BOOK 3: TECHNICAL SOLUTIONS PILOT STUDY

DISADVANTAGED COMMUNITY WATER STUDY FOR THE TULARE LAKE BASIN

GRANT AGREEMENT NUMBER: 4600009132
SAFE DRINKING WATER, WATER QUALITY AND SUPPLY, FLOOD CONTROL, RIVER AND COASTAL PROTECTION BOND ACT OF 2006 (PROPOSITION 84)
November 2010 through November 2014

AUGUST 2014

Prepared for:
County of Tulare

Final Submittal to:
Department of Water Resources
Division of Integrated Regional Water Management
South Central Region Office
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Community Water Center / El Centro Comunitario por el Agua
Provost & Pritchard Consulting Group (Est. 1968) — An Employee Owned Company
Self-Help Enterprises
Keller Wegley Consulting Engineers

TECHNICAL SOLUTIONS PILOT

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ABBREVIATIONS

µg/L .... micrograms per liter (same as ppb)
ACS .... American Community Survey
AF .... Acre-Feet
APWA .... American Public Works Association
AWWA .... American Water Works Association
BOD .... Biochemical Oxygen Demand
CAA .... Cleanup and Abatement
CDBG .... Community Development Block Grant
CDPH .... California Department of Public Health[1]
CEQA .... California Environmental Quality Act
CF .... Coagulation and Filtration
CFCC .... California Financing Coordinating Committee
CFS .... Cubic Feet per Second
CPUC .... California Public Utilities Commission
CRWA .... California Rural Water Association
CSA .... County Service Area
CSD .... Community Services District
CT .... Contact Time
CVP .... Central Valley Project
CWD .... County Water District
CWS .... Community Water System
CWSRF .... State Revolving Fund (Clean Water)
DAC .... Disadvantaged Community
DBCP .... Dibromochloropropane
DBP(s) .... Disinfection By-Product(s)
DWR .... Department of Water Resources
DWSAP .... Drinking Water Source Assessment & Protection
EDA .... United States Economic Development Administration

[1] The California Department of Public Health (CDPH), when referred to in this Study, pertains to the Drinking Water Program (DWP) which regulates public drinking water systems in California. Historically, the DWP has been administered through CDPH; however, as of July 1, 2014 the administration of the DWP has transferred from CDPH to the State Water Resources Control Board (SWRCB or State Water Board). Any reference to CDPH in this Study moving forward refers to the DWP now administered through the State Water Board.

E. Coli.. *Escherichia Coli*
EPA..United States Environmental Protection Agency
FEMA .... Federal Emergency Management Agency
FFY .... Federal Fiscal Year
FRF ....Fresno Regional Foundation
GIS... Geographic Information Systems
HAA(s)... Haloacetic Acid(s)
HAA5.. Sum of 5 Haloacetic Acids
HUD ....Department of Housing and Urban Development
ICF .... Iron Coagulation Filtration
IX.. Ion Exchange
IRWM ....Integrated Regional Water Management
IRWMA.. Integrated Regional Water Management Authority
JPA...Joint Powers Authority
KBWA..Kings Basin Water Authority
KW ....Kilowatt
KWh ....Kilowatt hours
LAFCo ....Local Agency Formation Commission
LPA ....Local Primacy Agency
O&M ....Operation and Maintenance
MCL...Maximum Contaminant Level
MG ....Million Gallons
mg/L .... milligrams per liter (same as ppm)
MGD... Million Gallons per Day
MHI..Median Household Income
MHP ....Mobile Home Park
MOU...Memorandum of Understanding
MSR .... Municipal Service Review
MWC ....Mutual Water Company
N...Nitrogen
NCWS ....Non-Community Water System
NO_3 ....Nitrate
NORM .... Naturally Occurring Radioactive Material

NOM .... Natural Organic Matter
NPDES .... National Pollutant Discharge Elimination System
NTNC .... Non-Transient Non-Community Water System
NTU .... Nephelometric Turbidity Units
PCB .... Polychlorinated Biphenyls
pCi/L .... picocuries per liter
pH .... - log Hydrogen Ion Concentration
POE .... Point-of-Entry
POU .... Point-of-Use
PPB .... Parts per Billion
PPM .... Parts per Million
PPSAG or PSAG .... Pilot Project Stakeholder Advisory Group
PUC .... Public Utilities Commission
PUD .... Public Utility District
PWS .... Public Water System
RCAC .... Rural Community Assistance Corporation
RMA .... Resource Management Agency
RO .... Reverse Osmosis
RUS .... Rural Utilities Service
RWQCB .... Regional Water Quality Control Board
SB .... Senate Bill
SBA .... Strong Base Anions
SDAC .... Severely Disadvantaged Community
SDWA .... Safe Drinking Water Act
SEP .... Supplemental Environmental Project
SFY .... State Fiscal Year
SMD .... Sewer Maintenance District
SOAC .... Stakeholder Oversight Advisory Committee
SRF or SDWSRF .... State Revolving Fund (Safe Drinking Water)
SSWS .... State Small Water System
S.U. .... Standard Units
SWP .... State Water Project

SWRCB....State Water Resources Control Board[2]
SWS....Small Water System
TBD....To be Determined
TCP....1,2,3-Trichloropropane
TCR....Total Coliform Rule
THM(s)....Trihalomethane(s)
TLB....Tulare Lake Basin
TMF....Technical Managerial & Financial
TNC....Transient Non-Community Water System
TOC....Total Organic Carbon
TSS....Total Suspended Solids
TTHM(s)....Total Trihalomethane(s)
UIC....Underground Injection Control
USDA....United States Department of Agriculture
USEPA, EPA....United States Environmental Protection Agency
USGS....United States Geological Survey
UV....Ultraviolet
VFD....Variable Frequency Drive
WC....California Water Code
WD....Water District
WDR....Waste Discharge Requirements
WTP(s)....Water Treatment Plant(s)
WWD....Water Works District
WWTF....Wastewater Treatment Facility
ZLD....Zero Liquid Discharge
ZOB....Zone of Benefit

[2] Reference to the State Water Resources Control Board (SWRCB or State Water Board) in this Study may include any of the programs administered by the State Water Board.

EXECUTIVE SUMMARY

Summary of Pilot Study

The Tulare Lake Basin Study Area which includes most of Fresno, Kern, Kings, and Tulare counties contains 530 communities. Of these, 353 communities are identified as a disadvantaged community (DAC) or as a severely disadvantaged community (SDAC). Those classified as DAC or SDAC (collectively referred to as DACs) are the focus of this Technical Solutions pilot study. Of the 353 DACs, 89 reported more than one drinking water maximum contaminant level (MCL) exceedance from 2008 to 2010.

The exceedances recorded were from a wide variety of contaminants including coliform bacteria, arsenic, nitrate, total trihalomethanes, uranium, fluoride, dibromochloropropane (DBCP), perchlorate and polychlorinated biphenyls (PCB). These contaminants were either present alone or in combination with other contaminants in exceedance of the MCL.

In addition to the water quality issues facing DACs, there are also wastewater issues. Of the 353 DACs, 38 communities have their own wastewater treatment facility (WWTF). Some of the communities not having their own wastewater treatment plant may have their wastewater treated at a nearby WWTF operated by another community. Of the 38 communities with WWTFs, 25 are listed as having a violation of their waste discharge requirements. A majority of these plants are simple aerated lagoons that discharge to percolation ponds, evaporation ponds, or leach fields. These systems may not be capable of meeting existing or future discharge limitations, and improvements will likely be needed. In addition, those communities without a sewer system may need to install a collection system and implement community wide wastewater treatment in order to abandon existing individual septic systems.

This pilot study has been prepared to identify the water and wastewater treatment challenges and provide potential technical solutions to be considered to address some of the ongoing water quality problems for DACs. Decision trees have been developed to help guide communities through some of the implementation processes involved with the technical solutions outlined in this report. The decision trees are flow charts that show data needed to evaluate the technical solutions and the decisions that may be made based on the available data. The decision trees are designed to aid DACs in determining potential technical solutions to address their water or wastewater issues.

Description of Problems

Several priority issues were developed during the Stakeholder Oversight Advisory Committee (SOAC) process, which was convened as an initial task of the Tulare Lake Basin Disadvantaged Community Water Study (TLB Study). The details of the SOAC, including the purpose of the committee and actions performed, are described in the main body of the Final Report. The priority issues to be addressed are:

- Lack of funding to offset increasingly expensive operations and maintenance costs in large part due to lack of economies of scale

- Lack of technical, managerial and financial capacity by water and wastewater providers
- Poor water quality
- Inadequate or unaffordable funding or funding constraints to make improvements
- Lack of informed, empowered, or engaged residents

Potential Technical Solutions

Water treatment facilities are typically costly to construct and maintain; therefore, it is generally preferred to resolve water contamination issues by means other than treatment. Often the preferred solution is to find a better quality source of water that does not require treatment. Many communities choose to drill a new well or connect to a neighboring water system to obtain safe drinking water. However, that is not always feasible, especially in areas that have widespread, known water quality contamination issues. If a high quality water source can be found, it can replace the contaminated supply or it can be blended with the contaminated source to provide water that meets water quality standards without treatment. This pilot study focuses on technical solutions for communities that have exhausted all other potential alternatives.

If a source with acceptable drinking water quality cannot be found, it may be necessary to provide a treatment system. Sometimes it may be advantageous to build a regional treatment system to treat the water to supply several neighboring communities. This pilot study examines these treatment alternatives and their potential use to remove the contaminants present in the study area. The findings and recommendations in this report are based only on a list of drinking water MCL exceedances and are therefore general and preliminary in nature. Determining the appropriate treatment approach for individual systems will require a more detailed evaluation of water quality and system-specific constraints that are beyond the scope of this pilot study.

All treatment systems generate liquid and/or solid waste streams that must be disposed. The disposal options will depend on the type of treatment system used; disposal options include non-mechanical and mechanical dewatering, discharge to a sewer collection system, deep well injection, evaporation, offsite disposal or zero liquid discharge. The treatment of residuals can be accomplished at the water treatment plant site or at a regional site that treats waste streams from multiple treatment plants. This pilot study also focuses on technical solutions for water treatment residual disposal that may remove obstacles for treatment or may reduce the overall cost of treatment.

In order to minimize the capital and operations and maintenance costs, a water treatment system should ideally treat water used primarily for potable and in-home use. If a large portion of a drinking water supply is used for non-potable purposes, a dual water distribution system can be considered as a technical solution that may reduce treatment costs. One distribution system would convey non-potable water for irrigation, landscaping, farming, etc., and a separate system would convey potable water.

Water conservation and energy conservation are technical solutions that can reduce the cost of producing potable water also minimizing potable water demand will minimize the cost of treatment facility construction and operation. Energy conservation will also minimize the energy cost associated with operating a water treatment plant. Energy conservation can be achieved through the use of energy efficient pumps, pumps with variable speed drives, and energy efficient motors. Renewable energy from biogas or solar is another option to reduce energy costs.

This pilot study investigates and discusses how various technical solutions can be implemented. Technical solution alternatives to be discussed and possibly implemented in the TLB include:

- Blending
- Dual water distribution systems
- Biological nitrate reduction for water treatment
- Joint residual handling, management and disposal
- Lower cost water treatment technology
- Water and energy efficiency technology

Most of the existing DAC WWTFs in the Tulare Lake Basin discharge to land either through percolation, evaporation, or leach fields. There are some WWTFs that have the ability to discharge to a surface water. Residents in unsewered DACs discharge wastewater to individual leach fields or alternative on-site systems. Since both WWTFs and individual household systems discharge to land, improperly treated wastewater has the potential to pollute underlying groundwater. The polluted groundwater could lead to drinking water quality issues. Improvements to existing WWTFs could include:

- Additional lagoon volume
- Improved treatment process to existing wastewater treatment facilities (for example: Biolac)
- Nitrogen removal via solids recycling
- Additional pollutant removal by adding filters for tertiary treatment
- For the unsewered communities, a solution would involve installing a sewer collection system in addition to constructing a WWTF. Additionally, the existing household treatment systems would need to be properly abandoned.

Any improvements to existing WWTFs or a new WWTF would require adequately trained staff to operate and maintain the more complex treatment systems. The costs to construct and operate a new or upgraded WWTF can be expensive, especially to DACs.

It may be beneficial to have nearby communities to join an existing regional wastewater treatment facility. A regional wastewater facility may allow for some economies of scale cost savings for the construction of the facility and a larger customer base to pay for ongoing operations and maintenance costs.

Case Studies

In order to demonstrate the process of selecting and implementing technical solutions, several communities, at various stages of implementation, are highlighted. For water technical solutions, these communities are:

- Riverdale Public Utilities District – in process of locating a new well and treatment for arsenic removal
- Caruthers Community Services District – in process of constructing a new well and designing a treatment plant for arsenic removal
- Home Garden Community Services District – exploring modifications to existing arsenic removal treatment plant

For wastewater technical solutions, these communities are:

- City of Kerman – constructed WWTF improvements to expand capacity and improve treatment plant pollutant removal
- Caruthers Community Services District – constructed WWTF improvements to add nitrification/denitrification to activated sludge process

Community Review

Communities were selected to help further evaluate and ground truth the technical solutions presented in this pilot study. The community review process was also used to aid communities in developing a roadmap to address their particular issues. For the Technical Solutions pilot study the following DACs were part of the community review process:

- Home Garden Community Services District - technical solutions regarding the disposal of residuals from their arsenic treatment system.
- Poplar Community Services District – technical solutions for elevated nitrate concentrations in a groundwater well.

The community review process provided insight into the many water issues DACs face. Both communities reported water and/or wastewater challenges. A majority of the issues DACs face are related to costs and keeping rates affordable for its users. These costs are associated with the necessary engineering work needed to develop a solution, the construction of the chosen solution and the impact of the ongoing operations and maintenance costs. DACs, by definition, are disadvantaged and any increase in utility bills will have an impact on the residents. The potential cost impacts on the community will be very important in evaluating any water solution.

Funding Opportunities

State regulators and funders already provide educational material as well as funding opportunities to DACs. However, many DACs have issues with navigating the funding process and evaluating potential solutions for their community. Several existing funding opportunities and proposed drinking water legislation are presented in this pilot study. Some of the traditional drinking water funding programs include Safe Drinking Water

Revolving Fund (SDWRF), Proposition 50, Proposition 84, Department of Water Resources (DWR) Integrated Regional Water Management Act (IRWM), Community Development Block Grant Program (CDBG), and United States Department of Agriculture (USDA) Rural Development. Each of these funding opportunities requires different applications with different informational requirements. These applications may be beyond the ability of a DAC to complete without assistance.

The State Water Resources Control Board administers the Clean Water State Revolving Fund (CWSRF) Program, which offers low-interest financing agreements for wastewater quality projects. Limited principal forgiveness/grants are available for disadvantaged communities. Eligible projects include, but are not limited to, construction and rehabilitation of publicly-owned wastewater treatment facilities, water reclamation facilities, and sewer systems. The types of improvements described in Section 7 of the Technical Solutions pilot study, including both improvements to existing treatment systems and installing sewer infrastructure in unsewered communities, would likely be eligible for funding under the CWSRF Program.

All these funding sources have limited funding available each year, meaning DACs must compete for funding. The need for funding exceeds the amount of available funding, meaning certain communities may not receive funding for a number of years. In addition to the typical funding sources for water and wastewater projects, funding for “green” projects that involve alternative energy, water conservation or energy conservation may be beneficial to DACs depending on the water solution.

The funding opportunities offered by the various agencies cover only the capital costs associated with any improvements through construction. Once constructed, the DAC will need to pay for the ongoing operations and maintenance of the improvements, typically through utility bills. Currently, there are no funding sources available to help offset ongoing operations and maintenance costs despite the widespread need.

Sustainability of Technical Solutions

The equipment involved with any of the technical solutions will have an estimated life of at least 20 years if properly maintained. The biggest sustainability issue with any of the technical solutions will be the ability of the community to pay for and operate the solution. The operations and maintenance costs will increase the utility bills of the residents; the ability of residents to pass any required rate increases and pay those increases will be the biggest issue affecting sustainability. The other issue affecting sustainability is the ability of the community to find and retain qualified operators to operate the technical solutions.

Since increased operations and maintenance costs can be burdensome to communities, the evaluation of potential solutions should include careful analysis of ongoing maintenance costs. For example, spending more in capital costs for an automated system may result in lower recurring operations and maintenance costs. Operations and maintenance costs may also be lowered by evaluating some of the solutions presented in the Management and Non-Infrastructure pilot study, such as sharing common resources or forming joint governmental agencies to share costs.

Obstacles and Barriers

There are numerous obstacles that a community must overcome in order to implement a technical solution. Some of these obstacles include:

- Lack of approved technologies – For certain pollutants, like nitrates and fluoride, there are a small number of approved technologies. However, there are alternate treatment technologies constantly being developed. CDPH currently has an approval process for these emerging technologies. However, having an expedited process set up to pilot and potentially approve emerging technologies could be helpful to DACs if a more cost effective treatment is developed.
- Proper selection of technology – This pilot study provides a guide of possible technical solutions. However, a more detailed evaluation of the technical alternatives would need to be completed to select a technology that will solve the particular problem(s) of a given community and is sustainable.
- Community acceptance – In order for the technical solution to be feasible it would need to be generally understood and accepted by the community. This acceptance would need to include the understanding of why a certain solution is being selected and how the community will benefit from the solution. Community acceptance would help with the passing of any rate increases and the payment of future utility bills. Levels of acceptance rise with increased community understanding of the necessity and benefits associated with any technical solution.
- Capital costs – There will be capital costs associated with any technical solution. If treatment is involved, the capital costs could be several million dollars. There is the opportunity to obtain funding through the traditional sources for water and wastewater projects or through funding for alternative energy or conservation projects. The ability to secure the necessary funding could be a major obstacle. Targeted and effective coordination of multiple funding coordinators and/or technical assistance providers can help address this obstacle.
- Operation and maintenance costs - The community may be able to obtain grants or low interest loans to pay for the associated capital costs for a technical solution; there are currently no funding mechanisms in place to assist with operation and maintenance costs. These costs will have to be borne by the rate payers in the community. Depending on the median household income in the community, the utility rate increase may adversely impact the rate payers. Potential solutions should be analyzed for ongoing maintenance costs so that these costs can be minimized and anticipated. Operations and maintenance costs may be lowered by evaluating some of the solutions presented in the Management and Non-Infrastructure pilot study such as sharing common resources or forming joint governmental agencies to share costs. A program that would provide transitional funding to help offset rate increases for a period of time would be beneficial.

- Licensed operators – The technical solutions may require a higher level certified operator than is currently employed or contracted by the community. A higher level operator would likely command a higher salary due to the scarcity of trained and certified operators at the higher level. It can be difficult for an operator at a DAC to maintain his certification since this requires on-going educational requirements. Obtaining these educational requirements can be costly and requires time off work to attend, as well as travel from remote, rural locations. It is also difficult for an operator at a DAC to obtain a higher grade license since this would require spending a certain amount of time at a higher rated plant.
- Water meters – There are some DACs that have water meters installed; however sometimes the meters are not read and billing is done at a flat rate. The meters are not read due to lack of staff available to perform this task. Reading meters and billing based on usage would lessen the water demand. This would result in lower operating costs for water pumping and treatment. Other DACs do not have water meters installed. These DACs would benefit from the installation of meters that can be read remotely to reduce the staff needed to perform the meter reading task. DACs would need to analyze and establish appropriate metered rates and billing systems. These tasks will require assistance. Many other DACs may have meters that are old or not working. DACs would benefit from funding to replace old and non-working water meters and to facilitate partnerships between other neighboring communities with or in need of water meters. Funding for meters has been limited and/or hard to obtain. For the most part funding has been limited to the funding made available through the IRWM program or Drinking Water Program as part of other larger projects.
- Waste disposal – If a water treatment solution is selected, there will be residuals that will need to be disposed. The waste to be disposed could be high in salinity or classified as hazardous waste. These will require additional costs to dispose of properly. During the evaluation of potential water solutions, the costs associated with waste disposal need to be evaluated. There are potential opportunities for DACs to reduce waste disposal costs by sharing resources with nearby communities that share a similar problem or instituting some of the solutions presented in the Management and Non-Infrastructure pilot study.

Considerations for Implementing Technical Solutions

The following are items to be considered when evaluating any of the options in the Technical Solutions pilot study. These are items to be considered by various parties in order to facilitate the implementation of technical solutions to communities in the Study Area.

- Overall Considerations Regarding Technical Solutions for Disadvantaged Communities
    - Water treatment should be a “last resort”.
    - The technical solution will be specific to each community although communities can learn from each other in regards to implementing a solution.

- For communities with failing septic systems, installation of a waste collection system and a wastewater treatment facility may be needed.
- The technical solution must be financially sustainable by the community and ideally reduce or minimize ongoing operations and maintenance costs.

- Funding Agency Considerations
  - Ensure that funds are not used to support unsustainable systems. During the evaluation of funding, an evaluation should be done to show that utility rates are and will remain affordable and that the potential solution should minimize operation and maintenance costs.
  - Funding should be made available to public and investor-owned utilities for assisting in the restructuring of small water systems. If funding is provided to investor-owned utilities, they should be required to conform to the same technical, managerial and financial requirements as publicly-owned systems.
  - Investigate the possibility of providing funding to offset the cost of increased operations and maintenance costs.
  - Make funding available for projects that only involve the installation of water meters that can be read remotely. Currently, these projects are ranked lower than larger projects that involve treatment or new water sources and are rarely invited to apply for funding through traditional funding sources.
  - Support the development and implementation of water conservation policies/measures by providing incentives and technical assistance to DACs and promoting the use of water and energy efficient equipment upgrades, such as energy-efficient or solar powered pumps.
  - Promote effective coordination of multiple funding sources whenever possible. This can be accomplished by working the local funding coordinators and/or technical assistance providers.

- Community Involvement Considerations
  - The community should be involved throughout the process of improvements to their water and wastewater systems. The community should be invited to understand the alternatives evaluated, the reason for selection of a certain alternative, and the analysis of potential operations and maintenance costs. Care should be taken to develop effective community outreach methods, with attention to language, cultural, and social barriers.
  - Local political issues may discourage some needed changes to the water/wastewater system. Community outreach and engagement can help residents understand the benefits of a proposed solution, which may outweigh political barriers.
  - In most cases the final solution to a water/wastewater issue is not so much “planned” as it is negotiated. Such a negotiated solution has the

potential to be regarded as a success in that it will be embraced by more stakeholders.

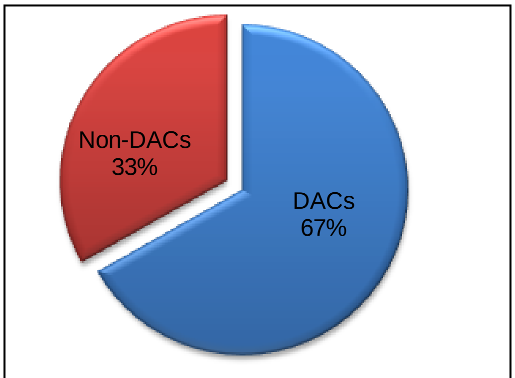
- Regulatory Considerations
    - EPA and CDPH could support fledgling water treatment technologies (i.e. titanium based nanofibers for arsenic removal, carbon nanotubes for nitrate removal, membrane biolfilm reactor (MBfR) for wastewater treatment, anaerobic migrating blanket reactors (AMBR) for wastewater treatment) through a verification program. The verification program is a study of a particular treatment process to establish its effectiveness at meeting its treatment claims.
    - Small systems could benefit from more technical assistance from state water regulators. The state currently offers funding workshops and community groups like Self-Help Enterprises can offer technical assistance. However, due to the locations of these workshops they are not easy for DAC staff to attend. Regulatory agencies could offer more assistance tailored to specific small systems in order to guide them through the funding and alternatives analysis.

1 INTRODUCTION

1.1 Project Information

The County of Tulare received a California Department of Water Resources (DWR) grant executed in May 2011, which was appropriated through Senate Bill SBx2 1 (Perata, 2008) (Refer to **Appendix A** and **B**). This appropriation was the result of disadvantaged community leaders in the region raising the visibility of local water and wastewater challenges, and advocating for funding to develop more sustainable and affordable approaches to solving disadvantaged community water and wastewater issues in the Tulare Lake Basin. The goal of the Tulare Lake Basin Disadvantaged Community Water Study (TLB Study) was to develop an overall plan to address water needs including recommendations for planning, infrastructure, and other water management actions, as well as specific recommendations for regional drinking water treatment facilities, regional wastewater treatment facilities, conjunctive use sites and groundwater recharge, groundwater for surface water exchanges, related infrastructure, project sustainability, and cost-sharing mechanisms. The plan was intended to identify projects and programs that will create long-term reliability and regulatory compliance, while optimizing the on-going operation and maintenance (O&M) and management costs for small water and wastewater systems. As the culmination of the TLB Study, recommendations are provided for legislation, funding opportunities, and other support that Federal, State, and local agencies can provide to help facilitate this plan.

The County of Tulare contracted with Provost & Pritchard Consulting Group to prepare the plan. Provost & Pritchard led a team of consultants, including Keller Wegley Consulting Engineers, Self-Help Enterprises, Community Water Center, and McCormick, Kabot, Jenner & Lew (project team or consultant team). The TLB Study focuses on unincorporated communities within the Tulare Lake Basin (Study Area) that are classified as disadvantaged communities. A disadvantaged community is defined as a community whose median household income is 80 percent or less of the statewide median household income. The Study Area encompasses most of the four-county area, including Fresno, Kern, Kings, and Tulare Counties, and is generally rural in nature with much of the population widely dispersed throughout the region. The Tulare Lake Basin Study Area boundary is shown in **Figure 1-1.** Approximately 353 of 530 identified communities within the Tulare Lake Basin are disadvantaged or severely disadvantaged. The estimated population within these 353 communities is approximately 260,000[3]. **Figure 1-1** through **Figure 1-5** show the disadvantaged communities within the Study Area.

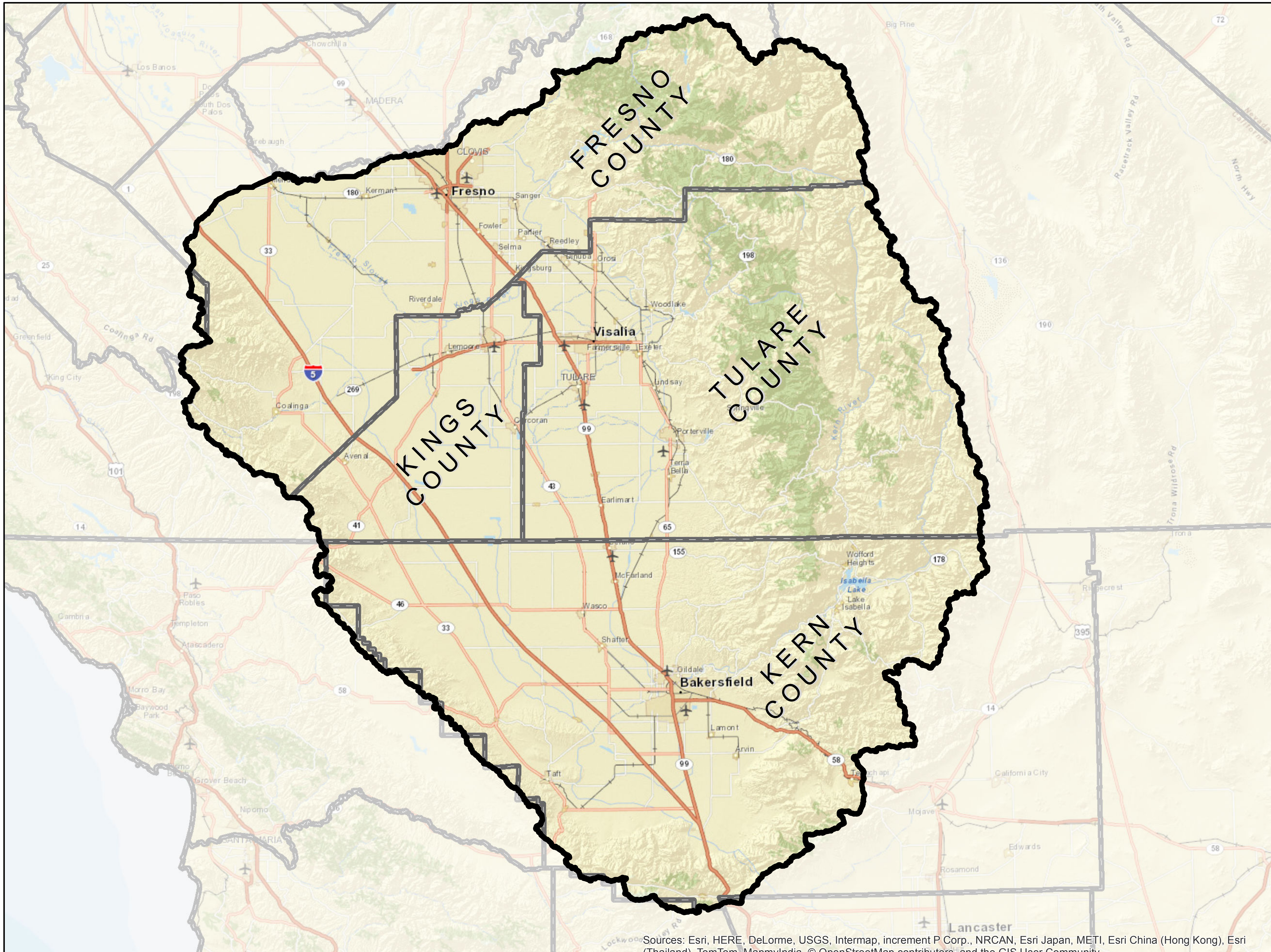


Communities in the Tulare Lake Basin

[3] Database information that was collected and analyzed for the TLB Study originated from multiple sources. Refer to Section 13 - References.

Tulare Lake Basin Disadvantaged Community Water Study

FIGURE 1-1
Tulare Lake Basin Study Area



Legend

Tulare Lake Basin

County

0 5 10 15 Miles

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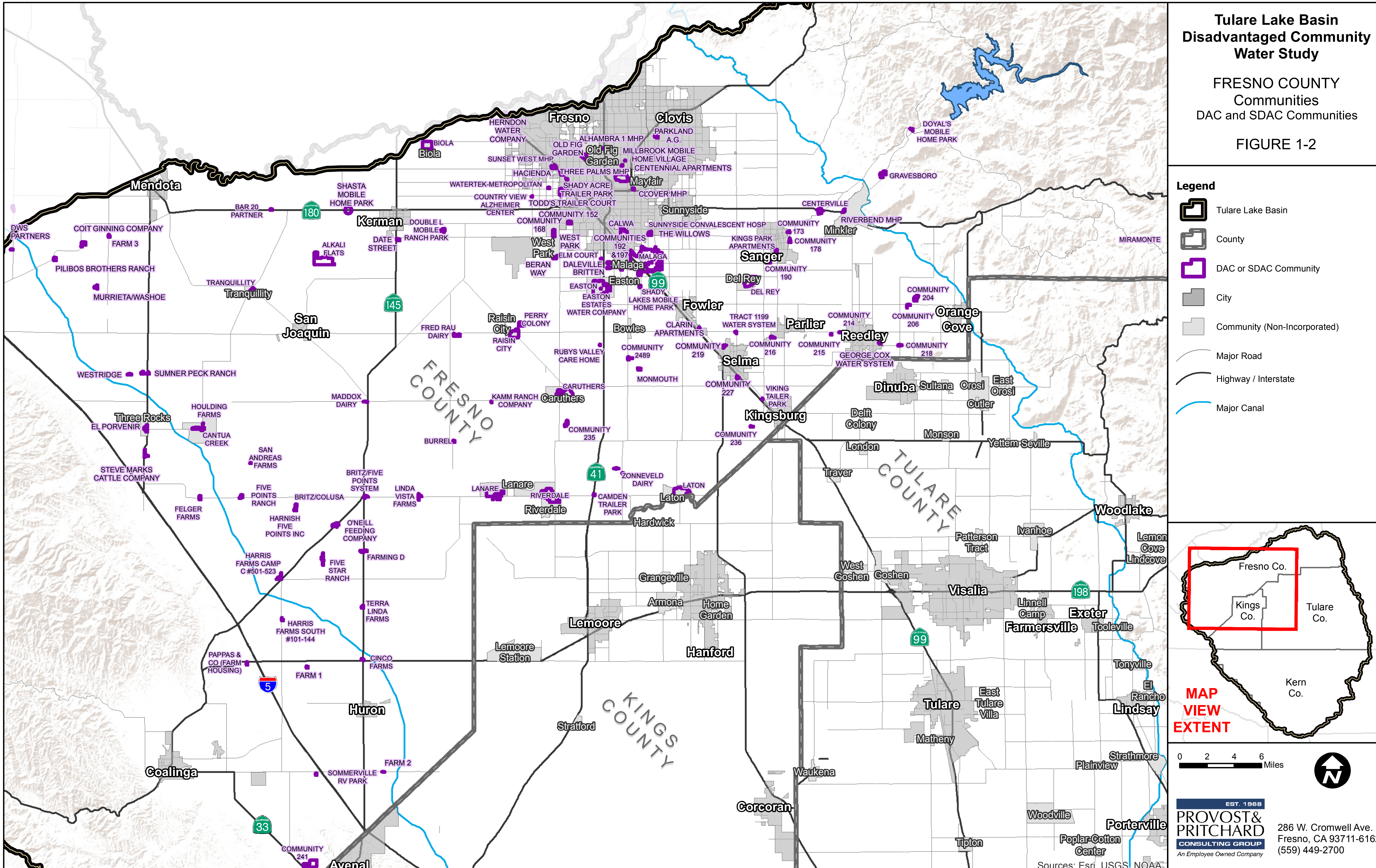

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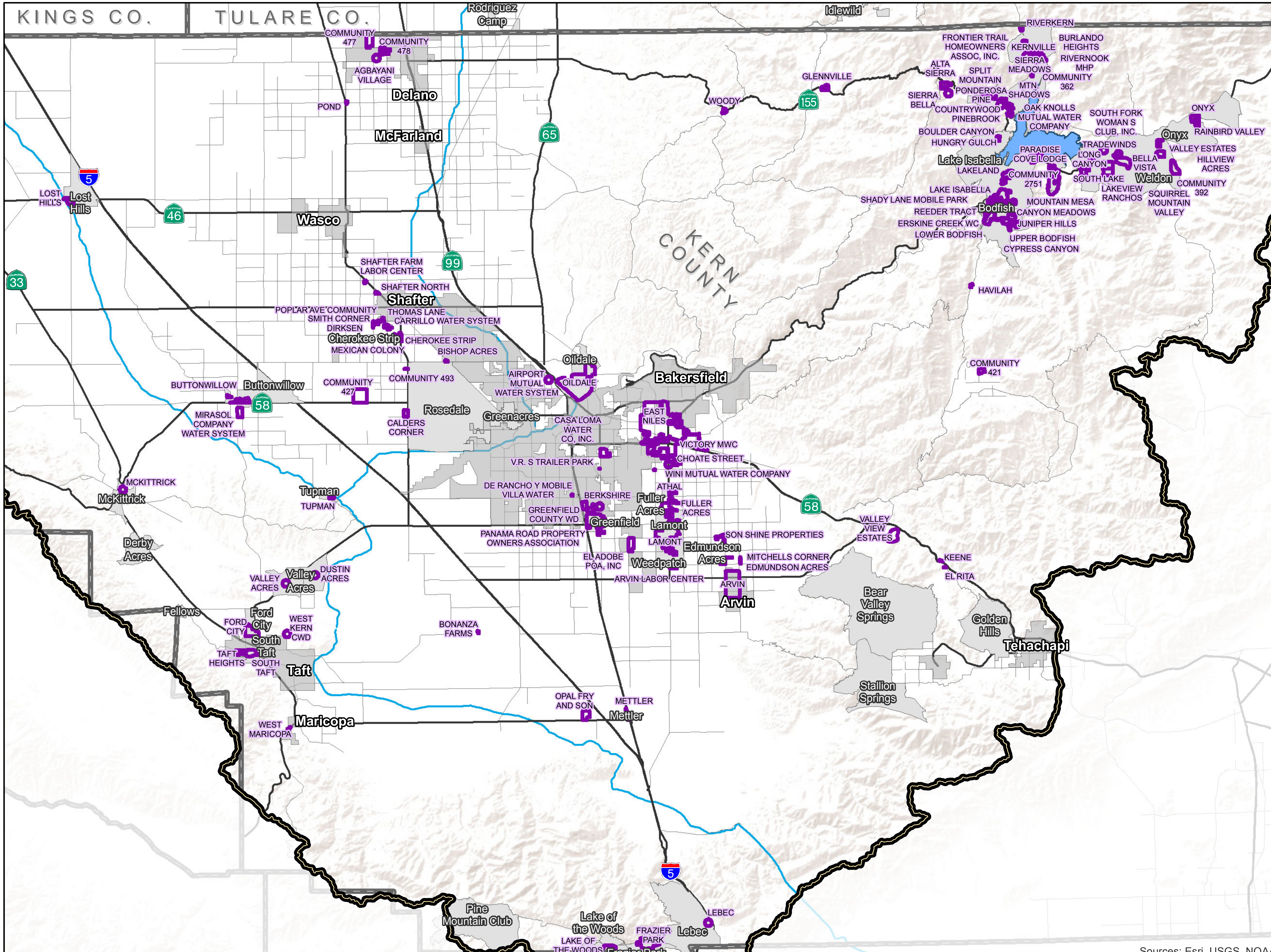
Tulare Lake Basin Disadvantaged Community Water Study

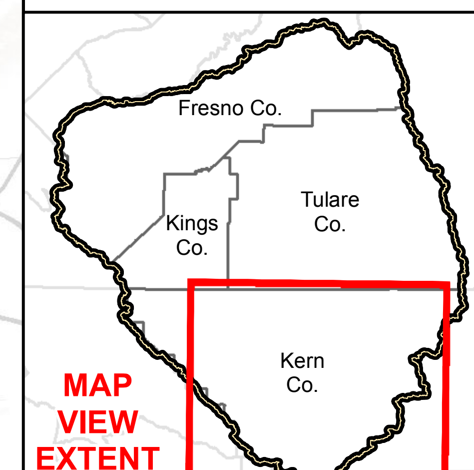
KERN COUNTY
Communities
DAC and SDAC Communities

FIGURE 1-3



Legend

- Tulare Lake Basin
- County
- DAC or SDAC Community
- City
- Community (Non-Incorporated)
- Major Road
- Highway / Interstate
- Major Canal



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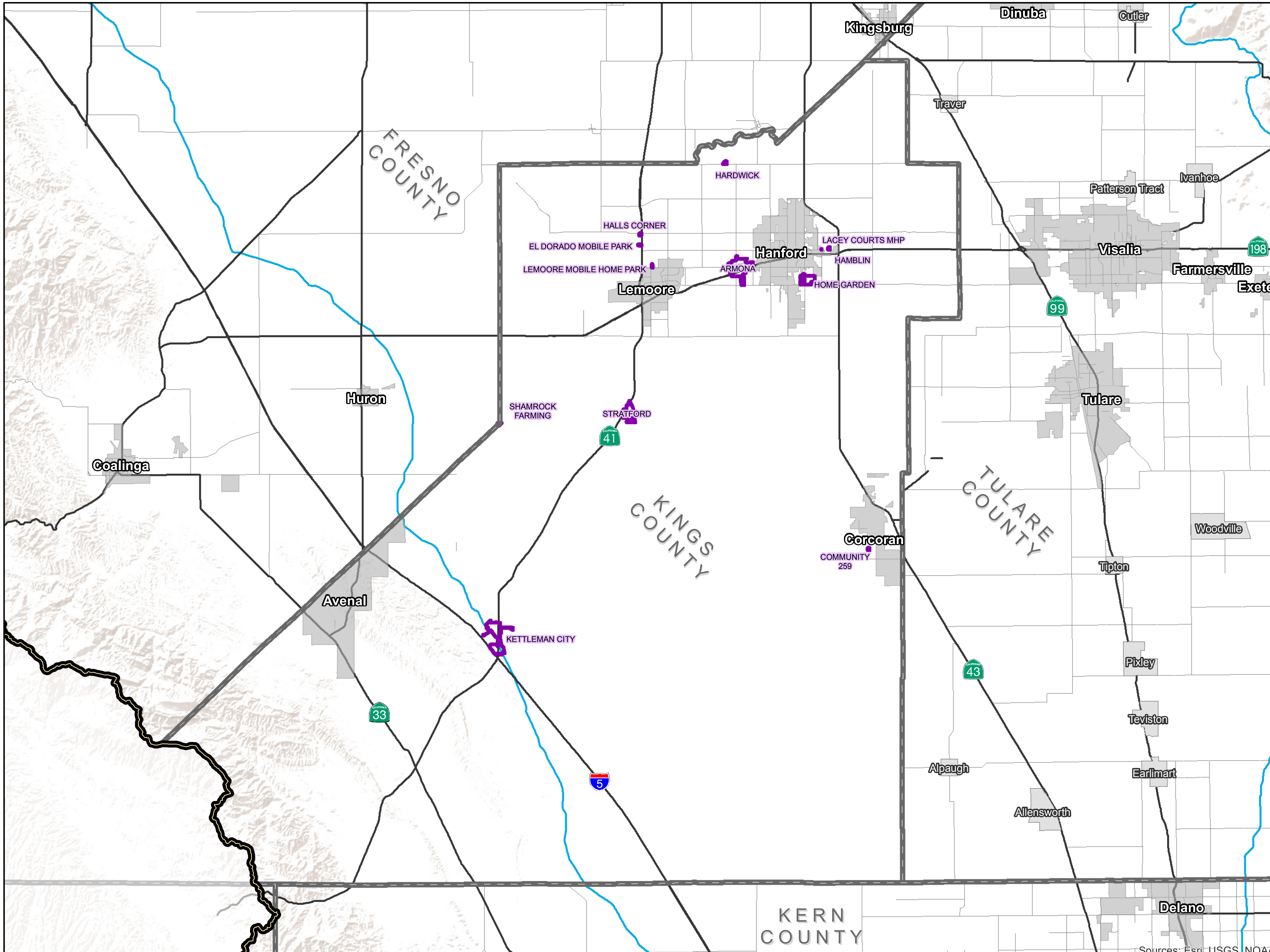


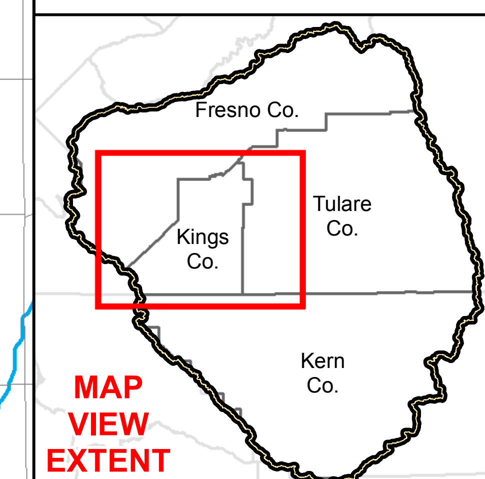
Tulare Lake Basin Disadvantaged Community Water Study

KINGS COUNTY
Communities
DAC and SDAC Communities

FIGURE 1-4

Legend

- Tulare Lake Basin
- County
- DAC or SDAC Community
- City
- Community (Non-Incorporated)
- Major Road
- Highway / Interstate
- Major Canal



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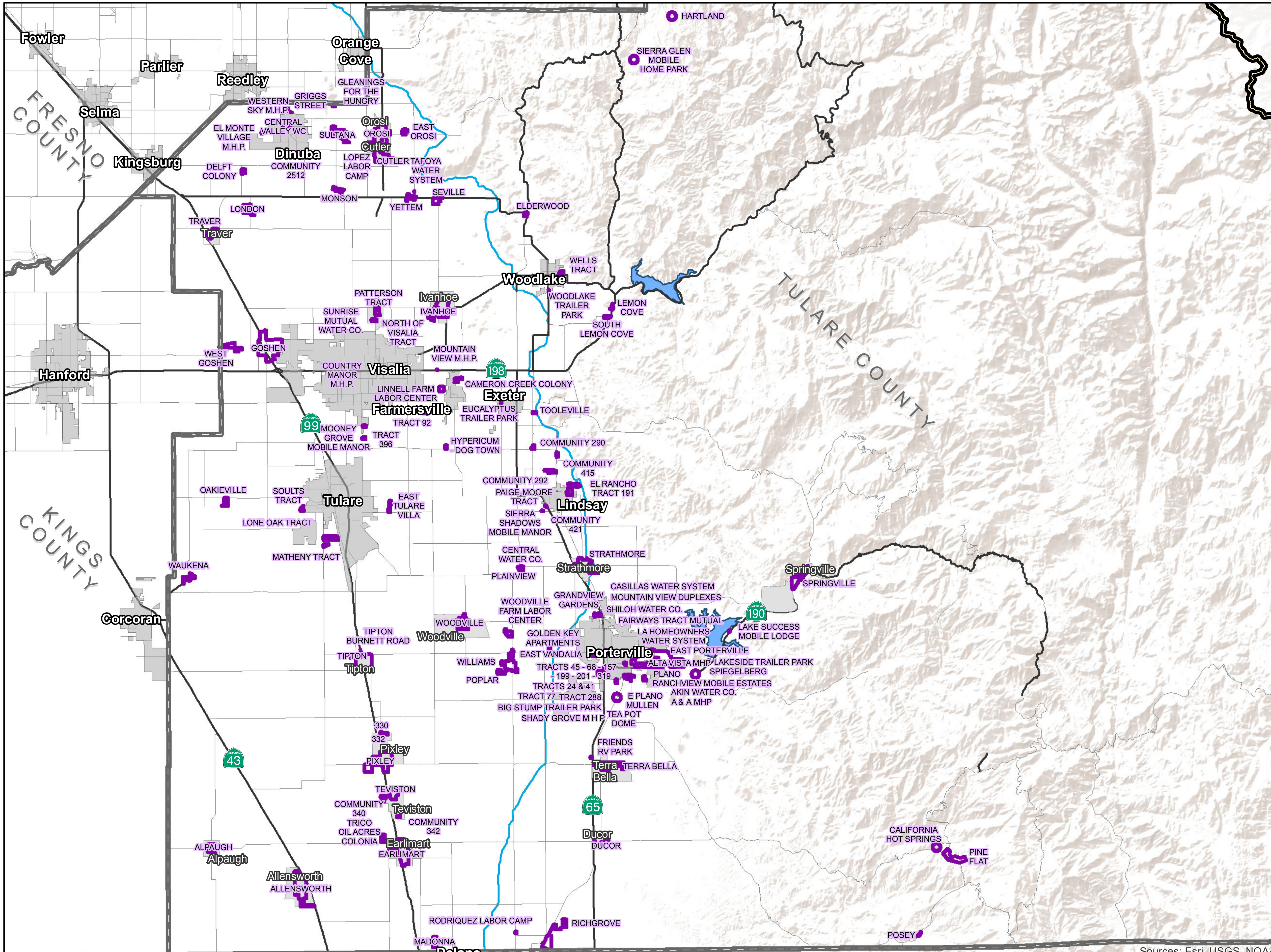
Tulare Lake Basin Disadvantaged Community Water Study

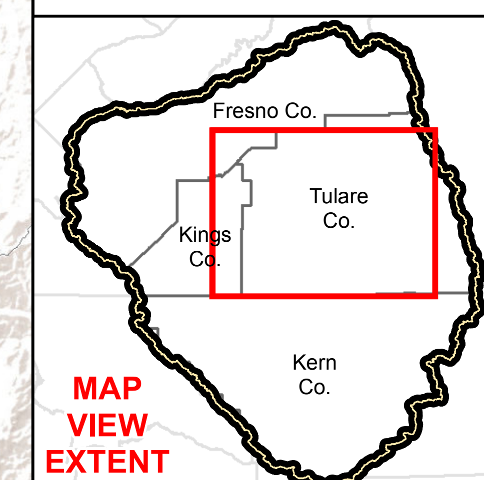
TULARE COUNTY
Communities
DAC and SDAC Communities

FIGURE 1-5



Legend

- Tulare Lake Basin
- County
- DAC or SDAC Community
- City
- Community (Non-Incorporated)
- Major Road
- Highway / Interstate
- Major Canal



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These communities may face a variety of source water issues, including (1) poor water quality, (2) insufficient water supply, and (3) unreliable water system infrastructure. A source water quality issue, as defined in this study, is considered to be more than one primary maximum contaminant level (MCL) exceedance within the three year period from 2008 through 2010. This does not necessarily constitute a formal violation, but is an indication that the system may be in jeopardy of having violations in the future and should be evaluated further. Evaluation of MCL exceedances was used to get a better understanding of where identified issues were present based on geography, community size, and other factors. Exceedance of maximum contaminant levels for arsenic, nitrates, and uranium are common in the Tulare Lake Basin Study Area.

