

MEMORANDUM

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SUBJECT: Guidance Document LPR-SRR-01-2013. Provision of Alternate Water Supplies to Operators of Petroleum-Impacted Water Supplies

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Summary:

The Virginia Department of Environmental Quality (DEQ) Storage Tank Program frequently provides carbon filtration units (CFUs) to operators whose water supplies have been impacted by petroleum. The purpose of this document is to provide guidance for staff regarding the provision and termination of CFU service at a site. This guidance replaces sections 5.3.2 through 5.3.2.2 and section 5.4.3.2.7 of the Storage Tank Program Technical Manual, Fourth Edition.

Electronic Copy:

An electronic copy of this guidance in PDF format is available for staff internally on DEQNET <http://deqnet/documents/index.asp?path=%2Fdocs%2Fwaste%2FWaste%5Fsrr%2Fremediation/Guidance>, and for the public on DEQ's website <http://www.deq.virginia.gov/Programs/LandProtectionRevitalization/PetroleumProgram/GuidanceRegulations.aspx>.

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Disclaimer:

This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.

Virginia Department of Environmental Quality

**Provision of Alternate Water Supplies to Operators of
Petroleum-Impacted Water Supplies**

DEQ Guidance Document # LPR-SRR-01-2013

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List of Acronyms

AWS – alternate water supply

CAP – Corrective Action Plan

CFU – Carbon Filtration Unit

DEQ – Department of Environmental Quality

EDB – ethylene dibromide (a.k.a. 1,2 dibromoethane)

MTBE – methyl tertiary butyl ether

RML – risk management level

RP – responsible person

UCR – usual and customary rate

1.0 Actions to Abate Hazards from Petroleum Impacted Water Supplies

Petroleum-contaminated drinking water supplies represent instances of known receptor impact and must receive the highest level of priority and attention by staff. DEQ may provide an alternate water supply (AWS) whenever petroleum constituents or fuel additives (e.g. MTBE) are detected in water supply wells. AWS, within the context of the Storage Tank Program, may include bottled water, filtration systems, water tanks, as well as connection to public water supplies and replacement wells. DEQ will, as a general practice, provide an AWS when private wells are impacted by petroleum and petroleum constituents and/or fuel additives are the primary contaminants of concern within that water supply.

Public water supplies are regulated by the Virginia Department of Health and operators of these water supply systems are required to test for contaminants (including petroleum constituents) on a routine basis. DEQ will, as a general practice, provide AWS-related assistance to the operator of a public water supply well when the following criteria are met: (1) the well is contaminated with petroleum constituents (including petroleum additives); (2) the concentration of one or more of the petroleum constituents exceeds the Virginia Department of Health's standards for public water¹; and (3) the petroleum constituents are the primary constituents of concern within the water supply. The Virginia Department of Health's Office of Drinking Water enforces drinking water regulations and standards of the Virginia Public Water Supply Law and the federal Safe Drinking Water Act. Additional questions about Virginia Drinking Water Standards should be directed to Virginia Department of Health's Office of Drinking Water at (804) 864-7500. Please see Table 5-10 of the Storage Tank Program Technical Manual for primary drinking water standards.

NOTE: DEQ Storage Tank Program may not provide alternate water supplies when wells are impacted by both petroleum and other constituents (e.g. chlorinated solvents) and those other constituents of concern are: (1) present in greater concentrations than the petroleum constituents or (2) deemed by the Virginia Department of Health to pose a greater risk to persons utilizing the water supply.

Water supplies and food safety at retail food establishments (e.g. convenience stores) are regulated by the Virginia Department of Agriculture and Consumer Services. Convenience store supply wells may be impacted by petroleum contamination when a release has occurred on site. Convenience stores or gas stations that have 15 or fewer seats on the premises at which food is served to the public and are not associated with a national or regional restaurant chain, are subject to the State Board of Agriculture and Consumer Services' Retail Food Establishment Regulations (2 VAC 5-585). Case Managers should notify the Department of Agriculture and Consumer Services' Food Safety and Security Division at (804) 786-3520 when a release has impacted the water supply of a retail food establishment.

Provided that a release is "fund eligible, costs for AWS-related activities usually are paid by VPSTF. DEQ directly accesses VPSTF to pay for CFU-related costs and applies these costs toward the responsible person's (RP's) fund limit. When a well is contaminated by petroleum and the source is unknown, staff need to inform the owner/operator of the water supply that DEQ may have to cost recover any monies spent if that owner/operator is found to be the RP for the petroleum or oil in the water supply and the petroleum or oil is from a source that is not fund eligible. The current AWS Referral Form prompts the Case Manager to discuss fund eligibility issues with the owner/operator of the water supply.

¹ The Virginia Department of Health has established a health advisory of 20 ug/l for MTBE. Additional questions about Virginia Drinking Water Standards should be directed to Virginia Department of Health's, Office of Drinking Water (804) 864-7500.

Periodically, staff members deal with pump oil in private water supplies. Oil discharged from well pumps is not fund-eligible. If analytical results or other information indicates that oil in a well appears to be from a well pump, staff should inform the owner/operator of that well that this type of discharge is not fund-eligible and DEQ will have to recover costs expended for installing/maintaining a CFU or any other AWS-related activity. In these instances, it is recommended that the owner/operator of the water supply directly deal with and pay for any AWS-related activities.

1.1 Providing Bottled Water as an Immediate Relief Measure

If petroleum constituents are discovered in a private water supply, the RP or their consultant must provide bottled water as soon as possible to ensure human health is protected and before a longer term solution can be provided. If the RP cannot or will not provide bottled water to the impacted persons, DEQ will provide bottled water via the CFU contractor or the State Lead contractor. If sampling indicates the presence of petroleum constituents, Case Managers should request bottled water be provided by the RP during the time required for the CFU contractor to perform a site assessment and install a CFU (typically two to three weeks).

