BOOK 5: INDIVIDUAL HOUSEHOLDS 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

FINAL DRAFT

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Prepared for:
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Department of Water Resources
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South Central Region Office
3374 East Shields Avenue
Fresno, CA 93726

Prepared by:

COMMUNITY WATER CENTER
EL CENTRO COMUNITARIO POR EL AGUA

EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

Self-Help Enterprises

KELLER WEGLEY
CONSULTING ENGINEERS

INDIVIDUAL HOUSEHOLDS PILOT

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In Care of:
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Prepared by:

KELLER/WEGLEY
CONSULTING ENGINEERS

APPENDIX B – SOLUTION SETS

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ABBREVIATIONS

ACS ..... American Community Survey
AF ..... Acre-Feet
APWA ..... American Public Works Association
AWWA ..... American Water Works Association
BOD ..... Biochemical Oxygen Demand
CDBG ..... Community Development Block Grant
CDPH ..... California Department of Public Health
CEQA ..... California Environmental Quality Act
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
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)
DBPR ..... Disinfection Byproduct Rule
DWR ..... Department of Water Resources
DWSAP ..... Drinking Water Source Assessment & Protection
EPA ..... United States Environmental Protection Agency
FBR ..... Filter Backwash Rule
FEMA ..... Federal Emergency Management Agency
FRF ..... Fresno Regional Foundation
GIS ..... Geographic Information Systems
IE ..... Interim Enhanced; LT1-Long Term 1; LT2-Long Term 2

IRWM ..... Integrated Regional Water Management
IRWMA ..... Integrated Regional Water Management Authority
JPA ..... Joint Powers Authority
KBWA ..... Kings Basin Water Authority
LAFCo ..... Local Agency Formation Commission
LCR ..... Lead and Copper Rule
LPA ..... Local Primacy Agency
O&M ..... Operation and Maintenance
MCL ..... Maximum Contaminant Level
MHI ..... Median Household Income
MHP ..... Mobile Home Park
MOU ..... Memorandum of Understanding
MSR ..... Municipal Service Review
MWC ..... Mutual Water Company
NCWS ..... Non-Community Water System
NTNC ..... Non-Transient Non-Community Water System
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
RUS ..... Rural Utilities Service
RWQCB ..... Regional Water Quality Control Board
SB ..... Senate Bill
SDAC ..... Severely Disadvantaged Community
SDWA ..... Safe Drinking Water Act
SMD ..... Sewer Maintenance District
SOAC ..... Stakeholder Oversight Advisory Committee
SRF or SDWSRF ..... State Revolving Fund (Safe Drinking Water)

SSWS ..... State Small Water System
SWP ..... State Water Project
SWRCB ..... State Water Resources Control Board
SWS ..... Small Water System
SWTR ..... Surface Water Treatment Rule
TCP 1,2,3-Trichloropropane
THM(s) ..... Trihalomethane(s)
TLB ..... Tulare Lake Basin
TMF ..... Technical Managerial & Financial
TNC ..... Transient Non-Community Water System
TSS ..... Total Suspended Solids
USDA ..... United States Department of Agriculture
USGS ..... United States Geological Survey
WC ..... California Water Code
WD ..... Water District
WDR ..... Waste Discharge Requirements
WWD ..... Water Works District
ZOB ..... Zone of Benefit

EXECUTIVE SUMMARY

Introduction

The individual household, for purposes of this Individual Households Solutions Pilot Study (Study), is a single household that utilizes a privately owned, individual groundwater well to satisfy its water supply demands. An individual household may also use an on-site wastewater treatment system, such as a septic tank and leach line system. An individual household may be represented by homeowner or renter. In general, individual households are not subject to drinking water quality regulations. Until May, 2013, individual households were not subject to wastewater treatment and disposal regulations. Wastewater treatment and disposal regulations now apply to new on-site wastewater treatment and disposal systems. Numerous water quality and wastewater problems have been encountered in rural areas populated by individual households.

Problems

Specific problems associated with the individual household or respective renter are difficult to establish due to very limited regulatory oversight. Problems that affect rural communities and water systems can be assumed to affect the individual household. Additional problem identification can result from voluntary reporting from individual households, academic studies and professional experience. Problems affecting individual households can be categorized into three (3) categories: 1) water quality, 2) water quantity and its delivery and 3) wastewater treatment and disposal.

EXECUTIVE SUMMARY

Solutions

The Pilot Study Report has been prepared to assist in directing the individual person(s), such as the homeowner or renter associated with a household, to potential solutions to identified water quality and/or wastewater problems. This Pilot Study Report is intended to provide guidance to the individual household in the process of selecting potential solutions to water quality and/or wastewater treatment and disposal problems. This Pilot Study Report establishes guidance utilizing questions and responses to direct the individual household to specific solutions. Categorical solutions to water quality and/or wastewater problems have been summarized for consideration by the person(s) associated with an individual household.

Obstacles

Numerous obstacles exist for individual households that prevent the use of a potential solution. Obstacles include financial, ownership, regulatory and governance considerations. Financial obstacles represent the primary obstacle since many individual households or renters may not have the financial capability to pursue a solution to the problem at the residence. Limited financial aid funding exists. Another significant obstacle results from the ownership status of the individual household. Renters may be at a disadvantage to pursue a solution.

SECTION ONE

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). This appropriation was the result of disadvantaged community leaders in the region raising the visibility of local water and wastewater challenges, and to 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. 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 and individual 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 (DAC). 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 disbursed throughout the region. Approximately 354 of 530 identified communities within the Tulare Lake Basin are disadvantaged or severely disadvantaged. Database work associated with the Project estimated the population within these 354 communities at approximately 280,000. 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.

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).

1.2 Individual Households

Throughout the Tulare Lake Basin Study Area, homes exist in rural areas where community-based domestic water and wastewater utility services do not exist. Domestic water and wastewater systems serving individual households result. An individual household, for purposes of this Study, is a single family residence that uses a private, individual groundwater supply well. In general, individual households also use private, on-site wastewater treatment systems such as septic tanks and leach line systems. Figure 1-1 illustrates the systems associated with an individual household. In this Study, an individual household may be represented by either the homeowner/landowner or the renter.

The homeowner is the person (or persons) with the main legal authority over the house (and property). The homeowner may or may not live in the individual household. The homeowner can make decisions regarding the household independently.

The renter is a person (or persons) that uses an individual household under a legal agreement with the homeowner. In general, a renter does not have authority to make decisions regarding the household. The renter must work with the homeowner (landlord) to make changes at a house.

Problems associated with the individual water and wastewater systems, in all respects, are the responsibility of the party associated with the individual household. If the individual household is a renter, additional communication and cooperation with the homeowner (landlord) becomes necessary to address water and/or wastewater system problems.

1.3 Overview of TLB Study

In order to meet the objectives of the Tulare Lake Basin Disadvantaged Community Water Study, five (5) 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; and
5. Preparation of Final Report for submittal to DWR.

1.3.1 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).

1.3.2 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.

1.3.3 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.

1.3.4 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 Individual Households pilot.

1.3.5 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.

1.4 Regulations

1.4.1 Drinking Water Regulations

The California Department of Public Health (CDPH) Drinking Water Program regulates and monitors all public water systems. Title 22 of the California Code of Regulations defines a public water system as a water system having 15 or more service connections, or 25 or more users for 60 or more days per year. State small water systems provide water to at least five (5), but less than 15 service connections. State small water systems are most always regulated by local health departments. In the Tulare Lake Basin Study area, small system oversight varies by county. Fresno and Kern Counties have CDPH oversight. Tulare and Kings Counties have County oversight (groundwater supplied systems) or CDPH oversight (surface water supplied systems). Systems with fewer than five (5) connections may or may not be regulated, depending on the number of residents and length of exposure to the water supply. Individual households that are not connected to a water system are not subject to public water system regulations. Table 1-1 presents a tabular summary of this information.

TABLE 1-1

SUMMARY OF DIFFERENT WATER SYSTEM TYPES

INDIVIDUAL HOUSEHOLDS PILOT STUDY

TULARE LAKE BASIN DISADVANTAGED COMMUNITY

WATER/WASTEWATER STUDY

Type of Water System	Number of Connections	Water Supply Usage Time	Regulated Status
Public Water System	15+	60+ days per year	Yes, by CDPH or local agency
State Small System	5-14	No Standard	Yes, by local health departments
Individual Household	1, but may be as many as 4	No Standard	No

1.4.2 Wastewater Regulations

The State Water Resources Control Board (SWRCB) and the Central Valley Regional Water Quality Control Board (RWQCB) regulate discharges from wastewater treatment and disposal systems under general waste discharge requirements (WDRs). Small, domestic systems having a maximum daily flow of 20,000 gallons per day or less that discharge to land are covered under general WDRs for small systems (WQO No. 97-10-DWQ).

Water Quality Order No. 97-10-DWQ does not apply to individual systems. On June 19, 2012, the SWRCB adopted its On-site Wastewater Treatment Systems Policy that established requirements for siting, design, operation and maintenance of individual wastewater treatment and disposal systems. The policy became effective in May, 2013.

1.5 Scope of the Pilot Study Report

1.5.1 Problem Description

Unlike community-based water and wastewater systems, individual households are not subject to drinking water and wastewater regulations. It is established, however, through sources such as neighboring public water systems, community organizations, academic studies and individual homeowners, that individual households and rural subdivisions experience water quality, water supply and wastewater treatment and disposal problems that would fail to satisfy regulatory requirements. Since these individual systems are not part of a community-based water and/or wastewater system, a knowledge base of and access to potential solutions does not typically exist, especially for individual households in disadvantaged community areas.

1.5.2 Purpose of this Pilot Study Report

This Pilot Study Report (Report) describes an array of water quality, water supply and wastewater treatment and disposal problems associated with individual household systems and provides guidance to an individual homeowner or renter in selecting potential solutions. This Report also provides general information regarding specific solutions that may be appropriate.

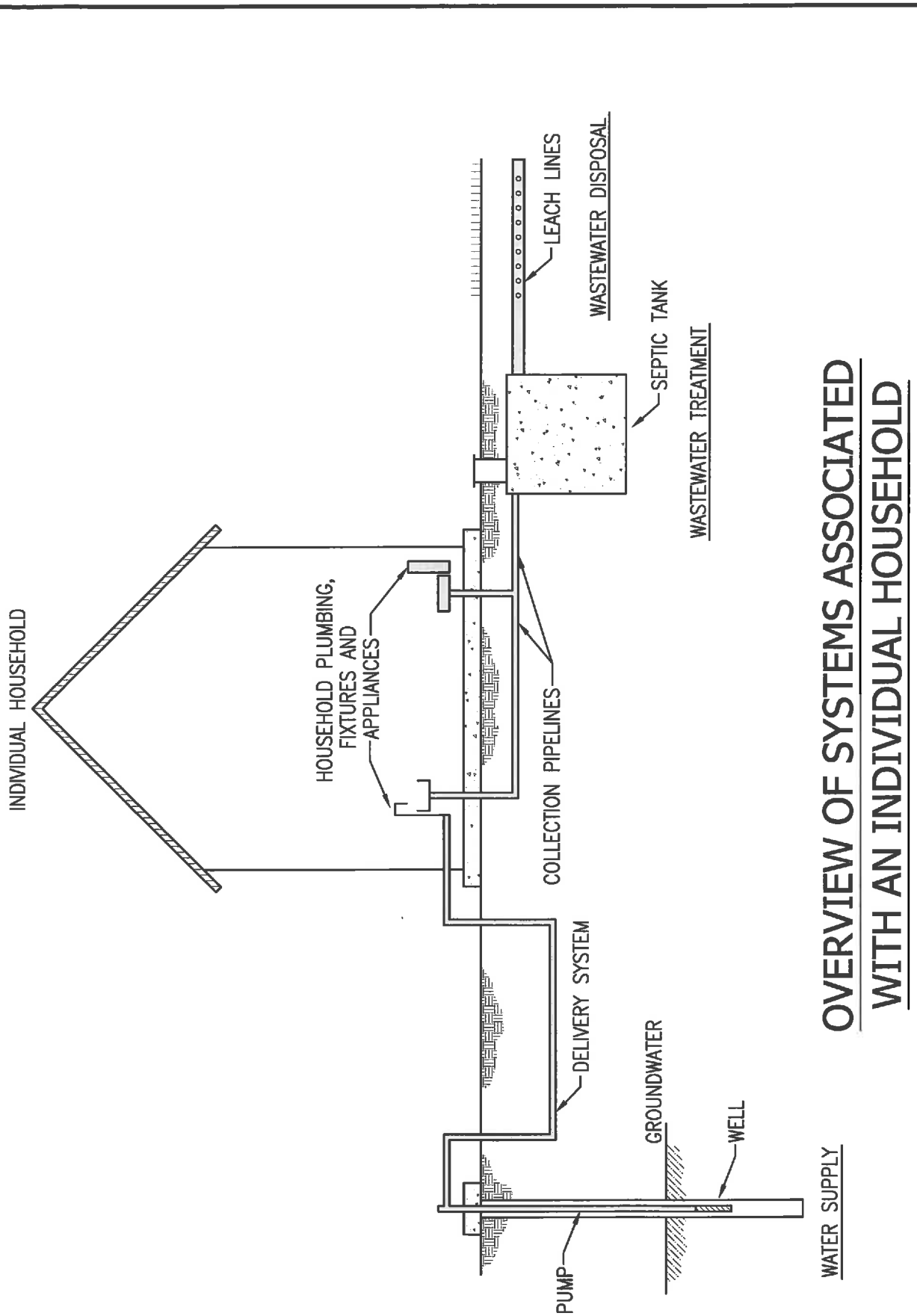
Although this Report focuses on individual households, the guidance and information within this Report can be utilized to address conditions associated with water systems and/or rural subdivisions that have up to 15 or possibly more connections. Clusters of homes, rural subdivisions or communities having households with individual groundwater wells and/or septic systems can also use this Report to address problems with individual water and wastewater systems.

1.5.3 Content of This Pilot Study Report

This Pilot Study Report consists of the following:

- Information describing the need, purpose and overview of the Pilot Study Report (Section 1);
- Descriptions of the problems facing individual households (Section 2);
- Descriptions and associated discussions regarding potential solutions for individual households (Section 3);
- Information describing considerations associated with the solution charts (decision trees) and solution sets (Section 4);
- An example (tutorial) following the steps undertaken to identify one or more solutions to an identified problem (Section 5);
- Information regarding resources available to the individual household to assist in problem identification and solution development (Section 6);
- Solution charts (decision trees) outlining questions to direct the individual household to potential solutions to identified problem(s) (Appendix A):
- Solution sets describing general information and considerations associated with a variety of potential solutions for identified problems (Appendix B); and
- Information describing case studies showing examples of solutions to water quality problems for communities of individual households (Appendix C).

FIGURE 1-1



OVERVIEW OF SYSTEMS ASSOCIATED WITH AN INDIVIDUAL HOUSEHOLD

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KELLER/WEGLEY

SECTION TWO

2 DESCRIPTION OF PROBLEMS

2.1 General

The purpose of this Pilot Study is to address water and wastewater related problems experienced by a person(s) associated with individual households in rural, unincorporated areas in the Study Area. This Pilot Study may also be considered as a tool when addressing rural subdivisions or clusters of individual households that experience common water and/or wastewater problems.

As a part of the Tulare Lake Basin Study, the project team developed a database compiling information regarding water and wastewater information. The database collects information from CDPH, County of Fresno, County of Tulare as well as other sources regarding community water and wastewater systems. Data for individual households does not readily exist.

Specific problems associated with these groups are difficult to establish due to limited regulatory oversight. A person(s) associated with individual households is not required to monitor and report water quality or wastewater discharges. Unregulated (non-permitted) systems serving up to four (4) individual households present the same situation. Problem identification can originate from voluntary individual household reports, community organization advocacy, academic studies and professional services experience.

Based upon these considerations, several problems that effect individual households have been identified. The problems can be categorized into three (3) areas: 1) water quality, 2) water quantity and its delivery and 3) wastewater treatment and disposal. Table 2-1 summarizes the types of specific problems that have been established or considered in this Pilot Study.

SECTION TWO

2.2.1 Water Quality

Water quality problems that affect permitted systems also affect small, unincorporated rural communities through their respective community water systems. It can be reasonably assumed that those water quality problems similarly affect rural individual households.

Water quality problems can be divided into five (5) general categories:

1) Bacteriological – problems associated with microorganisms such as Fecal Coliform or E. Coli;
2) Nutrients – problems associated with Nitrates or other nutrients such as phosphorus;
3) Inorganics – problems associated with constituents such as Arsenic, Copper, Hexavalent Chromium or Perchlorate;
4) Organics – problems associated with constituents such as 1,2,3-TCP, DBCP and pesticides; and
5) General Water Quality – problems associated with constituents not specifically categorized.

In general, constituents that cause water quality problems have state or federal primary drinking water standards.

Table 2-2 summarizes water quality violations compiled by the California Department of Public Health (CDPH) associated with regulated (community) water systems and reported in its 2011 Annual Compliance Report. As shown in Table 2-2, inorganic constituents such as Arsenic, Nitrates and bacteriological contamination (Total Coliform Rule violations) represent the most common water quality problem state-wide. Table 2-3 summarizes the 2011 violations for Fresno, Kern, Kings and Tulare Counties.

TABLE 2-1
PROBLEM CATEGORIES
INDIVIDUAL HOUSEHOLDS PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITIES
WATER/WASTEWATER STUDY

Problem Category	Specific Problem Sub-Category	Example(s)
WATER QUALITY		
	Bacteriological	Water supply and/or wastewater treatment deficiencies resulting in documented waterborne disease outbreaks. Water supply and/or wastewater treatment deficiencies producing a contaminated water source that results in Total, E. Coli or Fecal Coliform MCL violations. Other Total Coliform Rule violations not associated with the source water (example – contamination residing in plumbing fixtures).
	Nutrients	Water supplied exceeds state or federal primary drinking water standard MCL (example – Nitrates).
	Inorganics	Water supplied exceeds state or federal primary drinking water standard MCL. Some examples include Arsenic, Hexavalent Chromium, Lead and Perchlorate.
	Organics	Water supplied exceeds state or federal primary drinking water standard MCL. Some examples include DBCP (dichlorinated byphenols), TCE (trichloroethylene) and 1,2,3-TCP (trichloropropane).
	General Water Quality	Water supplied exceeds state or federal primary drinking water standard MCL. Water supplied that exceeds state or federal secondary drinking water standards or other established chemical constituent notification level (examples – Iron and Manganese).

TABLE 2-1
PROBLEM CATEGORIES
INDIVIDUAL HOUSEHOLDS PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITIES
WATER/WASTEWATER STUDY

Problem Category	Specific Problem Sub-Category	Example(s)
SOURCE WATER QUANTITY AND/OR DELIVERY		
	Household Plumbing Deficiencies	Plumbing that does not meet Uniform Plumbing Code standards. Improvements may also address water quality problems. Examples: old pipe, undersized pipe or isolation of lawn sprinklers.
	Individual Water Well Deficiencies	Problems with water well may affect drinking water quality. For example, Uniform Plumbing Code standards violations could result in wastewater from an onsite treatment system entering water supply (example – lack of a sanitary seal on the well).
	Water Delivery Deficiencies	Delivery systems that do not meet Uniform Plumbing Code standards. Example: Well does not meet household demands; inadequate storage tank.
WASTEWATER TREATMENT AND DISPOSAL		
	Wastewater Treatment and Disposal System Deficiencies	Problems may affect drinking water supply (example – a domestic water well). Addressing this problem could range from repairs to the existing system to the outright replacement of the system.
	Lack of Maintenance Activities	Conditions may result from a lack of knowledge or education regarding onsite treatment systems or an inability to fund required maintenance (example – affordability of maintenance).
	Community-wide Wastewater Improvement Needs	For areas that: 1) already use a community-based wastewater treatment system; or 2) experience common wastewater treatment and disposal problems among multiple households.

Within the Study Area, Arsenic and Nitrate contamination of the groundwater supply represent the most commonly identified water quality problems based upon compiled data associated with community water systems (Table 2-3). Other commonly detected contaminants include DBCP and Uranium. Additionally, previous and ongoing efforts regarding water supplies further develop the extent of water quality problems within the Study area and these efforts include:

1. Regulatory programs such as: Central Valley Salinity and Long Term Sustainability (CV-SALTS) and Groundwater Ambient Monitoring Assessment (GAMA) program;
2. Legislative programs such as the Integrated Regional Watershed Management Program (IRWMP);
3. Academic studies such as the Groundwater Nitrate Project (Report for the State Water Resources Control Board Report to the Legislature), January 2012;
4. Local consulting engineering experience including water district engineers and hydrogeologists; and
5. Outreach by community-based organizations such as Community Water Center, Rural Community Assistance Corporation and Self-Help Enterprises.

2.3 Water Quantity and Delivery

Individual households may experience water quantity and/or delivery problems resulting from plumbing or well deficiencies. Older households may be particularly affected. Additional water quantity problems result from lowering groundwater water levels associated with groundwater overdraft by adjacent wells and/or drought conditions. In general, problems with water quantity and/or delivery are revealed to (or by) community-based organizations or to water

supply services providers – such as plumbers or well contractors. Although water quantity and/or delivery problems are known to occur, the extent of the problem within the study area has not been established.

2.4 Wastewater Treatment and Disposal

In the rural setting, a person(s) associated with an individual household does not have access to community-based wastewater treatment and disposal. Individual households utilize on-site wastewater treatment and disposal systems such as septic tanks and leach fields. Study Area-wide experience with wastewater systems by local agencies, such as County health departments (See Section 6) or utility districts, community-based organizations and professional services such as septic tank installation and/or maintenance contractors have established that individual households experience wastewater treatment and disposal problems utilizing on-site systems. County health departments within the Study Area have undertaken community sewer system projects in the past to alleviate problems with individual wastewater systems. Deficiencies include infiltration through damaged wells and undersized or inadequate household plumbing. Problems include poorly performing leach fields, inadequate spacing between a well and the leach field and older, deteriorating on-site systems. These problems generate water quality impacts and subsequent health consequences associated with bacteriological contamination.

TABLE 2-2

NUMBER OF VIOLATIONS STATEWIDE (1)

INDIVIDUAL HOUSEHOLDS PILOT STUDY

TULARE LAKE BASIN DISADVANTAGED COMMUNITY

WATER/WASTEWATER STUDY

Category	Number of Violations		
	2009	2010	2011
	MCL/TT(2)	MCL/TT(2)	MCL/TT(2)
Inorganic contaminants	737	825	936
Synthetic organic contaminants	13	10	14
Volatile organic contaminants	4	0	0
Radionuclide contaminants	45	41	55
Total coliform rule	656	635	569
Disinfectant and disinfection byproducts rule (DBPR)(3)	219	188	162
Surface water treatment rules (SWTR, IESWTR, LT1SWTR, LT2SWTR and FBR)(3)	72	150	128
Lead and copper rule (LCR)(3)	1	6	5

Notes:

1. Source of data: 2011 Annual Compliance Report, CDPH (Table 1). Violations associated with community water systems (regulated by CDPH).
2. MCL – Maximum Contaminant Level; TT-Treatment Technique
3. Abbreviations:

   DBPR - Disinfection Byproduct Rule
   SWTR - Surface Water Treatment Rule.
   IE - Interim Enhanced; LT1 – Long Term 1; LT2 – Long Term 2.
   FBR - Filter Backwash Rule.
   LCR - Lead and Copper Rule.

TABLE 2-3

SUMMARY OF VIOLATIONS (2011)(1)

INDIVIDUAL HOUSEHOLDS PILOT STUDY

TULARE LAKE BASIN DISADVANTAGED COMMUNITY

WATER/WASTEWATER STUDY

Category - Parameter	COUNTY			
	Kern	Kings	Fresno	Tulare
Inorganic Contaminants				
Arsenic	150	34	40	72
Nitrates	33	(2)	30	106
Fluoride (Natural)	1	-	-	-
Synthetic Organic Compounds				
DBCP	-	-	6	-
Disinfection By-Products				
TTHM	3	5	69	4
HAA5	3	(2)	2	9
Surface Water Treatment	-	-	38	-
Radiological				
Uranium	1	-	17	-
Total Coliform Rule	10	9	53	(2)

Notes:
1. Source of Data: 2011 Annual Compliance Report, CDPH.
2. Violations associated with community water systems (regulated by CDPH).
3. Data not contained in referenced report.

3 DESCRIPTION OF SOLUTIONS

3.1 General

Section 2 established that the problems facing individual households can be principally categorized into three (3) areas: water quality, water quantity and delivery and wastewater treatment and disposal. Figure 3-1 shows an overview of the types of solutions to address these problems. Multiple solutions exist for each problem category. This section provides a summary of the solutions sets available for the individual household to address these problems. These solutions may also be applicable to small clusters of households or rural subdivisions that experience common problems. Identifying potential solutions for implementation is discussed in Section 4 – Finding a Solution and Appendix A – Solution Charts. General information regarding each solution set can be found in Appendix B – Solution Sets.

3.2 Water Quality Solutions

Table 3-1 lists the potential solutions that may address water quality related problems. Solutions range from individual directed improvements, to community oriented approaches. Well improvement solutions target problems that are associated with a domestic water well. An assessment of the well's design and operational features will be needed.

Water quality solutions address problems specific to the constituents detected in the water source. These solutions may include other referenced solutions such as well improvements or wastewater improvements. For this Pilot Study, water quality solutions have been grouped into five (5) constituent categories: bacteriological, inorganic, nutrients, organics and general (other) water quality. Table 3-2 summarizes the most common water quality constituents which are given consideration.

TABLE 3-1

POTENTIAL WATER QUALITY SOLUTIONS

INDIVIDUAL HOUSEHOLDS PILOT STUDY

TULARE LAKE BASIN DISADVANTAGED COMMUNITY

WATER/WASTEWATER STUDY

1) Well Improvement Solutions:

   These solutions address the condition of a well. Specific details regarding each solution can be found in Appendix B, Section B.1 – Well Improvements.

   1) Disinfection;
   2) Repairs;
   3) Modifications; or
   4) New Well.

2) Water Quality Solutions:

   These solutions address the water quality of the well water. Specific details regarding each solution can be found in Appendix B, Section B.2 – Water Quality.

   1) Address Causative Factors such as a well without a sanitary seal, or a septic system too close to a well;
   2) Point-of-Use (POU) Treatment Device;
   3) Point-of-Entry (POE) Treatment Device; or
   4) New Water Supply, such as a new well or bottled water supply.

3) Community Based Solutions:

   These solutions address either well conditions or well water quality for a well that is shared between individual households. In general, these solutions are similar to the solutions established for a private (individual) well. Specific details regarding these solutions can be found in Appendix B, Section B.3 – Community – Based Water Source Solutions.

   1) Water Well Improvements (for a shared well);
   2) Well Head Treatment (for a shared well);
   3) New Community Water Source, such as a new well; or
   4) Alternative Water Source, such as bottled water supplies.

TABLE 3-2

WATER QUALITY CONSTITUENT CATEGORIES (1)(2)

INDIVIDUAL HOUSEHOLDS PILOT STUDY

TULARE LAKE BASIN DISADVANTAGED COMMUNITY

WATER/WASTEWATER STUDY

NUTRIENTS	BACTERIOLOGICAL	INORGANICS	ORGANICS	GENERAL
Nitrates (NO_3)	Fecal Coliform	Arsenic (As)	DBCP	Chlorine
			1,2,3-TCP	
			MTBE	
	E. Coli	Copper (Cu)		Fluoride
	Giardia	Lead (Pb)	Volatile Organic Compounds	Radium 226
			-Pesticides	
			-Herbicides	
	Cryptosporidium	Hexavalent Chromium(Cr)	Disinfection By-Products	Hardness
	Bacteria	Perchlorate		Uranium
	Viruses			

NOTES:

(1) This table presents the most commonly identified parameters associated with water quality problems. It is not intended to be a comprehensive list of all problems.

(2) If a constituent is not listed on this table, please consult with your analytical testing laboratory or county health department to identify the most appropriate category for the constituent in question.

3.3 Water Quantity and Delivery Solutions

Table 3-3 presents potential solutions for water quantity and delivery problems. These solutions are designed to address problems associated with inadequate supply, such as pumping or plumbing deficiencies. Well improvements represent a common solution set to both water quality and quantity problems.

TABLE 3-3

POTENTIAL WATER QUANTITY AND DELIVERY SOLUTIONS

INDIVIDUAL HOUSEHOLDS PILOT STUDY

TULARE LAKE BASIN DISADVANTAGED COMMUNITY

WATER/WASTEWATER STUDY

1) Well Improvements Solutions:

   These solutions address conditions of the well that affect the delivery of water from the well. Specific details regarding each solution can be found in Appendix B, Section B-1, Well Improvement Solutions.

   1) Repairs, such as pump or casing repairs;
   2) Modifications, such as lowering a pump or drilling a deeper well; or
   3) New Well.

2) Household Improvements:

   These solutions address water quantity problems that result from existing plumbing conditions. Specific details regarding these solutions can be found in Appendix B, Section B-4, Household Improvement Solutions.

   1) Plumbing Improvements, such as piping or fixture replacement.

3) Water Delivery Improvements:

   These solutions address problems that address inadequate delivery of water to the household. Specific details regarding these solutions can be found in Appendix B, Section B-5, Water Delivery Improvement Solutions.

   1) Well Improvements, such as a pump or motor replacement;
   2) Water Delivery System Improvements (Distribution and storage); or
   3) Water Demand Considerations, such as the use of water efficient fixtures or appliances.

3.4 Wastewater Treatment and Disposal Solutions

For the purposes of this Pilot Study, individual households are assumed to use compliant on-site wastewater treatment systems, such as septic tank and leach field systems. Some rural household clusters may utilize a shared on-site wastewater system. Table 3-4 lists the potential solutions associated with wastewater treatment and disposal problems that may be experienced by on-site systems. Three (3) primary solution sets exist: individual system improvements, maintenance-based solutions and community based system improvements. These solution sets may also address water quality problems associated with bacteriological or nutrient related problems as a supplemental benefit.

TABLE 3-4

POTENTIAL WASTEWATER TREATMENT AND DISPOSAL SOLUTIONS

INDIVIDUAL HOUSEHOLDS PILOT STUDY

TULARE LAKE BASIN DISADVANTAGED COMMUNITY

WATER/WASTEWATER STUDY

1) Individual Wastewater System Improvements:

These solutions address conditions associated with a septic tank and leach field wastewater treatment and disposal system. Specific details regarding each solution can be found in Appendix B, Section B.6, Individual Wastewater System Improvements.

1) Repairs to existing treatment (Septic tank) system;
2) Repairs to existing disposal (leach field) system;
3) Enhancements to existing treatment/disposal systems, such as septic tank baffles;
4) Expansion/Upgrades to existing system elements, such as additional leach lines;
5) New treatment (septic tank) system;
6) New disposal (leach field) system; or
7) Community-based treatment and disposal system (Additional information, Appendix B Section B.8).

2) Individual Wastewater System Maintenance Activities:

These solutions address improvements to routine maintenance activities associated with septic tank and leach fields. Specific information regarding each solution can be found in Appendix B, Section B.7-Individual Wastewater System Maintenance Activities.

1) Implement/follow proper individual system use limitations, such as clothes washer connections;

2) Implement/follow proper maintenance practices, such as a routine pumping of septic tank;

3) Increase maintenance practice frequency, such as increased septic tank pumping; or

4) Implement community-based maintenance activities (cost sharing).

3) Community-based Wastewater Systems:

These solutions address situations where the wastewater system is shared amongst multiple households. In general, these solutions reflect the same system improvement and maintenance activities solutions for an individual household. Specific details regarding each solution can be found in Appendix B, Section B.7 – Community-based Wastewater Treatment and Disposal Solutions.

1) Existing wastewater system improvements;

2) New community wastewater (septic tank and leach field) system; or

3) Alternatives to community-based systems, such as connecting to an existing wastewater collection system.

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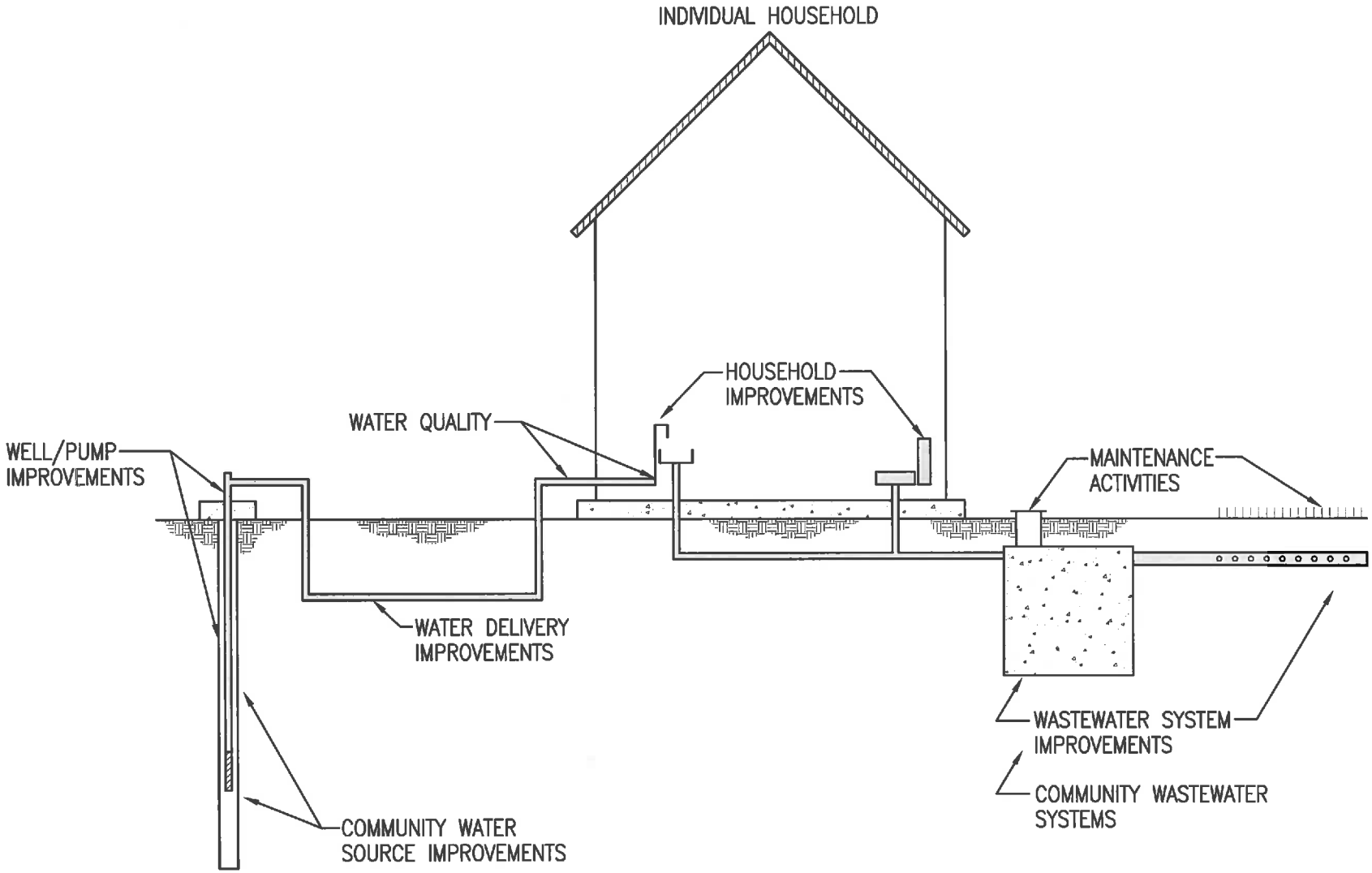


OVERVIEW OF SOLUTIONS FOR INDIVIDUAL HOUSEHOLDS

KELLER/WEGLEY

FIGURE 3-1

SECTION FOUR

4 FINDING A SOLUTION

4.1 General

Methods to identify domestic water and wastewater problems and an overview of potential solutions for individual households represents the overall purpose of this Pilot Study. Section 2 presented an overview of water and wastewater problems experienced by individual households within the Tulare Lake Basin Study area.

Section 3 summarized the potential solution sets available to the individual household to address water and/or wastewater problems. To assist individual households in identifying the most appropriate solution, this Pilot Study Report provides a self-guided series of questions as charts to direct the individual household occupant to potential solutions. The solution charts and associated questions are presented in Appendix A. Table A-1 summarizes the solution charts. The solution sets are presented in Appendix B.

Addressing the identified problem begins with the identification and selection of a potential solution by the individual homeowner. A homeowner can utilize professional or trade-based services for assistance, if desired. Proceeding with the selected solution remains the responsibility of the individual homeowner.

In a community-type setting, where multiple households with individual systems exist, problem identification and solution identification and implementation can occur on a collective basis. This type of approach can result in significant benefits to the households through resource sharing and associated cost saving. Some examples of this approach are summarized in Appendix C – Case Studies.

4.2 Solution Charts and Solution Sets

The use of the solution charts and solution sets begins with the identification of the problem (or problems) that affect the individual household's

water or wastewater system. Once a problem has been identified, the person(s) associated with the individual household uses the solution charts compiled in Appendix A to determine potential solutions for consideration. The solution charts are organized by the type of water or wastewater problem. The solution charts consist of a series of questions that guide the user through considerations leading to solutions.

Solutions represent improvements to address water quality or supply problems through repairs, modifications or new features such as equipment or facilities, as is the case with a new well. Solutions also result from new or additional operation and maintenance activities for existing water and/or wastewater systems. The solution sets compiled in Appendix B present information for consideration regarding specific solutions by the person(s) associated with the individual household. Information provided includes costs, advantages, disadvantages and miscellaneous considerations specific to the solution.

4.3 Cost Considerations

Specific costs for each solution have not been provided due to the broad, undefined nature of the potential problems under consideration. Costs will vary widely through the Tulare Lake Basin depending on the location of the individual household. For example, solutions considered for foothill regions will have significantly different costs compared to solutions along the valley floor. Specific costs associated with identified solutions can be obtained by the individual household. These solutions and costs will reflect the specific conditions associated with the problem(s).

Relative costs have been generated and are included with the solution sets. For comparison purposes, this Pilot Study has established a relative cost scale. The cost scale is summarized in Table 4-1. The cost scale is based upon the average Median Household Income (MHI) of Fresno, Kern, Kings and Tulare

Counties as compiled by the American Community Survey (2006-2010). The dollar range describing the relative cost, such as "low" or "high" represents a percentage range (0.5 percent to 5 percent) of the average MHI adjusted downward by disadvantaged community definitions. The low end of the dollar range uses the severely disadvantaged definition represented by incomes that are 60 percent of the MHI. The upper end of the dollar range uses the disadvantaged definition estimate by incomes that are 80 percent of the MHI.

TABLE 4-1
COST SCALE
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY
WATER/WASTEWATER STUDY

COST	DOLLAR RANGE
Very Low	Less than $200
Low	$200 to $500
Moderate	$500 to $1,300
High	$1,300 to $2,000
Very High	Greater than $2,000

The cost scale approximates the affordability considerations associated with identified solutions for disadvantaged communities. The cost scale applies to both up-front/one-time costs and ongoing/annual costs. Upfront costs include purchase cost and installation costs. Ongoing costs include costs for regular maintenance to ensure the equipment operates properly.

The cost scale is intended for the person(s) associated with the individual household to use when considering various solutions. Each individual household, however, will need to review its financial situation to determine the actual affordability of a solution which is under consideration. An example demonstrating the comparison of costs is presented in Section 5.

The evaluation of costs represents a consideration where the use of professional services may be warranted. Trade-based organizations, community-based organizations and manufacturers may also be available to assist the individual household.

4.4 Funding Opportunities

Funding opportunities are limited in the area of assistance to the parties associated with individual households. In general, funding programs are designed to serve community-based systems, in which a governance structure exists for disbursement of funds and repayment of funds, if necessary.

Funding opportunities for improvements related to individual households may be available through special funding programs offered at the county level or through community-based organizations, as well as philanthropic groups. Equipment manufacturers may also offer price incentives or discounts that would reduce solution costs.

One example of local agency funding exists through the Clean Water State Revolving Fund (CWSRF). Local agencies apply for funds for use in mini-loan programs to assist individual households with compliance with the new onsite wastewater system policy (reference Section 1). This approach has significant disadvantages, including loan costs passed on to the household and the local agency must apply and be awarded funds for distribution. The CWSRF program is a highly competitive funding program and local agencies may not be awarded funding.

Although funding programs exist for small community or private water systems, similar opportunities for funding do not exist for the individual household. Funding programs become available when multiple households come together for community-based solutions.

4.5 Obstacles

Numerous obstacles exist for implementing solutions for individual households, including financial, ownership, regulatory and governance considerations. These obstacles may prevent an otherwise responsible individual from pursuing solutions and subsequent implementation.

4.5.1 Financial

Financial obstacles represent the primary obstacle to solution implementation. In general, the individual household units throughout the Tulare Lake Basin Study area satisfy the income criteria for a household within a disadvantaged community (DAC) or a severely disadvantaged community (SDAC). This situation translates to the individual household owner/occupant not having sufficient financial capability to pursue a solution and/or maintain its viability and use. Additionally, current funding programs typically facilitate projects for community water systems, not individual households, subsequently preventing access to potential sources of grant funds. Charitable outreach programs represent the primary source of funds, or in most cases, assistance comes in the form of donated equipment and supplies. These types of programs are limited and, further, may be geographically focused on specific areas.

4.5.2 Ownership

The individual household may not be owned by its occupants. In these cases, the renters must work with the homeowners (landlords) to pursue and implement solutions. Homeowners may be unable or unwilling to pursue solutions on the renter's behalf resulting from financial or legal constraints. Solutions completed by the renter may be prevented by similar financial, legal or ownership considerations. For example, a renter may not want to put in an improvement, such as a POU device since it may have to remain with the house upon vacating at the end of a rental agreement.

4.5.3 Regulatory

At times, regulatory requirements inadvertently place obstacles in the pathway to potential solutions. For example, CDPH requires that all water treatment devices that state health benefits (i.e., nitrate removal) be certified prior to sale. Cost of certification by the manufacturer for state acceptance can be substantial and can reduce the number of potential equipment manufacturers that supply treatment devices. Consequently, the quantity and types of equipment may be limited for a potential solution. Fewer options available to the individual household typically result in increased costs.

4.5.4 Governance

Governance or other organizational considerations can also prevent the implementation of potential solutions. A person associated with an individual household may be reluctant to join a rural neighborhood association due to a variety of reasons, including lack of independence, lack of perceived benefit and legal considerations.

4.5.5 Access to Expertise

An additional obstacle for the individual household can be the complexity of the potential solutions to address the problem. Permitted water systems typically utilize professional services to identify the most appropriate and cost effective solutions. The use of professional services may not be readily available to the individual. Subsequently, the individual must determine solutions for which he may not have the necessary experience or expertise. In these cases, community-based organizations, or manufacturers, may help select suitable alternatives, if available. Section 5 demonstrates the typical process used to identify a potential solution and its associated considerations.

4.6 Getting Started

Understanding the conditions regarding the water and wastewater systems associated with the individual household represents the first step to effectively using this Pilot Study Report. Many individual households will need assistance in finding solutions to water and wastewater problems. Some individual households will know what solution they wish to pursue. Other individual households will need to determine the presence of water or wastewater problems before pursuing a solution. Table 4-2 summarizes actions and/or activities that can be undertaken to determine the existence of a water or wastewater problem.

Figure 4-1 presents an overview of the first step(s) that need to be taken by an individual household.

To get started, the individual household must be able to describe their situation as:

1. Knowing they have a problem; or
2. Unsure if a problem exists.

If a water or wastewater problem is known; the individual household needs to establish if:

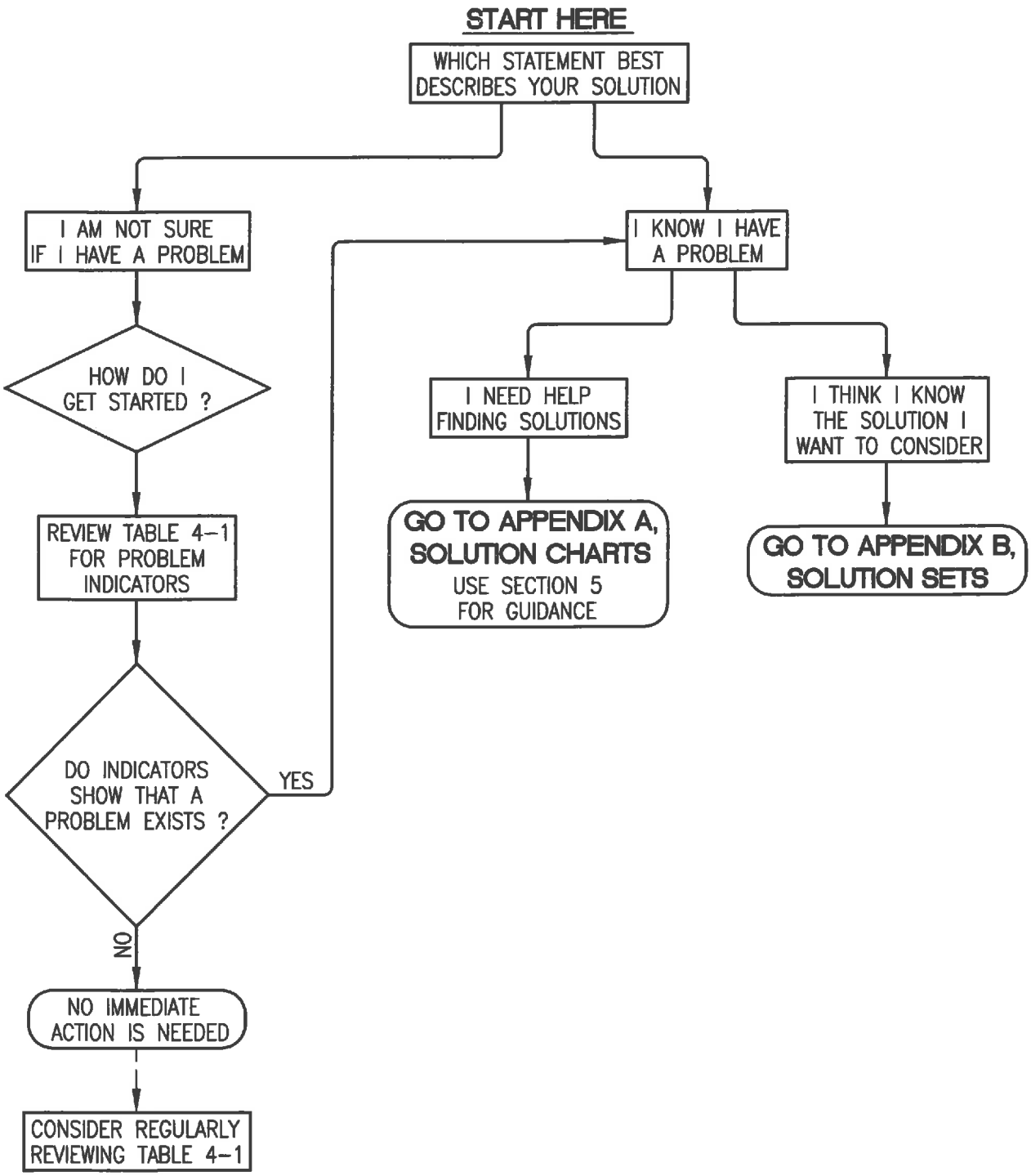
1. They need help finding solutions; or
2. They know the solution they wish to use.

The use of Figure 4-1 will help the individual household determine which sections of the Pilot Study Report to review.

TABLE 4-2
PROBLEM INDICATORS
INDIVIDUAL HOUSEHOLDS PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

HOW DO I KNOW I HAVE A PROBLEM?