Insufficient water supply, as described in this study, is considered to be a characteristic of a water system with only one (1) active water supply well (e.g., no backup source). Communities with surface water as their single source of supply can also be vulnerable depending on the reliability of the surface water source and of backup systems integrated into the surface water treatment plant.

Additionally, the general depth to groundwater in the Tulare Lake Basin continues to decline, a condition known as overdraft. In 2009, the United States Geological Survey (USGS) performed a comprehensive evaluation of groundwater supplies in the Central Valley (USGS, 2009). The Central Valley was divided into four regions: Sacramento, Delta and Eastside Streams, San Joaquin Basin, and Tulare Basin. The USGS found that the Tulare Basin had the highest rate of groundwater overdraft of any region, and that fifty seven percent of groundwater pumping in the Central Valley occurs in the Tulare Basin. Groundwater storage in the Tulare Basin had declined at a steady rate between 1962 and 2004. The total loss in storage due to un-replenished water stores was estimated to be 68 million acre-feet, which equates to an overdraft of about 1.6 million acre-feet/year.

The impacts of utilizing deeper groundwater, as necessitated by overdraft conditions, may include higher pumping costs and different constituents to be evaluated for treatment prior to distribution as a potable water source. For some communities, particularly those on private wells that are often utilizing more shallow aquifers, water supplies may dry up and require investment in constructing new sources or deepening of wells. These costs may be significant and may leave communities and households without water at all for some extended period if not proactively addressed.

Unreliable water system infrastructure is also a challenge for disadvantaged communities in the Study Area. Many systems have old and failing equipment and pipelines, lack of funds to proactively maintain their system, and lack of redundancy of system components. Systems with such limited reliability are more susceptible to system failures that may lead to emergency situations, where immediate repairs or replacement are necessary in order to deliver safe drinking water to customers.

In addition to the water supply issues faced by DACs in the Study Area, communities may also face issues with their wastewater. Wastewater challenges include reliance on septic systems that may be failing or are potentially contaminating the groundwater, failing or insufficient sewer collection systems, or wastewater treatment systems that are not capable of meeting the limitations set forth in the facility's Waste Discharge Requirements (WDRs).

Many disadvantaged communities with water supply or water quality issues have applied for and received funding for improvements to mitigate these problems. Report to the Legislature, Senate Bill X2 1 (2011), attached in **Appendix C**, provides a list of some recently funded projects in the region. Systems that have received funding for water system capital improvements are usually on their way to resolving their water supply issues. While there are cases where the funded improvements resolve some, but not all of the system's water supply issues, a system with a funded project should be on the path toward the goal of delivering safe, sufficient, and sustainable potable.

1.2 Overview of TLB Study

In order to meet the objectives of the Tulare Lake Basin Disadvantaged Community Water Study, five tasks were performed in accordance with the grant agreement. The tasks performed included:

1. Baseline Data Gathering, Mapping, and Database Creation of Disadvantaged Communities in the Tulare Lake Basin
2. Stakeholder Consultation and Community Outreach
3. Selection of Pilot Projects and Studies to Develop Representative Solutions to Priority Issues
4. Implementation of Pilot Project Stakeholder Process to Develop Studies and Representative Solutions to Priority Issues
5. Preparation of Final Report for submittal to DWR

1.2.1 Database

The County of Tulare and project team developed a database of disadvantaged communities in the Tulare Lake Basin. The project team coordinated with other local, state, and federal agencies as well as appropriate organizations to collect existing data and create the database. The project team utilized Geographic Information Systems (GIS) to map the location of disadvantaged communities in the Tulare Lake Basin and other available and relevant data in order to identify regional challenges and opportunities.

More information about the data gathering and database creation process, as well as ongoing database maintenance, is included in the Tulare Lake Basin Disadvantaged Community Water Study Final Report (Final Report).

1.2.2 Stakeholder Consultation and Community Outreach

An initial task for the TLB Study was to organize a Stakeholder Oversight Advisory Committee (SOAC or Committee). The County of Tulare established a basin-wide Committee comprised of community representatives, as well as regulatory and funding agency representatives and other organizations that work on and are familiar with disadvantaged community water and wastewater needs. The SOAC worked with the project team to identify priority issues, potential pilot projects, and review project recommendations. The details of the SOAC and their purpose, responsibilities, and actions performed are described in the Final Report.

The project team also conducted outreach to community representatives, including residents and local water board members that were the subject of individual pilot studies. These community representatives assisted the project team in confirming the viability of the alternatives presented, and helped inform the development of a roadmap, referred to as “decision trees”, for each of the pilot studies. The decision trees are sets of flow charts that are intended to help guide a community toward an appropriate solution, depending on its unique set of challenges and circumstances.

In order to ensure that each pilot study was developed with input from stakeholders, a separate Pilot Project Stakeholder Advisory Group (PPSAG or PSAG) was convened for each of the four pilot studies. Each group was comprised of members of impacted communities, regulatory and funding agencies, local water or wastewater providers, and other agencies and organizations as appropriate, in order to provide input and recommendations to the project team.

1.2.3 Selection of Pilot Studies

In consultation with the SOAC, the project team utilized the database to identify common problems associated with providing safe, reliable water and wastewater services to disadvantaged communities. Using this list of common problems, the project team worked with the SOAC to identify priority issues facing disadvantaged communities in the Tulare Lake Basin. Five (5) priority issues were identified through the SOAC, including:

1. Lack of funding to offset increasingly expensive operations and maintenance costs in large part due to lack of economy of scale;
2. Lack of technical, managerial, and financial (TMF) capacity by water and wastewater providers;

3. Poor water quality;
4. Inadequate or unaffordable funding or funding constraints to make improvements; and
5. Lack of informed, empowered, or engaged residents.

The SOAC approved a final roster of four (4) representative pilot studies to address the identified priority issues, as the culmination of several SOAC meetings that took place from October 2011 through July 2012. The four pilot studies developed through the SOAC to be further evaluated included:

1. Management and Non-Infrastructure Solutions to Reduce Costs and Improve Efficiency;
2. Technical Solutions to Improve Efficiency and Reduce Operation & Maintenance;
3. New Source Development; and
4. Individual Household Solutions.

1.2.4 Implementation of Pilot Studies

The project team further developed and evaluated the potential solutions recommended under each of the four (4) pilot studies identified. Recommendations and roadmaps for each pilot study were developed in consultation with the Pilot Project Stakeholder Advisory Groups as well as pilot specific Community Review groups.

The Final Report and each of the pilot studies reflect comments and information received as a result of outreach to various federal, state, and local agencies as well as community stakeholders, including representatives of disadvantaged communities. The four pilot studies are not mutually exclusive. Communities pursuing improvement in a specific pilot study topic will likely utilize information prepared in one or more of the other pilot studies. Each of the four pilot studies is included as an attachment to the Final Report. The pilot study that is the focus of this report is the Technical Solutions pilot.

1.2.5 Final Report

The Tulare Lake Basin Disadvantaged Community Water Study Final Report provides a complete discussion of all the tasks performed as a part of the TLB Study. The four pilot studies are appended to the Final Report and summarized within the Final Report. Based on the findings of the TLB Study and each of the pilot studies, the Final Report also provides several conclusions and recommendations to the State Legislature.

1.3 Scope of Pilot

The Technical Solutions pilot study is one of four pilot studies that are part of the Tulare Lake Basin Disadvantaged Community Water Study. This pilot study focuses exclusively on technical solutions to improve efficiency and reduce operation and maintenance of water and wastewater systems in order to bring these systems into compliance with applicable regulations. A greater emphasis has been placed on drinking water issues than on wastewater issues for this pilot study because the number of DACs with drinking water systems is much greater than the number of DACs with wastewater systems. Many DACs in the study area utilize single house septic systems and leachfields for wastewater treatment disposal which is discussed in the Individual Household Solutions pilot study. Most DACs in the Study Area are served by a community drinking water system.

Generally, technical solutions are a “last resort” for the DACs because they involve construction of various expensive facilities, including treatment plants, and require ongoing operations and maintenance costs that almost always exceed those associated with non-technical solutions. Usually the best strategy to keep costs low for a community is to first consider “non-technical, non-structural, non-physical” solutions or a new “source” before considering the technical solutions outlined in this pilot study meaning physical improvements to a system should be the last option considered. This is due to the fact that when treatment must be considered it has higher continuous operating and maintenance costs that other solutions may avoid or minimize. Management solutions, new sources and individual household point-of-use (POU) / point-of-entry (POE) water treatment devices are considered in the other three pilot studies.

Technical solutions considered in this pilot study include:

- Drinking water treatment as required to meet Federal Environmental Protection Agency (EPA) and California Department of Public Health (CDPH) drinking water standards and regulations. The study considers conventional, established water treatment technologies as well as developing technologies. The study focuses on treatment technologies applicable to the most common drinking water contaminants present in the Tulare Lake Basin and on lower cost systems appropriate to the community water systems.
- Wastewater treatment technologies as required to meet Regional Water Quality Control Board (RWQCB) waste discharge requirements (WDRs). The focus for these solutions is on the use of technology that provides cost-effective wastewater treatment and reliable compliance with WDRs. A collection system and wastewater treatment facility may be needed for DACs with household septic systems.
- Blending of a poorer quality water source with better quality water or treated water to meet drinking water standards.

- Water and energy use efficiency. Use of water and energy efficiently will lower system operating costs to the consumers. This solution may include the installation of water meters, utilization of renewable energy such as solar and bio-methane as well as retrofits to install more energy efficient pumps, electric motors and aeration systems.
- Joint or regional residuals management. The technical feasibility of treatment systems is often dependent on the ability to safely and cost-effectively dispose of residuals, including sludge, concentrate, brine and spent media from treatment processes. The cost of residuals disposal/regeneration/treatment can be a large fraction of the cost of treatment. The ability to handle residuals at a low cost is a key to the on-going success of a treatment system.
- Dual water distribution. Generally, water suppliers distribute water to customers through a pipe distribution system. The same water is used potable and non-potable uses. Drinking water must meet the highest standards and therefore all water must meet the highest standard at the water service connection. With a dual water distribution system, water can be delivered for non-potable uses, typically irrigation or fire flow that does not meet drinking water standards. The non-potable system can be used to supply water for firefighting purposes. This can allow for a smaller capacity potable water system since the system would not need to supply over 1000 gpm for a several hour period to meet fire flow requirements. The use of a contaminated well or recycled wastewater for outside irrigation can reduce the volume of water to be treated and thus lower water cost. This is offset by the cost of a second distribution system and the required management and skill level to operate and maintain a dual system.
- Developing technologies. There are some developing technologies that address the shortfalls of conventional treatment technology, especially with respect to residuals management and disposal. Some of the newer technologies are able to treat multiple contaminants with a single treatment system. Biological denitrification for removal of nitrates in water is one such developing technology that may work well in the Tulare Lake Basin.
- Decision trees. For the treatment solutions described in this report, decision trees have been included in **Appendix E**. The decision trees were developed in order to help guide communities through some of the major steps and decisions that would need to be evaluated.

The selection of appropriate technical solutions requires site specific engineering analysis. One major factor with respect to treatment process selection is the unique water chemistry of each water supply. Just because a treatment system works well at one location does not necessarily mean it will work well in a different location, even within the same community. Other factors to be considered include the size/capacity of the system, number of water sources, water use patterns, existing water infrastructure in place, land availability, and many others.

It is the intent of this pilot study to focus primarily on technical solutions applicable to the Tulare Lake Basin and the contaminants most often occurring in the water supply. Thus, with respect to water treatment, the study focuses foremost on nitrate, arsenic and trihalomethane (THM) maximum contaminant level (MCL) exceedances and Total Coliform Rule violations. Other contaminants present in the TLB that exceed their respective MCLs include uranium, fluoride, perchlorate, dibromochloropropane (DBCP) and polychlorinated biphenyls (PCB). Most water supplied to disadvantaged communities in the TLB is groundwater and thus this study focuses more on groundwater than surface water supply. All communities in the study area that utilize surface water have treatment systems that include coagulation, filtration and disinfection. A major water quality issue for surface water treatment systems is the formation of disinfection by-products (DBPs), including THMs, largely because chlorine, used for disinfection and oxidation, reacts with natural organic matter (NOM) in the raw water.

2 BACKGROUND

2.1 Regulatory Setting

2.1.1 Drinking Water Regulations

The Safe Drinking Water Act was originally passed by Congress in 1974 and amended in 1986 and 1996, to protect public health by regulating the nation's public drinking water supply. The Safe Drinking Water Act affects every public water system (PWS) in the United States. It is noted that any supplier delivering water for human consumption to less than 15 service connections or less than 25 regularly served persons is not considered to be a PWS, as defined by the Safe Drinking Water Act. The key provisions of the Safe Drinking Water Act are the National Primary Drinking Water Regulations, which are national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants that may be found in drinking water. Early on, the Safe Drinking Water Act primarily focused on treatment as a means of protecting drinking water, but in 1996 the Act was amended to include source water protection, operator training, funding for water system improvements, and public information as important components of protection.

Compliance with the Safe Drinking Water Act at the federal and state levels requires public water systems, regardless of size, to have (1) adequate and reliable sources of water that either are or can be made safe for human consumption; and (2) the financial resources and technical ability to provide services effectively, reliably, and safely for workers, customers, and the environment. Small public water systems must meet the same requirements as larger utilities, but with fewer financial resources available to them due to their smaller customer base. The ability of users to cover system costs is further reduced in disadvantaged communities where household incomes are less, resulting in increased challenges to meet their financial responsibility. Federal and state programs do provide these small public water systems with extra assistance, such as training and technical assistance, but operational subsidies are almost nonexistent and many small and disadvantaged community water systems continue to struggle to remain in compliance.

A public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents is considered by CDPH as a Community Water System (CWS), and is regulated either by CDPH or the Local Primacy Agency (LPA). The EPA has designated CDPH as the Primacy Agency responsible for the administration and enforcement of the Safe Drinking Water Act (SDWA) requirements in California. CDPH has adopted statutes and regulations to implement the requirements of the SDWA. CDPH has regulatory responsibility over water systems including tasks such as issuance of operating permits, conducting inspections, monitoring for compliance with regulations and taking enforcement action to compel compliance when violations are identified.

CDPH has delegated the drinking water program regulatory authority for small public water systems serving less than 200 service connections to 31 counties in California.

The delegated counties (Local Primacy Agencies or LPAs) are responsible for regulating approximately 5,500 small public water systems statewide. CDPH retains the regulatory authority over water systems serving 200 or more service connections and any small water systems not delegated to an LPA.

Kings County is the Local Primacy Agency under the California Department of Public Health in monitoring compliance for and in enforcing EPA's Safe Drinking Water Act in that county. Communities in Kings County with less than 200 connections are therefore monitored by the Kings County Department of Public, Environmental Health Services.

Tulare County has been the LPA responsible for regulating small public water systems in that county. However, as of July 1, 2014 Tulare County relinquished Local Primacy to CDPH, and will no longer serve as the LPA for that county.

In Fresno and Kern Counties, CDPH maintains responsibility for regulating small public water systems.

2.1.2 Wastewater Regulations

The State Water Resources Control Board (SWRCB) was created by the Legislature in 1967, with the goal of ensuring the highest reasonable quality of waters of the State. The SWRCB allocates water rights, adjudicates water rights disputes, develops statewide water protection plans, establishes water quality standards, and guides the Regional Water Quality Control Boards (RWQCB or Regional Boards) located in the major watersheds of the State. There are nine (9) RWQCBs under the SWRCB. The RWQCBs develop and enforce water quality objectives and implementation plans to protect the beneficial uses of the State's waters, recognizing local differences in climate, topography, geology, and hydrology. The Regional Boards develop "Basin Plans" for their hydrologic areas, issue waste discharge permits for wastewater treatment facilities, take enforcement action against violators, and monitor water quality.

Together with the Regional Boards, the SWRCB is authorized to implement the Federal Water Pollution Control Act (Clean Water Act) in California. The objective of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands. The Clean Water Act gives the EPA the authority to set effluent limits to ensure protection of the receiving water. Pollutants regulated under the Clean Water Act include priority pollutants, conventional pollutants such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH, and non-conventional pollutants including any pollutants not identified as either conventional or priority.

2.1.3 Changes to the Regulatory Setting

As of July 1, 2014, the drinking water division of CDPH is operated under the SWRCB.

The California Environmental Protection Agency and the California Health and Human Services Agency held a public meeting on January 15, 2014 to obtain input on the proposed transfer of the Drinking Water Program from the California Department of Public Health to the State Water Resources Control Board.

The Drinking Water Reorganization Transition Plan was developed in March 2014, to describe the proposed transfer that is effective as of July 1, 2014. http://www.swrcb.ca.gov/drinkingwater/docs/transition_plan_fullversion.pdf

According to the Transition Plan, The Administration's goal in transferring the Drinking Water Program is to align the state's water quality programs in an organizational structure that:

1. Consolidates all water quality regulation throughout the hydrologic cycle to protect public health and promote comprehensive water quality protection for drinking water, irrigation, industrial, and other beneficial uses;
2. Maximizes the efficiency and effectiveness of drinking water, groundwater, and water quality programs by organizing them in a single agency whose primary mission is to protect water quality for beneficial uses including the protection and preservation of public and environmental health;
3. Continues focused attention on providing technical and financial assistance to small, disadvantaged communities to address their drinking water needs;
4. Consolidates financial assistance programs into a single state agency that is focused on protecting and restoring California water quality, protecting public health, and supporting communities in meeting their water infrastructure needs;
5. Establishes a one-stop agency for financing water quality and supply infrastructure projects;
6. Enhances water recycling, a state goal, through integrated water quality management; and
7. Promotes a comprehensive approach to communities' strategies for drinking water, wastewater, water recycling, pollution prevention, desalination, and storm water.

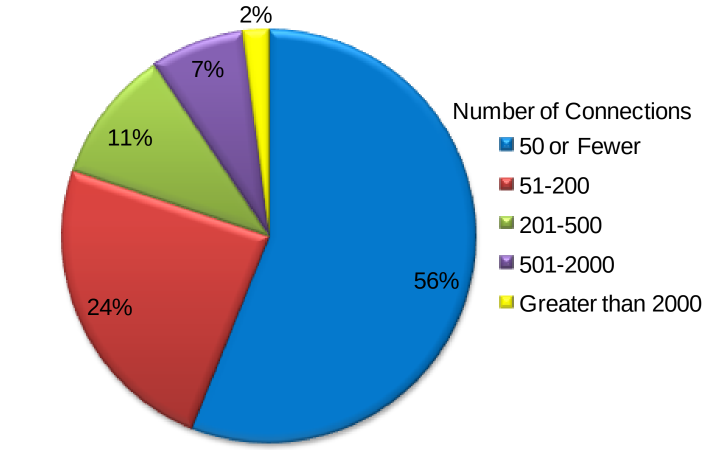
The Drinking Water Program is responsible for enforcing the federal and state Safe Drinking Water Acts. The main responsibilities are to: (1) issue permits to drinking water systems, (2) inspect water systems, (3) monitor drinking water quality, (4) set and enforce drinking water standards and requirements, and (5) award infrastructure loans and grants.

Under the proposed transfer, Drinking Water Program regulatory staff would be organized under a new ***Division of Drinking Water*** within the State Water Board. Headquarters staff for the Division would be relocated to the CalEPA building with other State Water Board staff. The remainder of the staff would continue to be locally-based in district offices and would continue their close working relationships with water system personnel and other interested community groups.

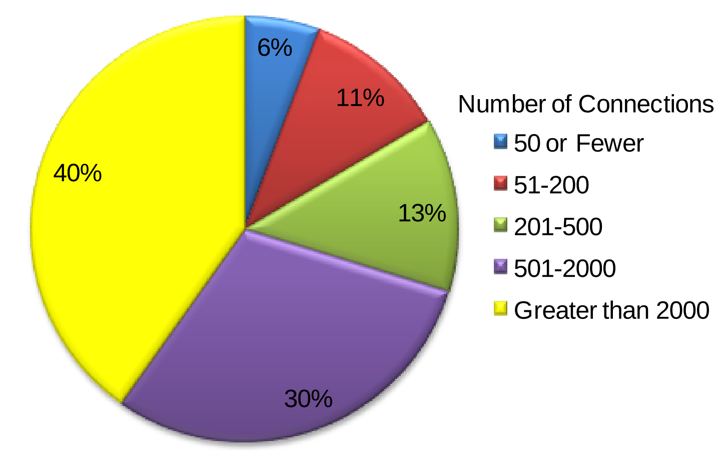
Federal law requires a single agency at the state level to carry out the federal Public Water System Supervision Program implementing the Safe Drinking Water Act. The Department of Public Health currently has been granted primacy for implementing the federal program. The Administration will work with U.S. EPA to ensure that the transfer of primacy from the Department of Public Health to the State Water Board occurs simultaneously with the transfer of the Drinking Water Division.

2.2 Summary of Database Findings

There are approximately 353 disadvantaged communities (DACs) within the Tulare Lake Basin Study Area. Of these 353 DACs, approximately 201 are severely disadvantaged communities (SDACs). The water and sewer systems in these unincorporated communities throughout the Tulare Lake Basin vary in size, from those with individual water wells and onsite septic systems, to community systems serving more than 2,000 connections. The majority (80%) of the communities range in size from less than 15 connections to 200 connections, although a large percentage (83%) of the overall population lives in communities with greater than 200 connections. The number of connections as discussed in this pilot study is generally based on water system connections.



Disadvantaged Communities in the Tulare Lake Basin Number of Communities by Size



Disadvantaged Communities in the Tulare Lake Basin Population by Community Size

Many water systems serving these DACs face challenges related to the quality of their water and/or the number of supply sources available. The water quality primary constituent MCL exceedances reported in these communities include coliform bacteria, arsenic, nitrate, uranium, fluoride, dibromochloropropane (DBCP), perchlorate, polychlorinated biphenyls (PCB), and disinfection by-products such as trihalomethanes. Based on the database information collected and analyzed, arsenic, nitrate, and uranium are the contaminants of greatest concern in the region since those constituents had the greatest number of exceedances reported. Coliform exceedances are also common, but coliform is readily treatable as discussed and documented in the Technical Solutions pilot study.

There are approximately 218 DACs with water systems in the Study Area. Approximately 89 out of the DACs with water systems in the Study Area reported at least two water quality exceedances between 2008 and 2010. An exceedance of an MCL does not always constitute a violation, but does indicate a potential issue. A breakdown of the water quality exceedances by contaminant is presented in the Technical Solutions pilot study.

Limited reliable water supply is also a concern within the region, since many communities only have a single source of water supply, usually from groundwater. Based on the database information available, approximately 96 out of the 353 DACs in the Study Area have a single supply source. Communities that rely on a single water source are especially vulnerable to drought and other water supply challenges, as well as changes in water quality. An entire community can go from having safe drinking water to not having access to safe water or not having water at all with the failure of a single source.

The communities with the various water supply and quality issues are illustrated on the maps shown as **Figure 2-1** through **Figure 2-4**. As noted, these systems are not all in violation of water quality standards. A list of compliance orders for the Fresno, Visalia and Tehachapi Districts of CDPH are presented in **Appendix D**.

The database is a collection of information from PolicyLink, CDPH, Self-Help Enterprises, County of Fresno, and County of Tulare, as well as other sources. The database has been reviewed to evaluate the water quality and supply source issues as well as wastewater treatment and disposal issues within the Study Area. More specifics of the database and how it was developed are found in the Tulare Lake Basin Disadvantaged Community Water Study Final Report. The database will continue to be maintained and updated by the County of Tulare after completion of this Study.

The database includes the best available data, but it is not a complete and comprehensive database of all water supply systems in the Study Area, and as such should be considered a work in progress for future updating. It is likely that there are communities and/or systems with water quality problems that have not been specifically identified because water quality data was limited or not available. Very small water systems (15 connections and less) are likely to have the most limited data available, and data for households with individual wells was not available. Their problem types, however, will likely fall within the family of problems identified to exist for other communities in the database. Very small water systems and individual household systems are discussed in the Individual Households pilot study.

There are also some emerging contaminants of concern that are discussed in this pilot study. The emerging contaminants of most imminent concern are Hexavalent Chromium (Chrome-6) and 1,2,3-Trichloropropane (TCP). CDPH developed a maximum contaminant level (MCL) for Chrome-6 of 10 parts per billion (ppb), which became effective on July 1, 2014. CDPH has also developed a public health goal for TCP and is in the process of developing an MCL. It is anticipated that many of the DACs within the

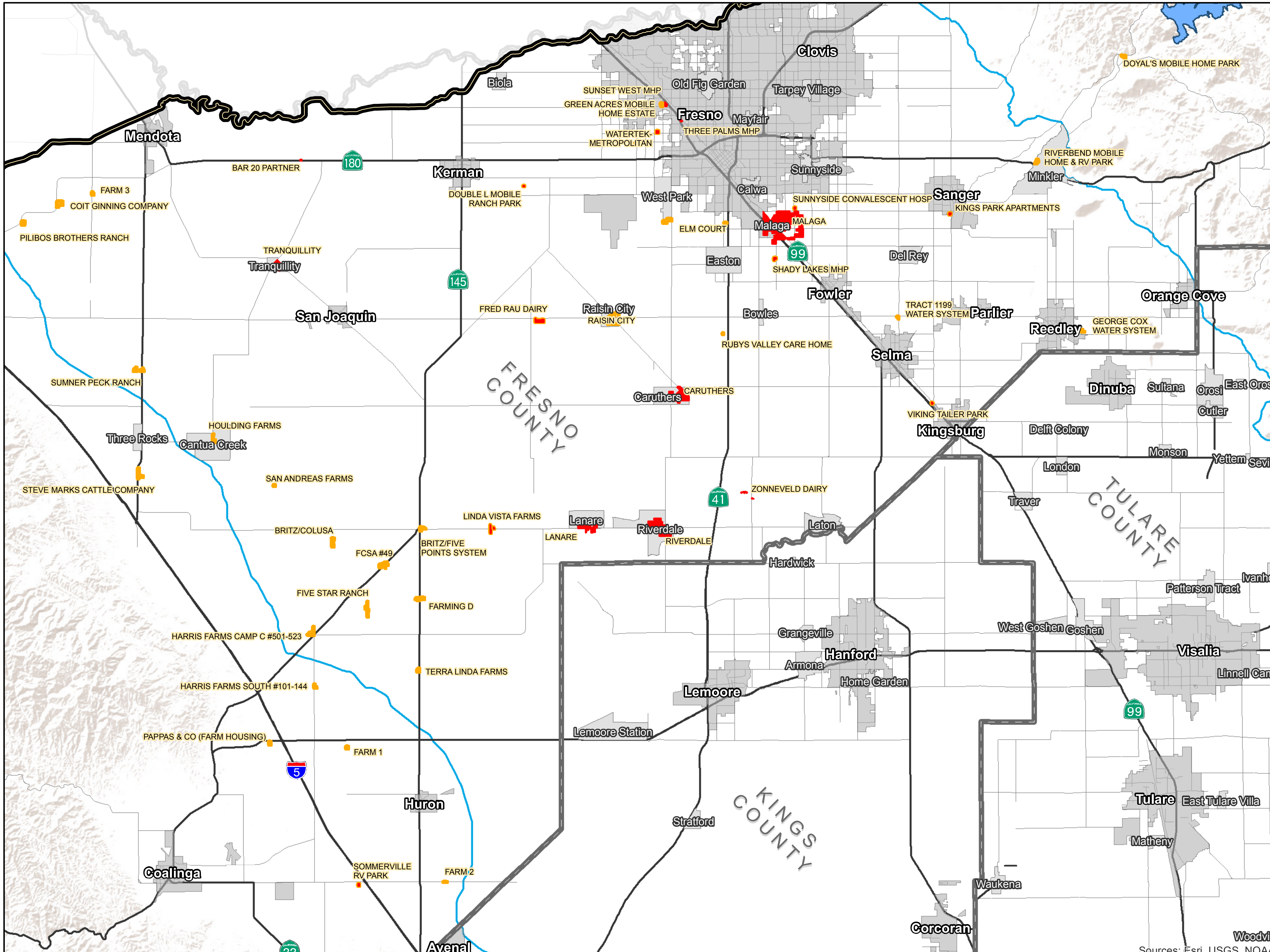
Tulare Lake Basin will be impacted by implementation of MCLs for Chrome-6 and TCP, and they could be expensive contaminants to mitigate.

The Tulare Lake Basin has been the subject of several other studies in recent years that are referenced in the TLB Study. The “Kings Basin Water Authority Disadvantaged Community Pilot Project Study” (KBWA Study) was commissioned to study the Kings Basin area, which overlaps much of the Tulare Lake Basin Study Area. The KBWA Study area included most of Fresno County, and portions of Kings and Tulare Counties. The Kings Basin Water Authority contracted with Provost & Pritchard to conduct the KBWA Study. The State Water Resources Control Board commissioned the preparation of the report entitled “Addressing Nitrate in California’s Drinking Water”. The University of California was contracted to prepare the report with a focus on nitrates in the groundwater of the Tulare Lake Basin and a portion of Salinas Valley. The State Water Resources Control Board also administer a report entitled “Communities that Rely on Contaminated Groundwater”, in response to Assembly Bill 2222.

Tulare Lake Basin Disadvantaged Community Water Study

FRESNO COUNTY
Communities
DAC and SDAC Communities
With A Single Active Water Source
Or *Water Quality Issues

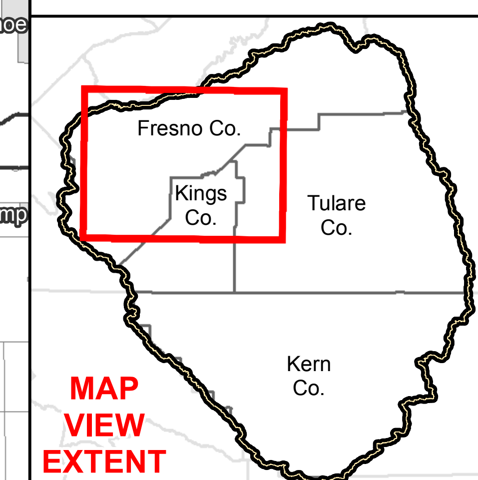
FIGURE 2-1



Legend

- Tulare Lake Basin
- County
- *Source Exceeded MCL for either Arsenic, Uranium, Nitrate or Half Nitrate (2008-10)
- 1 Active Water Source Identified
- City
- Community (Non-Incorporated)
- Major Road
- Highway / Interstate
- Major Canal

*Source exceeded MCL in one or more samples collected from 2008-2010. Source status is AU (Active Untreated), CU (Combined Untreated), AT (Active Treated), or CT (Combined Treated). Considered as delivered water. Communities with raw water samples that exceeded MCL are shown if no samples exist for the source codes listed above.



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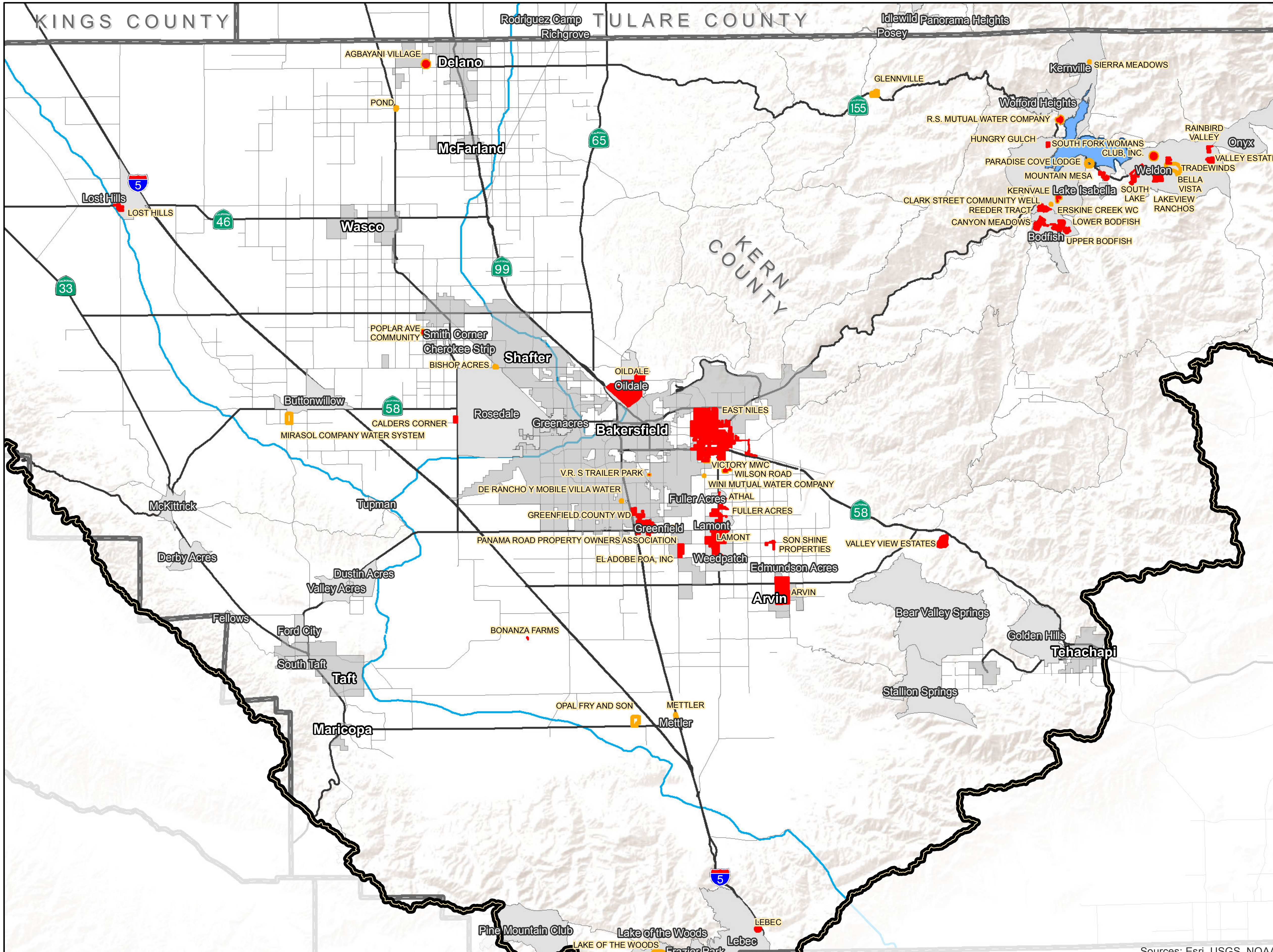


Tulare Lake Basin Disadvantaged Community Water Study

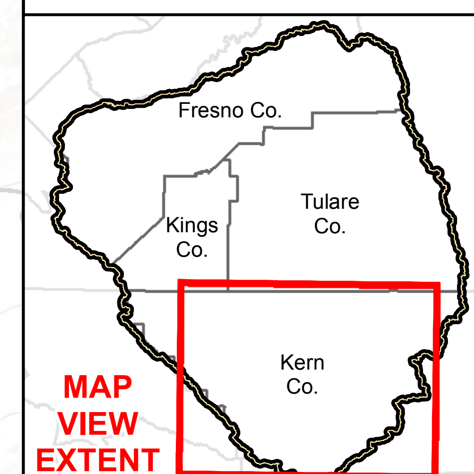
KERN COUNTY
Communities
DAC and SDAC Communities
With A Single Active Water Source
Or *Water Quality Issues

FIGURE 2-2

Legend

- Tulare Lake Basin
- County
- *Source Exceeded MCL for either Arsenic, Uranium, Nitrate or Half Nitrate (2008-10)
- 1 Active Water Source Identified
- City
- Community (Non-Incorporated)
- Major Road
- Highway / Interstate
- Major Canal

*Source exceeded MCL in one or more samples collected from 2008-2010. Source status is AU (Active Untreated), CU (Combined Untreated), AT (Active Treated), or CT (Combined Treated). Considered as delivered water. Communities with raw water samples that exceeded MCL are shown if no samples exist for the source codes listed above.



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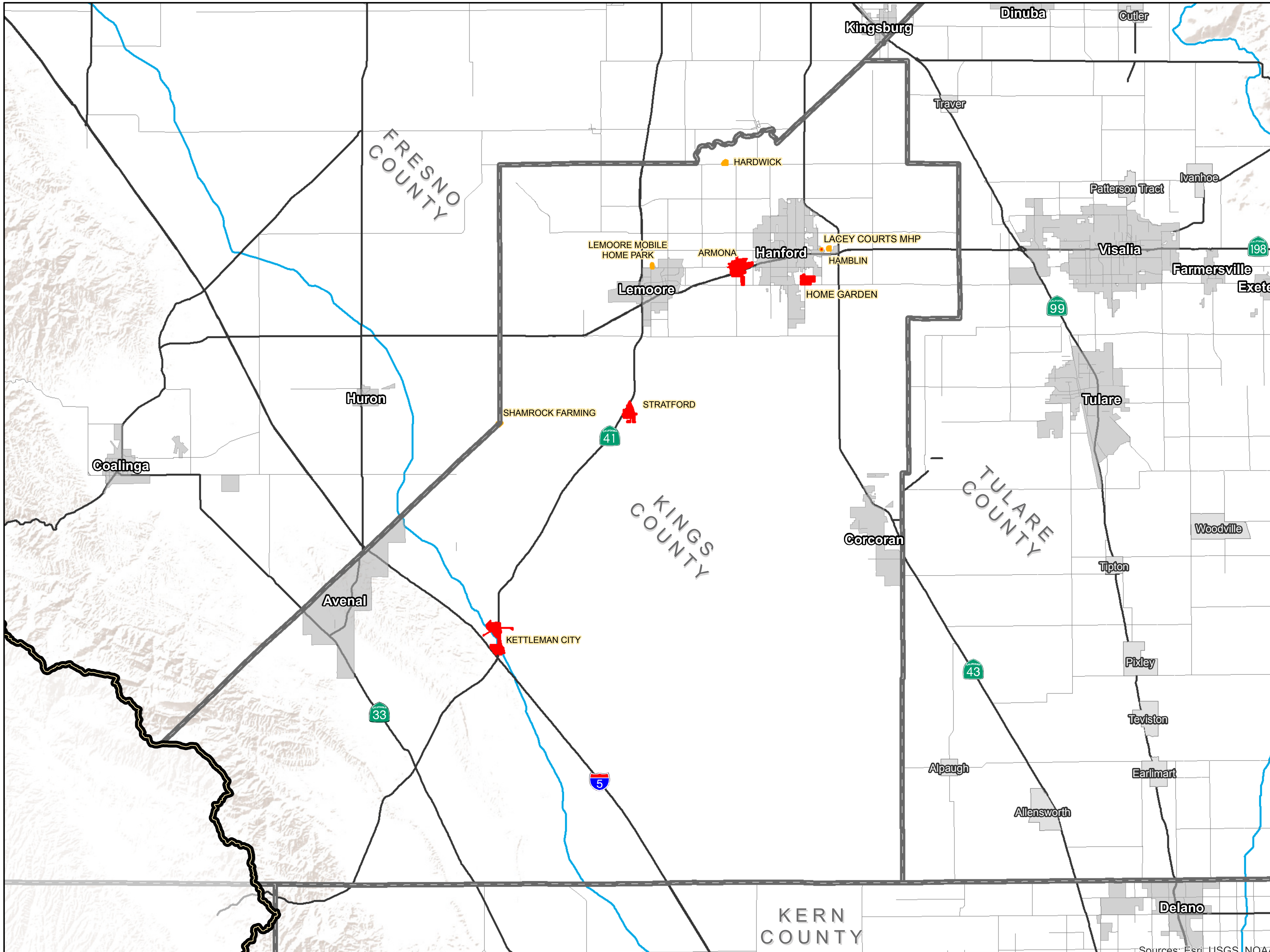


Tulare Lake Basin Disadvantaged Community Water Study

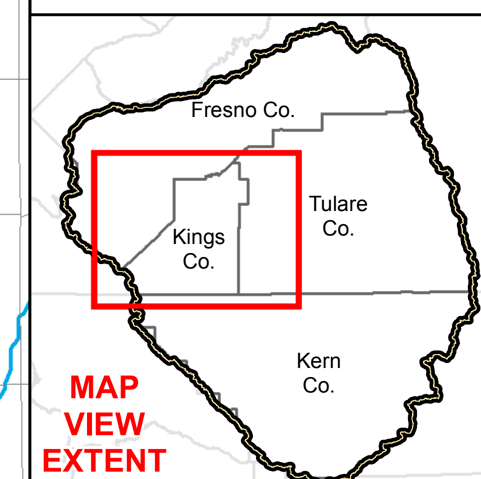
KINGS COUNTY
Communities
DAC and SDAC Communities
With A Single Active Water Source
Or *Water Quality Issues

FIGURE 2-3

Legend

- Tulare Lake Basin
- County
- *Source Exceeded MCL for either Arsenic, Uranium, Nitrate or Half Nitrate (2008-10)
- 1 Active Water Source Identified
- City
- Community (Non-Incorporated)
- Major Road
- Highway / Interstate
- Major Canal

*Source exceeded MCL in one or more samples collected from 2008-2010. Source status is AU (Active Untreated), CU (Combined Untreated), AT (Active Treated), or CT (Combined Treated). Considered as delivered water. Communities with raw water samples that exceeded MCL are shown if no samples exist for the source codes listed above.