When a Case Manager completes a site visit prior to receiving water supply analytical data, the Case Manager may use olfactory evidence (e.g. strong fuel odor emitting from water or visual evidence of petroleum inside supply well casing) along with professional judgment to conclude the water supply appears to be contaminated with petroleum constituents and that bottled water should be supplied to protect human health until water supply data are available and/or a CFU is provided.

1.2 DEQ-Supplied Carbon Filtration Units

Carbon filtration units (CFUs) may be provided by DEQ to operators of petroleum-impacted water supplies. DEQ's Case Managers also may request that a CFU be supplied as a pre-emptive measure even if dissolved petroleum constituents have not been detected in samples collected from that water supply.² CFUs generally are intended by DEQ to provide temporary relief from petroleum constituents in a water supply until: (1) petroleum constituents are no longer detectable in the water supply; (2) a petroleum free drinking water supply is provided to the operator; or (3) the site is completely characterized and it is demonstrated that petroleum constituents in the water supply are below the program's risk management levels (RMLs) for petroleum constituents in private drinking water supplies (see Appendix A). Procedures that staff will use to evaluate whether and when a CFU may be removed or no longer maintained by DEQ and its CFU contractor are contained in Appendix A.

DEQ staff realize that in some cases extending waterlines and connecting impacted persons to public water, installing replacement wells, or other typical ways of providing petroleum-free drinking water supplies presently are not viable options at the site. In these instances, the CFU will be maintained as an abatement tool until either the contaminant concentrations drop below the RMLs or an AWS can be provided.

² If a Case Manager requests a CFU be placed on a water supply that does not presently show detectable concentrations of dissolved petroleum constituents, the Case Manager should write a short memo to the file explaining their recommendation to place a CFU on the water supply and copy the CFU Program Manager and the State Lead Program Manager.

1.3 Water Tanks and Cisterns

Sometimes, a private water supply may be so badly contaminated by petroleum and/or have such significant problems with minerals or sediment that installing and maintaining a CFU is cost prohibitive. In these rare instances, a better course of action may be to install a water tank or cistern to provide potable water for daily use and consumption. If a Case Manager believes that a water tank or cistern will be more effective at a particular site than a CFU, the Case Manager should work with the CFU Program Manager and the State Lead Program Manager to evaluate the feasibility of installing a cistern or water tank versus a CFU as a temporary way of providing a petroleum-free drinking water supply to an impacted party until a long-term alternate water supply can be provided.

2.0 Evaluating and Selecting Long-Term Alternate Water Supplies

DEQ typically will install a CFU, even at sites where drinking water assessment samples show that petroleum constituents are present at concentrations that are below the Storage Tank Program's Risk Management Levels (RMLs). After a CFU has been installed at a site, all parties involved with the case need to evaluate the situation and decide upon a course of action for dealing with the petroleum-impacted water supply. When considering the best long-term AWS solution, RPs, consultants, and Case Managers may need to consider multiple factors including:

1. The type(s) of petroleum products and constituents involved;
2. The extent and severity of contamination in the area;
3. The degree to which the well is contaminated;
4. The availability of public water in the area;
5. The likelihood that a replacement well can be sited and provide a long-term, petroleum-free drinking water supply for the impacted party;
6. The presence of active petroleum facilities in the area and the possibility that a water supply may experience multiple periods of contamination; and
7. Costs, especially if different AWS options exist.

Staff may encounter situations where petroleum constituents in the water supply are below RMLs and another AWS option also appears to be viable (e.g. replacement well, connection to public water supply). Under the CFU procedures, a site that starts out with dissolved concentrations under the program's RMLs may immediately be placed on a disconnect monitoring schedule by the CFU Program Manager (see Appendix A). Unless the constituent concentrations in the water supply are all below detectable levels for four straight quarters, eight quarters of samples will need to be collected in order to attain the statistical confidence level required by the program. Staff may use an estimated cost of \$10,000 for installing the CFU plus two years of operation and maintenance expenses and quarterly sampling expenses when comparing the costs of immediately placing a CFU site on disconnect monitoring against other AWS alternatives.

Staff are encouraged to take a long-term view when considering AWS alternatives. The lowest cost AWS alternative for a particular site may not be the best solution if it has a much higher probability of failure than other, viable AWS options. See Example 1 on page 5.

2.1 Alternate Water Supplies and Corrective Action Plans

The provision of a permanent type of alternate water supply such as a replacement well or connection to a public water supply system is a type of corrective action and should go through the Corrective Action Plan process. It is also important that alternate water supplies be provided to the impacted parties as expeditiously as possible. Staff are encouraged to use the Interim Authorization process in order to minimize delays in the provision of an alternate water supply.

Cases involving the provision of a CFU and/or another type of AWS represent instances of documented receptor impact. Staff should, therefore, require a CAP and public notice for all cases involving the provision of alternate water supplies unless the responsible person contaminated his/her own water supply and the release is not expected to impact other receptors. If corrective actions other than the provision of an AWS are not needed, the CAP may consist of a summary of the AWS that has already been provided and any operation and monitoring schedules for that system (if applicable). Projected costs for operation

and monitoring also should be included in the CAP. The 007 UCRs provide a task for report writing (T100) and this limited CAP should be approved on a per hour basis. If the CAP preparation phase is performed under the 395 UCRs, staff may authorize work for the abbreviated CAP on a time and materials basis rather than using the task code in the UCRs for a standard CAP. See Section 5.7 of the Storage Tank Program Technical Manual for additional information regarding Corrective Action Plan procedures.

Example 1. Site with two potential AWS options

A residential well near an active gas station is contaminated by low levels of MTBE (MTBE concentration in assessment sample was 5 ug/l). A CFU is placed on the water supply. The site is characterized. There is no free product and no risks to other receptors. The only remaining corrective action needed is the long-term alternate water supply.