Type of Problem	Action or Activity	Finding or Result
WATER QUALITY	Visual Observations - Condition of well - Water - Physical health and well being	 Cracks in well head (at surface); lack of sanitary seal Clarity of water; color of water; staining, etc. Illness – confirm with water testing and/or medical testing
	Water Testing	Testing results exceed drinking water standards Results from nearby residences exceed standards
	Inspection	Findings issued by water contractor (i.e., well driller)
WATER QUANTITY AND SUPPLY	Visual Observations	Not enough water at faucets or fixtures Not enough water pressure Leaks along ground or at household
	Well Testing - Pump Test - Video inspection	 Poor pumping conditions, delivery restrictions, etc. Poor well conditions – problems with casing, etc.
	Inspection	Findings issued by water contractor (i.e., well driller)
WASTEWATER TREATMENT AND DISPOSAL	Visual Observations - Condition of leach field - Condition of treatment system	 Flooding/standing water Plumbing back-ups/overflows Smell/odors
	Water Testing	Testing results show fecal coliforms in well water
	Inspection	Citation issued by local agency (i.e., county health department) Findings issued by wastewater contractor (i.e., plumber)



GETTING STARTED
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

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SECTION FIVE

5 TUTORIAL - USING THE SOLUTION CHARTS AND SOLUTION SETS

5.1 Introduction

This tutorial has been prepared to demonstrate to the party associated with the individual household (homeowner or renter) how to use the solution charts and solution sets to identify and select potential solutions to water and wastewater problems. The solution charts present a series of questions that lead the homeowner or renter to potential solutions. The solution sets provide general information and considerations that help the homeowner or renter to select solutions.

5.2 Solution Charts

There are four (4) solution chart series that are available to the homeowner or renter. The solution charts are located for the homeowner's or renter's use in Appendix A.

The homeowner or renter starts the process with Solution Chart No. 1 – Initial Classification. In order to be able to use Solution Chart No. 1, the individual must have previously identified the problem (or problems) that needs to be addressed (Refer to Section 4, Table 4-2). The individual responds to the

question(s) presented by Solution Chart No. 1 which will subsequently direct the individual to a specific solution chart.

The individual responds to each question presented in the specific solution chart series (examples: Series 2A – Nutrients, or Series 3 – Water Supply and Delivery, etc.). The responses to the questions will direct the individual to appropriate solution sets presented in Appendix B for consideration.

5.3 Solution Sets

Each solution chart includes steps where the individual must identify and compare potential solutions that may address the problem(s) experienced by the individual household.

Elements of each solution that must be considered include:

- Construction cost;
- Ability to operate and maintain;
- Costs to operate and maintain;
- Practical nature;
- Advantages; and
- Disadvantages.

Under many conditions, a single solution may be identified to address the problem. In some cases, however, the person(s) associated with the individual

household will need to choose between equally viable solutions. Furthermore, the possibility exists that a solution may not be feasible for a number of reasons, such as total cost or operational characteristics.

SECTION FIVE

5.4 Example

The following example has been prepared to demonstrate the use of the solution charts and solution sets. The example walks through each question presented by the solution chart and reviews the considerations associated with the potential solution.

SECTION FIVE

Start Here

Mr. Jones owns a home in the rural area of Eastern Tulare County. He bought the home about 15 years ago. The home is surrounded by agricultural fields and orchards.

One day, his neighbor who lives down the road one-half of a mile tells Mr. Jones that his well water consistently exceeds the drinking water limit for nitrates. Since Mr. Jones has never tested his well water for nitrates, the neighbor suggests that Mr. Jones test his well water.

The neighbor indicates that Mr. Jones can contact the County Health Department for further assistance, or can contact a water testing laboratory directly. Mr. Jones finds a laboratory and has his well water tested. The results indicate that Mr. Jones' water has a nitrate level of 75 mg/L. The nitrates in Mr. Jones' water exceed the drinking water standard of 45 mg/L.

Mr. Jones needs to address the high nitrates in his drinking water. He proceeds to Solution Chart No. 1- Initial Classification.

SECTION FIVE

Solution Chart No. 1 – Initial Classification

Question: **Do you live in a rural residential subdivision having more than 15 dwellings?**

Response: No.

Reason: Mr. Jones lives in a rural area. His nearest neighbors are approximately one-half mile away.

Next Step: Mr. Jones proceeds to the next question on Solution Chart No. 1.

SECTION FIVE

Solution Chart No. 1 – Initial Classification

Question: Does household experience a domestic water quality issue?

Response: Yes.

Reason: Water testing has established that the water has high nitrates.

In most cases, follow-up testing should be conducted to confirm the initial test results. Nearby test results or historical experience with water quality of the area may serve, however, to support the initial test results.

Next Step: Mr. Jones goes to Solution Chart No. 2 – Water Quality Solutions

Notes: Mr. Jones wants to address a water quality problem associated with nitrates. If Mr. Jones experienced problems with his well pump or wastewater disposal system (septic system), Mr. Jones could continue with additional questions on Solution Chart No. 1.

SECTION FIVE

Solution Chart Series No. 2 – Water Quality Solutions

This solution chart is specifically prepared to identify and direct the homeowner to the appropriate water quality solution chart. Mr. Jones will use this chart to direct him to the proper solution chart to address his nitrate problem.

Question: Does water quality exceed a maximum contaminant level (MCL) or the drinking water standard?

Response: Yes.

Reason: The MCL for nitrates is 45 mg/L. Mr. Jones' water test shows 75 mg/L nitrates, which is higher than the MCL.

Next Step: Mr. Jones is not familiar with water quality. He needs to describe the water quality issue. Using Table 3-2 – Water Quality Constituent Categories, Mr. Jones finds that nitrates fall in the "Nutrient" category.

Mr. Jones goes to Solution Chart 2A – Nutrients.

Notes: Mr. Jones' water quality testing did not identify any other water quality constituents of concern.

If another contaminant, however, was identified, Mr. Jones would return to this solution chart after finding solutions for nitrates.

Mr. Jones would repeat this process and consider the solutions for each water quality contaminant so that he could develop a combined solution.

SECTION FIVE

Solution Chart Series 2A – Nutrients

This solution chart is prepared to guide the homeowner through a series of questions to help the homeowner identify potential solutions for water quality problems. The questions are listed in Appendix A.

Mr. Jones will use these questions to identify his options for his high nitrate problem.

Question No. 1: Is an individual water well (or other source) used?

Response:	Yes.
Reason:	Mr. Jones lives in a rural area. The nearest town with a water system is approximately five (5) miles away. Mr. Jones' property has a well that provides water to his home. The well was constructed by the previous homeowner.
Next Step:	Mr. Jones goes to Question No. 2.

SECTION FIVE

Solution Chart Series 2A – Nutrients

Question No. 2: **Are design and installation features of the water well system known?**

Response: No.

Reason: Mr. Jones has lived in the house for 15 years. Although he may have been given information about the well when he purchased the house, he has since lost or misplaced it. The only information he has is depth to water information provided by the pump maintenance company that he uses to annually service the pump.

Next Step: Mr. Jones needs to establish the features of his well. He contacts a local well drilling contractor for assistance. He learns that his well is in good condition with good sanitary seal.

Mr. Jones goes to Question No. 3.

SECTION FIVE

Solution Chart Series 2A – Nutrients

Question No. 3: **Are the water well features considered acceptable – do the features comply with standards?**

Response: Yes.

Reason: The well inspection completed for Mr. Jones did not identify any problems with Mr. Jones' well. The well had a sanitary seal in place and other features met standards.

Next Step: Mr. Jones goes to Question No. 4.

Notes: If the well inspection had identified a problem with Mr. Jones' well, Mr. Jones would need to consider well improvement solutions that are identified in Appendix B.1 – Well Improvements.

Any potential solution would be considered in Comparison Step No. 10.

SECTION FIVE

Solution Chart Series 2A – Nutrients

Question No. 4: Has the on-site wastewater system been evaluated?

Response: Yes.

Reason: During the well inspection, Mr. Jones established that his septic system and well were separated by over 200 feet. Mr. Jones has never had problems with his septic system and routinely cleans and pumps his system out. His leach field never floods.

Next Step: Mr. Jones goes to Question No. 5.

Notes: If Mr. Jones had answered "no" to Question No. 4, he would need to complete an evaluation of his septic system by following steps of Solution Chart No. 4 – Wastewater Solutions. This chart reviews consideration with construction, operation and maintenance of septic systems.

Septic systems can represent a source of nutrients in the well water; therefore, solutions that address problems with septic systems can address nutrients in well water.

SECTION FIVE

Solution Chart Series 2A – Nutrients

Question No. 5: **Does on-site wastewater system represent the primary source of the contaminants (nitrates)?**

Response: No.

Reason: No evidence exists to suggest that Mr. Jones septic system is the cause of the nitrates. His septic system is operating properly. His water well is adequately separated from the septic system. There is no other water quality data, such as coliform results, to suggest wastewater contamination of the well.

Next Step: Mr. Jones proceeds to Question No. 6.

Notes: If Mr. Jones' septic system represented the primary source of the nitrates, he would need to go to Solution Chart No. 4 – Wastewater Solutions to look at potential solutions for his septic system.

SECTION FIVE

Solution Chart Series 2A – Nutrients

Question No. 6: Is the system subject to outside influences that are external to the residence/property?

Response: Yes.

Reason: Mr. Jones lives in an area that has been farmed for decades. It is likely that fertilizers have been applied on the land surrounding his home for a long time.

Next Step: Mr. Jones goes to Question No. 9.

SECTION FIVE

Solution Chart Series 2A – Nutrients

Question No. 9: Is water quality problem shared by adjacent water wells and residences?

Response: Yes.

Reason: Mr. Jones' neighbor previously shared his nitrate problem with his own well. Mr. Jones' conversation with other neighbors reveals the same nitrate problems in well water.

Next Step: Consider community-based water quality solutions.

Mr. Jones goes to Solution Set B3-Community-based Water Solutions to identify potential solutions.

SECTION FIVE

Solution Chart Series 2A – Nutrients

Solution Set B3 – Community-Based Water Source Solutions

Action: Identify potential solutions.

Mr. Jones reviews Solution Set B-3 for potential solutions to his nitrate problem. The solutions presented in B-3, however, specifically address water quality problems for rural subdivisions that share a common well. There is no potential to develop a shared well because the distance between the neighbors is too great. This condition rules out Solutions B.3.1 (Well Improvements) and B.3.2 (New Water Source). Connecting to the water system of the nearby community (also known as consolidation) is not realistic, since it is five miles to town. Subsequently, Solution B.3.3 (Alternative Water Source) is also not possible.

Question: Is a community solution feasible?

Response: No. Mr. Jones concludes that potential community based water quality solutions do not exist.

Next Step: Mr. Jones goes to Consideration Step No. 7.

SECTION FIVE

Solution Chart Series 2A – Nutrients

Consideration Step No. 7 - Consider Individual Solutions

Action: Identify Potential Solutions.

Mr. Jones goes to Solution Set B2-Water Quality Solutions to identify potential solutions. Mr. Jones reviews Solution Set B2 for potential solutions that address his nitrate problem. Three (3) types of solutions exist: existing source options, treatment options and new source options.

Existing Source Options

Mr. Jones reviews the information associated with existing sources. These solutions address well construction and wastewater system improvements. Since Mr. Jones' well and wastewater system are not associated with the nitrate problem, these solutions do not apply to Mr. Jones' situation. Refer to Question Nos. 3, 4 and 5.

Treatment Options

Mr. Jones reviews the information associated with the treatment options. Both Point of Use (POU) and Point of Entry (POE) appear realistic solutions. Mr. Jones researches potential treatment units through web sites and phone calls to suppliers. He collects purchase and installation costs. Mr. Jones finds out the yearly cost to operate the units he is considering. Mr. Jones summarized his information in the following table.

SECTION FIVE

Type of Unit	Manufacturer /Supplier	Type	Purchase Cost	Installation Cost	Yearly Costs	Notes
POU	Brand A	Ion Exchange (IX)	$150	$100	$200	Change cartridge 4 times/year
POU	Brand B	IX	$220	$75	$150	Change cartridge 5 times/year
POU	Brand C	Reverse Osmosis (RO)	$200	$100	$200	Cartridge change out once per year; RO unit – every 3 years
POE	Brand D	IX	$1500	$300	$300	Size is flow dependent
POE	Brand E	RO	$2000	$300	$300	Size is dependent on flow

Note: Costs shown above are for example purposes only. The costs do not represent actual costs.

Mr. Jones reviews the information he has collected. Based upon his current finances, he cannot afford a POE device, so he settles for a POU device due to a lower annual cost. Ion exchange (IX) also offers advantages to Mr. Jones for his situation.

New Source Options

Mr. Jones also reviews the information regarding new water sources. A bottled water supply provides similar considerations to a POU device – water is available for drinking water purposes only. Mr. Jones can have water delivered to his home or go purchase it at a distribution center in the nearby town. Mr. Jones collects monthly costs for delivery and also considers his transportation costs for picking the water up in town. Mr. Jones decides that he does not want to drive to town for water, since he may not be strong enough to handle the large bottles. He chooses a bottled water delivery option for further consideration.

Mr. Jones also considers other options for a new water source. He considers a new well, however, a new well will likely not produce water low in nitrates since his neighbors also experience high nitrates. A new well will be very expensive when compared to other options. Mr. Jones also concludes that a tie-in to a community system or new multi-household system is not practical since his house is a long way from other residences or the town.

Findings: After working through Solution Set B2, Mr. Jones has identified the following potential solutions to his nitrate problem:

1) POU device; and
2) Bottled water delivery.

Next Step: Mr. Jones goes to Comparison Step No. 10.

SECTION FIVE

Solution Chart Series 2A – Nutrients

Comparison Step No. 10 – Compare Identified Solutions

Action: Collect information gathered regarding potential solutions.

Mr. Jones reviews the information and findings he has collected as he has worked through the solution series. He is ready to compare all of his identified potential solutions.

First, Mr. Jones knows that there are no solutions applicable regarding his water well (Question No. 3).

Second, two solutions exist for Mr. Jones that could be used at his household: a POU device or bottled water delivery (Consideration Step No. 7).

Finally, although community-based solutions exist, the solutions are not practical for Mr. Jones at this time (Question No. 9).

The following table summarizes the potential solutions considered by Mr. Jones.

POTENTIAL SOLUTIONS		
Well Improvement Solutions (Question 3)	Individual Water Source Solutions (Consideration Step No. 7)	Community Based Water Source Solutions (Question 9)
None	POU Unit (IX) Bottled Water Delivery	None

SECTION FIVE

Mr. Jones gathers all of the information he has collected regarding each potential solution. His information is shown in the following table.

Potential Solution	Advantages	Disadvantages	Initial Cost	Ongoing Costs
POU Unit (IX)	Undersink Installation Use as much water as needed	Equipment to maintain (plumbing, etc.) Cartridge changeouts	$300	$150/year
Bottled Water Delivery	No equipment maintenance	Extra Equipment (dispenser) Water supply could be limited between deliveries	-	$360/year

Note: Information listed above is for example purposes only. The user of this document will need to generate this information.

SECTION FIVE

Question: Can a solution be selected and implemented?

Response: Yes.

Reason: Mr. Jones reviews his finances. He has a limited income, but does have some money set aside for home improvements. He decides he can afford about $20 per month for water treatment. Consequently, a water treatment solution appears possible. Mr. Jones selects to install a IX POU unit.

Next Steps: After installing the POU unit, Mr. Jones will need to have water quality tests completed during the following year to determine his selected solution's effectiveness. If the water test results show that nitrate levels remain below the drinking water standard, Mr. Jones does not need to continue with any other activities.

If test results again show high nitrate levels, Mr. Jones will need to re-evaluate potential solutions by completing the solution charts with new considerations. This may require the use of water quality professionals, community assistance organizations, and further work with manufacturers and suppliers.

Financial Considerations:

Mr. Jones' financial capabilities affect the possibility of many alternatives. If Mr. Jones did not have the ability to pay any monthly costs, neither solution would be possible and Mr. Jones would be without a solution to his nitrate problem. If Mr. Jones had more financial resources, he may elect to choose a bottle water delivery solution to eliminate any POU ownership hassles, or choose to install a POE unit to treat all water that is used in his house.

6 RESOURCES

This section provides a list of resources available to the person associated with an individual household. The listed resources provide initial starting points for the individual that will direct him/her to additional resources.

6.1 Local Agencies

A. County of Fresno
Department of Public Health
Environmental Health/Water Surveillance Program
1221 Fulton Mall, Third Floor
Fresno, CA 93775
(559) 600-3357
www.co.fresno.ca.us

B. County of Kern
Environmental Health Division
2700 M Street, Suite 300
Bakersfield, CA 93301
(661) 862-8740
www.co.kern.ca.us/eh/

C. County of Kings
Environmental Health Services Division
330 Campus Drive
Hanford, CA 93230
(559) 852-2617
www.countyofkings.com/ehs/

D. County of Tulare
Environmental Health Services Division
5957 S. Mooney Blvd.
Visalia, CA 93277
(559) 624-7400
www.tchhsa.org

SECTION SIX

6.2 State Agencies

A. California Department of Public Health
Drinking Water Program
(Fresno/Kings/Tulare Counties)
265 W. Bullard Ave., Suite 101
Fresno, CA 93704
(559) 447-3300

B. California Department of Public Health
Drinking Water Program
(Kern County)
2925 Commerce Dr., Suite 120
Bakersfield, CA 93309
(661) 335-7315

Note: The California Department of Public Health (Department) does not regulate individual households. The Department, however, certifies Point-of-Use (POU) and Point-of-Entry (POE) devices.

www.cdph.ca.gov/certlic/device/pages/watertreatmentdevices.aspx

SECTION SIX

6.3. Internet (Web-based) Resources

A. California Department of Water Resources
- Groundwater well standards: www.water.ca.gov/groundwater/well_info_and_other/

B. California State Water Resources Control Board / Central Valley Regional Water Quality Control Board

- Domestic Well Owners Guide: www.waterboards.ca.gov/water_issues/programs/gama/docs/wellowner_guide.pdf
- Well Water Quality and Testing: www.waterboards.ca.gov/water_issues/programs/gama/wq_privatewells.shtml
- Septic systems: www.waterboards.ca.gov/water_issues/programs/owts/index.shtml

C. National Environmental Services Center
- Septic Systems: www.nesc.wvu.edu/subpages/septic.cfm
- Wells: www.nesc.wvu.edu/subpages/wells.cfm

D. United States Environmental Protection Agency (EPA)

- Private Drinking Water Wells: www.water.epa.gov/drink/info/well/
- Septic Systems: www.water.epa.gov/infrastructure/septic

Note: The list of internet resources is not intended to be comprehensive. The list represents a starting point for useful information.

SECTION SIX

6.4 Water Testing Laboratories

A. BC Laboratories, Inc.
4100 Atlas Court
Bakersfield, CA 93308
(661) 327-4911
(800) 878-4911
www.bclabs.com

B. BSK Laboratories
550 W. Locust Avenue
Fresno, CA 93650
(559) 497-2880
www.bskassociates.com

C. FGL Environmental Laboratories
9415 W. Goshen Avenue
Visalia, CA 93291
(559) 734-9473
www.fglinc.com

D. Moore Twining Associates, Inc.
2527 Fresno Street
Fresno, CA 93721
(559) 268-7021
(800) 268-7021
www.mooretwining.com

Note: The list of laboratories is not intended to be comprehensive. The list provides the individual with a starting point. Additional laboratories may be found at:

www.cdph.ca.gov/certlic/labs/Documents/CertifiedDrinkingWaterLabs.pdf

APPENDIX A – SOLUTION CHARTS

APPENDIX A – SOLUTION CHARTS

A.1 Preface

The solution charts presented in this Section are intended to assist the owner and/or renter of an individual household in the identification of potential solutions to water or wastewater problems experienced by the household. For the charts to be useful, the party associated with the individual household must first establish the problem that needs to be addressed. Additionally, the information provided in this Appendix is specifically designed to address conditions experienced by individual households (private systems) or groups of houses, which together, would consist of no more than 15 connections.

A.2 General

A series of charts have been prepared to assist a party associated with an individual household in identifying potential solutions to established water or wastewater problems. Each set of charts presents a series of responses to yes/no questions directing the individual to a solution or a set of solutions for consideration. Table A-1 summarizes the series of solution charts.

Each series of solution charts has been color coded to assist the individual in using the solution charts. The color identifies the type of solution chart and is shown on the right hand side of the solution charts.

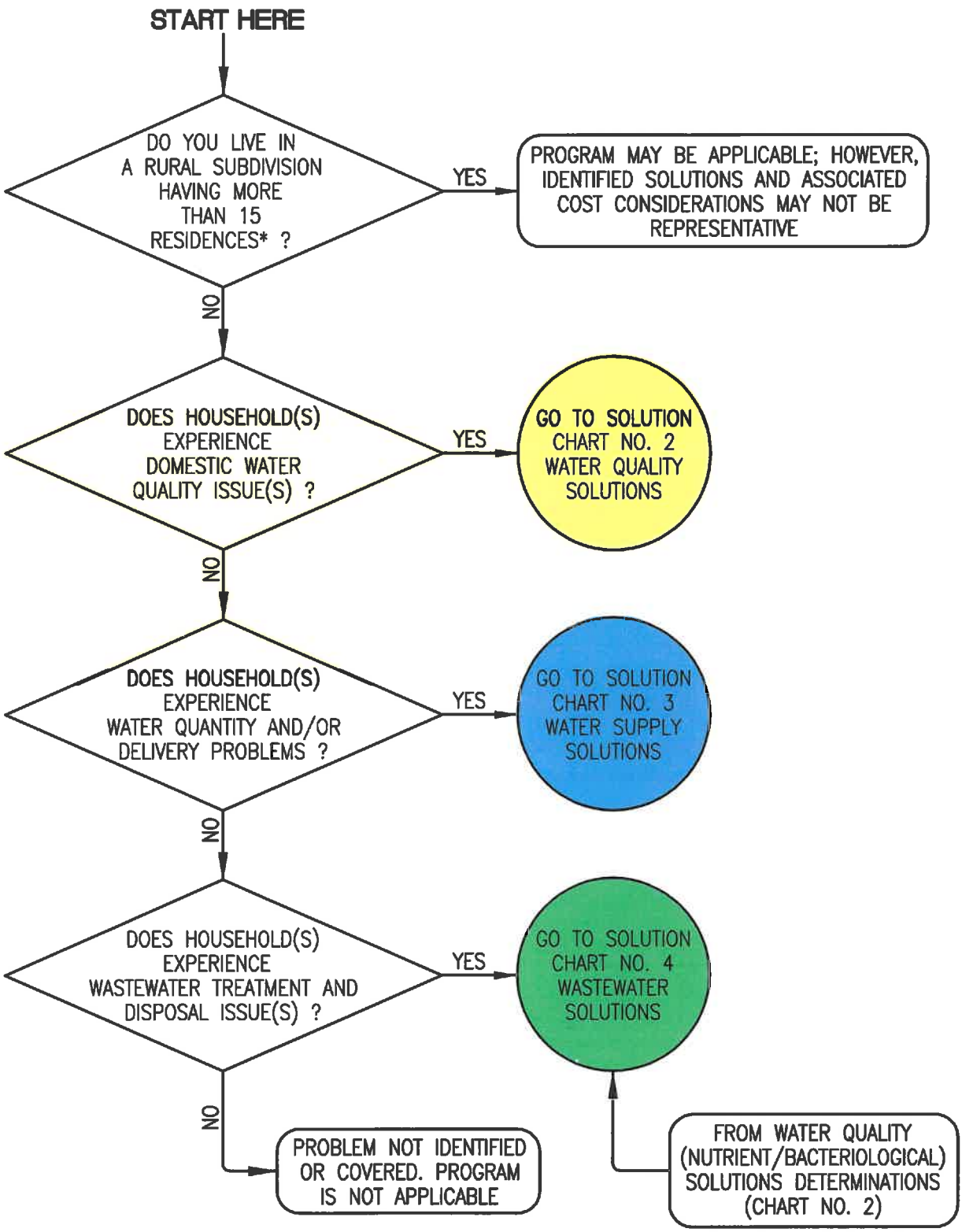
APPENDIX A – SOLUTION CHARTS

The individual starts with Solution Chart No. 1, Initial Classification. The individuals proceed to subsequent solution charts depending on the response to the questions presented by Solution Chart No. 1.

APPENDIX A – SOLUTION CHARTS

TABLE A-1
SUMMARY OF SOLUTION CHARTS
INDIVIDUAL HOUSEHOLD PILOT STUDY

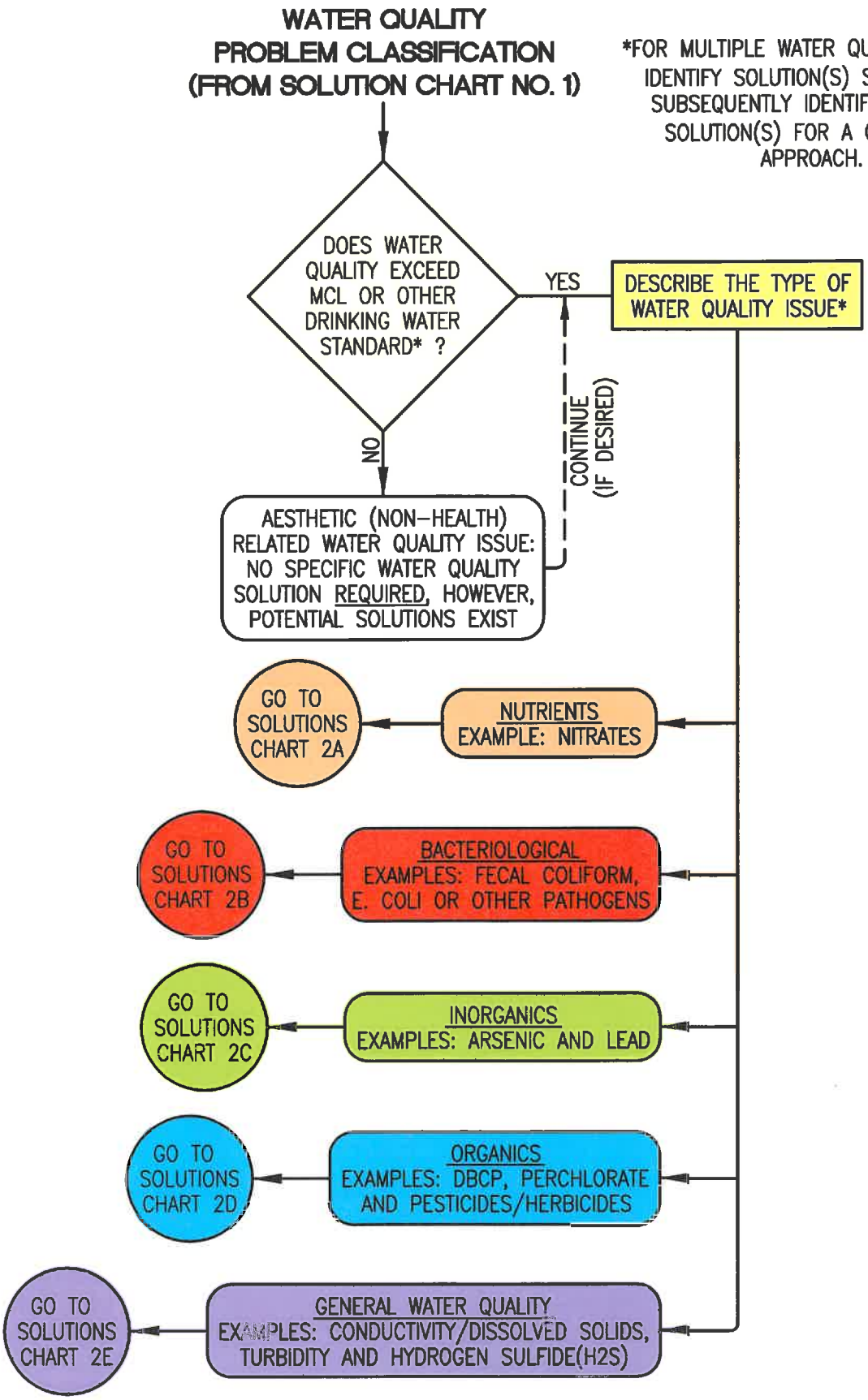
SOLUTION CHART (SERIES)	DESCRIPTION	PURPOSE	COLOR
1	Initial Classification	Use to direct party associated with individual household to solution chart based upon identified water and/or wastewater problems(s).	-
2	Water Quality Solutions	Use to direct party associated with individual household to solution charts for addressing water quality problems based upon identified conditions.	Yellow
2a	Nutrients	Use to establish solutions that address water quality problems associated with nutrients (example: nitrates (NO_3)).	Orange
2b	Bacteriological	Use to establish solutions that address bacteriological water quality problems (examples: fecal coliform and E. coli).	Red
2c	Inorganics	Use to establish solutions that address water quality problems associated with inorganic constituents (examples: arsenic and lead).	Light Green
2d	Organics	Use to establish solutions that address water quality problems associated with organic constituents (example: DBCP).	Dark Blue
2e	General Water Quality	Use to establish solutions that address general water quality problems with constituents that represent non-specific conditions (examples: conductivity, turbidity and hydrogen sulfide).	Light Blue
3	Water Quantity/Delivery Solutions	Use to establish solutions that address water quantity and/or delivery problems.	Blue
4	Wastewater Treatment and Disposal Solutions	Use to establish solutions that address wastewater treatment and/or disposal problems.	Green



*THIS PROGRAM IS SPECIFICALLY DESIGNED FOR INDIVIDUAL HOUSEHOLDS OR GROUPS OF HOUSEHOLDS CONSISTING OF 15 RESIDENCES OR LESS

SOLUTION CHART NO. 1 - INITIAL CLASSIFICATION
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\8.5 x 11 SOLUTION CHART NO. 1.Dwg



SOLUTION CHART NO. 2 - WATER QUALITY SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

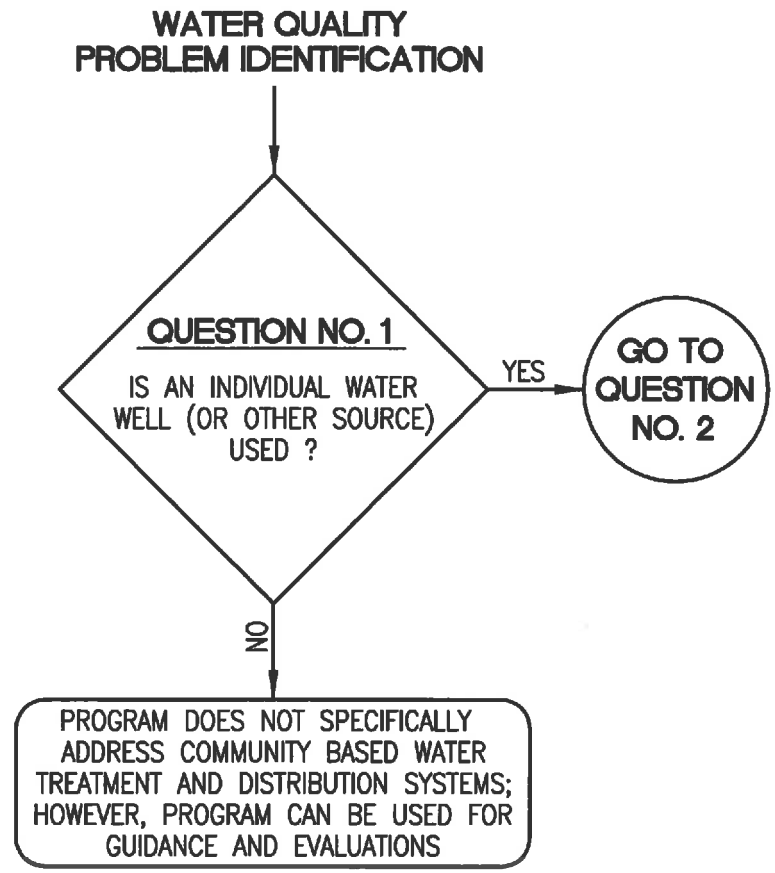
L:\TCDC\8.5 x 11 SOLUTION CHART NO. 2.Dwg

APPENDIX A – SOLUTION CHARTS

SOLUTION CHART SERIES 2A – NUTRIENTS

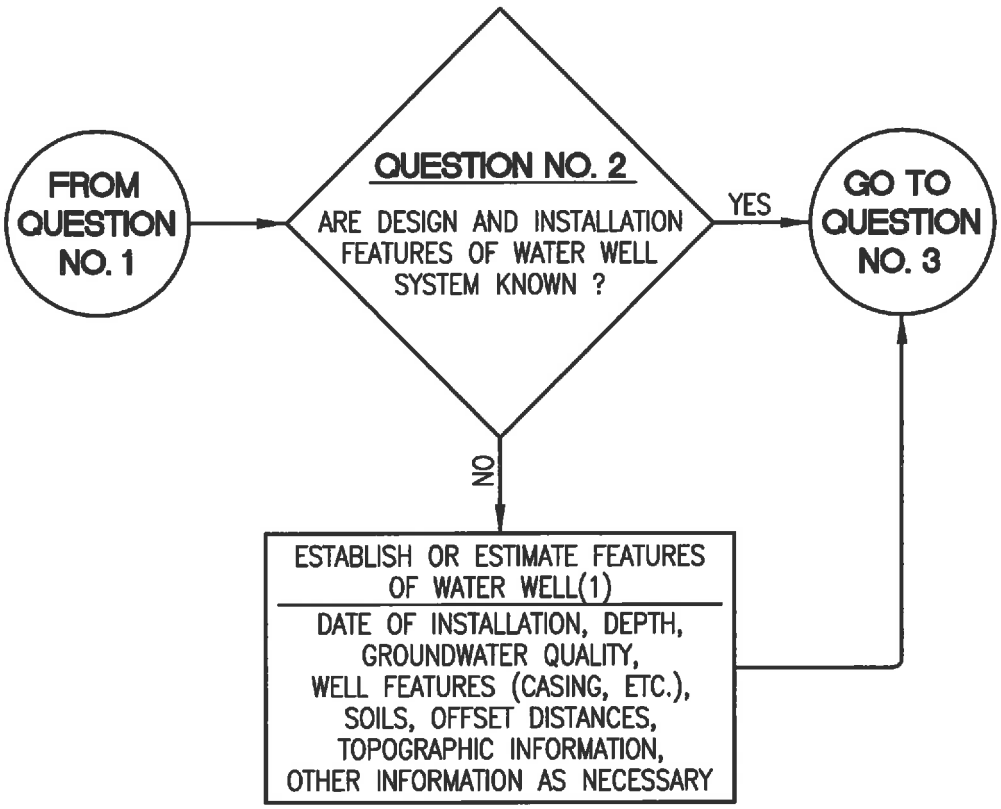
This series of solution charts is specifically prepared to address water quality problems associated with nutrients (e.g. nitrates).

The solution sets referenced in the charts can be found in Appendix B – Solution Sets.



QUESTION NO. 1

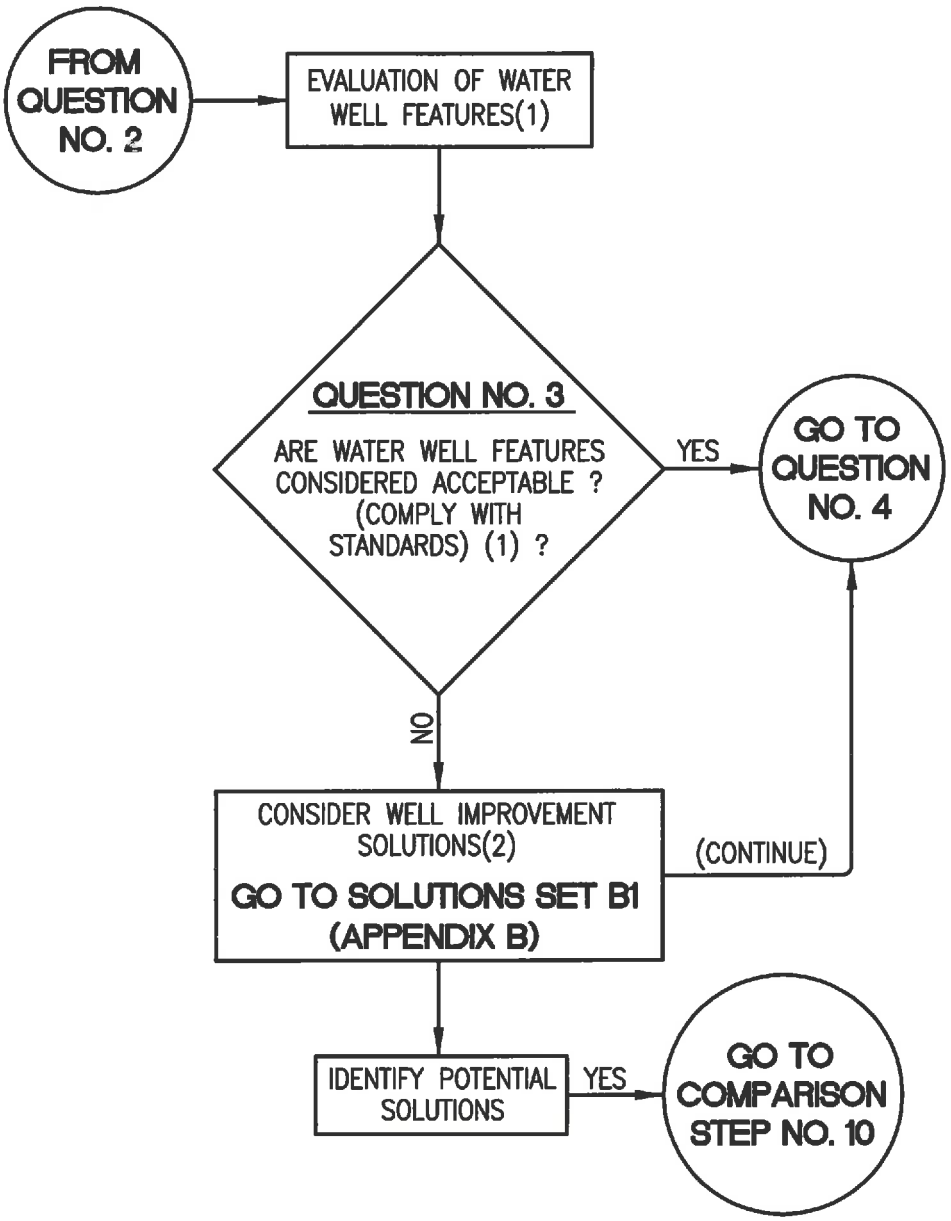
SOLUTION SERIES NO. 2A - WATER QUALITY SOLUTIONS - NUTRIENTS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



NOTE:
1. EVALUATION SHOULD BE CONDUCTED BY INDIVIDUAL WITH EXPERIENCE IN WATER WELL DESIGN AND INSTALLATION.

QUESTION NO. 2

SOLUTION SERIES NO. 2A - WATER QUALITY SOLUTIONS - NUTRIENTS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



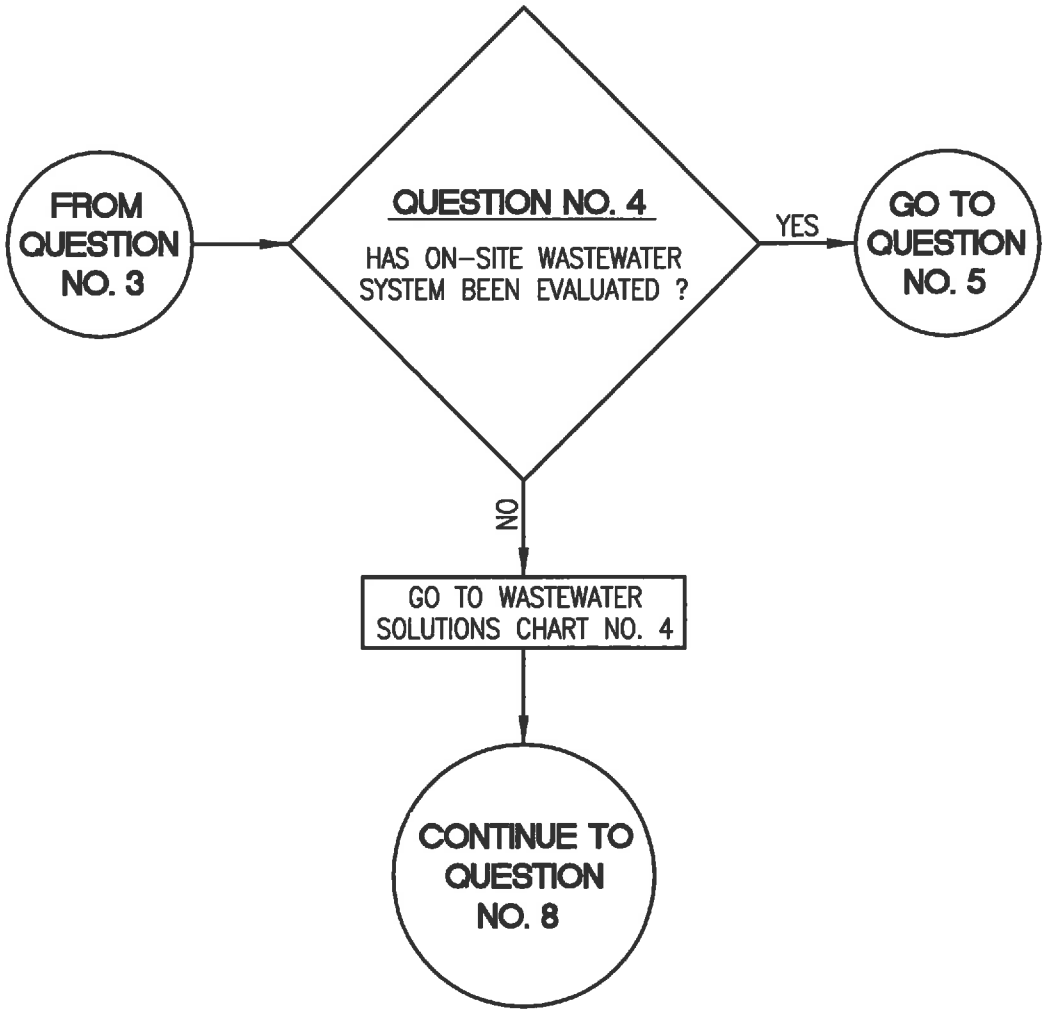
NOTES:

1. EVALUATION SHOULD BE CONDUCTED BY PROFESSIONAL WITH EXPERIENCE IN WATER WELL DESIGN, INSTALLATION AND REGULATORY REQUIREMENTS.

2. SOLUTIONS SHOULD BE EVALUATED AND ESTABLISHED BY PERSON(S) EXPERIENCED IN DRINKING WATER TREATMENT. EXAMPLES: DRINKING WATER TREATMENT CONSULTANTS, HEALTH DEPARTMENT REPRESENTATIVES AND WATER TREATMENT EQUIPMENT MANUFACTURERS.

