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# 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) 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 to potential solutions. The solution sets provide general information and considerations that help the homeowner to select solutions.

## 5.2 Solution Charts

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

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

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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,

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the possibility exists that a solution may not be feasible for a number of reasons, such as total cost or operational characteristics.

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### 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.

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### 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.

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**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.

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**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

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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### 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.

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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.

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### 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.

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### 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

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

<u>Potential Solution</u>	<u>Advantages</u>	<u>Disadvantages</u>	<u>Initial Cost</u>	<u>Ongoing Costs</u>
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.

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**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.

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### 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.