Staff believe the MTBE concentrations in the impacted water supply well will remain stable or decrease (i.e. the mean concentration will remain under the RML). Staff have a high degree of confidence that the CFU will be able to be removed after two years of monitoring. The projected total cost for all CFU related activities and disconnect monitoring of the water supply is \$10,000. Costs to sample monitoring wells at the site are estimated to be about \$8,000 over the next two years.

A public waterline is readily available but across the road from the residence and connection to this line will involve boring under the road. The service connection and availability fee from the water service authority is \$15,000. A preliminary cost estimate prepared by the consultant indicates that the road bore and plumbing needed to connect the house to public water is \$6,000. Costs for closing the resident's well after the service connection is made are estimated to be about \$5,000.

Option 1. Removal of the CFU after two years. Total estimated cost \$18,000

Pros: less expensive than option 2.

Cons: no absolute certainty that the CFU will be able to be removed in two years (although not expected, MTBE concentration in well could increase and/or other constituents e.g. benzene might be detected). The gas station is active. If future releases occur, might the water supply become re-contaminated?

Option 2. Connection to Public Water. Total estimated cost \$26,000

Pros: Probably a "definitive" solution to the contaminated water issue. Once the residence is connected, this pathway of exposure is gone regardless of any future releases from the nearby gas station.

Cons: More expensive than Option 1.

What is the recommended AWS for this case?

Answer: This is a judgment call that must be made by the RP/RP's consultant and the Case Manager. There is no definitively "better" choice between the two AWS options in this situation. In situations such as this, the alternatives should be considered in a CAP and the CAP should specify why one option was selected over another.

The installation of a carbon filtration unit (CFU) usually is intended by DEQ to be a temporary AWS measure until: (1) contaminant concentrations in the well remain below detection limits for four consecutive quarters; (2) contaminant concentrations in the water supply statistically are below the program's RMLs; or (3) a site can be supplied with a permanent petroleum-free alternate water supply such as a new water supply well or connection to a public water supply system. In some cases, a CFU may be the only available solution for the foreseeable future since site-specific geologic and hydrologic conditions may not be suitable for drilling a new well, access to a nearby property via an easement may

not be feasible at the present time, and a connection to a public water supply may not be available. In these instances a CAP should be prepared stating that the CFU will remain at the site as an abatement measure until either the contaminant concentrations drop below the RMLs or a permanent AWS can be provided. The CAP may consist of a summary of the CFU that has already been provided during initial abatement and an explanation why providing another type of permanent alternate water supply is not feasible at this time. Endpoints specified in the CAP should correspond with the Storage Tank Program's RMLs (Table A-1). The CAP also should contain a re-evaluation schedule whereby the RP periodically will re-assess the feasibility of providing replacement wells or public water connections to the impacted parties if drinking water is still impacted above the Storage Tank Program's RMLs. Public notice may be completed using, but not limited to, a direct mailing to impacted persons and persons potentially at-risk.

2.2 Sites Having Both Impacted Water Supplies and Other Receptors

Storage Tank Program staff periodically deal with sites where a water supply is impacted along with another type of receptor (e.g. a stream). RPs and consultants are not involved in the process of installing and maintaining CFUs and, thus, can forget about the water supply issue and focus entirely on the stream or other receptor. This loss of focus on the water supply problem may result in a case reaching its VPSTF reimbursement/funding limit without a long-term solution that addresses the impacted water supply. Staff need to be aware and also need to remind RPs/consultants that providing a long-term solution to an impacted water supply should not be subordinate to other corrective actions.

3.0 Alternate Water Supply Procedures

3.1 AWS Procedures When the Responsible Person is Known

DEQ Storage Tank Program generally will provide alternate water supplies when: (1) petroleum constituents are present in a private drinking water supply; or (2) petroleum constituents in excess of the Virginia Department of Health's standards are found in a public water system. DEQ may opt not to provide an AWS if non-petroleum constituents are present in the water supply and those non-petroleum constituents pose a greater risk than do the petroleum constituents. When water supplies are impacted or potentially impacted by petroleum and there is a known responsible person, regional staff must:

1. Ensure that the RP provides immediate relief to the impacted persons by supplying bottled water to the affected residence(s). If the RP cannot or will not provide bottled water, DEQ will provide bottled water via the CFU contractor. In rare instances, an impacted site may need a large potable water tank (cistern) for consumption and daily use; this should be arranged by the RP or their consultant after approval by the Case Manager and OSRR staff.
2. Notify the RP of their responsibility to provide a permanent potable water supply as part of their corrective action requirements under 9 VAC 25-580-10 et seq., or Article 11 of State Water Control Law. Any alternate water supply (AWS) corrective action by the RP or their consultant must be pre-approved by DEQ. Alternate water supplies for community and/or public water systems also must be approved by the Virginia Department of Health and, in most cases, must be certified by a registered professional engineer.
3. Direct the RP to collect samples at locations where regional staff believe that water supplies may be contaminated by the release. Staff have the authority to direct the RP to collect samples regardless of whether complaints of contaminated water have been received. Staff may choose to have the CFU contractor collect samples. In this instance, the Case Manager should send the CFU Program Manager an email along with a completed AWS referral form so an assessment of the impacted site can be completed. The CFU contractor will, as a matter of practice, analyze the samples collected during the initial assessment for volatiles and semivolatiles regardless of the type of petroleum source using SW846 Methods 8260B and 8270D. Additional analyses must come at the request of the Case Manager. Table 1 provides guidance regarding the types of analyses that should be performed for different potential sources. Staff should refer to Section 5.3.2.2.5 of the Storage Tank Program Technical Manual for information on requesting a CFU assessment.
4. If a long-term AWS is needed, DEQ Case Manager will direct the RP to develop a plan for the long-term provision of an AWS. This plan must be submitted to the Case Manager for concurrence. If the approved AWS plan involves the installation of a new well or connection to an existing public water supply system (connection to an existing water main), these actions should be initiated by the RP as soon as possible under the CAP Implementation Phase (Interim Authorization may be used).
5. If the approved AWS plan involves a public water supply extension (i.e. extension of a water main) or the development of a community water supply and/or treatment system, the regional Case Manager will advise the State Lead Program Manager of the selected water supply alternative. The State Lead Program Manager will then coordinate the development and implementation of the appropriate AWS with the locality.