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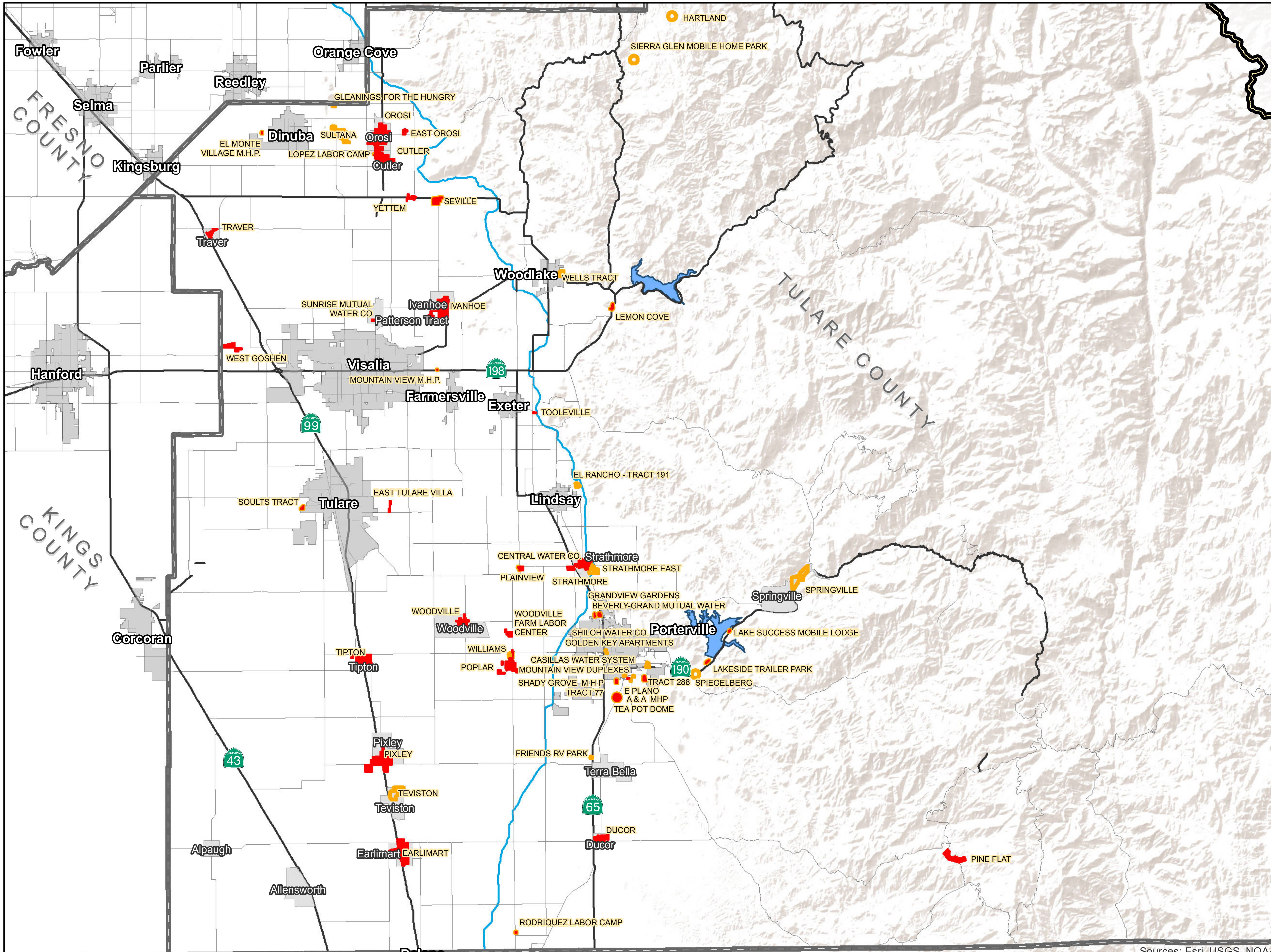
CONSULTING GROUP
An Employee Owned Company
286 W. Cromwell Ave.
Fresno, CA 93711-6162
(559) 449-2700



Tulare Lake Basin Disadvantaged Community Water Study

TULARE COUNTY

Communities

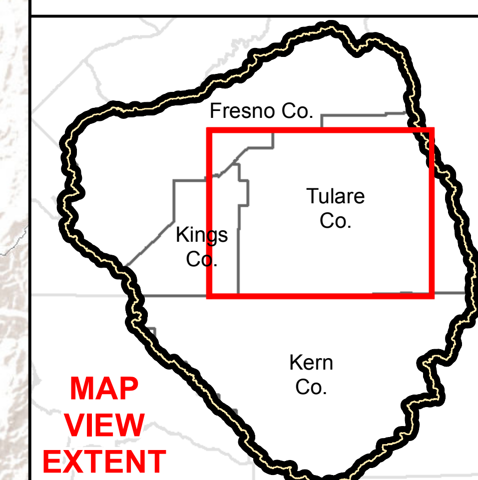
DAC and SDAC Communities
With A Single Active Water Source
Or *Water Quality Issues

FIGURE 2-4

Legend

- Tulare Lake Basin
- County
- *Source Exceeded MCL for either Arsenic, Uranium, Nitrate or Half Nitrate (2008-10)
- 1 Active Water Source Identified
- City
- Community (Non-Incorporated)
- Major Road
- Highway / Interstate
- Major Canal

*Source exceeded MCL in one or more samples collected from 2008-2010. Source status is AU (Active Untreated), CU (Combined Untreated), AT (Active Treated), or CT (Combined Treated). Considered as delivered water. Communities with raw water samples that exceeded MCL are shown if no samples exist for the source codes listed above.



MAP VIEW EXTENT

0 2 4 6 Miles

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Fresno, CA 93711-6162
(559) 449-2700

2.3 Definitions

2.3.1 Definition of Water Systems

The following are definitions from Title 22 California Code of Regulations, related to various categories of water systems. The emphasis of this study is on small water systems, state small water systems, and community water systems. Non-community water systems, non-transient non-community water systems, and transient non-community water systems do exist within the Study Area, but are not a focus of this pilot study. A decision tree, published by the California Department of Public Health, illustrating the classification of water systems as defined below, is presented in Figure 2-5. The decision tree provides a visual depiction of the terms defined herein.

Constructed Conveyances: Any manmade conduit such as ditches, culverts, waterways, flumes, mine drains or canals.

Community Water System (CWS): A public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents of the area served by the system.

Non-Community Water System (NCWS): A public water system that is not a community water system. A NCWS can serve either a transient or a non-transient population (see *Non-Transient Non-Community Water System* and *Transient Non-Community Water System*)

Non-Transient Non-Community Water System (NTNC): A public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year. This may include local schools or hospitals with their own water system.

Public Water System (PWS): A system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year.

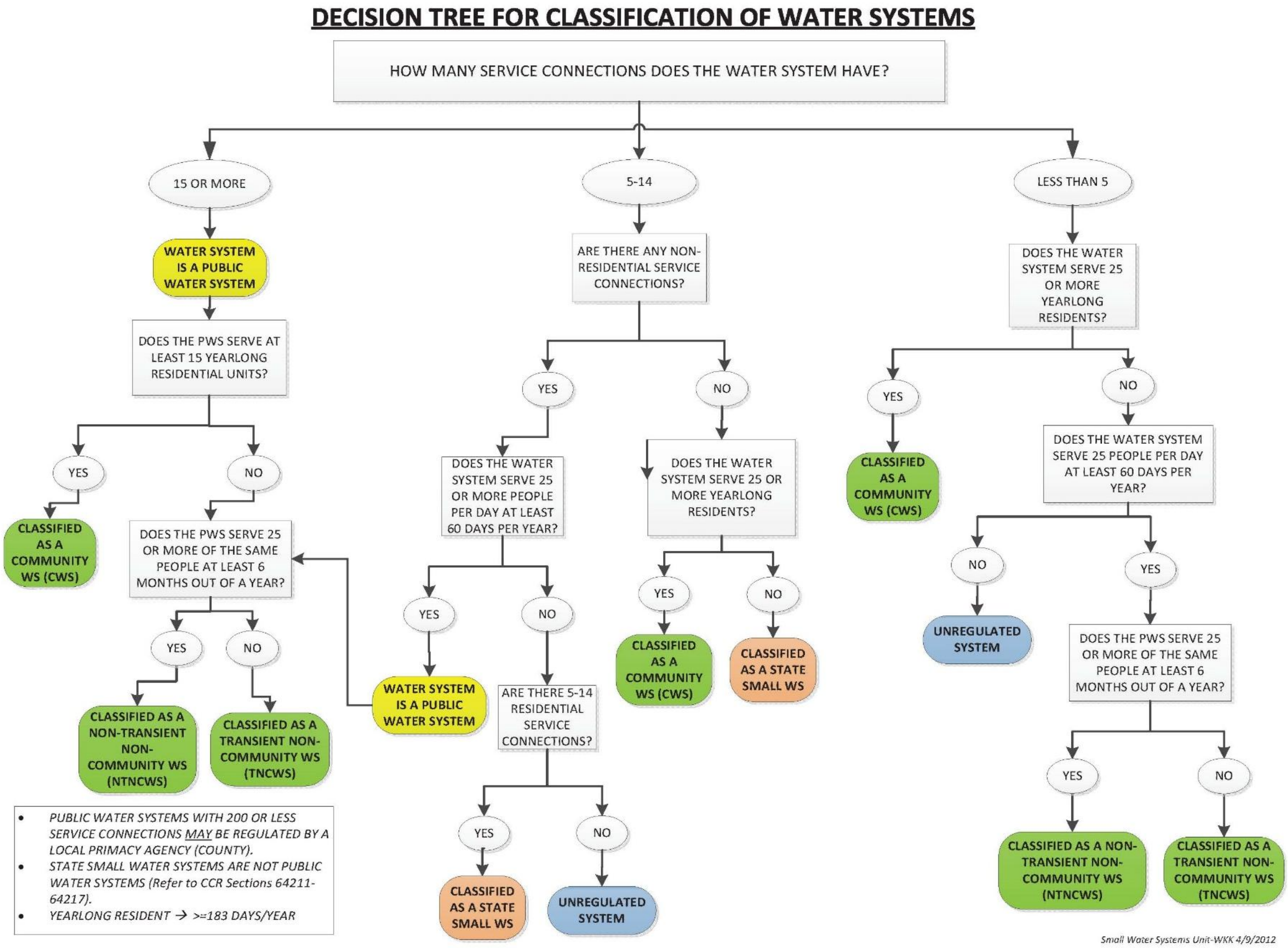
Small Water System (SWS): A community water system, except those serving 200 or more service connections, or any non-community or non-transient non-community water system.

> *It is noted that the U.S. Environmental Protection Agency (EPA) uses a different definition for small public water systems as follows: Public water systems with fewer than 1,000 service connections and a population served of less than 3,300.

State Small Water System (SSWS): A system for the provision of piped water to the public for human consumption that serves at least five, but not more than 14, service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year.

Transient Non-Community Water System (TNC): A non-community water system that does not regularly serve at least 25 of the same persons over six months per year.

Figure 2-5. Decision Tree for Classification of Water Systems (CDPH)



2.3.2 Types of Organizations

Community Services District (CSD): A community services district is an entity formed by residents of an unincorporated community, which is authorized to provide a wide variety of services, including water, garbage collection, wastewater management, security, fire protection, public recreation, street lighting, ambulance services, and graffiti abatement. A CSD may span unincorporated areas of multiple cities and/or counties. A CSD may issue bonds, or form an improvement district for the purpose of issuing bonds, as any City or County might do. Any bond issuance or other long-term debt will require a 2/3rds majority approval of registered voters residing within the CSD.

County Service Area (CSA): The County Service Area Law created in the 1950's allows residents or county supervisors to initiate the formation of a County Service Area. A CSA is authorized to provide a wide variety of services, including extended police protection, fire protection, park and recreation facilities, libraries, low power television and translation facilities and services. CSAs also may provide other basic services such as water and wastewater service and garbage collection if they are not already performed on a countywide basis. A CSA may span all unincorporated areas of a county or only selected portions.

County Water District (CWD): This type of district establishes rules and regulations for the sale, distribution, and use of water. The district also stores and conserves water for present or future beneficial use, and is authorized to run recreational facilities, sanitation facilities, and fire protection.

Joint Powers Agency/Authority (JPA): The Joint Exercise of Powers Act allows public agencies, ranging from federal government to the smallest special district, to enter into an agreement with each other to jointly exercise a common power.

Mutual Water Company (MWC): A mutual water company is a privately owned, public utility, regulated by the California Public Utilities Commission (CPUC). MWCs are most commonly formed as general corporations or as nonprofit mutual benefit corporations, although other structures are sometimes used for tax or other reasons.

Principal Act: The principal act of a special district is the law that enables a district of that type to form and gives it authority to operate. Each special district type (for example, flood control, public utilities, or community services districts) has its own principal act. (*See Special Act definition*)

Public Utility District (PUD): This district type maintains the infrastructure for public service and provides public utility service such as electricity, natural gas, sewer, waste collection, wholesale telecommunications, water, etc., to the residents of that district.

Special Act: Special acts are laws that the Legislature passes to address the specific needs of a community and establishes a district to address those needs. These specific districts (rather than district types) are uniquely created by the Legislature. (*See Principal Act definition*)

Special District: Special districts are a form of local government created by a local community to meet a specific need (for example water or sewer service). When residents or landowners want new services or higher levels of existing services, they can form a district to pay for and administer those services.

Water District (WD): A water district is a district that performs at least one of three specific duties: water delivery, waste disposal (sanitation), and flood control and water conservation. A water special district can be created either by forming under a general water district act or through a special act of the Legislature.

2.3.3 Other Definitions

Affordability Level: CDPH considers 1.5% of the Median Household Income (MHI) as the affordability level for water service for disadvantaged communities. With an annual MHI of $30,000, this would equate to $450 per year, or $37.50 per month.

Affordability thresholds set by other organizations and used in other studies range from 1.5% to 3% of the MHI. For the purposes of this study, a threshold of 1.5% of the MHI is used.

Disadvantaged Community (DAC): A community whose median household income is 80 percent or less of the statewide median household income. For the purposes of this study, the American Community Survey (ACS) for 2006-2010 was used. The annual California Median Household Income (MHI) for 2006-2010 was $60,883. A DAC is therefore a community whose annual MHI for the 2006-2010 ACS dataset is $48,706 or less.

Economy of Scale: The increased efficiencies inherent in providing services or delivering products by increasing the number of units over which the fixed costs are spread. Often operational efficiency is improved with increasing scale, leading to lower variable and overall costs.

Local Agency Formation Commission (LAFCo): A local agency formation commission (LAFCo) is an independent commission working within the boundaries of each county to help control the borders of cities and special districts, to discourage sprawl and encourage orderly government. As part of this effort, LAFCo’s conduct sphere of influence assessments and municipal service reviews. The Knox-Nisbet Act of 1963 established LAFCo’s in law.

Memorandum of Understanding (MOU): A memorandum of understanding (MOU) is a written agreement between two or more parties. This document is not as binding as a contract, but it outlines a commitment between the parties to work together toward a common goal. MOUs do not generally discuss the exchange of money. Instead, MOUs are helpful for organizations that want to formulate partnerships and exchange supportive services.

Non-Profit or Not-for-Profit: An entity that provides services at cost or operation on a not-for-profit basis, which is typically exempt from taxes under United States Internal Revenue Code Section 501(c), 26 U.S.C. 501(c). In the context of this study, a non-profit organization generally refers to those that provide technical assistance to and advocacy for community water and wastewater providers.

Operator Certification Levels: (Distribution System Operators: D1-D5; Treatment Plant Operators: T1-T5)

Operator certification helps protect human health and the environment by establishing minimum professional standards for the operation and maintenance of public water systems. In 1999, EPA issued operator certification program guidelines specifying minimum standards for certification and recertification of the operators of community and non-transient non-community public water systems. These guidelines are implemented through State operator certification programs.

The California Regulations Related to Drinking Water, Title 22 Code of Regulations, Chapter 15 Domestic Water Quality and Monitoring Regulations, Article 2 General Requirements describes the classification of water treatment facilities and distribution systems.

Water treatment facilities are classified pursuant to Table 64412.1-A of the California Code of Regulations.

Table 2-1. California Code of Regulations Table 64413.1-A - Water Treatment Facility Class Designations

Total Points	*Class*
Less than 20	T1
20 through 39	T2
40 through 59	T3
60 through 79	T4
80 or more	T5

The calculation of total points for a water treatment facility is described in the California Code of Regulations, and depends on the water source, water quality, and treatment method.

Distribution systems are classified pursuant to Table 64413.3-A of the California Code of Regulations.

Table 2-2. California Code of Regulations Table 64413.3-A - Distribution System Classifications

Population Served	*Class*
1,000 or less	D1
1,001 through 10,000	D2

Population Served	*Class*
10,001 through 50,000	D3
50,001 through 5 million	D4
Greater than 5 million	D5

Primary Drinking Water Regulations: National primary drinking water regulations (primary standards) are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water.

Proposition 218: Proposition 218, officially titled the “Right to Vote on Taxes Act”, was approved by California voters in 1996. It established additional substantive and procedural requirements and limitations on new and increased taxes, assessments, and property related fees and charges. When referred to in this Study, Proposition 218 refers to the requirements associated with changes to fees and charges imposed by an agency for water or sewer service (water/sewer rates). Prior to adopting or increasing a property-related fee or charge subject to Proposition 218 (such as a water or sewer rate increase), the agency must conduct a public hearing at which property owners can protest the rate change. The hearing must be held at least 45 days after the mailing of the notice of the proposed fee or change to record property owners. At the hearing, the agency must consider all protests against the proposed fee or charge; however, when evaluating whether the number of protests defeats the imposition or increase of the fee or charge, only written protests are counted. “If written protests against the proposed fee or charge are presented by a majority of owners of the identified parcels, the agency shall not impose the fee or charge.” (California Constitution, Article XIIID, § 6, Subdivision (a), Part (2).) If a majority (50% plus one) of owners or renters (utility rate payers) do not submit a written protest, the fee or charge proposed can be imposed.

Receivership: Whenever the [State Department of Public Health] determines that any public water system is unable or unwilling to adequately serve its users, has been actually or effectively abandoned by its owners, or is unresponsive to the rules or order of the department, the department may petition the superior court of the county within which the system has its principal office or place of business for the appointment of a receiver to assume possession of its property and to operate its system upon such terms and conditions as the court shall prescribe. The court may require, as a condition to the appointment of the receiver, that a sufficient bond be given by the receiver and be conditioned upon compliance with the orders of the court and the department, and the protection of all property rights involved. The court may provide, as a condition of its order, that the receiver appointed pursuant to the order shall not be held personally liable for any good faith, reasonable effort to assume possession of, and to operate, the system in compliance with the order (California Statutes Related to Drinking Water, Health & Safety Code, Division 104, Part 12, Chapter 4, Article 9, §116665).

Secondary Drinking Water Regulations: National secondary drinking water regulations (secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply.

Severely Disadvantaged Community (SDAC): A community whose median household income is 60 percent or less of the statewide median household income. For the purposes of this study, the American Community Survey for 2006-2010 was used. The annual California Median Household Income (MHI) for 2006-2010 was $60,883. A SDAC is therefore a community whose annual MHI is $36,530 or less, per the 2006-2010 ACS dataset.

3 GOAL

The goal of the Technical Solutions pilot study is to provide useful information and tools for the following potential audiences:

- Local users and consumers in the Study Area.
- Local provider of water and/or wastewater services to the communities.
- Agencies of Jurisdiction (regulatory, funding, land use, etc.) with oversight of the communities.
- State legislature.

3.1 Consumer Perspective

The impact to the consumer is critical when alternatives to address water and wastewater technical solutions are evaluated. Impacts may include:

- Health effects from consuming water not meeting state and federal requirements.
- Risks associated with communities served by one source of water if that source is no longer functional.
- Environmental impacts of the discharge of improperly treated wastewater.
- The cost of receiving the service. The costs may be in the form of initial capital costs and monthly service charges for water and wastewater. The consumers' most likely just care about the resulting rates.
- Restrictions regarding the use of water.
- Standard procedures and policies regarding uncollected accounts may change.

3.2 Provider Perspective

The provider of water and wastewater services will be charged with the responsibility to construct and operate any improvements to their systems. Impacts may include:

- Ability to finance capital improvements.
- Level of funding and affordability.
- Ability to pass potential rate increases to pay capital and operating costs (Proposition 218) while still maintaining affordable rates to the rate payers.
- Evaluation of annual revenue versus expenses.
- Ability to provide operators certified to operate the improvements.

3.3 Regulatory Agency Perspective

There are a number of agencies that have oversight of various aspects of any water or wastewater improvements. The appropriate agencies will need to approve the proposed improvements. Some the agencies are:

3.3.1 County Government

- Consideration of impacts to land use control/zoning/building permit.
- Consideration of County Environmental Health Departments regarding individual wells and on-site sanitary sewer facilities.
- Local Agency Formation Commission (LAFCo) for each county in regards to any changes in a DACs service area or potential joint agreements between communities.

3.3.2 Regulatory Agencies (CDPH, DWR, RWQCB, EPA)

- Permitting requirements for new or improved systems.
- Guidelines/directives to correct violations.
- Sustainability – require a means to sustain the facilities prior to allowing construction.
- Identification of impacts to DACs when new regulatory requirements are imposed.

3.3.3 Funding Agencies

- Impacts regarding funding assistance and requirements to receive funding assistance.
- Assistance with funding applications.

3.4 State Legislative Perspective

This pilot study will identify potential new policies for legislation to facilitate funding assistance opportunities and the identification of impacts to DACs when new regulatory requirements are imposed.

The information presented in this report will include descriptions of actual community efforts toward solving water and wastewater treatment challenges. The descriptions may include the difficult decisions that were made, the consequences of the solutions, and the results of the projects.

The information may also include recommendations for other communities to consider regarding steps toward solving water/wastewater treatment challenges and identifying obstacles to solving the challenges, and steps toward preventing or mitigating future water/wastewater treatment challenges.

4 PRIORITY ISSUES

The Stakeholder Oversight Advisory Committee was created by the Tulare County Board of Supervisors on August 16, 2011. The SOAC bylaws, created with input from the project team, and adopted by the Tulare County Board of Supervisors, defined the role of the Committee and established the Committee's composition. Key areas in the four-county Tulare Lake Basin Study Area were targeted in order to ensure that the SOAC was a dynamic group of stakeholders that accurately reflected the interests of the Study Area. The Tulare County Board of Supervisors made appointments to the Committee on October 11, 2011.

The responsibilities of the SOAC included recommending to the Tulare County Board of Supervisors which pilot projects and/or studies would be completed for the Tulare Lake Basin Disadvantaged Community Water Study. The SOAC worked with the project team to identify plan priorities for the Tulare Lake Basin pilot studies, and review and provide input on draft and final recommendations.

The SOAC developed a list of water and wastewater issues common to communities within the Study Area. The SOAC then divided into work groups and ultimately voted on the highest priority issues and approved a final prioritized list of issues to be addressed by the pilot studies. The pilot studies were identified in order to address those five priority issues approved by the SOAC. Each of the pilot studies had specific priority issues it aimed to address. The SOAC defined priority issues that this pilot is to address are discussed in this section.

4.1 SOAC Defined Issues

Several priority issues were developed during the Stakeholder Oversight Advisory Committee (SOAC) process, which was convened as an initial task of this TLB Study. The details of the SOAC, including the purpose of the committee and actions performed, are described in the main body of the Final Report. The priority issues to be addressed are:

- Lack of funding to offset increasingly expensive operations and maintenance costs in large part due to lack of economies of scale
- Lack of technical, managerial and financial capacity by water and wastewater providers
- Poor water quality
- Inadequate or unaffordable funding or funding constraints to make improvements
- Lack of informed, empowered, or engaged residents

The potential solutions that the Technical Solutions pilot study aims to address include the following:

- Separating potable water from non-potable water system uses (i.e. dual systems: in-home versus irrigation or fire flow water)

- Residual handling and management (on-site and off-site handling, all materials)
- Water and energy efficiency technology
- Less expensive water treatment technology and blending
- Nitrate biological treatment

In addition to the items to be addressed in Technical Solutions pilot study, the SOAC defined items to be addressed in all the pilot studies. These are:

- Policy Recommendations
- Implementation Roadmap including:
  - A guide to assist the communities in developing a list of promising solutions for each unincorporated DAC in the TLB
  - Leadership development recommendations
  - Financing and governance recommendations
- Stakeholder Facilitation Tools and Lessons Learned

4.2 Water Quality Issues

California drinking water regulations specify primary standards and secondary standards for water contaminants. The primary standard MCLs are health based standards. These standards are considered necessary for the immediate and long term protection of human health. Secondary MCLs are consumer acceptance contaminant levels. Secondary standards relate to the aesthetics of the water and include such parameters as turbidity, color, odor and total dissolved solids. This study focuses on compliance with primary standards, which represent the minimum standard for human consumption. Some contaminants are considered to be acute contaminants because they can have an immediate effect on health. Other contaminants are chronic, meaning that their effect is cumulative over a long period of time.

For example, bacterial contamination, as indicated by total coliform or fecal coliform violations, can result in almost immediate (acute) gastro-intestinal illness. When bacterial contamination is discovered, “do not drink” and “boil water” orders are immediately issued. Nitrate, while not bacterial, is also an acute contaminant. In contrast, arsenic contamination is chronic and has a cumulative effect over a lifetime. Its health effects will likely not be immediately noticed by the consumer.

A database of the communities in the Tulare Lake Basin Study Area was evaluated to determine those communities that have exceeded a primary drinking water maximum contaminant level (MCL). This database was composed of drinking water monitoring data from 2005-2010, but data evaluated for MCL exceedances was from 2008-2010. The information in the database was supplied by sources such as CDPH, PolicyLink, Self-Help Enterprises, County of Tulare, and County of Fresno. An exceedance was based on an analysis of drinking water monitoring data submitted from communities to CDPH. The fact that there was a single or multiple exceedances of a MCL for a certain constituent does not necessarily equate to a violation of drinking water standards. The specific circumstances of the violation are considered by CDPH to determine if the issuance of a violation is needed.

Compliance for constituents that are chronic contaminants is determined on a running annual average. For example, a violation of the arsenic water quality standard is determined by the running average of 12 consecutive months (or four quarters) of sampling. A single quarterly or monthly sample which exceeds the MCL, does not in itself cause a violation of the standards. For nitrate, perchlorate and coliform, which are acute contaminants, an initial exceedance must be confirmed by a second sample. If the average of those two samples is in exceedance of the water quality standard, then the system is in violation. The term ‘exceedance’ used in this report implies that at least one sample for a single contaminant from a single source reported a constituent at a level above the MCL.

4.2.1 Contaminants Exceeding Drinking Water MCLs

The database included a total of 530 unincorporated communities. Of the 530 communities, 353 have been classified as a Disadvantaged Community (DAC) or a Severely Disadvantaged Community (SDAC). Of the 353 DACs, 196 (55%) have water sampling data. Others may be communities of private well owners or communities served water by a larger system. In this report, both DACs and SDACs will be collectively referred as DACs.

Of the 196 DAC entities with reported sampling data, 89 (45%) reported more than one MCL exceedance. The 89 MCL exceedances were composed of nine contaminants present either alone or in combination. These contaminants were coliform, arsenic, nitrate, trihalomethane (THM), uranium, fluoride, dibromochloropropane (DBCP), perchlorate, and polychlorinated biphenyls (PCBs).

4.2.2 Coliform

Coliform bacteria are bacteria that are ubiquitous and naturally present in the environment and are used as an indicator that other, potentially-harmful, bacteria may be present. Coliform presence is an indicator of possible fecal contamination of a water source. A coliform violation is a potentially serious public health threat and must be immediately followed up with repeat sampling for confirmation. A water system is considered to have violated the coliform MCL if the following occurs:

- For a public water system which collects at least 40 samples per month, more than 5.0 percent of the samples collected during any month are total coliform-positive; or
- For a public water system which collects fewer than 40 samples per month, more than one sample collected during any month is total coliform-positive; or
- Any repeat sample is fecal coliform-positive or *E. Coli*-positive; or

- Any repeat sample following a fecal coliform or *E. Coli*-positive routine sample is total coliform-positive.

Fecal coliform and *E. Coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Such microbes may cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose an increased health risk for infants, young children, some of the elderly, and people with severely compromised immune systems.

Coliform bacteria was the contaminant most often recorded as violating a MCL. A coliform MCL exceedance was recorded in at least one of the samples in 23 of the 89 (25.8%) DAC entities with MCL exceedances. Of these 23, 17 entities had only coliform bacteria MCL exceedances. The remaining 6 entities had coliform bacteria in combination with another contaminant.

4.2.3 Arsenic

Most arsenic in groundwater in the TLB is naturally occurring and comes from the dissolution of arsenic containing sediments. Until the 1950s, arsenic was also a major component of agricultural insecticide. Anthropogenic arsenic sources are not considered a significant source of contamination in the TLB.

USEPA has classified arsenic as a human carcinogen, based primarily on skin cancer risks. Some people who drink water containing arsenic in excess of the MCL over many years may experience skin damage or circulatory system problems, and may have an increased risk of cancer. The current USEPA and California drinking water MCL for arsenic is 10 micrograms per liter, µg/L (ppb). The current MCL was effective in 2008. The previous MCL was 50 µg/L.

An arsenic MCL exceedance was recorded in at least one of the samples in 32 of the 89 (36.0%) DAC entities with MCL exceedances and 8.6% of all DACs. Of these 32, 17 entities had only arsenic MCL exceedances. The remaining 15 entities had an arsenic MCL exceedance in combination with an MCL exceedance of one of the other contaminants evaluated.

4.2.4 Nitrate

Nitrate (NO_3) is one of the major anions in natural waters and its background or natural levels in the TLB are believed to be well below the drinking water standard, but according to the EPA web site (http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm) and the report, Addressing Nitrate in California's Drinking Water (also known as the Harter Report), localized groundwater nitrate concentrations in the TLB are believed to be elevated due to leaching and oxidation of nitrogen from fertilizer application, dairies, feed lots, food processing wastes and or septic tank leach fields. Nitrate is of great concern because it is an acute contaminant.

Nitrate converted to nitrite in the body causes two chemical reactions that can lead to adverse health effects: induction of methemoglobinemia, and the potential formation of carcinogenic nitrosamides and nitrosamines. Infants, especially less than one year of age, who drink water containing nitrate in excess of the MCL may quickly become seriously ill, and if untreated, may die from methemoglobinemia. Methemoglobinemia is a medical condition in which high nitrate levels interfere with the capacity of the infant's blood to carry oxygen; symptoms include shortness of breath and blueness of the skin. Elevated nitrate concentrations may also affect the oxygen-carrying ability of the blood of pregnant women and the elderly. The current California drinking water MCL for nitrate is 45 milligrams per liter (mg/L) as NO_3. The USEPA drinking water MCL for nitrate is 10 mg/L as N. The federal and state standards are equivalent when reported in the same units.

A nitrate MCL exceedance was recorded in at least one of the samples in 25 of the 89 (28.1%) DAC entities with MCL exceedances and 6.8% of all DACs. Of these 25, 13 entities had only nitrate MCL exceedances. The remaining 12 entities had a nitrate MCL exceedance in combination with an MCL exceedance of one of the other contaminants evaluated.

4.2.5 Trihalomethanes (THM)

THMs are a group of halogenated organic compounds that include chloroform, dibromochloromethane, dichlorobromomethane, and bromoform. THMs are formed when dissolved organic material in a water system is exposed to chlorine in the water treatment processes. THMs are one of a class of contaminants, known as disinfection by-products (DBPs) that are formed during the disinfection process. Some people who drink water containing THMs in excess of the MCL over many years may experience liver, kidney, or central nervous system problems, and may have an increased risk of cancer.

Natural organic material (NOM) is often present in surface water sources in sufficient quantity to form THMs that exceed the MCL. Generally groundwater contains low concentrations of NOM and therefore THM formation is less of a problem. The formation of THMs from surface water supplied from the California Aqueduct is more problematic than water obtained more directly from the western slope of the Sierra Nevada Mountains (Friant-Kern Canal, Kings River, Kern River). The current USEPA and California drinking water MCL for total trihalomethane (TTHM) is 80 µg/L (ppb).

A TTHM MCL exceedance was recorded in at least one of the samples in 11 of the 89 (12.4%) DAC entities with MCL exceedances and 3.0% of all DACs. Of all of these 11 entities had only TTHM MCL exceedances.

The regulated DBPs include THMs and haloacetic acids (HAA). There are five haloacetic acids (HAA5) whose total is subject to the MCL HAA5 limit of 60 µg/L (ppb). The database used for this report showed one DAC entity had a HAA5 exceedance. This entity also had THM exceedances. This entity serves a population of 50.

4.2.6 Uranium

Most uranium in groundwater comes from the dissolution of naturally occurring uranium containing rocks and sediments.

Uranium is a known kidney chemotoxin and a suspected human carcinogen. Some people who drink water containing uranium in excess of the MCL over many years may have kidney problems or an increased risk of getting cancer. The current California drinking water MCL for uranium is 20 pCi/L (picocuries/liter). The federal standard is 30 µg/L. It should be noted that the California MCL regulated the amount of uranium by measuring the radioactivity of the uranium. The federal standard is not based on radioactivity but the mass of uranium. Both the California and Federal MCLs are considered to be equivalent even though they measure uranium in different ways.

An uranium MCL exceedance was recorded in at least one of the samples in 17 of the 89 (19.1%) DAC entities with MCL exceedances and 4.6% of all DACs. Of these 17, two entities had only uranium MCL exceedances. The remaining 15 entities had an uranium MCL exceedance in combination with an MCL exceedance of one of the other contaminants evaluated (predominately arsenic).

4.2.7 Fluoride

Fluoride occurs naturally in most soils and in many water supplies. Some fluoride in water is considered beneficial for dental health. The state drinking water standards identify the optimum beneficial range of fluoride concentrations based on temperature. However, too much fluoride can be harmful. The California drinking water MCL for fluoride is 2 mg/L and the Federal EPA standard is 4 mg/L. Some people who drink water containing fluoride in excess of the federal MCL of 4 mg/L over many years may get bone disease, including pain and tenderness of the bones. Children who drink water containing fluoride in excess of the state MCL of 2 mg/L may get mottled (discolored) teeth. Long-term health effects of elevated levels of fluoride include dental and skeletal fluorosis.

A fluoride MCL exceedance was recorded in at least one of the samples in 4 of the 89 (4.5%) DAC entities with MCL exceedances and 1% of all DACs. All 4 entities had fluoride in combination with another contaminant.

4.2.8 DBCP

DBCP (dibromochloropropane) is the active ingredient in a nematicide, Nemagon, also known as Fumazone. Until 1977, DBCP was used as a soil fumigant and nematicide on over 40 crops in the United States. Since 1977, the use of DBCP has been prohibited in California. DBCP may still be present in soils due to runoff/leaching from former usage on soybeans, cotton, vineyards, tomatoes, and tree fruit.

Acute exposure to DBCP by ingestion produces gastrointestinal distress and pulmonary edema. USEPA has classified DBCP as a probable human carcinogen. Some people who use water containing DBCP in excess of the MCL over many years may experience reproductive difficulties and may have an increased risk of cancer. The current USEPA and California drinking water MCL for DBCP is 0.2 µg/L

A DBCP MCL exceedance was recorded in at least one of the samples in 4 of the 89 (4.5%) DAC entities with MCL exceedances and 1% of all DACs. Of these 4, two entities had only DBCP MCL exceedances. The remaining 2 entities had a DBCP MCL exceedance in combination with an MCL exceedance of one of the other contaminants evaluated.

4.2.9 Perchlorate

Perchlorate is an inorganic chemical that can originate from both natural and manmade sources. Perchlorate is used in solid rocket propellant, fireworks, explosives, flares, matches, and in a variety of industries. Perchlorate is also naturally occurring in some fertilizers. It is reported that nitrate fertilizer, containing perchlorate, originating from Chile has been widely used in California since 1923. (http://perchlorateinformationbureau.org/perchlorate-basics). Perchlorate can get into drinking water as a result of environmental contamination from historic aerospace or other industrial operations that used or use, store, or dispose of perchlorate and its salts. However, the absence of such industries in the TLB suggests that perchlorate may be either associated with fertilizer application, it is naturally occurring or it occurs as a result of chemical reactions.

Perchlorate interferes with the iodide uptake of the thyroid gland which can decrease the production of thyroid hormones. These thyroid hormones are needed for prenatal and postnatal growth and development, as well as for normal metabolism and mental function in adults. The current California drinking water MCL for perchlorate is 6 µg/L.

A perchlorate MCL exceedance was recorded in at least one of the samples in 3 of the 89 (3.4%) DAC entities with MCL exceedances and 0.8% of all DACs. All three entities had a perchlorate MCL exceedance in combination with an MCL exceedance of one of the other contaminants evaluated.

4.2.10 PCB

PCBs (polychlorinated biphenyl compounds) are any of the over 200 chemicals that contain chlorine atoms attached to a biphenyl molecule. PCBs were widely used as coolant fluids in transformers, capacitors, and electric motors. Because of PCBs' environmental toxicity and classification as a persistent organic contaminant, PCB production was banned in 1979. PCBs enter a drinking water system by improper waste disposal or leaking electrical equipment. PCBs are probable human carcinogens. The current USEPA and California drinking water MCL for PCBs is 0.5 µg/L. Some people who drink water containing PCBs in excess of the MCL over many years may experience changes in their skin, thymus gland problems, immune deficiencies, or reproductive or nervous system difficulties, and may have an increased risk of cancer.

A PCB MCL exceedance was recorded in at least one of the samples in 1 of the 89 (0.1%) DAC entities with MCL exceedances and 0.3% of all DACs. The one entity had only a PCB MCL exceedance.

4.2.11 Summary of MCL Exceedances

The 89 DAC entities with MCL exceedances ranged in number of connections from less than 15 to over 2,000. In reviewing **Table 4-1**, as previously mentioned, an MCL exceedance does not necessarily indicate a violation or that the system is out of compliance with standards. These exceedance tables, however, are used to assess the need for eliminating and preventing existing or future water quality issues. **Appendix D** contains a list of those DACs that have been issued violations by CDPH.

Of the 89 DAC entities with MCL exceedances, 63 had exceedances for a single contaminant. The remaining 26 entities with MCL exceedances had exceedances of multiple contaminants. **Table 4-1** shows the DAC entities by size with the number having MCL exceedances. Many systems may indicate an exceedance on a well that is only used in emergency situations. The water supplied by that system likely meets all water standards in the distribution system.

Table 4-1: Summary of DAC Entities with Reported MCL Exceedances

Number of Connections	No. of DACs	No. with MCL Exceedances	Percent with MCL Exceedances
Less than 50	198	38	19.2%
51 to 200	86	19	22.1%
201 to 500	37	12	32.4%
501 to 2000	26	14	53.8%
Greater than 2000	6	6	100%
TOTAL	353	89	25.2%

Table 4-2 shows the breakdown of MCL contaminant exceedances by county.

Table 4-2: MCL Contaminant Exceedances by County

Contaminant	Fresno Co.	Kern Co.	Kings Co.	Tulare Co.	Totals
Coliform	3	0	0	14	17
Arsenic	4	6	5	2	17
Nitrate	1	1	0	11	13
THM	10	1	0	0	11
Uranium	0	1	0	1	2
Fluoride	0	0	0	0	0
DBCP	1	1	0	0	2
PCB	1	0	0	0	1
Coliform with					
Arsenic	1	0	0	0	1
Nitrate	0	0	0	4	4
Uranium	1	0	0	0	1
Nitrate with					
Arsenic	0	1	0	0	1
DBCP	0	1	0	1	2
Uranium	0	1	0	0	1
Perchlorate	0	0	0	2	2
Arsenic & Uranium	0	9	0	0	9
Arsenic & Perchlorate	0	1	0	0	1
Uranium & Fluoride	0	1	0	0	1
Arsenic, Fluoride & Uranium	0	1	0	0	1
Arsenic, Nitrate, Uranium & Fluoride	0	2	0	0	2

4.2.12 Future Water Quality Regulations

Revisions to the Total Coliform Rule

The existing Total Coliform Rule (TCR) regulations will remain in effect until March 31, 2016. Starting on April 1, 2016, water systems must comply with the revised TCR requirements. The basic monitoring requirements will remain the same but the new regulation links monitoring frequency to water quality and system performance by:

- Providing criteria that well-operated small systems must meet to qualify and stay on reduced monitoring;
- Requiring increased monitoring for high-risk small systems with unacceptable compliance history; and

- Requiring some new monitoring requirements for seasonal systems such as campgrounds and some state and national parks.

The new regulation establishes a health goal and a MCL for *E. Coli* and eliminates the MCL for coliform, replacing it with a treatment technique for coliform that requires assessment and corrective action.

The revised rule is establishing a health goal of zero for *E. Coli*, a more specific indicator of fecal contamination and potentially more harmful pathogens than total coliform. Many of the organisms detected by total coliform methods are not of fecal origin and do not have direct public health implication.

Under the new treatment technique for coliform, total coliform serves as an indicator of a potential pathway of contamination into the distribution system. A water system that exceeds a specified frequency of total coliform occurrence must conduct an assessment to determine if any sanitary defects exist and, if found, correct them. In addition, under the new treatment technique requirements, a water system that incurs an *E. Coli* MCL violation must conduct an assessment and correct any sanitary defects found.

<u>1,2,3-Trichloropropane (TCP)</u>

There is currently no California or federal MCL for TCP. The State has developed a public health goal for TCP of 0.0007 µg/L and is in the process of developing an MCL. The public health goal is based on carcinogenic effects observed in animals. TCP has been used as a solvent and degreasing agent and in the synthesis of other compounds such as epichlorohydrin and certain polymers. TCP also occurs as a byproduct in the production of chemicals and certain pesticides (Telone II). Pesticide use appears to be the origin of most of the contamination throughout the TLB.

As of 2011, CDPH had identified 336 drinking water sources with TCP levels of 0.005 µg/L or higher. Most of the reported detections resulted from sampling required by the State's Unregulated Contaminant Monitoring Rule (UCMR) that was in effect from January 2001 through December 2003. The rule did not require that systems with fewer than 150 service connections perform the monitoring and systems that tested early in the UCMR period used analytical techniques with detection limits significantly higher than the current detection limit of 0.005 µg/L. Of the 336 identified contaminated sources, approximately 186 are located within the TLB study area. Considering the smallest water systems were exempt from the rule and some of the systems that did comply used methods with high detection limits, it is anticipated that many more sources are contaminated than have been identified. There also appears to be a clear pattern of contamination where rural water systems located in agricultural areas (predominately DACs) are at greater risk of contamination than urban water systems which tend to be larger and better funded.

CDPH anticipates releasing a draft MCL for TCP for public comment in 2014. Until then, utilities with contaminated sources face the challenges of not knowing what MCL they will need to comply with and not being provided with any guidance on best available treatment technologies (BATs) to remove TCP from the water. BATs are only identified when the MCL is established. Based on treatment research to date, only granular activated carbon (GAC) treatment will be feasible for TCP removal at most water systems. This regulatory uncertainty is of greatest concern for water systems that are currently faced with the need to treat for one or more other contaminants (e.g. arsenic). These utilities are being forced to take corrective action for one contaminant, often involving installation of treatment, knowing that they may need to modify their new treatment process within a few years to comply with the upcoming TCP regulation.

Hexavalent Chromium (Chromium-6)

On August 23, 2013 CDPH proposed a 10 µg/L MCL for chromium-6 for public comment. Public comments were due by October 11, 2013. It is likely a final rule for the chromium-6 MCL will not be adopted and implemented until 2014. CDPH estimates that there are 78 water systems in the state with less than 1,000 service connections that will need to treat for chromium-6. It is not known how many of these water systems are in the study area. Chromium-6 occurs in drinking water as a result of both natural and anthropogenic sources. Many anthropogenic sources have been identified including the manufacture of metal plating, paint pigments, and wood preservatives and leaching from hazardous materials sites. It is likely that most of the chromium-6 found in TLB drinking water is from naturally occurring deposits.

Chromium-6 has been widely detected throughout the state. Approximately one-third of all drinking water wells monitored as part of the CDPH UCMR regulation had levels of chromium-6 in excess of the 1 µg/L detection limit. Most detections occurred in Los Angeles, San Bernardino, and Fresno Counties. Similarly to TCP, water systems smaller than 150 service connections were exempt from the UCMR chromium-6 monitoring. However, unlike TCP, agricultural activity is not expected to be a significant source of chromium-6 contamination and therefore, the UCMR monitoring results should better represent the chromium-6 occurrence and distribution of levels in DAC water systems. Table 2-3 summarizes CDPH monitoring results from 2000 through November 13, 2012. The table shows that the majority of detections were at levels below 5 µg/L and 86% of detections were at levels below 10 µg/L. Within the TLB study area, the highest level detected was 34.6 µg/L at the East Niles CSD in Kern County. In general, the TLB accounts for a large percentage of the overall number of detections, but most detections were in the lower ranges with almost 90% falling into the 1 – 5 µg/L range.

Table 2-3 Chromium-6 Peak Detections in Drinking Water Sources (2000 – 2012)

Peak Level (µg/L)	No. of Sources	No. of TLB Sources
1 – 5	1,596	690
6 – 10	496	71
11 – 20	247	7
21 - 30	66	2
31 - 40	17	1
41 - 50	5	0
> 50	4	0

CDPH has determined that there are three best available technologies for chromium-6: reduction/coagulation/filtration, weak base anion exchange, and reverse osmosis. CDPH estimates that the annualized treatment (capital and O&M) costs would be approximately $300,000 for water systems serving less than 1,000 service connections. CDPH estimates it will cost an additional $500 annually for increased monitoring associated with the new MCL.