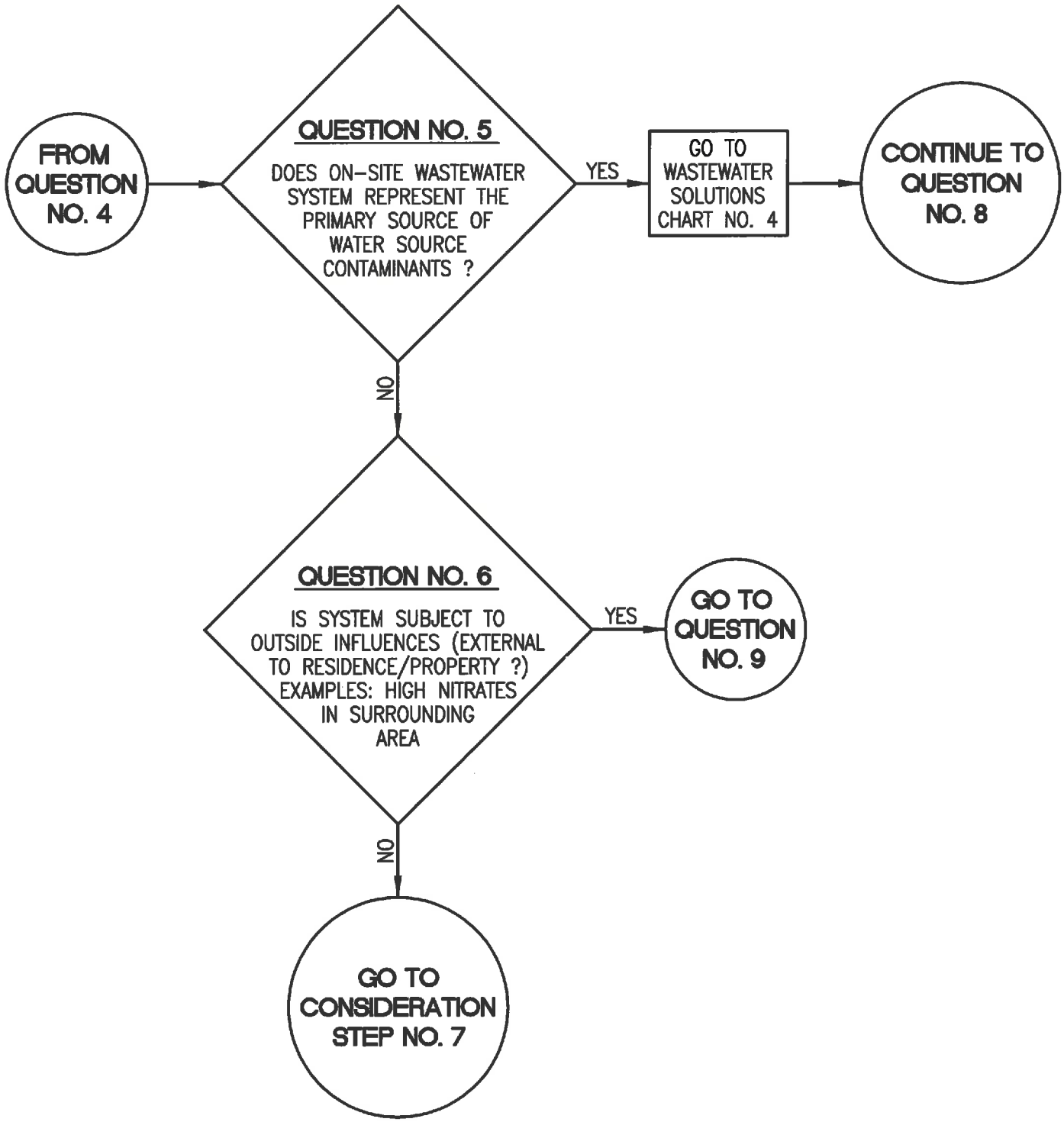
QUESTION NO. 3

SOLUTION SERIES NO. 2A - WATER QUALITY SOLUTIONS - NUTRIENTS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



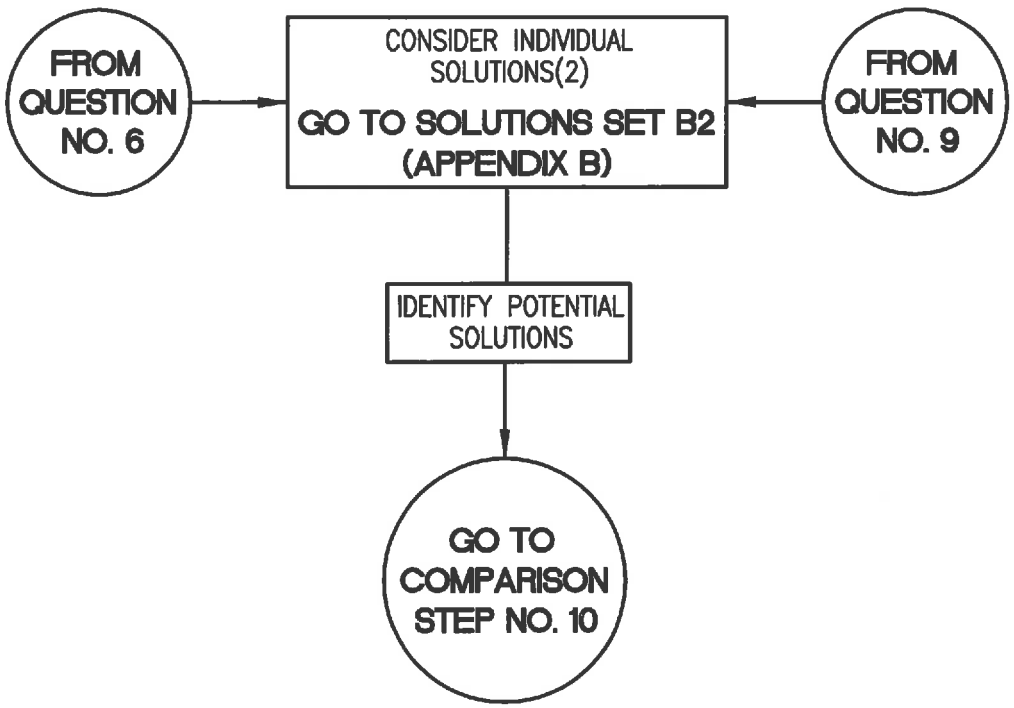
QUESTION NO. 4

SOLUTION SERIES NO. 2A - WATER QUALITY SOLUTIONS - NUTRIENTS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



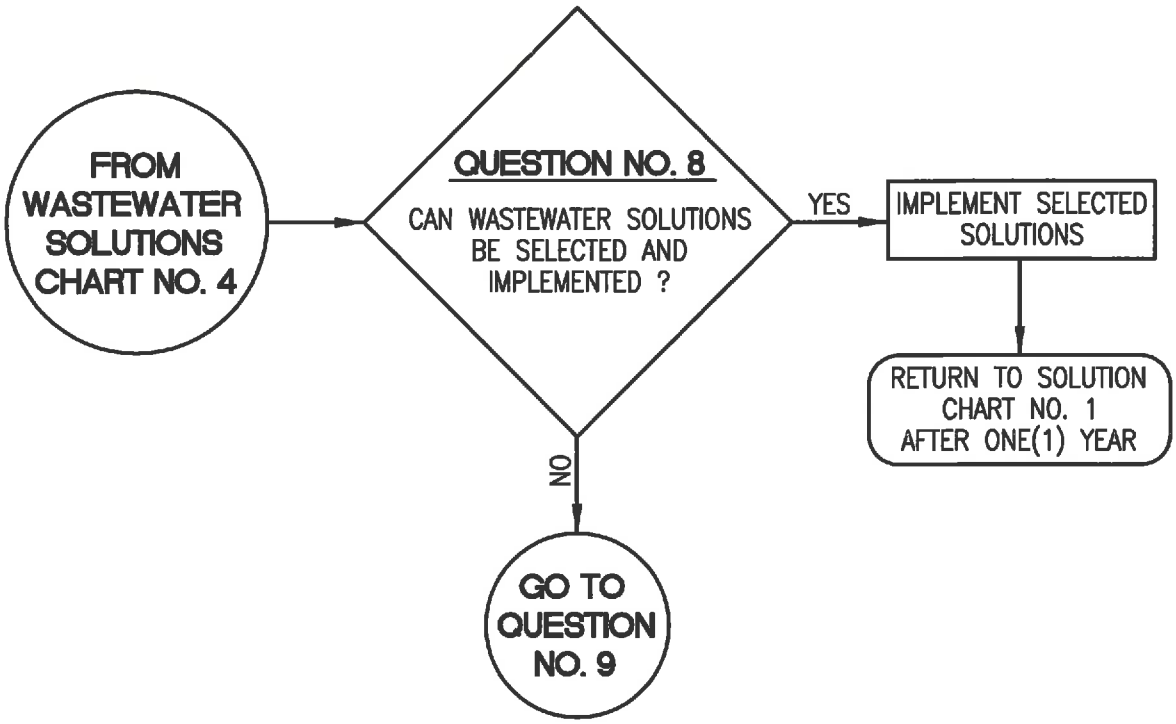
QUESTIONS NO. 5 AND NO. 6

SOLUTION SERIES NO. 2A - WATER QUALITY SOLUTIONS - NUTRIENTS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



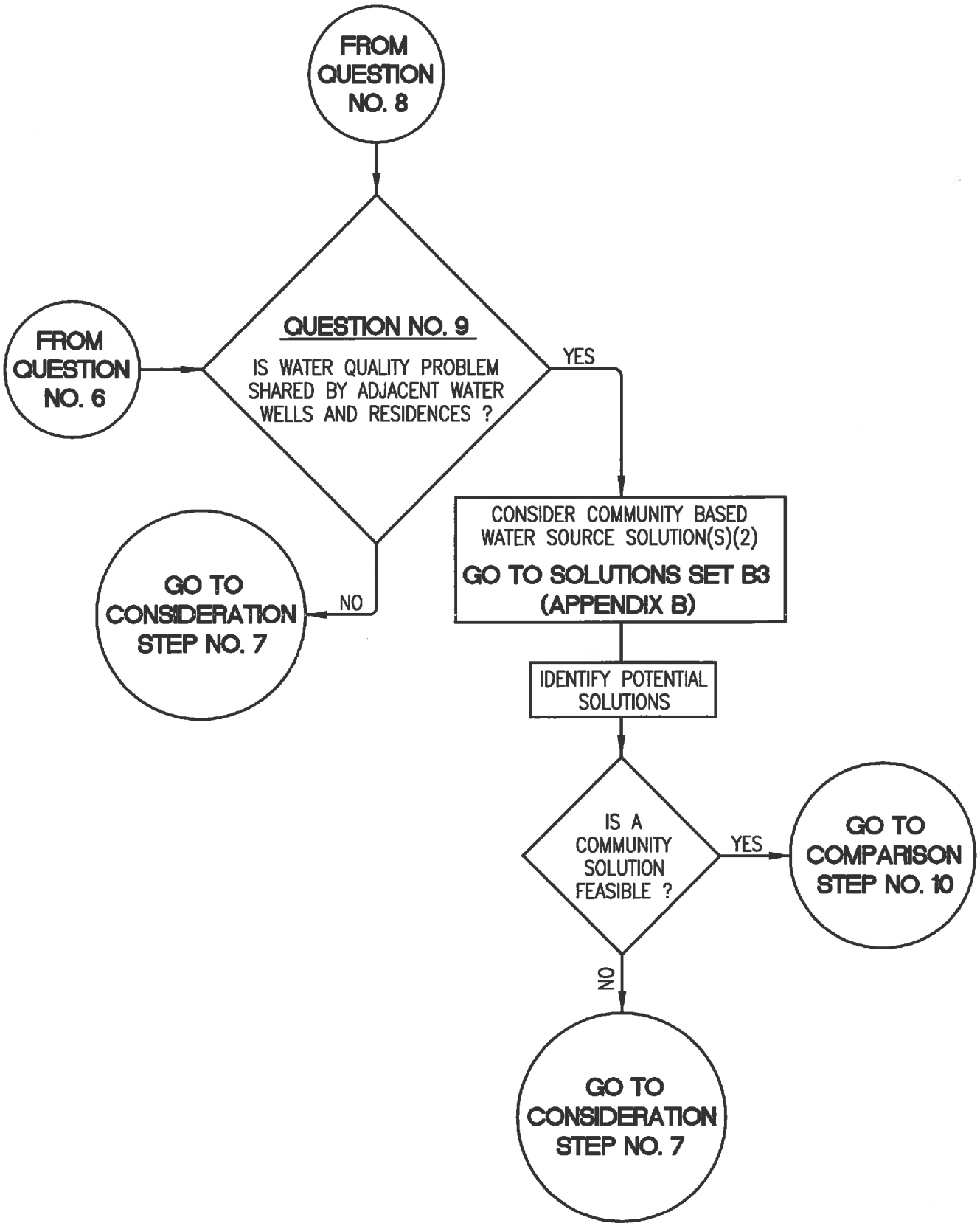
CONSIDERATION STEP NO. 7

SOLUTION SERIES NO. 2A - WATER QUALITY SOLUTIONS - NUTRIENTS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



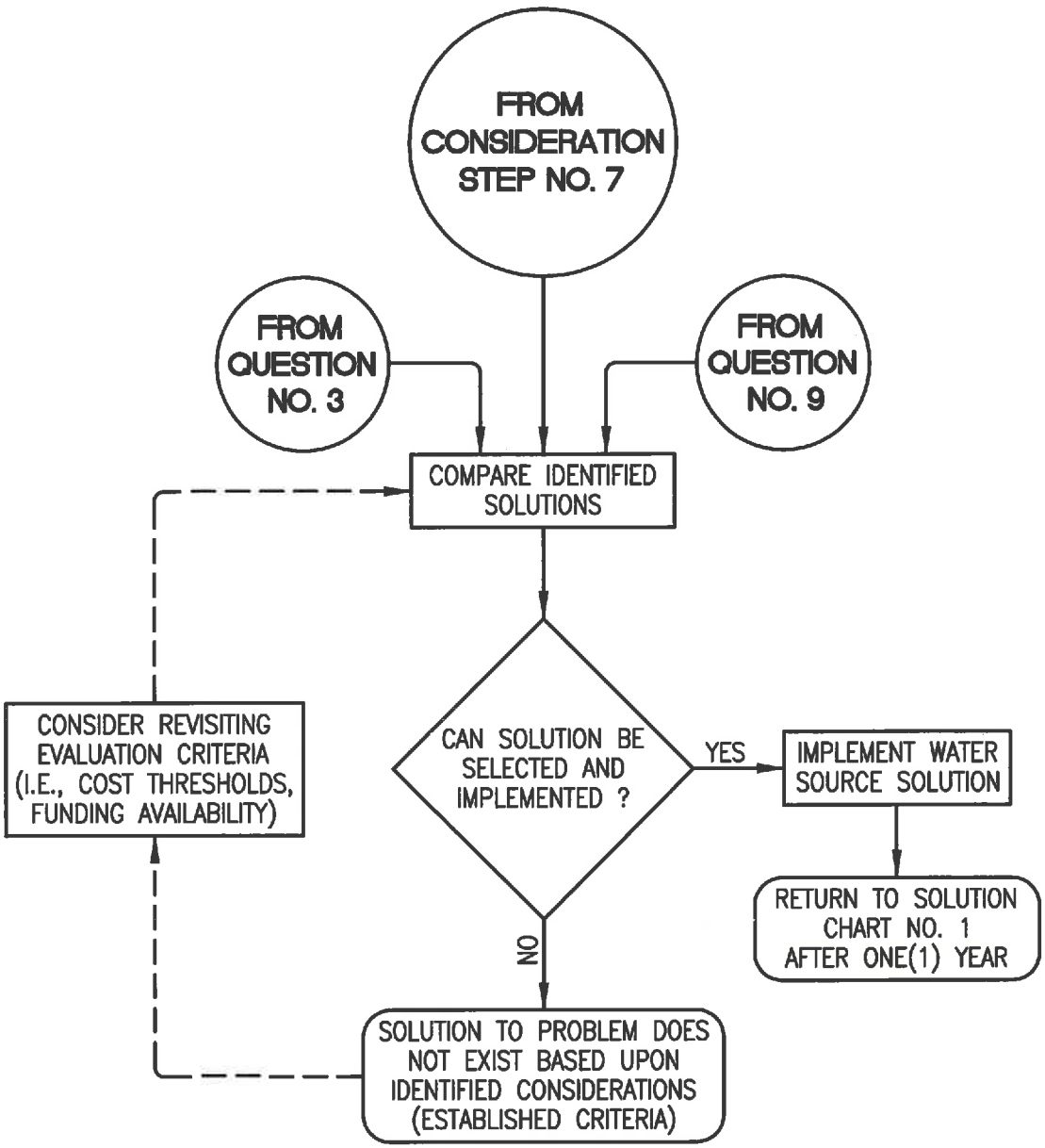
QUESTION NO. 8

SOLUTION SERIES NO. 2A - WATER QUALITY SOLUTIONS - NUTRIENTS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



QUESTION NO. 9

SOLUTION SERIES NO. 2A - WATER QUALITY SOLUTIONS - NUTRIENTS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



COMPARISON STEP NO. 10

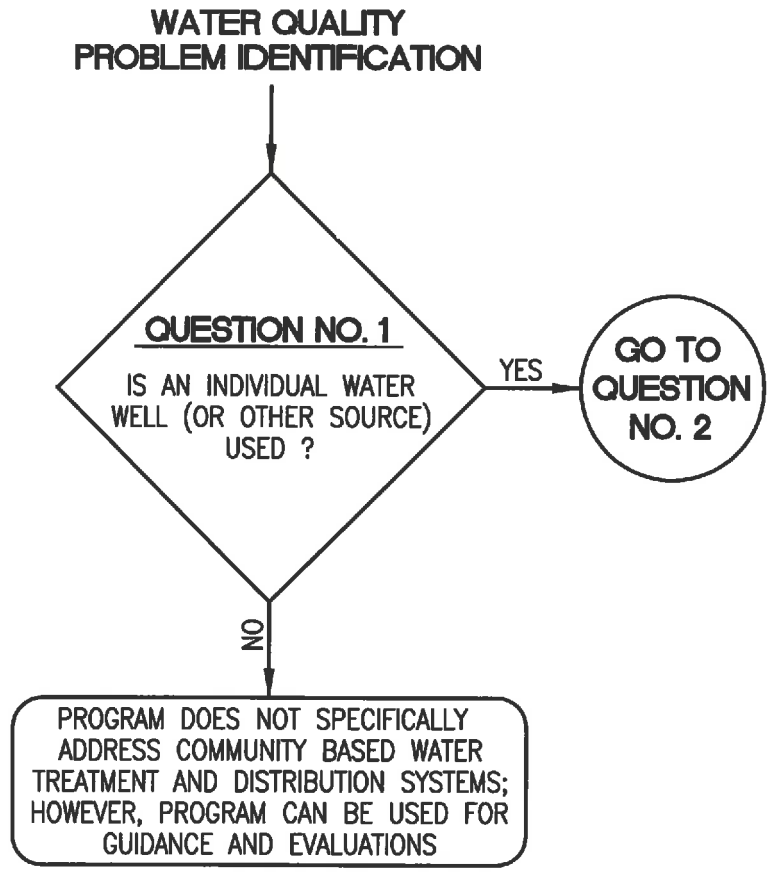
SOLUTION SERIES NO. 2A - WATER QUALITY SOLUTIONS - NUTRIENTS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

APPENDIX A – SOLUTION CHARTS

SOLUTION CHART SERIES 2B – BACTERIOLOGICAL

This series of solution charts is specifically prepared to address water quality problems associated with bacteriological contaminants (e.g. Fecal Coliform, E. Coli or cysts).

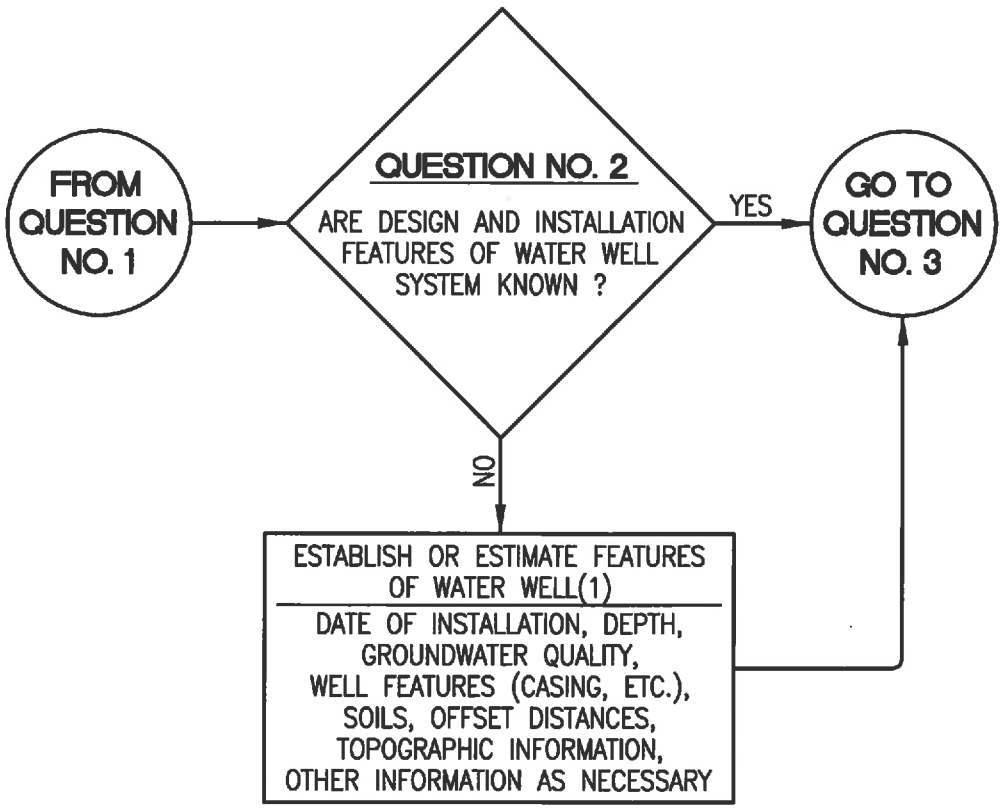
The solution sets referenced in the charts can be found in Appendix B – Solution Sets.



QUESTION NO. 1

SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

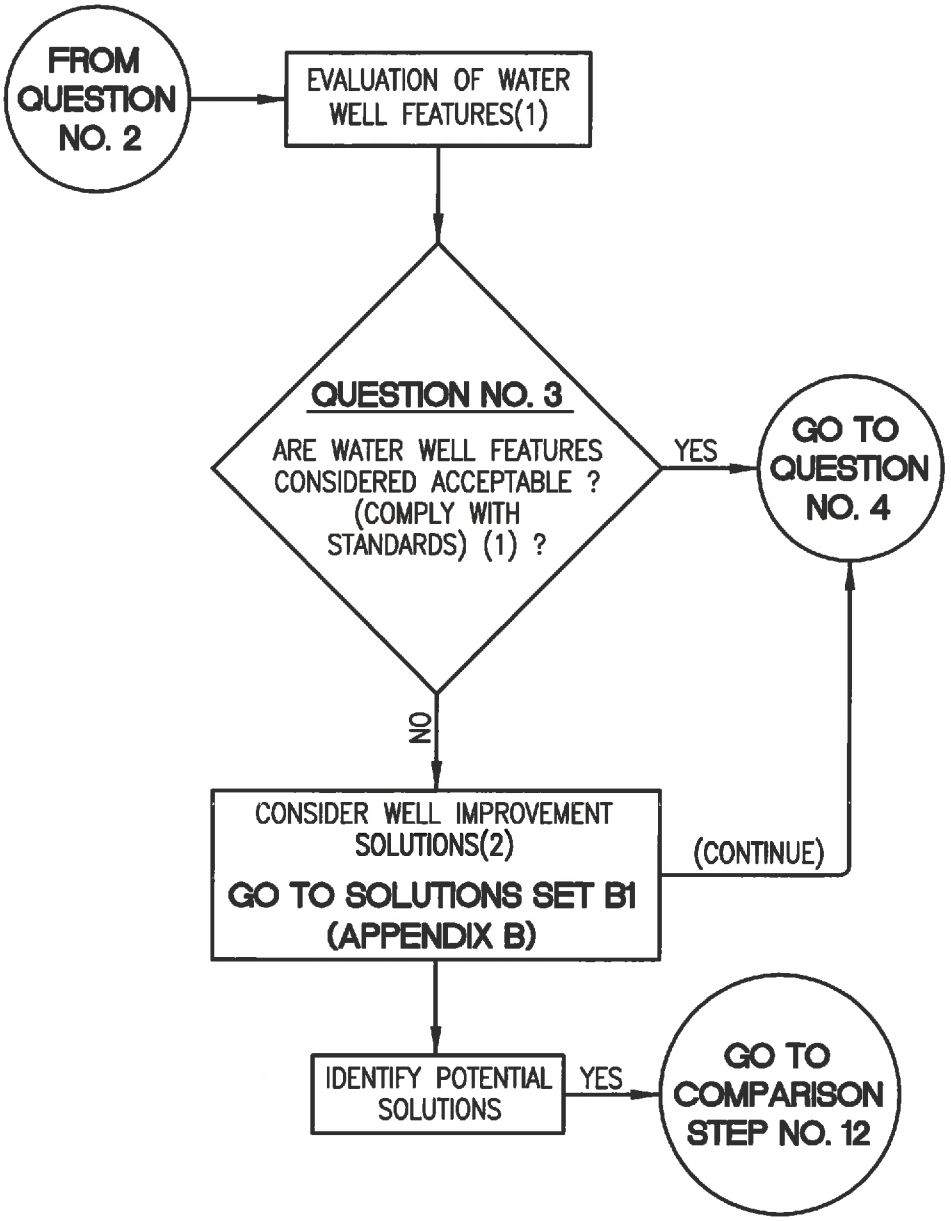
L:\TCDC\(1) BACTERIOLOGICAL-SOLUTION CHART 2B.Dwg



NOTE:
1. EVALUATION SHOULD BE CONDUCTED BY INDIVIDUAL WITH EXPERIENCE IN WATER WELL DESIGN AND INSTALLATION.

QUESTION NO. 2

SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



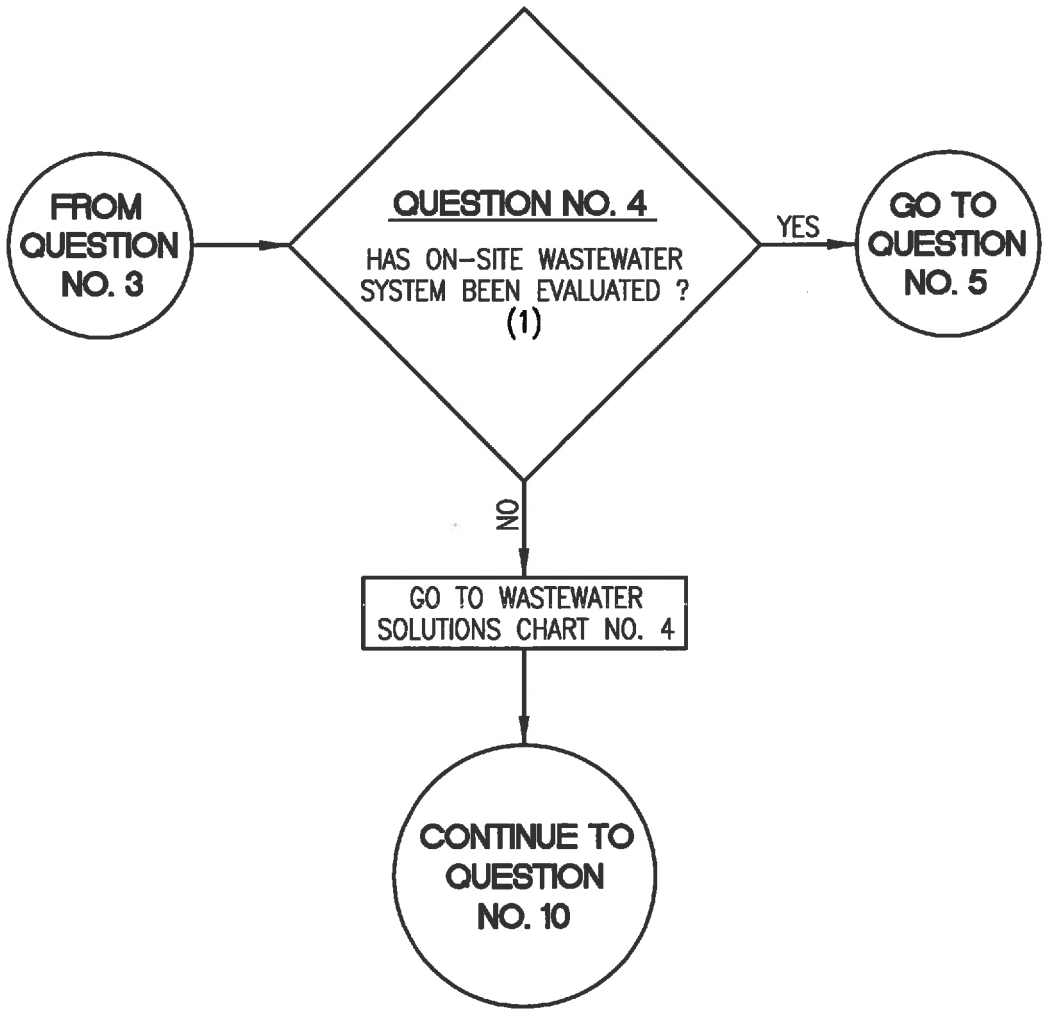
NOTES:

1. EVALUATION SHOULD BE CONDUCTED BY PROFESSIONAL WITH EXPERIENCE IN WATER WELL DESIGN, INSTALLATION AND REGULATORY REQUIREMENTS.

2. SOLUTIONS SHOULD BE EVALUATED AND ESTABLISHED BY PERSON(S) EXPERIENCED IN DRINKING WATER TREATMENT. EXAMPLES: DRINKING WATER TREATMENT CONSULTANTS, HEALTH DEPARTMENT REPRESENTATIVES AND WATER TREATMENT EQUIPMENT MANUFACTURERS.

QUESTION NO. 3

SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

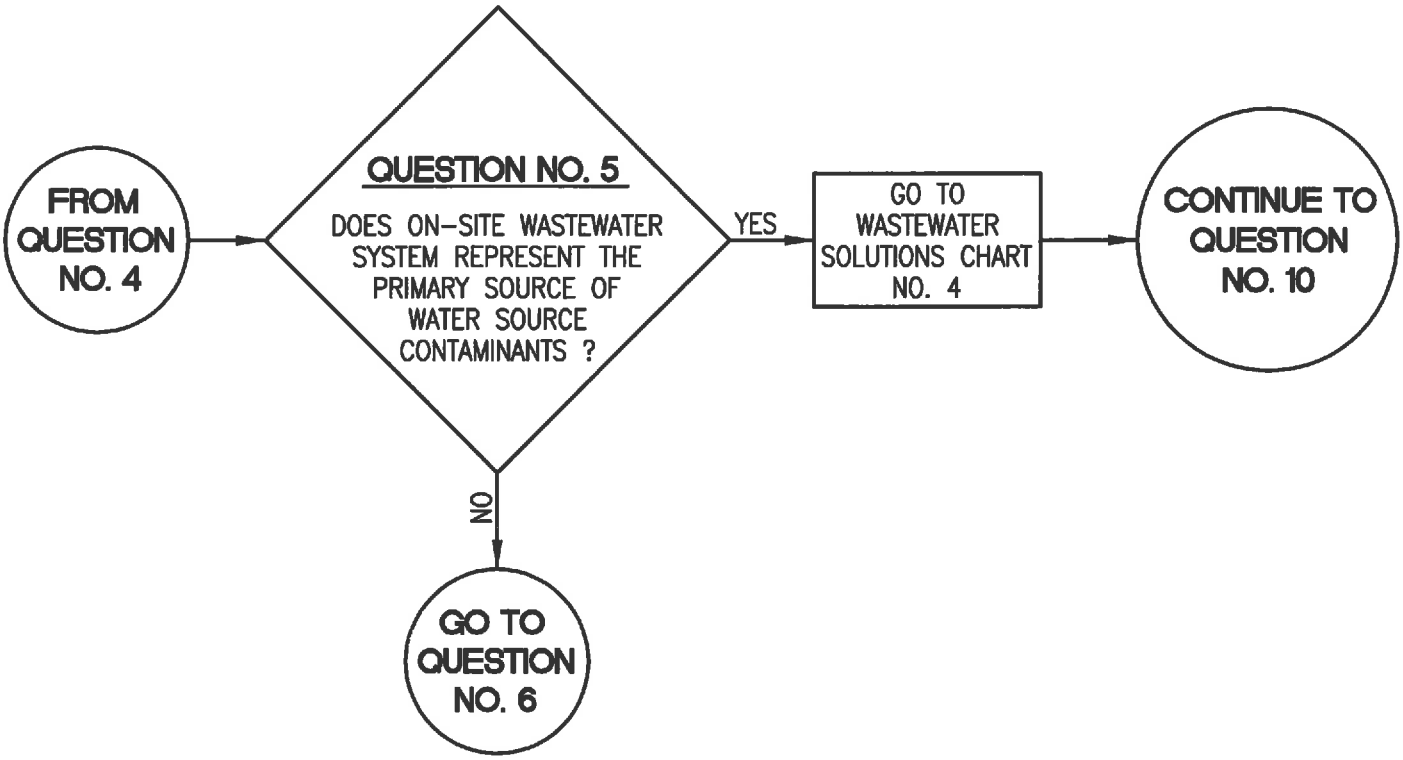


NOTE:
1. IF NO ON-SITE WASTEWATER SYSTEM EXISTS, GO TO QUESTION NO. 6.

QUESTION NO. 4

SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

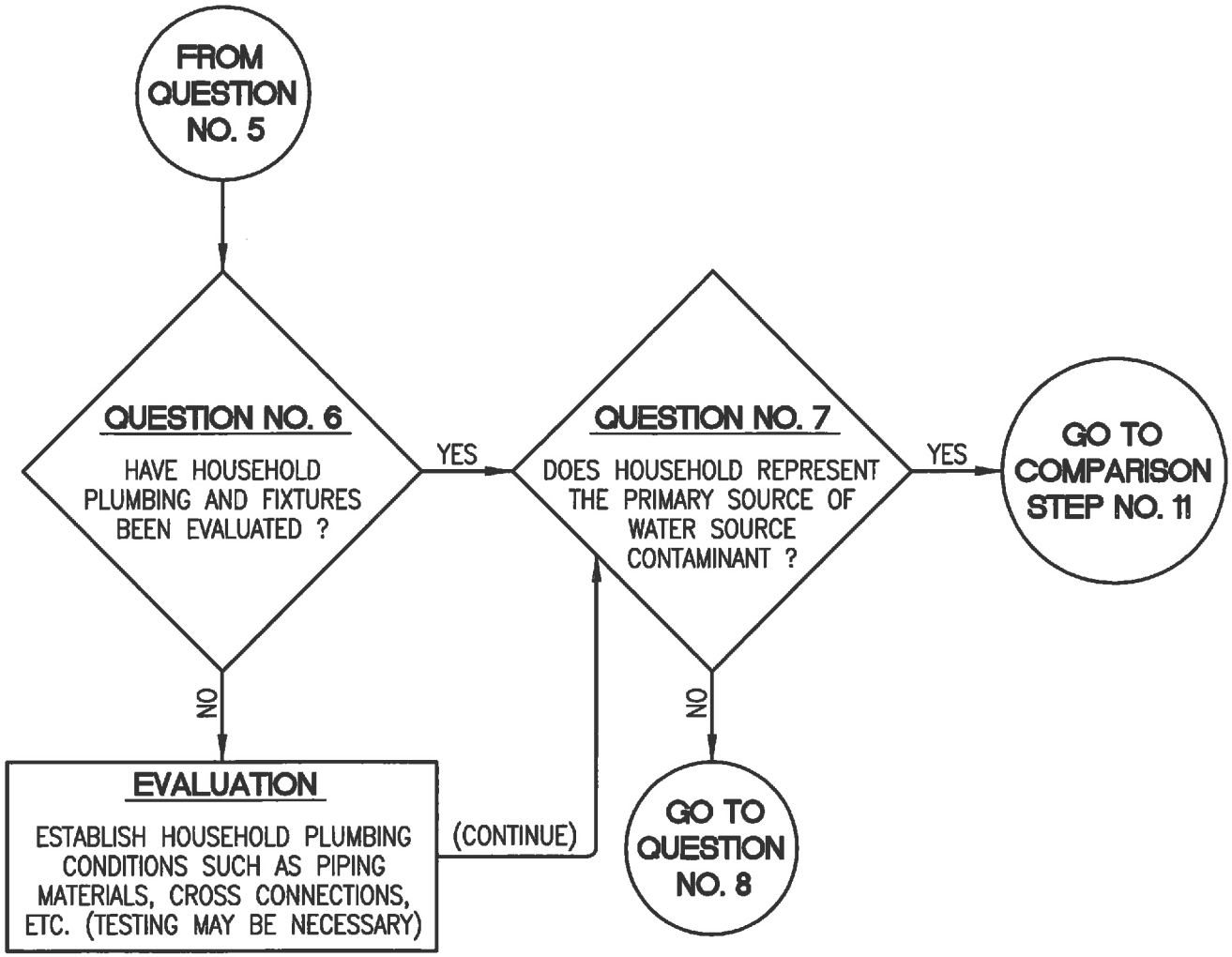
L:\TDDC\(4) BACTERIOLOGICAL-SOLUTION CHART 2B.Dwg



QUESTION NO. 5

SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

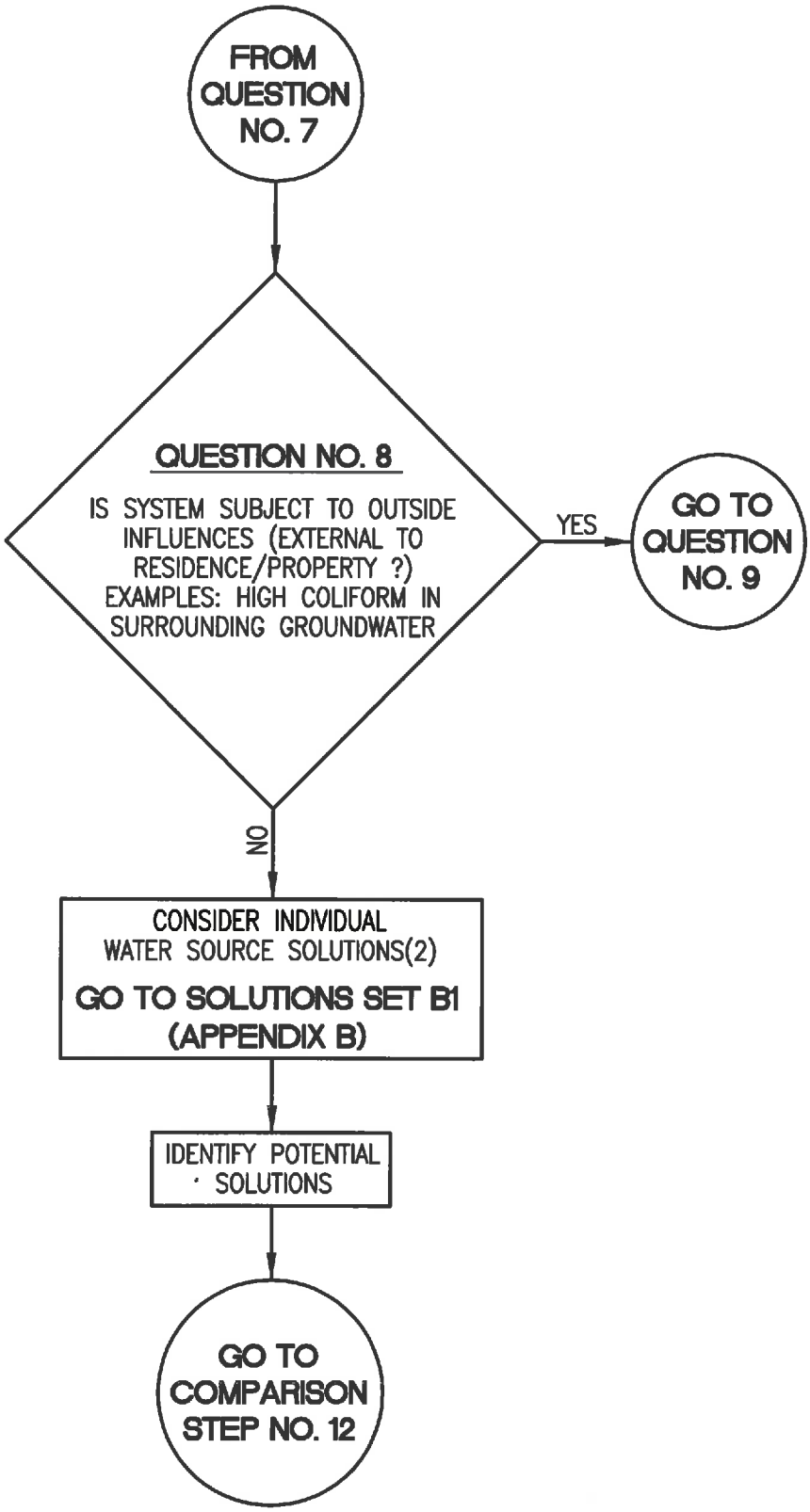
L:\TDDC\(5) BACTERIOLOGICAL-SOLUTION CHART 2B.Dwg



QUESTIONS NO. 6 AND NO. 7

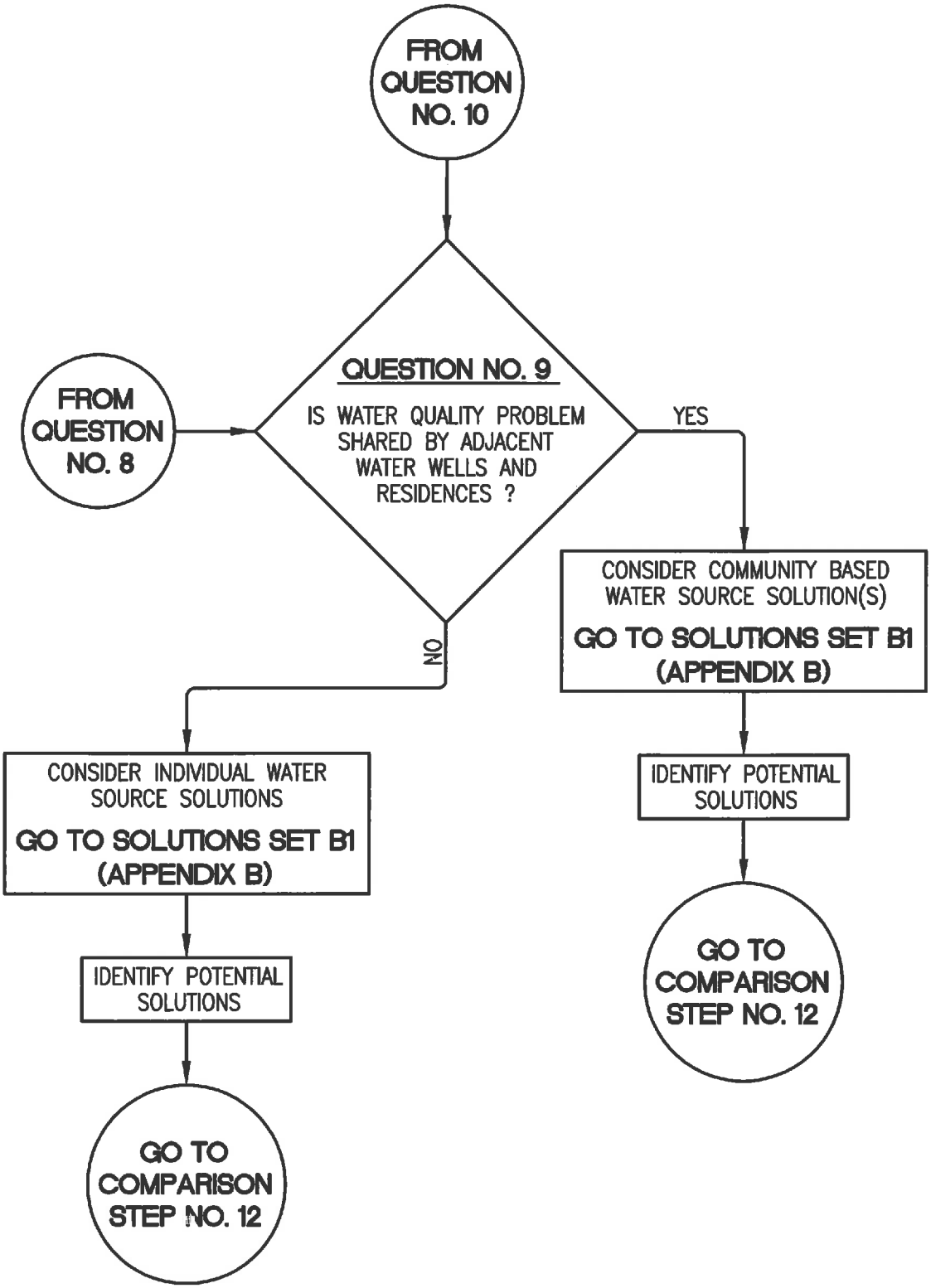
SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TODC\6 AND 7) BACTERIOLOGICAL-SOLUTION CHART 2B.Dwg



QUESTION NO. 8

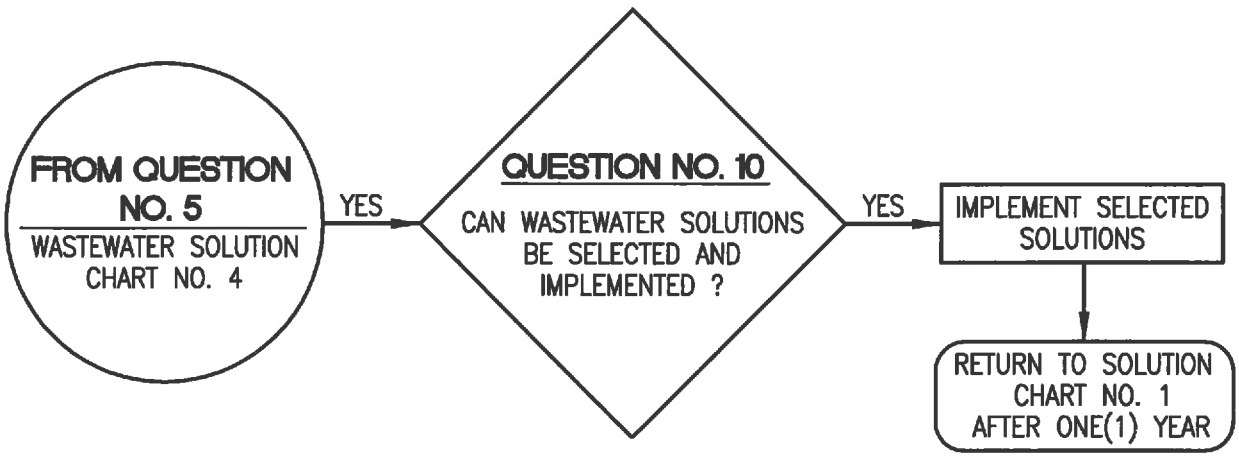
SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



QUESTION NO. 9

SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

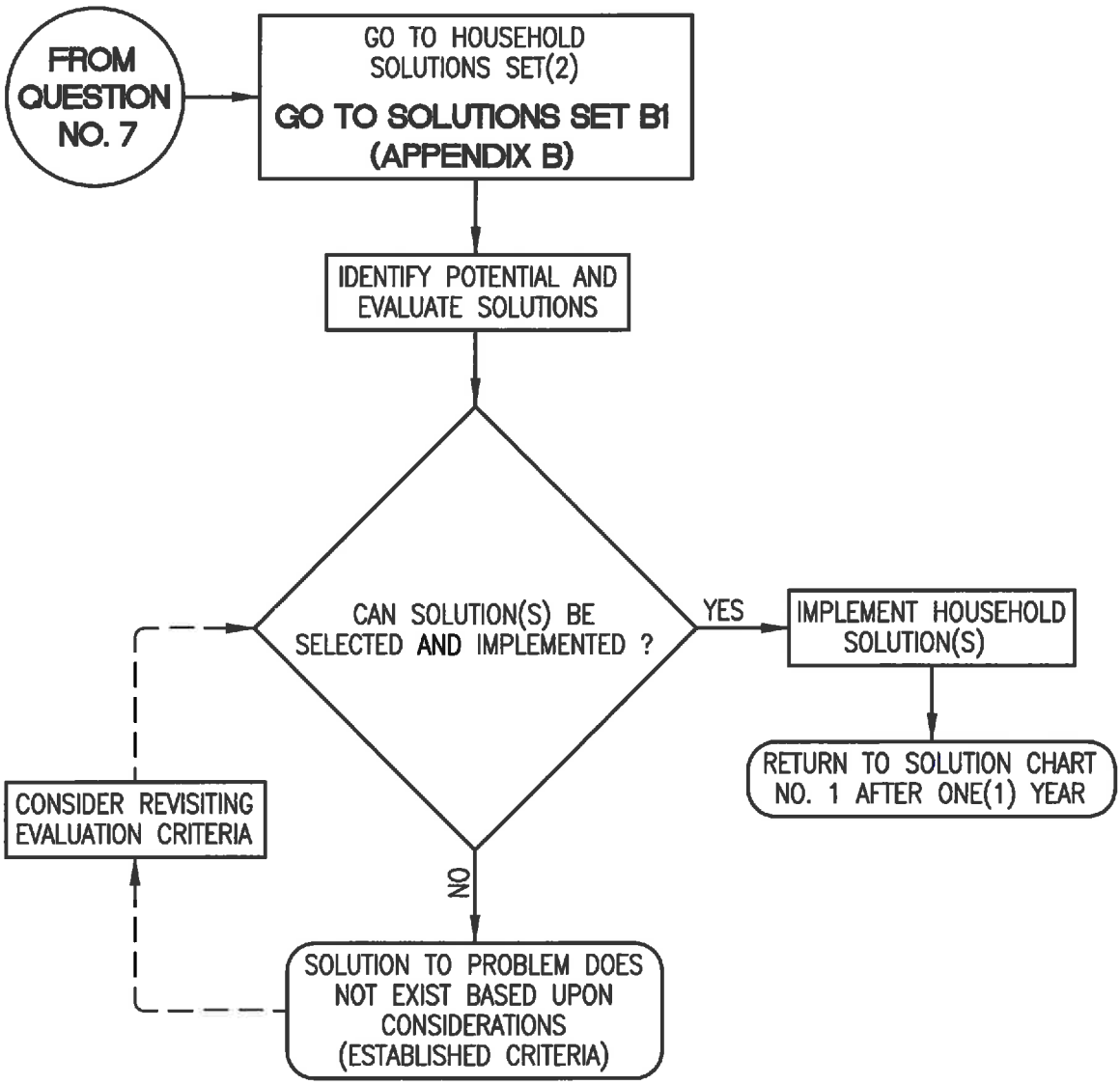
L:\TCDC\(9) BACTERIOLOGICAL--SOLUTION CHART 2B.Dwg



QUESTION NO. 10

SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

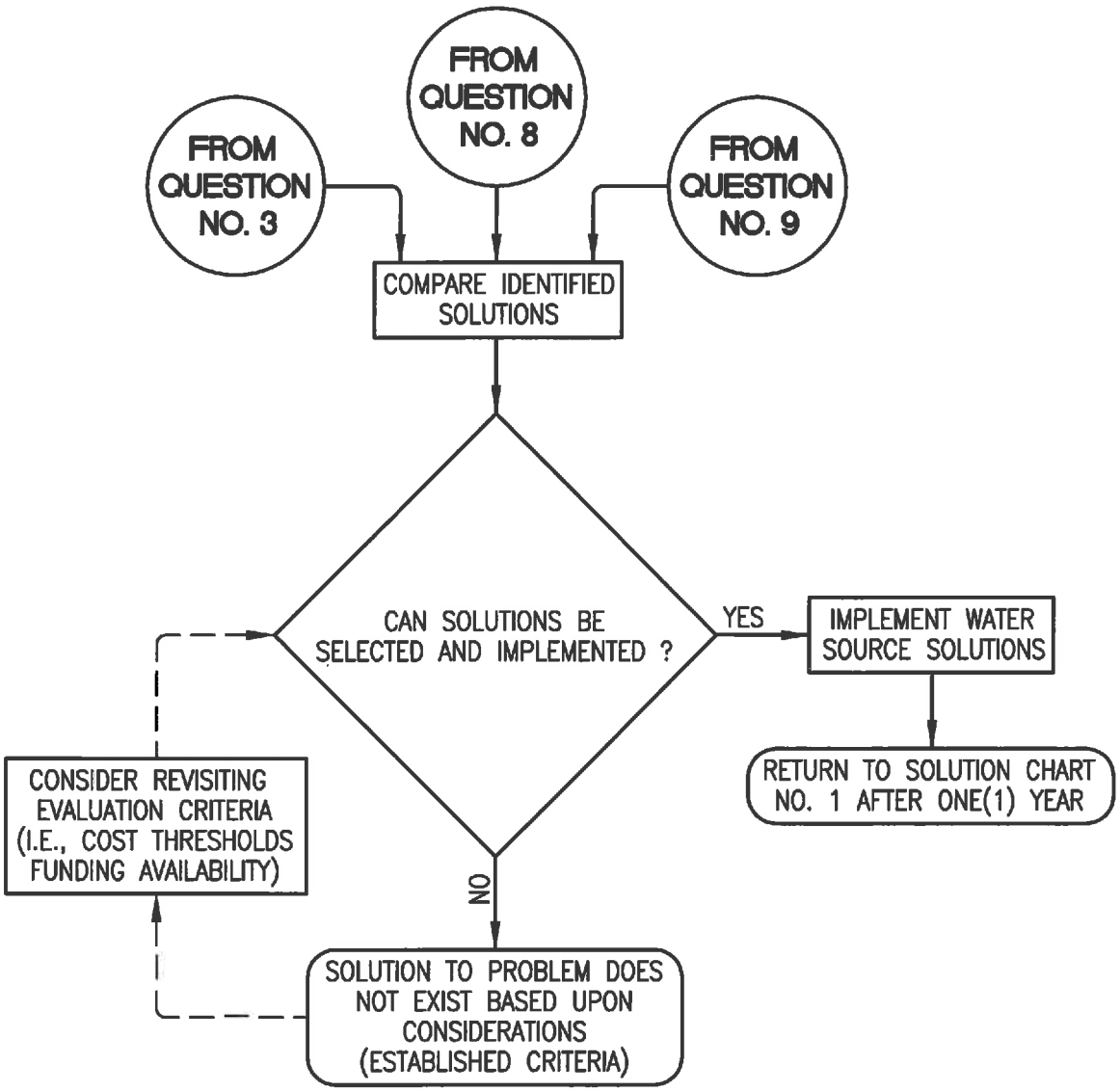
L:\TCDC\(10) BACTERIOLOGICAL-SOLUTION CHART 2B.Dwg



COMPARISON STEP NO. 11

SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\(11) BACTERIOLOGICAL-SOLUTION CHART 2B.Dwg



COMPARISON STEP NO. 12

SOLUTION CHART NO. 2B - WATER QUALITY SOLUTIONS - BACTERIOLOGICAL
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

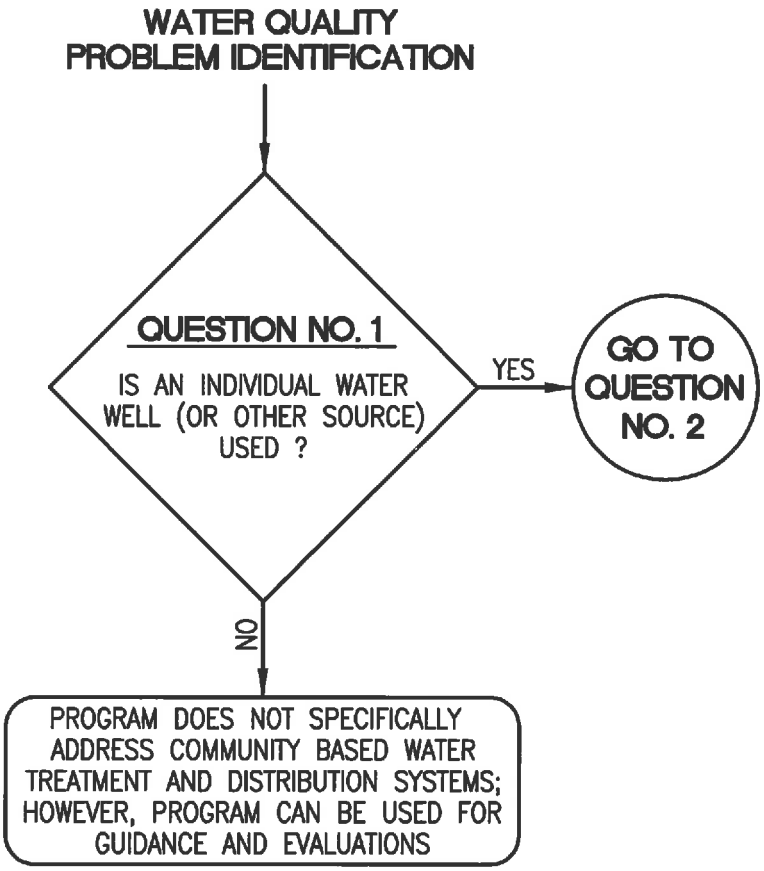
L:\TCDC\(12) BACTERIOLOGICAL-SOLUTION CHART 2B.Dwg

APPENDIX A – SOLUTION CHARTS

SOLUTION CHART SERIES 2C – INORGANIC

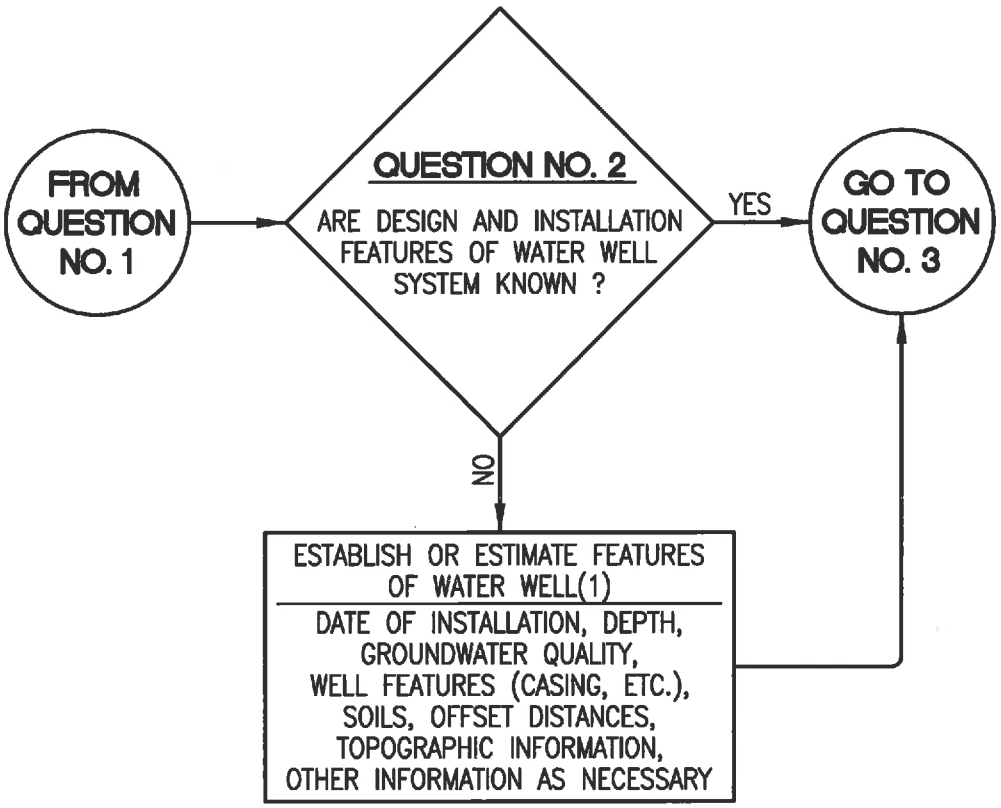
This series of solution charts is specifically prepared to address water quality problems associated with inorganic constituents (e.g. arsenic, copper, lead or chromium).

