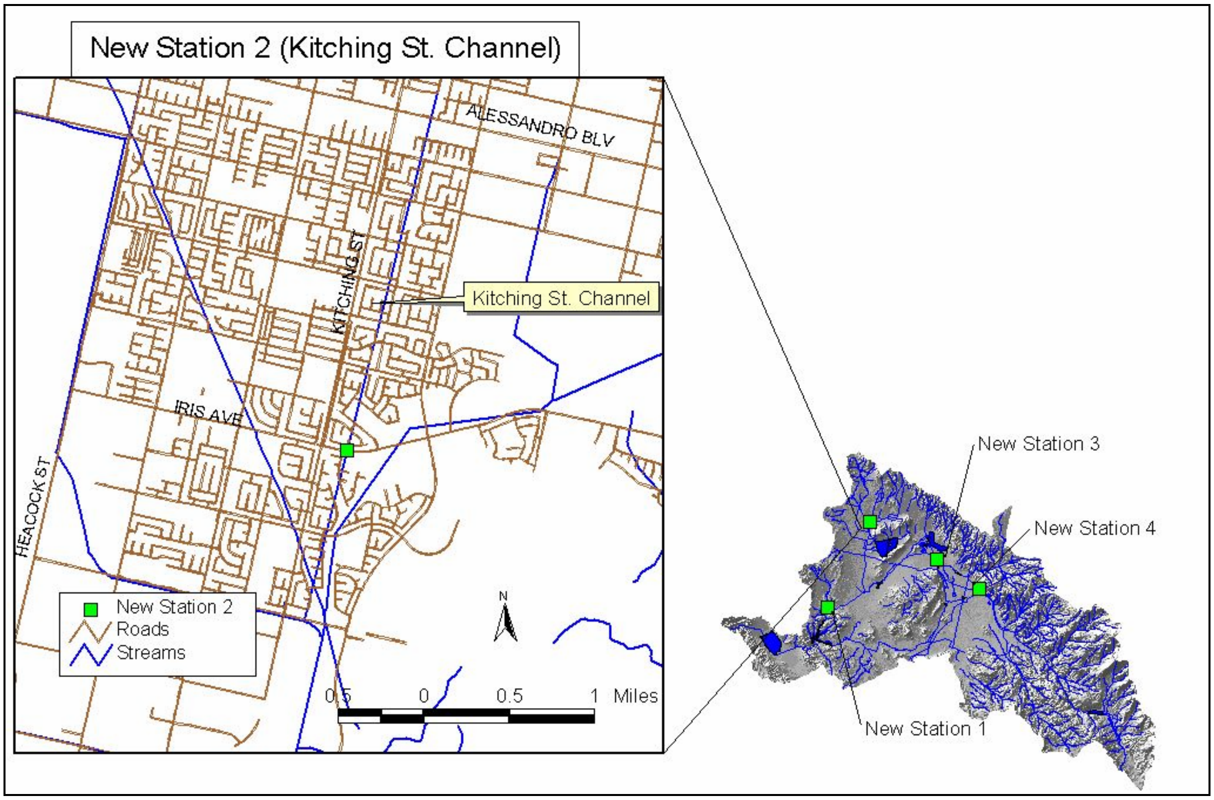

Figure A-2a. Candidate monitoring station at Kitching St. Channel

Figure A-3. Location for Monitoring Station on San Jacinto River at Bridge St.

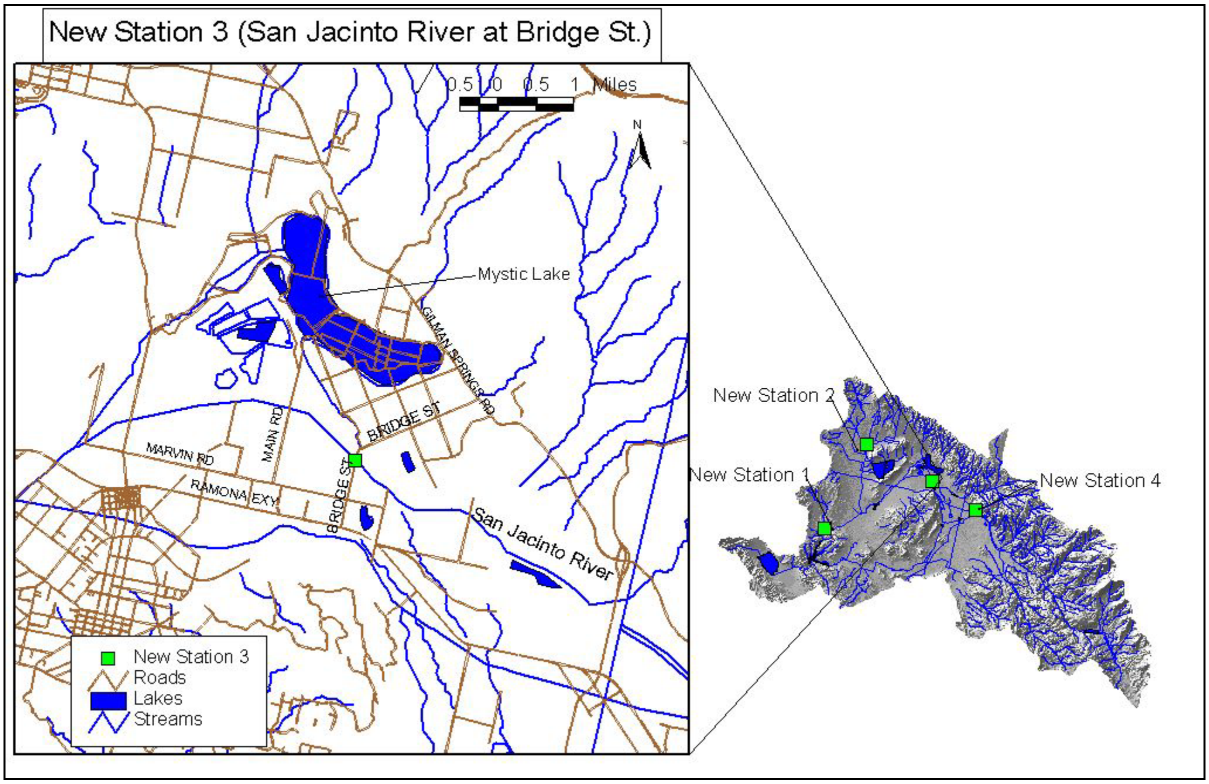

Figure A-4. Location for Monitoring Station on San Jacinto River at State St.