Other Future Regulations

The EPA and State of California are constantly evaluating existing MCLs and exploring the adoption of MCLs for currently unregulated chemicals. Any future MCLs would take over five years before promulgation and then several more years before compliance would be required.

4.2.13 Locations of DACs and the Related Water Issues

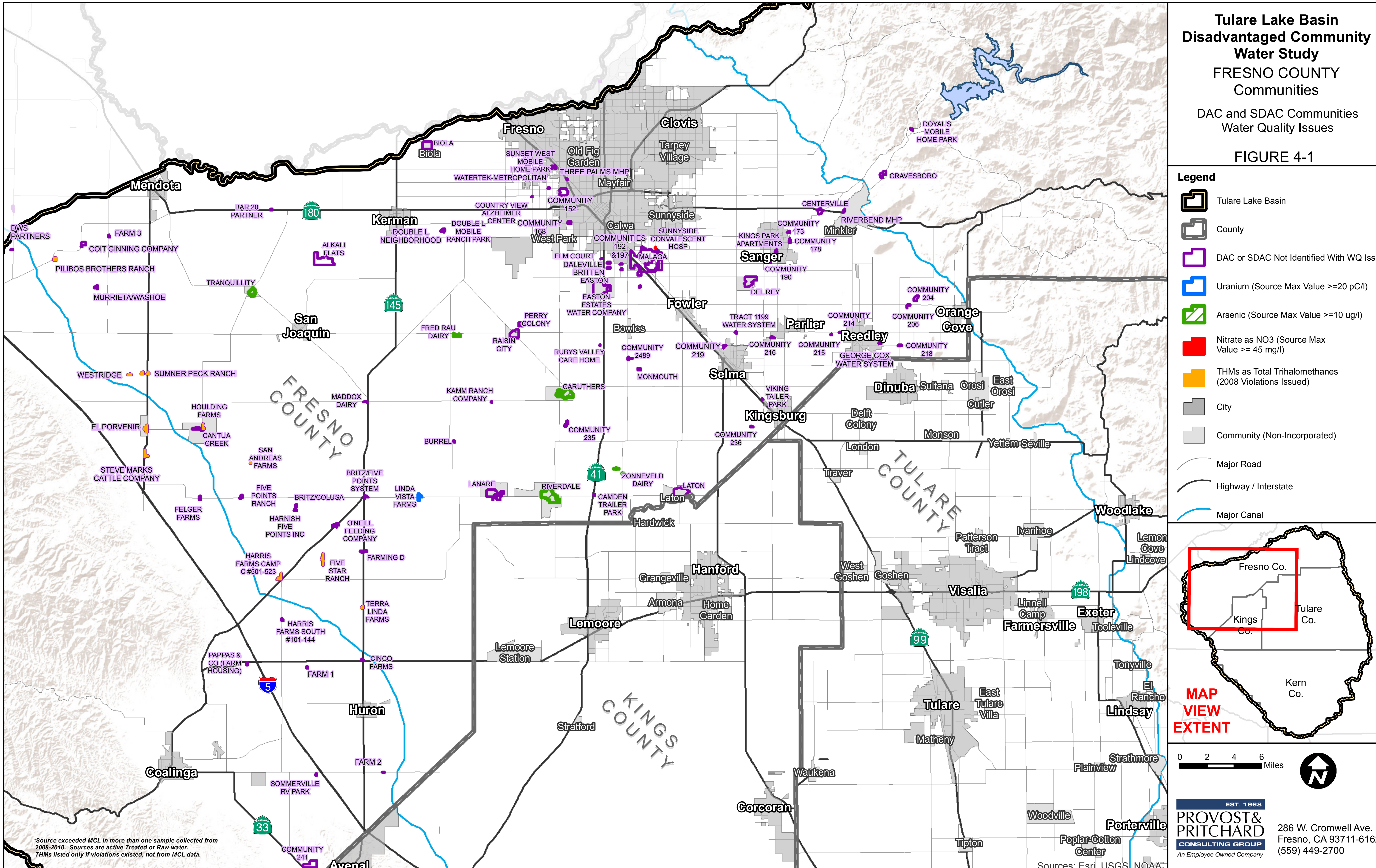
Figure 4-1 through **Figure 4-4** shows the locations of the DACs in each of the four counties in the study area along with highlighting those DACs that recorded an exceedance in 2008-2010 for uranium, arsenic, nitrate, and THM.

Tulare Lake Basin Disadvantaged Community Water Study

FRESNO COUNTY Communities

DAC and SDAC Communities Water Quality Issues

FIGURE 4-1



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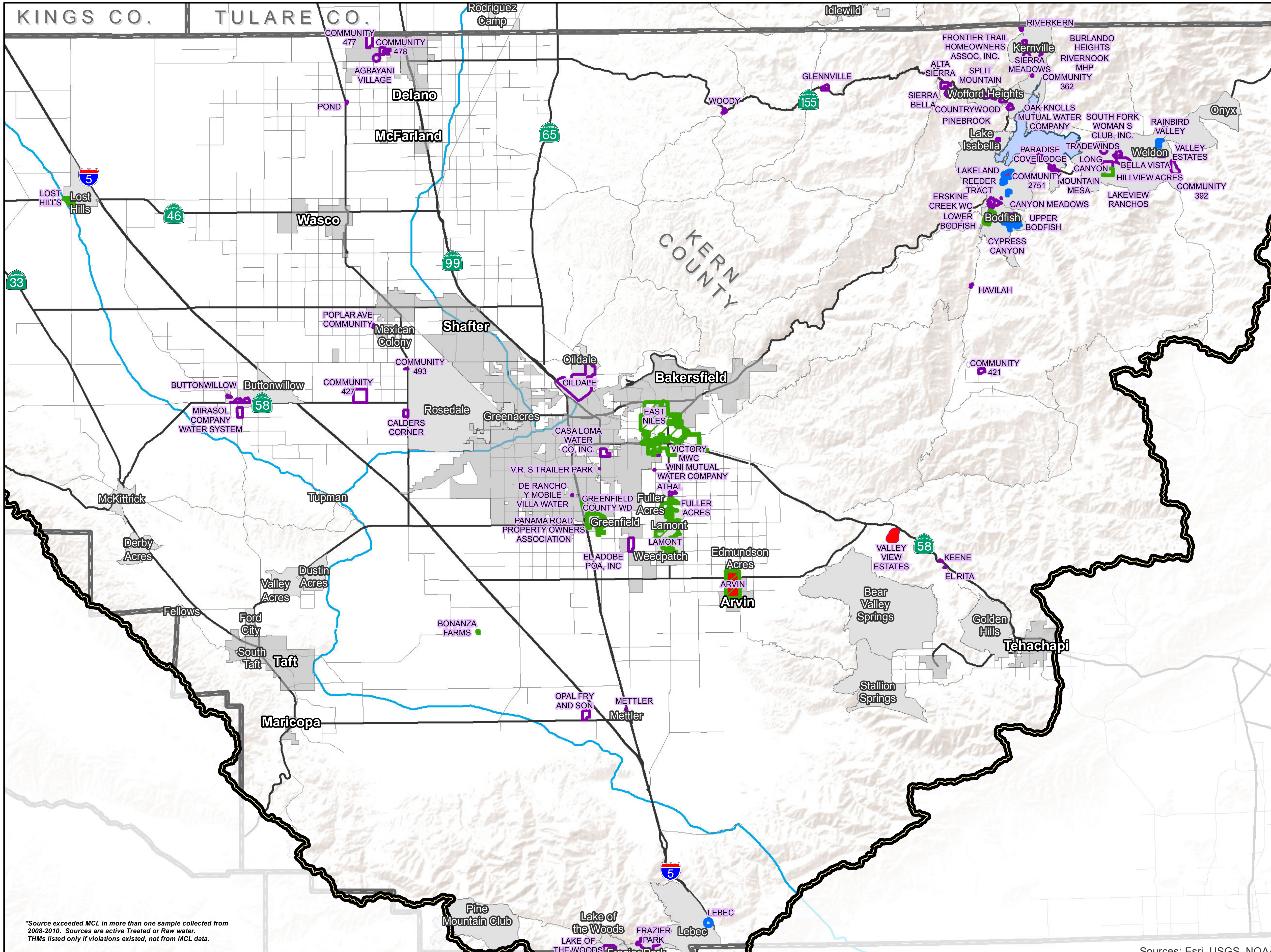
Tulare Lake Basin Disadvantaged Community Water Study

KERN COUNTY Communities

DAC and SDAC Communities Water Quality Issues

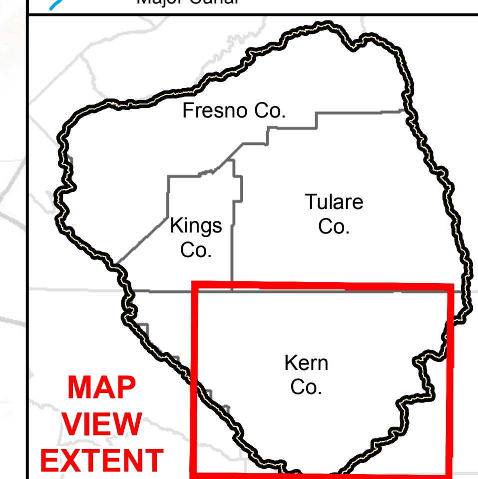
FIGURE 4-2



*Source exceeded MCL in more than one sample collected from 2008-2010. Sources are active Treated or Raw water. THMs listed only if violations existed, not from MCL data.

Legend

- Tulare Lake Basin
- County
- Uranium (Source Max Value >=20 pC/l)
- Arsenic (Source Max Value >=10 ug/l)
- Nitrate as NO3 (Source Max Value >= 45 mg/l)
- THMs as Total Trihalomethanes (2008 Violations Issued)
- DAC or SDAC Community
- City
- Community (Non-Incorporated)
- Major Road
- Highway / Interstate
- Major Canal



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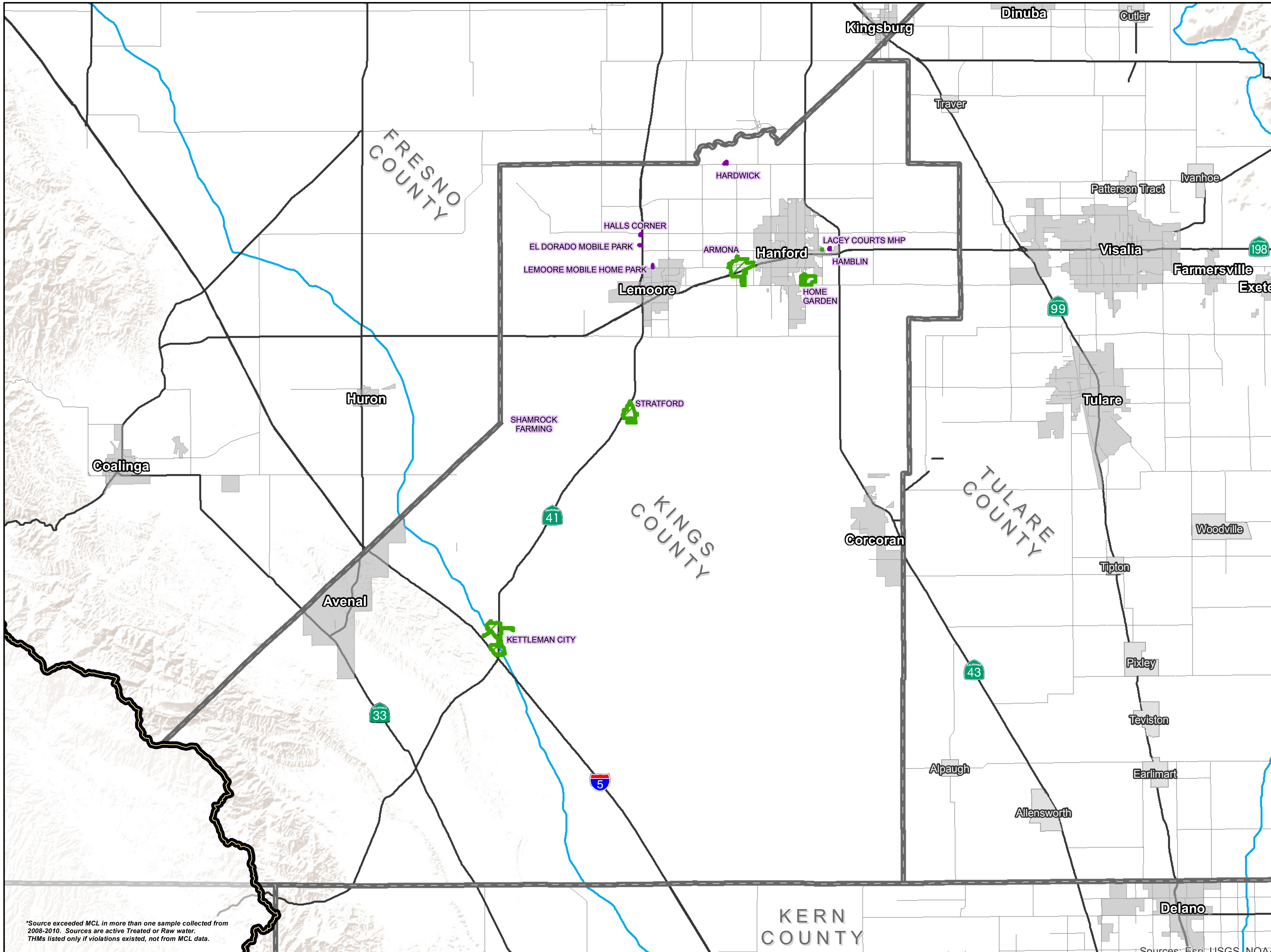
Tulare Lake Basin Disadvantaged Community Water Study

KINGS COUNTY Communities

DAC and SDAC Communities Water Quality Issues

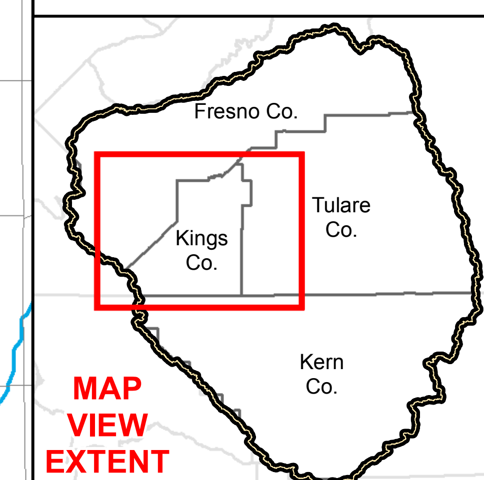
FIGURE 4-3



*Source exceeded MCL in more than one sample collected from 2008-2010. Sources are active Treated or Raw water. THMs listed only if violations existed, not from MCL data.

Legend

- Tulare Lake Basin
- County
- DAC or SDAC Not Identified With WQ Issue
- Arsenic (Source Max Value >=10 ug/l)
- Uranium (Source Max Value >=20 pC/l)
- Nitrate as NO3 (Source Max Value >= 45 mg/l)
- THMs as Total Trihalomethanes (2008 Violations Issued)
- City
- Community (Non-Incorporated)
- Major Road
- Highway / Interstate
- Major Canal



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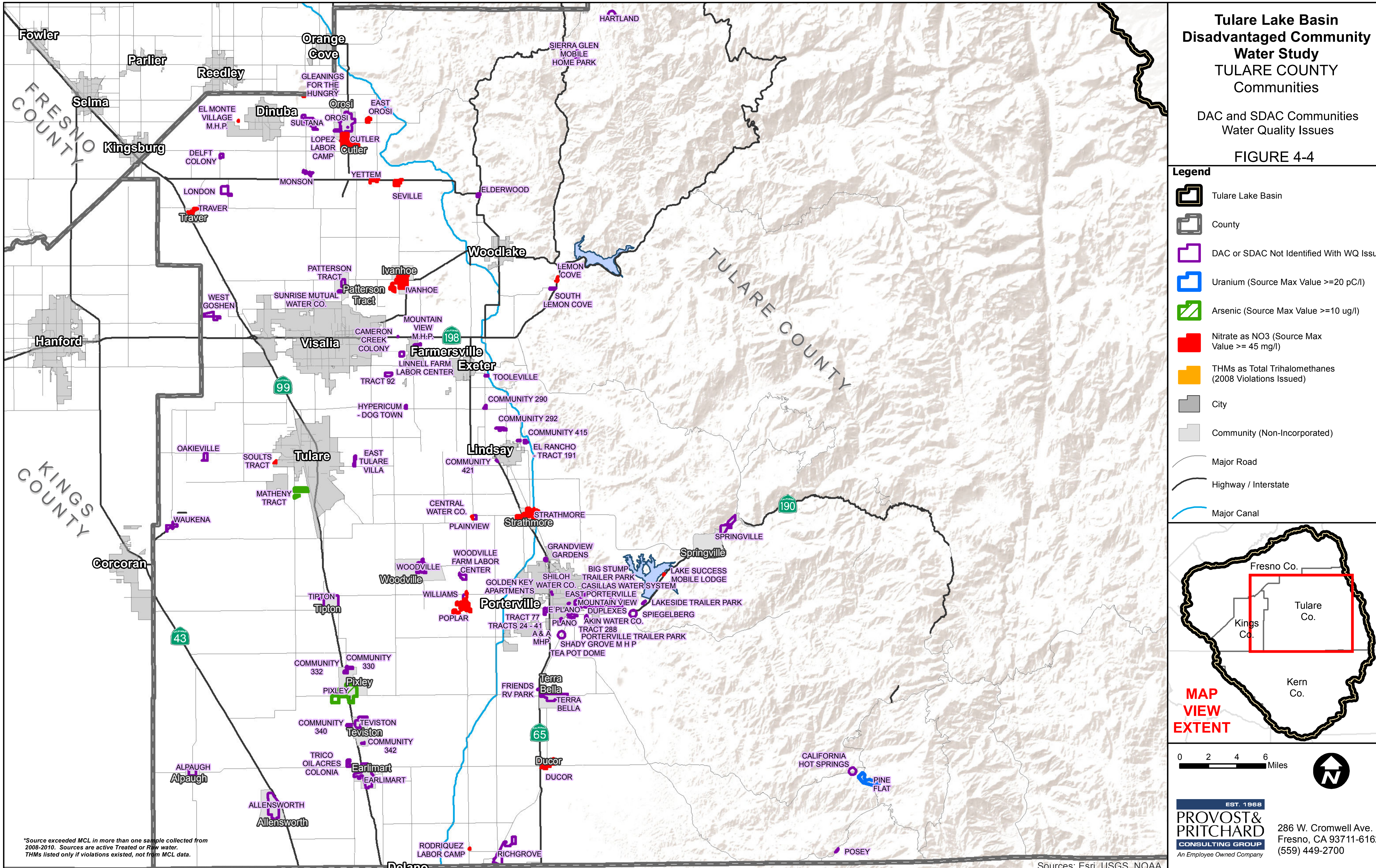

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4.3 Wastewater Issues

In addition to the water issues faced by DACs in the Tulare Lake Basin, many communities also face issues with their wastewater. The wastewater issues may stem from the community relying on failing septic systems or wastewater treatment systems that are not capable of meeting applicable effluent limitations. According to a database supplied by the University of California-Davis, of the 353 DACs there are 38 communities (11%) with their own wastewater treatment facility (WWTF). These 38 communities make up 25.2% of the Study Area population. This implies that up to 74.8% of people within the Study Area are not served by their own community wastewater treatment facility. Those communities not served by their own wastewater treatment facility may have their wastewater treated at a neighboring community wastewater treatment plant or individual septic systems. Of the 38 wastewater treatment facilities, 25 (65.8%) are listed as having a violation of their Regional Water Quality Control Board (RWQCB) waste discharge requirements (WDRs) in the years 2007 to 2010.

Of the 38 wastewater treatment facilities, 27 utilize some type of pond or lagoon treatment. The lagoon may be aerated by either mechanical surface aerators or submerged diffused aeration systems. Aerated lagoons typically are classified by the amount of mixing provided. A partial mix system provides only enough aeration to satisfy the oxygen requirements of the system and does not provide energy to keep all total suspended solids (TSS) in suspension. Aerated lagoons can reliably produce an effluent with both biochemical oxygen demand (BOD) and TSS < 30 mg/L. However, it may be difficult to meet a total nitrogen discharge concentration of 10 mg/L or less.

There are two systems that utilize trickling filters. Six communities use an activated sludge treatment system (two oxidation ditch systems, three traditional activated sludge plants, and one membrane bioreactor). Two systems provide tertiary treatment. One system uses a community septic system.

All 38 treatment systems discharge to land in some form – percolation, evaporation, or leachfields.

If a community is not served by a wastewater treatment facility, then the households would be served by individual septic systems. Depending on the age and upkeep of the septic systems, the septic systems may be failing and potentially polluting nearby groundwater. A possible technical solution for these communities is to install a collection system and either construct a community wastewater treatment facility or a lift station to neighboring wastewater system.

4.4 Water Quality Database

The database used to evaluate DAC water quality issues contains limited numeric information about the water quality in the water systems listed. The information included in the database consists primarily of simplified numeric data. It does not provide explanation or comment on the possible unique circumstances associated with the data. There are many details that are not included in the database that would be beneficial in further analyzing the water quality issues and potential solutions. These additional details are described in the following sections.

4.4.1 Water Systems with No Water Quality Data

The database contains water quality data for 196 of the 353 DACs in the Study Area. Of the 157 DACs without water quality data, approximately 75 are provided with water from another public water system. Thus, there are approximately 82 DACs that have no sample data in the database. It is not possible to determine if there are water quality issues associated with the DACs that have no sample data. The DACs for which data is not available have a total population of approximately 30,000. These DACs make up about 10% of the DAC population in the Study Area. Since DACs encompass a substantial population, a course of further investigation would be to develop a sample database for these DACs.

These DACs may be served by private individual wells or private water systems (less than 15 connections).The database does not indicate which systems are supplying water to other systems. Data for water systems that are not permitted by CDPH or by the local county health department, such as individual wells for single family homes, are not included in the database. The lack of data for individual, unregulated systems precludes the precise determination of the population of TLB DACs affected by MCL exceedances.

4.4.2 Data Regarding Other Water Quality Parameters

The database contains no details of the general mineral or general physical characteristics of the water (e.g. pH, alkalinity, total dissolved solids, etc.); and contains no details of other contaminants other than for a select few contaminants. Exceedances of secondary standards are not documented. Certain natural water quality characteristics and contaminants cause interference with some treatment technologies. This may render some forms of treatment impractical. For example, silica, phosphate, and vanadium are known to interfere with the arsenic adsorption treatment process. Therefore, the use of adsorption for arsenic treatment for a system with elevated concentrations of silica, phosphate, and/or vanadium would not be recommended. The lack of other water quality parameters makes it difficult to determine whether a particular treatment system will be applicable to a specific water system.

4.4.3 No Water Production Information

The database does not contain information regarding the volume of water produced and consumed at the listed water systems. Thus, it is difficult to reliably determine the size of a treatment system that may be needed to address a system’s water quality issues. This, in turn, will affect the estimate of waste produced. These factors will affect any projected capital and O&M costs since the size of any treatment system will be dependent upon the flow to be treated. Population data for each water system is included, and thus typical per capita water use within the TLB can be used to estimate water production. This type of estimate, however, would not account for large commercial, institutional or industrial water users, such as schools, parks and industry that may be present in the community.

4.4.4 Incomplete Treatment Plant Details

The database indicates the number of treatment plants in each water system and what contaminant is treated. For example, arsenic treatment or nitrate treatment is listed as being implemented at several DACs. However, there is no information on the exact treatment process utilized.

4.4.5 Database Use

Because of the limitations discussed above, the primary use of the database is to statistically evaluate drinking water contamination issues in the TLB. The results are valid only for the period of time reviewed and thus may not accurately reflect current conditions. Accordingly, the primary value of the database search is to indicate the general occurrence of the problems faced by DACs, to identify the magnitude of the problems and general location and to identify the major contaminants.

Technical solutions for each water system must be developed with complete water system and water quality information. The water quality of each source is unique. Each water system is unique. There is no “standard” solution that will apply for each water system with a given contaminant issue.

5 DESCRIPTION OF ALTERNATIVES – WATER TREATMENT

This section discusses water treatment options for the various contaminants affecting communities throughout the Tulare Lake Basin.

5.1 Coliform

The presence of Coliform bacteria was tied with arsenic as the most commonly reported water quality contamination issue in the TLB. Depending on the cause, it may be one of the easiest and least expensive contaminants to control, or it may be one of the most difficult. Coliform violations are an indicator that pathogenic bacteria or virus may be present. A Coliform violation is considered an acute contamination issue because it may immediately infect persons drinking or contacting the water. If a well is confirmed to have a coliform violation, CDPH will require disinfection sufficient to provide 4-log virus inactivation (meaning 99.99% reduction in coliform). If a well routinely has fecal or *E. Coli* positive tests, CDPH will not allow the well to be used even with reliable disinfection. Typically total Coliform is tested since it is a quick and inexpensive method to determine contamination. To further determine the nature of a positive total coliform test, fecal coliform or *E. Coli* can be tested. Coliform violations generally fall into one of the following categories:

1. Transient contamination resulting from a documented short term event in the water system (e.g. water main break, maintenance work, etc.). This will often involve total coliform detections without any fecal coliform or *E. Coli* detected. Water at the source (e.g. well) may not be contaminated.
2. Chronic contamination of a well source caused by naturally occurring coliform in the soil around the well. This will usually manifest itself through frequent total coliform detections at the well and within the distribution system.
3. Chronic contamination of a well source caused by poor sanitary conditions at the wellhead and/or an ineffective sanitary seal around the well casing. This may involve the detection of fecal coliform and/or *E. Coli*.
4. Bacterial re-growth within the distribution system of a surface water supplied system. This may involve detections of total coliform, fecal coliform and/or *E. Coli* depending on the source of contamination in the surface water.

Transient contamination is preventable and typically easy to resolve. They can be prevented by implementing proper maintenance practices and by properly disinfecting distribution system components following maintenance or replacement. Resolution typically involves either permanently or temporarily chlorinating the water entering the distribution system.

Chronic contamination by naturally occurring coliform does not pose a threat to public health, but generates an MCL violation under the original Total Coliform Rule (TCR). Under the Revised TCR, total coliform detections will no longer automatically trigger an MCL exceedance. Under either rule, it can be anticipated that CDPH will require an investigation to confirm the origin of the contamination, and will likely require that disinfection (e.g. chlorine contact or UV) be added to the well.

Chronic contamination of a well source caused by poor sanitary conditions poses the greatest threat to public health and is the hardest to resolve. Some wells within DACs may not have been constructed to waterworks standards because they were originally constructed as agricultural wells or for other purposes other than producing drinking water. Common deficiencies are the absence of a sanitary seal and the top of the casing, or at an insufficient elevation above the surrounding grade. The well may also be located in a floodplain. In either case, the well is at risk for surface water (e.g. storm runoff) contamination. It is often difficult and expensive to correct these deficiencies after the well has been constructed. The only alternatives to improving the sanitary protection of the existing well are to install a proper sanitary seal in the existing well, construct a new well, or to treat the water.

Bacterial re-growth within the distribution system is caused by loss of chlorine residual in a distribution system supplied with treated surface water. Water distribution systems are not sterile, even if system wide chlorination is practiced. For example, build-up on pipe walls and sediment at the bottom of storage tanks shields bacteria from the effects of disinfection. If the chlorine residual in the water drops too low in the distribution system, these bacteria can be re-introduced into the distribution system and trigger total coliform detections. The solution to this problem is to modify the systems procedures to prevent the loss of chlorine residual. Example solutions include increasing the chlorine dosage at the source, boosting the chlorine in the distribution system, cleaning storage tanks, and replacing old pipes.

Occasionally, a coliform exceedance may be caused due to improper sampling techniques. It is actually quite easy to fail a coliform test due to bad sampling practices if the sampler has not been trained in proper sample handling or if the sample collection tap is poorly designed. The possibility of contamination during sampling is one reason a coliform bacteria exceedance requires a re-test to confirm the exceedance. The presence of suspended particles in water, as measured by turbidity, greatly increases the probability of coliform contamination because the suspended materials may shield bacteria from direct contact with the disinfectant.

5.1.1 Chlorination

Depending on the cause of the coliform bacteria contamination, some combination of procedural changes, infrastructure improvements, and disinfection will be required to resolve the problem. Temporary or permanent disinfection using chlorine will be required in almost all cases.

Chlorination is the most common method of disinfection currently practiced in the United States. Injection of chlorine into water will result in the inactivation of a very high percentage of pathogenic organisms provided that there is an adequate dose and contact time between the bacteria and the chlorine. The combination of chlorine dose and contact time is commonly designated by the acronym “CT”, which represents the chlorine concentration in mg/L times the contact time in minutes. Chlorine gas and liquid sodium hypochlorite solution are the most common forms of chlorine used. Other forms of chlorine, such as chloramines or chlorine dioxide can also be used, but their use is far less common. The use of chlorine gas has reduced significantly in recent years because of safety issues related to potential accidental release of chlorine gas into the atmosphere. Sodium hypochlorite is now by far the most commonly used drinking water disinfectant chemical. Despite its popularity, sodium hypochlorite is a difficult chemical to work with and injection systems can experience frequent failures if not properly designed and operated. Normally, a chlorine solution is injected at the well head for groundwater systems. In a surface water treatment plant, chlorine may be injected at multiple locations. Chlorine may also be injected within a water distribution system to boost the residual concentration, typically at water reservoirs (storage tanks) or at booster pumping stations.

Chlorine is added until a “free” chlorine residual is measured leaving a source. A free chlorine residual is reached when the addition of more chlorine results in a proportional increase in the measured free chlorine. Free chlorine is the amount of chlorine available to kill bacteria. The presence of free chlorine residual indicates that enough chlorine has been added to satisfy the water’s chlorine demand. The initial demand is created by organic and inorganic constituents in the water which react with the chlorine. Examples of constituents that generate a chlorine demand include iron, manganese, TOC, ammonia and hydrogen sulfide. Free residual chlorine in the water supply is considered to be a safeguard against contamination that may subsequently occur in the distribution system or customer plumbing systems. Drinking water regulations require that treated surface water contain a minimum disinfectant residual of 0.2 mg/L throughout the distribution system. Groundwater systems do not always require disinfection; however, some systems have installed disinfection systems because of past coliform violations or as a preventative measure. CDPH will require mandatory disinfection of groundwater if there are frequent TCR violations.

Chlorine acts as an effective disinfectant only if it comes in direct contact with the organisms to be killed. Turbidity can prevent good contact and act to shield the pathogens. If the turbidity is high enough to interfere with disinfection then the turbidity must be lowered by some means of filtering before chlorine addition.

Almost all water sources contain some concentration of natural organic matter (NOM). If NOM is present in the water, it is almost certain that the addition of chlorine will form disinfection by-products (DBPs), such as trihalomethanes (THMs) and haloacetic acids (HAA), which are regulated drinking water contaminants. Generally, the NOM present in groundwater is at relatively low levels and thus the formation of DBPs is not of significant concern. However, NOM is often present in surface water supplies at significantly higher levels and thus the formation of DBPs is often a concern. If DBP levels at the discharge of a surface water treatment plant are near their respective MCLs, a water supplier must consider the use of alternative disinfectants or must enhance the removal of NOM and/or DBPs in the treatment process. This is because DBPs (including THMs) will continue to form in the distribution system, so a concentration near the MCL at the plant discharge will likely lead to an exceedance in the distribution system where compliance is determined.

One way to mitigate the formation of DBPs is to use a form of combined (not free) chlorine called chloramines for residual disinfection in the distribution system. Chloramines are produced by adding chlorine and ammonia to water in a precise ratio. Chloramines do not produce DBPs as abundantly as free chlorine. However, chloramines are not effective at satisfying regulatory CT requirements for a surface water treatment plant because they do not provide a free chlorine residual. Additionally, chloramines are less potent disinfectants compared to chlorine and chloramines contain ammonia, which can result in biological nitrification within the distribution system. The use of chloramines as a residual disinfectant necessitates strict and labor intensive monitoring and maintenance of the distribution system if nitrification is to be avoided. An experienced operator is also required to assure that the correct ratio of ammonia and chlorine is maintained at the point of dosing. Switching to chloramines will require notification to consumers of impacts on dialysis patients and fish aquariums. For these reasons, chloramination will typically not be a viable alternative for DAC systems.

5.1.2 Alternative Disinfection

There are alternatives for disinfection other than chlorination. Some of these alternatives include ultraviolet (UV) light, ozone and other chemicals such as bromine, iodine, and chlorine dioxide. Even though these alternative disinfection processes will reduce pathogens in the water at the treatment plant, they do not leave a residual in the water entering the distribution system. It is important to provide residual disinfection to help protect the distribution system from coliform contamination. Thus, chlorine (of some form) will be required to provide chlorine residual in the distribution system.

For most of the DACs included in this evaluation, UV disinfection systems with chlorine addition are likely the only feasible alternative disinfection technique because it requires minimal operator interaction. Additionally, if several DACs group together to provide a regional treatment system, the designer of this larger regional treatment system may want to consider these alternate forms of disinfection.

5.1.3 Typical Chlorination System

A chlorination feed system, as might be utilized for typical water well in the TLB will include a sodium hypochlorite solution storage tank, a chemical feed pump and an injection quill. The injection quill injects chlorine solution directly into the discharge pipeline of the well pump. The chemical feed pump is typically wired to start and stop when the well pump starts and stops. Because the well water quality and pumping rate are relatively constant in most systems, there is no need for flow paced or compound loop chemical feed controls. For transient non-fecal coliform bacteria contamination, temporary or permanent disinfection of the distribution system using free chlorine residual will be required. In those cases, no CT requirement must be met. However, if the source is determined to be contaminated and CDPH mandates permanent disinfection treatment at the source, and a CT requirement will be imposed. CDPH requires four log virus removal, the formula for the required contact time is:

CT=0.2828 * (pH^2.69)*(Cl^.15)*(.933^(T-5))*L

Where:

CT=	Required contact time (mg/L - min)
pH=	pH of water (S.U.)
Cl=	Free chlorine residual (mg/L)
T=	Temperature, deg C
L=	Log removal (may vary depending on treatment)

The required contact time would then need to be compared to the existing contact time. If the existing contact time is less than the required contact time then changes will need to be made to increase the existing contact time. It is likely that not enough contact time will be provided in the distribution pipeline between the source and the first consumer to meet the required CT. If that is the case, a chlorine contact tank or pipeline contactor will be needed.

A temporary chlorination system (without a contact tank) can be installed in an emergency situation in less than a day if a local supplier has the solution tank and pump in stock. Cost for a temporary system up to 1000 gpm well capacity would be approximately $2,500. A permanent disinfection system with a tank to provide additional contact time may cost up to $100,000.

5.2 Arsenic

Arsenic is tied with coliform as the most common contaminant with MCL exceedances in the TLB. Arsenic affects the broadest base of systems in terms of population and number of connections affected. Arsenic is a naturally occurring contaminant that is ubiquitous in nature. The presence of arsenic that exceeds the MCL is almost exclusively a groundwater issue. Surface water sources treated in the TLB do not contain arsenic at levels greater than the MCL. Arsenic in groundwater is regional. Its presence is much greater in western and southern parts of the San Joaquin Valley than in other areas. According to CDPH, Kern County has the highest number of active water sources with peak arsenic detections greater than the MCL. Its presence is more common in deep groundwater rather than shallow groundwater. However, the possibility of arsenic contamination exists for almost any well drilled in the TLB.

Depending on oxidation-reduction conditions in the groundwater aquifer, either arsenite (As +3) or arsenate (As +5) will be the predominant species of arsenic. Arsenate is the predominant species under aerobic conditions. Arsenite is the predominant species under anoxic conditions with pH greater than 8 S.U. To remove arsenic from water the arsenic must be in the arsenate (As +5) state. In order to accomplish this, the pH must be lowered to below 7.0 standard unit (S.U.) and the arsenite must be oxidized to convert most of the arsenic to arsenate. The oxidation can be accomplished by the addition of chlorine, potassium permanganate, hydrogen peroxide, aeration or accomplished electrically. After oxidation, the following treatment processes can be used to remove the arsenate from the water.

5.2.1 Arsenic Treatment Alternatives

Arsenic treatment alternatives include the following broad categories that are generally applicable in the TLB:

- Adsorption processes, including iron-based adsorbents and activated alumina;
- Iron Coagulation filtration (ICF) or oxidation/filtration;
- Ion exchange (IX).

ICF and adsorption are currently the most commonly applied technologies in the TLB. The selection of the best technology for a community requires a site specific engineering analysis that considers the size of the system, peak and average water production rates, water chemistry and presence/absence of other contaminants or interfering constituents, location, technical and managerial capability and other factors.

5.2.2 Adsorption

5.2.2.1 Activated Alumina

Activated alumina, a highly porous and adsorptive form of aluminum oxide, can be effective in removing arsenic and it can also be used for the removal of fluoride. It is not commonly used because of the operational complexity of regenerating the activated alumina. Regeneration requires multiple steps including pH reduction, backwashing and final pH adjustment. It is not recommended for DAC communities unless fluoride removal is also required.

5.2.2.2 Iron Based and Other

The adsorptive media most commonly used for arsenic treatment are iron-based (e.g. iron oxide and granular ferric hydroxide), although titanium based materials are also commercially available. The primary advantage of iron based adsorption treatment over the other treatment technologies is simplicity of operation. The media is placed inside pressure vessel contactors and there are no moving parts associated with the adsorption system. Backwashing of the media bed is usually only required infrequently and most systems that are currently used do not regenerate the media. When the arsenic levels leaving the treatment system approach the MCL (referred to as breakthrough), the spent media is removed and replaced with new media. As with other arsenic treatment technologies, it is almost always necessary to add acid to depress the pH to approximately 7 and chlorinate the water prior to treatment. It may also be necessary to raise the pH back up after treatment in order to avoid corrosion problems in the distribution system. Several naturally occurring ions will interfere with this treatment process. The most common interfering constituents are silica, phosphate, and vanadium. High concentrations of interfering or competing constituents may significantly reduce the media life and may significantly affect the economic viability of the process.

Despite the relative simplicity of the process, there have been several documented failures involving adsorptive treatment plants not meeting performance predictions established during design. The media is expensive and DAC systems will likely struggle to pay for an unplanned media replacement that they have not budgeted for. This has resulted in increased scrutiny by regulatory and funding agencies whenever this process is proposed. It is highly recommended that a full pilot study be performed prior to constructing an adsorption treatment plant. Piloting this technology can be time consuming and expensive. The CDPH requirement for piloting adsorptive media is that the pilot must be conducted for a year's time. The yearlong pilot study is essential to determine the expected life of the media so that accurate operations costs can be determined.

5.2.3 Ion Exchange (IX)

For groundwater systems with TDS less than 500 mg/L and sulfate less than 150 mg/L, ion exchange (IX) for arsenic removal can be considered; however, implementation of IX treatment for arsenic removal is rarely the most cost effective alternative. This is due to sensitivity of the process to pH changes and the competition for the arsenic ion exchange sites with other constituents in the water. Ion exchange is not applicable for systems with TDS concentrations greater than 500 mg/L because the TDS will interfere with ability of the IX media to remove arsenic. In the IX process, water is passed through a 2.5 to 5 feet deep bed of chloride-form strong base anion exchange resin. The chloride on the resin is exchanged for the arsenic and the arsenic is retained within the resin. When the resin is exhausted, it is regenerated with a high strength chloride solution (brine) to remove the arsenic from the resin and reinstate the chloride. The regeneration waste stream will be high in arsenic (but below hazardous waste concentrations) and TDS/EC and will require off-site disposal.

High concentrations of arsenic have the potential to lead to short resin run times (the time until regeneration is required) and arsenic breakthrough. Arsenic breakthrough happens when the resin is not thoroughly regenerated and some of the arsenic not removed passes into the treated water stream. Arsenic breakthrough can also happen in the presence of particulate iron.

Sulfate affects the run length of the resins. Sulfate is exchanged with the resin preferentially over arsenic. Therefore, any sulfate in the water will take up capacity of the resin meaning the full resin capacity is not available to arsenic.

5.2.4 Iron Coagulation Filtration

The iron coagulation filtration (ICF) system uses iron, usually in the form of liquid ferric chloride, to co-precipitate arsenic. The arsenic is first oxidized to the arsenate (As+5) state, usually with chlorine addition. In the arsenate state, the arsenic will adsorb onto the iron hydroxide precipitates which are subsequently removed in a filtration process. Most arsenic treatment systems will utilize pressure filters; however, conventional gravity filters and membrane filters will work as well. Various media can be used in the granular filtration processes; typical media include silica sand, manganese greensand, anthracite and proprietary media. The effectiveness of the coagulation filtration system depends on the raw water quality, pretreatment chemicals used, and effectiveness of the backwashing of the filter media.

The filtration equipment used in the ICF process is identical to that of more conventional water treatment processes such as sedimentation followed by filtration. As such, the filters must include a method for backwashing and rinse-to-waste with the associated backwash water handling system. Backwash intervals typically range from 6 to 12 hours of run time. All ICF filtration processes will incorporate several open-close actuated valves in order to accommodate filter backwashing.

Because of the multiple chemical feed systems required (e.g. acid, sodium hypochlorite, ferric chloride, and potentially caustic) and the number of moving parts and active controls in the system, ICF treatment plants tend to be not cost effective for very small water sources (< 100 gpm) due to high capital cost of the equipment per gallon of water treated.

ICF systems are especially applicable to larger water treatment systems, where multiple contaminants must be removed (e.g. manganese, iron, hydrogen sulfide, color in addition to arsenic) and where arsenic concentrations in the groundwater are high (greater than 20 to 25 µg/L). In these systems the use of adsorption or IX would lead to rapid exhaustion of the media or inefficient removal of co-contaminants. ICF is not affected by the presence of sulfate, high TDS and other water constituents to the same extent that they interfere with adsorption or IX.

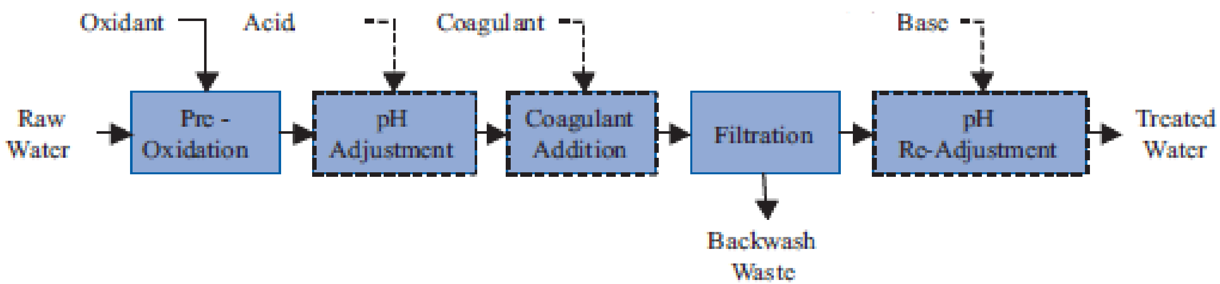
The ICF process produces an iron/arsenic sludge from the filter backwash process. The filter backwash is usually captured in a tank where the sludge settles to the bottom. The clarified water higher up in the tank is recycled back to the treatment process leaving a more concentrated sludge. Depending on the amount of arsenic removed, and the solids concentration achieved, the sludge may be classified as hazardous waste. If the waste is not hazardous, it may be possible to discharge to a sewer, if available. Otherwise it will need to be thickened and possibly dewatered and disposed at an off-site facility. There are a limited number of sites that can accept arsenic sludge as a hazardous waste. Disposal of the arsenic sludge is a major cost factor in the selection of this treatment process.

An ICF arsenic water treatment plant requires a relatively high skill level for effective operation. In theory, the system should be capable of operating automatically and unattended most of the time. However, in practice, many of these systems require more frequent operator intervention in order to operate efficiently and reliably. The installation of a treatment system will require an operator with at least a grade T2 or T3 license. Most simple water systems that use only chlorine for routine disinfection require only a T1 licensed operator. Operator requirements are discussed in Section 5.10.

A typical flow diagram for an ICF system is shown in Figure 5-1. The capital cost (equipment only) is in the range of \$0.50 to \$1.00 per gallon per day of capacity. The actual construction costs will be 3 to 4 times the equipment costs. Operating costs are between $500 and $700 per million gallons treated.

There are several ICF systems of various capacities currently operating in the TLB such as Home Garden, Delano and Corcoran.