NOTE: Connections to existing water mains are not considered public water supply extensions and must be initiated by the RP.

At all sites where DEQ has decided that the appropriate immediate initial abatement measure is to install a carbon filtration unit (CFU) on the existing water supply system, the DEQ Case Manager will advise the RP in writing that:

1. DEQ will undertake the CFU installation and Operations and Maintenance (O&M) of same.
2. All costs incurred by DEQ in providing the CFU and O&M will be applied towards the RP's dollar limit of corrective action costs from VPSTF. That is, the costs incurred by DEQ for providing the CFU/O&M and the RP's corrective action costs will be added together in determining the million dollar limit on the amount of funds that may be used from the VPSTF in performing corrective action at the site.
3. If the other (non AWS) corrective action costs total less than the RP's limit of financial responsibility, DEQ will cost recover CFU costs from the RP up to the financial responsibility limit amount.
4. DEQ will remove the CFU if contaminant concentrations drop and remain at levels below the RMLs. Staff probably will address items 1 – 4 in the same letter.

NOTE: The CFU contractor will, as a matter of practice, analyze the samples collected during the initial assessment for volatiles and semivolatiles regardless of the source using the respective Methods 8260B and 8270D. Additional analyses such as EDB and ethanol must come at the request of the Case Manager. Once the impacted water has been properly characterized, the CFU Program Manager and Case Manager will evaluate which analyses will be required during future sampling events.

3.2 Alternate Water Supply Procedures when the Responsible Person is Unknown

At sites where an impacted water supply is reported and the RP is unknown, DEQ will investigate the report and evaluate whether the water supply is contaminated. The CFU Program Manager typically will direct the CFU contractor to collect water samples from the water supply and submit the samples to their contracted laboratory for analysis. If a water supply is contaminated, the following guidelines should be used:

1. The CFU or State Lead contractor may be utilized to provide bottled water to the impacted persons. Bottled water generally will be used for individual residences as opposed to community water systems or public water supplies. In rare instances, an impacted site may need a cistern or water tank for consumption and daily use; regional staff after consulting with the State Lead Program Manager may direct the State Lead Contractor to provide this water storage device.
2. The Case Manager should notify the impacted property owner and tenant that they will be contacted by the CFU Program Manager. The Case Manager should verify all contact information and any special site directions using the AWS referral form.
3. Contact the CFU Program Manager by email and request an AWS assessment. Also staff need to

attach a completed AWS referral form

(<http://deqnet/documents/index.asp?path=%2Fdocs%2Fwaste%2FWaste%5Fsrr%2Fremediation/aws%5Fstatelead%5Fcfu%5Freferral%5Ftemplates>). Please see Section 5.3.2.2.5 of the Storage Tank Program Technical Manual for additional information about requesting an assessment.

4. The Case Manager will direct the State Lead Contractor to develop an AWS workplan. The CFUs installed by the DEQ CFU contractor will remain at the impacted site(s) until a permanent, long-term AWS solution is implemented or contaminant concentrations drop and remain below the Storage Tank Program's RMLs.
5. When the AWS to be provided is either a new well or connection to an available public water supply system, regional staff should utilize the State Lead Contractor to complete the approved corrective action.
6. When the selected, long-term (permanent) AWS is the extension of an existing public water supply system or the development of a community water supply system, the Case Manager shall advise the State Lead Program Manager of the selected water supply alternative. The State Lead Program Manager will then coordinate the development and implementation of the selected alternative with the appropriate entity for that locality.

Table 1. Decision Matrix for Water Supply Samples Collected by Responsible Persons

Contaminant Source	Ground Water Characterized? ¹	Analyses	Recommended Methods ²	Drinking Water Methods ³
Gasoline	Yes	BTEX and MTBE	8021B	502.2, 524.2
	No	Volatile organics (including MTBE)	8260B	502.2, 524.2
Petroleum products other than gasoline	Yes	BTEX and MTBE	8021B	502.2, 524.2
		Semivolatile organics	8270D	525.2
	No	Volatile organics (including MTBE)	8260B	502.2, 524.2
		Semivolatile organics	8270D	525.2
Gasoline + other petroleum products	Yes	BTEX and MTBE	8021B	502.2, 524.2
		Semivolatile organics	8270D	525.2
	No	Volatile organics (including MTBE)	8260B	502.2, 524.2
		Semivolatile organics	8270D	525.2
Leaded Gasoline	Yes	BTEX, MTBE, and 1,2 DCA	8021B	502.2, 524.2
		EDB	8011	504.1
	No	Volatile organics (including MTBE and 1,2 DCA)	8260B	502.2, 524.2
		EDB	8011	504.1
Leaded Gasoline + other petroleum products	Yes	BTEX, MTBE, and 1,2 DCA	8021B	502.2, 524.2
		EDB	8011	504.1
		Semivolatile organics	8270D	525.2
	No	Volatile organics (including MTBE and 1,2 DCA)	8260B	502.2, 524.2
		EDB	8011	504.1
		Semivolatile organics	8270D	525.2

¹ DEQ Case Manager evaluates whether the ground water at the site is sufficiently characterized to identify the potential contaminants in local water supply wells. If the Case Manager believes that the local ground water has been sufficiently characterized, he/she may direct the RP to analyze water samples for BTEX and MTBE by 8021B. If the Case Manager believes that ground water has not been sufficiently characterized or that contaminants other than petroleum constituents may be present in the water supply well, the Case Manager should direct the RP to run a complete volatile scan on the samples by method 8260 B.