The solution sets referenced in the charts can be found in Appendix B – Solution Sets.



QUESTION NO. 1

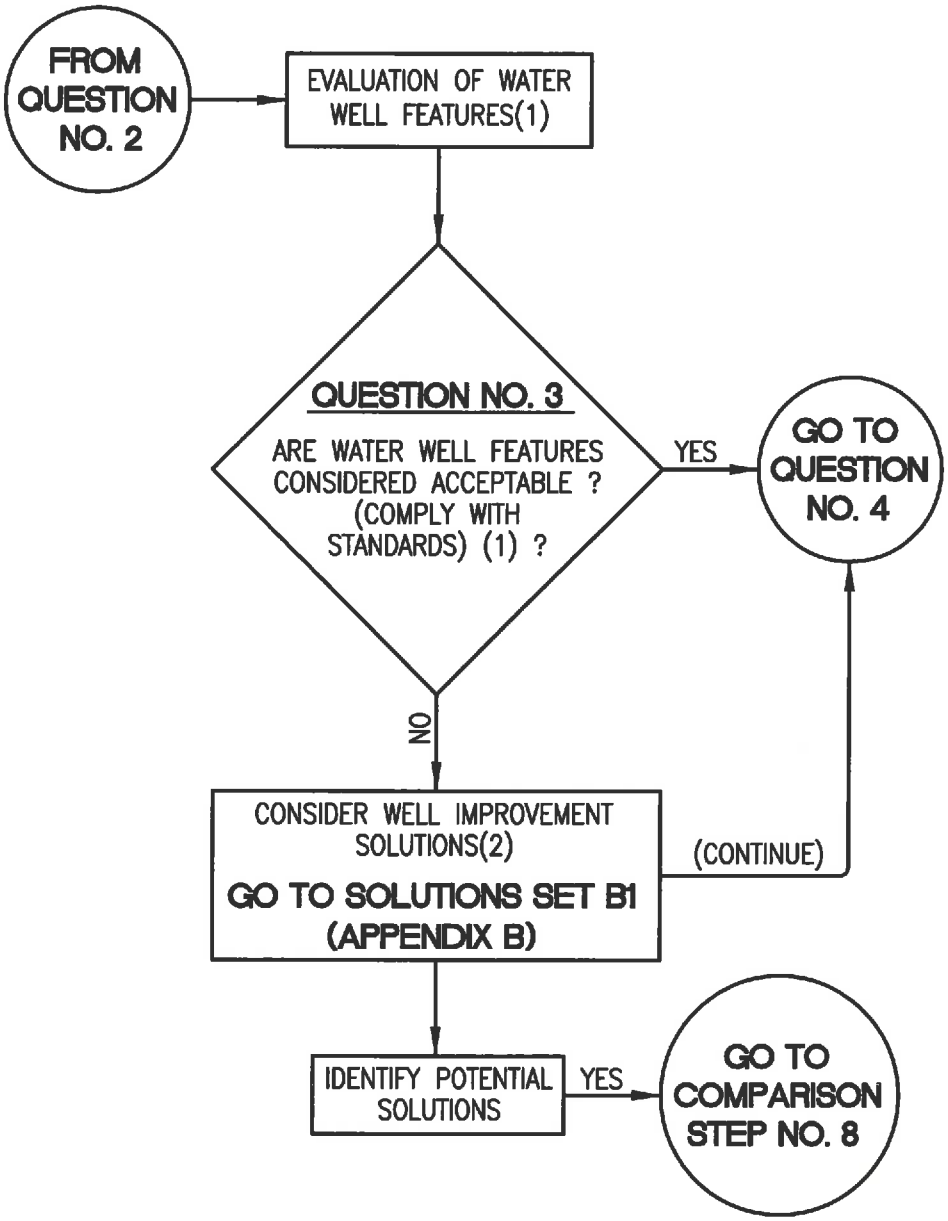
SOLUTION SERIES NO. 2C - WATER QUALITY SOLUTIONS - INORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



NOTE:
1. EVALUATION SHOULD BE CONDUCTED BY INDIVIDUAL WITH EXPERIENCE IN WATER WELL DESIGN AND INSTALLATION.

QUESTION NO. 2

SOLUTION SERIES NO. 2C - WATER QUALITY SOLUTIONS - INORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



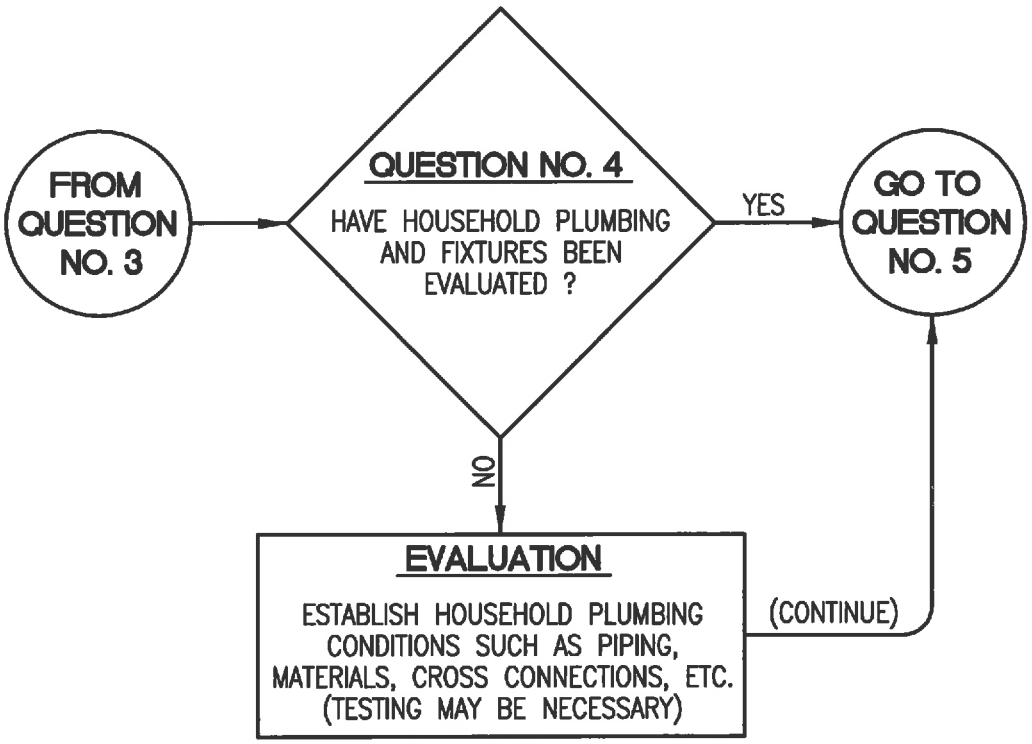
NOTES:

1. EVALUATION SHOULD BE CONDUCTED BY PROFESSIONAL WITH EXPERIENCE IN WATER WELL DESIGN, INSTALLATION AND REGULATORY REQUIREMENTS.

2. SOLUTIONS SHOULD BE EVALUATED AND ESTABLISHED BY PERSON(S) EXPERIENCED IN DRINKING WATER TREATMENT. EXAMPLES: DRINKING WATER TREATMENT CONSULTANTS, HEALTH DEPARTMENT REPRESENTATIVES AND WATER TREATMENT EQUIPMENT MANUFACTURERS.

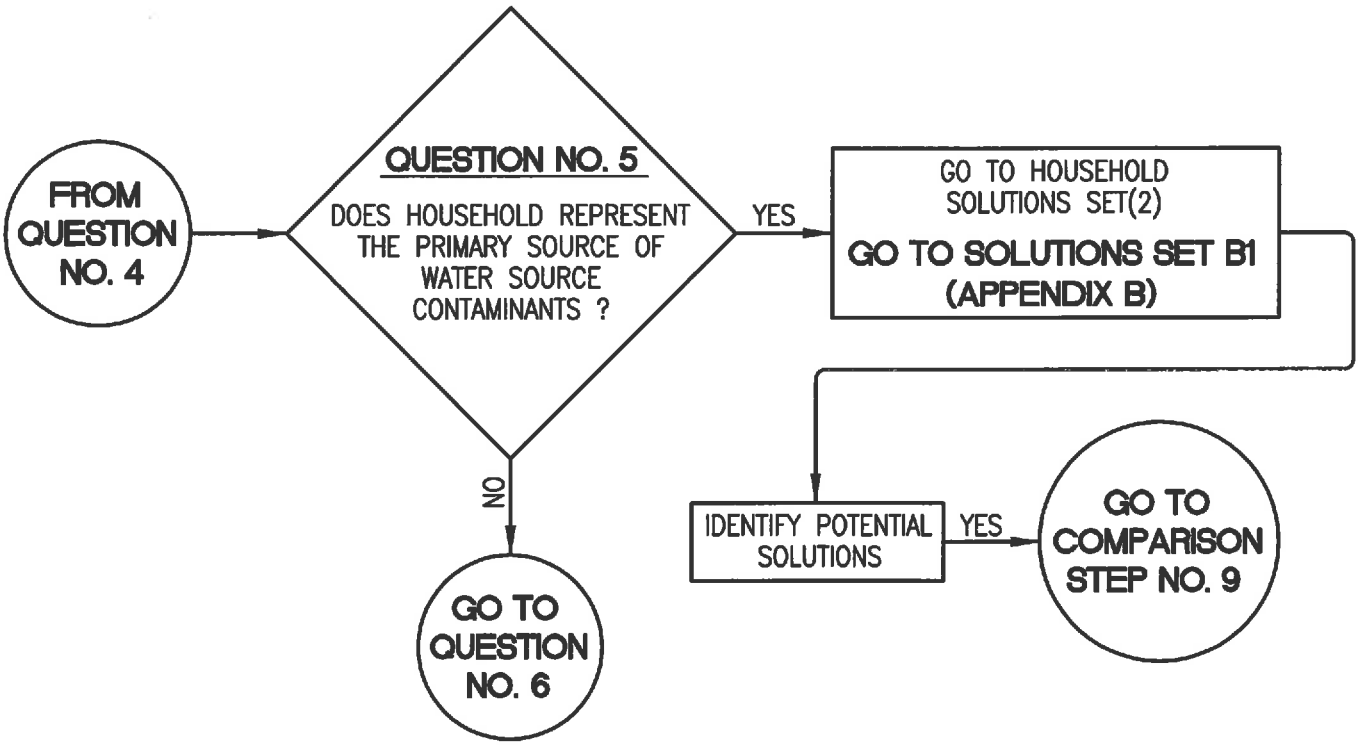
QUESTION NO. 3

SOLUTION SERIES NO. 2C - WATER QUALITY SOLUTIONS - INORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



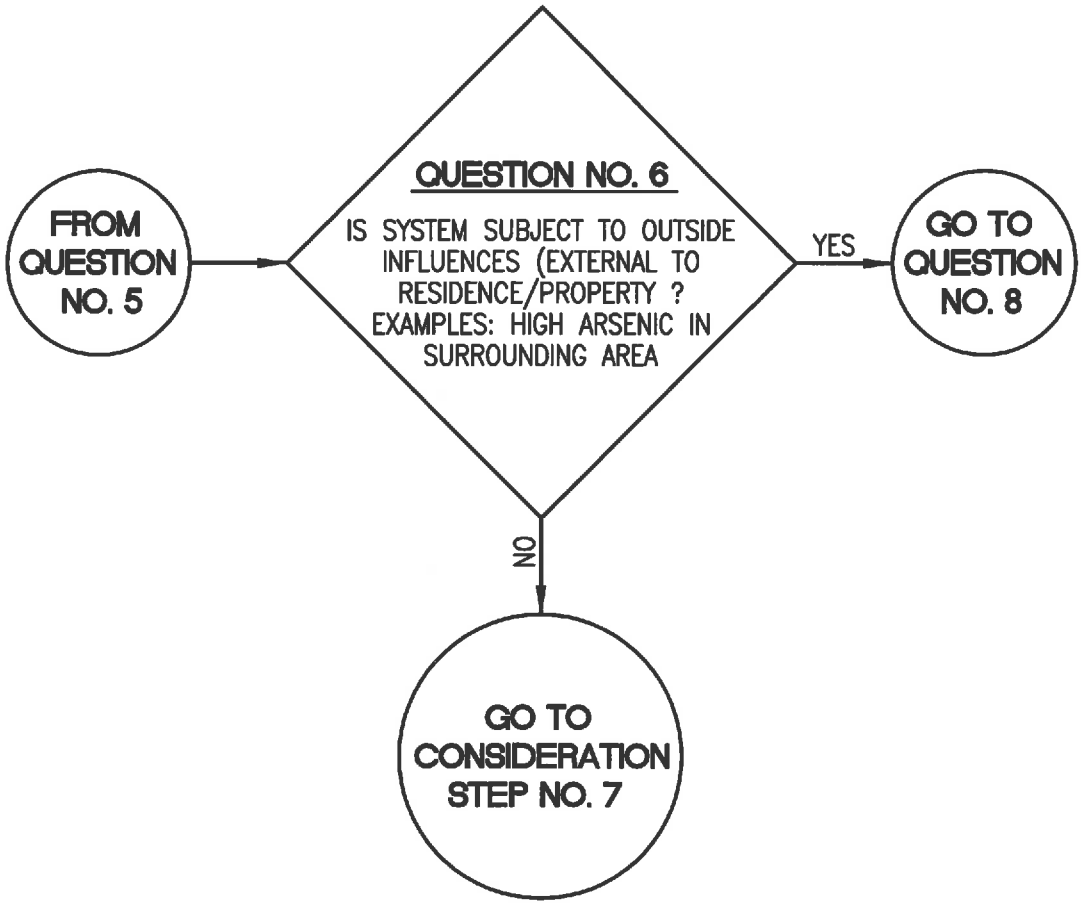
QUESTION NO. 4

SOLUTION SERIES NO. 2C - WATER QUALITY SOLUTIONS -INORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



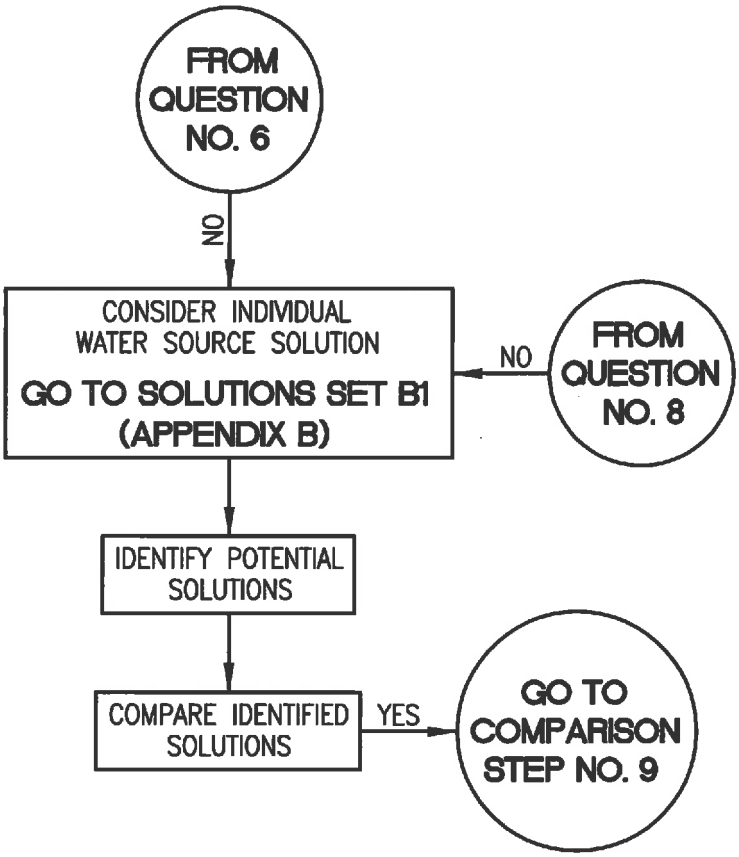
QUESTION NO. 5

SOLUTION SERIES NO. 2C - WATER QUALITY SOLUTIONS - INORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



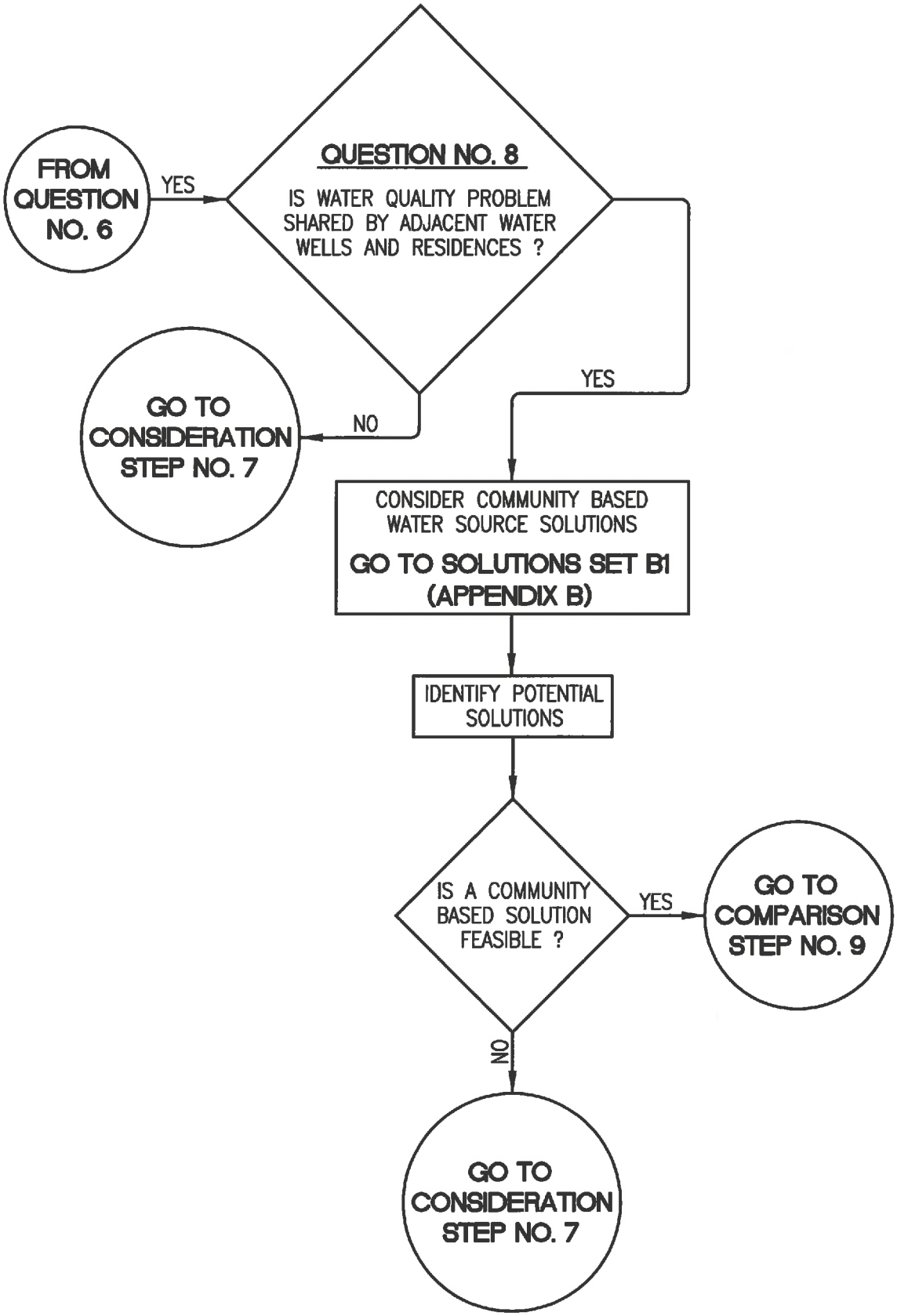
QUESTION NO. 6

SOLUTION SERIES NO. 2C - WATER QUALITY SOLUTIONS - INORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



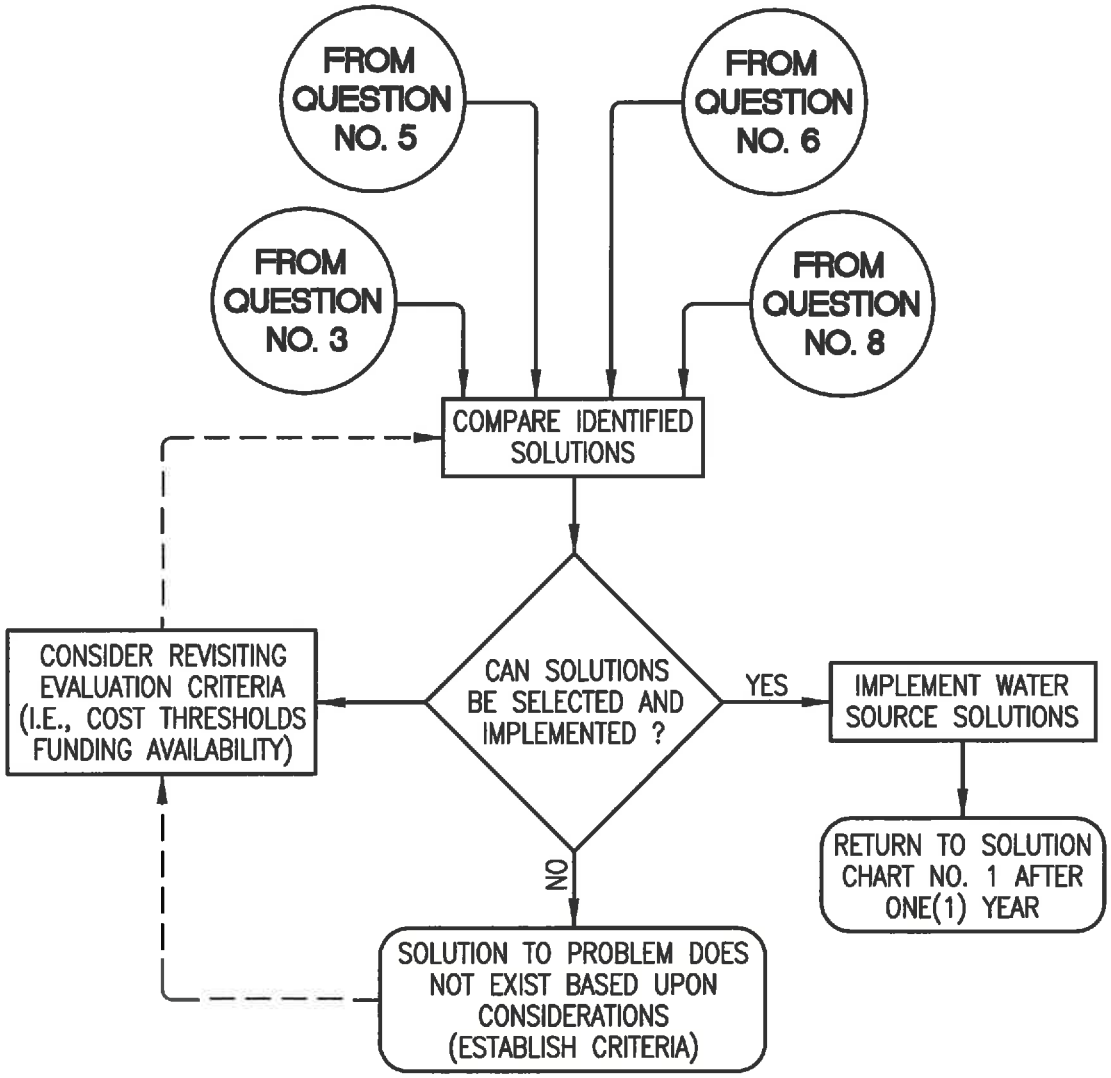
CONSIDERATION STEP NO. 7

SOLUTION SERIES NO. 2C - WATER QUALITY SOLUTIONS - INORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



QUESTION NO. 8

SOLUTION SERIES NO. 2C - WATER QUALITY SOLUTIONS - INORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



COMPARISON STEP NO. 9

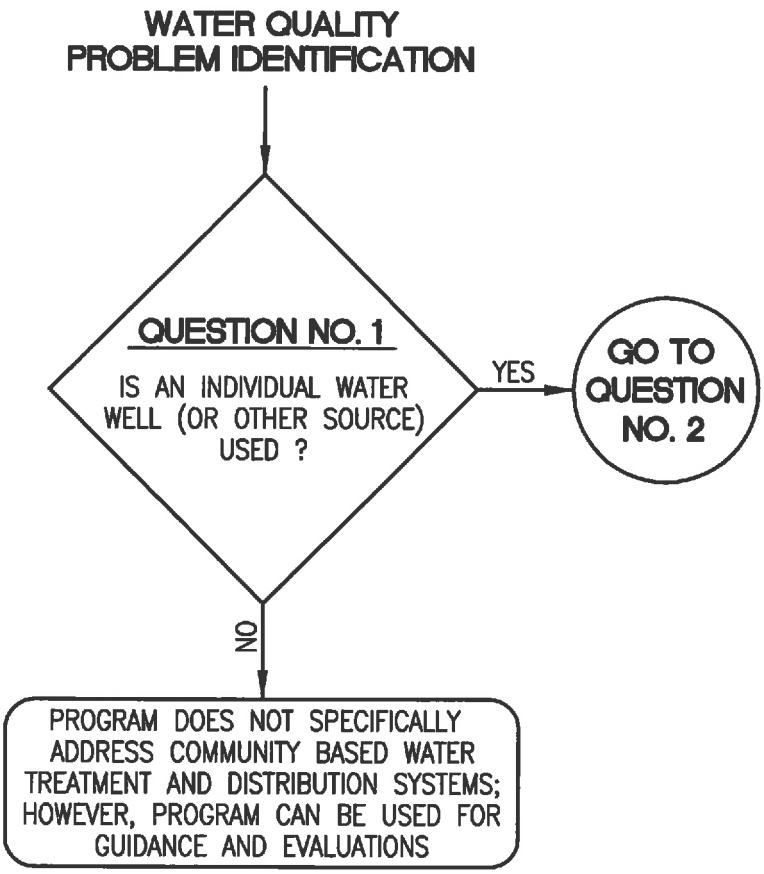
SOLUTION SERIES NO. 2C - WATER QUALITY SOLUTIONS - INORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

APPENDIX A – SOLUTION CHARTS

SOLUTION CHART SERIES 2D – ORGANICS

This series of solution charts is specifically prepared to address water quality problems associated with organic contaminants (e.g. DBCP).

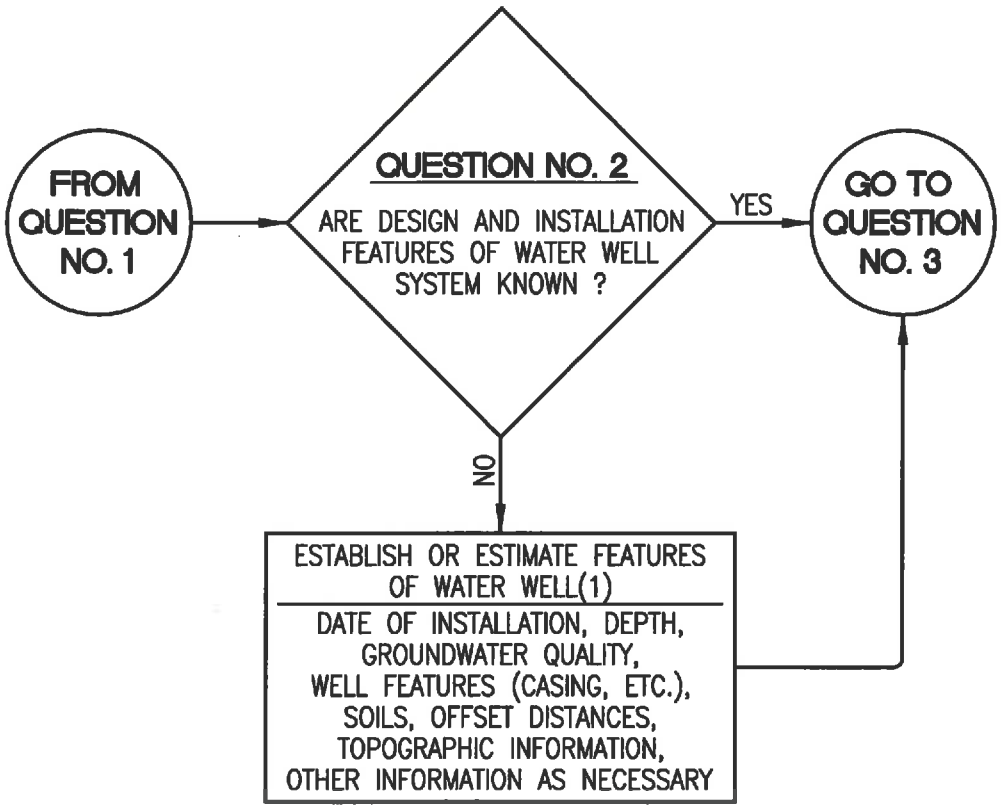
The solution sets referenced in the charts can be found in Appendix B – Solution Sets.



QUESTION NO. 1

SOLUTION CHART NO. 2D - WATER QUALITY SOLUTIONS - ORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\(1) ORGANICS- CHART 2D.Dwg

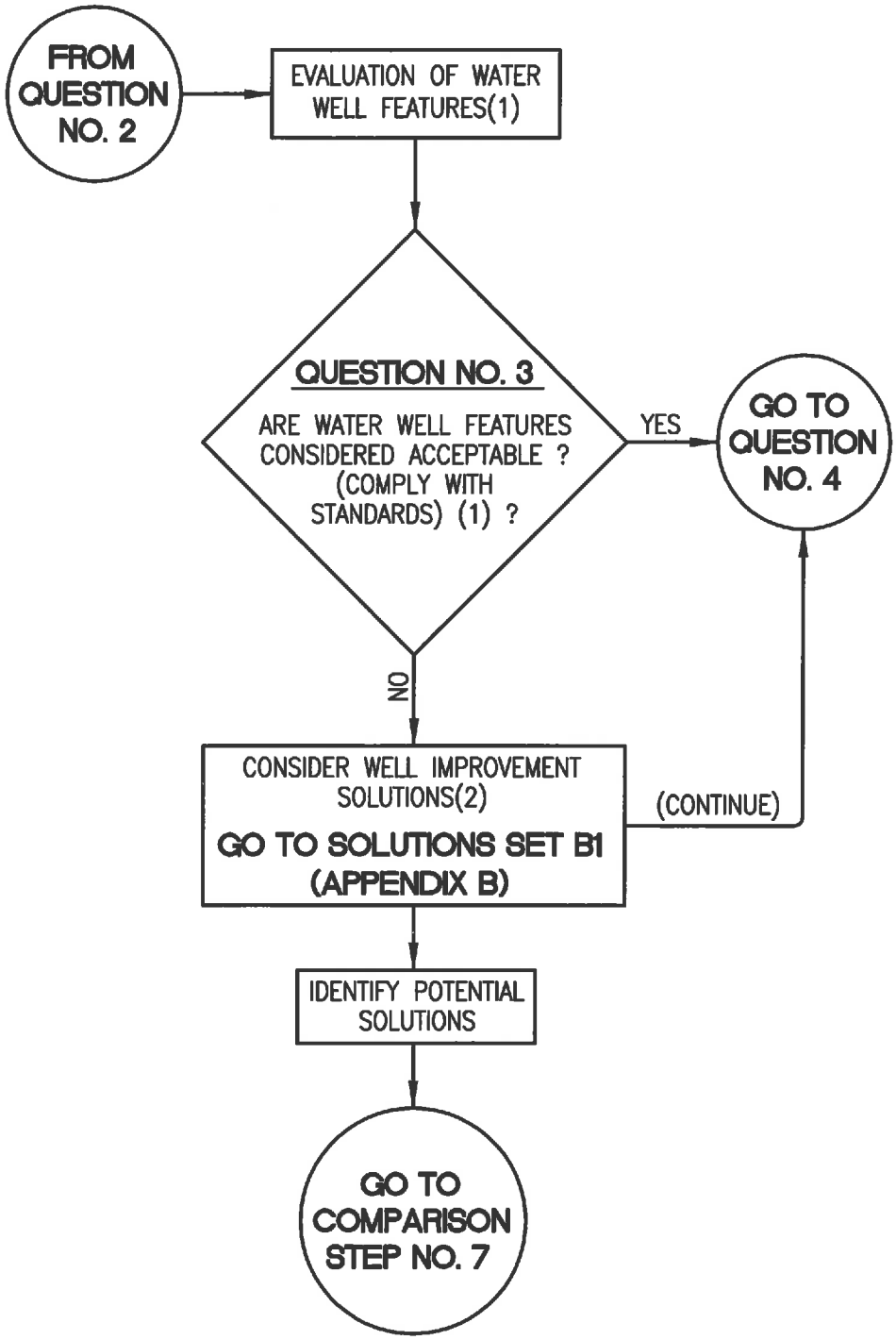


NOTE:
1. EVALUATION SHOULD BE CONDUCTED BY INDIVIDUAL WITH EXPERIENCE IN WATER WELL DESIGN AND INSTALLATION.

QUESTION NO. 2

SOLUTION CHART NO. 2D - WATER QUALITY SOLUTIONS - ORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\(2) ORGANICS-CHART 2D.Dwg



NOTES:

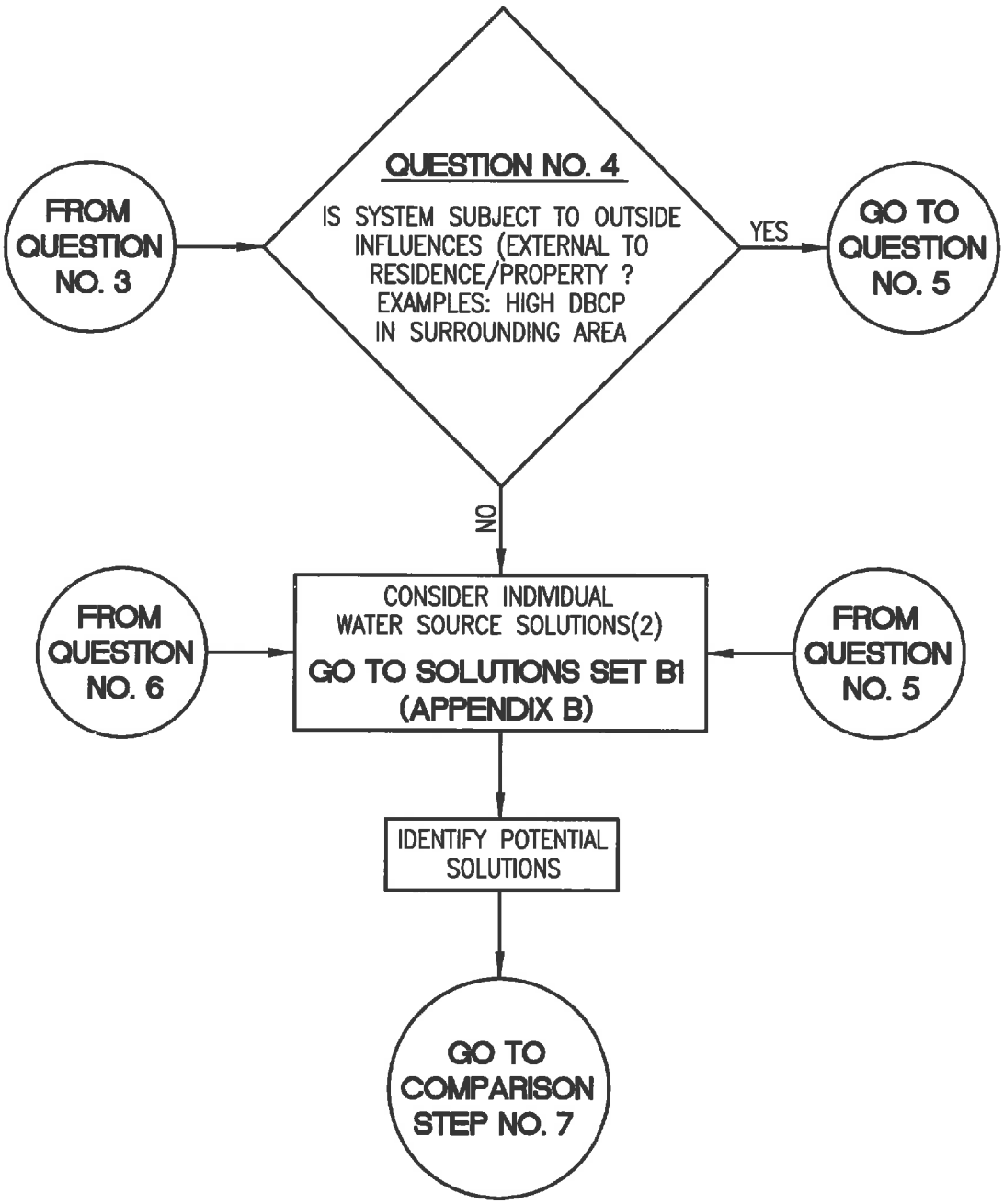
1. EVALUATION SHOULD BE CONDUCTED BY PROFESSIONAL WITH EXPERIENCE IN WATER WELL DESIGN, INSTALLATION AND REGULATORY REQUIREMENTS.

2. SOLUTIONS SHOULD BE EVALUATED AND ESTABLISHED BY PERSON(S) EXPERIENCED IN DRINKING WATER TREATMENT. EXAMPLES: DRINKING WATER TREATMENT CONSULTANTS, HEALTH DEPARTMENT REPRESENTATIVES AND WATER TREATMENT EQUIPMENT MANUFACTURERS.