Figure 5-1 – Coagulation Filtration Flow Diagram



5.3 Nitrate

The treatment of water for nitrate removal in the Central Valley has been extremely challenging and has been rarely accomplished. The most commonly available nitrate removal treatment technology, ion exchange (IX), generates a significant volume of concentrated “brine” waste that is difficult to dispose. The lack of an environmentally sound and economical means of disposing brine waste has been a major impediment to use of IX for nitrate removal. Reverse osmosis (RO) can also be used for nitrate removal and may be an advantageous means of treatment if there are other ionic contaminants in the water such as arsenic and uranium or there is a high total dissolved solids (TDS) level. RO produces a concentrate side stream of high TDS water that, like brine, is difficult to dispose in an economical and environmentally sound manner. Because the Tulare Lake Basin is an enclosed basin, with no outlet to the ocean, increased mineralization of groundwater is a major, basin wide water quality concern. The RWQCB has adopted a water quality plan (Basin Plan) that essentially prevents the discharge of salts, brine, and concentrates in the TLB. Some communities in southern California have constructed “brine” sewer outfalls that carry mineralized, salty water to wastewater treatment plants that discharge to ocean outfalls. These brine outfalls provide an environmentally safe and economic means of disposing waste streams from nitrate treatment plants. Consequently, whereas IX or RO for nitrate removal is rare or absent in the TLB, it is more common in southern California.

Within the TLB, when there are nitrate contamination issues in the water supply, it has been more practical to abandon wells and locate another source or blend, than to treat and handle the waste. Recently, multiple suppliers have proposed and are testing the use of biological nitrate removal treatment processes. These treatment technologies promise to resolve the brine and concentrate waste disposal issues by utilizing microorganisms to metabolize the nitrate to nitrogen gas. These technologies have experienced some early success, yet one of the major remaining questions is how reliable the processes are going to be, especially in a DAC setting where constant oversight of the treatment process is not practical. Biological nitrate removal processes are currently under review by CDPH and is being piloted in the City of Delano.

5.3.1 Ion Exchange (IX)

Ion exchange (IX) for nitrate treatment is currently the simplest and lowest-cost method for removing nitrate from groundwater. The process is mature, well developed and can provide consistent, reliable low nitrate water. As discussed above, the major impediment to its use is disposal of brine utilized to regenerate the IX resins.

The nitrate removal IX process consists of vessel(s) containing resins formulated specifically for nitrate removal. Water flows through the vessel and exchanges a negatively charged chloride ion for a negatively charged nitrate ion on the resin surface, similar to the process for arsenic removal. Chloride-form, strong-base anion exchange resins are used for nitrate removal. The resins are housed in pressure vessels. The number and size of pressure vessels will vary depending on the flow rate to be treated. When the resin is nearly exhausted (no further capacity to exchange nitrates), it will be regenerated with a concentrated brine (sodium chloride) solution.

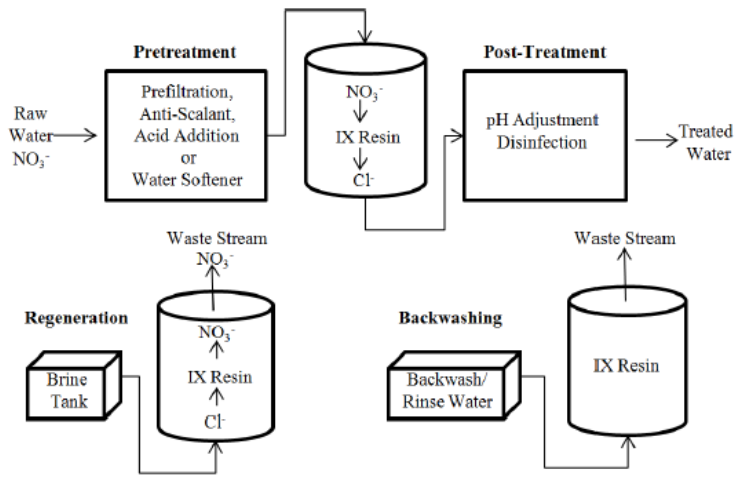
The resins used for nitrate treatment also remove other negatively charged ions. The general affinity of standard anion exchange resins is, in order of greatest to least affinity; perchlorate, sulfate, arsenate, nitrate, chloride, and bicarbonate. Therefore the sulfate (and perchlorate if present) content in the raw water will influence the volume of water that can be treated prior to nitrate breakthrough. For waters with high sulfate levels, nitrate selective ion exchange resins are available. The nitrate selective resins have the following order of ion affinity; nitrate, sulfate, arsenate, chloride, and bicarbonate.

The nitrate and salt-laden regeneration waste cannot be disposed of into useable groundwater or surface waters, including irrigation ditches, because the high salt and nitrate content would impair the beneficial uses of the receiving water. The disposal of these wastes would require an NPDES permit or issuance of Waste Discharge Requirements from the Regional Water Quality Control Board. The high concentration of salts will preclude the issuance of these permits in the TLB. It may, however, be possible to dispose of this type of waste through deep well injection into a deep saltwater zone.

A typical flow diagram for a nitrate ion exchange system (from the Drinking Water Treatment for Nitrate as submitted to the California Legislature, aka the “Harter Report”) is shown in Figure 5-2. The construction costs (equipment and site improvements) will be between $0.30 and $1.21/1000 gallons capacity. Operating costs are between $460 and $4,650 per million gallons treated. The wide range in operating costs is due to other treatment equipment that may be needed due to other water quality issues and the cost of disposing or treating the regeneration waste.

The McFarland Mutual Water Company in the City of McFarland (Kern County) constructed an IX nitrate removal system in the 1990’s. Its use was soon abandoned because of brine disposal issues. There are no known IX treatment plants for nitrate removal currently operating in the TLB. However, Ionex is testing an ion exchange system for nitrate removal in Springville, California that has the potential to lessen the volume of residuals produced.

Figure 5-2 – Nitrate Ion Exchange Flow Diagram



5.3.2 RO Membranes

RO membranes can be used to remove nitrate from water. Typically, a cartridge filter precedes the high pressure pump needed to pump to the RO membranes. Additionally there would be systems for scale inhibitor and the cleaning/flushing system. Typical concentrate reject (the concentrated pollutant stream from an RO system) can range from 20 to 50 percent of the feed water. The high RO reject rates cause two potentially significant problems. The first is that the water source must be capable of supplying up to twice the amount of water needed by the system to account for the fact that up to 50 percent of the feed water will be rejected. The second problem is waste disposal. The concentrate reject will be high in contaminants and salinity and may not be able to be discharged to a wastewater treatment plant. This may mean large evaporative ponds or deep-well injection will be needed to dispose of the reject. In areas with limited groundwater availability, other treatment processes that do not waste as much water may need to be considered, even if those processes are more expensive.

5.3.3 Biological Denitrification – Emerging Technology

Biological denitrification exploits the ability of certain naturally-occurring bacteria to metabolically convert nitrate to inert nitrogen gas under anoxic conditions (absence of oxygen). Biological denitrification uses an organic carbon substrate, such as methanol, ethanol or acetic acid, as an electron receptor for the reaction. The carbon dosed water passes to the denitrification reactor where reduction of nitrate occurs. Microbes utilize the nitrate as a respiratory electron acceptor in the oxidation of the organic carbon substrate. Some biological denitrification systems in development may also have the potential to remove other contaminants, such as perchlorate, DBCP, 1,2,3-TCP, PCE, and chromium-6. As discussed previously, biological denitrification does not produce brine, concentrate or concentrated nitrate as a waste product, nor does it significantly affect the total dissolved solids (TDS) or electrical conductivity (EC) of the treated water. The denitrification process results in the reduction of nitrate to nitrogen gas, which is degassed from the water and discharged to the atmosphere. The only waste products from biological denitrification are from filter backwashing and biological solids wasting. These waste streams can be disposed in an environmentally sound manner in the TLB in lagoons or land application.

Biological denitrification is an emerging technology and several process designs are currently being evaluated. The process is not currently approved by CDPH, but it is actively undergoing development and pilot testing. Most reactors fall into one of three categories; fixed bed; fluidized bed; and membrane bioreactor. All reactors have to incorporate a means of cleaning the filter or support medium to remove excess biomass that accumulates. Because organic carbon is added to the water, dissolved oxygen is reduced, and the growth of bacteria is enhanced, significant post-treatment is required. Typically this involves re-aeration followed by filtration or alternatively aerated filters can be used.

The main concerns with biological denitrification are the potential for contamination of the treated water with bacteria, residual organic carbon in the treated water and the possibility of nitrite formation as a byproduct of incomplete treatment. Post treatment with clarification and/or filtration is necessary to remove any bacteria carried over from the biological process. The presence of carbon sources, such as methanol, may also be considered undesirable on health grounds. Biological denitrification processes require a long start up period of up to six weeks in order for the biomass to establish itself. However, once initial start-up is complete and the de-nitrifying bacteria are well established, the developers of these processes claim that the systems can operate intermittently. A high degree of monitoring and control is required to ensure proper operation of the process. The economics of biological denitrification is dominated by the cost of the carbon source (methanol, ethanol or acetic acid). As with any biological treatment system, the process is dependent on a continuous and reliable “food” (carbon) source.

The primary advantage of this system in the TLB over other processes such IX or RO is the complete absence of a brine or concentrate waste stream. There are currently no environmentally acceptable or economical acceptable means of brine or concentrate disposal in the TLB. Piloting is currently being performed in Delano for biological denitrification removal to evaluate this process for water treatment. Biological denitrification offers the possibility of using a process that produces only a biological waste solids stream, which can be permitted in the TLB.

5.4 Disinfection Byproducts (DBPs)

Disinfection byproducts are formed when organic material in water is exposed to chlorine or other disinfectants. Organic material is normally present at higher concentrations in surface water systems than groundwater systems. For water systems that use only chlorine for disinfection, as most DACs do, two classes of disinfection byproducts are typically formed; trihalomethanes (THMs) and haloacetic acids (HAA). Total trihalomethanes (TTHM) and a total of five haloacetic acids (HAA5) are regulated with MCLs of 80 µg/L and 60 µg/L, respectively. The communities that had TTHM exceedances were surface water systems or were combined ground and surface water systems.

Technical enhancements intended to reduce the formation of DBPs generally fall into four categories:

1. Changing sources or improving source water quality;
2. Enhancing the removal of background naturally occurring organic matter (NOM), also known as DBP precursors, prior to disinfection;
3. Changing disinfection practices to reduce the rate at which DBPs are formed; and,
4. Removing DBPs after they have formed.

It is almost always more efficient and cost effective to implement the first three strategies than removing DBPs after they have been formed.

5.4.1 High-Pressure Membranes (Reverse Osmosis)

High pressure, high rejection (tight) membranes, such as nano-filtration or reverse osmosis (RO) membranes, are highly effective at removing organic material that can react with chlorine to form THMs and HAAs. RO is also effective at removing THMs and HAAs after they have formed, however it is rarely cost effective to do so.

Membrane systems require extensive pretreatment to prevent fouling by particulate matter, scaling or biofouling. High pressure membrane systems use differential pressures significantly greater than those typically used in surface water treatment to force water through a membrane and therefore tend to be very energy intensive. The retained solids are concentrated in a reject or waste stream that is discharged from the membrane system.

Membranes must be backwashed periodically to dislodge particles that have accumulated on the membrane surface. The backwash water, which will be high in contaminants, will need to be disposed of appropriately. The membranes will require chemical cleaning to reduce membrane fouling (particulate buildup on the membranes).

Typical concentrate reject for an RO system can range from 20 to 50 percent of the feed water. The high RO reject rates cause two potentially significant problems. The first is that the water source must be capable of supplying up to twice the amount of water needed by the system to account for the fact that up to 50 percent of the feed water will be rejected. The second problem is waste disposal. The concentrate reject will be high in contaminants and salinity and may not be able to be discharged to a wastewater treatment plant. This may mean large evaporative ponds or deep-well injection will be needed to dispose of the reject. In areas with limited groundwater availability, other treatment processes that do not waste as much water may need to be considered, even if those processes are more expensive.

Due to the complexity and capital/O&M costs associated with membrane treatment, it is only feasible for larger communities treating at least one million gallons per day.

5.4.2 GAC

Granular Activated Carbon (GAC) contactors can be used to treat water that has been previously filtered or supplied directly from a well water source. The GAC acts as both an adsorbent and as a filtering medium. The decision to use GAC should be based on a study to determine the time until the constituent(s) reaches break though (the point at which the constituent exceeds the targeted removal when it exits the GAC filter). Breakthrough time, also known as time to exhaustion of the media, will determine the economics of the system. When the GAC is exhausted, it must be replaced or regenerated. The effective life of GAC can be anywhere between a few months and three years, depending not only of the concentration of organic material but on other substances that may be also be adsorbed. The effective life is the amount of time the GAC can operate until the available sites on the carbon are used up.

GAC filters must be backwashed periodically for effective filtration and adsorption. This backwash water must be disposed of properly. If the filters are not adequately cleaned, both filtration and adsorption capacity will be lost, and mud balls will begin to form. Mudballs are round conglomerations of filter material, ranging in size from pea-sized to two inches or more in diameter. Mudballs form when adhesive materials cause particles out of the water and media grains to stick together.

5.4.3 Enhanced Coagulation Filtration

Filtration is used to remove turbidity and organic matter. The more effective the process is in removing organic matter, the lower the concentration of DBPs produced. Filtration may occur in conventional gravity filters or in pressure filters. Gravity multimedia filtration is considered conventional treatment. Conventional treatment includes coagulation, rapid mixing, flocculation, and sedimentation, followed by filtration. With pressure filters, direct filtration is often utilized, which skips the sedimentation step. Enhanced coagulation/filtration is often utilized in surface water treatment plants.

The filter media can consist of graded sand, anthracite coal and/or GAC, or a combination of the three media. Multi-media filtration usually consists of graded sand and anthracite. Depending on the raw water quality and chemicals added before filtration, organic matter that may form DBPs can be removed using conventional treatment. The filters require backwashing periodically to maintain contaminant removal capacity of the media. Conventional treatment requires significant operator attention to ensure all processes are operating correctly. Conventional treatment is normally feasible for plants of one million gallons per day or larger. Pressure filtration is often used in smaller capacity treatment plants.

5.4.4 Alternative Disinfection

Since chlorine used for disinfection can lead to DBP formation, alternative disinfection processes can be used that produce fewer DBPs. The most common alternative disinfection processes include ultraviolet (UV) radiation, ozonation, and chloramination. Even with an alternative disinfection process, some chlorine addition is generally required to provide a chlorine residual in the distribution system.

For UV disinfection to work properly, the turbidity of the water should be less than 1 NTU (nephelometric turbidity units). Natural organic matter (NOM), hardness, and other minerals can foul UV lamps causing a decrease in UV effectiveness. Dissolved inorganic constituents, such as iron, can precipitate on the lamps and decrease performance. A detailed water quality analysis should be done to determine if UV may be applicable to a specific water source. The capital cost of UV systems makes them feasible for plants treating more than one million gallons per day.

Ozone must be generated on-site as it is needed because it cannot be stored. Ozone is generated by passing an electrical current through air or pure oxygen. Ozone is commonly dispersed into water using a fine bubble diffuser. There must also be a system to collect ozone off-gas. Ozone generating installations must include a thermal or catalytic ozone destroyer. Ozone is so highly corrosive that only certain materials can be used in constructing treatment plant equipment. Ozone can also be effective in the treatment of hydrogen sulfide and other contaminants that produce taste and odor problems. It is commonly used in Europe but it is not widely utilized in the United States.

Chloramination is a disinfection process that utilizes a mixture of chlorine and ammonia to produce chloramines. The ammonia reacts with chlorine thus eliminating free residual chlorine and making the free chlorine unavailable to further react with organic matter. Chloramines are less effective than free residual chlorine in disinfection; however they form fewer DBPs. In most water systems that use chloramines as the principal disinfectant, the ammonia is added at a point downstream from the initial chlorine application so that microorganisms, including viruses, will be exposed to free chlorine for a short period before chloramines are formed. Chloramination must be carefully controlled and monitored to prevent nitrification in the distribution system.

5.5 Uranium

Uranium is a naturally-occurring radioactive element found at low levels in virtually all rock, soil, and water. About 99 percent of the uranium ingested in food or water will leave a person’s body in feces, and the remainder will enter the blood. Intakes of uranium exceeding drinking water standards can lead to increased cancer risk, liver damage, or both.

5.5.1 Adsorption

There is a vendor (Water Remediation Technology - WRT) that manufactures an adsorptive media designed specifically to remove uranium from drinking water. Currently, WRT is the only CDPH approved adsorptive media for uranium treatment. The process removes uranium by passing the water through a fluidized bed of a proprietary adsorptive media in a pressure vessel. This system is unique in that the treatment system supplier enters into a contract with the water agency to dispose of the low level Naturally Occurring Radioactive Material (NORM) waste generated by the process. Because WRT is the only supplier that has the necessary licenses to handle the NORM disposal, this system is currently the only adsorptive system approved by CDPH.

5.5.2 Ion Exchange (IX)

The most stable state of uranium in groundwater is as UO_2^{2+}, which forms soluble complexes with carbonate, CO_3^{2-}. Under neutral and slightly alkaline conditions, UO_2^{2+}, combines with bicarbonate and carbonate anions to form uranyl carbonates which have a strong affinity for ion exchange resins. Strong base anion (SBA) exchange resins have been shown to have the most capacity for uranyl carbonates. Similar to arsenic removal using IX, the uranium is exchanged for chloride. Typical run lengths for uranium IX are in the range of 30,000 to 50,000 bed volumes. Ion exchange for uranium removal works within a pH range of 6 to 8 SU (Standard Unit). However there is a substantial decrease in the resins capacity for uranium at a pH below 7. Additionally, the concentrations of sulfates and chlorides in the water will affect the capacity of the resin.

When the resins are regenerated, the waste water will contain elevated levels of uranium that may make it difficult to dispose of the waste water since they may be classified as a hazardous waste.

5.5.3 RO Membranes

RO membranes can be used to remove uranium from water. Typically, a cartridge filter precedes the high pressure pump needed to pump to the RO membranes. Additionally there would be systems for scale inhibitor and the cleaning/flushing system. Typical concentrate reject for an RO system can range from 20 to 50 percent of the feed water. The high RO reject rates cause’s two potentially significant problems. The first is that the water source must be capable of supplying up to twice the amount of water needed by the system since up to half of the flow will be lost to concentrate reject. The second problem is waste disposal. The concentrate reject will be high in contaminants and salinity and may not be able to be discharged to a wastewater treatment plant. This may mean large evaporative ponds or deep-well injection will be needed to dispose of the reject. In areas with limited groundwater availability, other treatment processes that do not waste as much water may need to be considered, even if those processes are more expensive.

5.6 Fluoride

There are no systems in the TLB that have fluoride as the only MCL exceedance. There are several systems that have fluoride with other contaminant exceedances; four in Kern County violated the State MCL of 2.0 mg/L. The federal standard for fluoride is 4.0 mg/L. CDPH can allow a variance in the fluoride standard following a procedure that requires public notification and approval. This variance allows for exceedance of the state MCL of 2.0 mg/L as long as the federal MCL of 4.0 mg/L is met.

5.6.1 Adsorption – Activated Alumina

Activated alumina, an inorganic adsorbent, is an excellent medium for fluoride removal. Alumina is superior to any synthetic anion-exchange resin because fluoride has a higher ion affinity with alumina, whereas with resins, fluoride is the least preferred of the common anions.

The pH of the raw water must be adjusted to between 5.5 and 6.0 and then passed through the activated alumina bed. Following exhaustion, the medium is backwashed and then subjected to a two-step regeneration with base followed by acid. The spent-regenerant brines are normally neutralized and sent to a lined evaporation pond for interim disposal. The ultimate disposal of high-fluoride salt residues is a problem that still remains unsolved.

5.7 DBCP

1,2-Dibromo-3-chloropropane (DBCP) was used primarily as a nematocide for soil fumigation. Drinking water in excess of the MCL for many years could result in reproductive difficulties, and may result in an increased risk of getting cancer.

5.7.1 GAC

The cities of Fresno and Clovis have used GAC for wellhead treatment of DBCP. Granular Activated Carbon (GAC) contactors can be used to treat water that has been previously filtered or directly from a water source. GAC can be used for any sized system. The GAC vessels can range from units that serve a single building or home up to units to serve a large city. The GAC acts as both an absorbent and a filtering medium. The decision to use GAC will depend on a study of how long the adsorption qualities of the GAC will last, how much it will cost to remove exhausted material, and how much it will cost to have the old material either reactivated or replaced with new material. The effective life of GAC can be anywhere between a few months and three years depending not only of the concentration of DBCP but on other substances that may be removed too.

The GAC filters must be backwashed periodically for effective filtration and adsorption. If the filters are not adequately cleaned, both filtration and adsorption capacity will be lost, and mudballs will begin to form. This backwash water must be disposed of properly since it will contain elevated levels of DBCP.

5.8 Perchlorate

Perchlorate is both a naturally occurring and man-made chemical that is used to produce rocket fuel, fireworks, flares and explosives. Perchlorate may have adverse health effects because scientific research indicates that this contaminant can disrupt the thyroid’s ability to produce hormones needed for normal growth and development.

5.8.1 Ion Exchange (IX)

Perchlorate has a very high affinity for the common polystyrene SBA (strong base anion) resins. Perchlorate exchange is similar to nitrate removal by ion exchange, except that perchlorate has a much higher affinity for resins than nitrate. IX for perchlorate treatment has the same benefits and challenges as previously described for ion exchange processes.

5.8.2 GAC

GAC can be used for perchlorate removal similar to DBCP removal. See Section 5.7.1 for details regarding GAC treatment.

5.9 PCB

There is one identified systems in the TLB area that has a PCB (polychlorinated biphenyl) MCL exceedance.

5.9.1 GAC

GAC can be used for PCB removal similar to DBCP removal. However, if there is turbidity in the water, pre- and post-filtration may be needed around the GAC units. PCB's will attach to colloidal material or carbon fines and pass through the carbon bed without being adsorbed.

5.10 Operator Requirements

All suppliers of domestic water to the public are required to be operated and maintained by operators who are certified at the appropriate level, assuring the protection of public health and safety. CDPH is the certifying agency in the state of California. Certified operators are required to receive on-going training to ensure that their knowledge of treatment, operations, and public health issues remains current. Certified operators must be knowledgeable of the following elements:

- California Safe Drinking Water Act and regulations promulgated pursuant thereto.
- Water treatment calculations.
- SCADA (Supervisory Control And Data Acquisition) operation.
- Handling of laboratory chemicals used for drinking water analyses.
- Laboratory analyses conducted by operators.
- Safety training.
- Distribution system operation.
- Treatment chemical dosing and monitoring.
- Treatment process and controls.

Water treatment operator certifications are classified as T1, T2, T3, T4 and T5 depending upon the class designation of the water treatment facility. Class designations are based upon total points. Points are determined using the following criteria:

Table 5-1: Water Treatment Class Designation Points

Type of source water used by the facility	
Groundwater	2 points
Surface water or ground water under the direct influence of surface	5 points
Influent water microbiological quality points based upon median coliform density	
Less than 1 per 100 ml	0 points
1 through 100 per 100 ml	2 points
Greater than 100 through 1,000 per 100 ml	4 points
Greater than 1,000 through 10,000 per 100 ml	6 points
Greater than 10,000 per 100 ml	8 points
Influent water turbidity points based upon NTU	
Less than 15	0 points
15 through 100	2 points
Greater than 100	5 points
Influent water nitrate and nitrite points	
Less than or equal to the MCL	0 points
Greater than the MCL	5 points
Influent water chemical and radiological contaminant points	
Less than or equal to the MCL	0 points
Greater than the MCL	2 points
5 times the MCL or greater	5 points
Points for surface water filtration treatment	
Conventional, direct, or inline	15 points
Diatomaceous earth	12 points
Slow sand, membrane, cartridge, or bag filter	8 points
Backwash recycled as part of process	5 points
Points for disinfection treatment	

Ozone	10 points
Chlorine and/or chloramines	10 points
Chlorine dioxide	10 points
Ultra violet (UV)	7 points
Points for disinfection treatment without inactivation credit	
Ozone	5 points
Chlorine and/or chloramine	5 points
Chlorine dioxide	5 points
Ultra violet (UV)	3 points
Other oxidants	5 points
Points for any other treatment not listed	
Other treatment processes	3 points

Based upon the total points from the above table, the facility and operator classification is determined from the following table.

Table 5-2: Operator Classification Based on Class Designation Points

Total Points	*Class*
Less than 20	T1
20 through 39	T2
40 through 59	T3
60 through 79	T4
80 or more	T5

A ground water system with only chlorination would be classified as a T1 facility. If improvements would be made to treat the water, it is likely the additional points would reclassify the system as a T2 or T3 facility. The higher the operator certification required, the more experience and education is required by the operator. Therefore, higher level operators can demand a higher salary compared to lower level operators.

5.11 Summary of Treatment Technologies

5.11.1 <u>Decision Trees</u>

In order to aid communities in determining potential technical solutions to their water quality issues, decision trees were developed (**Appendix E**). The decision trees are designed to highlight the information needed, major processes and decisions needed to be made to determine which technical solutions may be applicable to a particular community. More details of the decision trees can be found in Section 5.12 Use of Decision Trees. Table 5-3 summarizes some of the pros and cons of the treatment technologies discussed above. Selection of a treatment process will be site specific for each water system based on various considerations such a water quality, treatment residuals disposal, etc. It is therefore necessary for an engineer to assist any community considering water treatment.

Table 5-3: Summary of Treatment Technologies

Treatment Technology	Pros	Cons
Chlorination	Inexpensive, simple, common	May form DBPs if organics are present. Safety of handling. Adds to mineralization of water.
Adsorption	Easy to operate	Non-selective; often requires pH adjustment for optimum performance
		Difficult to predict performance and time to exhaustion of media
		Requires replacement or regeneration of media. Disposal of media may be issue for some contaminants.
		De-sorption possible
Ion Exchange (IX)	Well established technology	Other contaminants can foul or compete for adsorption
	Effective for nitrate and hardness removal	Moderately complex to operate; requires regular regeneration
		Brine disposal is a major issues
Coagulation Filtration (CF)	Cost effective for larger systems	High operator involvement; requires regular backwashing
	Effective and proven technology	High O&M costs
		Disposal of backwash water and solids
Membranes (RO, NF or MF)	Effective at removing multiple contaminants	Other contaminants can foul, interfere, or require pretreatment
	Removes TDS and is effective at removing many secondary contaminants	High capital cost; High operator involvement
		For RO and NF, low water recovery (high

Treatment Technology	Pros	Cons
		reject flow)
		High O&M costs
		Concentrate disposal (RO and NF)
GAC	Easy to operate	Moderate capital cost
	Effective at removing a wide range of organics	Challenges with GAC regeneration. Virgin replacement GAC most commonly used.
	Does not add to mineralization of water	Nitrate dumping
Gravity multimedia filtration	Effective and proven technology	High capital cost and operator involvement
		Backwash and solids handling
Alternate Disinfectants	Reduced DBP formation	More costly than chlorine; some have no residual disinfection capability
		Complexity; potential for nitrification with chloramines
		O&M Costs potentially higher
Biological Denitrification	Ability to discharge/dispose backwash and solids in TLB; no brine or concentrate issues	Unproven technology that has not yet been approved by CDPH; Requires supply of carbon based feed stock; uncertain performance in intermittent operation; high cost of carbon source

5.11.2 Combinations of Treatment for Multiple Contaminants

Table 5-4 shows the contaminants and contaminant combinations present in the Tulare Lake Basin study area sorted by number of connections based on available data as discussed in Section 3. This information is provided to illustrate the various contaminants in the study area and the size of water systems they are seen.

Table 5-5 shows the treatment possibilities for the various contaminant combinations present in the Tulare Lake Basin. Where multiple treatment systems are possible, the preferred treatment process is shown with asterisks and is based upon the treatment systems discussed in Section 5.

5.11.3 Individual Household Treatment Systems

For those community water systems that serve 15 or less connections, it may not be cost effective to install a treatment system to treat raw water at the well site. For these cases it may be beneficial for the community to install point-of-use or point-of-entry at each individual connection. Details of these individual household treatment systems can be found in the Individual Households pilot study.

Table 5-4: Contaminant Combinations

Water System Size	Coliform Only	Arsenic Only	Nitrate Only	THM Only	Uranium Only	Fluoride Only	DBCP Only	Perchlorate Only	PCB Only
Less than 15 connections	0	0	1	2	0	0	0	0	0
15 to 50 connections	9	3	6	7	1	0	0	0	1
51 to 200 connections	7	0	4	2	0	0	0	0	0
201 to 500 connections	0	7	0	0	1	0	1	0	0
501 to 2000 connections	1	5	2	0	0	0	0	0	0
More than 2000 connections	0	2	0	0	0	0	1	0	0
Total	**17**	**17**	**13**	**11**	**2**	**0**	**2**	**0**	**1**

Water System Size	Coliform and Arsenic	Coliform and Nitrate	Arsenic and Uranium	Coliform and Uranium	Nitrate and Perchlorate	Nitrate and Uranium	Arsenic and Nitrate	Nitrate and DBCP
Less than 15 connections	0	1	0	0	0	0	0	0
15 to 50 connections	1	1	3	1	1	0	0	0
51 to 200 connections	0	2	2	0	0	1	0	1
201 to 500 connections	0	0	0	0	0	0	0	0
501 to 2000 connections	0	0	3	0	1	0	0	1
More than 2000 connections	0	0	1	0	0	0	1	0
Total	**1**	**4**	**9**	**1**	**2**	**1**	**1**	**2**

Water System Size	Uranium and Fluoride	Arsenic and Perchlorate	Arsenic Fluoride & Uranium	Arsenic, Nitrate, Uranium & Fluoride
Less than 15 connections	0	0	0	0
15 to 50 connections	0	0	0	0
51 to 200 connections	0	0	0	0
201 to 500 connections	1	0	1	1
501 to 2000 connections	0	0	0	1
More than 2000 connections	0	1	0	0
Total	**1**	**1**	**1**	**2**

Table 5-5: Treatment Possibilities

Connections	Coliform Only	Arsenic Only	Nitrate Only	THM Only	Uranium Only	Fluoride Only	DBCP Only	Perchlorate Only	PCB Only
Less than 15 connections	------------	-------------	3*	5,6*,7*,8	------------	------------	---------	-------------	-------
15 to 50 connections	1*, 8	2*,3,5	3*	5,6*,7*,8	2*,3	------------	---------	-------------	6*
51 to 200 connections	1*, 8	-------------	3*	5,6*,7*,8	------------	------------	---------	-------------	-------
201 to 500 connections	------------	2,3,4*,5	------------	-------------	2*,3	------------	6*	-------------	-------
501 to 2000 connections	1*, 8	2,3,4*,5	3*,5	-------------	------------	------------	---------	-------------	-------
More than 2000 connections	------------	2,3, 4*,5	------------	-------------	------------	------------	6*	-------------	-------

Connections	Coliform and Arsenic	Coliform and Nitrate	Arsenic and Uranium	Coliform and Uranium	Nitrate and Perchlorate	Nitrate and Uranium	Arsenic and Nitrate	Nitrate and DBCP
Less than 15 connections	------------	1*, 8 and 3*	------------ -	-------------	------------	------------	------------ -	-------------
15 to 50 connections	1*,8 and 2*,3,5	1*, 8 and 3*	2* / 3 / 5	1*,8 and 2*,3	3* and 6*	------------	------------ -	-------------
51 to 200 connections	------------	1*,8 and 3*	2* / 3 / 5	-------------	------------	3/ 2* and 3*	------------ -	3*,6*
201 to 500 connections	-------------	-------------	------------ -	-------------	------------	------------	------------ -	-------------
501 to 2000 connections	-------------	-------------	2,3 / 2*,3 and 4*	-------------	3* and 6*	------------	3*,5	-------------
More than 2000 connections	-------------	-------------	2,3 / 2*,3 and 4*	-------------	-----------	------------	------------ -	-------------

Connections	Uranium and Fluoride	Arsenic and Perchlorate	Arsenic Fluoride & Uranium	Arsenic, Nitrate, Uranium & Fluoride
Less than 15 connections	-------------	-------------	------------	------------
15 to 50 connections	-------------	-------------	------------	------------
51 to 200 connections	-------------	-------------	------------	------------
201 to 500 connections	2*,3	6* and 2,3,4*,5	2*/ 2 and 3 / 2 and 3 and 5	3* / 3 and 2 and 5
501 to 2000 connections	-------------	-------------	------------	3* / 3 and 2 and 5
More than 2000 connections	-------------	-------------	------------	------------

1 = chlorination (gas or liquid)
2 = adsorption
3 = ion exchange
4 = coagulation filtration
5 = membrane
6 = GAC
7 = gravity multimedia filtration
8 = alternative disinfection (amines, UV, ozone)
* = generally preferred treatment system

5.12 Use of Decision Trees

The decision trees were developed to guide communities to possible technical solutions. The processes in rectangles indicate an action that should be completed prior to moving forward. The processes in diamonds are decisions that the community should make in consultation with an engineer or other knowledgeable group. Below is an explanation of each decision tree in the order they should be used.

1) Technical Solutions Decision Starting Tree - This is the first decision tree that a community should use. It walks through some of the data that should be collected and some of the non-treatment technical solutions. Some decisions may lead to decision trees in the other pilot studies.
2) Non-treatment Technical Solutions Decision Tree – This decision tree guides the community through decisions regarding blending, connecting to a neighboring system, or teaming with a neighboring system to share O&M costs. Some decisions may lead to decision trees in the other pilot studies.
3) Treatment Technology Decision Tree – There are five trees that comprise the treatment technology decision tree.
    a. First decision tree (Part 1) goes through the alternatives evaluation, funding, and general design.
    b. Second decision tree (Part 2) goes through the various pollutants seen in the study area. The letters in the octagons reference the other treatment decision trees. After those treatment decision trees, the reader will be directed back to the second decision tree (Part 2) to go through the other pollutants.
    c. Third decision tree (Part 3) discusses treatment of arsenic and nitrate.
    d. Fourth decision tree (Part 4) discusses treatment of THM and uranium.
    e. Fifth decision tree (Part 5) discusses treatment of fluoride, perchlorate, coliform, DBCP and PCB.
4) Regional Water or Wastewater Facility Decision Tree – this decision tree discusses processes and items to consider for a community to join with other communities to construct a regional water or wastewater treatment facility.
5) Blending Decision Tree – this decision tree discusses the data needed and decisions to be made to determine if blending water to meet drinking water standards is a potential solution.
6) Dual Water System Decision Tree – this decision tree discusses the factors and decisions to be made to evaluate the possibility of providing a non-potable water distribution system for non-potable uses.
7) Residuals Management Decision Tree – this decision tree goes through many of the potential options disposing of residuals from a water treatment process.

8) Regional Residuals Management Decision Tree - this decision tree discusses processes and items to consider for a community to join with other communities to construct or operate a regional residuals management facility.
9) Energy Conservation and Renewable Energy Decision Tree – this decision tree discusses the decisions to be considered to evaluate the potential for energy conservation and renewable energy technical solutions.

5.13 Existing Treatment Systems In Study Area

Of the 89 systems with MCL exceedances, 34 employ some form of technical solution to their water quality. These technical solutions and the numbers employing that solution are:

- Chlorine only – 19
- Blending – 4
- Coagulation filtrations for iron/manganese – 2
- Coagulation filtration for arsenic – 2
- Granular activated carbon – 2
- Treatment listed with no additional details – 2
- Treatment systems for nitrate and perchlorate – 2

Table 5-6 shows the existing treatment systems by contaminant in the Study Area. It should be noted that the existing treatment system listed may not be sufficient to treat the pollutant(s) that caused an exceedance. For example, 8 out of 9 systems with arsenic and uranium exceedances have chlorine only for treatment. The chlorine is used for disinfection purposes. Chlorine, by itself, is not adequate to remove arsenic and uranium.

Twenty-eight of the 89 systems are currently under compliance orders either from CDPH or the EPA (**Appendix D**). A compliance order means the system has been given a deadline to show compliance with the water quality standards or else face increased enforcement actions or fines. Details of those systems with compliance orders are shown in Table 5-7.

Some of these systems are currently receiving funding from the State to explore options for addressing their particular water quality issues. Of the 89 systems that recorded at least one exceedance, 34 currently have some sort of State funding (SRF, Prop 84 and/or Prop 50) to pursue a solution to their water quality issue(s). As shown in Table 5-7, 55 systems of those 89 (61.8%) systems with exceedances do not have funding at this time. The most systems that indicate no funding in place have exceedances for TTHM (11 systems – 91.6%), arsenic (7 systems – 41.2%), arsenic and uranium (7 systems – 77.8%), and nitrate (3 systems - 23.1%).

Table 5-6: Existing Treatment in Study Area

Pollutant	# of systems with exceedances	# having treatment	Existing Treatment
Coliform only	17	0	
Arsenic only	17	1	Blending
		3	Chlorine only
		1	Coagulation filtration for iron/manganese
		1	Coagulation filtration for arsenic
		1	Ion exchange for arsenic. Greensand for iron/manganese
Nitrate only	13	2	Blending
		1	Chlorine only
		1	Treatment listed (?)
THM only	11	0	
Uranium only	2	0	
DBCP only	2	1	GAC
PCB only	1	0	
Coliform and arsenic	1	0	
Coliform and nitrate	4	0	
Arsenic and uranium	9	7	Chlorine only
Coliform and uranium	1	0	
Nitrate and uranium	1	1	Chlorine only. Uranium in active well. Nitrate in standby well.
Nitrate and perchlorate	2	0	
Arsenic and nitrate	1	0	
Nitrate and DBCP	2	2	Chlorine only
Uranium and fluoride	1	0	
Arsenic and perchlorate	1	1	Chlorine only
Arsenic & fluoride & uranium	1	1	Ion exchange, activated alumina, greensand
Arsenic & nitrate & uranium & fluoride	2	1	Reverse osmosis and blending
		1	Blending and uranium and fluoride. Coagulation filtration for iron/manganese
TOTALS	89	26	

Table 5-7: Systems with Compliance Orders and Funding

Pollutant	# of systems with exceedances	# with orders	Compliance Order	# with funding
Coliform only	17	0		1
Arsenic only	17	9	for arsenic	10
Nitrate only	13	2	for nitrate	10
THM only	11	3	for THM	0
Uranium only	2	1	for uranium	1
DBCP only	2	0		0
PCB only	1	0		0
Coliform and arsenic	1	1	for arsenic	1
Coliform and nitrate	4	1	for nitrate	3
Arsenic and uranium	9	2	for arsenic and uranium	2
Coliform and uranium	1	1	for uranium	0
Nitrate and uranium	1	1	for nitrate and uranium	1
Nitrate and perchlorate	2	1	for nitrate	0
Arsenic and nitrate	1	1	for arsenic and nitrate	1
Nitrate and DBCP	2	2	for nitrate and DBCP	2
Uranium and fluoride	1	1	for fluoride	1
Arsenic and perchlorate	1	1	for arsenic	1
Arsenic & fluoride & uranium	1	0		0
Arsenic & nitrate & uranium & fluoride	2	0		0
TOTALS	89	27		34

6 DESCRIPTION OF ALTERNATIVES – WASTEWATER

In addition to the water quality and supply issues faced by DACs in the Tulare Lake Basin, many communities also face issues with their wastewater. The wastewater issues may stem from the community relying on failing septic systems or wastewater treatment systems that are not capable of meeting applicable effluent limitations. Of the 353 DACs, 38 communities (11%) have their own wastewater treatment facility (WWTF) or discharge their wastewater to a nearby WWTF. The 38 communities are served by 35 RWCQB permitted WWTFs. These 38 communities make up 25.2% of the population in the study area. This implies that up to 74.8% of the population is not served by a wastewater treatment facility. According to the World Health Organization, 17% of the American population is served by septic systems. Therefore, people living in DACs in the TLB Study Area are over four times as likely to be on septic systems compared to the nation as a whole.

Of the 38 wastewater treatment facilities, 25 (65.8%) are listed as having a violation of their Regional Water Quality Control Board (RWQCB) waste discharge requirements (WDRs) in the period from 2010 to 2013. As a comparison, according to the State Water Resources Control Board there are 533 permitted WDRs in the State. Of these, 165 had violations (31.0%) in the period of December 2012 to December 2013. Therefore, it appears WDRs in the TLB study area have a higher percentage of violations compared to the State as a whole.

Of the 38 wastewater treatment facilities, 27 utilize some type of pond or lagoon treatment. The lagoon may be aerated by either mechanical surface aerators or submerged diffused aeration systems. Aerated lagoons typically are classified by the amount of mixing provided. A partial mix system provides only enough aeration to satisfy the oxygen requirements of the system and does not provide energy to keep all total suspended solids (TSS) in suspension. Aerated lagoons can reliably produce an effluent with both biochemical oxygen demand (BOD) and TSS < 30 mg/L. However, it may be difficult to meet a total nitrogen effluent concentration of 10 mg/L or less.

There are two systems that utilize trickling filters. Six communities use an activated sludge treatment system (two oxidation ditch, three traditional activated sludge plants, and one membrane bioreactor). Two systems provide tertiary treatment. One system uses a community septic system.

All 38 treatment systems discharge to land in some form – percolation, evaporation, or leachfields.

There are a number of communities that do not have their own wastewater treatment facility but have their wastewater treated at a neighboring city or community's wastewater treatment facility. For example, the Porterville WWTP treats the wastewater from the communities of Porter Vista (East Porterville) and Fairways Tract. The Cutler-Orosi regional wastewater treatment plant treats the wastewater from Yettem, Seville, East Orosi, Sultana, Cutler and Orosi.

If a community is without their own wastewater treatment facility or does not discharge to a neighboring wastewater treatment facility, then the households are likely served by individual septic systems. Depending on the age and upkeep of the septic systems, the septic systems may be failing and potentially polluting nearby groundwater. A possible technical solution for these communities is to install a sewer collection system and construct a community wastewater treatment facility or delivery to a nearby WWTF.

6.1 Improvements to Existing Wastewater Facilities

According to data supplied from the RWQCB, of the 25 treatment facilities that had a recorded violation, 24 had Category 1 violations and one had both Category 1 and Category 2 violations. Category 1 violations include BOD, chloride, nitrogen, oil and grease and suspended solids. Category 2 violations include organics, pesticides, and chlorine. There were no details as to which pollutant(s) limitation was exceeded for each category.

Of the 13 treatment facilities with no violations over the last three years, 12 were lagoon systems and one was a trickling filter. The 15 lagoon systems that did record a violation violated their WDRs due to BOD, TSS or nitrogen (either nitrogen, nitrate or nitrite) issues although the exact nature of the violation was not included in the data reviewed. To address TSS, an existing lagoon system could add additional lagoon volume to allow the suspended solids to settle prior to exiting the lagoons.

6.1.1 Extended Aeration

Process modifications can be made to an existing conventional sewage treatment facility's to allow for higher removal rates of nitrogen, BOD and TSS. In extended aeration, the aeration period is 24 hours or greater and the sludge age is longer. These factors allow for lower effluent BOD, TSS and nitrogen.

Some of the common extended aeration processes are the Biolac process and the use of sequencing batch reactor technology. The Biolac process uses a fine bubble aeration system. By controlling the air distribution system, the Biolac system can produce areas of nitrification and denitrification which will convert ammonia to nitrogen gas.

Sequencing batch reactors also create a longer sludge age. Sequencing batch reactors work on a batch basis. The influent into a basin is opened allowing the basin to fill. The wastewater is mixed mechanically so that no air is added. Then the basin is aerated by pumping air through fine bubble diffusers in the basin. The aeration is shut down and the solids are allowed to settle. The supernatant is then decanted for discharge.

6.1.2 Tertiary Treatment

The secondary sewage treatment plants could be improved by adding additional capacity, tertiary treatment (sand filters, biofilters), or improved operations of the existing facilities. Properly sized and operated activated sludge and tertiary treatment systems should be capable of meeting their WDR limitations.

Tertiary treatment filters can be added to the existing effluent from a secondary distribution system to provide for additional reduction of BOD, TSS and phosphorus. Tertiary sand filters can provide for removal of these pollutants between 95% and 98%.

Tertiary treated water can be disinfected and re-used for irrigation.

6.2 Servicing Unsewered Communities

In many small communities, each home and business has an individual onsite septic system consisting of a septic tank and a soil treatment area or leachfield. As communities grow, land often becomes too valuable to be dedicated to wastewater. Another common reason to upgrade local wastewater infrastructure is that approximately 50% of the individual onsite wastewater systems in the United States were built before most jurisdictions adopted modern standards for acceptable installation. If a significant number of individual onsite wastewater systems are malfunctioning, a community-scale wastewater solution may be warranted.

Those communities that do not have a wastewater facility have several potential options: construct a wastewater treatment facility to serve their community, join with nearby communities to construct a regional wastewater treatment facility, connect to an existing nearby wastewater treatment facility, or continue to utilize individual septic systems.

6.2.1 Sewer Collection System

If a community needs to abandon individual septic systems, the community would need to install a sewer collection system. A sewer collection system is used to collect wastewater from multiple sources and convey the wastewater to a central location. Most collection systems are gravity sewer systems. Properly designed and constructed gravity sewers are a viable collection option for urban areas, but can be expensive for small communities. The cost of gravity sewers may be prohibitive unless there is sufficient population density to justify the installation.

When considering options for paying for the collection system, the community must decide whether on-lot cost for installation, maintenance and repair will be borne directly by the landowner or spread across the community.

Installation costs include five major factors: pipe diameter, excavation depth, total length of pipe, restoration, and labor. While each of these factors is system-specific, the purchase and installation of gravity sewer components could easily range from $100 to $200 and more per foot of main line service. If gravity flow can be maintained throughout the system, there is no electrical requirement. If lift stations are needed, energy costs vary according to the number, specifications and size of the pumps used.