² The SW-846 methods are listed as the recommended methods. Staff may allow the use of other analytical methods as deemed appropriate.

³ The drinking water methods are approved by EPA for detecting contaminants in drinking water.

NOTES: 1. Samples collected as part of the Alternate Water Supply Program during the initial site assessment will be analyzed for both volatile organics and semivolatile organics. Additional analysis must come at the request of the Case Manager on the AWS referral form.
2. Method 8260 can be used if EDB is a constituent of concern at the site; however, this method cannot achieve detection limits for the EDB MCL. Method 8011 or Method 504.1 should be used to reach the MCL of 0.05 ug/l if one is sampling to determine the presence of EDB in a drinking water supply.
3. Methods 8260B may be used to test for ethanol. Ethanol is not a typical "target analyte" of this method, however, and persons needing this information specifically need to request the lab report ethanol.

4.0 Drinking Water Standards and Remedial Endpoints

Remedial endpoints used by the Storage Tank Program are site-specific and risk-based. Moreover, remedial endpoints are based upon actual risks to current receptors and known future receptors (see Section 5.4.3.2.2 of the Storage Tank Program Technical Manual for additional information on endpoint determination and future use). Drinking water is only a pathway of concern when ground water in the area near the release is presently used as a drinking water source or plans have been filed with a governmental entity for using the ground water as a drinking water source.

DEQ Storage Tank Program does not use promulgated drinking water standards (i.e. EPA's MCLs, the Virginia Health Department's Drinking Water Standards) as cleanup endpoints for petroleum constituents in ground water. Some MCLs and drinking water standards may have been developed considering both risk and treatment technology and they do not necessarily meet the Storage Tank Program's risk management thresholds.

DEQ Storage Tank Program considers the cleanup of the source area to endpoints that prevent impacts to water supplies to be the preferred method of protecting drinking water supplies. DEQ staff, tank owners/operators, and consultants need to be aware, however, that current cleanup technologies may not be able to prevent drinking water supplies from becoming contaminated at certain sites. The tank owner/operator and consultant must consider remedial alternatives related to both the cleanup of contaminants and the permanent provision of alternate water supplies in any situation where water supplies have been impacted or may be impacted by the release.

NOTE: The provision of an alternate water supply that is highly unlikely to become contaminated may be the preferred course of action in those instances where the source is still active (i.e. the storage tanks are still being used) and future releases are possible.

Appendix A

Procedures for Evaluating a Site for CFU Removal

Once the Storage Tank Program provides a CFU, samples from the water supply will be analyzed as part of the routine operation and maintenance of the system. When concentrations of all constituents are either below the method detection limits or below the program's risk management levels (RMLs; Table A-1) for two consecutive sampling events, the site will be placed on a quarterly monitoring program unless the Case Manager informs the CFU Program Manager that the site should remain on the regular O&M schedule. The CFU will be removed when: (1) all constituents are below the method detection limits for four consecutive quarters; or (2) the mean concentration of each constituent of concern is statistically below the RML for the constituent as outlined below. The overall procedure for evaluating a site for CFU removal may be found in Figure A-1.

Constituent of Concern	Risk Management Level, ug/l	Source
Benzene	0.39	DEQ VRP Tap Water RSL
Toluene	86	DEQ VRP Tap Water RSL
Ethylbenzene	1.3	DEQ VRP Tap Water RSL
Total Xylenes	19	DEQ VRP Tap Water RSL
Methyl tert-butyl ether	12	DEQ VRP Tap Water RSL
Di-isopropyl ether (DIPE)	150	DEQ VRP Tap Water RSL
TAME	12	Set at same level as MTBE
TBA	10	NC drinking water guideline
TAA	10	Set at same level as TBA
Naphthalene	0.14	DEQ VRP Tap Water RSL
2 methyl naphthalene	2.7	DEQ VRP Tap Water RSL
acenaphthene	40	DEQ VRP Tap Water RSL
pyrene	8.7	DEQ VRP Tap Water RSL
Ethylene dibromide (EDB)	0.0065	DEQ VRP Tap Water RSL
1, 2-dichloroethane (1,2-DCA)	0.15	DEQ VRP Tap Water RSL
Ethanol	760,000	California Secondary MCL
Acetone	120	DEQ VRP Tap Water RSL
Methyl Ethyl Ketone (MEK)	490	DEQ VRP Tap Water RSL

Procedure for Establishing or Revising Risk Management Levels for Constituents in Drinking Water

Storage Tank Program staff have developed drinking water risk management levels (RMLs) using the procedures listed below. Most of the RMLs used by the Storage Tank Program correspond with drinking water risk screening levels (RSLs) used by Virginia's Voluntary Remediation Program. The RMLs used by the Storage Tank Program will be updated as needed so that they are in agreement with the most current VRP RSLs.

Staff will re-evaluate RMLs that were derived from a source other than the VRP at least once per year and determine if changes to the RML need to be made based upon new information. If a VRP RSL does not exist for a particular constituent, Storage Tank Program staff may use a screening level from other

sources as outlined below:

1. Storage Tank Program staff will derive a RML using VRP risk and exposure protocols if a slope factor and/or reference dose for the constituent is available.
2. Storage Tank Program Staff will use the lower of:
 - a. Federal MCL (it is unlikely that one will exist if VRP RSL does not exist); or
 - b. Risk-based drinking water standard, guideline recommendation, from Virginia's Health Department or another state if a VRP RSL is not available.
3. Taste and odor threshold for the constituent.
4. Other screening threshold as approved by DEQ Storage Tank Program Staff and Management (e.g. may be assigned a RML equal to that for a similar chemical).

Table A-2 shows screening and regulatory levels for selected petroleum constituents in drinking water supplies.