QUESTION NO. 3

SOLUTION CHART NO. 2D - WATER QUALITY SOLUTIONS - ORGANICS
INDIVIDUAL HOUSEHOLD PILOT PROJECT
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

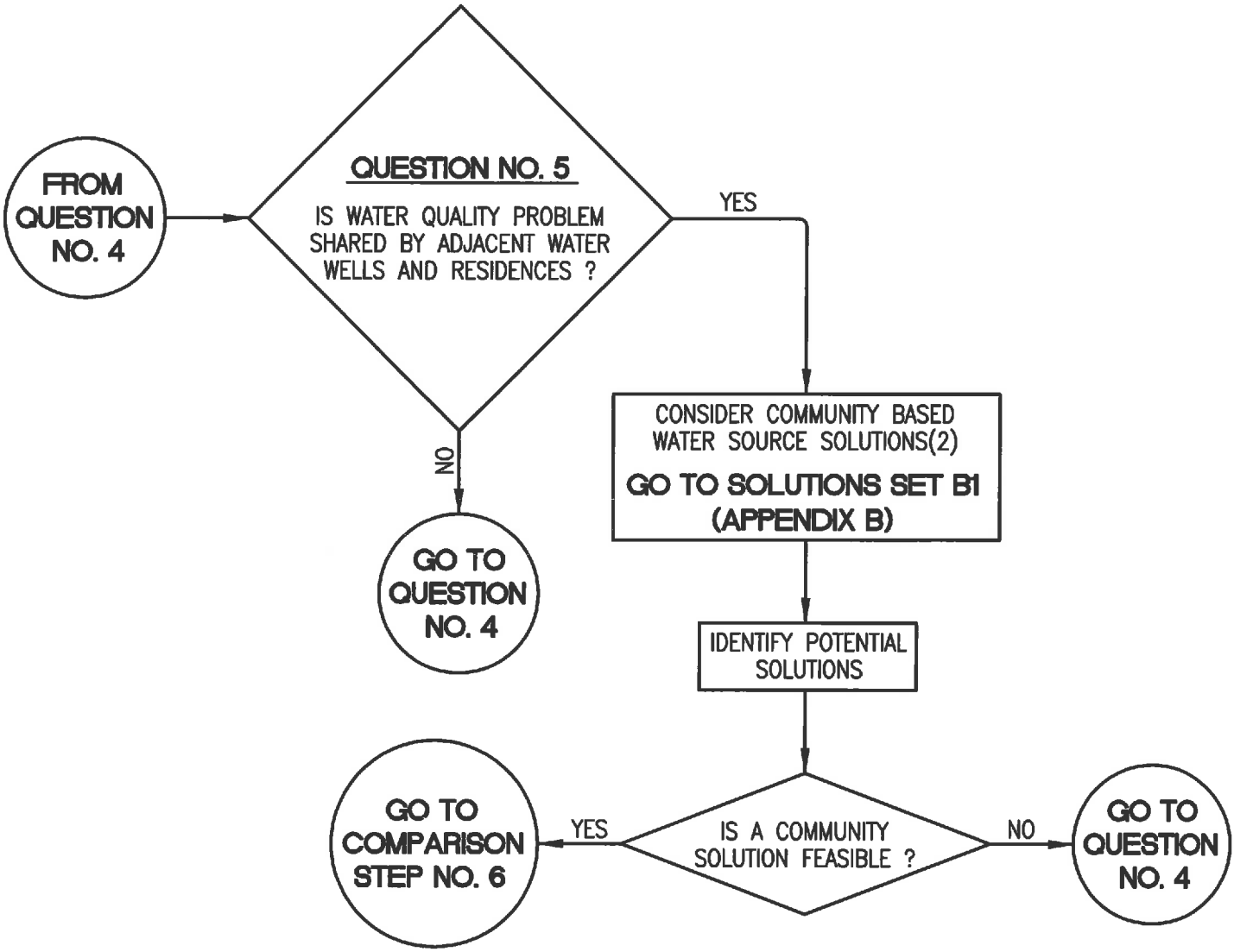
L:\TCDC\(3) ORGANICS-CHART 2D.Dwg



QUESTION NO. 4

SOLUTION CHART NO. 2D - WATER QUALITY SOLUTIONS - ORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

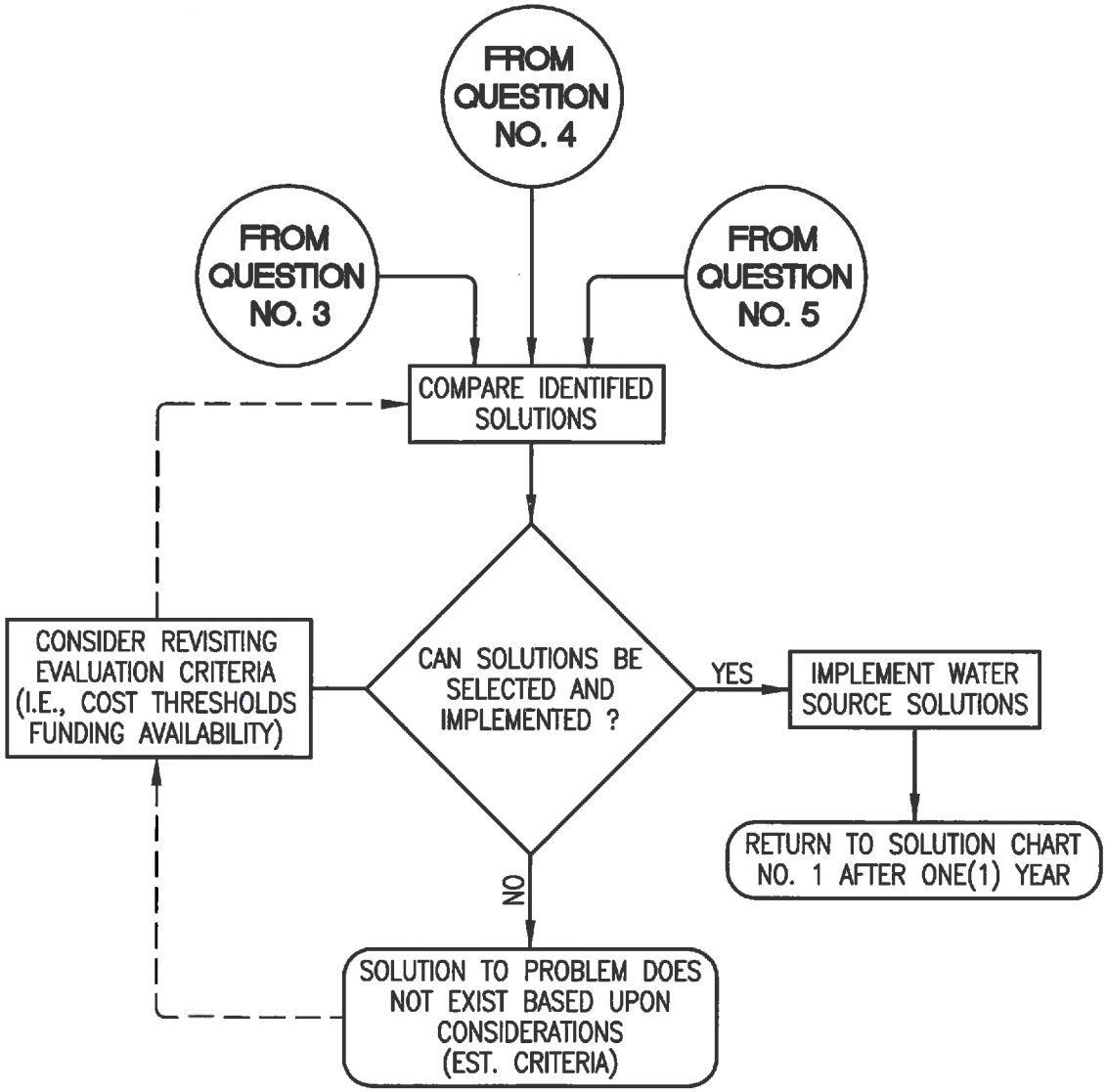
L:\TCDC\(4) ORGANICS-CHART 2D.Dwg



QUESTION NO. 5

SOLUTION CHART NO. 2D - WATER QUALITY SOLUTIONS - ORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\(5) ORGANICS-CHART 2D.Dwg



COMPARISON STEP NO. 6

SOLUTION CHART NO. 2D - WATER QUALITY SOLUTIONS - ORGANICS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

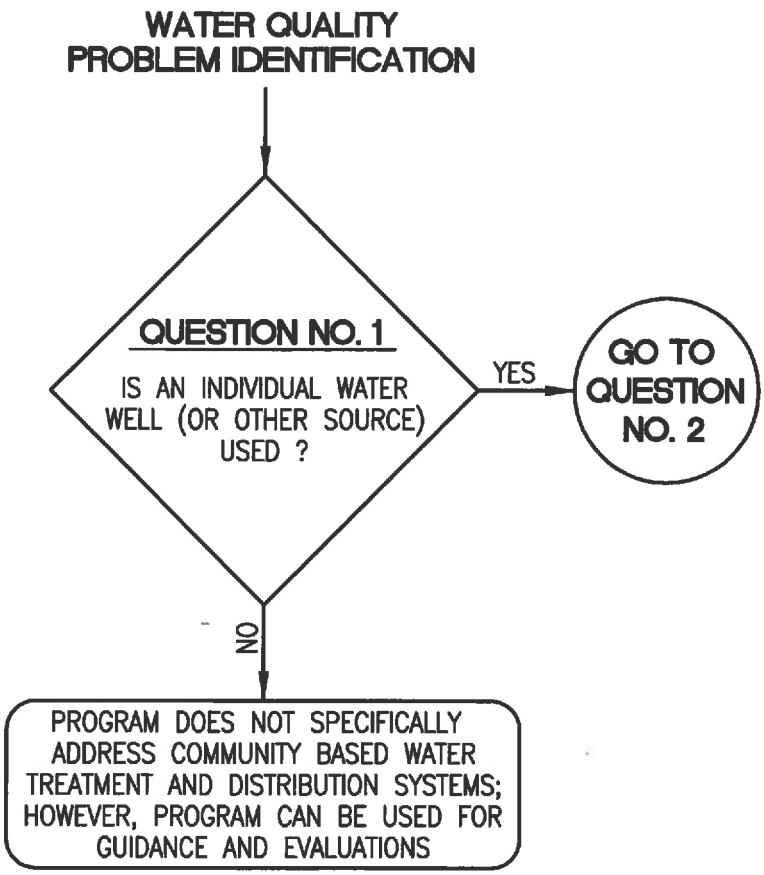
L:\TCDC\(6) ORGANICS-CHART 2D.Dwg

APPENDIX A – SOLUTION CHARTS

SOLUTION CHART SERIES 2E – GENERAL WATER QUALITY

This series of solution charts is specifically prepared to address water quality problems associated with other general water quality constituents (e.g. total dissolved solids).

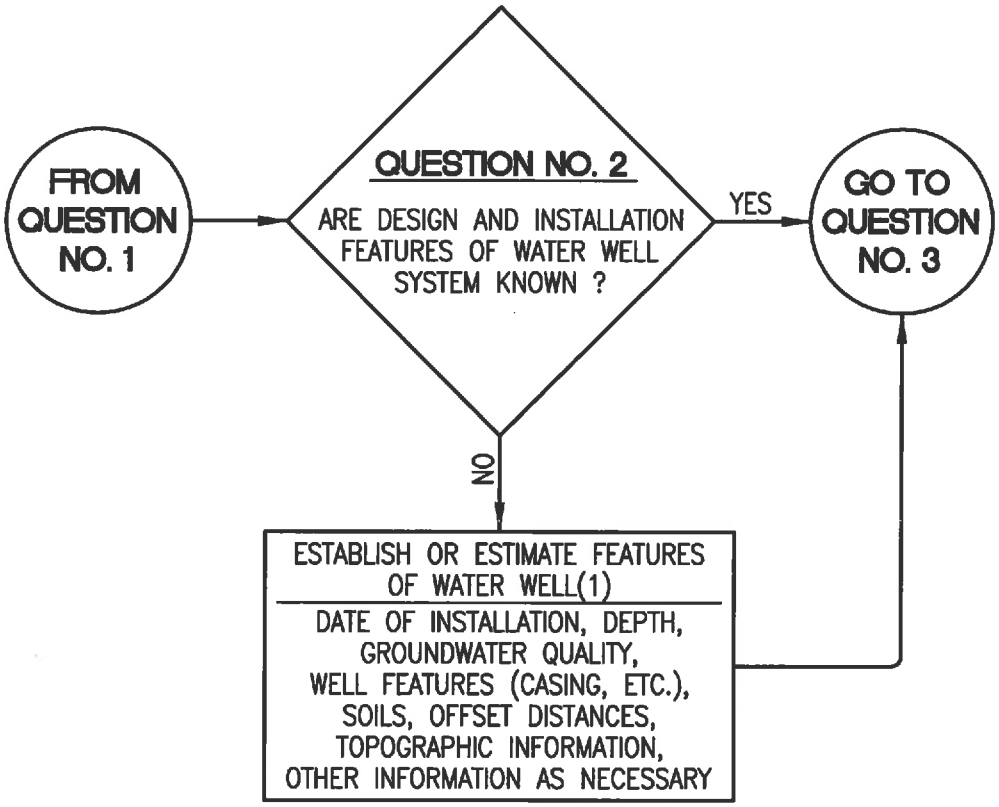
The solution sets referenced in the charts can be found in Appendix B – Solution Sets.



QUESTION NO. 1

SOLUTION CHART NO. 2E - WATER QUALITY SOLUTIONS - GENERAL WATER QUALITY
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

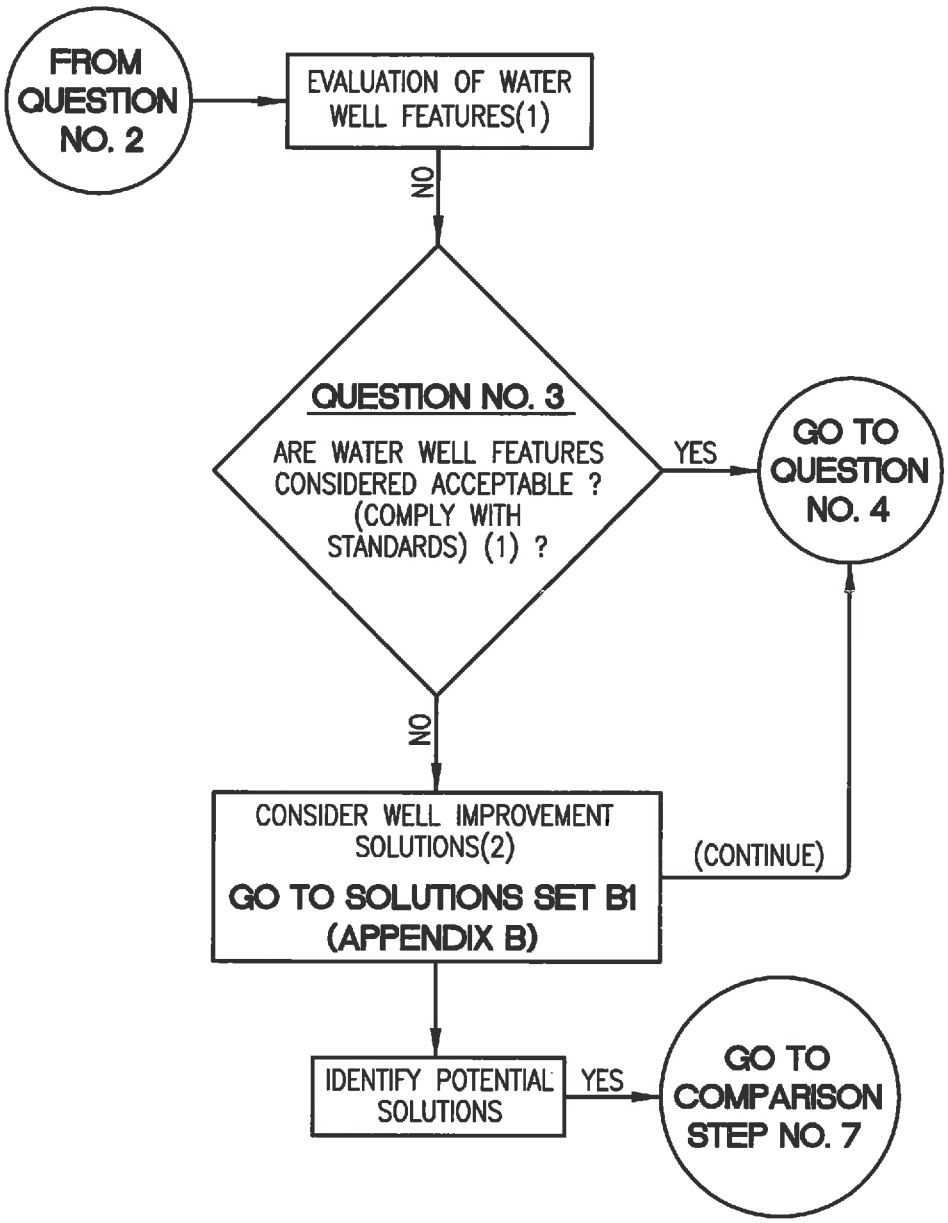
L:\TODO\(1) GENERAL WATER QUALITY- CHART 2E.Dwg



NOTE:
1. EVALUATION SHOULD BE CONDUCTED BY INDIVIDUAL WITH EXPERIENCE IN WATER WELL DESIGN AND INSTALLATION.

QUESTION NO. 2

SOLUTION CHART NO. 2E - WATER QUALITY SOLUTIONS - GENERAL WATER QUALITY
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



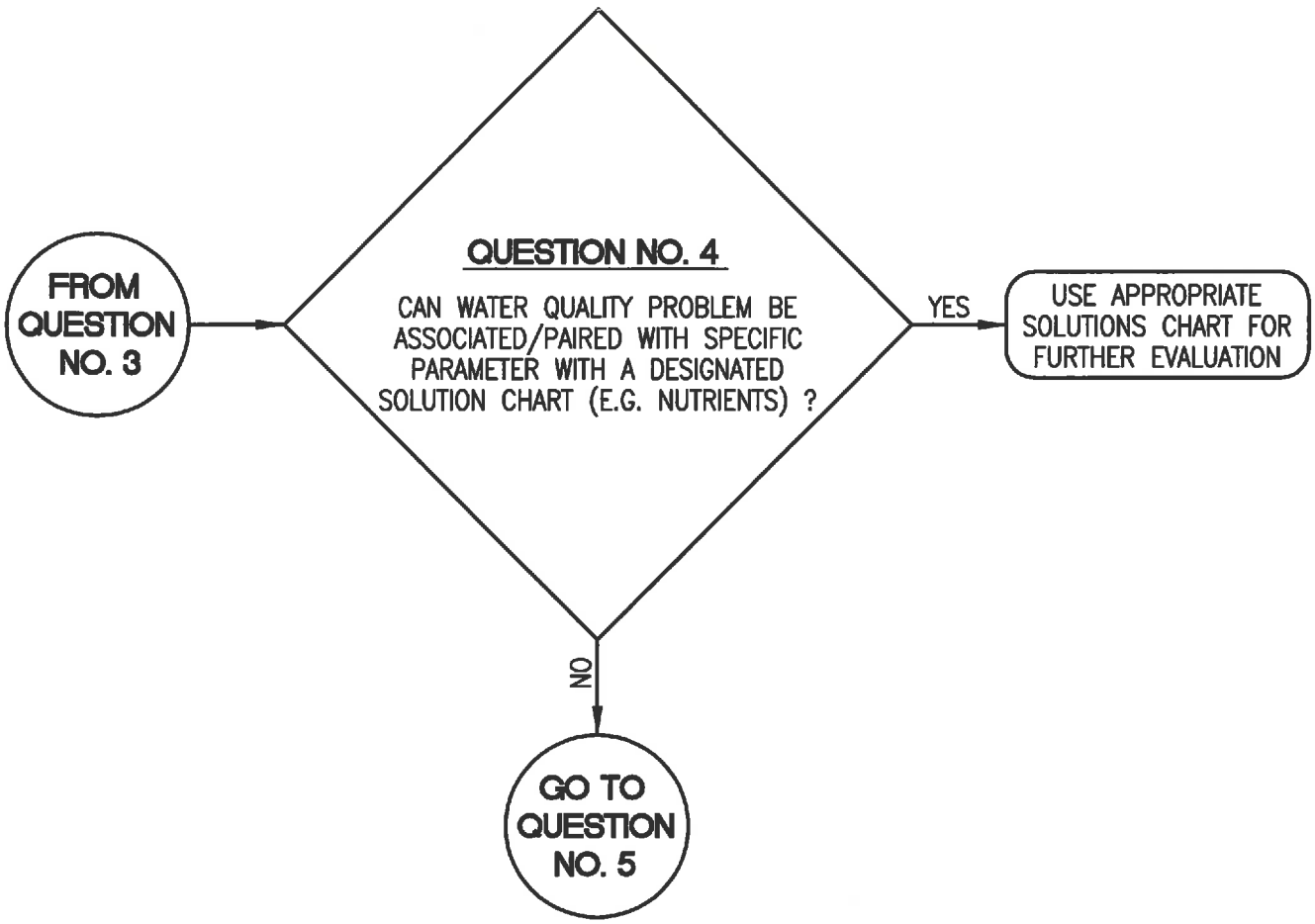
NOTES:

1. EVALUATION SHOULD BE CONDUCTED BY PROFESSIONAL WITH EXPERIENCE IN WATER WELL DESIGN, INSTALLATION AND REGULATORY REQUIREMENTS.

2. SOLUTIONS SHOULD BE EVALUATED AND ESTABLISHED BY PERSON(S) EXPERIENCED IN DRINKING WATER TREATMENT. EXAMPLES: DRINKING WATER TREATMENT CONSULTANTS, HEALTH DEPARTMENT REPRESENTATIVES AND WATER TREATMENT EQUIPMENT MANUFACTURERS.

QUESTION NO. 3

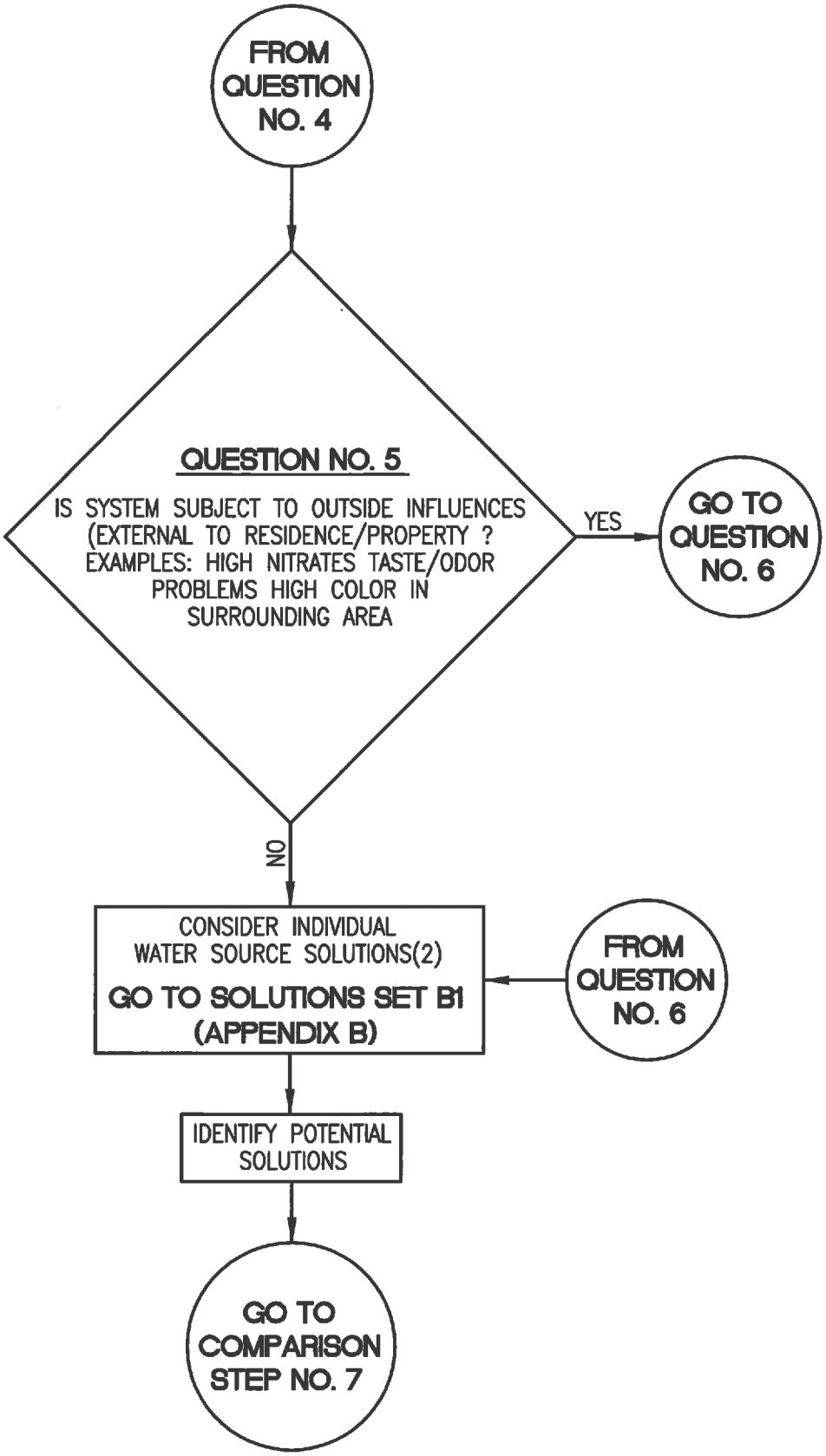
SOLUTION CHART NO. 2E - WATER QUALITY SOLUTIONS - GENERAL WATER QUALITY
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



QUESTION NO. 4

SOLUTION CHART NO. 2E - WATER QUALITY SOLUTIONS - GENERAL WATER QUALITY
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

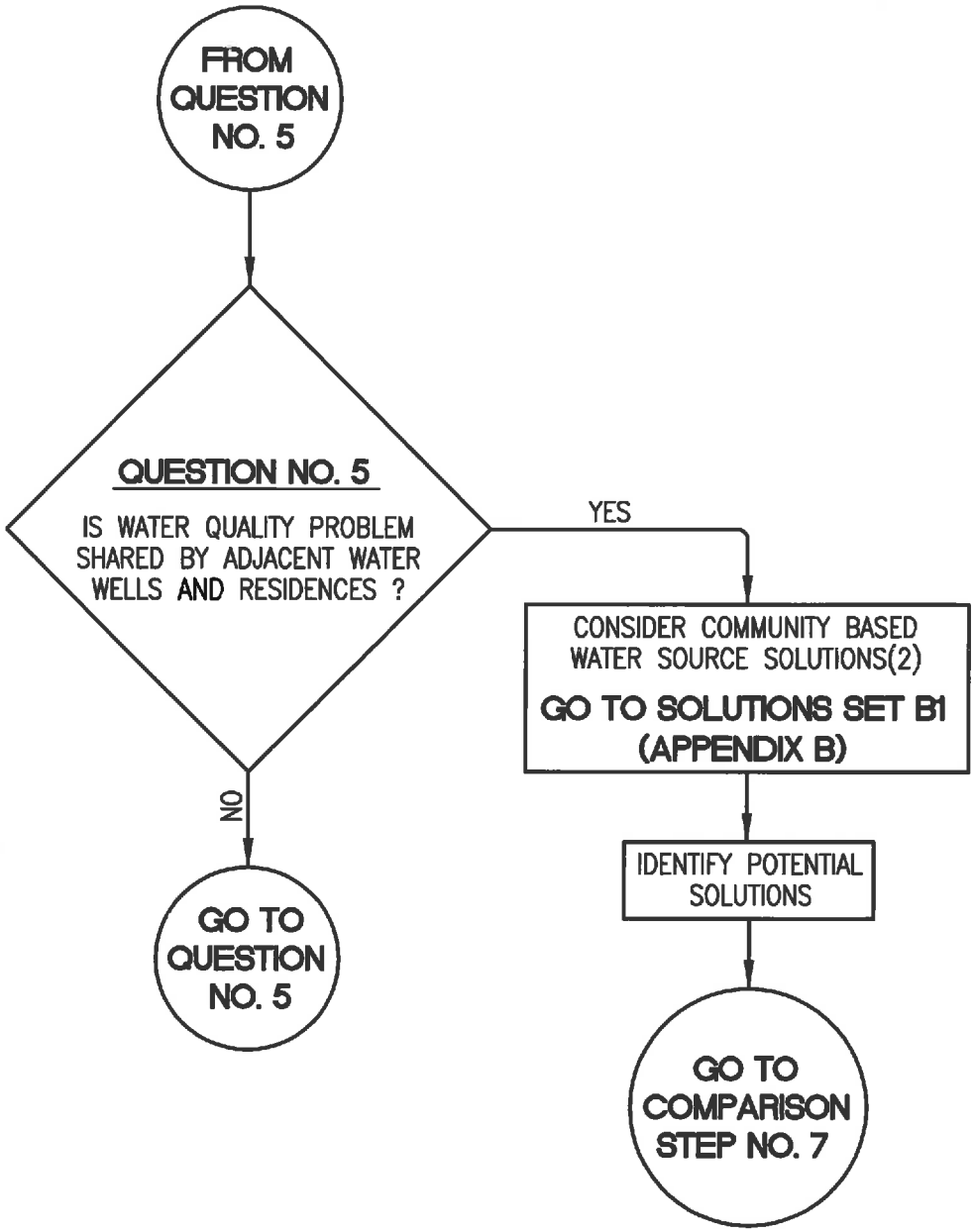
L:\TCDC\(4) GENERAL WATER QUALITY-CHART 2E.Dwg



QUESTION NO. 5

SOLUTION CHART NO. 2E - WATER QUALITY SOLUTIONS - GENERAL WATER QUALITY
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

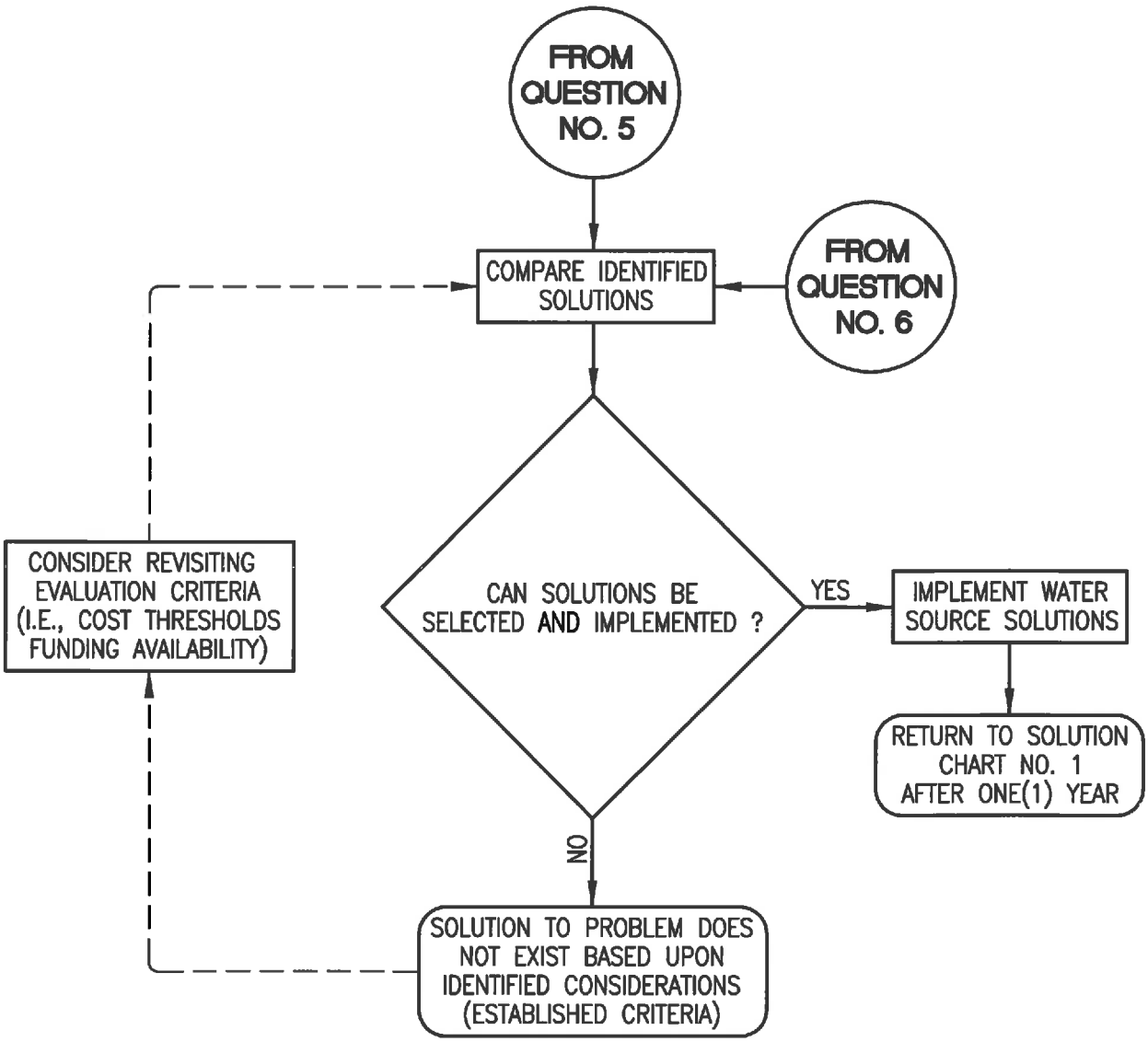
L:\TCDC\(5) GENERAL WATER QUALITY-CHART 2E.Dwg



QUESTION NO. 6

SOLUTION CHART NO. 2E - WATER QUALITY SOLUTIONS - GENERAL WATER QUALITY
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\(6) GENERAL WATER QUALITY-CHART 2E.Dwg



COMPARISON STEP NO. 7

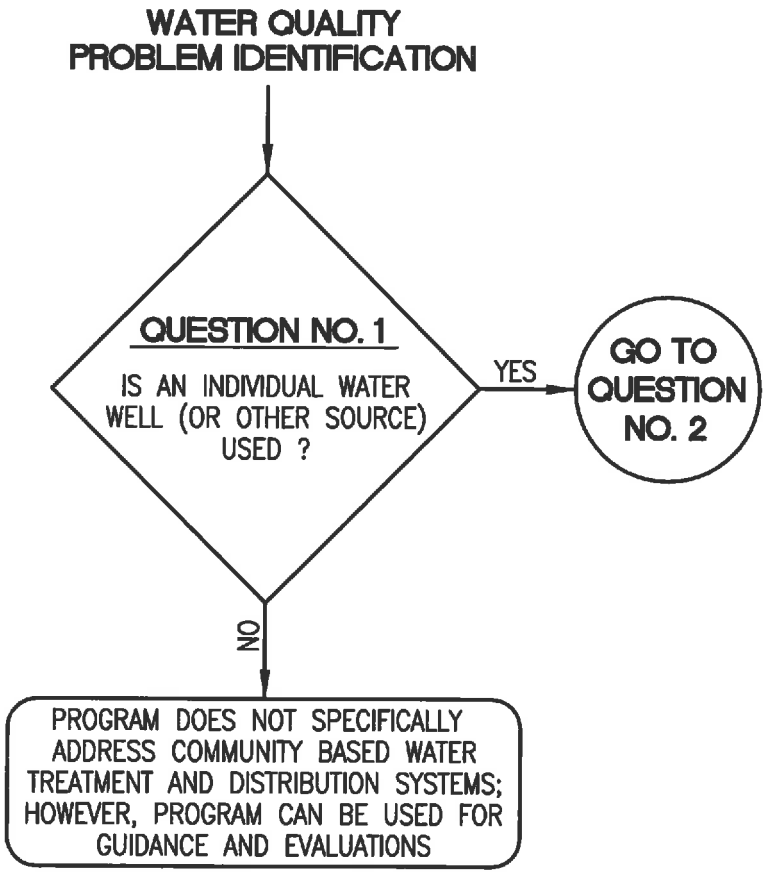
SOLUTION CHART NO. 2E - WATER QUALITY SOLUTIONS - GENERAL WATER QUALITY
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

APPENDIX A – SOLUTION CHARTS

SOLUTION CHART SERIES 3 – WATER SUPPLY AND DELIVERY

This series of solution charts is specifically prepared to address problems associated with water supply and delivery conditions.

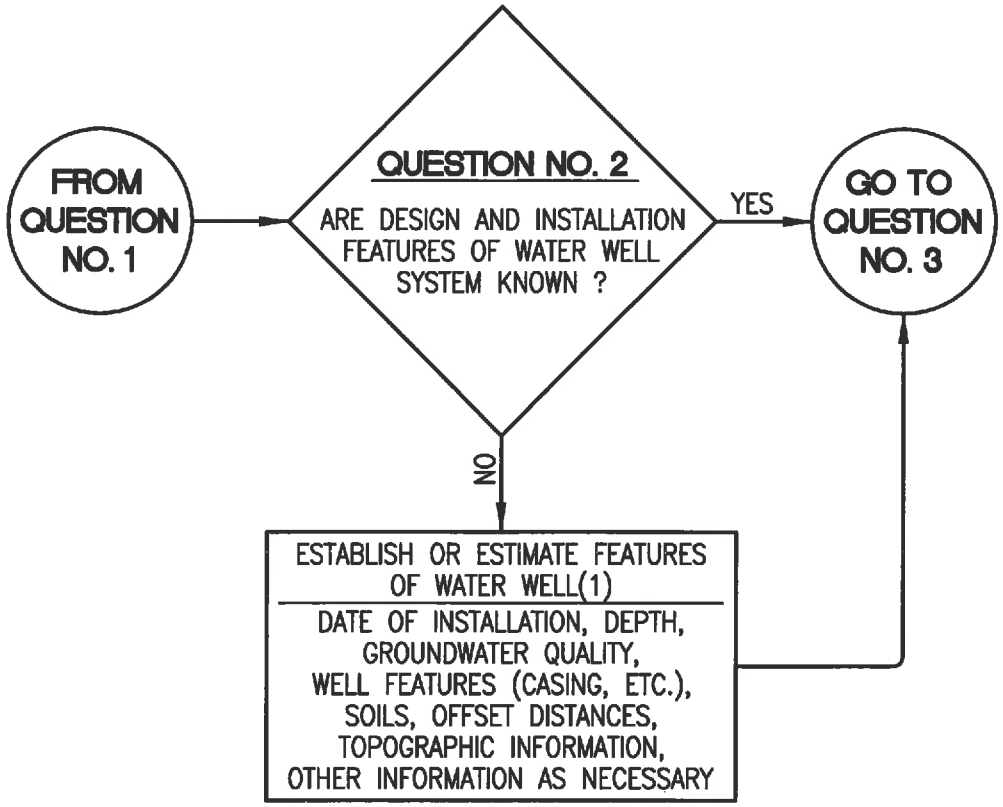
The solution sets referenced in the charts can be found in Appendix B – Solution Sets.



QUESTION NO. 1

SOLUTION CHART NO. 3 - WATER SUPPLY SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

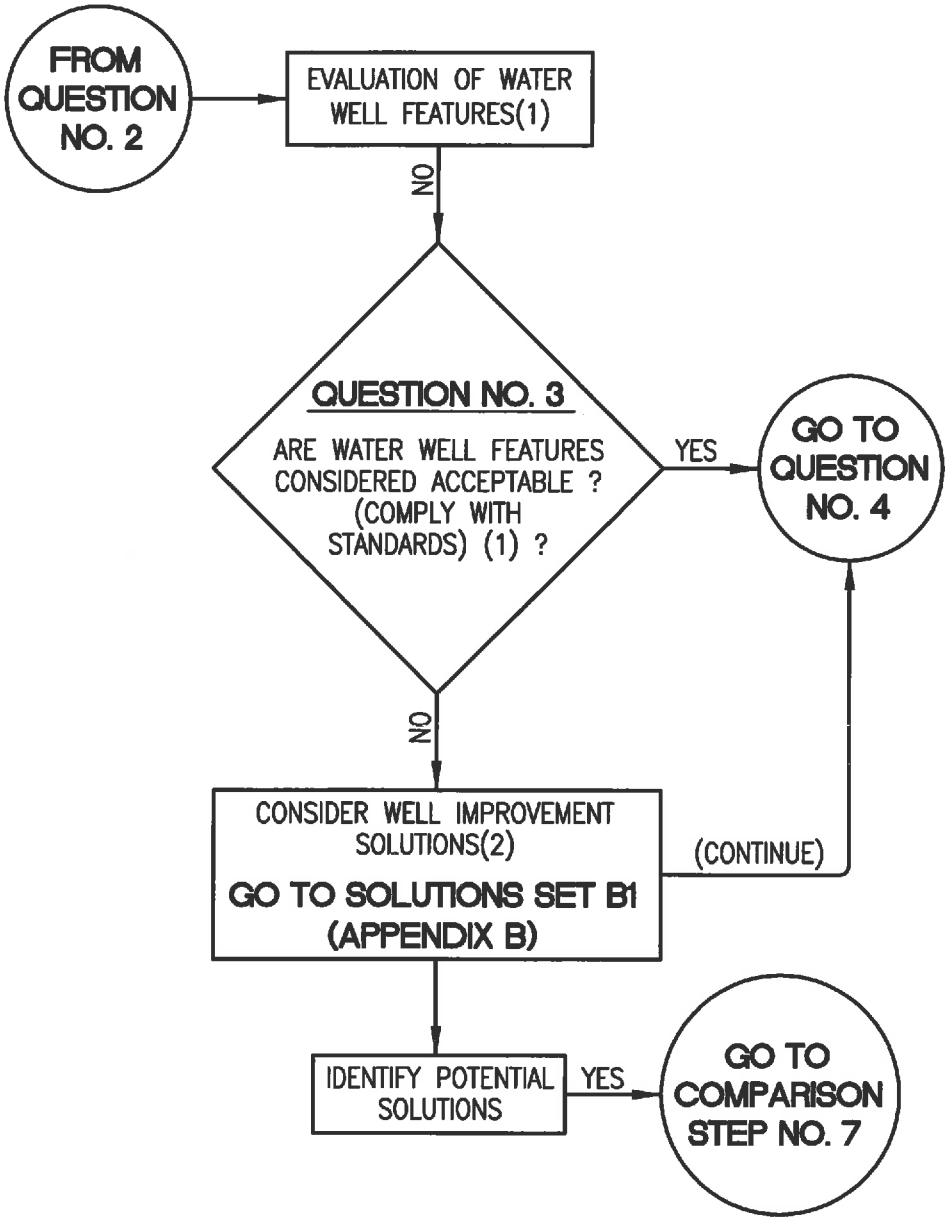
L:\TCDC\(1) WATER SUPPLY SOLUTIONS- CHART 3.Dwg



NOTE:
1. EVALUATION SHOULD BE CONDUCTED BY INDIVIDUAL WITH EXPERIENCE IN WATER WELL DESIGN AND INSTALLATION.

QUESTION NO. 2

SOLUTION CHART NO. 3 - WATER SUPPLY SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



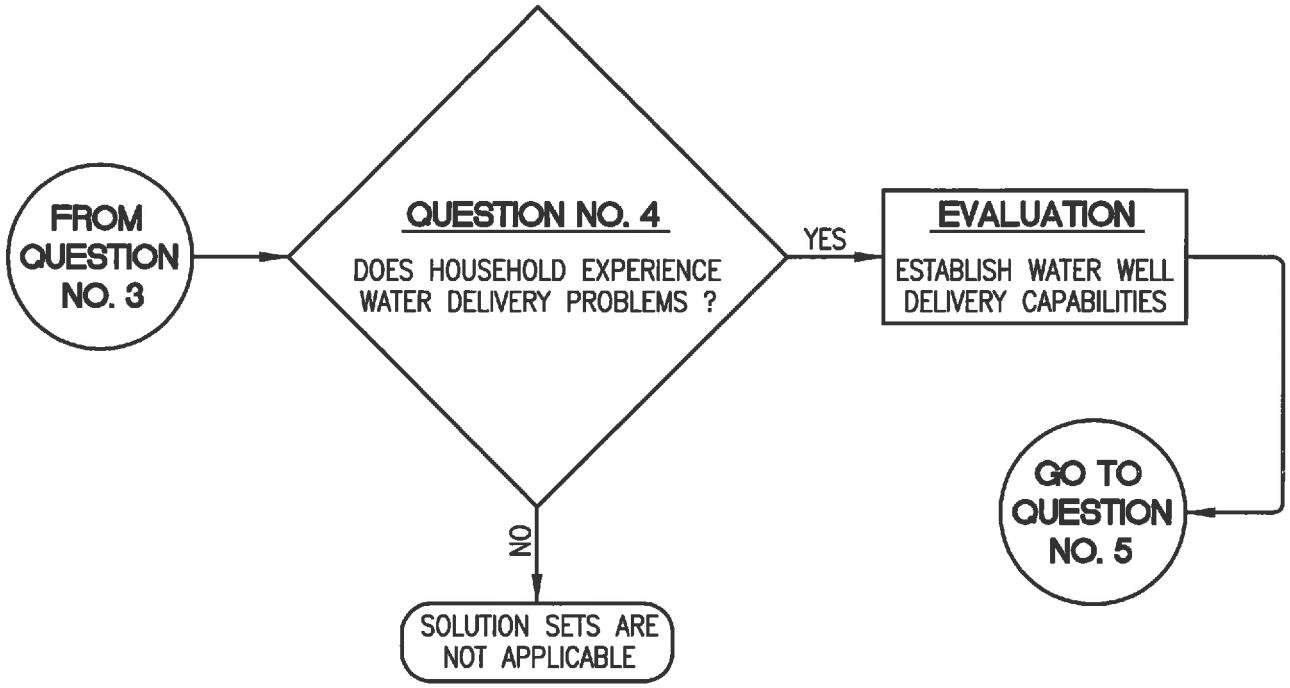
NOTES:

1. EVALUATION SHOULD BE CONDUCTED BY PROFESSIONAL WITH EXPERIENCE IN WATER WELL DESIGN, INSTALLATION AND REGULATORY REQUIREMENTS.

2. SOLUTIONS SHOULD BE EVALUATED AND ESTABLISHED BY PERSON(S) EXPERIENCED IN DRINKING WATER TREATMENT. EXAMPLES: DRINKING WATER TREATMENT CONSULTANTS, HEALTH DEPARTMENT REPRESENTATIVES AND WATER TREATMENT EQUIPMENT MANUFACTURERS.