Table 6-1 shows the potential cost to the lot owner if the utility does not cover the materials and installation of on-lot components. The costs in the following tables are from the Water Environment Research Foundation (WERF) Fact Sheet on Decentralized Wastewater Systems.

Table 6-1: Lot Owner Costs for Sewer Connection

On-Lot Item	Cost Issues	Costs
Materials and Installation	Install building sewer and connect to sewer main	$1,800 - $2,700
Annual Electricity	No energy unless source needs lift pump to sewer main	$0
Annual O&M	Annualized cost to clean building sewer	$16 - $24 per year

Table 6-2 and **Table 6-3** provide three example gravity sewer systems developed and priced for flows ranging from 5,000 to 50,000 gpd. The costs presented are for comparison purposes only. The actual cost for a system will vary tremendously depending on site conditions and local economies. The costs for the systems include piping, manholes, installation, and maintenance. These examples do not include a lift station.

Table 6-2: Collection System Costs <u>Without</u> On-Lot Components

Network Cost	Wastewater Volume (gpd)		
	5,000 gpd or 20 homes	10,000 gpd or 40 homes	50,000 gpd or 200 homes
Materials and Installation	$210,000-$315,000	$419,000-$629,000	$2,182,000-$3,273,000
Annual O&M	$6,400-$9,600	$12,800-$19,200	$65,000-$97,000
Annual Electricity	Lift stations are the primary energy demand for gravity collection systems. The number of lift stations will depend on the system size and topography.		

Table 6-3: Collection System Costs <u>With</u> On-Lot Components

Network and On-Lot Cost	Wastewater Volume (gpd)		
	5,000 gpd or 20 homes	10,000 gpd or 40 homes	50,000 gpd or 200 homes
Materials and Installation	$234,000-$352,000	$469,000-$703,000	$2,429,000-$3,644,000
Annual O&M	$6,400-$9,600	$12,800-$19,200	$65,000-$97,000

Network and On-Lot Cost	Wastewater Volume (gpd)		
	5,000 gpd or 20 homes	10,000 gpd or 40 homes	50,000 gpd or 200 homes
Total Cost per lot	$11,700-$17,600	$11,700-$17,600	$12,000-$18,000
60 year life cycle cost	$435,000-$653,000	$871,000-$1,306,000	$4,472,000-$6,708,000

6.2.2 New Wastewater Treatment Plant

Designing, constructing and maintaining a community-scale wastewater collection and treatment system is an expensive undertaking. Before design work can begin, local leaders and planners must establish a vision for the future of the community. The vision must include estimations for expanding or shifting population as well as commercial and industrial development.

If acres of land are available, an aerated lagoon treatment system with percolation/evaporation ponds would have the lowest capital and maintenance costs.

If space is limited, an activated sludge treatment plant should be considered. Activated sludge plants have higher capital and maintenance costs and require more skilled operators. In activated sludge plants, wastewater is settled in a primary settling tank. Extended aeration activated sludge plants often do not utilize primary settling. Wastewater is then fed continuously into an aerated tank/basin, where the microorganisms metabolize and biologically flocculate the organics. The microorganisms (activated sludge) are settled from the aerated mixed liquor under quiescent conditions in the final clarifier and returned to the aeration tank. The liquid that has been clarified (supernatant) from the final settling tank can be discharged. Depending on the quality of the sludge produced, it can be land applied or hauled to a landfill.

6.2.2.1 Aerated Lagoons

Lagoon systems perform best when there are multiple (usually three or more) cells in series. Multiple cells maximize treatment by ensuring slower effluent progression through the system. Lagoons can produce effluent that approaches secondary treatment standards for BOD. TSS is less reliably removed. Aerated lagoons will not adequately remove nitrogen to consistently meet a nitrogen limit in a WDR. Aerated lagoons can be an inexpensive solution for treating wastewater generated by a small community.

An aerated lagoon is a pond (usually at least one acre in area) with either diffused aeration or mechanical aerators. The lagoon system is typically a simple earthen basin with a synthetic plastic liner to prevent percolation of wastewater into the ground. Aerated ponds are typically 15 feet to 25 feet deep and have a 20-40 day detention time. In a two-cell system, the first cell is aerated and completely mixed. The second cell is only aerated for the first 2/3 of the cell length. The last 1/3 is quiescent to promote settling of solids prior to discharge.

During warm weather months, some nitrification generally occurs in most aerated lagoons. However, such nitrification is usually unpredictable and cannot be depended upon to meet discharge limitations. This is due to the fact that the organisms responsible for nitrification are slow growers and more sensitive to environmental factors than are those that remove BOD. For aerated lagoons to be viable for nitrification, the lagoon process must be modified to increase the solids age. This can be accomplished through sedimentation in clarifiers with solids recycle.

Table 6-4 estimates the cost of a lagoon system. Engineering and other fees are not included in the costs. The maintenance cost is based on a part-time service provider, and the annualized cost of removing sludge on an eight-year cycle. Costs in the table are from the Water Environment Research Foundation (WERF) Final Report – Performance & Cost of Decentralized Unit Processes.

Table 6-4: Lagoon System Estimated Costs

Network and On-Lot Cost	**Daily Wastewater Volume (gpd)**		
	5,000 gpd or 20 homes	10,000 gpd or 40 homes	50,000 gpd or 200 homes
Materials and Installation	$314,000-$471,000	$628,000-$942,000	$3,141,000-$4,711,000
Annual O&M	$2,400-$3,500	$4,700-$7,100	$24,000-$35,000
60 year life cycle cost	$397,000-$596,000	$794,000-$1,191,000	$3,971,000-$5,956,000

6.2.3 Activated Sludge

After removing solids from the wastewater, dissolved and some suspended organic matter is still present. The goal of activated sludge treatment is to provide oxygen to naturally-occurring organisms present in the wastewater so that they will consume the organic matter before it is discharged into the environment.

A typical activated sludge plant includes aeration basins filled with wastewater into which air is injected. Air injection mixes the contents of the basin and causes oxygen to become dissolved in the wastewater. The mixing action brings the suspended microorganisms into contact with the organic matter (food) and dissolved oxygen (fuel). Because there is plenty of food and fuel, the microorganisms thrive and become concentrated within the basin. The microbes oxidize the organic matter into carbon dioxide, new microbes and insoluble matter (sludge).

The treated water from the aeration basins moves into a settling basin or clarifier. This is a quiescent environment that allows the concentrated biomass to settle out of the water. The clarified effluent then can be further treated or disposed. The removed biomass becomes a residual that can be taken to a landfill, applied on farmland or subjected to further treatment.

Table 6-5 estimates the cost of an activated sludge system. Engineering and other fees are not included in the costs. The maintenance cost is based on a part-time service provider, a five-year blower, biomass wasteage, and that the system will last for 30 years. Costs in the table are from the Water Environment Research Foundation (WERF) Final Report – Performance & Cost of Decentralized Unit Processes.

Table 6-5: Estimated Costs to Install and Maintain an Activated Sludge System

Network and On-Lot Cost	Daily Wastewater Volume (gpd)		
	5,000 gpd or 20 homes	10,000 gpd or 40 homes	50,000 gpd or 200 homes
Materials and Installation	$100,000-$150,000	$148,000-$223,000	$410,000-$616,000
Annual Electrical ($0.15 per kW-hr)	$900-$1,400	$1,800-$2,700	$9,000-$14,000
Annual O&M	$5,300-$8,000	$9,000-$13,000	$34,000-$51,000
60 year life cycle cost	$320,000-$480,000	$527,000-$791,000	$1,915,000-$2,873,000

7 DESCRIPTION OF WATER TECHNICAL ALTERNATIVES – OTHER

7.1 Blending

Blending may be a viable option for some water systems not meeting drinking water standards if they have access to better quality water sources nearby. Simply stated, blending is combining and mixing poorer quality water with better quality water to meet drinking water standards. CDPH currently allows blending as a form of treatment to meet drinking water standards. Blending utilizes a second source of water that has sufficient volume and better water quality to dilute existing water source contaminants such that the combined water meets the drinking water standards. Blending is an attractive alternative because it has very low ongoing operations and maintenance costs relative to treatment.

For example, an existing well with a 200 gpm production may have a nitrate concentration of 60 mg/L, which exceeds the MCL for nitrate of 45 mg/L. A target blended nitrate concentration below the MCL of 45 mg/L would be established. For the purpose of this example, it is assumed that the target would be 36 mg/L, which is 80 percent of the MCL. In order to accomplish this, a new source of water with a nitrate concentration of 30 mg/L or less would need to produce 800 gpm to result in a blended concentration of 36 mg/L. Sometimes a community water system may have multiple wells with one or two that do not meet the MCL for a contaminant. If a method of blending and mixing can be developed, the contaminated well can be utilized to extend the water supply capacity.

Because most inorganic contaminants are non-reactive in water, the benefits of blending can be mathematically determined using the equation below:

$$[C]_b = \frac{([C]_1*[Q]_1 + [C]_2*[Q]_2)}{([Q]_1 + [Q]_2)}$$

Where,

$[C]_b$ = concentration of blended sources

$[C]_1$ = concentration in source 1

$[C]_2$ = concentration in source 2

$[Q]_1$ = flow from source 1

$[Q]_2$ = flow from source 2

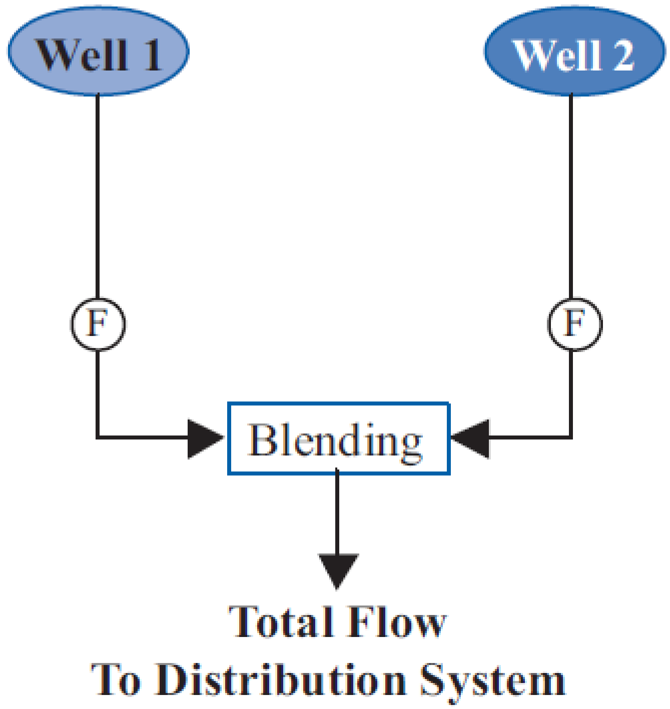
Finding a better quality source of water may not be a feasible option for all water systems since better quality groundwater or surface water may not be available. Finding another source of groundwater would involve knowledge of the existing aquifer and drilling test holes with associated water quality sampling. If a source of groundwater is found, the well would need to be developed and put into production.

A blending system requires that the two water sources be piped to a common location for mixing/blending before the water can enter the distribution system.

Blending requires that the flow from each source be metered and mixed in the correct proportion to meet the target blended concentration. A means of proportioning the flow must be devised to achieve the target blend concentration. This may include variable speed pumps and/or automatic proportioning valves. Normally, blending will use two water sources that have consistent water quality. Otherwise, the process may be unreliable and may need to utilize “real time” measurement of the constituent of concern. Real time monitoring will probably be required regardless of water quality stability when blending the acute contaminants nitrate or perchlorate. Blending may occur directly in a pipeline or a tank may be utilized. Additional equipment needed may include flow control valves, flow meters, and additional monitoring requirements. A plan for blending will require CDPH approval prior to implementation. A schematic conceptual diagram for a blending system is shown in Figure 7-1. A sampling program will be required to verify that the blended water meets the water quality standards.

The cost of a blending system will vary depending on factors such as distance between sources and the ability to utilize existing infrastructure. If an existing well, that is in compliance with water quality standards, and a contaminated well are near each other and they have the right proportionate capacity, the costs could be quite low. If a new source (water well) must be developed and the distance is great, the costs could be very high. The initial capital costs for blending, in some cases, may exceed the costs of a treatment system; however, the lower long term O&M costs associated with blending will usually make blending a preferred option if it can be successfully implemented. Each proposed blending system will be unique and thus the cost for such a system must be individually estimated. A blending decision tree can be found in **Appendix E**.

Figure 7-1 – Example Blending System



For the Figure above, it is assumed Well 1 is an existing well that does not meet water quality standards. The new well (Well 2) is of better quality and meets water quality standards. However, the flow from both wells is needed to meet peak demands. Water from the New Well (Well 2) and Well 1 will each enter the water blending tank. Each well line is equipped with a flow meter.

7.2 Regional Water Treatment

Regional treatment systems could be considered when there are neighboring systems with similar water quality issues and there is the potential to inter-connect the systems. This would have the advantage of allowing the communities involved to share capital and operations & maintenance costs. There are typically some economies of scale in constructing and operating larger treatment systems jointly compared to operating several separate treatment plants. Often, the time required for operating a system may be largely independent of the size of the system. Consequently, considerable saving in operator costs can be attained with joint systems.

The physical location of the treatment plant relative to the participating communities would depend on the availability of land, the location of the water sources to be treated, and on the length of transmission pipelines that would be required. A consolidated treatment project involving multiple communities may encounter significant resistance from one or more communities, especially where there is a perception that the benefits and impacts are not evenly distributed or where one of the communities does not perceive that they have an issue that will be resolved by the project. These issues can be resolved if community concerns are understood, evaluated, addressed and incentivized whenever possible.

A variation on the regional water treatment approach would be to have a regional water treatment plant that would supply treated water to nearby water systems with the intent of them blending the treated with their existing water to meet water quality standards.

7.3 Dual Water Distribution Systems

Drinking water systems, must deliver water to the consumer's tap that meets all State and Federal primary drinking water quality standards. However, a significant portion of the water delivered is used for non-potable purposes. The water may be used for landscape irrigation, agricultural crops, farm animals, pasture irrigation, fire flow or activities such as residential car washing. The water used for these non-potable purposes does not need to meet drinking water standards. Sizing a treatment system and paying O&M costs to treat water largely used for non-potable purposes may not make economic or environmental sense. The non-potable system can also be used to supply water for firefighting purposes. This can allow for a smaller capacity potable water system since the system would not need to supply over 1000 gpm for a several hour period. Efforts should be made to make sure, to the extent feasible; the treatment system is used to supply mostly potable uses.

One of the most effective ways to limit the use of potable water for non-potable uses is to install water meters and implement a tiered volumetric rate schedule. Another benefit for consumption based rates, particularly for DACs, is that it accounts for the higher water usage rates that occur in multi-family homes, extended family homes, and homes with occupied outbuildings served off of hose bibs. However, in rural communities, with larger parcel size, there may be a desire to have a water system that can provide irrigation water at a reasonable cost for farm animals, gardens and micro scale farming.

In some communities facing significant cost for treating water to meet drinking water standards, it may make economic sense to utilize a dual water distribution system. One system would be used exclusively for potable use. A separate second system would be supplied with non-potable water for non-potable use and for fire flow. Having a separate non-potable water system would lessen the potable water demand to the water just needed for potable purposes. Small systems may have issues with cross connections. Cross connections are connections between a potable water supply and a non-potable source, where it is possible for a contaminant to enter the drinking water supply. The cross connection could be used to allow potable water to supplement agricultural wells. Cross connections should be removed or a backflow preventer installed to prevent the non-potable source from entering the potable water supply.

Typically, indoor water use varies from about 50 to 100 gpcd. Many rural communities have an overall per capita water use of 200 to 300 gpcd. Thus, it is possible to provide a potable water only system that is 25 to 33 percent the overall size of a typical water system. Where costly treatment is required, this may result in significant savings to the community. However, the treatment system capital and operations cost savings may be offset by the cost of constructing and operating a new independent water system. It is not likely that a dual water distribution system will be cost effective in most water systems because the cost of constructing a dual distribution system will be very large. There is the possibility a dual system may be affordable to a DAC if it is grant funded. However, for new construction in a rural, large lot community, or an existing large lot rural system, with significant non potable water use, a dual water distribution system could be considered.

If the community served by the water system also has a wastewater treatment plant, there is the possibility of the treated recycled wastewater being used to supply a non-potable water system. This would involve upgrading the wastewater treatment plant to provide tertiary treated effluent that would meet the California recycled water regulations (Title 22). These upgrades would likely include tertiary filtration and disinfection. Additional infrastructure such as pipelines, pump stations and storage would be needed. The use of recycled wastewater would also have the advantage of conserving water and reducing groundwater pumping.

A smaller potable water system would have lower capital and O&M costs. A detailed cost analysis would need to be performed for each water system to determine the costs of installing meters or a non-potable system versus the cost savings of a smaller treatment system and the associated operational costs. There are no known DAC systems in the TLB that have a dual water system.

7.4 Distribution System Losses and Improvements

Maintaining system infrastructure to deliver clean and safe drinking water to customers is often a significant challenge for the operators of public water systems. Depending on the age of the distribution system, water loss through the system can be significant. Water losses can be from physical leaks and consist of leakage from transmission and distribution mains, leakage and overflows from the utilities storage tanks or leakage from service connections up to and including the meter.

In addition to physical loss of water from the distribution system, water can be lost through unauthorized consumption (theft) and metering inaccuracies or failure.

Accurate metering is crucial to minimizing water loss. Metering establishes production and customer use volumes as well as provides historic demand and consumption data that is useful not only for auditing but for planning future needs.

Water loss from a distribution system is a problem that is not only confined to lost revenue. Water losses in the distribution system require more water to be treated, which requires additional energy and chemical usage, resulting in wasted resources and lost revenues.

Perhaps the most common form of water loss leak detection is from proactively searching for leaks in the field. Searches must be planned carefully and conducted in a disciplined manner for the results to be meaningful. These searches use a wide variety of tools to aid in discovery of potential system leaks. Most of these leak detection approaches locate and quantify the leaks by observing the presence of, or change to physical property (noise, temperature, etc.) that occurs only when a pipe leaks. It is likely a DAC would need to hire a company experienced with leak detection to perform these functions.

If leaks are discovered in the distribution system, a variety of technologies are available to repair pipeline leaks depending on their location and size. Many studies have shown that the most significant portion of leak repair cost and time is attributed to uncovering the leak site and dewatering. From there, the repair techniques are relatively easy. For this reason, a growing portion of the leak repair market is centered on approaches that do not require that the pipeline be uncovered.

For pipes that can be uncovered, some small pipe leak repairs may be made using a surface wrap depending on pipe material. Many of these products take the form of a fiberglass cloth impregnated with a resin that is activated by water. Cracked pipes can be wrapped with the cloth and secured with a pressure sensitive rubber tape. Corrosion holes are typically patched with a two-part epoxy before being wrapped.

Repair clamps are collars that can be fitted around the outside of the pipe that has been uncovered to patch the hole or break. The metal collar contains a partial or full size gasket that is subsequently compressed onto the surface of the pipe by the clamp providing a pressure tight fitting to stop the leak.

An approach for repairing badly leaking old water mains without having to uncover them is a process known as sliplining. In this process, the old lines are repaired by pulling a thin-walled plastic liner inside the old, cleaned pipe to seal its leaks. Sliplining leaves the old pipe intact and uses it for structural support of the much thinner plastic lining. Once the liner is in place, hot water is pumped through it, causing the liner to become malleable, expand and tightly seal onto the surface of the old pipe. Excavation is only needed at intervals along the pipe to facilitate entry and exit from the line. Sliplining does not work well in pipelines with a lot of elbows and isolation valves.

If a section of pipe is too deteriorated to repair with a clamp or sliplining, it may be necessary to replace one or more lengths of the pipe. While pipe repair replacements are best done using the same material as the existing pipe, lack of availability of needed pipe material or desire to upgrade to a less corrosive pipe material may dictate that the replacement length be another material.

Many water mains cannot be effectively uncovered and replaced when they are located in congested areas and critical traffic arteries. One approach to replacing these leak-ridden lines is to drag a new pipe through the older pipeline using a flexible and typically much smoother pipe material. The annular space between the new pipe and the old pipe should be grouted to provide added stability to the new line. This technique requires a long area of space for assembly and joining of the new pipe sections. This limits the application to pipe sizes of 8 to 96 inches in diameter.

An alternative approach called pipe bursting, is to destroy the old pipe as the new one is being dragged through it. This technique can permit the same-sized or even larger diameter pipe to replace the old line. Pipe bursting can be a reasonable-cost approach to replacing long lengths of the system in areas where excavation may be difficult or impossible. Trenchless pipe replacement is most effective where long, uninterrupted runs of new pipe are needed. The approach is less cost-effective in areas where numerous fittings must be placed on the new pipe as the pipe must be exposed at each location that such an attachment is needed.

7.5 Residuals Handling

A major cost component and management issue for water treatment systems is residuals handling and disposal. All water treatment systems produce side stream flows, solids or spent media. The sides stream flows may include filter back wash, precipitated solids, concentrates, brines, dewatered solids and other materials. Spent media such as GAC and adsorptive media are also produced. Some of this material may be classified as hazardous because it contains concentrated metals such as arsenic or uranium. It may also have a high or low pH that will require neutralization. In the case of media used for uranium removal, it may be radioactive and will require special handling. Because of the limited ability of hazardous wastes in California (Waste Management in Kettleman City and Laidlaw Environmental Services in Buttonwillow and Westmoreland), it may be necessary to ship some residuals out of state, at great cost. Other side streams, such as concentrate from RO systems or brines used for IX regeneration, may not be classified as hazardous, but may contain high concentration of salts and minerals which may not be able to be disposed of in the TLB because of environmental water quality regulations specifically elevated salinity and electroconductivity in the groundwater.

Water treatment plant waste management will be an integral component of the treatment system itself. The term residuals is used to describe all water treatment plant process wastes, either liquid or solid. Water treatment systems produce unique waste streams, each of which has different associated waste handling issues. When examining waste handling several questions must be answered:

- What must be removed?
- Is it hazardous or otherwise regulated?
- Where will it be disposed? Costs of disposal?
- What treatment is necessary to prepare it for disposal? Or reduce the volume needing disposal?

A residuals handling decision tree can be found in **Appendix E**.

7.5.1 <u>Solid Waste</u>

Treatment processes such as iron coagulation filtration, gravity filtration and, to a lesser extent, GAC produce a concentrated solids waste stream when the filters are backwashed. The solids produced are from both the raw water and the chemicals added to the water to coagulate suspended and dissolved contaminants that are removed in a filtration process. These solids are settleable and can be removed through further treatment.

The quantity of the solids residuals generated from the water treatment process depends on the raw water quality, dosage of chemicals, performance of the treatment process, method of sludge removal, and backwash frequency.

The solids quantity is usually determined as an annual average based on the yearly volume to be treated. Depending on the specific treatment process utilized, the volume of solids can normally be estimated by knowing the yearly volume of water treated and the amount of calcium hardness removed, magnesium hardness removed, iron added for treatment (ferric chloride for example), alum or polymer added, and suspended solids removed. The solids concentration from most filter backwashes is around 0.1 percent, although this varies greatly with the process utilized. Often, these residuals can be disposed of at a municipal wastewater treatment plant, liquid decanted and recycled, and/or disposed of in ponds on site.

The solids can also be further thickened to reduce the volume of waste to be disposed. For example, thickening a one (1) percent solids concentration sludge to 10 percent solids concentration, a volume reduction of approximately 90 percent is achieved. Therefore, 90 percent less volume is needed to be stored or disposed.

7.5.1.1 Non-Mechanical Dewatering

Non-mechanical (typically, solar) dewatering is normally used where land is available and where it can be both economical and efficient for dewatering water treatment plant wastes.

<u>Sand Drying Beds</u>

Sand drying beds are normally rectangular beds with walls and a layer of sand or gravel with underdrain piping. Drainage (via percolation), decanting and evaporation are the dewatering mechanisms. When wastes are applied to the drying beds, free water drains through the sand. Remaining water is removed through evaporation. The residuals can stay in the drying bed until a desired solids concentration is reached. Eventually the dried solids will need to be removed using a front end loader.

The use of sand drying beds will depend on the soils in the area and the amount of evaporation that can be expected.

<u>Solar Drying Beds</u>

Solar drying beds are similar to sand drying beds in terms of operation except they are constructed with sealed bottoms. In these beds all dewatering is accomplished through decant of free water and evaporation. Solar beds have lower maintenance and cleaning since sand does not need to be replaced and the sealed bottoms makes loading and cleaning easier. Because solar beds rely on evaporation, they have a lower solids loading rate compared to sand drying beds.

7.5.1.2 Dewatering Lagoons

Dewatering lagoons are similar to sand drying beds except they operate at much higher initial loadings, and therefore have longer drying times between cleanings. Dewatering lagoons are equipped with a decant structure and may be equipped with underdrains.

The dewatering lagoons are filled over a long time (3 to 12 months) and then allowed to dry for a long period of time while another lagoon is filled.

7.5.1.3 Mechanical Dewatering

Centrifuges, plate-and-frame filter presses, diaphragm filter presses and belt filter presses can be used, in conjunction with polymer chemicals, to mechanically dewater water treatment plant residuals. Centrifuges and belt presses will produce solids in the 15 to 25 percent dry solids range. Diaphragm and plate-and-frame presses can produce solids between 30 to 45 percent dry solids. The resulting solids are dry enough to truck off-site. The ultimate choice of mechanical dewatering should be based upon pilot studies based on the specific characteristics of the material to be dewatered.

7.5.1.4 Ultimate Disposal of Solids

The final location for dewatered solids will be based on the chemical characteristics of the material, its dry solids content and its classification as hazardous or non hazardous waste. The chemicals added and the contaminants removed in the water treatment process will affect the ultimate disposal of the solids. If the solids have relatively few contaminants, they may be land applied. Solids exceeding the concentration limits for land application may be accepted for disposal of in a local Class III landfill (municipal solid waste). If the dewatered solids have reached hazardous concentrations, such as for arsenic, the solids will require disposal of in a Class I landfill (hazardous waste).

7.5.2 Brine and Concentrate Disposal

Certain treatment processes produce a liquid waste stream that contains primarily dissolved solids, minerals and salts. These wastes are called brines or concentrates and include spent brine from IX regeneration, reject water (concentrate) from high pressure membrane systems (RO) and spent regenerant (acid or caustics) from specific adsorption media such as activated alumina.

Conventional methods of brine disposal involve discharge to a wastewater treatment plant, evaporation, deep well injection, septic systems, or zero liquid discharge.

7.5.2.1 Sewer Collection System

If a sewer system is available nearby and the wastewater treatment plant can accept the brine or concentrates, disposal to the sewer system is the preferred method of disposal. However, in many cases discharge limits imposed on the effluent of the wastewater treatment itself (e.g. total dissolved solids or electrical conductivity) prevent the wastewater treatment plant from accepting the influx of water treatment plant residuals brine. It is unlikely that sewer disposal of brines or concentrate will be possible except for very small water treatment systems and where significant dilution is available in the sewer.

Brine disposal options to wastewater treatment plants are limited in the Tulare Lake Basin area. Trucking of waste brine to coastal wastewater facilities, although costly, is sometimes the only viable disposal option. East Bay Municipal Utility District (EBMUD), in Oakland, California, can accept some high salinity waste.

7.5.2.2 Deep Well Injection

Deep well injection is another possible option for concentrate disposal. In deep well injection, concentrates are pumped into salty aquifers that are isolated from and below useable drinking water. Within the TLB, deep well injection is widely used for disposal of produced water from oil production. However, there is currently no use of deep well injection for disposal of water treatment concentrates in the TLB. This method requires a Underground Injection Control (UIC) permit for well operation and underground injection from EPA. Deep well injection is typically very costly because it usually requires the construction of a well several thousand feet deep. The costs are incurred in the construction of the well, the extensive monitoring that is required, and increased electrical costs to run the injection pumps. It is not likely that a single DAC entity would be financially capable of such construction. However, it may be possible to consider deep well injection for a group of water treatment systems, if the only other opportunity is long-term trucking of concentrates.

7.5.2.3 Zero Liquid Discharge (ZLD)

A zero liquid discharge system will completely convert liquid wastes into solid wastes that can be trucked offsite. A ZLD system typically includes multiple stages of solids concentration. The first stage is RO which produces a high quality permeate and a concentrate stream. The permeate is returned to the water treatment process and the concentrate moves to the next stage. Following RO treatment, a much smaller volume of waste will be treated in the next stage thus enhancing performance and reducing power consumption. The RO concentrate will be further concentrated further using an evaporation process. After evaporation, the next stage is crystallization. Crystallizers will then evaporate any remaining water past the crystallization point. The condensate can be recycled and the dried crystals can be transported off site for disposal.

The cost of a ZLD system is high and may equal or exceed the cost of the water treatment system. The advantage is that most of the liquid in the waste can be recycled and the solids remaining will be of small volume and can be easily disposed of. As with deep well injection, there are no operating ZLD systems used for concentrate or brine disposal from water treatment in the TLB. ZLD is used in the TLB for disposal of cooling tower waste at some power plants. A ZLD system is very costly to construct and operate. It is not likely that a ZLD system could be constructed and operated by a single DAC entity, however, it may be possible to consider for a group of water systems if there are no other viable options and trucking of liquid concentrate waste outside the TLB is not economically feasible in the long-term.

7.5.2.4 Solar Evaporation

Solar evaporation is possible in the TLB because evaporation greatly exceeds precipitation on an annual basis. Approximately 4 to 5 acre-feet of water can be evaporated annually for every acre of a solar evaporation pond. Solar evaporation of brines or concentrates will be similar to the operations described in Solar Drying Beds under Non-mechanical Dewatering. Solar evaporation is attractive because it has very low operating cost and requires no external energy. However, it requires a very large land area and it will require the construction of shallow ponds with a double liner system and continuous monitoring to protect the underlying groundwater. The ability to consider and utilize solar evaporation for brine or concentrate disposal will be site specific and dependent on the volume of concentrate and the availability of land. It will not likely be a viable option for many systems.

7.5.2.5 Septic System

As discussed in the Drinking Water Treatment for Nitrate as submitted to the California Legislature (Harter Report), several small water systems indicate disposal of brine to an onsite septic system. With a low volume waste stream (depending on chemical composition to avoid negatively impacting septic system function or underlying groundwater), disposal to a septic system can avoid other, more costly disposal options. Disposal to a septic system with on-site disposal is not considered a viable alternative, except for the very smallest systems (individual household) for DAC communities. Generally, regulatory requirements for the protection of groundwater will preclude the use of on-site disposal.

7.5.3 Brine – Regeneration

7.5.3.1 Electrochemical (nitrate)

There are brine handling systems currently in development that will allow multiple use of brine to regenerate nitrate IX resins. Currently brine used for IX resin regeneration is used once and cannot be re-used because of the nitrate present. With the system under development, the usual sodium chloride brine is substituted with potassium chloride. The potassium brine is electrochemically regenerated and nitrogen present is converted to nitrogen gas. According to the manufacturer, approximately 50 to 100 regenerations can occur before the brine is spent and requires off-site disposal. If successful, this type of system will significantly reduce the volume of brine disposal and possibly make IX systems for nitrate removal much more viable.

Electrochemical techniques are being developed to remove nitrates from water. Bench scale tests obtained intermediate formation of nitrite using nickel, lead, zinc, and iron cathodes, with ammonia as the final product.

Photochemical methods have demonstrated that light can activate the nitrate ion directly or indirectly via a catalyst for reaction with a reducing agent. However, reducing nitrate with water photochemically is an uphill energy process and not suitable for large scale water treatment.

7.5.4 Regionalized Residuals Treatment

Regionalized residuals treatment may be feasible for those communities that are located near each other and share similar treatment systems. For example, Home Garden (a small community in Kings County) has an iron coagulation filtration treatment system for arsenic removal. Home Garden currently hauls the residuals from the treatment plant to a facility in Arizona. Home Garden does not have a wastewater treatment plant but discharges into the City of Hanford. The City of Hanford (a large community in Kings County) has a wastewater treatment plant that could accept the waste from the Home Garden water treatment plant. It may be possible for these two communities to own and operate a regional residuals treatment system to treat and dewater their water treatment plant waste. This could allow both communities to share the capital and O&M costs associated with residuals treatment. There would be legal and fiscal issues for the communities to work out regarding a regional residuals treatment plant.

Any of the previously mentioned residuals handling options could be regional to serve multiple communities. However, the regional facility would still have a solids and/or liquid waste stream that would need disposal.

7.6 Water and Energy Conservation

7.6.1 Water Conservation

Water is a valuable resource in California. Water conservation – using water efficiently and avoiding waste – is fundamental to ensuring water availability in the future. Less water used will result in less water needing to be pumped and potentially treated resulting in cost savings to the community. According to the State of Washington Department of Ecology, the largest use of potable water inside the home is from inefficient fixtures, mainly the toilet. The State of Washington Department of Ecology also estimates that nearly 40 percent of municipal water is used for watering lawns. Installing newer fixtures inside the home and installing low-water landscaping are just a couple ways to conserve water. There are numerous publications available to communities detailing ways to conserve water and how to encourage their customers to conserve water. Publications can be found at www.saveourh2o.org and the California Urban Water Conservation Council website at www.cuwcc.org. An energy conservation and renewable energy decision tree can be found in **Appendix E**.

Some of the DACs have water meters installed however the meters are not read and billing is done at a flat rate. The meters are not read due to lack of staff available to perform this task. Reading meters and billing based on usage would lessen the amount of water needing to be pumped and potentially treated thus conserving water. This would result in lower overall operating costs of the water system. The DACs may benefit from the installation of meters that can be read remotely to lower the staff needed to perform the meter reading task. Many other DACs may have meters that are old or not working. DACs would benefit from funding to replace old or non-working water meters and to facilitate partnerships between other neighboring communities with or in need of meters. Funding for meters has been limited and/or hard to obtain. For the most part funding has been limited to the funding made available through the IRWM program or Drinking Water Program as part of other larger projects.

Other water conservation measures could include requiring low flow appliances within residences. Water conservation, as encouraged through water meters, rate schedule, and encouragement of other water conservation measures may result in water savings for a community. Each community is unique; however, a water savings of up to 20 percent is not unreasonable.

7.6.2 Energy Conservation

A majority of the energy used by water utilities is for pumping. This pumping could be from wells, pumps used in the treatment process or booster pumps. There are several options to provide more efficient pumps. Most electric utility providers offer rebates and other incentives for making energy efficiency improvements. The best way to evaluate possible energy conservation is to conduct an energy audit. The following information, at a minimum, is needed:

- Utility bills from the last 12 to 36 months.
- Design, average and peak flows.
- Building square footage(s).
- Operating hours.
- An inventory of major equipment including pumps, motors, drive systems, lighting and HVAC equipment and the associated nameplate information.

The EPA has developed a free, downloadable, Excel-based energy audit tool. The tool allows both water and wastewater systems to conduct an energy audit. The tool can be downloaded at http://water.epa.gov/infrastructure/sustain/energy use.cfm. The State of California has a document titled 'How to Hire an Energy Auditor' that can be downloaded at http://www.energy.ca.gov/reports/efficiency_handbooks/400-00-001C.PDF.

7.6.2.1 Energy Efficient Pumps

The pump and motor work together to move fluids. The pump's efficiency is greatly influenced by the system it supplies. For an efficient pump, the pump should be sized according to usage requirements and avoid oversizing at all costs, choose low head loss components, design a pipe system layout that reduces pressure drops, and select pumps that perform efficiently with varying flow rates and both high and low head (depending on conditions).

The initial cost of buying a pump is only 10 percent of its life cycle cost, whereas the energy costs and maintenance costs associated with that pump are 45 percent and 37 percent, respectively. As such, a high efficiency pump system may cost more now but have significant savings over the long-term. Further, it is important to remember that energy savings may be gained by simple, low-to-no cost operational changes (e.g., managing energy demand in treatment and pumping, water loss reduction and water efficiency efforts) versus technology upgrades.

7.6.2.2 Variable Frequency Drives (VFDs)

A VFD is an electronic controller that adjusts the speed of a motor and the equipment it is connected to, thereby accommodating the fluctuations in demand by running motors slower when full capacity is not needed. Also, as opposed to abruptly turning pumps on and off again, VFDs have the capability of slowly bringing a motor to the appropriate speed so as to reduce mechanical and electrical stress on the motor and equipment, and to reduce pressure surges on hydraulic systems. This can result in lower maintenance and repair costs. According to the California Energy Commission, VFDs can reduce pump energy use by 50% and can save up to 20% or more on electric usage at water facilities. The advantages of VFDs are that they are reliable, easy to operate, increase the degree of flow control, and since they work with most three-phase electric motors used by throttled pumps, retrofitting is a viable option. The initial cost of a VFD is relatively high (ranging for $3,000 for a 5 hp motor to $45,000 for a 300 hp motor) but payback can occur as early as a few months. The payback assumes the pump will not operate at full speed for extended periods of time. It is important to note that VFDs are not a panacea for energy efficiency; they will not save energy for systems without variability and will yield benefits only when operated properly.

7.6.2.3 Energy Efficient Motors

In most water treatment plants, continuously operated pump motors account for 80-90% of the total energy cost, meaning that their lifetime operational cost can be significantly greater than their original purchase price. Energy efficient motors are only 2-8% more efficient than standard motors, but they usually have longer insulation and bearing lives as well as less vibration, lower heat output, and are more tolerant to overload conditions and phase imbalances. Consequently, their failure rate is much lower. The difficulty with energy efficient motors is deciding whether or not to use them to replace existing motors. Since replacement of motors is costly, the standard rule is that a motor should be immediately replaced with an energy-efficient one if it is being used 8,000 hours or more per year. If used between 4,000 and 8,000 hours per year, the motor should be replaced with an energy efficient motor upon failure.

7.6.3 Renewable Energy

Renewable (green) energy can be used to offset some of the electrical demands for a water treatment plant. Below are several examples of renewable energy applicable to water treatment plants.

7.6.3.1 Microturbines

If the community operates a wastewater treatment plant and can collect the bio-gas, microturbines can be used to produce energy from the bio-gas. This energy can be used to supplement the energy needs of a water treatment plant. An individual microturbine produces anywhere from 15 to 300 kilowatts (kW) of energy, they are often grouped to produce the required energy. For comparison purposes, a standard 1 MGD activated sludge treatment plant may have a 2,200 kWh/MG energy demand, a 10 MGD facility may have a 1,200 kWh/MG energy demand, and a 50 MGD facility may have a 1,000 kWh/MG energy demand. Aerated lagoons and trickling filters use approximately 1,500 kWh/MG for a 1 MGD plant.

Microturbines are cheaper to build and run in comparison to larger conventional gas or diesel powered generators. However, they are less efficient than internal combustion engines. The technology is well understood and has been implemented in many applications throughout the U.S. One disadvantage of microturbines is a limit on the number of times they can be turned on. Microturbines also run at a very high speed and high temperatures, causing noise pollution for nearby residents and potential risks for operators and maintenance staff.

Capstone and Ingersoll Rand are two of the larger microturbine manufacturers. Each offers different models of microturbines that depend on the power output that is needed. Costs for these units can range from $30,000 to $250,000, installed, depending on the unit.

7.6.3.2 Solar Power

Commercially available solar modules are between 5 to 17 percent efficient at converting sunlight into electrical energy. Solar modules generally can produce electric energy in the range from 1 to 160 kilowatts. An individual solar cell will typically produce between one and two watts. A backup storage system should be included with the solar system to store power so that it can be used during low light conditions or at night.

Solar cells can generate electricity with no moving parts, they can be operated quietly with no emissions, they require little maintenance, and are therefore ideal for remote locations. Although solar cells require very little maintenance, they can be difficult to repair when maintenance is needed. Additionally, the initial cost of solar cells is very high.

Currently, installed solar systems cost from $6,000/kW to $10,000/kW. The cost of a solar system depends on the system's size, equipment options, and installation labor costs. If a community has land available for solar cells and there are monetary incentives from the power company or from state and federal sources, solar cells may be a way for communities in the TLB area to offset some of their power usage.

7.6.4 Funding

Many energy utility providers offer financial incentives such as rebates and reduced energy rates for customers who purchase energy efficient equipment or implement energy efficiency management practices.

State funding organizations offer a variety of financial assistance programs including shared-cost energy efficiency studies, incentives for efficiency measures and renewable energy projects, and loan funds to reduce the cost of installing equipment to improve efficiency and promote the use of alternate energy sources.

The Database of State Incentives for Renewables and Efficiency (DSIRE) is a comprehensive source of information on state, local, utility, and federal incentives and policies that promote renewable energy and energy efficiency (http://www.dsireusa.org/).

8 CASE STUDIES

Following are several examples of communities within the Study Area that had MCL exceedances or wastewater treatment issues and are in the process of implementing solutions. The following sections detail the water or wastewater issues faced and the explanation of the recommended technical solutions. These examples are provided to give an example of how selected DACs addressed their water quality issues.

8.1 Riverdale Public Utilities District (PUD) – New Well and Coagulation Filtration for Arsenic Removal

Riverdale PUD is located in Fresno County. In 2008, Riverdale pursued and received Proposition 84 funding for implementing a water treatment system. Riverdale PUD originally planned to install adsorptive media for arsenic treatment. Their existing Well 2 did have an adsorptive media filtration installed and around the time funding was received the media began to have rapid breakthrough of arsenic. It was determined that the raw water quality in Riverdale was not ideal for using adsorptive media. Pilot testing was performed using iron based coagulation filtration pressure filters. The possibility of constructing a centralized treatment system to treat all available wells for explored. However, the cost of transporting the raw water to a centralized location made the centralized treatment alternative capital cost much higher than constructing individual treatment systems at the well sites.

The existing water supply facilities include 3 wells, Numbers 2, 4, and 5. Well 2 is no longer used due to decreased water quality and increasing depth to groundwater. Well 4 is only used during periods of peak demand and in emergency situations due to decreased water quality. Well 5 is the only actively used well and has a pumping capacity of 1,000 gpm. The primary water quality issues are arsenic and color.

A new well (Well No. 6) is scheduled to be operational in late 2014 with the intent of obtaining at least 1,000 gpm to replace the capacity of existing Well 4 and maintain the present water supply capacity. The new well has been designed and constructed to avoid arsenic concentrations above 10 ppb. Currently, treatment is not expected to be needed at the Well 6 site.

Pilot studies at Well No. 5 have indicated that coagulation-filtration (CF) is effective in removing arsenic and color to meet drinking water standards.

The water treatment plant for Well No. 5 will be comprised of the following systems to be installed: three filter vessels, chemical storage building and injection system (for sodium hypochlorite, ferric chloride or ferric sulfate, polyaluminum chloride or alum, sulfuric acid and sodium hydroxide), backwash pump, reclaimed water tanks and pump, sludge storage, sludge dewatering equipment, sludge drying beds, new motor control cabinet and electrical controls with canopy, light poles and antenna for radio communication, and a larger backup generator to serve the treatment system in addition to the existing well. A steel 285,000 gallon treated water storage tank and booster pumps would also be installed. The Project site, including the treatment plant and well site areas, will be graded to direct any storm water runoff to an approximately 5,000 square foot onsite storm water retention pond. The estimated construction costs for the water treatment plant at Well 5 and Well 6 is $7.7 million. Construction is estimated to start in late 2014. The community has already adopted the needed rates to cover any capital costs not covered by a grant and the future O&M costs associated with the treatment system. The expected monthly water rates will increase from $32 in 2013 up to $51 in 2018 to pay for the water improvements.

Two maintenance personnel (T3 certified operators) will perform most maintenance and operation tasks, including weekly site visits at a minimum. Well and treatment operations would be automated but operations may require an average of two employee visits per day. General maintenance of the well and treatment plant would also include weed abatement, trash removal and fence maintenance.

8.2 Caruthers CSD – New Well and Coagulation Filtration for Arsenic Removal

Caruthers CSD is located in Fresno County. In 2007, Caruthers pursued and received SRF funding for installing a new well and constructing a water treatment system. Caruthers investigated adsorptive media, iron based coagulation filtration, and consolidating with another water system. Based on a review of the cost effectiveness and the environmental consequences, iron based coagulation was chosen as the treatment method.

The existing water supply facilities include 4 wells, Numbers 1, 3, 4, and 5. The depths of Wells 1, 3, 4, and 5 are 150, 415, 520, and 750 feet, respectively. Well No. 1 (flow rate of 350 gpm) is not used except in the summer months. Well No. 4 (flow rate of 650 gpm) is only used sparingly due to arsenic concentrations above 20 ppb. Well 5 is also exceeding the arsenic MCL. The four (4) wells have a total supply capacity of 3,050 gpm, which is adequate for the current population.

Based on the 2000 Census, the District serves a population of 2,103 people and has 672 service connections. Total water use in 2010 was 232 million gallons. The average annual water use for the District from 2006 to 2010 was 239 million gallons, which equates to an annual average daily per capita water use of 312 gallons per person per day (gpcd). The high value is due in part to landscape irrigation facilities for the local school systems and fair grounds which are irrigated with potable water.

The water system is presently operated with two water supply wells (Well No. 3 and Well No. 5). The operator manually selects the lead well; the lag well will turn on if the water system pressure falls below an established limit. Generally, one well is sufficient to meet water system demands, with the exception of summer months.