Procedure for Evaluating When a CFU may be Removed

Samples from the water supply typically are analyzed as part of the routine operation and maintenance of carbon filtration systems. When concentrations of all constituents in the "raw" water supply are below the program's RMLs (Table A-1), the Case Manager will use their knowledge of site conditions including apparent trends in ground water monitoring data to decide if the site should be evaluated for placement on a quarterly, "disconnect" monitoring program. OSRR staff also may approach the Case Manager and ask if a particular site should be evaluated for placement on a quarterly "disconnect" monitoring program. Staff should especially pay attention to the concentration of petroleum constituents in both source area and "sentinel" monitoring wells when making a decision to recommend a site for disconnect monitoring. The Case Manager along with the CFU Program Manager usually will decide when a case should be placed on disconnect monitoring. If a Case Manager believes that case specific factors warrant a statistical trend test be performed on monitoring well data, they should discuss this with the State Lead Program Manager.

Statistical Trend Analysis on Ground Water Data (if needed by the Case Manager)

It is not anticipated that staff will routinely need a statistical trend analysis in order to evaluate ground water monitoring data. If staff want a statistical trend test to be performed, at least six observations (i.e. sample results) from each monitoring well are needed to achieve the desired confidence level of 95% for the trend analysis. The Case Manager will need to provide the State Lead Program Manager with an excel spreadsheet that contains, at a minimum, results of the previous six ground water monitoring events. The Case Manager also will provide information regarding which monitoring wells are considered "source area" wells and which ones are "sentinel" wells. The State Lead Program Manager or one of the regional staff serving as Storage Tank Program statisticians will evaluate the monitoring well data using the Mann-Kendall trend test (Gilbert 1987) to determine if a trend exists. If the data from the source wells and any sentinel wells show either stable or decreasing trends, the program statistician will recommend that the CFU be placed on a quarterly disconnect monitoring schedule. If data from any source area wells or sentinel wells show an increasing trend, the statistician will recommend continued operation and maintenance of the CFU and continued ground water monitoring in the monitoring wells in accordance with existing schedules.

Table A-2. Pertinent Screening and Regulatory Levels for Petroleum Constituents in Drinking Water Supplies.

Contaminants of Concern	CAS No.	EPA R3 RBC Tap Water (a), ug/l	DEQ VRP Tap Water, ug/l	Federal Maximum Contaminant Level (MCL), ug/l	MCL Goal (MCLG), ug/l	California's MCL ug/l	California's Secondary MCL: Taste & Odor, ug/l	other standards or recommendations, ug/l
Benzene	71-43-2	0.39	0.39	5	0	1	170	
Toluene	108-88-3	860	86	1000	1000	150	42	
Ethylbenzene	100-41-4	1.3	1.3	700	700	300	29	
Total Xylenes	1330-20-7	190	19	10000	10000	1750	17	
Methyl tert-butyl ether	1634-04-4	12	12	<i>Candidate for MCL</i>		13	5	20 - 40 (MA secondary MCL), 70 (MCL, NJ), 10 (NY DW standard), 40 (WY dw equivalent level)
Di-isopropyl ether (DIPE)	108-20-3	1500	150				0.8	30 (MI), 50 (NY guideline), 100 (CT DW action limit), 1200 (WY dw equivalent level)
TAME	994-05-8							128 (NC), 90 (MA guideline), 50 (NY guideline), 100 (CT DW action limit), 128 (WY dw equivalent level)
TBA	75-65-0							10 (NC), 120 (MA guideline), 50 (NY guideline), 100 (CT DW action limit), 220 (WY dw equivalent level)
TAA	75-85-4							50 (NY guideline), 100 (CT DW action limit)
Naphthalene	91-20-3	0.14	0.14			170	21	140 (MA MCL), 170 (CA notif. level), 100 (WI DW Standard), 300 (NJ MCL), 700 (WY dw equivalent level)
2 methyl naphthalene	91-57-6	27	2.7					
acenaphthene	83-32-9	400	40					
pyrene	129-00-0	87	8.7					
Ethylene dibromide (EDB)	106-93-4	0.0065	0.0065	0.05	0	0.05		.02 (MA MCL)
1, 2-dichloroethane (1,2-DCA)	107-06-2	0.15	0.15	5	0	0.5		
Ethanol	64-17-5						760000	
Acetone	67-64-1	1200	120					6300 (MA guideline)
Methyl Ethyl Ketone (MEK)	78-98-3	4900	490					4000 (MA guideline)

Disconnect Monitoring

Once all constituents in a water supply are confirmed by DEQ staff to be below the applicable RMLs, the Case Manager and the CFU Program Manager may decide to place the site on disconnect monitoring. Once a site is placed on disconnect monitoring, the CFU contractor will collect raw water samples from

the water supply on a quarterly schedule.