QUESTION NO. 3

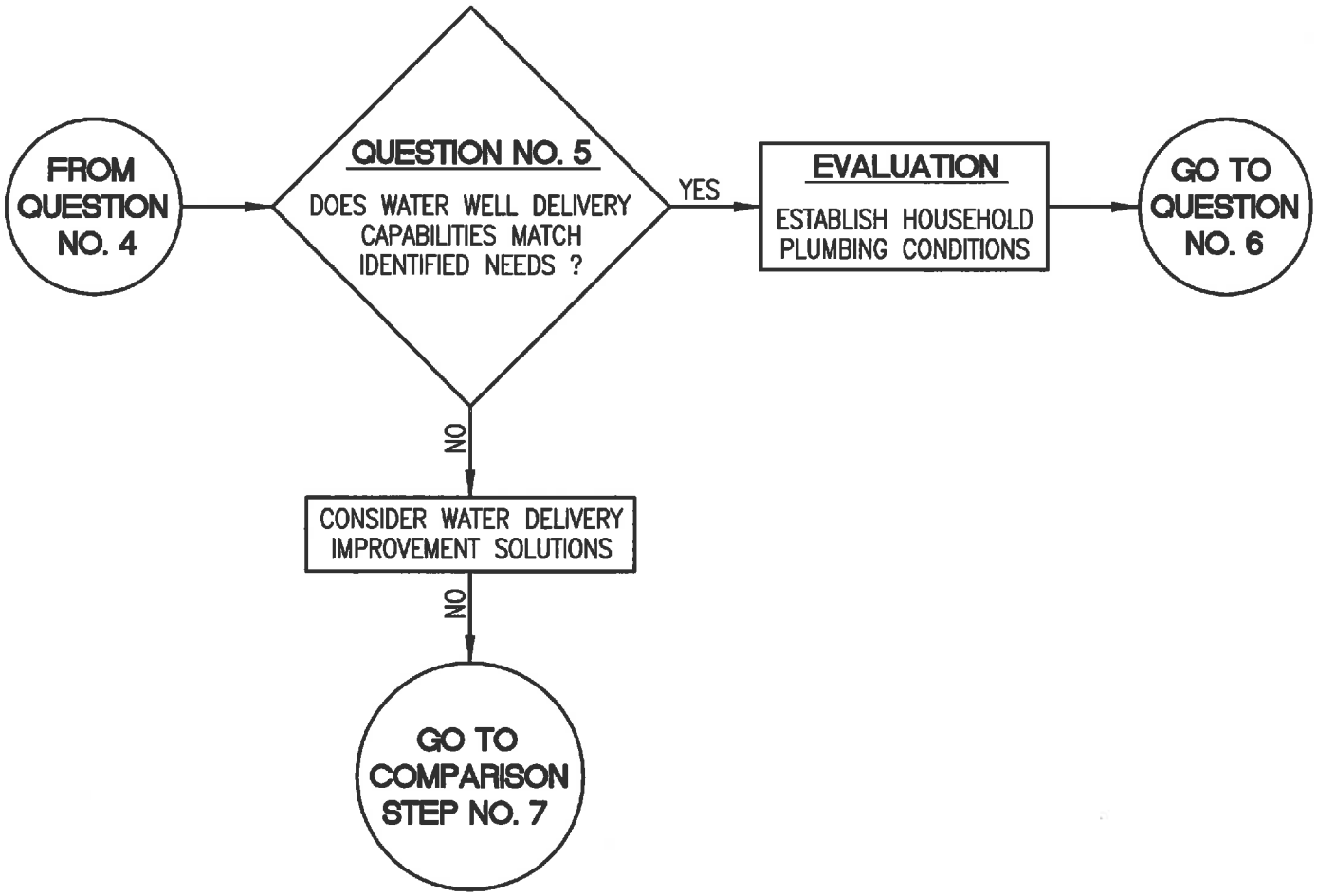
SOLUTION CHART NO. 3 - WATER SUPPLY SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



QUESTION NO. 4

SOLUTION CHART NO. 3 - WATER SUPPLY SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

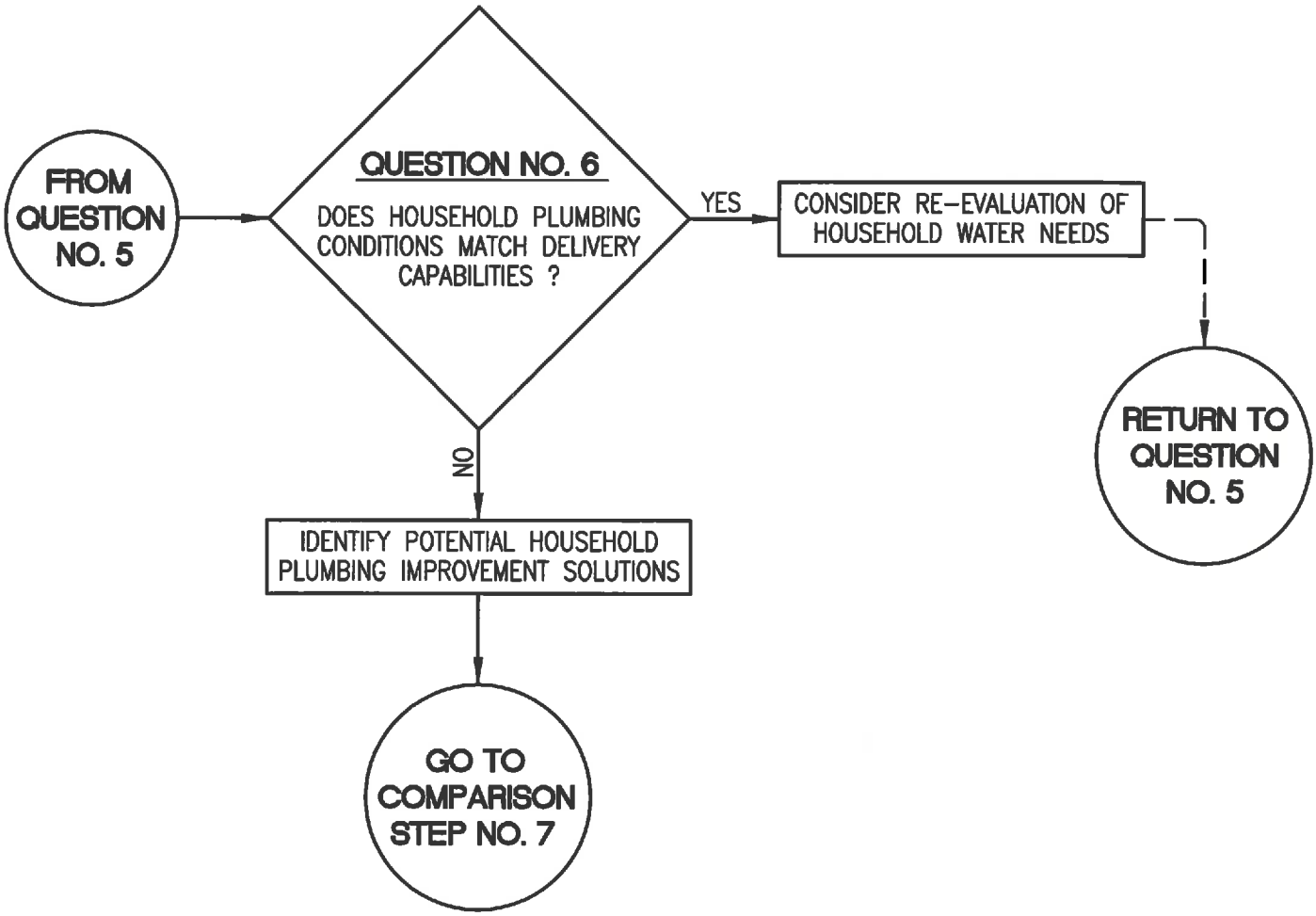
L:\TCDC\(4) WATER SUPPLY SOLUTIONS-CHART 3.Dwg



QUESTION NO. 5

SOLUTION CHART NO. 3 - WATER SUPPLY SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

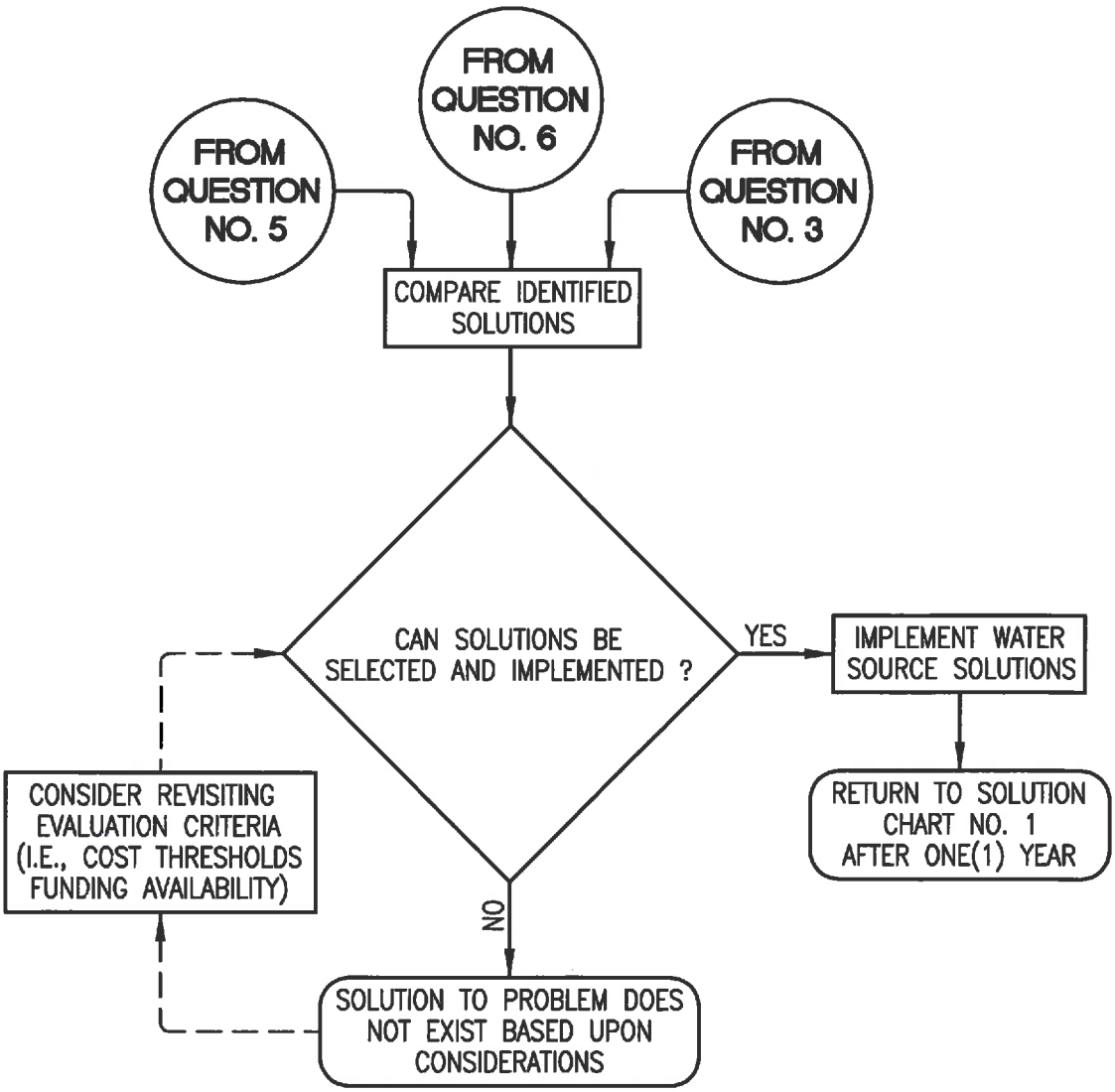
L:\TCDC\(5) WATER SUPPLY SOLUTIONS-CHART 3.Dwg



QUESTION NO. 6

SOLUTION CHART NO. 3 - WATER SUPPLY SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\(6) WATER SUPPLY SOLUTIONS-CHART 3.Dwg



COMPARISON STEP NO. 7

SOLUTION CHART NO. 3 - WATER SUPPLY SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

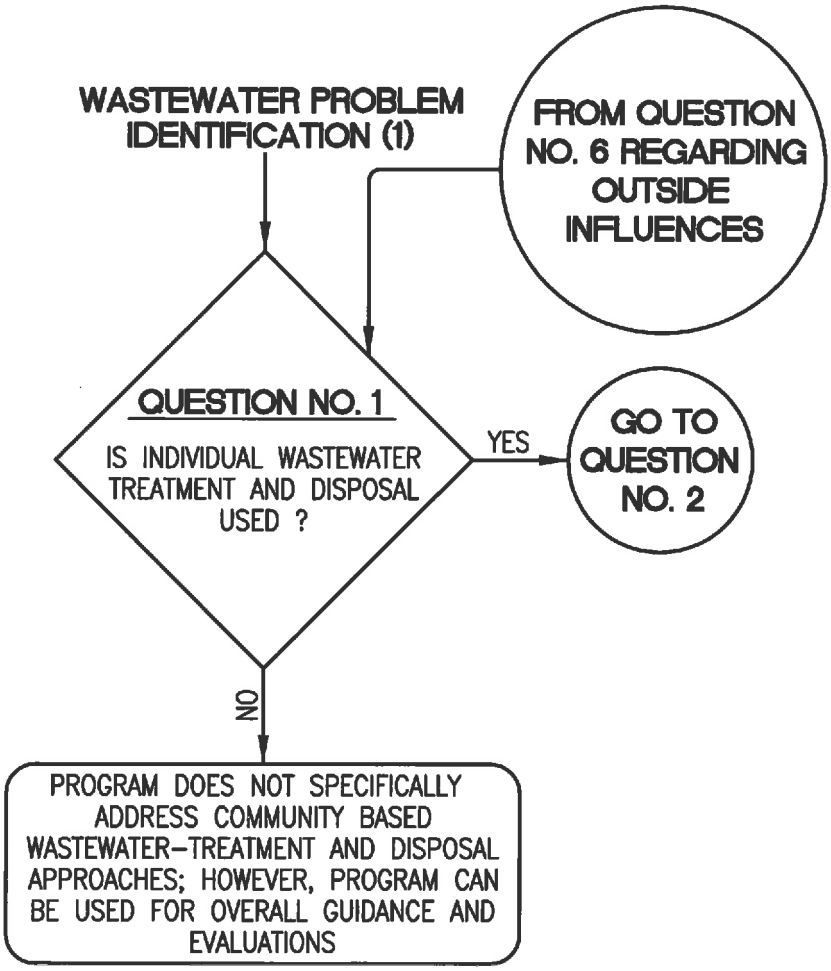
L:\TCDC\(7) WATER SUPPLY SOLUTIONS-CHART 3.Dwg

APPENDIX A – SOLUTION CHARTS

SOLUTION CHART SERIES 4 – WASTEWATER TREATMENT AND DISPOSAL

This series of solution charts is specifically prepared to address problems associated with individual, onsite wastewater treatment and disposal systems.

The solution sets referenced in the charts can be found in Appendix B – Solution Sets.

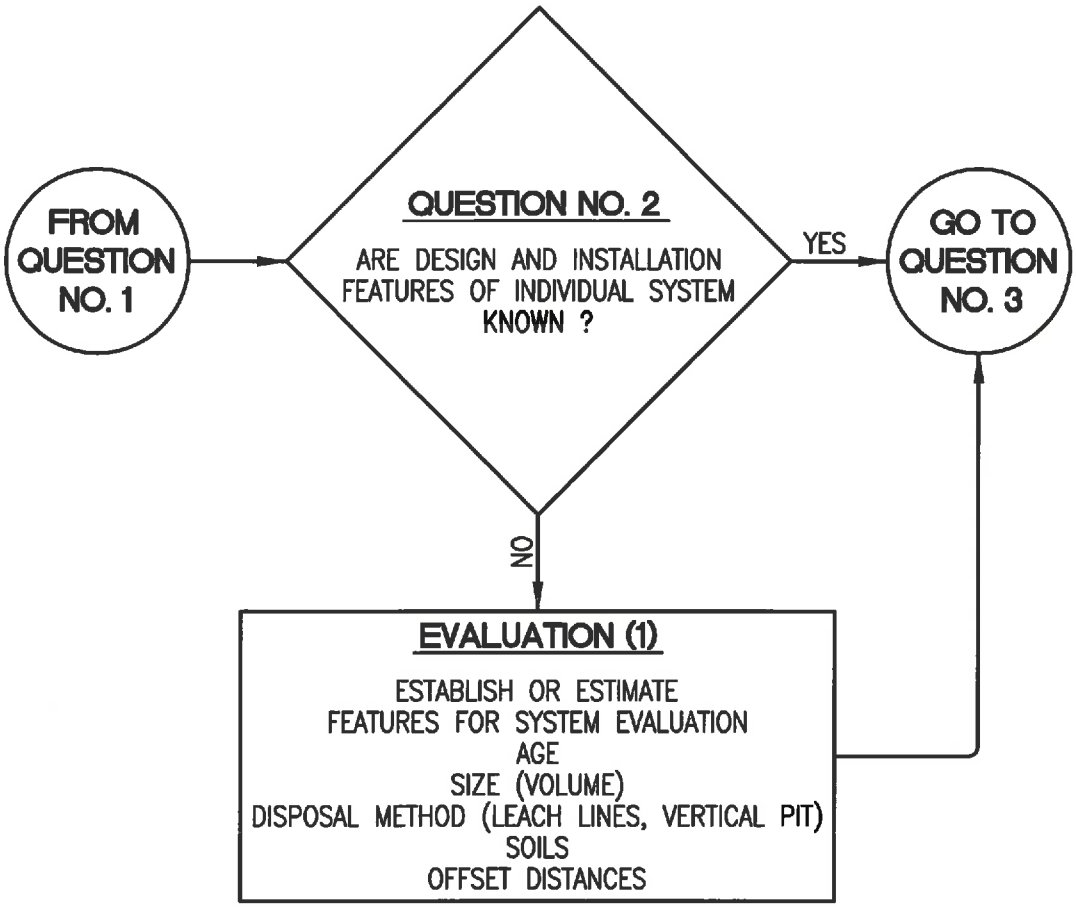


NOTE:
1. THIS SOLUTION CHART ADDRESSES DEFICIENCIES IN INDIVIDUAL WASTEWATER SYSTEMS.

QUESTION NO. 1

SOLUTION CHART NO. 4 - WASTEWATER SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\(1) WASTEWATER SOLUTIONS- CHART 4.Dwg

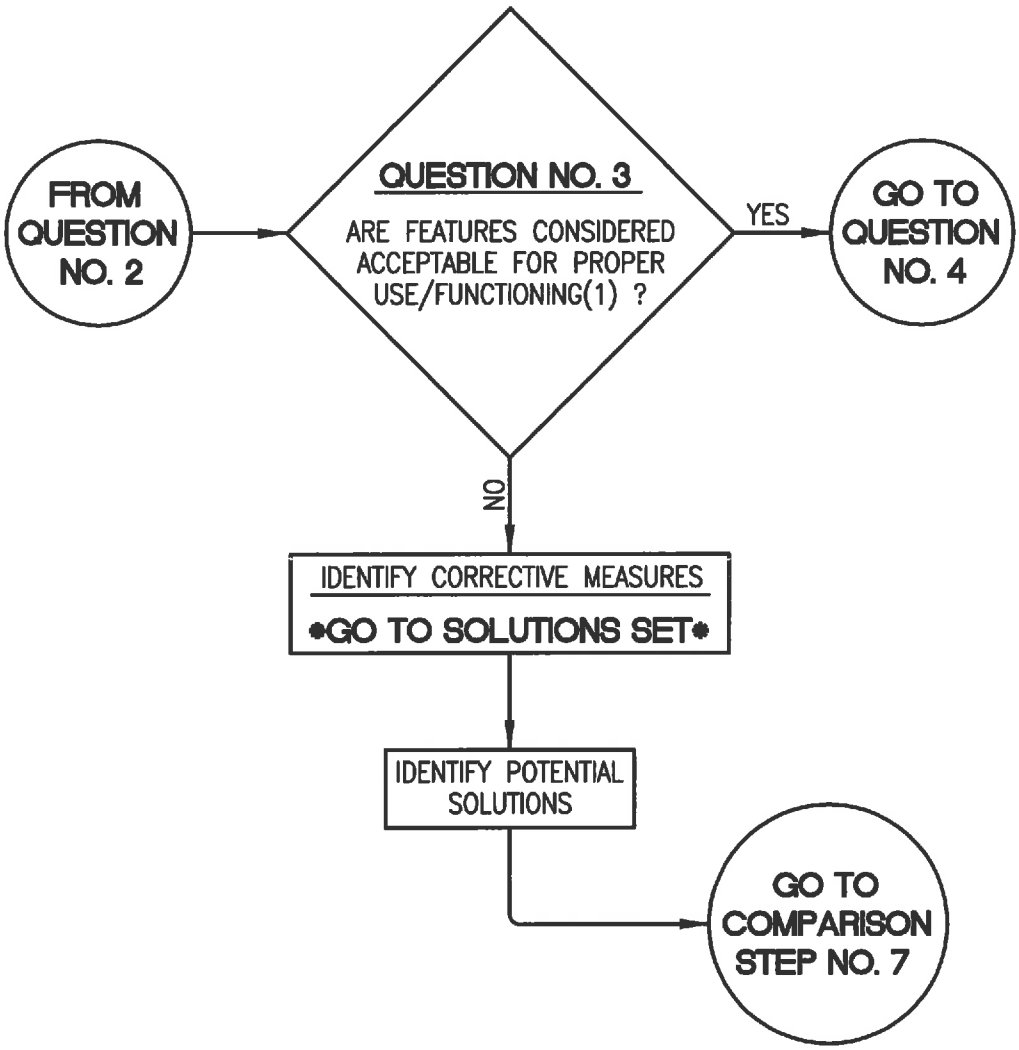


NOTE:
1. EVALUATION SHOULD BE CONDUCTED BY PROFESSIONAL WITH EXPERIENCE IN ON-SITE WASTEWATER TREATMENT AND DISPOSAL SYSTEM DESIGN AND INSTALLATION.

QUESTION NO. 2

SOLUTION CHART NO. 4 - WASTEWATER SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\(2) WASTEWATER SOLUTIONS-CHART 4.Dwg

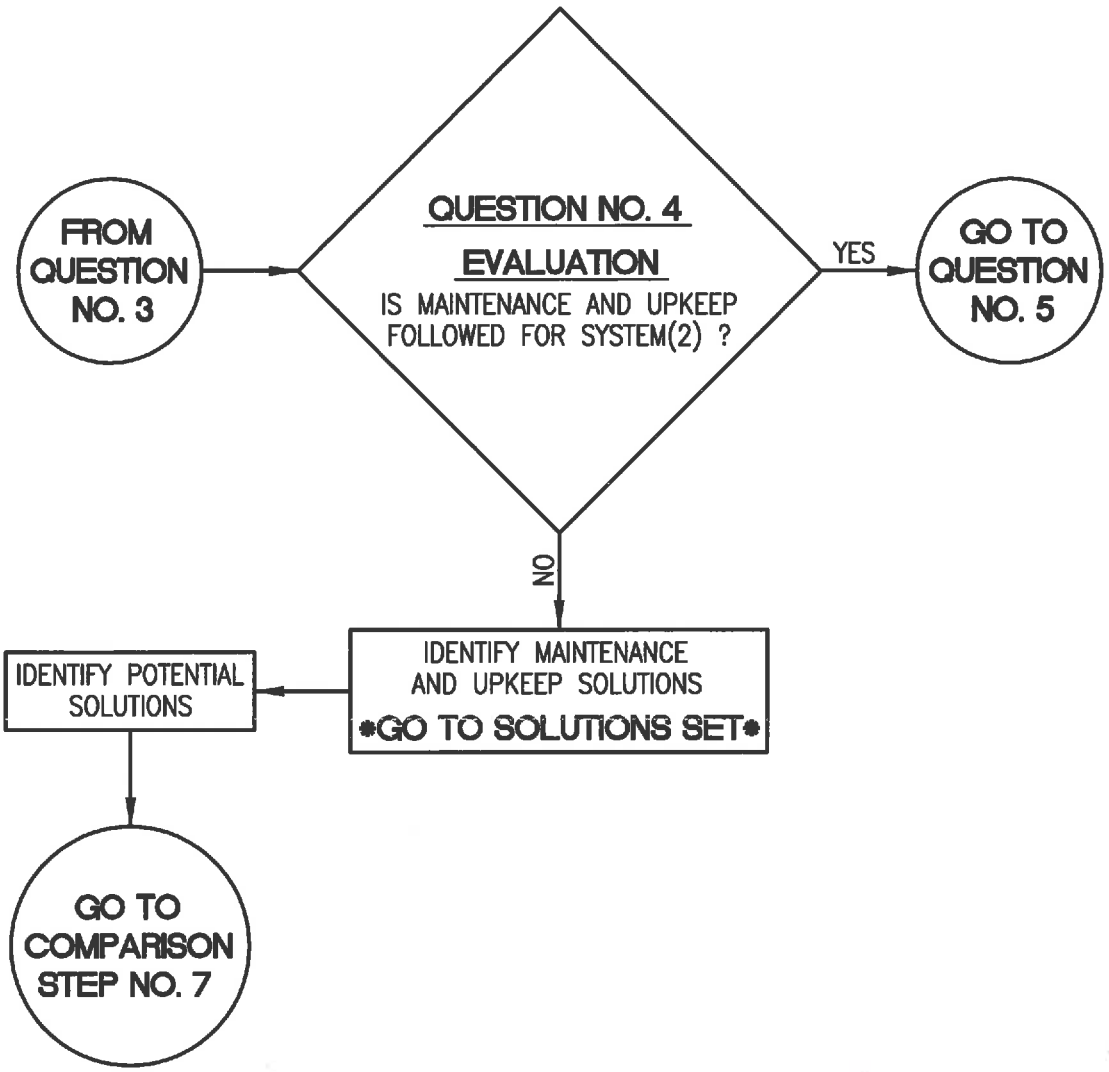


NOTE:
1. INDIVIDUAL SYSTEM EVALUATIONS SHOULD BE CONDUCTED BY PROFESSIONAL WITH EXPERIENCE IN ON-SITE WASTEWATER TREATMENT AND DISPOSAL SYSTEM DESIGN AND INSTALLATION.

QUESTION NO. 3

SOLUTION CHART NO. 4 - WASTEWATER SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT PROJECT
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

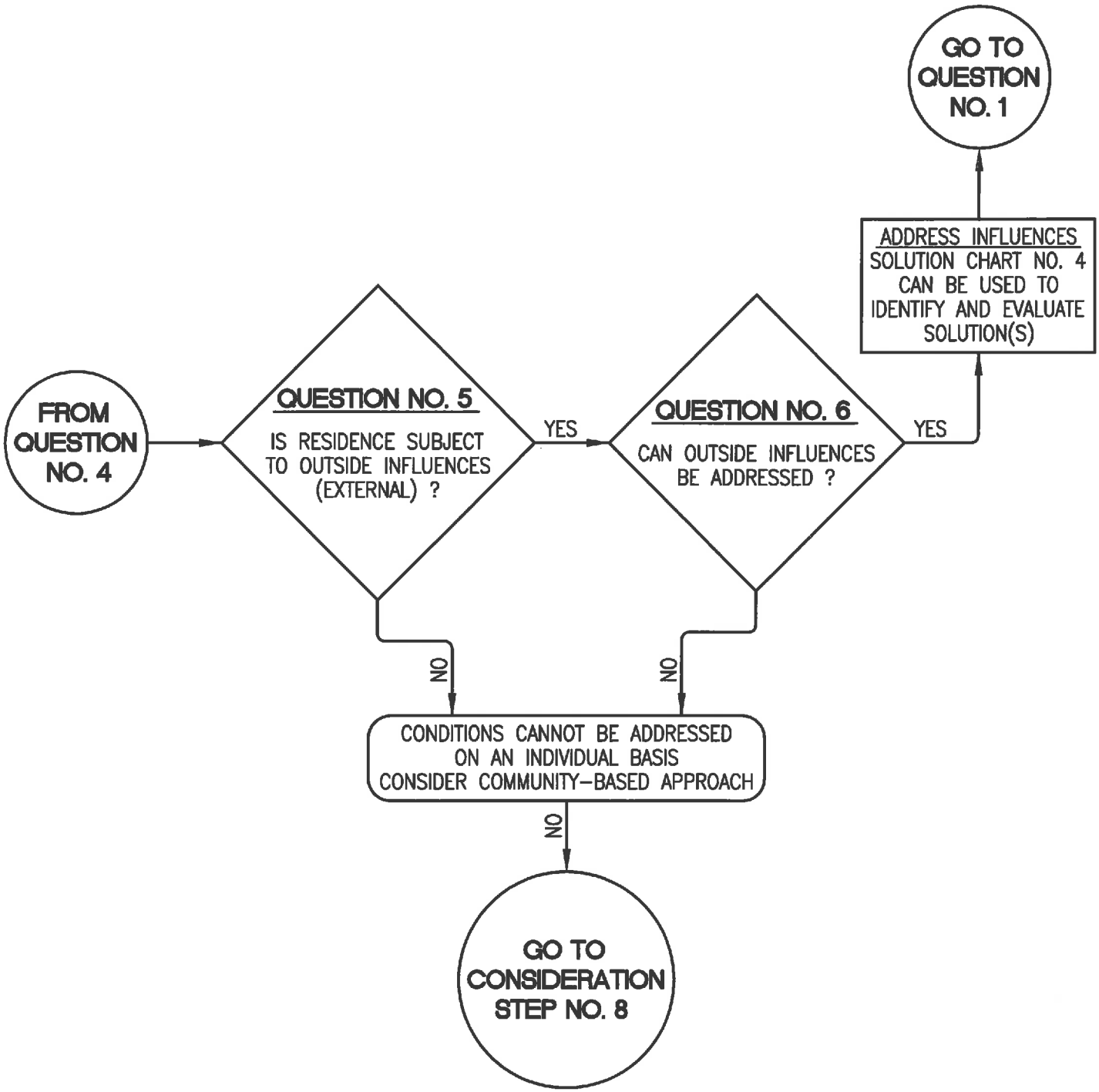
L:\TDDC\(3) WASTEWATER SOLUTIONS-CHART 4.Dwg



QUESTION NO. 4

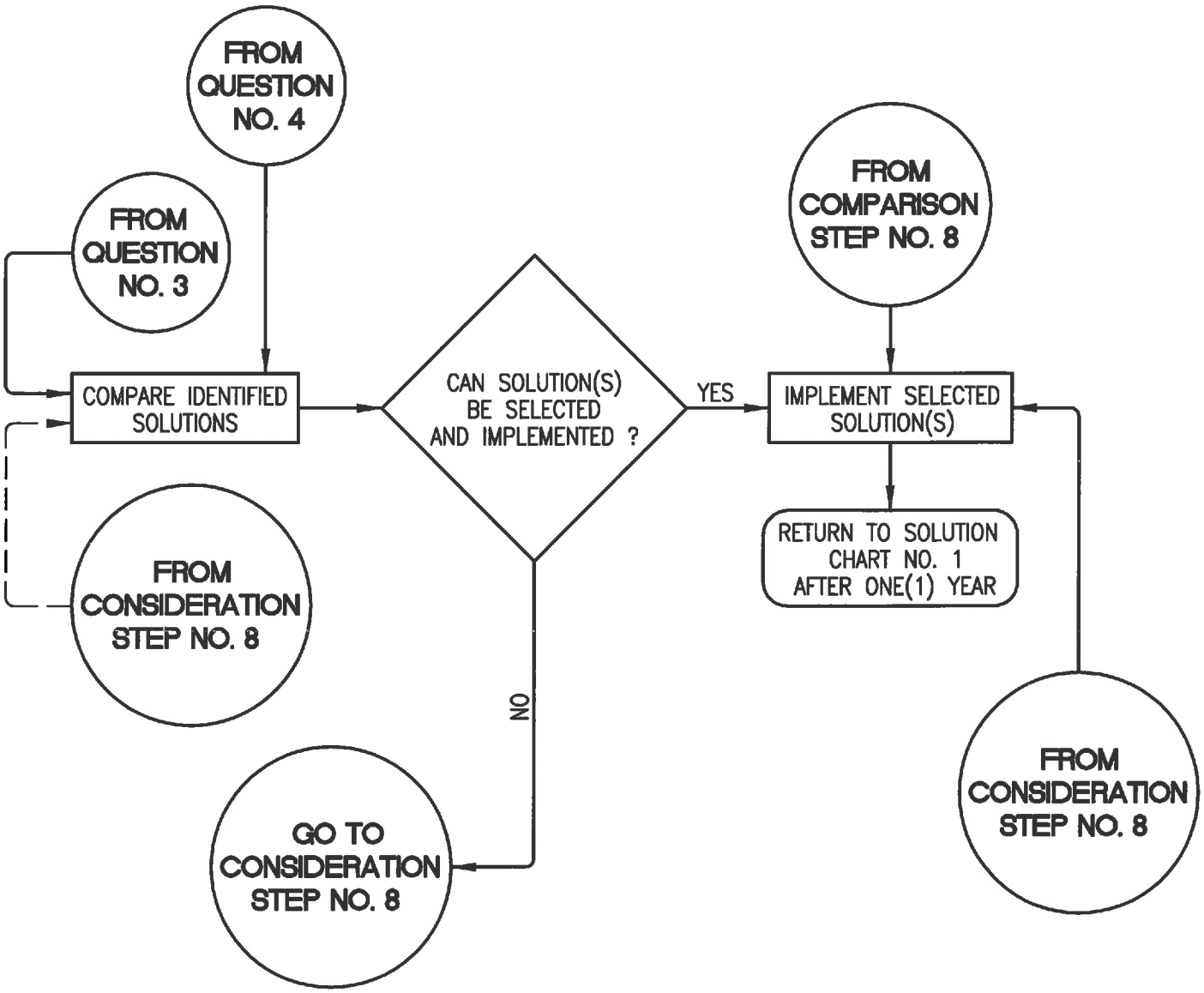
SOLUTION CHART NO. 4 - WASTEWATER SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\(4) WASTEWATER SOLUTIONS-CHART 4.Dwg



QUESTIONS NO. 5 AND NO. 6

SOLUTION CHART NO. 4 - WASTEWATER SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY



COMPARISON STEP NO. 7

SOLUTION CHART NO. 4 - WASTEWATER SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

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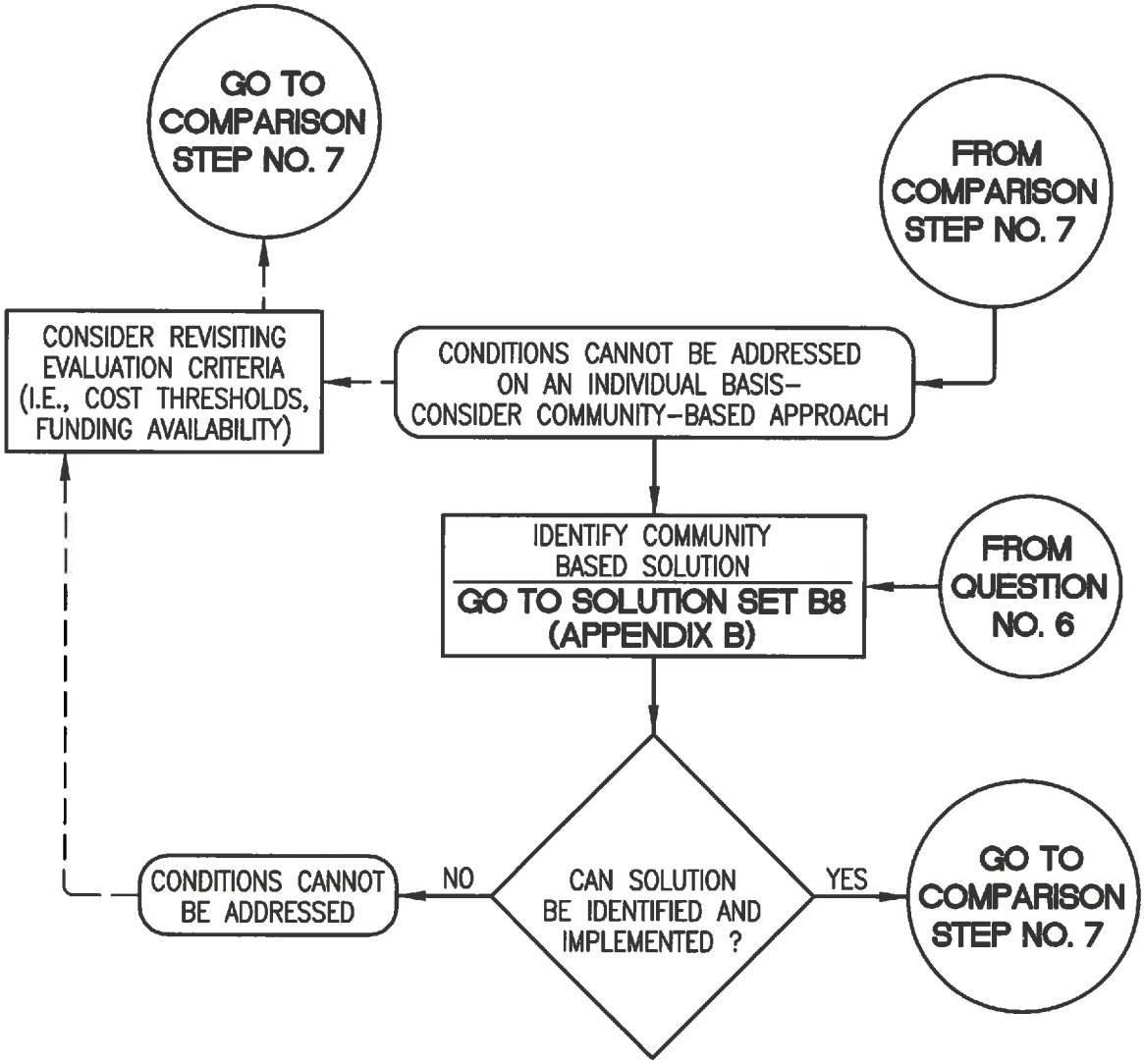

CONSIDERATION STEP NO. 8

SOLUTION CHART NO. 4 - WASTEWATER SOLUTIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

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APPENDIX B – SOLUTION SETS

APPENDIX B – SOLUTION SETS

B.1. General

The solution sets have been color coded to assist the individual household or renter in locating the appropriate solution. The solution sets are color coded as follows:

- Yellow – Water Quality;
- Blue – Water Supply; and
- Green – Wastewater.

APPENDIX B – SOLUTION SETS

3.2 Contents

APPENDIX B – SOLUTION SETS

APPENDIX B – SOLUTION SETS

B.1 WELL IMPROVEMENT SOLUTIONS

In a rural setting, the domestic groundwater extraction water well represents the typical and primary water supply source for the individual household. Typical features of a groundwater well are shown on Figure B.1-1.

The first step in addressing identified problems associated with a groundwater well is establishing the physical features and construction considerations of the well. Specific well information is needed to determine the appropriate solution(s). Well information can originate from the drilling contractor that installed the well, however, this information may not be readily available due to the circumstances related to the property such as the current owner is not the original owner. A qualified professional and in depth research may be necessary to determine the specific features of the well.

The Well Improvement Solution set addresses problems specific to a groundwater well. Four main categories of solutions exist: disinfection, repairs, modifications and new well construction. These solutions should address problems facing an individual household with a well source problem. Table B.1-1 summarizes the applicability of each solution.

In general, trained professionals and qualified contractors will be required to implement these solutions.

APPENDIX B – SOLUTION SETS

TABLE B.1-1

APPLICABILITY OF WELL IMPROVEMENTS

INDIVIDUAL HOUSEHOLD PILOT STUDY

Solution	Problem/Applicability		
	Water Quality	Water Supply	Wastewater
1. Well disinfection	X (Bacteriological only)	-	-
2. Well Repairs			
a. Sanitary seal	X	-	-
b. Well repairs – casing	-	X	-
3. Well modifications			
a. New wellhead seal (sanitary seal)	X	-	-
b. New casing	-	X	-
c. Deeper well and or casing	X	X	-
d. Strata isolation	X	-	-
e. New pump	-	X	-
4. New domestic well	X	X	Potential to eliminate influence of wastewater system

APPENDIX B – SOLUTION SETS

B.1.1 Well Disinfection

This solution addresses bacteriological (Coliform) contamination of a well. This solution consists of the introduction of a disinfectant, usually chlorine, to the well. This solution can be implemented by professional or by the party responsible for individual household. Basic math skills and limited knowledge of chemistry is needed to ensure that the proper amount of chlorine is utilized. Bacteriological test samples need to be collected and analyzed by a certified analytical laboratory to demonstrate that disinfecting the well achieved its purpose.

B.1.1.A Considerations

Advantages: Implementation is straightforward. The solution can be implemented quickly. Compared to other well improvements, the costs associated with this solution are relatively low.

Disadvantages: Solution may not address causative factor of bacteriological contamination, such as no well sanitary seal. Frequency of solution use may prove prohibitive, if causative factor is not addressed. In addition, the area for disposal of water may be limited.

B.1.1.B Costs

Table B.1-2 summarizes cost considerations related to disinfection.

APPENDIX B – SOLUTION SETS

TABLE B-1.2
SOLUTION COSTS – WELL DISINFECTION
INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Notes/Considerations
Chemicals	Very Low to Low	Cost dependent on quantity
Pumping	Variable	Pumping required for flushing
Testing	Very Low to Low	Cost dependent on quantity
Operation/Maintenance	None	Solution may need to be repeated, if causative factor is not satisfactorily addressed

B.1.1.C Supplemental Considerations

The use of input from local agencies such as the County health department, qualified community organizations or professional services may be warranted to ensure that a solution is correctly implemented. The use of professional services will increase the cost of this solution. Testing will be required to demonstrate the successful implementation of this solution.

B.1.1.D Useful Information

The following information will be useful when considering this solution:

1. Diameter of well;
2. Depth of well;
3. Depth to standing water;
4. Water level drawdown during pumping (flow);
5. Pump capacity (flow); and
6. Testing laboratory information and protocols.

APPENDIX B – SOLUTION SETS

B.1.2 Well Repairs

This set of solutions addresses items related to groundwater wells that are damaged where those damages are contributing to water quality problems. A sanitary seal is a layer of concrete or other impervious material surrounding the well casing that prevents surface water from getting into the well. A cracked sanitary seal provides an opportunity for well contamination.

Damaged well casing can cause water quality problems, as well as water supply problems. Well casings can become damaged through deterioration from age and/or subsurface changes in soil conditions such as those related to an earthquake. The solutions outlined herein, call for repairs to be made to the damaged portion of the well. In general, well repairs require the services of an experienced contractor.

B.1.2.A Considerations

Advantages: Repairs allow for continued use of a good production well.

Disadvantages: Extensive repairs may not be cost effective or present significant cost savings over facility replacement.

APPENDIX B – SOLUTION SETS

B.1.2.B Costs

TABLE B.1-3
SOLUTION COSTS – WELL REPAIRS
INDIVIDUAL HOUSEHOLD PILOT STUDY

Solution	Cost	Notes
Well head/sanitary seal repair	Low – Moderate	Cost dependent on extent of required repairs
Casing repairs	Moderate – High	Cost dependent on extent of required repairs
Operation/Maintenance	None	Not applicable

B.1.2.C Supplemental Considerations

The implementation of this solution will require the use of properly trained contractors and installers. Individuals or companies under consideration should have the capability to evaluate the existing conditions and provide recommendations and anticipated costs for comparative purposes. This information will establish the feasibility of implementing the solution as compared to other alternatives, such as a new well.

B.1.2.D Useful Information

The following information will be useful when considering this solution:

1. Well drillers log;
2. Well construction plans or details;
3. Date of construction;
4. Well casing details; and
5. Site access conditions.

APPENDIX B – SOLUTION SETS

B.1.3. Well Modifications

Well modifications consist of enhancements or improvements to an existing well. Table B.1-4 summarizes potential well modifications. In general, the party associated with the individual household will have to use trained professionals and contractors to implement any of these solutions.

The primary disadvantage to pursuing well modifications as a solution is that they present moderate to very high cost impacts for the individual household.

B.1.3.A Considerations

Considerations for each type of well modification are summarized in Table B.1-5. In general, modifying an existing well presents its own characteristic specific considerations and challenges.

B.1.3.B Costs

Table B.1-5 summarizes cost considerations. Well modifications result in the expenditure of moderate to very high amounts due to the relative complexity of the modifications. In general, well modifications do not result in increases in annual costs.

B.1.3. C Other Considerations

The potential for well modifications will need to be established by licensed professionals and contractors experienced in well modifications. Detailed investigations,

APPENDIX B – SOLUTION SETS

such as video inspections, may be required to establish the potential for certain modifications.

B.1.3.D Useful Information

The following information will be useful when considering this solution:

1. Well drillers log;
2. Well construction plans or details;
3. Date of construction;
4. Well casing details; and
5. Well site access.

TABLE B.1-4
WELL MODIFICATIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY

New well (sanitary seal)	Existing well may not have a sanitary seal
New casing	Existing well casing may be damaged beyond repair. Well may not use casing. Well casing may be improperly sized for available water flow.
Deeper well casing and/or Pump/motor changes (lower pump)	Water level may have dropped below current pump and/or casing level. Well may be dry and too shallow, but be above good water bearing strata.
Strata separation/Isolation	Well may be drawing from strata with poor water quality
New pump	Existing pump may not be capable of meeting water supply demands and/or conditions.
New pump motor	Existing motor may not be sufficient to allow pump to extract available water supply.

TABLE B.1-5
WELL MODIFICATION CONSIDERATIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY

Modification	Advantages	Disadvantages	Capital Costs	O&M	Supplemental
New Well Head (Sanitary seal)	Provides protection to groundwater source	None	Moderate	Not Applicable	None
New Casing	Can extend life of well	May be difficult to install	Moderate to High	Not Applicable	Cost dependent on depth and type of casing
Deeper Well Casing or Pump/Motor Changes	Continued use of existing location	Extensive modifications may be necessary	Moderate to Very High	Very Low to Very High	Scope of improvements may be extensive
Strata Separation/ Isolation	Isolate poor water quality	May reduce well yield	Moderate to Very High	Not Applicable	Not typically practiced for individual wells
New Pump/Motor	Can extend well life; new equipment	Pumping requirements may require additional electrical, more power costs	Moderate to High	Very Low to Moderate	Costs dependent on final pumping conditions

APPENDIX B – SOLUTION SETS

B.1.4. New Domestic Well

This solution consists of the drilling and construction of a completely new well. This solution also calls for the abandonment of all existing well features.

For the individual household, many disadvantages exist that render this approach to a last resort as a solution to water quality problems. These disadvantages include the following:

1) Uncertainty of water quality improvement if well cannot be located far enough away from the influence of the existing well;
2) The lot size may prevent the construction of a new well; and
3) The presence of an on-site wastewater disposal system could eliminate potential locations due to separation requirements.

Individual households on large lots may be able to accommodate a new well without experiencing these problems.

A new domestic well will need to be installed by a licensed well drilling contractor. In some areas, a professional hydrogeologist may be necessary to establish the necessary depth and casing characteristics of the well to ensure good water quality. Proper documentation, such as permits and drillers reports needs to be completed.

This solution represents; notwithstanding the drawback of expense, a comprehensive solution that potentially can be used to address both water quality and

APPENDIX B – SOLUTION SETS

water quantity problems. This solution does represent the most costly initial approach to the individual household quality problem.

B.1.4.A Considerations

Advantages: Provides opportunity to address all well-related issues (water quality and supply).

Disadvantages: Highest initial capital cost solution.

New location may not be available.

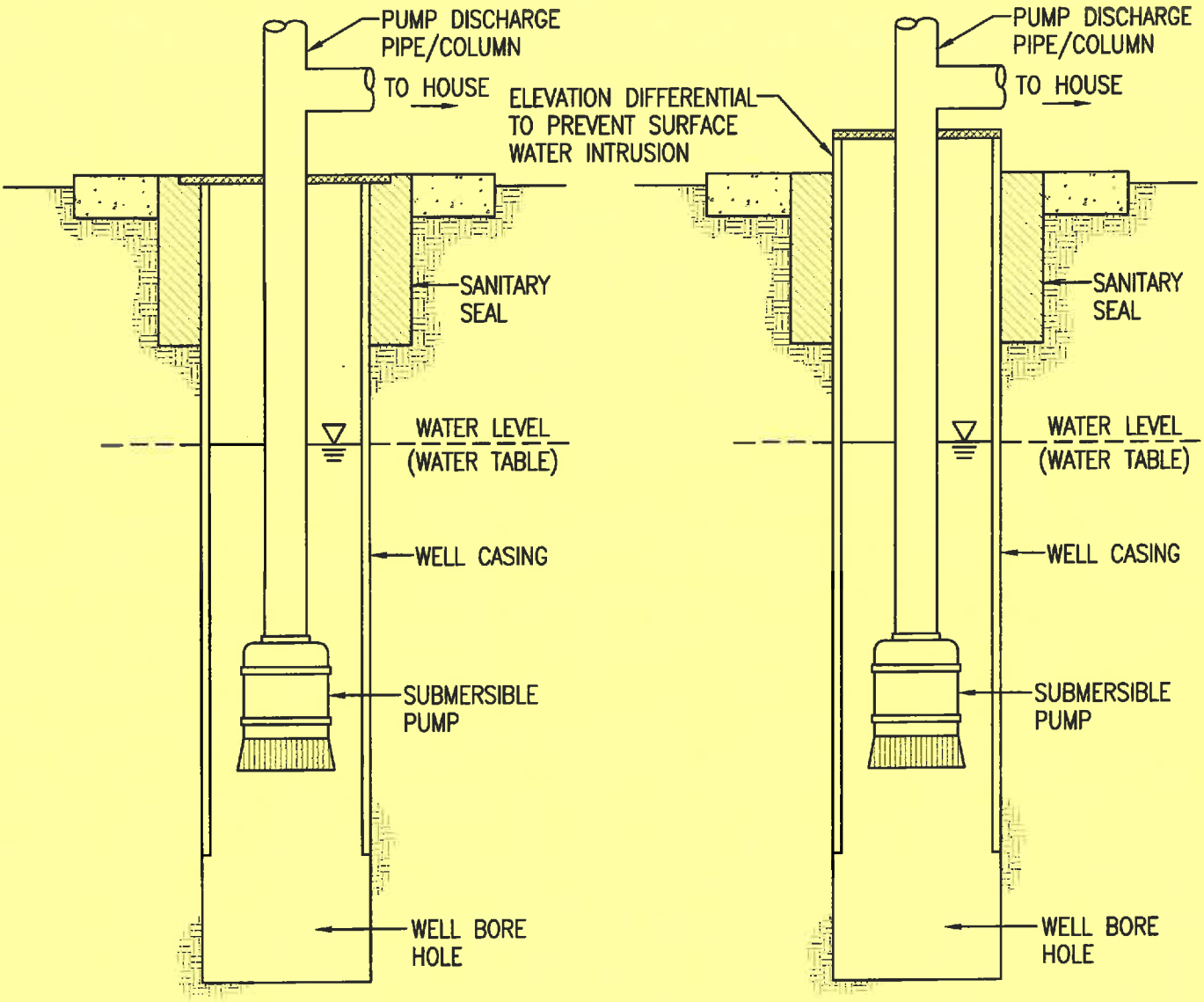
Deeper well may be cost prohibitive due to pumping costs.

New well may eventually experience same problems (i.e., nitrates).

B.1.4.B Costs

TABLE B.1-6
SOLUTION COSTS – NEW WELL
INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Notes
New well	High – Very High	
New pump and motor	Moderate – Very High	Cost dependent on final pumping conditions
Operation/Maintenance	Very Low – Moderate	Annual cost will have additional cost to existing O&M cost if pumping level is deeper.



TYPICAL DOMESTIC (HOUSEHOLD) WELL CONFIGURATION
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

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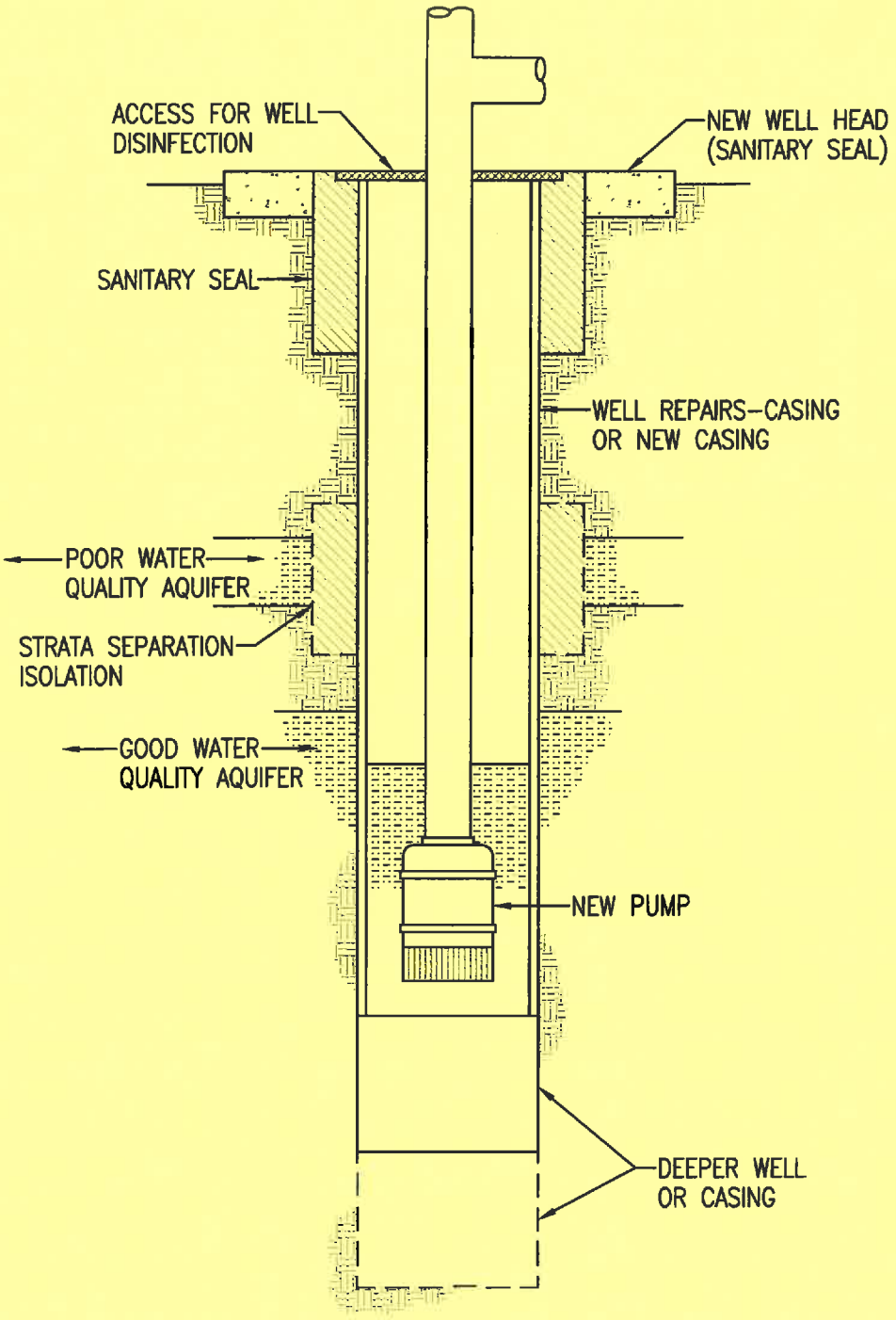


WELL MODIFICATION TYPES
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

L:\TCDC\TYPICAL WELL SOLUTION (6-13-13).Dwg

APPENDIX B – SOLUTION SETS

B.2 WATER QUALITY SOLUTIONS

The Water Quality Solution set addresses problems associated with groundwater water quality parameters.