If the new well exceeds the arsenic concentration that is sufficient for blending with existing Well 5, but below the MCL of 10 ppb, a coagulation filtration (CF) plant will be constructed on the new well site to treat water from the existing Well No. 5 and potentially treat the water from the new well (Well No. 6), if needed. Once Well No. 6 is in production, a pilot study of various CF processes will be performed. The CF treatment process requires additional equipment to be installed; a backwash tank, a pre-oxidation chemical feed, a pH adjustment chemical feed, additional on-site electrical, and a control building. The project will include construction of treatment vessels, chemical feed and storage facilities, automated process equipment, piping and electrical, and sewer service facilities. This will also require the construction of piping and valves from Wells No. 5 and No. 6 to the treatment plant, storage tank, and backwash tank. In addition, a drain from the backwash tank would be required for removing the accumulated solids and a small amount of non-recyclable water will discharge through a sewer connection to the community sewer system.

The treatment system will be designed to remove arsenic. Other contaminants in the water such as TDS and vanadium will not be removed in the proposed treatment system. The overall quality of the treated water will not change significantly from the present quality except that arsenic levels will be below the MCL.

The estimated construction costs for the water system improvements is $5.7 million. Construction of the new well started in 2014. Construction of the treatment system is estimated to start in 2015. The community has already adopted the needed rates to cover any capital costs and the future O&M costs associated with the treatment system. The expected monthly water rates will increase from $33 in 2013 up to $48 in 2015 to pay for the water improvements.

8.3 Home Garden CSD - Coagulation Filtration for Arsenic Removal

Home Garden CSD is located in Kings County approximately 1.5 miles southeast of Hanford and 35 miles south of the City of Fresno. The population in the Home Garden community has not grown significantly over the past 10 years, 3.3% growth according the recorded populations of 1,702 (census 2000) and 1,761 (census 2010). Derived from a variety of sources including the 2000 Census, American Community Survey, and community income surveys the Median Household Income (MHI) is $33,092[4], meeting the State's definition of an SDAC.

Home Garden began operations of an arsenic treatment system in approximately 2010, utilizing a coagulation-filtration pressure filter treatment system. The water for the treatment system is mainly provided by a single well (D1) at 900 gallons per minute (gpm) which has a raw water arsenic concentration of 20 parts per billion (ppb). The drinking water limit for arsenic is 10 ppb. There is another well at the D1 site (Well D4) that has a raw water arsenic concentration of 30 ppb and a flow of 900 gpm. Well D4 can be sent to the treatment system; however, the primary use for Well D4 is to provide backwash water to the pressure filters.

The raw water is treated with sulfuric acid (to lower the pH), sodium hypochlorite (to oxidize the arsenic), and ferric chloride (to coagulate the arsenic in order to form a particle to be filtered) prior to going through four vertical pressure filters. Upon leaving the filters, sodium hydroxide is added to raise the pH. Treated water from the filters is

[4] 2007-2011 American Community Survey 5-Year Estimate; United State Census Bureau

discharged into a 240,000 gallon finished water tank. The finished water tank is used to supply water to Home Garden CSD's customers. The existing treatment system has consistently produced treated water arsenic concentrations well below the 10 ppb limit.

Depending on water demand, the pressure filters are backwashed every 3-4 days during the summer and every 10-12 days during the winter. A backwash is triggered when the differential pressure across the filters exceed 10 pounds per square inch (psi). Backwashing the filters cleans the filter media by reversing the flow through the filters and carrying away the associated solids that accumulate during normal operations. The backwash water is collected in a 57,300 gallon backwash reclaim tank. The solids are allowed to settle in the backwash reclaim tank for one day. After settling, the water in the reclaim tank is decanted and recycled back through the treatment system. When the water has been decanted, the solids from the bottom of the reclaim tank are pumped into a 30 cubic yard bin. This bin is equipped with a perforated false floor to further dewater the solids. Approximately every six months, solids are removed from the 30 cubic yard bin, and are hauled off site for disposal.

The solids removed from the site are typically above the hazardous waste limit for arsenic, requiring disposal at a hazardous waste site. The most recent arsenic concentration in the sludge from March 2012 was 14.8 milligrams per liter (mg/l) (the hazardous waste limit is 5 mg/l). The cost of disposing of hazardous waste is significantly more than non-hazardous waste. Home Garden pays between $3,400 and $6,000 every six months to dispose of the sludge as a hazardous waste. The cost of sludge disposal was a reason Home Garden CSD was selected to be part of the Community Review process of this Study.

In 2002, Home Garden pursued and received $2 million in Proposition 50 funding for constructing an arsenic water treatment system. In 2008, Home Garden received another $1 million from SRF funding. The total cost for the treatment plant was $3 million. The treatment plant began operation in August 2010. The average monthly water bill increased by $15 to fund the water improvements.

8.4 Caruthers – WWTF Improvements

The original Caruthers (a DAC in the study area) wastewater facilities were constructed in 1963. The original Caruthers WWTF treatment process consisted of an aerated lagoon treatment system. The facility included a wet well with two (2) submersible pumps, two (2) aerated lagoons that could be operated in series or parallel, two (2) stabilization ponds, two (2) disposal ponds, and standby power facilities. The original permitted capacity was 0.24 mgd. If the anticipated demands from proposed developments were added to existing demands, the resulting flowrate would 0.23 mgd. This was near the capacity of the existing plant. The improved facilities consisted of a new headworks and lift station that has a hydraulic capacity of 0.28 mgd. The lift station includes a wet well with a triplex pumping station to provide for reliability and redundancy of pumping capacity. The headworks includes a self-cleaning screen, by-pass channel with a bar screen, and a flowmeter. The headworks discharges to an activated sludge treatment (Biolac) facility that includes nitrification/denitrification capabilities as required to comply with new Waste Discharge Requirements. Treated effluent is discharged to the existing ponds and the new storage pond for percolation/evaporation. These improvements were constructed in 2013.

8.5 Kerman – WWTF Improvements

The existing lagoons for the City of Kerman (not a DAC according to this study but a small WWTF facing issues similar to DACs in the study area) were designed for an average daily flow of 2.0 MGD. The plant was expanded to 3.3 MGD. The plant improvements included the installation of a Biolac system. The Biolac system utilizes an existing lined pond. The pond is 12 ft deep with a hydraulic detention time of approximately 35 hours. Two new circular clarifiers were constructed to the east of the Biolac pond. Each clarifier has cast in place walls and floor, 65' in diameter. Return activated sludge is collected from the clarifier bottom and pumped back to the aeration basin. The remaining two lagoons (existing PS-1 and PS-3) renamed Polishing Lagoon A and B respectively are utilized as polishing lagoons. New effluent piping from the clarifiers discharge to Polishing Lagoon A and B and allows flow to the lagoons in parallel. Polishing Lagoons were provided with an outlet structure with adjustable overflow weir. Effluent disposal facilities consist of 8 unlined earth disposal ponds. In addition to effluent losses due to percolation and evaporation, a portion of effluent is applied to 60 acres of adjacent cropland.

The Biolac plant generates approximately 900 – 1200 lbs/day of excess sludge settling in the clarifiers at 2-4 percent concentration. This sludge is treated in an aerobic digester for further solids reduction and stabilization.

The waste sludge from the clarifier is pumped to the existing refurbished sludge digesters. One third of the existing rectangular aeration basin was modified and converted into an aerobic digester. The stabilized solids are dewatered on-site by either drying beds or mechanical dewatering equipment.

9 STAKEHOLDER OUTREACH PROCESS

9.1 Evaluation of Potential Projects

The goal of the community review process was to further evaluate and perform a pilot study of one or two of the identified potential projects, in order to ground truth the solutions presented and help develop a roadmap to implement the solution. The roadmap that was developed with the assistance of the community review process is intended to be a guide for other communities considering the same types of solutions. The community review process also aims to help initiate conversations with communities that have potential to implement these types of solutions.

9.1.1 Selected Community Review DACs

The communities of Home Garden and Poplar were identified as communities where there is a potential for technical solutions.

The Home Garden CSD and Poplar CSD met the community applicability criteria as follows:

- Water system issues – Poplar has issues with nitrates and Home Garden has residual disposal issues from a coagulation filtration treatment system.
- Wastewater system issues – Poplar has issues with capacity at their wastewater treatment system. Home Garden does not have wastewater system issues. Home Garden's wastewater is discharged and treated at the City of Hanford wastewater treatment plant.
- Funding – Poplar has tried to secure funding, but has not obtained funding at this point. Home Garden obtained funding several years ago to construct their water treatment plant. However, Home Garden has issues with the costs associated with operating the plant.
- Factsheets were developed and presented before a regular community board meeting for each of the selected community. Once permission by the board was secured, one-on-one meetings with district staff to discuss the district's needs and conduct a water and wastewater assessment. The process also included a single community meeting with multiple stakeholders to discuss and verify water needs, try on solutions and seek feedback (solution preferred, least liked/why, implementation needs and recommendations improve process for DACs), and a final community board presentation to discuss outcomes of the community review process and draft recommendations.

9.2 Poplar Community Review Process

9.2.1 Goals of the Poplar Community Review

The goals of the Poplar CSD community review process included:

- Provide information to the community participants about the goals and objectives of the Tulare Lake Basin DAC Study and the Technical Solutions pilot study.
- Develop an understanding of the local water and wastewater needs and visions for improvements.
- Provide preliminary findings of the applicable solutions identified in the Technical Solutions pilot study.
- Obtain feedback on the solutions identified, and determine what is needed to implement these solutions, and develop a roadmap to guide the community toward a solution based on information and feedback provided by the community participants.

9.2.2 Selection of Poplar CSD for Community Review

The Poplar CSD was selected for a Community Review as part of the Technical Solutions pilot study based on the following criteria:

- Poplar is classified as a Severely Disadvantaged Community (SDAC).
- Poplar has a well with nitrate concentrations above the drinking water standard.
- Poplar has not yet obtained funding for water improvements.
- Poplar has not been able to obtain funding for improvements to improve the treatment capacity of the wastewater treatment plant.
- Poplar's benefit from the other pilot studies is unknown.
    - Management and Non-Infrastructure – this study looks at the benefits of communities working together to save costs by combining or sharing resources. Poplar is isolated enough that this pilot study may not be feasible.
    - New Source Development – this study looks at the possibility of obtaining other sources of water. Poplar may potentially benefit from this pilot study if a new well is the preferred option to address the water system issues. Poplar may also benefit from the New Source Development pilot study if consolidation is the preferred option.
    - Individual Household Solutions – this study looks at solutions for private well owners. The CSD customers are not served by private wells and the population is too large to benefit from individual household treatment.

- In addition to issues with the water system, Poplar has issues with their wastewater treatment plant. Technical solutions for wastewater treatment are also part of the Technical Solutions pilot study.

Based on the above, it is believed that Poplar would benefit most from the alternatives presented in the Technical Solutions pilot study.

The Technical Solutions pilot study includes descriptions and evaluations of the following alternatives:

- Water treatment systems to treat ground water or surface water.
- Centralized water treatment to provide potable water to multiple communities.
- Blending lower quality water with higher quality water to meet water quality standards.
- Dual water systems – one system for potable water and another system for non-potable water.
- Lowering water system losses.
- Treatment of the residuals remaining after water is treated.
- Water and energy conservation options.
- Improvements to existing wastewater systems.
- Construction of sewer conveyance and wastewater treatment systems.
- Operational considerations.

These technical solutions were further evaluated for applicability to the Poplar community.

9.2.3 Results of the Poplar CSD Community Review

Community Review Meeting

A community meeting was held on January 21, 2014 at the Poplar CSD office and was attended by residents of the Poplar community, residents residing outside the Poplar CSD boundaries and members of the Poplar CSD Board. The project team organized and facilitated the meeting and provided information on technical solutions that could be considered to improve the water and wastewater systems. The District Engineer for the Poplar CSD (Keller Wegley Engineering) also attended. The meeting was attended by four (4) community residents (including one private well owner), two board members (President and Vice President) and the district Secretary.

The meeting began with introduction of the goals and objectives of the Tulare Lake Basin DAC Study and the Technical Solutions pilot study. Participants were asked to share about the water and wastewater challenges faced in their community. The project team then provided a summary of the solutions identified in this study. Participants indicated that there was interest in these solutions.

The Poplar CSD supplies water and wastewater services to the community of Poplar.

Key water challenges noted included:

- Participants of the community review process discussed local water and wastewater challenges.
- Board members noted water quality challenges with their existing wells and challenges with accessing funding to address challenges.
- They also noted how expensive solutions are and the need to keep costs down given demographics of the community.
- Community residents also discussed current water quality concerns and water conservation measures.
- The private well owner in attendance also noted interest with connecting to the water system but expressed concern with the high connection fees.
- Issues with existing connections fees were also discussed. Private well owners outside the district boundary seeking to connect to the system found them to be extremely expensive and unfair. Board members found them to be appropriate, fair and needed. Further, connection fees were highlighted as the main issue hindering consolidation between the Poplar CSD and neighboring water system of Cotton Center.

<u>Water System</u>

The water system consists of three wells. Well 1 (South well) has a capacity of 770 gpm and is not used because nitrate concentrations are above the drinking water standard of 45 mg/L. Well 2 (North well) has a capacity of 640 gpm and is the lead well. Well 3 (Middle well) has a capacity of 420 gpm and is the lag well. The nitrate concentrations in Wells 2 and 3 are less than 30 mg/L and currently meet the drinking water standard. Because Well 1 is not used, the water system is currently in full compliance with drinking water primary standards. All the wells are disinfected with sodium hypochlorite (liquid chlorine solution) to provide a 0.5 mg/L chlorine residual in the distribution system. Wells 2 and 3 currently meet the year round water demand. However, if one of these wells is out of service, the one remaining well would not be capable of supplying peak water demands. To meet peak water demand the District would need to obtain permission from California Department of Public Health (CDPH) to place Well 1 in service. Because Well 1 does not meet drinking water standards, customers must be notified before it could be utilized if the nitrate standard would be exceeded. The District is currently in compliance with the water quality regulations.

In addition to the nitrate issues, the District does not have the current capacity to meet peak day demands in compliance with State regulations when the largest capacity well is out of service.

The District has a 290,000 gallon standpipe (reservoir). The standpipe is 120’ high with a 20’ diameter. However due to pressure conditions in the distribution system, the standpipe typically is only filled to 70 feet. The effective useable storage is estimated to be only about 50,000 gallons. In order to meet State requirements for capacity during peak flow events, a larger storage tank and additional capacity (from another well) would be needed.

The water system serves 568 residential accounts with a $25 per month flat rate. Meters are installed; however, the meters are not read or used for billing purposes because Poplar CSD does not have the staff capacity. The meters are over 20 years old and are likely not in working order. According to the District, approximately 70% of the residential accounts are rental houses.

In discussions with the community members at the meeting, it was clear that keeping rates low for the customers is very important. The community is classified as Severely Disadvantaged Community (SDAC) (<60% of the statewide median household income). Any rate increase would adversely affect the customers.

For those households located within the District service area, the water connection fee is $3,650 and a sewer connection fee is $5,450. Connection fees for homes located outside of the District boundary are double the In-District rates. These fees are charged, in part, to aid the District in paying off the loans previously taken out to pay for construction of the current water and wastewater system.

The District mentioned they had been approached by residents of Cotton Center to have Cotton Center become part of the District. Cotton Center has approximately 56 service connections. The houses are served by the Williams Mutual Water Company by a single well. Each connection is charged $100/month for water. All the homes are served by individual septic systems. The single Cotton Center well is surrounded by the community's individual septic systems. This makes the well especially vulnerable if one the individual septic systems should fail. If the well needs to be taken down for maintenance, there is no other source of water available. Cotton Center would benefit from becoming part of the District by having more than one source of water and having the ability to discharge to the Poplar CSD wastewater treatment plant. If Cotton Center is connected to Poplar CSD wastewater treatment plant, the septic systems in Cotton Center can be decommissioned. Currently, the major obstacle hindering consolidation of the two systems is the high cost of connection fees Cotton Center would need to pay.

The District currently has one employee who operates and maintains the water and wastewater systems. The District does not have the employees available to read the existing meters. The District has applied for State funding to install meters that can be read remotely, however, the State has told the District that funding cannot pay for meter replacement. Funding is only available for installation of meters in areas that do not already have meters installed, regardless of the condition of existing meters.

The District has submitted several applications to the State for funding various water system improvements. The District has ranked high enough to be invited for funding. However, the District has not been able to secure funding through the State for reasons that are currently not known.

Potential Water System Technical Solutions

Potential technical solutions for the water system discussed at the community review meeting included:

a. Blending

Blending higher nitrate water with lower nitrate water in a storage tank. The higher nitrate well could remain in production if the water from the high nitrate well can be blended with a better quality well. This would require the construction of a storage tank where the blending would be accomplished since regulations do not allow blending in the distribution system.

Pros - Would provide needed system reliability. Would allow continuing use of all wells.

Cons – The nitrate concentration of the new well and existing high nitrate well will determine how much water can be blended. If nitrates in the new well are near the water quality standard, blending may not be feasible. Nitrate concentrations in the area have been trending up. The well may provide good quality water in the near term but this might not always be the case.

b. Water Treatment

i. Install ion exchange to remove nitrates in the raw water. Based on the existing water quality data, the ion exchange process would be the best option for nitrate removal in Poplar. The ion exchange process involves a special media that will remove nitrates from the water and store the nitrate in the media. When the media becomes incapable of removing any more nitrate, it must be regenerated. This regeneration is accomplished by pumping a concentrated salt solution (brine) through the media. This spent brine solution must be disposed of properly; either discharged to a wastewater treatment plant or hauled off site to a potential centralized brine treatment facility.

Pros – Will remove nitrates in the water regardless of nitrate concentrations in the raw water. Ion exchange is a relatively simple treatment process with no chemical addition or hazardous waste to dispose.

Cons – The capital cost and ongoing O&M costs may be too high for the customers. Capital costs may be completely covered by a grant or low interest loan. However, the O&M costs would need to be borne by the customers. The wastewater treatment plant has an electroconductivity (EC) limit. The brine disposed from the ion exchange process will be very high in EC and may cause issues at the wastewater treatment plant. The cost of brine disposal (part of the O&M costs) may be too high for the customers.

ii. Obtain surface water from the Lower Tule Irrigation District and construct a surface treatment plant. The Lower Tule Irrigation District canal is located approximately one mile east of Poplar. It is possible that the Poplar CSD could purchase surface water from the Irrigation District. This would require the CSD to construct and operate a surface water treatment plant (likely a package multimedia filtration plant).

Pros – Surface water would not have nitrates.

Cons – Surface water is not available year round. One month of the year, the canal is taken down for maintenance. During this one month, another source of water would be needed. Additionally, surface water is much more expensive to purchase compared to ground water (greater than $400 per acre-foot compared to the minimal cost to pump ground water). The operation of a surface water plant is much more complicated and expensive to operate compared to the existing well system. This would result in higher rates due to increased O&M costs.

c. Water Conservation

i. Install water meters than can be read remotely and bill according to usage. The current meters installed in within the District are not read and billing is done on a flat rate. Billing based on usage would reward water conservation by lower monthly bills.

Pros – Encourages water conservation.

Cons – Would require a new rate structure that would include a base rate that would be billed regardless of how much water is used and then a per gallon rate for water used. The new rate structure may cause some water bills to increase which may adversely affect some customers.

d. Operational Considerations

i. Operator requirements for any treatment option would need to be considered. Treating the nitrate or obtaining/treating surface water would result in higher operating costs for the District and the need for a higher grade operator. These higher costs would result in higher water rates.

e. New Source

i. Drilling a new well to replace the high nitrate well. First, a test well would need to be drilled at a chosen location. If the expected water quality would not require treatment, a production well could be constructed. The existing higher nitrate well could then be removed from production.

Pros - Would provide needed system reliability.

Cons – May not be able to find good quality water. Nitrate concentrations in the area have been trending upward. The well may provide good quality water in the near term but this might not always be the case.

f. Consolidation

i. Consolidation with Williams Mutual Water Company (Cotton Center). Distribution system piping within Cotton Center would need to be modified to allow connection to the Poplar CSD distribution system. The existing Cotton Center well could remain active and be integrated into the Poplar CSD system. This would need to be coordinated with the decommissioning of the Cotton Center septic systems to prevent potential contamination of the Cotton Center well.

Pros - Would expand the Poplar CSD customer base. An expanded base would provide more customers to distribute costs among. Would provide reliability to the Cotton Center customers and potentially result in lower monthly water bills. CDPH is encouraging consolidation of water systems. A plan to consolidate Cotton Center with the Poplar CSD could cause CDPH to re-rank a currently low-ranked Poplar CSD project into a fundable category through the State Revolving Funding (SRF). Also, Poplar would gain another good well.

Cons – The process of expanding the Poplar CSD boundaries may take some time. There would need to be negotiations between Cotton Center and the Poplar CSD to facilitate any potential consolidation.

The above technical solutions were discussed at the community review meeting. The consensus of those in attendance was that constructing a new well would be the preferred alternative. However, the consolidation with Cotton Center should continue to be evaluated.

The District and their engineer (Keller Wegley Consulting Engineers) are moving forward to obtain funding for drilling a test well with the hopes of finding sufficient water capacity and water that would not require treatment. It is hoped that the cost of the test well and production well would mainly be covered through grants from the State. This would minimize any increases to the existing water rates.

Potential Wastewater System Technical Solutions

The District owns and operates a sewer collection system and wastewater treatment plant. The treatment plant consists of two aerated ponds and two storage ponds. Treated wastewater is land applied on neighboring alfalfa fields. The Waste Discharge Requirements (WDR) apply limitations on biochemical oxygen demand (BOD) and electro-conductivity (EC). The District is able to comply with these limitations.

There is limited additional treatment capacity available to treat increased wastewater flows. There is also limited ability to land apply additional treated wastewater.

The liners in the two storage ponds are ripped and due to the slopes on the storage ponds, the sides are sloughing in spots. Because of the condition of the liner and the steep slopes, sludge has not been removed from the ponds in the 18 years since the plant became operational.

District customers currently pay a flat monthly rate for sewer service of $25.

Potential solutions for the wastewater system discussed at the community review meeting included:

a. Improved aeration.
b. Expanding and modifying the existing storage ponds to allow for additional capacity and easier sludge removal.
c. Modify aeration basins to remove TSS and nitrogen.
    ii. Biolac modification. Only needed if WDRs become more stringent.
d. Explore options to dispose of treated water to a larger acreage of agricultural fields.

The District and their engineer (Keller Wegley Consulting Engineers) have obtained a grant to explore improvements to the wastewater treatment plant. These improvements will likely include expanding the storage ponds and increasing the area for irrigation of treated effluent. The District owns 40 acres of land adjacent to the existing plant that can be used for future expansion. At this time, there is no indication that the treatment plant will have to comply with more stringent WDR regulations. However, the WDRs will not be set until the wastewater treatment plant improvements are designed and submitted for review by the Regional Board.

The District is open to expanding their sewer customer base (including Cotton Center) but the sewer connection fees are cost prohibitive to those customers exploring connecting to the District.

9.2.4 Recommended Future Action

If the Poplar CSD decides to move forward with any of the potential projects identified, additional work will be necessary to move the projects forward. Some of the tasks that will be required for future action include:

- Define funding options to offset the costs of producing the planning documents. The District has submitted funding applications through CDPH and USDA with limited results. Other funding options, such as through the Lower Tule River Irrigation District Integrated Regional Water Management Planning (IRWMP), should be explored. Additionally, there may be options to participate in the Tule and Kaweah IRWMP process.

- Meet with CDPH, USDA and other potential funding agencies. This will help the District understand the funding process for each agency. Meeting with CDPH and USDA may provide some insight as to why previous applications have not been acted upon by these agencies. Potentially apply to CDPH to re-rank previously submitted Poplar CSD projects if consolidation with Cotton Center is a possibility.
- Define the proposed project(s). Most planning funding applications would require a description of the proposed project and the alternatives considered. The Community Review process has defined some of these potential projects.
- Submit the planning funding application.
- Begin the engineering feasibility study. This assumes funding was offered and accepted by the District.
- Produce the engineering feasibility study. The water and wastewater system projects would need to be further evaluated and defined. For the selected alternatives, environmental documentation would need to be produced. Any changes to the existing District boundaries would need to be evaluated by legal professionals. As part of a larger project, the replacement and upgrading of the water meters should be included. Some other items to consider in the feasibility study include:
  - The District should consider including consolidation with Cotton Center when pursuing grant funding. Projects that include consolidation are strongly preferred by CDPH and tying consolidation into any water system improvements may result in a higher ranking for the project. The same may be true with Cotton Center abandoning their septic systems to connect to the Poplar CSD wastewater treatment facility. Any connection fees may be able to be covered by the funding source.
  - CDPH has a Pre-Planning and Legal Entity Formation Assistance Program to assist communities in forming a regional entity to provide water or expand the District to serve private well owners near the existing CSD boundaries. This Program just provides funding for planning, up to $250,000.
  - The District may want to consider expanding the District boundaries to encompass adjoining private well and septic tank users.
  - The District should consider including the installation of new water meters that can be read remotely in any larger project. A new billing rate structure would need to be determined that would include a base rate to cover basic O&M costs that would be billed regardless of how much water is used and then a per gallon rate for water used. This would encourage water conservation within the District.
  - Financial analysis of any proposed projects would need to evaluate affordability, revenue sources, estimated capital costs, estimated operation and maintenance costs, estimated debt service and proposed rate adjustments, if needed, and their impact on the community.

- During the feasibility study and alternatives analysis it is important to provide information to the public through public meetings and presentations. It is important for the community to understand and be involved with any changes to their water and wastewater systems. Due to the large Spanish speaking population in the community, it is important to have materials translated into Spanish and have interpreters available at any public meetings. It will be important to overcome any obstacles or barriers with public acceptance early in the process so that the community will support the proposed changes.
- Finalize the engineering feasibility study. After the final projects have been defined, evaluated and received approval by the customers, the final engineering feasibility study can be submitted. After submittal and approval by the appropriate funding agency, the District can move forward with construction funding to produce the documents needed to construct the projects.

9.3 Home Garden Community Review Process

9.3.1 Goals of the Home Garden CSD Community Review

The goals of the Home Garden CSD community review process included:

- Provide information to the community participants about the goals and objectives of the Tulare Lake Basin DAC Study and the Technical Solutions pilot study.
- Develop an understanding of the local water needs and community member's visions for improvements.
- Provide an overview of the Kings Basin DAC Study (2013) that included Home Garden CSD as a Community Pilot Project. Provide an update of changes at Home Garden CSD between the Kings Basin DAC Study and the Tulare Lake Basin DAC Study.
- Provide preliminary findings of the applicable solutions identified in the Technical Solutions pilot study.
- Obtain feedback on the solutions identified, and determine what is needed to implement these solutions. Develop a roadmap to guide the community toward a solution based on information and feedback provided by the community participants.

9.3.2 Selection of Home Garden CSD for Community Review

The Home Garden CSD was selected for a Community Review as part of the Technical Solutions pilot study based on the following criteria:

- Home Garden is classified as a Severely Disadvantaged Community (SDAC).
- Home Garden has a coagulation-filtration water treatment system for arsenic removal. It also has a wastewater collection system that discharges to the City of Hanford.

- Home Garden is struggling with the management of the District and with operations and maintenance costs of the water treatment system.
- Home Garden may find some benefit from the other Pilot Studies.
    - Management and Non-Infrastructure Solutions – this study looks at the benefits of communities working together to save costs by combining or sharing resources. Home Garden is adjacent to the City of Hanford and within five miles of Armona. Home Garden could explore sharing resources with these communities.
    - New Source Development – this study looks at the possibility of obtaining other sources of water. Home Garden may potentially benefit from this pilot study if a new well is the preferred option to address the water system issues. Home Garden may also benefit from the New Source Development pilot study if consolidation is the preferred option.
    - Individual Household Solutions – this study looks at solutions for private well owners. The CSD customers are not served by private wells and the population is too large to benefit from individual household treatment.

Based on the above, it is believed that Home Garden would benefit most from the alternatives presented in the Technical Solutions pilot study.

The Technical Solutions pilot study includes descriptions and evaluations of the following alternatives:

- Water treatment systems to treat ground water or surface water.
- Centralized water treatment to provide potable water to multiple communities.
- Blending lower quality water with higher quality water to meet water quality standards.
- Dual water systems – one system for potable water and another system for non-potable water.
- Reducing water system losses.
- Treatment of the residuals remaining after water is treated.
- Water and energy conservation options.
- Operational considerations.

These technical solutions were further evaluated for applicability to the Home Garden community.

9.3.3 Results of the Home Garden Community Review

A community meeting was held on March 17, 2014 at the Kings Community Action Organization building in Home Garden and was attended by residents of the Home Garden community. The project team organized and facilitated the meeting and provided information on technical solutions that could be considered to improve the water and wastewater systems. Also in attendance was Summers Engineering, the District Engineer for Home Garden CSD, Water Dynamics, the contract operator of the Home Garden water treatment system and three community residents.

The meeting began with an introduction of the goals and objectives of the Tulare Lake Basin DAC Study, the previous Kings Basin DAC Study and the Technical Solutions pilot study. Participants were asked to share their thoughts on the water challenges faced in their community. The project team then provided a summary of the solutions identified in this study. Participants indicated that there was interest in further evaluation of these solutions.

The Home Garden CSD supplies water service to the community of Home Garden. The wastewater generated by the community is treated at the City of Hanford wastewater treatment plant.

Water System

The water system consists of three wells. One well on the west side of Home Garden is only used in emergency situations. The other two Wells, D1 and D4, are located at the water treatment site and provide the primary source of potable water. Each well has a raw water arsenic concentration of 20 ppb, which is above the drinking water standard of 10 ppb. Each of the active wells has a capacity of 900 gpm. The current water demands can be met if one of the active wells is out of service.

In order to address the arsenic compliance issue, the District installed a water treatment system to remove arsenic. The water treatment system began operation in 2010. The water treatment system consists of four vertical pressure filters, a backwash water reclamation tank, a sludge storage bin and a 240,000 gallon finished water storage tank. Sulfuric acid, sodium hypochlorite and ferric chloride are injected before the pressure filters to aid in the coagulation and flocculation of arsenic. The filters are backwashed periodically to remove accumulated solids from the filter media. The backwash water is allowed to settle in the backwash water reclamation tank. The liquid from the backwash water reclamation tank is recycled back through the pressure filters. The settled solids are transferred to the sludge storage bin for additional de-watering. When enough sludge is collected in the storage bin, the sludge is hauled off site for disposal. Because of the high arsenic concentration, the sludge is classified as a hazardous waste and must be disposed of accordingly. The treatment system is adequately removing enough arsenic to meet the drinking water standard.

The water system serves 450 residential accounts with a $33 per month flat rate. Meters have not been installed on any of the service connections.

In discussions with the community members at the meeting, it was clear that keeping rates low for the customers is very important. The community is classified as Severely Disadvantaged Community (SDAC) (<60% of the statewide median household income).

As of June 2013, the District contracted with Water Dynamics to operate the water treatment system. The system was previously operated by CSD staff.

9.3.4 Kings Basin DAC Study

In 2011, the Home Garden CSD was part of a community pilot project for the Kings Basin DAC Study. The pilot project was tasked with identifying options to decrease operational costs of the Home Garden CSD water treatment plant. The options identified in the Kings Basin DAC Study included:

- *Modifying the treatment system chemical feed locations*. All chemicals are fed at single location just before the pressure filters. Ideally, the feed locations should be separated to allow some time for the chemicals to react before entering the filters.
    - 2014 Update: When Water Dynamics took over operation of the water treatment plant in June 2013, Water Dynamics lowered the amount of chemicals being fed while maintaining arsenic removal. Water Dynamics also ceased using sodium hydroxide, thereby cutting the number of chemicals used from four to three. Feeding a lower dose of chemicals has resulted in less sludge being produced. No sludge has been hauled off site since Water Dynamics began operating the plant. Water Dynamics plans on modifying the chemical feed locations; however, Board approval of the costs would be needed first.
- *Automate chemical feed systems*. Chemical feed adjustment is done manually.
    - 2014 Update: Chemical feed rates are still set manually. Although not critical for plant operation, automating the chemical feed system would allow chemical usage to closer match what the raw water demands. With an automated system, the chemical feed rate will be proportional to the flow and has the potential to lower chemical costs and optimize treatment plant performance.
- *Discharge backwash to sewer*. A major operational cost is sludge disposal. Discharging to the sewer could lessen the costs of sludge disposal. Approval would be needed from the City of Hanford since they operate the wastewater treatment plant.
    - 2014 Update: Since Water Dynamics has reduced sludge production; disposal of solids should be less frequent. However, sludge still will need to be hauled off site. When the water plant was originally being constructed, the City of Hanford told the District that the treatment plant solids could not be discharged to the sewer. New discussions could be held with the City of Hanford to determine if the City would allow discharge of the treatment plant sludge if it could be shown that the sludge is not hazardous.
- *On-site dewatering*. The volume of sludge needing to be disposed of can be reduced using a filter press or solar drying beds.
    - 2014 Update: Although sludge production has decreased, the disposal of the sludge will continue to be an ongoing operational cost. Reducing the

volume of sludge will lessen the frequency of the offsite hauling. Reducing the volume of sludge can be done by utilizing a filter press or on-site solar drying beds to reduce the water content. However, the current low sludge accumulation rate will diminish the value of additional sludge dewatering.

- *Partner with a nearby community for dewatering*. The Armona CSD is constructing an arsenic treatment system similar to the Home Garden CSD system. However, Armona is constructing a filter press system to dewater sludge. Home Garden may be able to partner with Armona to dewater solids.
    - 2014 Update: The Armona water treatment plant will likely be operational in early 2015. If sludge disposal is still a concern in 2015, Home Garden may want to approach Armona to discuss the possibility of Armona dewatering Home Garden's sludge.

9.3.5 Potential Water System Technical Solutions

In addition to the remaining potential technical solutions from the Kings Basin DAC Study, potential technical solutions for the water system from the Tulare Lake Basin DAC Technical Solutions pilot study that were discussed at the community review meeting included:

a. Develop O&M plan and funding for treatment plant

The $33/month flat water rate is not enough to cover the ongoing operation and maintenance of the water treatment plant. As the plant equipment is used and ages, equipment will breakdown and need to be repaired or replaced. If funding from water rates is not sufficient, ongoing maintenance may not be performed, potentially leading to a larger failure at the treatment plant. The District should assess the existing funding for O&M costs and determine if the funding is adequate for daily operation of the water plant as well having a reserve for equipment maintenance and replacement.

Pros - Would provide needed treatment plant operational reliability and funding for needed improvements.

Cons – A rate increase may be needed. Since Home Garden is a severely disadvantaged community, any rate increase will adversely affect residents. Any rate increase would also need to follow the Proposition 218 process regarding public notification and acceptance.

b. New Source

Drilling a new well to replace the high arsenic wells. First, a test well would need to be drilled at a chosen location. If the expected water quality would not require treatment, a production well could be constructed. The higher arsenic wells could then be removed from production.

Pros – The water treatment plant may no longer be needed.

Cons – May not be able to find good quality water. The City of Hanford has had about a 50/50 outcome in finding wells below the arsenic drinking water standard. The good quality wells in Hanford are at 1700 feet, while the Home Garden wells are about 900 feet. Deeper wells require more money to construct and higher electrical costs to operate. Funding would need to be obtained to explore the potential of a new well.

c. Consolidation

Consolidation with the City of Hanford. Distribution system piping within Home Garden would need to be modified to allow connection to the City of Hanford distribution system. The City of Hanford water system does not need to provide treatment for arsenic at this time.

Pros – The water treatment plant may no longer be needed. CDPH is encouraging consolidation of water systems. A plan to consolidate Home Garden with the City of Hanford could cause CDPH to rank the project into a fundable category through the State Revolving Funding (SRF).

Cons – There would need to be negotiations between Home Garden and the City of Hanford to facilitate any potential consolidation. During the evaluation of arsenic alternatives for Home Garden, the District approached the City of Hanford regarding consolidation. In addition to connecting to the City, the City of Hanford would require a water distribution loop be constructed around Home Garden. This greatly increased the cost of consolidation. Initial discussions could be held with the City of Hanford to determine if the City would still require the distribution system loop.

d. Water Meters

Install water meters than can be read remotely and bill according to usage. There are currently no meters installed within the District. Installing water meters that can be read remotely would allow billing based on usage. This would reward water conservation by lower monthly bills. Water conservation would mean less water needing treatment. This could reduce the overall O&M costs of the water treatment plant.

Pros – Encourages water conservation.

Cons – Would require a new rate structure that would include a base rate that would be billed regardless of how much water is used and then a per gallon rate for water used. The new rate structure may cause some water bills to increase which may adversely affect some customers.

The above technical solutions were discussed at the community review meeting. The consensus of those in attendance was that whatever options are explored any rate increases should be minimal. Additionally, the District should encourage the community to be involved with any proposed changes to the water treatment system.

9.3.6 Recommended Future Action

If the Home Garden CSD decides to move forward with any of the potential projects identified, additional work will be necessary to move the projects forward. Some of the tasks that will be required for future action include:

- Define funding options to offset the costs of producing the planning documents. The District should submit funding applications through CDPH and USDA. Other funding options, such as through the Kaweah River Basin and Tulare Basin Integrated Regional Water Management Planning (IRWMP), should be explored.
- Meet with CDPH, USDA and other potential funding agencies. This will help the District understand the funding process for each agency. Potentially apply to CDPH if consolidation with the City of Hanford is a possibility.
- Define the proposed project(s). Most planning funding applications require a description of the proposed project and the alternatives considered. The Community Review process has defined some of these potential projects. The District should consider developing a well-defined project in advance so that it can readily apply for funding when invited. Often times, opportunities are lost when a District does not have a “ready to go project” when funding applications are opened.
- Submit the planning funding application.
- Begin the engineering feasibility study. This assumes funding was offered and accepted by the District.
- Produce the engineering feasibility study. The water system projects would need to be further evaluated and defined. For the selected alternatives, environmental documentation would need to be produced. Any consolidation with the City of Hanford would need to be evaluated by legal professionals. As part of a larger project, the installation of water meters should be included and may be required to obtain funding. Some other items to consider in the feasibility study include:
    - The District should consider including consolidation with the City of Hanford when pursuing grant funding. Projects that include consolidation are strongly preferred by CDPH and tying consolidation into any water system improvements may result in a higher ranking for the project.
    - The District should consider including the installation of water meters that can be read remotely in any larger project. A new billing rate structure would need to be determined that would include a base rate to cover basic O&M costs that would be billed regardless of how much water is used and then a per gallon rate for water used. This would encourage water conservation within the District and provide the District with adequate baseline funding
    - Financial analysis of any proposed projects would need to evaluate affordability, revenue sources, estimated capital costs, estimated operation and maintenance costs, estimated debt service and proposed rate adjustments, if needed, and their impact on the community.

- During the feasibility study and alternatives analysis it is important to provide information to the public through public meetings and presentations. It is important for the community to understand and be involved with any changes to their water and wastewater systems. Due to the large Hispanic population in the community, it is important to have materials translated into Spanish and have interpreters available at any public meetings. It will be important to overcome any obstacles or barriers with public acceptance early in the process so that the community will support the proposed changes.

- Finalize the engineering feasibility study. After the final projects have been defined, evaluated and received approval by the customers, the final engineering feasibility study can be submitted. After submittal and approval by the appropriate funding agency, the District can move forward with construction funding to produce the documents needed to construct the projects.

10 FUNDING OPPORTUNITIES

The Department of Water Resources, California Department of Public Health, State Water Resource Control Board, and United States Department of Agriculture have historically provided the bulk of public funds available for drinking water infrastructure improvements. Funding alternatives that may be available to DACs would generally include grants, loans, and rate adjustments to increase revenues. Specific sources of funding assistance may include:

- California Department of Public Health, Safe Drinking Water State Revolving Fund (SDWSRF)
- State of California Bond Measures such as Proposition 50 and Proposition 84
- Department of Water Resources (DWR), Integrated Regional Water Management Planning Program
- State Water Resources Control Board (SWRCB), Clean Water State Revolving Fund (CWSRF) and Cleanup and Abatement Account (CAA)
- The Department of Housing and Urban Development (HUD) – Community Development Block Grant (CDBG) program
- United States Department of Agriculture (USDA) Rural Utilities

Each of the funding alternatives has qualifying requirements and specific application requirements. The community may qualify for the funding opportunity, or the community may need to coordinate the application through another entity such as a County or Integrated Regional Water Management Authority.

Additional information on the funding sources listed above may be found through the California Financing Coordinating Committee (CFCC) at www.cfcc.ca.gov. The CFCC has available a Common Funding Inquiry Form that may be completed and submitted for review by all CFCC member agencies. The community would then receive feedback regarding potential funding assistance opportunities for the community and the specific needs identified. The CFCC conducts Funding Fairs each year to provide education regarding the various funding assistance programs, and to provide interested parties an opportunity to meet with representatives of specific funding agencies.

This section provides a description of several funding sources that are available for water and wastewater system improvements. The funding opportunities described herein are not the only funding options available. There are other existing and new funding sources that may be utilized, and therefore the CFCC resources should be utilized to get additional information.

10.1 Traditional State Drinking Water Funding Programs

CDPH currently administers and oversees several sources of funds to address drinking water quality issues. The sources of these funds are summarized below.

10.1.1 Safe Drinking Water State Revolving Fund (SDWSRF)

The 1996 amendments to the federal Safe Drinking Water Act (SDWA) responded to the national drinking water infrastructure needs by establishing the Safe Drinking Water State Revolving Fund program. The SDWSRF provides financial assistance in the form of federal capitalization grants to states that in turn provide low interest loans and other assistance to public water systems.

CDPH uses the resource of the SDWSRF for low interest loans or grants to enable water systems to fund necessary infrastructure improvements. CDPH manages SDWSRF resources to fund projects to ensure that public water systems are able to provide an adequate, reliable supply of safe drinking water that conforms to federal and state drinking water standards. The funds are provided from the federal government, with a 20 percent match from the State required. Interest and loan repayments are re-incorporated into the fund. The SRF currently provides ongoing allocations of approximately $80 to $130 million per year in California.

10.1.1.1 Safe Drinking Water State Revolving Fund – Intended Use Plan

The 2014-2015 Intended Use Plan (IUP) is part of CDPH's application for the federal fiscal year (FFY) 2014 capitalization grant from the USEPA. For FFY 2014, California is eligible for an $83 million grant from the $907 million appropriated by Congress for the nation's SDWSRF programs. The federal funding, in coordination with CDPH's existing loan and interest repayments, as well as associated state match funds, will help ensure funding for drinking water projects that address the State's highest public health priorities.

Federal and State laws allow a portion of federal funds to be used for specified set-aside activities in addition to providing financial assistance to PWS for infrastructure improvements. CDPH intends to use 22 percent of the FFY 2014 SDWSRF allotment award for these set-aside activities. The remaining 78 percent of federal funds, plus all state matching funds and all interest and repayments, will be used for project funding.

In State Fiscal Year (SFY) 2014-2015, CDPH will continue to focus on implementing the public health aspects of SDWA and will ensure that funds are expeditiously and timely disbursed from all available sources. These efforts are instrumental in achieving the requirements of the SDWA.

10.1.2 Proposition 50 Funding

California voters passed Proposition 50 – Water Security, Clean Drinking Water, Coastal and Beach Protection Act, in 2002. CDPH is responsible for portions of this act that deal with water security, safe drinking water, and treatment technology. Proposition 50 allocated approximately 500 million dollars to CDPH for use as direct grants and loans to community water systems for infrastructure development, construction, and maintenance. Proposition 50 also allocated funds to the State Water Resources Control Board and to the Department of Water Resources. CDPH's portion of the Proposition 50 funds has been fully allocated, and **CDPH is no longer accepting applications for this funding source**.

Although the CDPH is no longer accepting applications, this is an example of a funding mechanism that many DACs have been able to utilize to address water quality challenges. Future bond measures may offer similar opportunities.

10.1.3 Proposition 84 Funding

California voters passed Proposition 84 – Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act, in 2006. Proposition 84 allocated approximately $250 million to CDPH for grants and loans to communities for drinking water planning and infrastructure. This $250 million allotment included $60 million specifically earmarked for use as grants to reduce or prevent contamination of groundwater that serves as a source of drinking water. Proposition 84 also allocated funds to DWR for use in Integrated Regional Watershed Management planning and development. The CDPH component of Proposition 84 is fully allocated and **CDPH is no longer accepting applications for this funding source from projects that are not already in the Proposition 84 funding stream**.

10.1.4 DWR IRWM Program

In 2002, Senate Bill 1672 created the Integrated Regional Water Management Act to encourage local agencies to work cooperatively to manage local and imported water supplied to improve the quality, quantity, and reliability.

DWR has a number of IRWM grant program funding opportunities. Current IRWM grant programs include: planning, implementation, and stormwater flood management. DWR's IRWM Grant Programs are managed within DWR's Division of IRWM by the Financial Assistance Branch with assistance from the Regional Planning Branch and regional offices. As of 2014, $472 million of the $1 billion dollars allocated to DWR for IRWM planning and implementation remain. Further, on March 1, 2014, Governor Brown signed AB103 to assist drought-affected communities and directed DWR to expedite the solicitation and award of $200 million (of the $472 million) in IRWM funding. The expedited funds are to support projects and programs that provide immediate regional drought preparedness, increase local water supply reliability and the delivery of safe drinking water.