1. If constituent concentrations for any four consecutive quarters are all below detection limits, the CFU manager and the Case Manager will decide if the CFU may be removed.
2. If constituent concentrations do not remain below detectable limits for four consecutive quarters, the CFU contractor will collect water supply samples for at least 8 consecutive quarters. If the concentration of any constituent reported during this time appears to be unusual within the context of recent site data, the CFU Program Manager or State Lead Program Manager may contact the CFU contractor and the lab to find out if a sampling or lab error may have biased the sample.
3. At the end of eight consecutive quarters or other time period as decided upon by the CFU and Case Managers, the raw water data will be evaluated to determine if the CFU may be removed.
4. The Case Manager will qualitatively screen or evaluate the raw water data from the CFU sampling events and look both at the concentration trend over time and the apparent mean concentration versus the RML. Staff are not expected to calculate the mean concentration at this time. The term "apparent mean" is meant to be an uncalculated, estimated mean where the Case Manager quickly looks at the concentrations and decides if the mean appears to be below the RML.
 - a. If the contaminant concentrations in the water supply appear to either be stable or decreasing, the Case Manager should next evaluate the apparent mean of the data.
 - b. If the contaminant concentrations appear to be increasing, the CFU site probably is not, at present, a good candidate for CFU removal. The Case Manager and the CFU Program Manager will decide:
 - i. to continue with disconnect monitoring
 - ii. to terminate disconnect monitoring and revert to regular O&M schedule until constituent concentrations appear to stabilize
 - c. If the mean concentration of one or more constituents appears to be greater than the program's RML for that constituent in drinking water, the Case Manager and the CFU Program Manager will decide:
 - i. to continue with disconnect monitoring
 - ii. to terminate disconnect monitoring and revert to regular O&M schedule until all constituents in the well appear to stay below the screening levels.
 - d. If the mean concentration of all constituents appears to be below the applicable RMLs, the Case Manager will notify the State Lead Program Manager and request that a statistical analysis be performed on the raw water data to determine if the CFU may be removed.
5. The State Lead Program Manager or one of the Storage Tank Program's statisticians will evaluate the raw water data to determine if: (1) the data exhibit a stable or decreasing trend; and (2) the upper confidence limit (UCL) for the mean of each constituent is less than the program's RMLs.
 - a. If the data do not exhibit a statistically significant increasing trend, the statistician will evaluate the UCL of the mean of each constituent against the program's RML for that constituent.
 - b. If the raw water data appear to be below the RMLs, the program statistician will recommend to the CFU Program Manager and the Case Manager that the CFU be removed.

- c. If the raw water data indicate that the upper confidence limit of the mean for one or more constituents is greater than the corresponding RML, the program statistician will notify the Case Manager and the CFU Program Manager and they will decide whether to continue with disconnect monitoring or place the CFU back on a regular O&M schedule.

Risk Management Levels (RMLs) and Method Quantification and Detection Limits

The RMLs for a number of constituents are below method quantification levels and, in some cases, even below method detection limits. The DEQ Storage Tank Program expects labs to meet the requirements for individual methods. If a lab has met the method requirements, but their method detection limit is above the RML, Storage Tank Program staff will deal with the constituent on the basis of presence/absence.

Staff Responsibilities Within CFU Program

CFU Program Manager

1. Manages CFU contractor. If the CFU Program Manager is out of the office, management of the CFU contractor is performed by: a. OSRR's Program Assessment Specialist; and b. the State Lead Program Manager.
2. Enters water supply well analytical data into CEDS. The CFU Program Manager often is the person who observes that water supply well data are below RMLs or detection limits and may make a recommendation to the Case Manager that a CFU site be placed on disconnect monitoring.

Case Manager

Day-to-day management of the pollution complaint case.

1. The Case Manager decides if a CFU should be provided for a particular site.
2. The Case Manager completes the AWS Referral form, confirming the data and addressing specific topics on the second half of the form. Once the well owner has been contacted and the form is complete, the Case Manager e-mails the referral form to the CFU Program Manager. Since modifications to the form are made by OSRR staff, OSRR is the file of record for these forms and uploads the form into ECM.
3. The Case Manager directly interacts with the owner of the impacted drinking water well about proceeding towards a permanent alternate water supply.
4. The Case Manager periodically evaluates water supply well data and recommends to the CFU Program Manager that a CFU be placed on disconnect monitoring.
5. The Case Manager will qualitatively screen disconnect monitoring data and request statistical analysis of data as appropriate.
6. After the AWS is complete, the Case Manager:
 - a. Ensures that the consultant properly disconnects the CFU prior to hooking up the new water supply source.
 - b. Immediately notifies the CFU Program Manager that the AWS is complete so that the CFU Program Manager may arrange for the CFU Contractor to retrieve the CFU from the site.

Case Manager and CFU Program Manager (joint responsibility)

1. Place site on disconnect monitoring.
2. Remove CFU from site.
3. Terminate disconnect monitoring and return CFU site to regular O&M schedule