Table 2-1 summarized the types of water quality problems addressed by this Pilot Study. Potential solutions to water quality problems can be placed into three (3) general categories:

1) Existing source options;
2) Treatment options; and
3) New source options.

Existing source options look to address the causative factors of the water quality problem. The party associated with an individual household may be able to make improvement or repairs to the domestic well or its surroundings that result in the improvement of water quality. For example, a new sanitary seal for the well may address the issue of bacteriological contamination.

Treatment options are available for water sources which have well established water quality problems that cannot be addressed by other means.

New source options address a new water supply providing an acceptable drinking water supply. A new water supply can be provided through dedicated access to a bottled water supply or the construction of a new well.

APPENDIX B – SOLUTION SETS

B.2.1 Existing Source Options

An on-site evaluation of existing conditions at and around a well can assist in identifying potential sources of water quality problems. The evaluation includes assessing the condition of the well head and the proximity of contaminating activities, such as leach fields, agricultural practices materials storage and commercial activities.

This solution set for water quality problems present approaches that can result in improvements to water quality for the existing water supply. These types of solutions aim to address the source of the water quality problem. In general, the potential solutions will originate from evaluations of the existing water source, such as from a groundwater well and potential contamination sources, such as from septic tank and related disposal systems.

Examples of these types of improvements include:

1) Well improvements, such as:
   a) A deeper well,
   b) Casing improvements (strata isolation);
   c) Well head improvements; and
2) Wastewater system improvements, such as:
   a) New septic tank and disposal system (including a relocated system); and
   b) Connection to a subdivision or community-based system.

APPENDIX B – SOLUTION SETS

B.2.1.A Well Improvements

Well improvement solutions consist of actions that address water quality problems resulting from deficiencies related to the well. Causes of water quality problems include: well drawing from poor quality aquifer or poor well head conditions, such as no surface sanitary seal. Specific details and considerations regarding well improvements are discussed in Section B.1 – Well Improvements.

B.2.1.B Wastewater System Improvements

Wastewater system solutions consist of improvements that address on-site wastewater system deficiencies that may be contributing to water quality problems in the drinking water source. Poor operational procedures and inadequate separation represent typical problems that could impact the drinking water source. Specific details and considerations regarding wastewater system improvements are discussed in Section 3.6 – Individual Wastewater System Improvements.

B.2.1.C Supplemental Considerations

Well improvements and wastewater system improvements represent the most common solutions. Other solutions exist, however, these solutions will be less common. These types of solutions may be evident following the inventory of potential contaminating sources. For example, the cessation of washing out of spray rigs used for agricultural practices adjacent to a well may reduce the presence of pesticides in a groundwater well.

APPENDIX B – SOLUTION SETS

B.2.2 Treatment Options

Treatment options represent solutions to water quality problems that cannot be corrected by changes/improvements at the water source. Examples of this type of water quality situation include:

- Nitrates;

- Arsenic; and

- DBCP (1,2-Dibromo-3-chloropropane).

Water treatment processes that remove the contaminant enable the individual household to continue to be served utilizing its existing well. For the individual household, two (2) types of water treatment units are available: point of use (POU) and point of entry (POE).

Treatment Technologies

There exists several technologies for POU and POE units. The two most prominent types of devices are ion exchange (IX) and reverse osmosis (RO).

IX units utilize a resin media that is specifically selected to remove the targeted contaminant. After a certain amount of water has been treated, the resin loses its capacity to remove the contaminant. The spent resin can be replaced with a new cartridge or the resin can be recharged using a suitable cleaning solution, depending on the IX unit design. A typical IX POU installation is shown on Figure B.2-1

APPENDIX B – SOLUTION SETS

RO units utilize membrane cartridges that are operated under high pressure to filter out the constituents in the water. Once the membranes become clogged, the RO unit must be cleaned. RO units typically utilize a salt-based (brine) cleaning solution. A typical RO POU installation is shown on Figure B.2-2.

It should be noted that all water treatment devices must be certified and approved by the California Department of Health Services before they can be marketed for use in California.

B.2.2.A Considerations

A POU unit treats water for consumptive use only. A POU unit is located at a designated use location such as a kitchen sink. The unit is attached to the plumbing at the sink, usually underneath. The POU unit typically utilizes a separate, dedicated faucet to deliver treated water.

Advantages:	Smaller unit is normally associated with lower costs; and Smaller quantity of residuals is generated for disposal.
Disadvantages:	Provides water for single location (sink) only; Unit capacity sized for consumption use (typically small water volume); and Multiple units would be required for multiple locations.

A POE unit is installed on the water supply line to the house and treats all of the water used in the household. Sinks, showers, toilets, water heater, dishwasher and

APPENDIX B – SOLUTION SETS

clothes washer would all use water that has been treated by the POE unit. A POE unit may be referred to as a "whole-house" water system.

Advantages: Eliminates concerns regarding exposure to contaminants through exposure, such as while taking a shower.

Disadvantages: Larger unit is normally associated with higher costs; and Larger amount of residuals are generated for disposal.

B.2.2.B Costs

Costs for specific POU and POE units can be kept relatively competitive, due to competition created in the consumer marketplace. This situation will provide the individual household the opportunity to minimize cost. In general, POU and POE device use will present the cost considerations outlined in Table B.2-1.

TABLE B.2-1
SOLUTION COSTS
INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Notes
Capital cost (Equipment, etc.)	Low – Moderate	Cost dependent on equipment size; competitive marketplace
Annual cost (material replacement, pumping, etc.)	Low – Moderate	Cost dependent on replacement frequency. Increased pumping may occur due to recovery rates. Some units may require additional electrical power such as for UV disinfection systems.

APPENDIX B – SOLUTION SETS

B.2.2.C Supplemental Considerations

Water Pressure. POU and POE units typically have minimum operating pressures for proper operation. An operating pressure of 20 to 40 psi should be anticipated. Upgrades to the existing individual household water system may be necessary to meet POU and POE device pressure requirements.

Water Storage. In general, POU and POE units utilize additional tanks for water storage to deliver water during unit operation and to reduce the size of the installed device.

Water Recovery. Water recovery refers to the percentage of water produced when compared to the total amount of water used in the production and backwash processes. Water recovery rates range widely between 20 percent to 95 percent. Actual water recovery rate information will need to be obtained from individual equipment manufacturers. The actual water recovery rate is an important consideration since it demonstrates the actual amount of water produced for use for the total available and gives indication of the disposal requirements for the generated backwash.

Waste Stream/Residuals. POU and POE units will generate a waste stream from the regeneration or backwash cycle which is started when the units' treatment capacity is used up. IX processes typically utilize a regeneration process with a salt water (brine) solution that may prove detrimental to on-site wastewater systems and receiving groundwater quality. Some IX processes utilize exchangeable cartridges that can be

APPENDIX B – SOLUTION SETS

thrown away or exchanged, if residual concentrations meet standard disposal limits. Otherwise, special disposal handling or recycling is required.

RO processes present similar backwash water management considerations. It should be noted that backwash water from RO processes will contain higher concentrations of constituents, including the target constituent.

Cartridge Life: The replacement of IX cartridges and RO membranes will vary depending on the concentration of the target contaminant and other non-target materials. In general, replacement is driven by the number of gallons of water treated through the cartridge. The cartridge life will need to be estimated once the installation considerations have been established.

Limitations: All water treatment devices must be certified and approved by the California Department of Public Health before they can be marketed for use in California. Water treatment technologies are continuously evolving and the certification list changes regularly. CDPH maintains lists of certified treatment devices at:

www.cdph.ca.gov/certlic/device/Pages/watertreatmentdevices.aspx

CDPH maintains lists for treatment devices that address the following contaminants:

- Arsenic;
- Cysts;
- Fluoride;
- Hexavalent Chromium;
- Lead;
- Microbiological Treatment;

APPENDIX B – SOLUTION SETS

- MTBE;
- Nitrates;
- Perchlorate;
- Radium 226/Radium 228; and
- Volatile Organic Compounds.

Table B.2-2 pairs these parameters to the solution sets prepared for this Pilot Study.

APPENDIX B – SOLUTION SETS

TABLE B.2-2
TREATMENT DEVICES AND PARAMETERS
INDIVIDUAL HOUSEHOLD PILOT STUDY

Solution Set Target	Treatment	Target Constituents(s)
Nutrients	Reverse Osmosis; Ion Exchange	Nitrates
Bacteriological	Reverse Osmosis; Filter Cartridge UV unit	Cysts Microbiological Treatment
Inorganics	Reverse Osmosis; Ion Exchange	Arsenic Fluoride Hexavalent Chromium Lead Radium 226/Radium 228
Organics	Reverse Osmosis	MTBE Perchlorate Volatile Organic Compounds
General water quality	Reverse Osmosis; Ion Exchange; Granulated Activated Carbon (charcoal) Filter Cartridge	Taste Hardness Chlorine residuals

Note: CDPH does not certify devices that address aesthetic conditions such as taste, odor and color.

APPENDIX B – SOLUTION SETS

B.2.3 New Source Options

This group of solutions is structured toward offering the party associated with the individual household a source of domestic water supply as an alternative to upgrading the physical well source or treating existing supplies. Two (2) options exist within this set of solutions. The first is a nonstructural solution, such as bottled water and the second, a structural solution, such as a new well.

Non-Structural Solutions

Non-structural solutions offer options for the party associated with the individual household that do not result in tangible, fixed improvements that address water quality problems. These solutions are coupled, however, with ongoing costs. These solutions consist of various bottled water arrangements, including bottled water delivery or centralized bottled water distribution. Non-structural solutions in this case, provide water for consumptive use only.

Centralized bottled water distribution is an option to delivery of bottled water to the individual household. With this solution, bottled water is obtained at a centralized location. The party associated with the individual household would be required to travel to the location of distribution to obtain the bottled water.

Bottled water delivery provides an individual household with a supply of water for consumption purposes. The water is delivered to the household. Typically, water

APPENDIX B – SOLUTION SETS

delivery is scheduled by the household and the billing (cost) is associated with the amount of water delivered.

B.2.3.A Considerations

A summary of the consideration of advantages and disadvantages regarding non-structural solutions can be found in Table B.2-3.

B.2.3.B Costs

Table B.2-4 summarizes cost information related to the non-structural solutions.

B.2.3.C Supplemental Considerations

Use of centralized distribution centers could present additional obstacles, such as inability of some individuals to reach a distribution center possibly due to lack of transportation or physical impairment.

Structural Solutions

Structural solutions consist of options that permanently address water quality problems by eliminating the use of poor water quality sources. These options include a new individual well, a new well serving multiple individual households and consolidation into or extension of service from a community water system.

In general, structural solutions are based upon infrastructure developed to address other water quality problems. Specific features associated with specific structural solutions are as follows:

1) New individual well: B.1 – Well Improvements (B.1.4)

APPENDIX B – SOLUTION SETS

2) New multi-households well: B.3 – Community-Based Water Source Solutions (B.3.3)

3) Consolidation/Interties: B.3 – Community-Based Water Source Solutions (B.3A)

Relative costs and supplemental considerations can be found with each solution set.

TABLE B.2-3
NON-STRUCTURAL SOLUTION CONSIDERATIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY

SOLUTION	ADVANTAGES	DISADVANTAGES
Bottled water distribution	Relatively low cost implementation Can be implemented in short time frame	Addresses water for consumption only Does not address VOC's that may be released in showers Represents an ongoing cost (monthly and annually) Could be subject to delivery limitations
Bottled water delivery	Short implementation schedule Water delivered to household No significant up front (capital) cost	Provides water for consumptive use only Constrained to delivery schedule and availability (vendor) Service can be tied to delivery contract

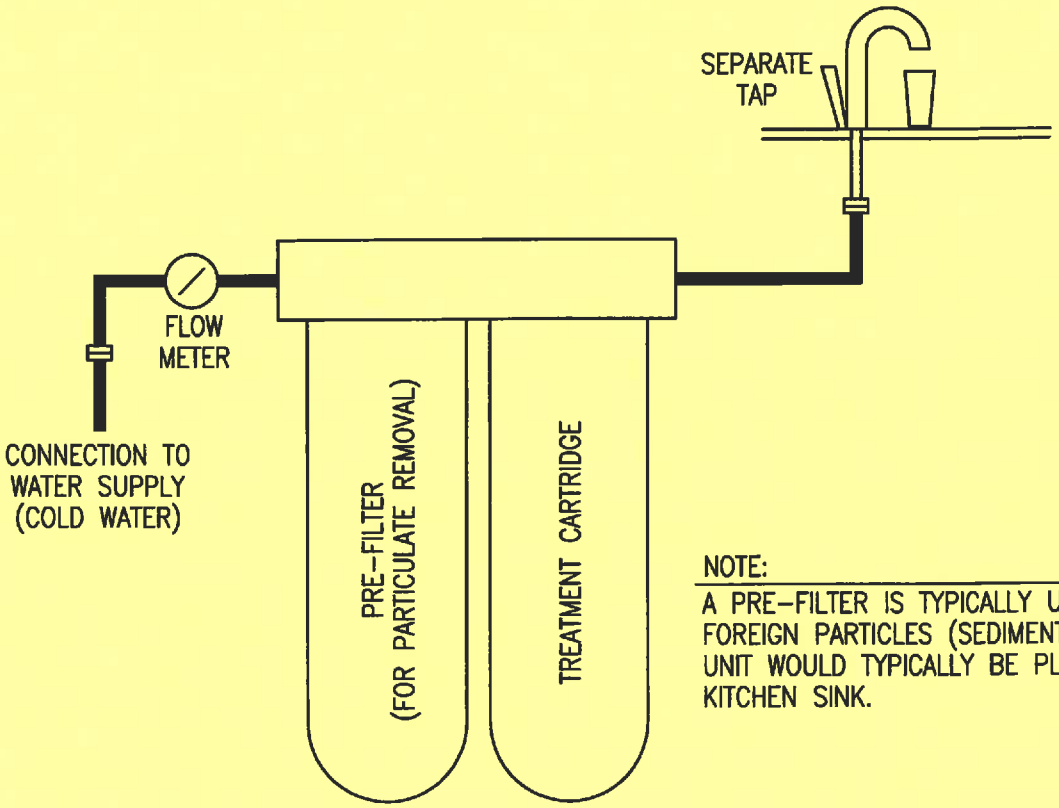
APPENDIX B – SOLUTION SETS

TABLE B.2-4

NON-STRUCTURAL SOLUTION COSTS

INDIVIDUAL HOUSEHOLD PILOT STUDY

SOLUTION	CAPITAL	ANNUAL	NOTES
Bottled water distribution	None	Moderate	
Bottled water delivery	Start-up cost may be required	Annually/monthly cost may be dependent on quantity and delivery distance.	



NOTE:
A PRE-FILTER IS TYPICALLY USED TO REMOVE FOREIGN PARTICLES (SEDIMENTS, ETC. TREATMENT UNIT WOULD TYPICALLY BE PLACED UNDER THE KITCHEN SINK.

SOURCE: USEPA

TYPICAL POU INSTALLATION
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

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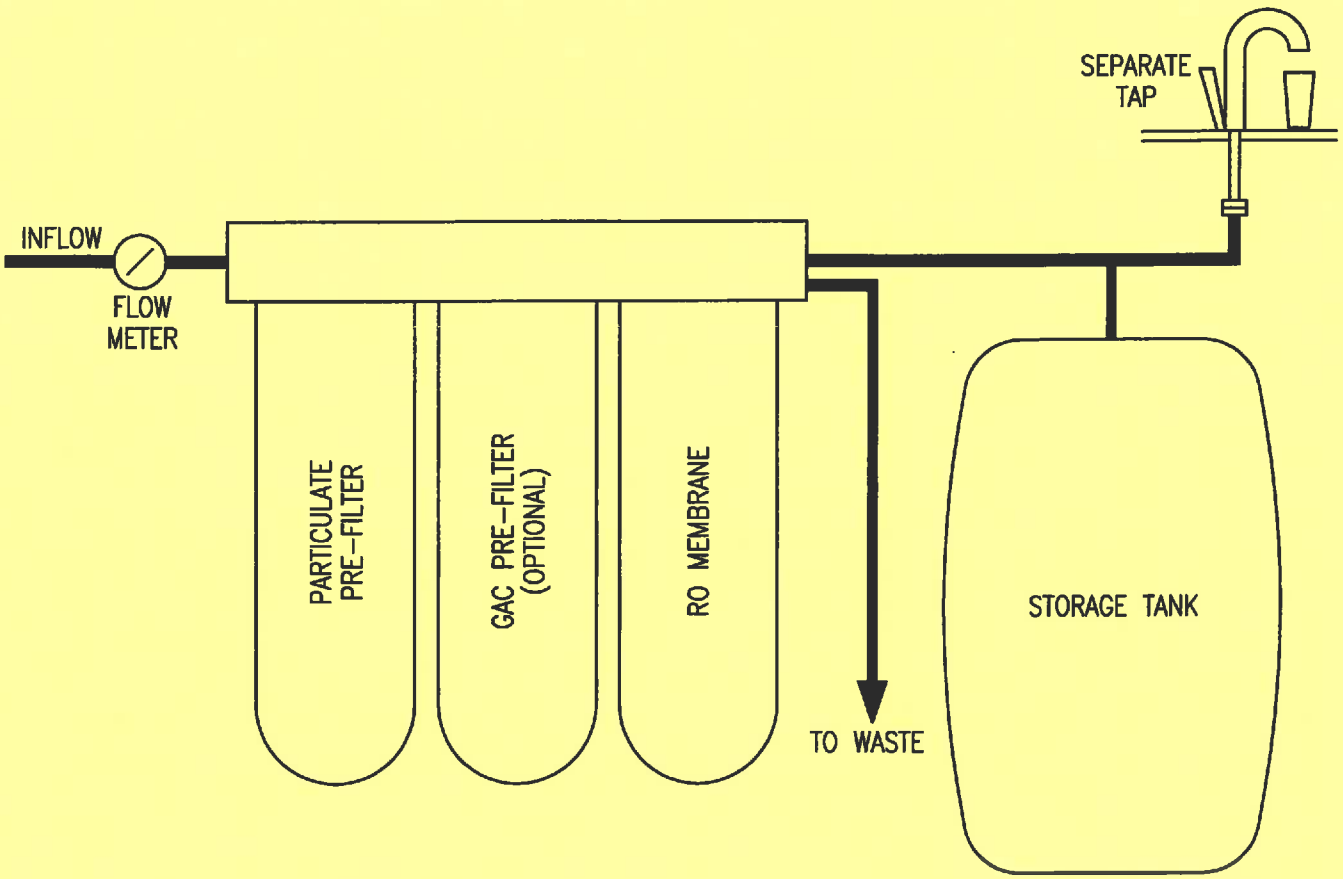

SOURCE: USEPA

TYPICAL POU RO INSTALLATION
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

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APPENDIX B – SOLUTION SETS

B.3 COMMUNITY BASED WATER SOURCE SOLUTIONS

Community based water source solutions consist of potential actions for individual households that share common problems or clusters of households currently utilizing a common water source, typically a well. Solutions may address both water quality and quantity problems. In general, community-based solutions reflect similar considerations as individual household solutions as presented in Sections B.1 and B.2. Community-based solutions aim to address a similar problem for multiple households as a single action.

Some solutions could recommend the development of a common water source, if a common water source does not already exist.

B.3.1 Water Well Improvements

This solution set pertains to rural subdivisions or household clusters that already utilize a shared (common) water well or have the potential to develop a common water well as the solution to a contamination problem. If already a common source, it is assumed that some degree of shared cost arrangement already exists. Well improvement solutions for community based water sources are the same as those for individual households. Details regarding specific well improvement solutions can be found under Section B.1 – Well Improvements.

APPENDIX B – SOLUTION SETS

B.3.2 Well Discharge Treatment

Wellhead treatment solutions for the generated supply consist of options that treat the water quality problem at the source (well). This set of solutions applies to household clusters or rural subdivisions that do or could use a common (shared) well.

Wellhead treatment options consist of water treatment facilities that are installed at the site of the water well. The treatment unit or process is specifically designed to remove or reduce the level of the target constituent/contaminant in the final discharge. In general, these units operate under the pressure provided by the well or other post discharge pressure source.

Wellhead treatment systems are designed by licensed professionals to ensure that the unit provides the necessary treatment and capacity. In some cases, the equipment manufacturer provides the design services as part of the equipment purchase process. Installation will need to be completed by the manufacturer or licensed contractor to maintain equipment warranties and to insure applicable code compliance.

The primary technologies utilized for wellhead treatment are ion exchange (IX) and reverse osmosis (RO). Both technologies require the use of backwash water (and/or brine solutions) to clean the units after use. Disposal of the spent backwash can present difficulties for onsite treatment systems. Specific details regarding IX and RO processes can be found in Section B.2-Water Quality Solutions.

APPENDIX B – SOLUTION SETS

B.3.2.A Considerations

Advantages: Treatment allows continued use of production well with sufficient yield.

Disadvantages: Residual disposal issues.

High capital and O&M costs.

Operator skills and possibly certificate may be necessary.

B.3.2.B Costs

TABLE B.3-1
SOLUTION COSTS
INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Notes
Treatment unit	High – Very High	Unit needs to be designed for installation
Pumping unit	Moderate – High	Pumping may not be required
Operation and maintenance	Moderate – Very High	Ongoing maintenance will be required. Part-time operations assistance may be necessary.

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B.3.2.C Supplemental Considerations

Proper design of the treatment system will be necessary which may require the use of professional services. Any professional utilized should have the capability to estimate costs and operational considerations. This information can be used for comparison to other alternatives.

Processes for wellhead treatment are rapidly evolving. Technology advances continue to improve design and operational features of wellhead treatment processes. This solution set should be revisited periodically for consideration of new technology.

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B.3.3 New Community Water Source

For a cluster of rural households with independent water sources, establishing a new community water source could represent a viable solution to individual water source problems. A new water source can be developed from either groundwater or surface water.

Developing a new groundwater source presents the considerations presented in B.1 – Well Solutions. For a cluster of households, a distribution system will also have to be installed.

Utilizing surface water, if available, may provide an additional option. Surface water, to be utilized as a new source, will require very specific treatment processes that require specific operational skills. In the pilot Study Area, access to surface water and long-term rights to the surface water, represents the most significant obstacle to surface water treatment.

B.3.3.A Considerations

Advantages:	Eliminates reliance on unsuitable water sources.
	Cost sharing between households lowers individual cost.
Disadvantages:	Land requirements.
	Governance structure required.
	Relatively high cost.
	Operations with specific skills required.

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B.3.3.B Costs

TABLE B.3-2
SOLUTION COSTS – COMMUNITY WATER SOURCE
INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Notes
Capital cost		
Land	Variable	Land purchase or easement likely required
Equipment	High – Very High	
Distribution system and service connections	High – Very High	Extent of system directly impacts costs
Annual cost		
Operation and maintenance	Low to Moderate	

Note: Cost sharing will affect the evaluation of costs, and is dependent on the number of participants.

B.3.3.C Supplemental Considerations

The development of a community water source will require the collective participation of the aggregated households to successfully accomplish the construction and operation of the facilities. A governance structure will need to be established in order to ensure that costs are equitably distributed amongst the participants and the facility is properly operated and maintained.

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B.3.4 Alternative Water Sources

This solution set consists of approaches to water quality or water supply problems through the use of an alternative water supply. The use of existing water supplies is discontinued. An alternative water source can be secured through consolidation, interties or the use of non-structural approaches.

Non-structural solutions for community based water sources are typically represented by solutions based upon provision of bottled water. For community needs, two options exist: use a community distribution center or provide delivery to the individual households. These options were previously discussed in greater detail in Section B.2.3, New Source Options.

Consolidation occurs when a cluster of independent households connects to an existing community water system and the subdivision or cluster of homes is added to the water system's responsibilities. This situation is typically accommodated through an annexation or extraterritorial services agreement process.

With an agreement a cluster of homes connects to a community water system, but maintains its identity apart from that of the water system. The water is often purchased wholesale as a delivery to the area rather than individual households. The entire area becomes responsible for the payment for water delivered.

B.3.4.A Considerations

Advantages: Responsibility for quality of water removed from the individual household.

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Disadvantages: Independence/autonomy of individual household is lost. Additional financial responsibilities become necessary to ensure delivery of water.

B.3.4.B Costs

TABLE B.3-3
SOLUTION COSTS – ALTERNATIVE WATER SOURCES
INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Notes
Distribution system, connections and fire flow provisions	Variable	Cost is highly variable depending on the extent of distribution system and cost share requirements
Operation & maintenance	Variable	Cost is dependent on cost share requirements and basis of charges for supplying entity

B.3.4.C Supplemental Considerations

For an individual household, there will be no physical difference between consolidation and an intertie. In each case, the individual household is connecting to a community water distribution pipeline. After connection, the party associated with the individual household pays for the use of the water, typically on a monthly basis. Up-front costs in the form of capacity rights fees and connection costs may also be required.

Approaches that rely on consolidation or an intertie to an existing water distribution system may be eligible for funding through programs offered by the California Department of Public Health (CDPH) or other regulatory agencies. Funding reduces or eliminates the capital costs of project implementation. Parties associated

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with individual households would, however, remain responsible for annual operating costs and associated cost of obtaining water supply.

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B.4 HOUSEHOLD IMPROVEMENT SOLUTIONS

Household improvement solutions address problems experienced by the individual household with an individual solution approach. These solutions address both water quality and water supply problems. Water quality problems include lead or copper contamination as well as bacteriological contamination that has been isolated to have been generated within the household. Water delivery/supply problems include insufficient flow at the delivery points.

Household improvements can be grouped into two categories: plumbing improvements and water treatment solutions. Plumbing improvements consist of solutions where changes are made to the individual household's plumbing. Water treatment solutions address water quality problems through utilization of treatment devices.

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B.4.1 Plumbing Improvements

Plumbing improvements may provide an opportunity to address both water quality and/or water supply problems. Water quality problems may originate from the individual household plumbing or an existing cross connection to a non-domestic well. Water supply problems may be caused by poor-sized plumbing fixtures or undersized plumbing. Plumbing improvements can be summarized as follows:

1) Plumbing/piping replacement – An option where existing plumbing is removed and replaced with new plumbing.

2) Fixture Replacement – Under this option, fixtures, primarily faucets and other delivery devices, are replace to improve the flow of water.

3) Plumbing disinfection – This option specifically addresses bacteriological contamination that is occurring with the household plumbing not from the source well. Detailed investigation(s) into the cause of contamination will be needed to ensure that this solution permanently addresses the problem.

4) Cross Connection Elimination – A cross connection exists when a non-domestic well or contaminated well is connected to a household (or system) served by a domestic well. In the pilot Study Area, this situation is unlikely, as most individual households are served by only one well. Households with large acreages, such as farms, however, may have irrigation wells that may have been connected in the past. A cross connection provides an opportunity for contaminated water to enter the individual household water supply. Under

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this scenario, person(s) associated with the individual household takes action to eliminate the cross connection.

Table B.4.-1 summarizes the applicability of the plumbing improvement solutions.

B.4.2 Water Treatment Solutions

Solutions that utilize water treatment units may be feasible for households that have established water quality problems that originate from within the household. For these types of problems, a point-of-use (POU) device represents the most appropriate approach.

A POU device will produce water for the point of application (use), most likely a faucet. The POU device can address many different contaminants. More details can be found in Section B.2 – Individual Water Source Solutions.

A POE device will produce water for the entire household. Its application, however, will be more limited, depending on the household problem. For example, if lead represents the primary contaminant, its most probable source is the plumbing. A POE device targeting lead will not address this situation. More details regarding the capabilities of POE devices can be found in Section B.2. – Individual Water Source Solutions.

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B.4.3 Solution Costs and Considerations

Table B.4.2 summarizes the relative cost and general considerations associated with household improvement solutions. Plumbing improvements will typically result in somewhat costly solutions, depending on the extent of plumbing work.

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TABLE B.4-1

APPLICABILITY OF PLUMBING IMPROVEMENTS

INDIVIDUAL HOUSEHOLD PILOT STUDY

Solution	Water Quality	Water Supply
Plumbing/piping replacement	X	X
Fixture replacement	-	X
Plumbing disinfection	X	-
Cross connection elimination	X	-

TABLE B.4-2

SOLUTION CONSIDERATIONS AND COSTS – IMPROVEMENTS

INDIVIDUAL HOUSEHOLD PILOT STUDY

Solution	Advantages	Disadvantages	Cost	Notes
Plumbing/piping replacement	A single/one time action that addresses problem Replaces old, potentially undersized plumbing	Difficult to implement especially throughout household; Costly	High to Very High	Can address delivery problems
Fixture replacement	Opportunity to upgrade fixtures	Most new fixtures implement water saving (conservation) designs	Moderate	Only addresses delivery problems
Plumbing disinfection	Straightforward implementation	Potential for repeated application procedures Disposal of residuals	Low to Moderate	Need to address cause of contamination Testing required
Cross connection elimination	Permanently eliminates potential contamination risk	-	Moderate	Multiple wells most commonly associated with large properties
Water treatment	Can address multiple issues	POE effectiveness may be limited	High to Very High	See Section B.2. for supplemental information

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B.4.4 Supplemental Considerations

The Uniform Plumbing Code has brought about a standardized approach to household plumbing issues since 1945. Older homes, therefore, are the most likely locations that may experience deficiencies regarding plumbing. Rural households may also have insufficient plumbing due to limited access to professional plumbers and the use of unlicensed contractors.

In general, the potential for household plumbing to represent the primary cause of water delivery problems is small.

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B.5 WATER DELIVERY IMPROVEMENT SOLUTIONS

This solution set addresses issues specific to the delivery of water from the primary source, such as a well, to the individual household for use. These solutions address the quantity and delivery of water for an individual household.

These solutions can be categorized as to their approach as follows:

a) At the well;

b) To the household; and

c) In the household.

Delivery improvements associated with a well consist of pump replacement or other improvements to increase the water delivery amount.

Piping to the household may be the most significant restriction that prevents sufficient water from reaching the household. Finally, water conservation measures at or in the household may represent alternatives to increase available water at the household.

B.5.1 Well Improvements

Solutions that address water delivery from a well are specifically associated with the pumping capacity of the well. The primary solution consists of replacing the pump and motor to achieve the objective delivery conditions. Specific considerations regarding pumping improvements can be found in Section B.1 – Well Improvements.

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It should be noted that prior to making any changes to the pump and/or motor, the person(s) associated with the individual household needs to consider the well conditions. The party needs to ensure that the well has the capacity to deliver the increased design quantity. A detailed well evaluation may need to be performed to ensure a workable solution. For example, a well that produces 20 gallons per minute will not meet the demands of a 25 gallons per minute pump.

B.5.2 Water Distribution (Delivery) Improvements

Options under this solution alternative consist of addressing pipeline deficiencies for individual households or clusters of households on a common distribution system. Deficiencies may exist as damaged pipe, undersized pipe or inefficient installations, such as unnecessarily long pipeline routes, excessive valve arrangements and pipeline bottlenecks.

In general, the types of problems associated with this solution set are associated with very old households where upgrades may have overlooked the pipeline between the well and household, such as when connecting a new well to an old line. Older rural subdivisions may experience undersized pipelines or inefficient system capabilities as a result of additions (expansions) to the original delivery system pipelines.

B.5.2.A Considerations

Advantages: Opportunity to upgrade pipelines, provide improved alignment

Disadvantages: Cost (depending on extent of improvements)

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B.5.2.B Costs

Pipeline cost is the primary cost element for this solution. This solution will also require earthwork and connection fittings. The overall cost associated with this solution will be dependent on the size (diameter) and length of the pipeline from the well to the house. There should be no significant annual (recurring) costs associated with this solution.

B.5.2.C Supplemental Considerations

A sufficient supply of water must be available. Replacing old pipelines may address water quality issues.

B.5.3 Water Demand Considerations

Another potential solution to water delivery problems is to address water demand considerations. Under this solution, the water demand of the individual household is reviewed for water savings that could result in sufficient water supply for the household. Prominent options include:

1) Low flow toilets;

2) Low flow shower heads;

3) Low flow faucets;

4) Tankless water heaters; and

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5) Water efficient appliances.

As technology regarding these options improves, the availability of these units increases and the cost typically decreases.

Water conservation practices implemented by the individuals living in the household can also reduce water demand. Any practice or action taken to reduce the use of water represents a conservation effort. Common practices include:

1) Repairing leaking water fixtures;

2) Installing water efficient fixtures and appliances (previously discussed);

3) Modifying landscape irrigation practices;

4) Installing water conserving (drought-tolerant) landscaping; and

5) Grey-water recovery systems and reuse for irrigation demand.

Water that is conserved by these or other practices becomes available for higher priority water demands.

Irrigation represents a significant area where water conservation can assist with reducing water demands. First, scheduling irrigation cycles to not coincide with daily water uses such as bathing and clothes washing can reduce the water demand from the water well. Water savings can also be realized by applying the proper amount of water during irrigation (lawn watering, for example). Finally, utilizing native plants or xeriscaping can significantly reduce the amount of water needed for irrigation.

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B.5.3.A Considerations

Advantages: In general, implementation can be completed at a low cost;

Most practices can be readily implemented.

Disadvantages: Most solutions require changes in established activities, which will require acceptance by individuals within the household such as lower flow fixtures and reduced watering per application.

B.5.3.2 Costs

Table B.5-1 summarizes relative cost information for water demand considerations.

TABLE B.5-1
SOLUTION COSTS – WATER DEMANDS
INDIVIDUAL HOUSEHOLD PILOT STUDY

Solution	Cost	Notes
Water conserving fixture	Low	
Water saving appliances	Moderate	
Water conservation practices	Low to Moderate	

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Water conservation practices will likely result in lower annual costs due to a reduction in water use and associated power costs. Any increase in consumptive use, however, could offset annual cost savings.

B.5.3.C Supplemental Considerations

In rural areas, the potential exists for more individuals to occupy a household than can be supported by the water (and wastewater) systems of the household. The evaluation of the water demands can establish the existence of this condition.

B.6 INDIVIDUAL WASTEWATER SYSTEM SOLUTIONS

Preface

On June 19, 2012, the State Water Resources Control Board (State Board) adopted the Water Quality Control Policy for Siting, Design, Operation and Maintenance of Onsite Wastewater Treatment Systems (Policy). The Policy became effective May 13, 2013. The Policy establishes statewide regulations associated with septic systems and associated required performance standards. The Policy will affect considerations associated with the solution set for individual household wastewater treatment and disposal systems.

One element within the Policy consists of a local agency management program. Under this element, a local agency becomes responsible for developing and implementing septic system implementation and oversight policies that meets the requirements of the Policy.

B.6 Individual Wastewater Systems Improvements

In general, an individual wastewater treatment and disposal system consists of two components: a septic tank and a disposal system. This disposal system is typically a leach field. A septic tank treats wastewater generated with an individual household by its toilets, sinks, showers, tubs and water-using appliances. From the septic tank, treated wastewater flows to a disposal system where it percolates through the soil for final treatment and disposal. A leach field, vertical seepage pit or evapotranspiration mound requires the proper soil type and properly configured disposal line to ensure proper application rates.

The components of an individual wastewater treatment and disposal system are shown on Figure B.6-1.

Treatment

Typical septic tank configurations are shown in Figure B.6-2. Septic tanks can be constructed out of concrete or plastic. Septic tanks come in many shapes including rectangular-box, cylindrical or spherical. Septic tanks will have an inlet connection, outlet connection and an access cover. Baffles to create multiple chambers and to prevent short circuiting are typically present.

Disposal

Common components to a leach field are shown on Figure B.6-3. A properly functioning leach field enables treated wastewater to percolate through the soil and away from the leach field. Multiple leach lines often direct flow throughout

the leach field. A distribution box commonly is used to direct flow equally or to allow for rotation between disposal areas. In general, perforated leach lines are placed within a trench filled with graded gravels with asphalt coated felt paper to retard the invasion of the fine soil particles and to optimize percolation. Some installations utilize shields or domed chambers to protect the leach lines from roots and other invasions.

This solution set addresses deficiencies in an individual wastewater treatment and disposal system. Solutions range from repairs to enhancements or modifications to new installations. The solutions discussed in this section cover activities typically completed on a one-time, or infrequent basis. Routine maintenance activities are discussed in Section B.7 – Maintenance Activities.

In general, solutions identified for individual wastewater systems will require the assistance of qualified professionals in part due to permit requirements.

B.6.1 Repairs to Existing Components

Over time, an individual wastewater system may become damaged or impaired to such a degree that its treatment and/or disposal capacity becomes limited or adversely affected. Table B.6-1 summarizes typical damages and impacts to a septic system and potential causes. If repairs become too extensive, the replacement of the existing system becomes warranted (Section B.6.3).

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TABLE B.6-1
TYPICAL DAMAGE TO SEPTIC SYSTEMS
INDIVIDUAL HOUSEHOLD PILOT STUDY

Component	Damage	Cause(s)	Impact(s)	Repairs
Septic tank	Cracks/holes	Age Vehicular Traffic Vegetation (roots) Excavation work	Infiltration (additional water) in tank	Crack repair; joint sealants
Leach lines	Broken pipe	Vehicular traffic Vegetation (roots) Excavation work	Inadequate disposal of wastewater flows	Leach line replacement
Septic tank	Poor pumping (if pump is used)	Age Poor operating conditions	Inadequate delivery of wastewater flows	Repair and/or replace pump
Leach field	Compacted soils	Vehicular traffic Age	Poor operation of leach field	Break up soils (can damage leach lines)

Repairs to Septic Tanks

In general, concrete and plastic formulations (polyethylene) are the most common materials used for septic tanks. A septic tank is buried below ground which provides the tank a certain degree of protection. Damage to a septic tank, however, can result from the following:

- Vehicular traffic. Heavy vehicles can damage tanks when they drive over tanks. Vehicles can also damage risers or access ports, leading to infiltration to the septic tank.
- Age. The annual physical toll can result in damage in a septic tanks, especially concrete tanks. Concrete tanks are susceptible to corrosion over long periods of time. Tank seals can also wear out from routine maintenance activities.
- Depending on subsurface soil conditions, damage to the septic tank can occur any time the septic tank is empty, such as after pumping or during installation. Soil and/or groundwater pressure exerted on the tank can cause damage to the walls or damage to the inlet and outlet connections.

In most cases, significant damage to a septic tank will warrant its replacement. Minor damage can be addressed through crack repair materials and sealants. Connection repairs can be completed through normal plumbing repair practices.

Repairs to Disposal System

Procedures noted herein are for a disposal system consisting of leach lines and a drain field (leach field). In general, treated wastewater flows by gravity from the septic tank to the leach field. In some systems, a pump may be required to deliver treated flow to the drain field. Leach lines consist of perforated plastic pipe located within a gravel rock trench. A network of leach lines comprises the leach field. Indicators of damaged leach lines or leach field conditions include dry areas, uneven ground cover growth and standing water in the leach field. Damage to the leach lines and leach field can result from the following:

- Vehicular traffic. Heavy vehicles can damage leach lines and excessively compact drain field soils. Damaged leach lines lead to uneven distribution of wastewater flows.
- Vegetation. Trees and shrubs growing too close to the drain field can produce roots that enter into and clog/plug leach lines.

Physical damage to the leach lines will require replacement. Roots may be able to be removed by maintenance practices, however, tree and shrub removal will likely be necessary to prevent future damage. Significant clogging may require leach line replacement as well.

Worn or damaged pumps (if used) will show signs of inconsistent operation and wastewater delivery. A septic tank back-up is the most common sign of pump

problems. The condition of the pump will determine whether it is more cost effective to repair or replace the pump.

B.6.1.A Repair Considerations

Advantages:	Repairs may be at a lower cost than outright replacement of system.
	Extends service life of existing system.
Disadvantages:	May not address causative factors of septic system damage.
	Some repairs may require extended out of service time to complete.

B.6.1.B Costs

TABLE B.6-2

SOLUTION COSTS – REPAIRS

INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Notes/Considerations
Crack repair-joint sealant	Low – Moderate	Cost dependent on quantity; if cost too high, replacement may be warranted
Concrete repair	Low – Moderate	Extensive damage may require replacement
Plumbing repairs (inlet/outlet connections)	Low – Moderate	
Leach line replacement	Moderate – High	
Cover soil modification	Moderate – High	
Vegetation removal - groundcover repair	Moderate – High	
Pump repair/replacement	Moderate – Very High	

B.6.2 Enhancements/Modifications to Existing Systems

This solution set consists of approaches to improve the capabilities of existing onsite wastewater systems through upgrades, modifications, or expansions.

Modifications

Evaluation of the existing onsite wastewater system may establish that modifications are warranted to improve treatment and/or disposal. Modifications provide the homeowner opportunity to extend the operational life of an existing system.

B.6.2.A Treatment Modifications

These solutions describe improvements to the treatment portion of the system. Examples include baffle installation, inlet-outlet reconfiguration, outlet filters and aeration. Older septic tanks may consist of a single chamber. The installation of a baffle wall to create two chambers can improve the treatment capabilities of an existing system. Baffles can prevent scum and other floatable material from reaching (and impacting) the disposal system. Baffles also reduce short-circuiting to ensure the wastewater is adequately treated.

Inlet and outlet "tees" can also be used to improve hydraulic and treatment conditions of a septic tank. Outlet filters can also be installed to provide further removal of solids prior to disposal. The use of filters, however, will require additional operation and maintenance (O&M) considerations. Another modification that can improve O&M efforts is the installation of access cover

risers. A riser enables the person(s) associated with an individual household to readily have the septic tank pumped. A buried access cover provides the opportunity to "forget" the pumping requirement for the septic tank.

B.6.2.B Disposal Modifications

Several modifications exist to address disposal limitations. Grading modifications can prevent unwanted storm water or irrigation water from entering the soils area over a leach field. Oversaturated leach fields prevent the proper disposal of treated wastewater. Improvements to the soil conditions can also be accomplished. Existing solids may need to be augmented to provide suitable condition for leach field vegetation (grass) and percolation, in lieu of standing water.

If space allows, incorporating a second leach field can address problems associated with poor disposal. A second drain field allows the resident to alternate leach field use. Typically, alternating occurs every six months, which allows one leach field to recover while using the other.

Expanding the existing leach field also represents a modification to improve the disposal capacity. Under this solution, the leach field is expanded by extending or adding leach lines and disposal field area. The entire leach field is available for disposal, in lieu of alternating leach field areas. Sufficient area and suitable soils are required for this solution.

TABLE B.6-3
SOLUTION SUMMARY – MODIFICATIONS CONSIDERATIONS

Modification	Advantages	Disadvantages	Costs	Other Information
Baffle installation	Lower cost than replacement of system; Straightforward improvement; Treatment Improvement	Does not address hydraulic capacity; May not extend service life of system	Low – High	Useful for older unbaffled tanks; Full access to tank will be required Need for baffles will likely be observed in leach field (clogging, etc.)
Inlet/outlet modification	Treatment improvement	May not extend service life of system	Moderate	Requires access to tank ends; Not common due to standardized septic tank designs
Outlet filters	Straightforward improvement; Treatment improvement	May not extend service life of system	Moderate	Useful for older tanks; Modifications to accommodate filler may be required Filter cleaning on regular basis; (O&M) Work may be completed by homeowner
Access risers	Improves access and visibility	Risers susceptible to damage	Low – Moderate	

Modification	Considerations	Advantages	Disadvantages	Costs	Other
Disposal:					
1) Grading Modifications		Above-ground modifications, no modifications to system		Low – Moderate	Improvement may address offsite generated problems
1) Soil Improvements	Soils evaluation needed			Moderate – High	
2) Additional leach field	Additional land required	Provides redundancy; enables household to "rest" one leach field	Additional space requirements; High cost	Very High	Feasible for large lots only

B.6.3 New Treatment and/or Disposal Systems

Based upon the evaluation of the existing onsite treatment and disposal system, a new wastewater system may be warranted. This solution set discusses options and considerations associated with a new onsite wastewater treatment system.

New Treatment System

This solution consists of installing a new treatment system for the individual household. If feasible, the new treatment system can be installed after the removal of the existing system; otherwise a new, suitable location will be necessary.

A new treatment system allows the individual household opportunity to improve treatment capabilities and capacity. A new treatment system also represents an opportunity to incorporate advances in onsite treatment technologies and features. New regulations and requirements may render a new system infeasible at the existing location.

Primary considerations for a new treatment system include:

a. Locations of existing water wells;

b. Size of household (wastewater flow quantity);

c. Location of existing (or new) leach field area.

Specific considerations for the new treatment system will be identified during evaluation activities which are typically accomplished by a qualified professional and/or contractor.

New Disposal System

The evaluation of the existing disposal system (leach lines and leach field) may establish the need for the replacement of the existing system with a new disposal system. Damaged leach lines and poor surface and subsurface conditions represent typical conditions warranting a new disposal system. This solution consists of installing a new disposal system. Depending on the site conditions, the new system may be installed at the existing site, but this is seldom the case. Normally, a new location will need to be identified.

The new disposal system may utilize the existing leach field location if the primary purpose of the new system is to replace damaged leach lines. Repairs to the infiltration trenches may be necessary.

A new disposal system provides an opportunity to utilize new approaches in disposal. Primary considerations for a new leach field include:

a. Soil characteristics;

b. Location of existing wells;

c. Size of system (disposal quantities); and

d. Location of existing treatment system.

Specific considerations and details associated with a new disposal system will need to be identified during evaluation activities, typically accomplished by a qualified professional and/or contractor.

Considerations

Advantages: Entirely new components.

Can address all adverse conditions.

Disadvantages: Installation options may be limited. A new site may be required.

High cost.

B.6.3.B Cost

TABLE B-6.4
SOLUTION COSTS – NEW SYSTEMS
INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Notes
New treatment system	Very High	Must be designed by a professional
New disposal system	Very High	Must be designed by a professional. Unlikely an option for small parcels

B.6.3.C Supplemental Considerations

A new treatment system and new disposal system can be paired together to provide the individual household an entirely new onsite wastewater system.