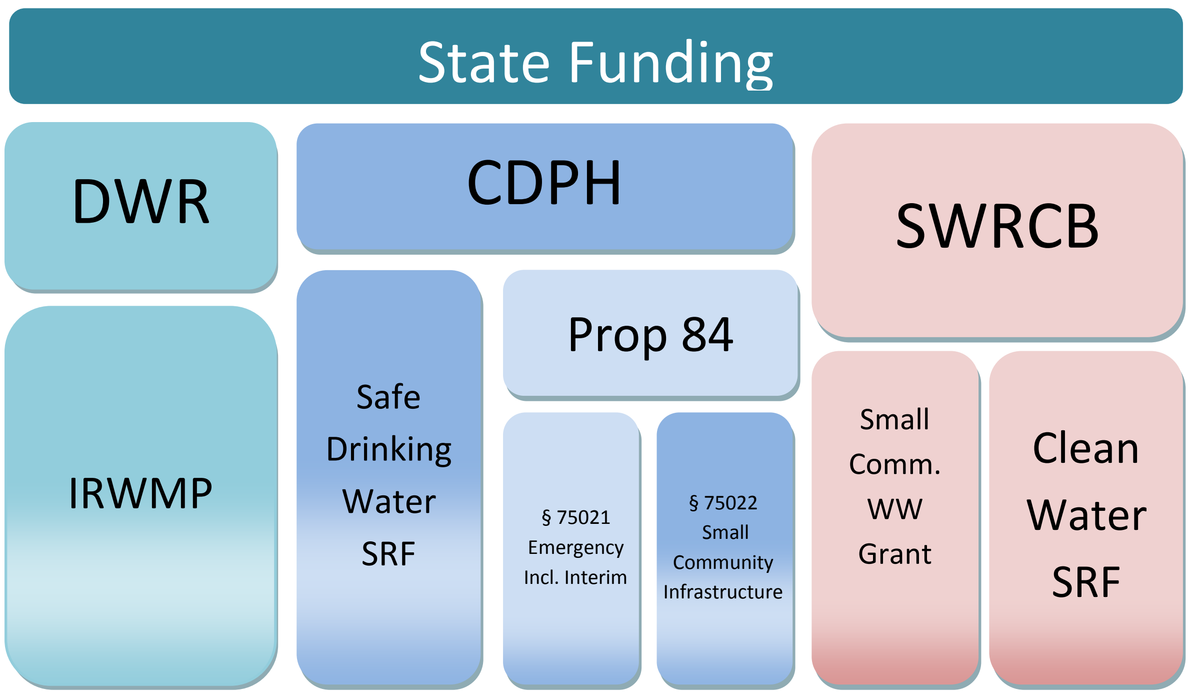
10.1.5 Clean Water State Revolving Fund (CWSRF)

The State Water Resources Control Board Division of Financial Assistance funds wastewater projects that serve disadvantaged communities. The Clean Water State Revolving Fund (CWSRF) can provide loan and principal forgiveness (grant) funding for planning, design and construction of wastewater infrastructure to serve disadvantaged communities. The CWSRF Program operates pursuant to an agreement between the State Water Resource Control Board and the United States Environmental Protection Agency and has an annual grant of $75 to $100 million for projects. The CWSRF

Program has funded a broad range of projects. About 76 percent of funds were used for wastewater treatment and water recycling facilities.

The CWSRF Small Community Grant Fund (when available) provides grants to small, disadvantaged communities for their wastewater projects through a fee, assessed in lieu of interest, on CWSRF financing agreements. This program can provide grants of up to $2,000,000 to cover planning, design and construction of wastewater infrastructure to serve disadvantaged communities. Demand for this funding is high and now always available. In general, a DAC must bring its sewer rates to at least 1.5% of the MHI for the community before grants can be issued.

[http://www.swrcb.ca.gov/water_issues/programs/grants_loans/]



10.2 Other State Funding

10.2.1 State Water Resources Control Board and Regional Board Clean Up and Abatement Account Program

The Cleanup and Abatement Account (CAA) was created to provide public agencies with grants for the cleanup or abatement of pollution. The CAA is supported by court judgments and administrative civil liabilities assessed by the SDWSRF and the Regional Water Quality Control Boards. Eligible entities that could apply for this funding include public agencies, as well as non-profit organizations and tribal governments that serve a disadvantaged community. CAA is not a permanent and consistent source of funding, and it fluctuates annually in terms of the number of projects that are funded. For example, the program funded $12.5 million in projects in 2009, but only $1.8 million in 2013.

10.2.2 Central Valley Regional Water Quality Control Board Supplemental Environmental Projects (SEPs) Program

The State Water Resources Control Board and Regional Water Quality Control Boards may allow a discharger to satisfy part of the monetary assessment imposed in an administrative civil liability order for polluting, by completing or funding one or more Supplemental Environmental Projects (SEPs). These projects implement water quality monitoring programs; well rehabilitation or replacement; watershed assessment programs; wetland, water body, or riparian habitat conservation or protection programs; pollution prevention projects; and public awareness projects.

In March 2014 the Central Valley RWQCB adopted a program specifically geared towards funding SEPs that benefit disadvantaged communities in the Central Valley. Funding amounts available for this program will fluctuate year to year since they are based on assessed and collected fines. The Rose Foundation for Communities and the Environment was selected to act as a third-party oversight group to administer the SEP funds and select the projects with final authorization from the Central Valley RWQCB staff. Projects are selected through a competitive application process.

10.2.3 The Strategic Growth Council, Sustainable Communities Planning Grant

The Sustainable Communities Planning Grant and Incentives Program funded by Proposition 84, authorized $90 million for planning grants to, among other things, protect the environment and promote healthy, safe communities. This program also includes and Environmental Justice Set-Aside fund totaling twenty-five percent (25%) of the funding per funding cycle. This funding is for Environmental Justice communities, which are defined as those communities that receive the top ten percent (10%) of statewide scores using the latest published version of the California Environmental Protection Agency's (Cal/EPA) CalEnviroScreen tool. Eligible projects could include protects that protect drinking water from contamination or improve water infrastructure systems. The minimum grant award is $50,000. The maximum grant award is $500,000, unless the application is a joint proposal, in which case the maximum award is $1 million.

10.2.4 Proposition 84, Safe Drinking Water Emergency Funding ($10 Million)

In December 2012, CDPH revised the criteria for Proposition 84, Emergency Grants to expand the allowable uses of the funding to address an urgent need to provide interim water supplies to public water systems that serve severely disadvantaged communities and lack the technical and financial capability to deliver water that meets primary safe drinking water standards and are facing a health emergency. $10 million was made available to CDPH to provide alternate water supplies to existing water systems, necessary to prevent contamination, or provide other sources of safe drinking water including bottled water. In this effort, shorter term emergency project funding such as bottle water supplies, were capped at $50,000 per project. A total of $2 million dollars was made available for emergency interim projects. This left $6 million for larger, longer term emergency responses such as establishing connections to an adjacent water system, design, purchase, installation and initial operation costs for water treatment equipment, and other water system construction projects. These projects are capped at $250,000 per project.

10.3 Federal Funding Programs

10.3.1 Community Development Block Grant Program

The Community Development Block Grant program is a flexible program that provides communities with resources to address a wide range of unique community development needs. The CDBG program is a federally funded program run by the Department of Housing and Urban Development (HUD). The CDBG program was created by the Housing and Community Development Act of 1974 and continues to provide funding. Grants through this program are only given to cities and counties. Community water systems can receive funding through their local county.

DACs can compete for CDBG funds to resolve water, wastewater and storm drain/flooding issues. The HUD CDBG program is broken into two primary components. Cities and counties with larger population centers such as Fresno and Kern Counties receive an annual formula-driven allotment of CDBG funds which is considered an entitlement. Smaller cities and counties including Kings and the non-Metropolitan Statistical Area portions of Tulare county compete on an annual basis for CDBG discretionary "small cities program" funds administered by the State Department of Housing and Community Development. [http://hcd.ca.gov/fa/cdbg/index.html]

Under the entitlement program in Fresno and Kern Counties, communities compete for funding at the County level. An advisory committee makes recommendations to the Fresno County Board of Supervisors which makes the decisions on CDBG funding provided the proposed project meets HUD criteria. In the unincorporated portions of Kings and Tulare Counties, the local Board of Supervisors selects projects to compete for funding at the state level.

CDBG funding is one of the few sources available to cover project-related work on private property. Such work may include sewer and water connections and abandonment of old water wells and septic tanks.

Some entitlement counties and small cities have opted out of Fresno County's entitlement program because there is the potential that a larger amount of funding could be secured through the competitive process through the Small Cities Program. On the flip side, the jurisdiction may receive no CDBG funding in an annual funding cycle if their application does not compete well. This is a highly competitive program and in order to compete, the City would need to emphasize health and/or safety issues related to water, wastewater or storm water needs that would be resolved by the proposed project. To be competitive, the community would also need to have a very high percentage of low income households.

Under the discretionary small cities program, pre-design Feasibility Study costs can be applied for through CDBG's Planning and Technical Assistance grants for a maximum of $50,000.

10.3.2 USDA Rural Development, Rural Utility Service

United States Department of Agriculture (USDA) Rural Development provides program assistance funding through direct loans, guaranteed loans, and grants. USDA Rural Development provides direct loans and grants to develop water and waste disposal systems in rural areas and towns with a population not in excess of 10,000. These funds are available to public bodies, non-profit corporations, and Indian tribes. Additionally, USDA Rural Development provides loan guarantees for the construction or improvement of water and waste disposal projects serving the financially needy communities in rural areas. The water and waste disposal guarantee loans are to serve a population not in excess of 10,000 in rural areas.

- USDA Rural Utilities Service (RUS) has been the largest funding source for rural water and wastewater system improvements over the years. RUS funding is often quicker to secure than State funding but there is usually less grant available and the community normally takes on a higher percentage of loan. In recent years, RUS's loan interest rate has been lowered to rates competitive with State-operated SRF programs.

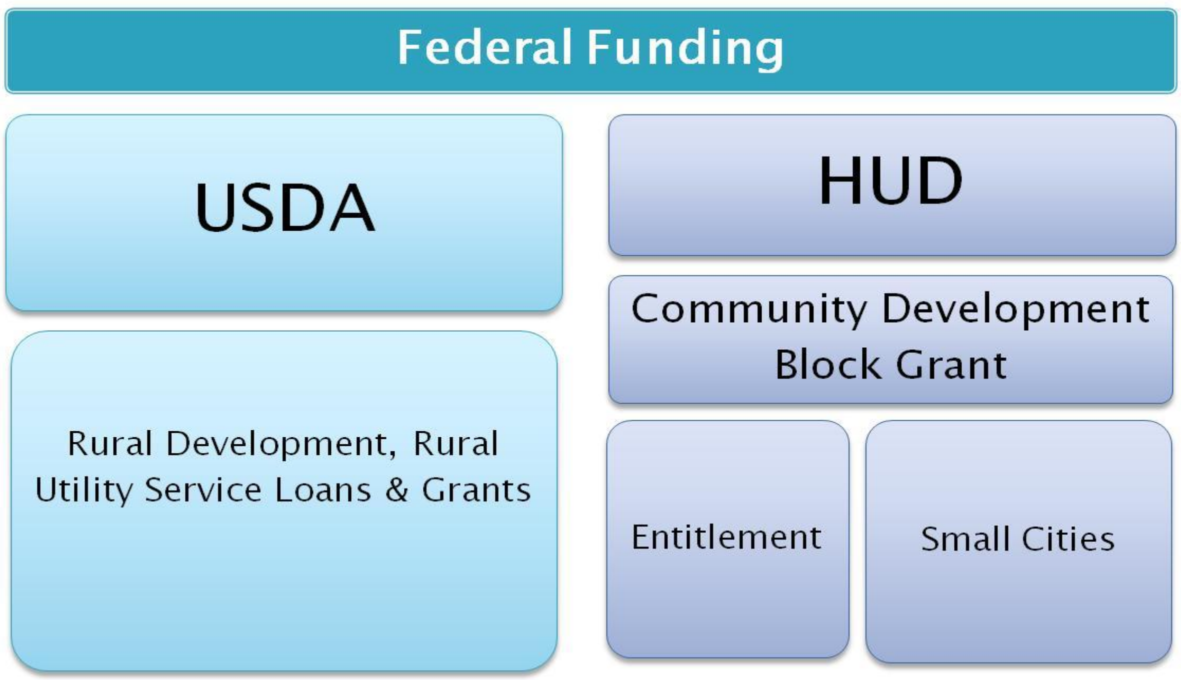
  [http://www.rurdev.usda.gov/UWEP_HomePage.html]

- RUS funding usually covers a broader definition of eligible project costs than many State operated programs. This simplifies the process when USDA is the sole source of project funding. When USDA funding complements other funding sources, USDA can often finance costs ineligible in other programs such as land purchase and contingencies (not eligible in SWRCB programs for example) or replacement of a water distribution system (often times ineligible in CDPH programs). In "unusual cases" (RUS Instruction 1780) USDA water and wastewater program funds can be used to fund water and sewer service connections on private property and the abandonment of old private wells and on-site septic systems.

- At the time of the preparation of this report, the State of California was suffering from one of the worst droughts in recorded time. In response to the drought, USDA has allowed eligible rural communities affected by the drought to apply for Emergency Community Water Assistance Grants for up to $500,000. Eligible rural communities are those with a population of less than 10,000 that are experiencing a significant decline in the quantity of water (or such a decline is imminent) that is attributable to the drought conditions and the proposed project is necessary to alleviate this problem. This funding source is a very streamlined process. Funds were obligated within 2 months of submission of applications to 11 parched Tulare County (primarily disadvantaged) communities in July 2014. For the duration of the drought, it is likely more Emergency Community Water Assistance Grants funds will be made available.

- Individual loan applications may be submitted by income eligible property owners that reside on their property to USDA's 504 housing rehabilitation program. This program can cover the costs of water and sewer service connections and/or the abandonment of old water wells or on-site septic systems, though funding is often limited.

[http://www.usda-rural-development-direct-mortgage.com/504_repair_loan_and_grant.htm]



10.4 Newer and Emerging CDPH Funding Programs

10.4.1 Pre-Planning and Legal Entity Formation Assistance Program

The Pre-Planning and Legal Entity Formation Assistance Program (Pre-Planning) is designed to assist communities that do not have access to safe drinking water, and public water systems not eligible for SDWSRF funding due to the lack of an eligible entity. CDPH had grant funds available under a new local assistance set-aside for a pilot program to assist with the formation of a legal entity with the necessary authority to enable access to the SDWSRF project funding process for subsequent planning and construction funding. Funds through this program are to be used to explore formation of an eligible legal entity and to complete such formation where it is feasible and desired by the affected community. Possible project outcomes include the identification and/or creation of a regional authority, identification of an existing authority which could extend service, or the creation of a new governing authority.

Pre-Planning applications were accepted through November 2013. This was a pilot program whose results will be reviewed to determine future funding availability.

Program Eligibility and Application Information:

Currently, communities of private well owners and state smalls[5] (systems between 5-14 connections) do not qualify for funding under the Safe Drinking Water State Revolving Loan Fund (SDWSRF), which grants millions of dollars a year to PWSs for water related projects. Under a new set-aside, communities of private wells or state smalls that want to create a new water system or be consolidated into existing PWSs are eligible to receive SDWRSRF funding. Entities that are eligible to submit an application on behalf of one or more affected communities include: public entities such as cities, counties, special districts, LAFCo; existing PWSs; public colleges; public universities; non-profit organizations; and joint powers authorities. Applicants are required to demonstrate their ability to carry out the activities identified in the work plan.

http://www.cdph.ca.gov/services/funding/Pages/Pre-Planning.aspx

10.4.2 Consolidation Incentive Program

The Consolidation Incentive Program is designed to promote consolidation as a cost-effective solution to water systems that do not meet safe drinking water standards. CDPH is providing an incentive to encourage larger systems to consolidate nearby noncompliant systems. Through the consolidation incentive process, lower ranked projects that do not usually receive SRF invitations can become eligible for funding. By agreeing to consolidate a neighboring noncompliant system, CDPH will re-rank a low-ranked project into a fundable category.

Consolidation Incentive Planning applications were accepted through March 2014. Consolidation Incentive Construction applications were accepted through June 2014.

Program Eligibility and Application Information:

In order to apply for a consolidation incentive project, systems must first submit a re-ranking request form for a project that was previously submitted but not funded. Once approved, CDPH will notify the system and invite the newly-ranked projects to submit full applications during the next round of invitations.

http://www.cdph.ca.gov/services/funding/Pages/ConsolidationIncentive.aspx

10.4.3 The Small Water Systems Program Plan (SWSPP)

In 2012, CDPH announced plans to concentrate funding and other resources on 177 specific small public water systems (PWSs)[1] in need of meeting drinking water standards. Most of the water systems are in disadvantaged communities. This program outlines specific actions that CDPH intends to take that will incrementally reduce the

[5] State small system serves at least five, but not more than 14 service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year.

number of small systems not meeting the State's water quality standards. CDPH staff have set a goal of bringing 63 of the 177 identified small systems into compliance by the end of 2014 and most of the remaining others within three years.

Specific Actions Taken by CDPH Staff:

CDPH and third-party providers will prioritize these small systems over other systems for receiving available technical and financial resources and work with stakeholders to identify opportunities for consolidation.

CDPH will track progress towards resolving problems and provide stakeholders an annual report on the status of all water systems still listed.

CDPH staff, working with counties, will prepare a one-page summary for each system on the list that identifies issues and barriers that keep water systems from executing permanent drinking water solutions.

CDPH will create a small system specific webpage, with technical information and updates.

Program Eligibility and Application Information:

Eligible communities are those with small systems with fewer than 1,000 service connections and a population up to 3,300. Communities that meet these criteria and are currently out of compliance, with one or more drinking water quality violations, will be contacted by CDPH with further details on how to participate in this program. CDPH intends to work closely with third party provider to fully implement this program. Communities in the Central Valley, that believe they qualify for this program, but aren't listed as one of the 177 identified communities should contact CDPH Drinking Water Program staff, the Community Water Center, or a respective regional third party provider (Rural Community Assistance Corporation (RCAC), California Rural Water Association (CRWA) and Self-Help Enterprises). ***San Joaquin Valley Contact List:*** CDPH Drinking Water Program (916) 552-9127, Marques.Pitts@cdph.ca.gov; Community Water Center (559) 733-0219 or (916) 706-3346; Self-Help Enterprises (559) 651-1000.

10.5 New Drinking Water Legislation

10.5.1 Assembly Bill 21 (Alejo): Small Community Safe Drinking Water Grant Fund

This bill would provide funds for disadvantaged communities without safe drinking water by authorizing the assessment of a charge in lieu of interest payments on loans and depositing the monies into a newly created grant fund. The new grant program would allow disadvantaged communities who are unable to repay interest-bearing loans to apply for grants to remedy their unsafe drinking water.

This bill was signed by Governor Brown on October 8, 2013.

10.5.2 Assembly Bill 30 (Perea): Small Community Grant Funds

The State Water Pollution Control Revolving Fund Small Community Grant Fund (SCG Fund) finances wastewater treatment projects in small disadvantaged communities. The SCG Fund is scheduled to sunset in 2014. This bill would extend the sunset date to 2019.

This bill was signed by Governor Brown on October 8, 2013.

10.5.3 Assembly Bill 115 (Perea): Small Community Consolidation

This bill would clarify applicant eligibility for state drinking water funding and encourage existing PWSs, and private well owners, primarily in disadvantaged communities with unsafe drinking water, to consolidate and form a new or revised PWS.

This bill was signed by Governor Brown on October 8, 2013.

10.5.4 Senate Bill 103: Public Water System Drought Emergency Response Program

Senate Bill 103 was amended in Assembly February 25, 2014 to revise items of appropriation and make other changes for the purpose of addressing drought conditions in the state. SB 103, as amended, directed that, of the amount appropriated in Schedule (7), $15,000,000 shall be available for encumbrance until June 30, 2016, for purposes consistent with subdivisions (a) and (c) of Section 75021 of the Public Resources Code for grants of up to $500,000 per project for public water systems to address drought-related drinking water emergencies or threatened emergencies. The State Department of Public Health shall develop new guidelines for the allocation and administration of these moneys, including guidelines that dictate the circumstances under which the per-project limit of $500,000 may be exceeded. The department shall make every effort to use other funds available to address drinking water emergencies, including federal funds made available for the drought, prior to using the funds specified in this provision.

10.5.5 Interim Replacement Drinking Water for Economically Disadvantaged Communities with Contaminated Water Supplies

On March 1, 2014, Governor Brown approved a $687.4-million emergency drought relief package to take effect immediately. As a result of the Governor's action, the State Water Resources Control Board approved $4 million in funding from the Cleanup and Abatement Account to provide interim replacement drinking water for economically disadvantaged communities with contaminated water supplies. Eligible entities that can apply for this funding include public agencies, as well as certain non-profit organizations and tribal governments that serve a disadvantaged community and that have the authority to clean up or abate the effects of a waste. Emergency water projects include bottled water, vending machine, point of use devices (water filters), hauled water, wellhead treatment, and planning activities.

In an effort to distribute funds as quickly and efficiently as possible, the State Water Board will coordinate with the Regional Water Quality Control Boards, the California

Department of Public Health district offices, the Office of Emergency Services, and other stakeholders (e.g. environmental justice groups, community assistance groups, etc.) to identify those disadvantaged communities that are most at-risk and would benefit from financial assistance.

11 SUSTAINABILITY

A sustainable water system is one that can meet fiscal and customer performance goals over the long-term. Sustainable systems have the following characteristics:

- A commitment to meet service expectations.
- Access to water supplies of sufficient quality and quantity to satisfy current and future demand.
- A distribution and treatment system that meets customer expectations and regulatory requirements.
- The technical, institutional, and financial capacity to satisfy public health and safety requirements on a long-term basis.

Small systems today face severe challenges, including rapidly increasing regulations, declining water quality and quantity, legal liability for failing to meet the Safe Drinking Water Act, financial distress, and customer resistance. A system's ability to deal with these challenges depends, to a great degree, on its managerial, technical, and financial capabilities.

Small water systems must find ways to make the capital improvements or operational changes necessary to ensure long-term sustainability. Maintaining this long-term focus in the face of pressing immediate needs is one of the greatest challenges small water systems face.

As is often the case, financial capacity lies at the heart of this challenge. Small systems in particular are hampered by limited access to capital often due to an insufficient rate and/or tax base, either because the number of customers is small or because the population served has a low MHI.

The technical solutions mentioned in this report will have an estimated life of at least 20 years if properly maintained. A major issue with any of the technical solutions will be the ability of the community to pay for and operate the solution. The operations and maintenance costs will increase the utility bills of the residents. The ability of residents to pass any required rate increases and pay those increases will be the biggest issue affecting sustainability. A related issue affecting sustainability is the ability of the community to find and retain qualified operators to operate the technical solutions.

12 OBSTACLES AND BARRIERS

12.1 Potential Obstacles, Barriers and Solutions

There are numerous obstacles that a community must overcome in order to implement a technical solution. Some of these obstacles include:

Lack of approved technologies – For certain pollutants, like nitrates and fluoride, there are a small number of approved technologies. However, there are alternate treatment technologies constantly being developed.

Solution - Having a quicker process set up to pilot and potentially approve emerging technologies could be helpful to DACs if a more cost effect treatment is developed.

Proper selection of technology – This pilot study provides a guide of possible technical solutions. However, a more detailed evaluation of the technical alternatives would need to be done to select a technology that will sustainably solve the particular problem(s) of a specific community.

Solution – Select an engineering firm with experience in dealing with water quality issues similar to the community's issues. The engineering firm should also be familiar with helping the community obtain funding for any possible improvements.

Community acceptance – In order for the technical solution to be feasible it would need to be accepted by the community. This acceptance would need to include the understanding of why a certain solution is being selected and how the community will benefit from the solution. Community acceptance would help with the passing of any rate increases and the payment of future utility bills. The community understanding the necessity and benefits associated with any technical solution would be beneficial.

Solution – It is critical to get the community involved early on in the process of any technical solution. The community should be given the opportunity to be informed of technical solutions being considered and how the changes may affect their water/wastewater and the additional costs. Providing the community as much information as possible, early on in the process is critical for community acceptance.

Capital costs – There will be capital costs associated with any technical solution. If treatment is involved, the capital costs could be several million dollars. The ability to secure the necessary funding could be a major obstacle.

Solution – Engineering firms or some community groups (like Self Help Enterprises) are experienced in helping small communities obtain funding. These firms or groups are familiar with the available funding and the process needed to secure the funding. There is the opportunity to obtain funding through the traditional sources for water and wastewater projects or through funding for alternative energy or conservation projects as well as other newer and emerging funding sources.

Operation and maintenance costs - The community may be able to obtain grants or low interest loans to pay for the associated capital costs for a technical solution. There is currently no funding mechanism in place to assist with operation and maintenance costs. These costs will have to be borne by the citizens in the community. Depending on the median household income in the community, the utility rate increase may have an adverse impact on the citizens

> **Solution** – Selecting the best technical solution that meets the water quality standards and is most cost effective for the rate payers. It is likely that any technical solution will involve some rate increase to cover increased O&M or payback any loans for the capital costs. Community acceptance of the technical solution may help ease the acceptance of any rate increases. Potential solutions should be analyzed for ongoing maintenance costs so that these costs can be minimized. Operations and maintenance costs may be lowered by evaluating some of the solutions presented in the Management and Non-Infrastructure pilot study such as sharing common resources or forming joint governmental agencies to share costs.

Water meters – Using water meters and billing based on usage are ways to encourage water conservation. While some DACs have water meters, the meters may not be used in billing due to the fact that staff is not available to read the meters. For these DACs, water billings are done at a flat rate.

> **Solutions –** Current funding through CDPH does not allow for replacement of water meters. DACs would benefit from State funding for water meter replacement. The replacement meters should be capable of being read remotely. Additionally, the DAC would need to modify their billing system to bill customers based on the volume of water used.

Licensed operators – The technical solutions may require a higher level certified operator than is currently employed or contracted to the community. The operator at the higher level would likely command a higher salary. It can be difficult for an operator at a DAC to maintain his certification since this requires on-going educational requirements. Obtaining these educational requirements can be costly and requires time off work to attend. It is also difficult for an operator at a DAC to obtain a higher grade license since this would require spending a certain amount of time at a higher rated plant.

> **Solutions** – Explore the possibility of an existing operator for the community upgrading their certification to be able to operate and maintain the technical solution. If an operator cannot be found from existing staff, the community may need to explore the possibility of hiring a contract operator. Another option is to share operators with neighboring communities. This option is discussed in more detail in the Management and Non-Infrastructure Solutions Pilot report.

Waste disposal – If a water treatment solution is selected, there will be residuals that will need to be disposed. The waste to be disposed could be high in salinity or a hazardous waste. These will require additional costs to properly dispose.

Solutions - If disposal of treatment residual will be an issue, the technical solution considered should produce the smallest volume of residuals. During the evaluation of potential water solutions, the cost associated with waste disposal need to be evaluated. There are potential opportunities for DACs to reduce waste disposal costs be sharing resources with nearby communities that share the similar problem or instituting some of the solutions presented in the Management and Non-Infrastructure pilot study.

13 CONSIDERATIONS FOR IMPLEMENTING TECHNICAL SOLUTIONS

The following are items to be considered when evaluating any of the options in the Technical Solutions pilot study. These are items to be considered by various parties in order to facilitate the implementation of technical solutions to communities in the Study Area.

- Overall Considerations Regarding Technical Solutions for Disadvantaged Communities
  - Water treatment should be a “last resort”. The decision trees in **Appendix E** are provided as a guide for communities to see what information is needed and what technical solution may be applicable.
  - The technical solution will be specific to each community. Each community will need to be examined individually to evaluate the possible technical solutions.
  - For communities with failing septic systems, installation of a sewer collection system and a wastewater treatment facility may be needed.
  - In addition to the technical solution meeting the water/wastewater regulations, the solution must be financially sustainable for the community.
- Funding Agency Considerations
  - Ensure that funds are not used to support unsustainable systems. Although it is already done it should be mentioned again that funding should be provided to systems that are fiscally sustainable and providing adequate water quantity and quality to their customers.
  - Funding should be made available to public and investor-owned utilities for assisting in the operating of small water systems. If funding is provided to privately owned systems, these systems should be held to the same regulations and technical, managerial, and financial requirements as public systems.
  - Investigate the possibility of providing funding to offset the cost of increased operations and maintenance costs.
  - Make funding available for projects that only involve the installation of water meters that can be read remotely. Currently, these projects are ranked lower than larger projects that involve treatment or new water sources.
  - Support the development and implementation of water conservation policies/measures by providing incentives and technical assistance to DACs and promoting the use of water and energy efficient equipment upgrades, such as energy-efficient or solar powered pumps.

- Community Involvement Considerations
    - The community should be involved early on and throughout the process of improvements to their water and wastewater systems. The community should be given the opportunity to understand the alternatives evaluated and the reason for selection of a certain alternative, and the analysis of potential operations and maintenance costs.
    - Local political issues, including voter resistance to water/wastewater system rate increases, water system ownership changes and budget conflicts, may discourage some needed changes to the water/wastewater system.
    - In most cases the final solution to a water/wastewater issue is not so much “planned” as it is negotiated. Such a negotiated solution has the potential to be regarded as a success in that it will be embraced by more stakeholders.
- Regulatory Considerations
    - EPA and CDPH could support fledgling water treatment technologies (i.e. titanium based nanofibers for arsenic removal, carbon nanotubes for nitrate removal, membrane biolfilm reactor (MBfR) for wastewater treatment, anaerobic migrating blanket reactors (AMBR) for wastewater treatment) through a verification program. Approved technologies should be kept in an available online database that would include complete information on source and finished water quality, for standard treatment units, and costs for each technology.
    - Many small systems not only lack the treatment facilities needed to meet regulatory requirements but also have broken equipment or corroded or substandard distribution lines that need to be replaced. These small systems could benefit from technical assistance from state water regulators, but state agencies generally lack the resources to provide the detailed assistance that would most benefit small systems. Regulatory agencies could offer better assistance to small systems to guide them through the funding and alternatives analysis.

13.1 Recommendations

The recommendations contained herein are provided for general consideration by the various entities identified. The information contained herein is not intended to be and should not be construed as legal advice. Readers should seek the advice of an attorney when confronted with legal issues, and an attorney should perform an independent evaluation of the issues addressed in these materials.

13.1.1 Improve Local TMF Capacity

13.1.1.1 Target existing technical assistance training programs to specific communities who have shown a need and interest, to focus on their needs and provide locally available and specialized training programs.

- *Who: State Agencies and technical assistance providers (RCAC, SHE, etc.)*
- *Why: Local, targeted trainings are more effective because they are more accessible to rural communities, and can be tailored to meet the unique needs identified by water and wastewater system representatives. There is an additional benefit to bringing local water and wastewater system representatives together so they can network and learn from each other.*
- *How: SWRCB (Division of Drinking Water) in coordination with Rural Community Assistance Corporation (RCAC) and Self-Help Enterprises (SHE) will be providing targeted board training for several communities in the Study Area. This initial effort can inform how a program can be expanded, improved and continued to other targeted groups of communities. SWRCB staff and technical assistance providers should work together to identify target communities. A local venue would be identified and invitations extended to water system representatives, including board, staff and operators.*
- *When: Quarterly or biannually, in different locations. Follow-up trainings could be scheduled as needed, depending on response.*
- *Funding: State Water Resources Control Board technical assistance funding through the SRF set aside, or current or future bond funding.*

13.1.1.2 Improve the operator certification process by providing more frequent testing, and offering certification tests in more locations.

- *Who: SWRCB Operator Certification Programs*
- *Why: Operator certification is challenging for people in remote areas and for those without English language skills. Training opportunities are limited, testing sites are distant, and the exams are offered only in English. Sometimes valued staff members are lost because they cannot achieve a basic distribution operator certification, despite adequate skills and long experience. Particularly for lower-level certifications, such as water distribution or treatment certification level D-1 or T-1, or wastewater operator Grade I, the need for accessibility and affordability of certification programs may outweigh other precautions. Currently, drinking water treatment and distribution system operator exams are only offered in eight locations throughout the State, including one location (Fresno) within the Tulare Lake Basin Study Area. Each distribution and treatment certification test is offered two times per year. Similarly, wastewater*

treatment plant operator certification exams are currently held two times per year, with only one exam location in the Tulare Lake Basin (Fresno).

- *How: Provide opportunities for examinations in more locations, on a more frequent basis. Consider providing exams in at least three locations throughout the Tulare Lake Basin (for example, Fresno, Visalia, and Bakersfield). Consider making examinations available in Spanish or other languages, at least for lower-level certifications that do not require English literacy to perform relevant duties. Consider remote testing that could be done online, possibly from local libraries.*
- *When: Exams should be offered quarterly.*
- *Funding: SWRCB Operator Certification Programs*

13.1.1.3 Consider developing operator training programs at local community colleges to address the lack of licensed water and wastewater operators.

- *Who: Local Community Colleges (State Center Community College District, Sequoias Community College District, Kern Community College District, West Hills College, or others)*
- *Why: There is a lack of properly certified operators available to operate water and wastewater systems throughout the Study Area. With increasing regulations necessitating the need for more and higher grade treatment facilities, this will only become more of an issue if operator training programs do not become a higher priority.*

  Training programs have been attempted at local community colleges, however, they have had trouble filling seats, and so these programs have not been sustainable. It may require some outreach efforts to encourage students to pursue this career path, but local job opportunities and compensation would need to support that.
- *How: Community college districts should discuss and evaluate the need for providing operator training programs. If such programs are developed, the community college district should outreach to youth to inform them of the benefits of these training programs and the need for water and wastewater system operators. It is recommended that an evaluation be conducted of the magnitude of operator needs and relative compensation levels for those who complete such training programs, so that the outreach efforts can be properly informed. These discussions should involve CWEA and their experience related to operator training needs.*
- *When: Now. Ongoing.*
- *Funding: Community college districts.*

13.1.2 Improve O&M Funding

Local Service Provider:

13.1.2.1 Project alternatives should be analyzed to minimize ongoing costs and secure TMF capacity. If O&M costs cannot be supported or TMF capacity challenges are not adequately addressed, other alternatives should be pursued.

- *Who: Any DAC considering making any improvements to their water or wastewater system.*
- *Why: O&M costs have to be borne by the users in the community. Depending on the median household income in the community, the utility rate increase may adversely impact the users. State agencies have implemented requirements within their funding programs for full evaluation of the operation and maintenance lifecycle costs for a selected project, along with a water rate study to identify what impact the project has on the cost of water for that community. If the projected water rate is deemed to be unaffordable, they will not (and should not) fund the selected project.*
- *How: Solutions should be analyzed to minimize ongoing costs. If O&M costs of a project cannot be supported, other alternatives should be pursued. Developing an O&M plan that includes the types of ongoing O&M costs needed, O&M servicing and parts replacement schedule, and amount needed for O&M fund reserve can help the community plan ahead to address covering O&M adequately. If O&M costs cannot be supported by the community, it may be that the system is not viable (too small, too remote, insufficient water supply or water quality, etc.) and should be discontinued.*
- *When: Whenever a DAC is evaluating potential improvements to their water or wastewater system.*
- *Funding: Local Funding from the water or sewer fund of the local service provider should support O&M costs. The source of revenues is the water or sewer charge for service. Funding agencies fund an alternatives analysis conducted in a feasibility study, and/or during the project planning phase.*

State Agencies:

13.1.2.2 Consider providing increased funding for capital improvements for water (or wastewater) related projects when it would allow for reduced O&M costs over the long term. For example, construction of dual water systems for DACs with poor distribution systems or high non-potable water demand.

- *Who: State and Federal funding agencies*
- *Why: Grant funding for DACs is currently capped at $5 million for capital costs (for Prop 84 funding). O&M costs must be paid by the system*

customers. There may be instances when a capital cost greater than $5 million may provide a DAC with less O&M costs compared to an improvement with a capital cost less than $5 million. For example, a dual water system would allow the DAC to treat a smaller volume of potable water resulting in lower on going O&M costs. Other funding sources such as SRF and USDA are available, which typically have loan components.

- *How: Consider allowing DACs to obtain grant funding for capital costs greater than $5 million if the higher capital costs solution will lower ongoing O&M costs. An evaluation to determine appropriate levels of funding and qualifications would need to be done prior to increasing current funding limits.*
- *When: When considering new funding programs or funding program updates.*
- *Funding: Local funds, State legislature, SWRCB*

13.1.2.3 Support the development and implementation of water conservation policies/measures by providing incentives and technical assistance to DACs and promoting the use of energy efficient equipment upgrades, such as energy-efficient or solar powered pumps.

- *Who: State Agencies*
- *Why: Water systems that implement water conservation techniques and bill their customers based on water used will use less water. Less water used will mean less water needing treatment that will result in lower O&M costs. Energy efficient upgrades to pumps and other large electrical consumption equipment will lower electrical costs to the water system.*
- *How: Provide incentives for water systems to install water meters and implement water conservation policies, and measure their effectiveness. Energy companies can provide incentives in the manner of rebates or funding for water systems to install more energy efficient equipment.*
- *When: Now for water conservation measures. When existing pumps or electrical equipment is due for replacement for energy efficient upgrades.*
- *Funding: Local funding, State legislature, SWRCB/RWQCB, energy companies.*

13.1.2.4 Seek funding to install or replace water meters. The replacement meters should be capable of being read remotely (if the system size or agreements with neighboring systems support it) to reduce labor costs.

Consider installing same meters as neighboring community(ies) so that meter reading and billing systems can be shared.

Develop a tiered rate structure with appropriate base rates and water usage rates to encourage conservation while ensuring sufficient revenue.

- *Who: Local government boards, technical assistance providers/consultants*
- *Why: Installation of water meters is a basic and very effective method of water conservation. Metering leads to natural behavioral changes by water consumers because meters tie water use directly to household finances. Reduction in water use results is lower operating and maintenance expenses to the utility. Use of water meters also provokes the development and use of tiered rate structures, which are an excellent tool for improving overall utility finances and distributing costs over customers with different use patterns. Additionally, installing compatible meters in several locations in a given region can provide a very good opportunity for communities to enter into contractual agreements to share equipment, software, billing functions and staffing positions.*
- *How: Consult with a technical service provider and/or engineering consultant to determine the available funding opportunities. Water meter installation could be considered as part of a larger infrastructure project, or as a separate project.*
- *When: Immediate and ongoing.*
- *Funding: A source of funding is the water or sewer fund of the local service provider. State agencies could redefine Category H projects (as defined by the State Revolving Fund Project Ranking Criteria) to include replacement metering projects, including meter reading equipment and necessary software. DWR could fund an ongoing Water Use Efficiency program (currently the program is funded only periodically) in which metering and re-metering projects are eligible.*

13.1.2.5 Consider establishing a transitional funding program to assist with O&M costs on a temporary basis.

- *Who: State agencies and the legislature*
- *Why: At the state level there is a need for a targeted and coordinated funding program with the clear goal of transitioning small disadvantaged communities in unincorporated areas without safe drinking water (including those communities with and without existing public water systems) to achieve, self-sustaining, affordable drinking water systems.*
- *How: This newly targeted program should specifically include funding for the following:*
  - ✓ *Technical Assistance for both 1) project application and project operation and management (currently eligible under SWRCB (Division of Drinking Water) funding but not DWR IRWM funding), and 2) leadership and capacity training;*
  - ✓ *A pooled capital reserve fund, which can cover both short-term financing costs and help lower O&M costs; and*

✓ *Some O&M subsidies for an initial period of time until long-term solutions are implemented and self-sustaining.*

As a "transitional" program, the associated funding should be limited to supporting the transition of existing disadvantaged communities into self-sustaining systems that can achieve compliance with the applicable regulatory requirements and ensure affordable rates. The program should not be a long-term, on-going financial support mechanism. As such, a disadvantaged community's participation in a transitional funding program should have conditions and incentives to ensure it is meeting certain objectives and milestones in a timely manner. In particular, at minimum state agencies should require and provide TMF training and improvements as a condition of receiving this O&M funding.

- *When: This should be considered as part of the IUP process, state budget and legislative process, and within the creation or appropriation of new funding sources, including the new water bond.*
- *Funding: Such an effort would need to include targeting significant amounts of existing funding sources, and will need new and additional funding sources to adequately address the needs and gaps identified above. The modified Water Bond should include significant funding for this effort. It may be possible to create a set aside in the SRF Intended Use Plan (IUP) for some or all of this purpose, as well as utilizing the Clean Up and Abatement Account and IRWMPs for at least some of these purposes. If a statewide or other scale of water user fee were established, part of it could be used for this purpose.*

13.1.2.6 Allow drinking water funding agencies to fund infrastructure for fire flow requirements. Where affordability or feasibility of the project is jeopardized by meeting full fire flow requirements, also allow drinking water projects to be funded for domestic purposes provided a limited level of fire flow is available. Where a viable option, the feasibility of installing a dual water distribution system to meet domestic supply and fire flow requirements, should be considered (especially where irrigation demands can be accommodated through the non-potable system used for fire flow).

- *Who: County Fire, County Boards of Supervisors, and funding agencies such as USDA*
- *Why: Especially in communities where water must be treated to remove contaminants, it should be an option for utilities to choose to treat only the water that is actually consumed by people. Fire flow and outside irrigation demands can represent a significant portion of the total water demand in a given community, and requiring that fire flow is always available means that more water is being pumped and treated than is being consumed. Dual systems present one way for communities to protect public safety without building oversized treatment and potable water distribution*

systems. The dual system can also allow for use of untreated water for irrigation purposes, additionally reducing the system treatment requirements. In cases where a dual system is cost prohibitive, and attaining fire flow requirements through the main potable system is much to expensive to operate, allowing a reduced fire flow capacity should be considered.

- *How: Adjust fire codes to allow for greater flexibility in the manner in which communities meet fire flow requirements, or perhaps reducing those requirements. Provide funding (e,g, Community Facility loans and grants through USDA) to install parallel piping that is dedicated for fire flow and landscape irrigation use. Utilize existing wells that do not meet Title 22 requirements to supply the second system, when available.*
- *When: As soon as practicable.*
- *Funding: USDA Community Facilities or Water & Wastewater loans/grants.*

13.1.3 Improve Funding for DACs

State Agencies:

13.1.3.1 Consider changes on Category E (insufficient source water capacity or delivery capability) project rankings, to make it easier to get funding for that category of projects.

- *Who: State Agencies*
- *Why: There are many communities with insufficient water supply, however, the criteria for funding eligibility is heavily weighted on water quality challenges. The lack of sufficient water quantity is often a significant problem.*
- *How: Review and revise the guidelines for ranking of funding eligibility criteria to enable funding assistance for water supply sources, especially for those communities with a single source of supply.*
- *When: Now.*
- *Funding: Unknown.*

13.1.3.2 Consider ways to expedite the funding process, so that communities applying for funding do not spend several years drinking water that does not meet primary drinking water standards, and/or relying on insufficient water supply.

- *Who: All funding agencies (US EPA, SWRCB, USDA, DWR)*
- *Why: Currently, communities cannot apply for funding until an actual water quality violation is documented. Often, though, it is apparent that a*

problem is emerging as contaminant levels slowly climb. Allowing systems to apply for funding based on documented contamination levels that are projected to exceed an MCL in the coming two to five years, for example, would give communities a big head start on fixing problems. This could significantly reduce the time that people spend drinking unsafe water.

Another consideration would be to streamline the funding process so that it does not take five plus years from the time of initial application to implementation of a project.

- *How: Consider amending funding regulations and intended use plans to allow application by water systems that can demonstrate a documented increase in a regulated contaminant that is projected to exceed the MCL in two to five years.*

  Also, consider methods to speed up the funding process, including amending planning contracts by adding design and construction phases.

- *When: This is a change to regulations that could be made immediately. It is anticipated that the recent Drinking Water Program transition from CDPH to SWRCB may help the Drinking Water Program funding process.*
- *Funding: The Safe Drinking Water State Revolving Fund would be the most obvious, and possibly this change could be implemented through a change to the Intended Use Plan. DWR IRWMP funding could also be a good source for funding to avert future problems. In both cases, planning funding could be expanded to allow for studies that monitor, assess and project contamination that could exceed a health standard.*

13.1.3.3 Require privately owned for-profit systems to conform to all requirements (including audits and other fiscal requirements) of publicly owned systems in order to receive public funding assistance.

- *Who: State of California.*
- *Why: Private for-profit systems are owned by an individual or private corporation. The general purpose of a private system is associated with the fiscal incentive for the owner of the system. Providing public funding assistance to upgrade privately owned water or wastewater systems may be construed as a gift of public funds. Private systems may not have been constructed or operated to the same standards as public systems. It may periodically be perceived that the users (tenants) of the private system are the primary consideration for determining if public funding assistance is appropriate. Care should be exercised to not remove the private owner responsibility for the water or wastewater infrastructure.*
- *How: Ensure that the requirements associated with audits, fiscal reserves, rate structures, operational budgets, operational and managerial*

requirements, and technical requirements are mandated equally to all potential recipients of public funding assistance.

- *When: On-going.*
- *Funding: No additional funding is necessary.*

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