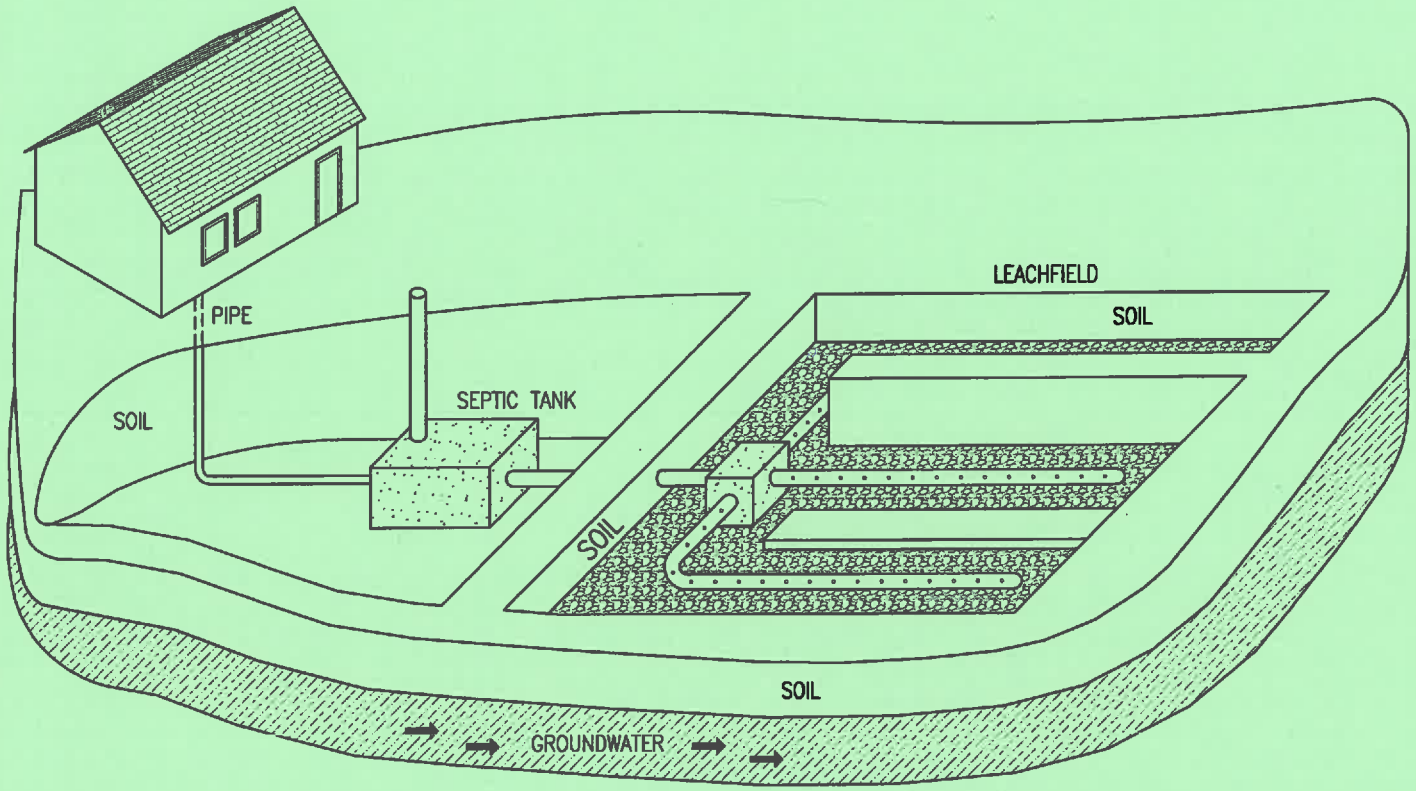
New systems are associated with a very high cost to the person(s) associated with an individual household. It is likely that these solutions will not be feasible unless a means to fund the solution is available to the individual household or the house is uninhabitable due to the lack of sewerage capability.

For small rural residential lots, a new system may only be feasible if the new system can be installed in the location of the existing system. This option often results in the most extreme cost requirement.

B.6.4 Community Based Treatment and Disposal Systems

If multiple individual households in reasonable geographic proximity experience similar problems with their wastewater systems, a shared system may represent a potential solution for each household.

Discussion and specifics of Community based Wastewater Treatment and Disposal solutions can be found in Section B.8.



TYPICAL INDIVIDUAL WASTEWATER TREATMENT AND DISPOSAL SYSTEM
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

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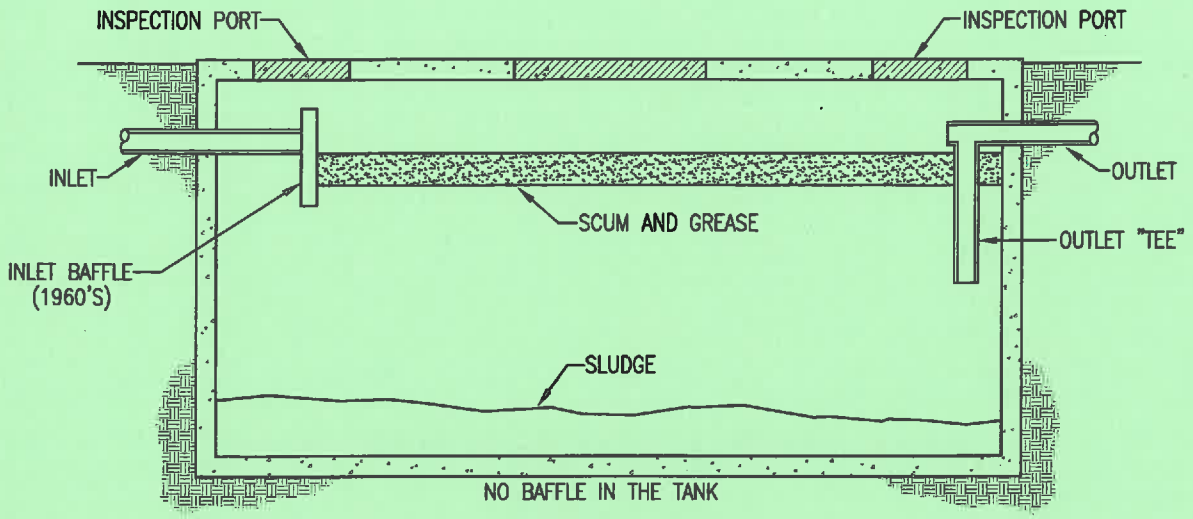
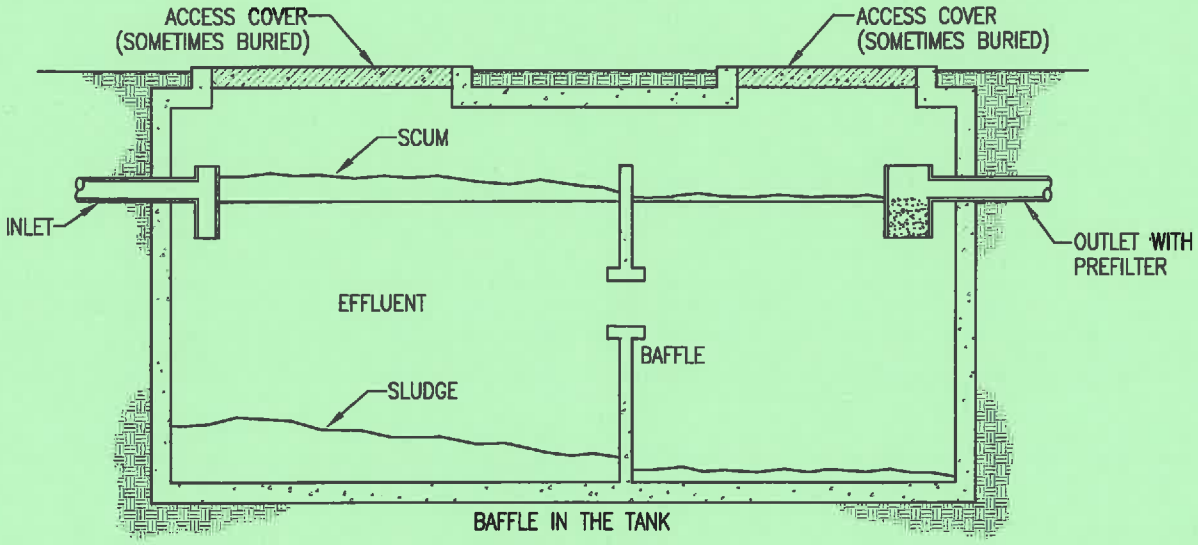


SEPTIC TANK
(OLDER DESIGN)



SEPTIC TANK
(CURRENT DESIGN)

SEPTIC TANK DESIGNS
INDIVIDUAL HOUSEHOLD PILOT STUDY
TULARE LAKE BASIN DISADVANTAGED COMMUNITY WATER/WASTEWATER STUDY

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B.7 INDIVIDUAL WASTEWATER SYSTEM MAINTENANCE ACTIVITIES

As a part of the evaluation of an individual wastewater system, the person(s) associated with an individual household may establish that the existing system is properly designed but that maintenance activities need to be addressed. This section discusses solutions that address maintenance activities associated with individual wastewater systems.

B.7.1 Implement/Follow Proper Individual System Use Limitations

These solutions describe efforts by the individual household to operate its wastewater treatment system within its proper design and operational limitations. The individual may not understand the limitations associated with an on-site wastewater treatment and disposal system. Improper disposal of drainage flows, garbage material and chemicals can adversely affect an on-site system's performance, subsequently leading to problems.

Reducing excess flows to the system

An aspect of septic systems operation is the principle of detention time. An individual system is sized to provide a specific "holding time" (detention time) based upon an estimated amount of wastewater. Over time, an individual household may unknowingly increase the amount of wastewater directed to the septic system. Sources of additional flows include:

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- Increased household size (number of residents);
- Additional fixtures added as a result of remodeling;
- Increased frequency of processing clothes for laundry;
- Hot tub discharge; and
- Leaking plumbing fixtures.

Solutions for reducing excess flows consist of:

- Installation of water conserving fixtures;
- Installation of water conserving appliances;
- Repairing leaking fixtures and appliances;
- Spacing out laundry activities such as multiple laundry days; and
- Draining hot tubs to locations other than the septic system.

Disposal of inert material and chemicals

In many households, the kitchen sink represents the primary means for disposing of coffee grounds and household cleaners. These materials can adversely affect an individual household's onsite treatment system (septic tank).

Inert materials consist of materials that cannot be treated by the septic system. Coffee grounds and egg shells are two types of inert materials. Dumping of cooking grease down the drain also introduces materials into the septic system that cannot be

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adequately treated by the on-site wastewater treatment system and actually hinder the proper treatment of other materials.

Inert materials interfere with a septic system operation by reducing the available storage volume used for treatment, subsequently resulting in reduced treatment performance. Septic tank pumping (cleaning) frequencies typically increases as well.

Many chemicals can detrimentally effect the treatment performance of on-site treatment systems. Paints, solvents and household pesticides represent examples of chemicals that should not be dumped into drains for disposal in the septic system. Chemicals can adversely affect the microorganisms in the septic system which result in wastewater treatment impacts.

In general, solutions that address the improper disposal of materials to a septic tank consist of changes to disposal habits. If multiple households or a rural subdivision share the same disposal problem, community based disposal services may provide an additional solution.

Septic tank inserts for grease (grease traps) are available, however, maintenance and disposal procedures related to the accumulated grease must be conducted.

B.7.1.A Costs:

Water conserving fixtures are considered relatively low cost solutions, however, water saving appliances result in significant expenditures. Some cost savings can be realized through utility replacement programs or other special funding, if available.

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In general, implementation costs for water conservation measures and changes in disposal practices will result in cost savings. Less septic tank pumping and maintenance activities will be required.

B.7.1.B Supplemental Considerations

In rural areas, the potential exists for more individuals to occupy a household than can be supported by the then existing wastewater system. Water conservation efforts may extend the capacity of the wastewater system, however, additional capacity may need to be considered to ensure proper operation.

Many water conservation efforts and disposal practices result in changes in water use habits. Water use and disposal habits can be difficult to change.

A properly designed greywater system can relieve a portion of the flow to the septic system. Greywater consists of flows from sinks and showers and other water use locations that do not contribute human waste. In lieu of discharge to the septic system, greywater can be used for landscape irrigation.

Annual costs may be incurred if regularly scheduled tank contents collection and disposal is implemented.

B.7.2 Implement/Follow Proper Maintenance Practices

On-site wastewater treatment and disposal systems require regular maintenance to ensure proper operation and long term sustainability. Regular maintenance activities include:

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1) Septic tank pumping;

2) Leach line flushing; and

3) Leach field maintenance and care.

Poor attention to maintenance activities can result in reduced system performance and adverse impacts. This solution set emphasizes the importance of following the specified maintenance practices for the on-site system.

Over time, septic tanks will accumulate solids. If not removed, the solids build-up will adversely affect the treatment and disposal efficiency. A common frequency for pumping is between 3 and 5 years. The the frequency is dependent on many factors, including the capacity of the tank, usage and other maintenance considerations.

Depending on the degree of treatment provided by the septic tank, solids can accumulate in the leach lines related to the disposal system. Flushing the leach lines distributes these accumulated solids. Flushing is accomplished by directing a high rate of flow through the leach lines. In general, a leach field must have the capability for flushing to accomplish this effectively. Access ports are the usual appurtenance.

The leach field needs to be properly maintained to ensure adequate disposal condition. The leach field should utilize vegetation as groundcover. Mowing is required to prevent lush conditions that may hinder disposal. In addition, grass clippings need to be removed, to prevent matting of the grass. The leach field area needs to be clear of shrubs and trees, where roots may grow and clog the leach lines.

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Leach lines need to be protected from heavy vehicles, otherwise damage may result. This may represent a significant concern for rural areas where vehicular restrictions to an individual household's property are not extensive.

B.7.2.A. Costs

Costs associated with this solution set represent routine costs incurred on a regular basis. Some costs, such as tank pumping will occur less frequently. Leach field maintenance such as mowing will need to be more regular, depending on the season. Annual costs for this solution set are estimated to exist in the Low to Moderate range.

B.7.2.B Other Considerations

New homeowners may not be familiar with the maintenance requirements of an on-site wastewater treatment system. Public education offers a potential solution to improve awareness of the importance of maintenance activities.

Several companies offer microbial additives to improve treatment and for maintenance benefits. There is much debate regarding the benefit of additives. Additives do not eliminate the need for regular tank pumping.

B.7.3 Increase Maintenance Practice Frequency

Conditions may exist at the individual household level that warrant considering increasing maintenance practice frequencies. An existing septic tank may be undersized for the current conditions at the household. As a result, septic tank pumping

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on no more than an annual basis may be necessary to maintain proper operational conditions.

The features and considerations associated with these solutions are the same as the solutions in Section B.7.2. The frequency of use increases. With an increase of use, however, comes an associated increase in cost.

The primary consideration for this solution set pertains to the conditions warranting the additional maintenance such as, being more frequent. Excessive maintenance typically indicates that the proper operating conditions are being exceeded. Upgrading the on-site wastewater treatment system may be warranted.

B.7.4 Community Based Maintenance Activities

This solution set addresses approaches where maintenance activities associated with on-site wastewater treatment systems are shared amongst multiple individual households. Typical maintenance activities are summarized in Section B.7.2. The activities that represent candidates for community based approaches include:

- Septic tank pumping; and
- Leach field maintenance.

Under this solution, a group of households, or a rural subdivision, contracts with a septic system maintenance provider to conduct the maintenance, such as tank pumping for all households within the group.

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Scheduled contract maintenance of several on-site systems provides the individual households opportunity to negotiate lower costs with a common maintenance provider.

B.7.4.A Supplemental Considerations

A maintenance service provider may require a service contract which results in contracted participation requirements. A service contract may require additional governance considerations for the participants.

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B.8 COMMUNITY BASED WASTEWATER TREATMENT AND DISPOSAL SOLUTIONS

Community based wastewater system solutions consist of solutions for individual households that share common problems or household clusters utilizing a common wastewater treatment and disposal system, such as a common septic system. These solutions are presented to address potential wastewater treatment disposal and water quality problems. In general, community based solutions reflect similar considerations as individual household solutions presented in Sections B.6 and B.7. Community based solutions aim to address problems for multiple households.

B.8.1 Wastewater System Improvements

This solution set pertains to rural subdivisions or household clusters that already use a common wastewater treatment and disposal system. Solutions for community-based wastewater systems are the same as for individual households. Improvement solutions may need to address wastewater treatment, wastewater disposal, or both. Details regarding wastewater system improvement solutions can be found in Section B.6 – Individual Wastewater System Improvements. Under this solution set, it is assumed that a cost sharing agreement exists amongst the multiple households to collect funds for the existing system.

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B.8.2 New Community Based Wastewater System

This solution set addresses common or shared wastewater treatment or disposal problems for multiple individual households or rural subdivisions. The solutions describe new wastewater treatment and/or disposal systems that address a problem on a community-wide basis. One primary consideration for this solution set is the creation of the necessary governance structure to facilitate cost sharing between the connected households. Two primary options exist for small wastewater treatment and disposal systems: septic systems and package wastewater treatment plants.

B.8.2.A Considerations

Community septic systems have similar design and operational considerations as septic systems for individual households. The primary difference exists in the treatment and disposal capacity, since the system must accommodate multiple households. Although very little equipment is typically associated with a septic system, the septic tank needs to be pumped out on a periodic basis, typically every one to three years.

A community septic system presents several advantages. First, septic systems require a low amount of operational attention. Septic system can be considered passive, having few, if any, equipment considerations. Specialized training is not necessary to operate a septic system.

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Disadvantages exist for a septic system. A community-based septic system will need a separate site (property) for the tank and leach field (disposal area). A suitable area must be available for proper treated wastewater disposal.

Package wastewater treatment plants typically provide more advanced treatment than septic systems. The disposal system, however, must meet the same conditions as those for a septic system. Disposal systems can vary from leach fields to disposal ponds. Reclamation of the wastewater can also be considered.

The primary advantage to utilizing a package plant is the higher degree of treatment, which increases disposal alternatives, including reclamation. Package plants also rely less on storage volumes which typically translates into smaller treatment units.

Package plants for a community system present several disadvantages to the party(s) associated with an individual household. First, package plants will require specifically trained personnel for operation and maintenance. As the level of treatment increases, to accommodate disposal, the level of expertise increases. Package plants require daily attention. Package plants and associate disposal system will need a separate site (property). Finally, package plants utilize treatment processes that use ancillary equipment (pumps and motors) that will present increased operation and maintenance costs.

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B.8.2.B Costs

TABLE B.8-1
SOLUTION COST CONSIDERATIONS
INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Notes
Septic System		
Facilities	Moderate – Very High	Complexity of system affects cost
Operations	Low – Moderate	Few equipment considerations Simple operation
Package Plant		
Facilities	High – Very High	More complex equipment
Operations	High – Very High	Will require trained operator

Both options will require considerations associated with land costs and/or easements. New facilities will require a separate site for treatment and disposal. Availability of the necessary land will affect the cost associated with the land.

B.8.2.C Supplemental Considerations

In many cases, septic systems can be configured and installed by a properly licensed contractor. In rural areas, contractors specializing in construction of septic systems typically exist due to the demand for such systems.

In general, licensed professionals specify the requirements for a package plant. Many variations of package plants exist which require detailed evaluation to ensure the

APPENDIX B – SOLUTION SETS

proper type of package plant. A separate contractor is utilized to install the treatment system.

B.8.3 Alternatives to Community Based Approaches

This solution set presents an alternative for wastewater treatment and disposal systems for rural subdivisions or individual household clusters. The use of existing systems is discontinued. Wastewater treatment and disposal is completed through consolidation or an intertie with other wastewater systems.

Consolidation refers to the situation where a rural subdivision connects to a larger community wastewater system and the subdivision or cluster of homes is added to the wastewater system's responsibilities. This situation is typically accommodated through an annexation or extra territorial service agreement process. Consolidation can also occur through the combination of multiple small community based systems to create a larger system.

With an intertie, an area connects to a community wastewater system, but maintains its identity apart from the wastewater system. The capacity in the wastewater system is purchased at-large for the subdivision, rather than by individual household. The group becomes responsible for the payment for the capacity and operation and maintenance costs related to the wastewater system.

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B.8.3.A Considerations

Advantages: Responsibility of wastewater treatment and disposal is removed from the individual household.

Disadvantages: Independence/autonomy of individual household is lost or compromised. Additional responsibilities become necessary to ensure access to wastewater treatment and disposal, such as monthly costs.

B.8.3.B Costs

TABLE B.8-2
SOLUTION COSTS – COMMUNITY BASED ALTERNATIVES
INDIVIDUAL HOUSEHOLD PILOT STUDY

Item	Cost	Note
Collection system, connections and treatment system (if necessary).	Variable	Cost is highly variable depending on the extent of collection system and cost share requirements
Operation & maintenance	Variable	Cost is dependent on cost share requirements

APPENDIX C – CASE STUDIES

APPENDIX C – CASE STUDIES

C.1 GENERAL

Although this Pilot Study Report has been prepared to assist the individual household, its solutions can be utilized in a community setting where a community water system does not exist.

The attached presentation, as prepared by Community Water Center (Visalia, CA), summarizes efforts undertaken to install treatment devices in individual households in Monson, California.

A similar project was completed in March, 2005 for the community of Grimes, California. NSF International completed the project through a U.S. Environmental Protection Agency grant. The final report, "Feasibility of an Economically Sustainable Point-of-Use/Point of Entry Decentralized Public Water System," is available in the public domain. The Executive Summary has been included in this Appendix for reference purposes.

It should be noted, however, that although the individual households described in the case studies addressed the identified problem through the installation of a water treatment device, the decisions leading up to the selection and use of the device and subsequent installation of the selected device were completed by outside groups (third parties). An individual household that does not exist in a community setting will likely be required to make decisions and subsequently take action regarding potential treatment devices.

Community-Driven Implementation: Reverse Osmosis Point-of-Use Case Study in Monson, CA

Shen Huang
Technical Analyst
Community Water Center
September 5, 2013

COMMUNITY WATER CENTER
EL CENTRO COMUNITARIO POR EL AGUA

Outline

- Monson profile
- Project background
- Water use /perception before filters
- Implementation process
- Ongoing O&M challenges
- Benefits of RO POU
- Limitations of RO POU
- Lessons Learned
- Impact

Monson

Photo: Mark Crosse, “Impoverished town of Monson getting water filters,” Fresno Bee, 09/16/2012.

Monson profile

- Small, unincorporated, rural community in Tulare county
- Surrounded by dairy farms and agricultural fields, has sandy soil
- Primarily Latino farmworkers or retirees
- Population (US Census 2010)
  - 49 households
  - 188 people
- All houses on private wells and septic systems
- Contaminants: nitrates (up to 5x MCL), bacteria, DBCP

Project background

- 2008
  - Monson community residents identify water quality concerns, formed La Voz de Monson
  - CWC and Self Help Enterprises help secure resources for free water testing of wells
    - Nitrates can be 3x MCL (45 mg/L)
  - La Voz de Monson, CWC, Self Help, County explored long-term solution options
    - Face many technical delays from existing state funding mechanisms

Project background

- 2012
  - Local Rotary Clubs help fundraise $15K for a short-term interim solution
  - POU filter project begins in Oct. (outreach and installation, water testing)

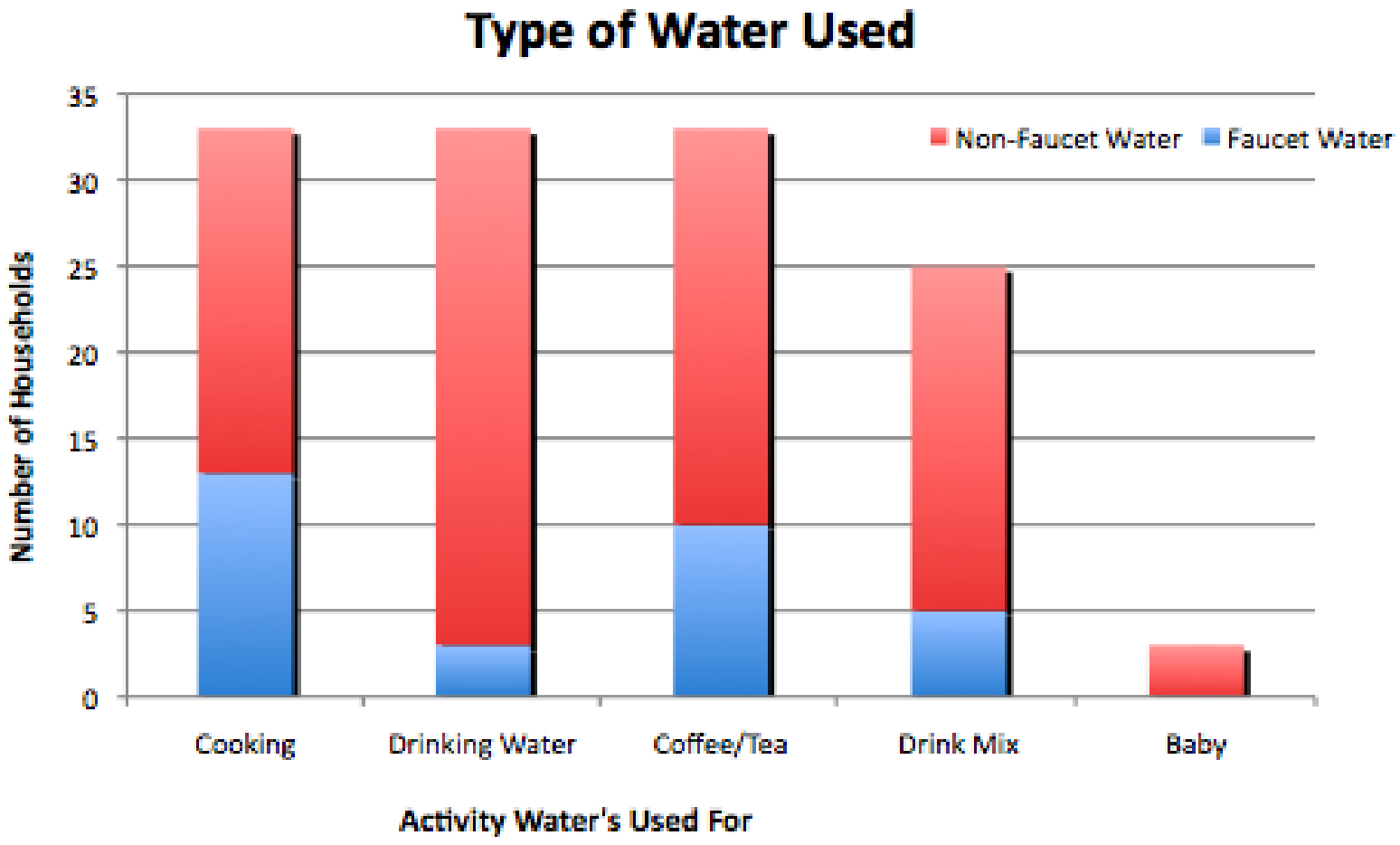
- 2013
  - POU filter projects ends in June (installations)
  - Ongoing operations and maintenance (O&M) and water testing monitoring

Aerial map of Monson

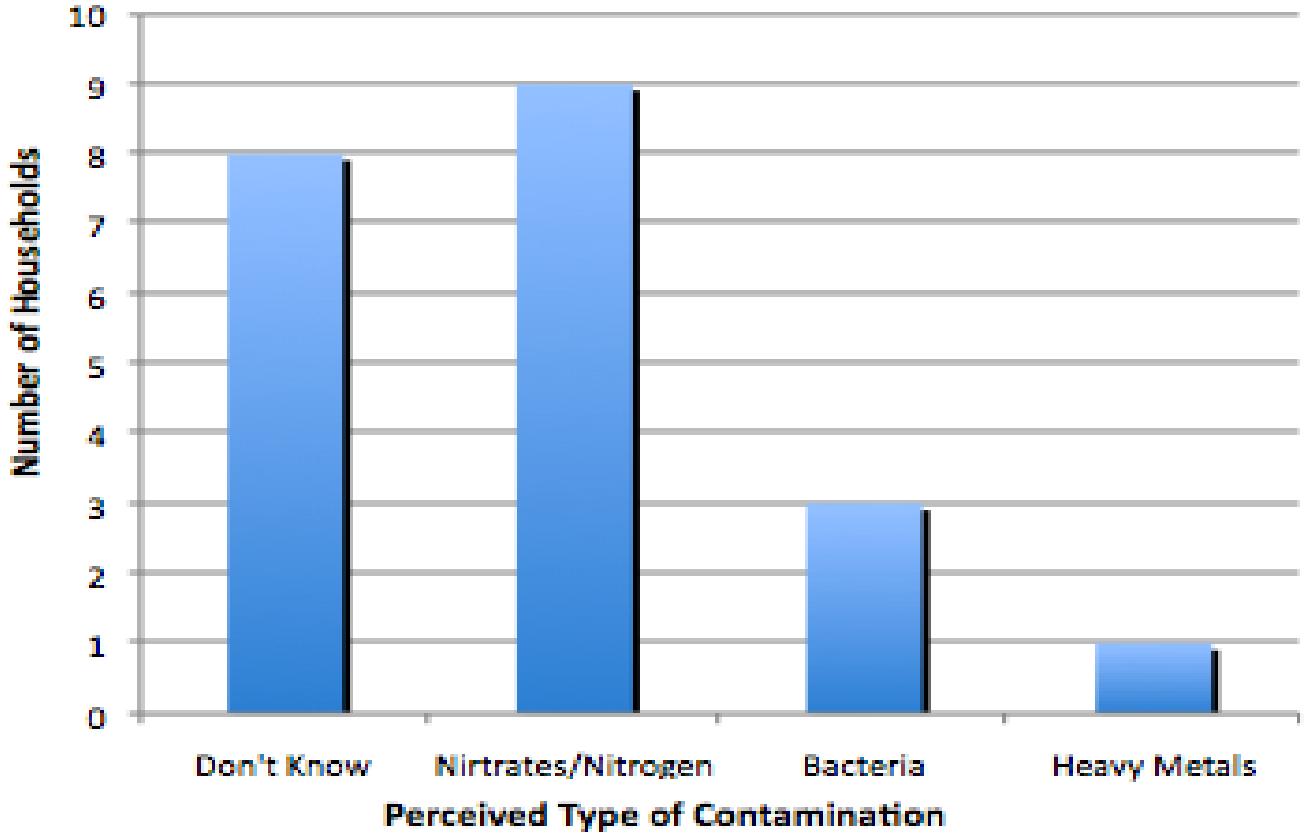
Water use before filters

Photo: Max Whittaker, “Why Federal Efforts to Ensure Clean Tap Water Fail to Reach Faucets Nationwide,” The New York Times, 05/10/2013.

Water use before filters



Perception of water quality



Note: 19 households believe their water is contaminated. The number of responses is more than 19 since residents were allowed to choose more than one option.

Implementation process

- Community outreach meetings and door-to-door: buy-in
  - Contacted 41 households
  - Installed in 29 houses
  - Other houses: plumbing issues, not interested, not available
- Pre-installation inspections of homes
- Installation team: Rotarian volunteers, plumbers, CWC staff
- Water quality monitoring by CWC and Rotary, in-kind support by Cal Water
- Evaluation: pre and post filter installation surveys
- Education: O&M, well disinfection

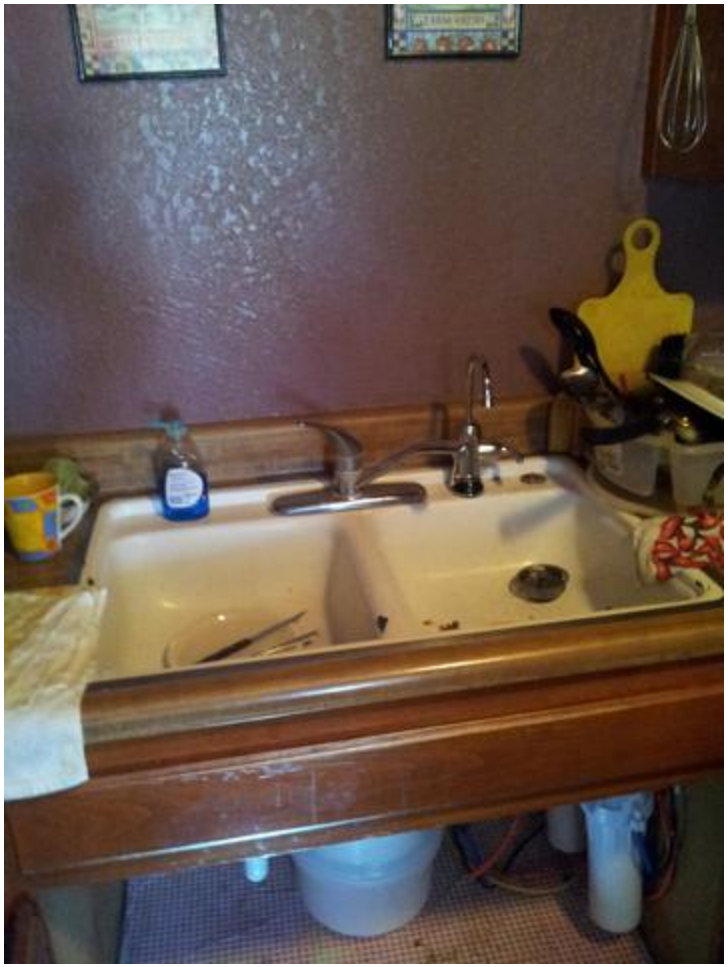
Filter system costs

- GE Reverse Osmosis Filtration System (GXRM10RBL): $149
- Replacement filters: $45 (x2 a year)
- Replacement membrane: $54 (2-3 years)
- Certified by NSF/ANSI 58 and CDPH
- Available in Home Depot

Community outreach

Installations

Installations



Education – proper O&M

Education – well disinfection

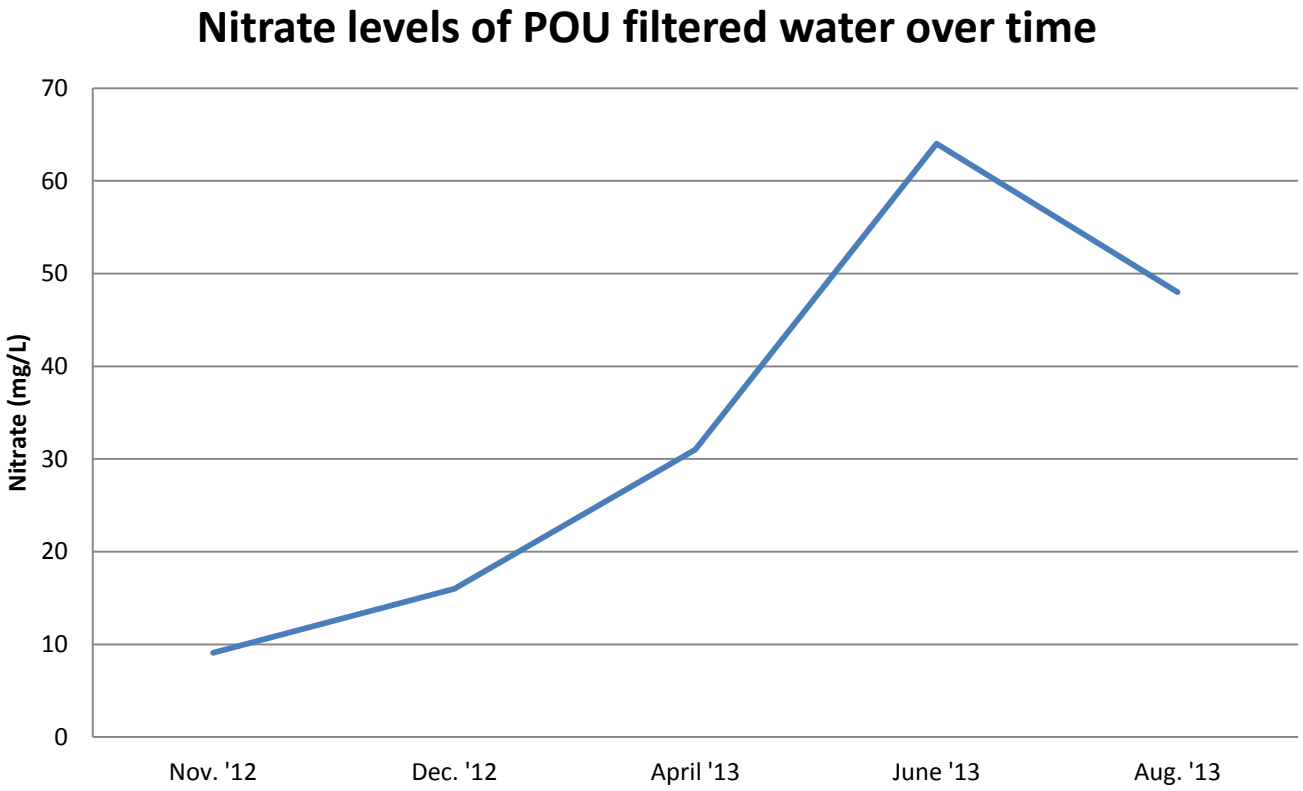
Evaluation

Raw water vs. Filtered water

6 families installed in Oct. ‘12, samples taken in Nov. ‘12.

Raw water (mg/L)	Filtered water (mg/L)
85	9.1
39	0
100	7.4
56	1.4
50	0
110	19

Filter performance over time



85 mg/L in raw water sampled in Nov ‘12.

*Change filters every 6 months – recommended by manufacturer

Ongoing O&M challenges

Benefits of RO POU

- Pros
  - Affordable and cost effective
  - Parts available locally
  - Reduces TDS levels – better taste
  - Don’t have to buy water
  - Don’t have to travel to get water

NSF RO POU limitations

- Monitoring is typically all on burden of consumer
- Performance indicator light tied to water quality – very expensive
  - TDS monitor as surrogate?
  - Light is reminder to change replacement pre and post cartridges or 500 gal dispensed
- Certified levels up to 120 mg/L as nitrate

Lessons learned

- Community driven project with supportive community base crucial
- Regular O&M and monitoring follow-up necessary
- Many logistical challenges, but can be an effective interim solution
- Limitations of RO POU technology – user side

Impact

- **Before Filter**: "Maybe if we catch it now, our children will benefit from it," said Tony Torres. "I think it’s great."

- **After filter**: "I'm really glad this project did this for us because it makes me feel safer about drinking tap water. Before, I didn't feel safe drinking it so I would buy bottled water"

Thank you!

EPA Grant: X82952310
March 2005

Feasibility of an Economically Sustainable Point-of-Use/Point-of-Entry Decentralized Public Water System

Final Report

Prepared By

NSF International

Authors:

Gordon Bellen, NSF International, Ann Arbor, Michigan; Joseph Cotruvo, Cotruvo & Associates, Washington, D.C.; Patrick Mann, West Virginia University, Morgantown, West Virginia; Perialwar Regunathan, Regunathan & Associates Inc., Wheaton, Illinois

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Evyonne Harris, Project Officer for Assistance Agreement
Office of Groundwater and Drinking Water (OGWDW)
U.S. Environmental Protection Agency
Washington DC 20460

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Foreword

Small community water treatment has posed an enormous problem for the drinking water regulatory community, drinking water professionals, and the people living in these communities. The Safe Drinking Water Act (SDWA) and subsequent regulations require that all water in the distribution system and at every tap connected to the distribution system comply. This essentially mandates central treatment prior to entering the distribution system. For very small communities, this may be a cost that poses an undue burden. Often it could be a cost that has negative public health implications. For a very low-income family, the money spent on water treatment may not be available for other essentials. Rather than spend that money; a community may apply for a variance or exemption. Exemptions and variances are intended to be temporary solutions to regulatory compliance. They may, however, extend indefinitely leaving a community with no water that meets the regulation. Point-of-use (POU) treatment provides an alternative by treating a portion of water for less cost. The new arsenic regulation mostly affects small communities. This may be the time when this alternative treatment technology may be the best choice. This report details the feasibility and results of implementing a centrally managed POU strategy in the small community of Grimes, California.

Abstract

This project had the goal of identifying the important issues for successfully implementing a centrally managed point-of-use (POU) treatment system in a small community for the purpose of complying with the new EPA national drinking water regulation that will reduce the standard for arsenic in drinking water from 50 μg/L to 10 μg/L. Several small communities were identified in a number of states. Ultimately, the city of Grimes, California was selected because of its demographics, water quality, and the support of the California Department of Health Services (DHS). Treatment equipment was selected from a variety of options. Kinetico, Incorporated, the selected commercial manufacturer, provided the project with an activated alumina treatment system. Kinetico was selected as the vendor for the project based on its ability to donate equipment and time and the availability of a qualified dealer in the area for support. The equipment was installed in every home that agreed to participate. As the project progressed, more people in the community volunteered to have equipment installed. At the end of the project there were 122 treatment units in place including businesses and residences. Only three residents were not participating. Sampling of treated water was conducted quarterly for one year. The units were very effective, reducing arsenic at 25 μg/L to less than 2 μg/L. There were no problems with microbial growth. The units were left with the community for them to maintain. This approach was less than one half of the projected cost of central treatment for Grimes.

Feasibility of an Economically Sustainable Point-of-Use/Point-of-Entry Decentralized Public Water System

Executive Summary

The Safe Drinking Water Act (SDWA) imposes significant demands on small water systems to achieve compliance, but it also provides opportunities to devise unconventional compliance approaches that are geared to the specific problems and capabilities of small and very small communities. Numerous decentralized Point-of-Use (POU) treatment technologies have been shown by challenge testing and experience to possess the capability to reliably reduce contaminants in drinking water to below maximum contaminant levels (MCLs).

This project evaluated the approaches and methodologies for a day-to-day management, operating, and compliance system that would be within the financial reach of many very small communities. The objective was to demonstrate to the satisfaction of all stakeholders, particularly state and local decision makers, that there is a feasible procedure available to economically meet SDWA standards in very small communities. The goal is that the documented results will encourage those decision makers to apply these methods within their jurisdictions. Thus, many very small public water supplies will finally have the necessary knowledge and opportunity to provide safe drinking water to their residents. This project is intended to identify the conditions necessary for successful implementation of a centrally managed POU system strategy for compliance with the SDWA.

A project management group (PMG) was formed to help guide this project. The PMG included representatives from the US Environmental Protection Agency (EPA), Association of State Drinking Water Administrators (ASDWA), American Water Works Association (AWWA), National Rural Water Association (NRWA), and the Water Quality Association (WQA). The PMG helped develop criteria for community and equipment selection, and review and comment on project outcomes.

Criteria for the community selection included size (25-100 connections), compliance (otherwise in compliance with the SDWA), arsenic concentration (20-50 μg/L), water quality compatible with selected technologies, support from appropriate regulatory agencies, community willingness to participate, and a community with a variety of different installations; i.e. residences and businesses. The community selected was Grimes, CA. It is a small residential and farming community about 45 miles northwest of Sacramento. The arsenic concentration in Grimes was 25 μg/L; evenly split between arsenic (III) and arsenic (V). The

water was chlorinated, so for treatment purposes the arsenic was all in the +5 valence state. The community was mostly residential but did have two restaurants, a store, library, school and church. The homes varied from cabins and trailers to more typical family homes. Three volunteer town board members managed the community water supply.

Criteria for treatment equipment selection included performance, cost, and ease of use. The PMG preferred a media based product to reverse osmosis (RO). Other considerations were the inclusion of an automatic shut off device or alarm to signal when the media cartridges needed replacement, availability of a local service representative, certification against appropriate NSF International (NSF) and American National Standards Institute (ANSI) standards, a warranty, whether the manufacturer would donate the treatment units, commercial availability of the product, and ease of installation and maintenance. Several manufacturers offered equipment free of charge. A Kinetico, Incorporated activated alumina (AA) device was selected. It was composed of two AA cartridges in series followed by a granular activated carbon (GAC) cartridge. It was designed to be installed under the sink with a separate drinking water tap. It had an automatic shut off device set to activate after 500 gallons. There was a local distributor available for service during the project and after project completion. Kinetico donated the equipment for the project and a complete set of replacement cartridges for change out at project completion.

Certification of the Kinetico product for arsenic reduction under NSF/ANSI Standard 53, *Drinking water treatment units - Health effects*, was not possible because the test protocol was still in draft status at the time of the project. The product was tested against the draft test protocol for arsenic (V) reduction. It passed for a 500-gallon treatment capacity, and it also met the other requirements of the standard, such as materials safety and structural integrity. The AA media itself was certified to NSF/ANSI Standard 61 - *Drinking water system components - Health effects*. Pilot testing of the product was also conducted in Grimes prior to installation to confirm performance with Grimes drinking water and to verify that units were still producing water with non-detectable (<2 μg/L) levels of arsenic at shut off (500 gallons). The California Department of Health Services (DHS) requested that the units meet the <2 μg/L criteria instead of the MCL to provide a safety factor. Two units were run to exhaustion with their shut off devices disabled. The units were producing water containing <2 μg/L of arsenic beyond 500 gallons. The treated water did not reach 10 μg/L until approximately 800 gallons.

The spent cartridges from the pilot test, loaded with more arsenic than they would under normal operation, were tested for disposal safety according to the California Waste Extraction Test (WET) and EPA Toxicity Characteristics Leaching Procedure (TCLP) test. They passed both tests; indicating that disposal in the household trash would be acceptable.

A town meeting was held in Grimes to explain the project and encourage participation. The response was generally positive although a few individuals thought the regulation was unnecessary. As the project progressed more people participated. At the end of the project, only six residences did not have units installed, two of which already had their own RO systems. The fact that the units included GAC treatment to remove chlorine, tastes, and odors was a contributing factor to acceptance. Homeowners were asked if they would be willing to pay more for water service that included the POU devices. At the time of the project, residents paid $5 per month for water in Grimes. The average response was that they would be willing to pay $8 per month for POU treatment and $12 per month for central treatment.

Installation provided some challenges. Installations began in July, which coincided with the beginning of the harvest period. It was difficult to schedule them with residents who worked in agriculture. Also, several residents spoke very little English. The physical configuration of plumbing in some of the homes was unusual. Installation of the system in a typical modern home should take 15 to 30 minutes. Installation times in Grimes ranged from 15 minutes to 3 hours, including business installations. Note that the time the plumbers spent tracking down unusual parts and fittings was not included in the installation times, but was included in the calculation of the cost of installation.

The performance of every unit was verified at installation. All units were producing water with <2 μg/L of arsenic. Sampling continued on a quarterly basis. Most units continued to produce water with <2 μg/L of arsenic throughout the project. Very few units needed to be replaced during the 12 months of operation. A few units produced water with greater than 2 μg/L but less than 10 ppb before the shut off device activated. When arsenic was detected in the treated water at >2 μg/L, the filter cartridges were replaced immediately. The carbon filters used in this project were standard production units, but the AA cartridges were not. Kinetico discovered late in the project that the contractor filling the AA cartridges was not filling all of them to capacity. This may explain the few positive arsenic samples. Cartridges not completely filled could experience channeling through the media.

Treated water samples were also collected for heterotrophic plate count (HPC) and fecal coliform analysis. There were no positive fecal coliform samples. The geometric mean of the HPC counts from each quarterly sampling event were 134 colony-forming units per milliliter (cfu/ml), 169 cfu/ml, 255 cfu/ml, and 33 cfu/ml.

The units whose automatic shut off devices activated during the project were all in high use situations, such as the school drinking fountains, businesses, or large families.

Water meters were installed on some units as an additional indicator of use. The mean use per person per day was 0.49 gallons. Mean household usage per day was 1.26 gallons.

The sole complaint of homeowners was the low flow rate of the treated water (less than 0.5 gallons per minute). Homeowners did not object to people entering their homes for installation, sampling, and maintenance.

Costs were tracked for installation, operation and maintenance. Kinetico also provided estimated costs for installing central treatment equipment. These data were used to predict monthly homeowner costs for POU treatment and central treatment, both using AA. Costs were calculated using a projected seven-year life and a seven percent cost recovery rate. Central treatment would be $24.31. POU treatment with all cartridges changed every six months, and no sampling for equipment performance monitoring would be $18 per month. If the filter cartridges were changed annually, and every unit was sampled once per year, the monthly cost would be $14.67. Annual filter cartridge change-out with sampling from only one half of the units would drop the cost to $13.75 per month. If the units were allowed to operate until shut off device activation, with one half of the units sampled per year, the cost would be $11.46. This figure assumes that the average time to shut off is 2 years. For a community with more standard installations, monthly costs could be reduced by $3.75. Grimes costs were probably higher than average for installation, but administration costs were lower because so much of the work was volunteered in this community.