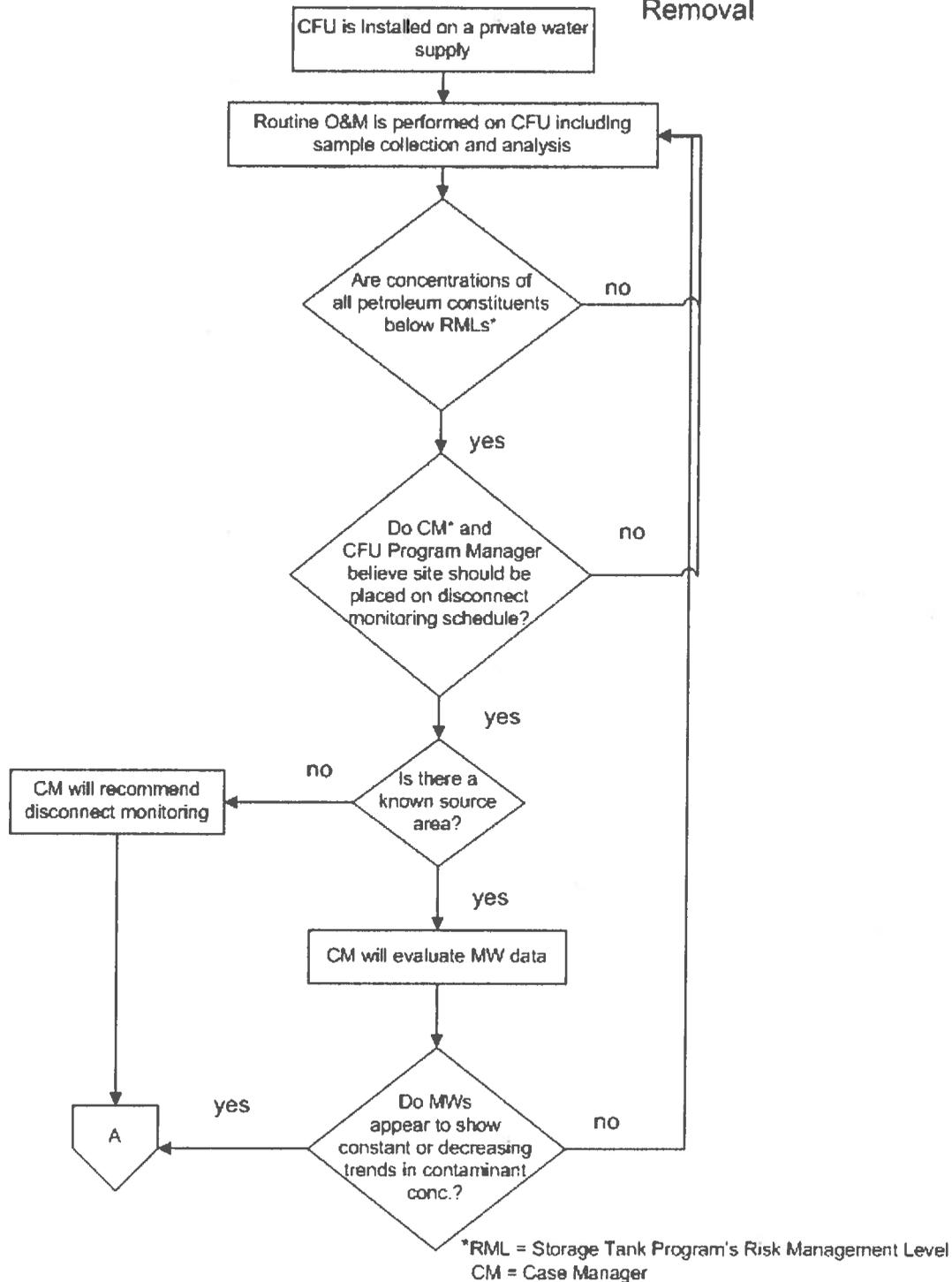
State Lead Program Manager

1. Manages CFU contract revisions and modifications.
2. Receives requests for statistical analyses at CFU sites from Case Managers
3. Ensures that statistical analyses are performed and results/recommendations are provided to the Case Manager

Storage Tank Program Statistician (staff trained in statistical analyses and the State Lead Program Manager)

1. Evaluates water supply data
 - a. Informs Case Manager if statistical analyses indicate UCL of mean of all constituents are less than RMLs. If so, will recommend CFU removal.
 - b. Informs Case Manager of statistical exceedance (UCL of mean of one or more constituents exceeds RML). Statistician also will make recommendations as appropriate such as... "the UCL of the mean for one constituent is barely above the RML, recommend continuing with disconnect monitoring," or " the UCL of the mean for one or more constituents is/are way above the RML, recommend returning to regular O&M schedule.
2. Evaluates trends in monitoring well data as requested by the Case Manager.

Figure A-1. Procedure for evaluating a site for CFU Removal



Appendix B

Statistical Procedures for the CFU Program

follow neither a normal nor a gamma distribution, a non-parametric test as described below will be used to evaluate the UCL of the mean.

The presence of petroleum constituents in a drinking water supply indicates that persons are likely to come into contact with petroleum. In this type of instance, the Storage Tank Program wants to ensure, to the extent possible, that risks from exposure are below the program's risk based thresholds. Staff, therefore, will use an UCL of the mean calculated at 99% level in order to have a high degree of confidence that the mean concentration of constituent(s) in the water supply will remain below the program's RMLs. As with the Mann-Kendall test above, it is expected that staff will use the ProUCL software to calculate the upper confidence limit of the mean.

- a. If the raw water data appear to be below the RMLs, the program statistician will recommend to the CFU Program Manager and the Case Manager that the CFU be removed.
- b. If the raw water data indicate that the UCL of the mean for one or more constituents is greater than the corresponding RML, the program statistician will notify the Case Manager and the CFU Program Manager and they will decide whether to continue with disconnect monitoring or place the CFU back on a regular O&M schedule.

Example data set from the Smith Residence.

MTBE data, all values in ug/l

11, 9.7, 6.8, 5.8, 5.1, 1.6, 3.3, 3.5

Example of a Mann-Kendall test printout from ProUCL

General Statistics		
Number of Values	8	
Minimum	1.6	
Maximum	11	
Mean	5.85	
Geometric Mean	5.01	
Median	5.45	
Standard Deviation	3.227	
SEM	1.141	
Mann-Kendall Test		
Test Value (S)	-22	
Tabulated p-value	0.002	
Standard Deviation of S		8.083
Standardized Value of S		-2.598
Approximate p-value		0.00469

Statistically significant evidence of a decreasing trend at the specified level of significance.

Appendix B

Statistical Procedures for the CFU Program

The statistical analyses outlined below will be used by staff as aids when making decisions about removing a CFU from a site when petroleum constituents still may be detected in that water supply. Figure B-1 shows the steps that DEQ staff will use when evaluating water supply data for possible CFU removal. This guidance document will not cover the mathematics involved with performing the various statistical procedures discussed below. If staff want additional information about statistical tests, they may refer to the references cited at the end of Appendix B.

Trend Analysis

If a Case Manager requests a statistical analysis to determine if a CFU may be removed, the first step in the data analysis process is to perform a trend analysis. Staff will use the Mann-Kendall test to determine if water supply well data exhibit a trend. The Mann-Kendall test (Gilbert 1987) is a non-parametric test for a linear trend based on the idea that a lack of trend should correspond to a time series plot fluctuating randomly about a constant mean with no apparent upward or downward trend. The Mann-Kendall statistic (S) is derived by computing the difference, positive or negative, between each pair of data points (EPA 2006). If S is a large positive value, then there is evidence of an increasing trend. Likewise, a large negative value for S suggests a decreasing trend.

The Mann-Kendall test may be used for data sets of as few as six samples. Since at least eight samples are needed to evaluate the upper confidence limit of the mean at the significance level required by the Storage Tank Program, the Mann-Kendall trend test also should be run on the same set of data.

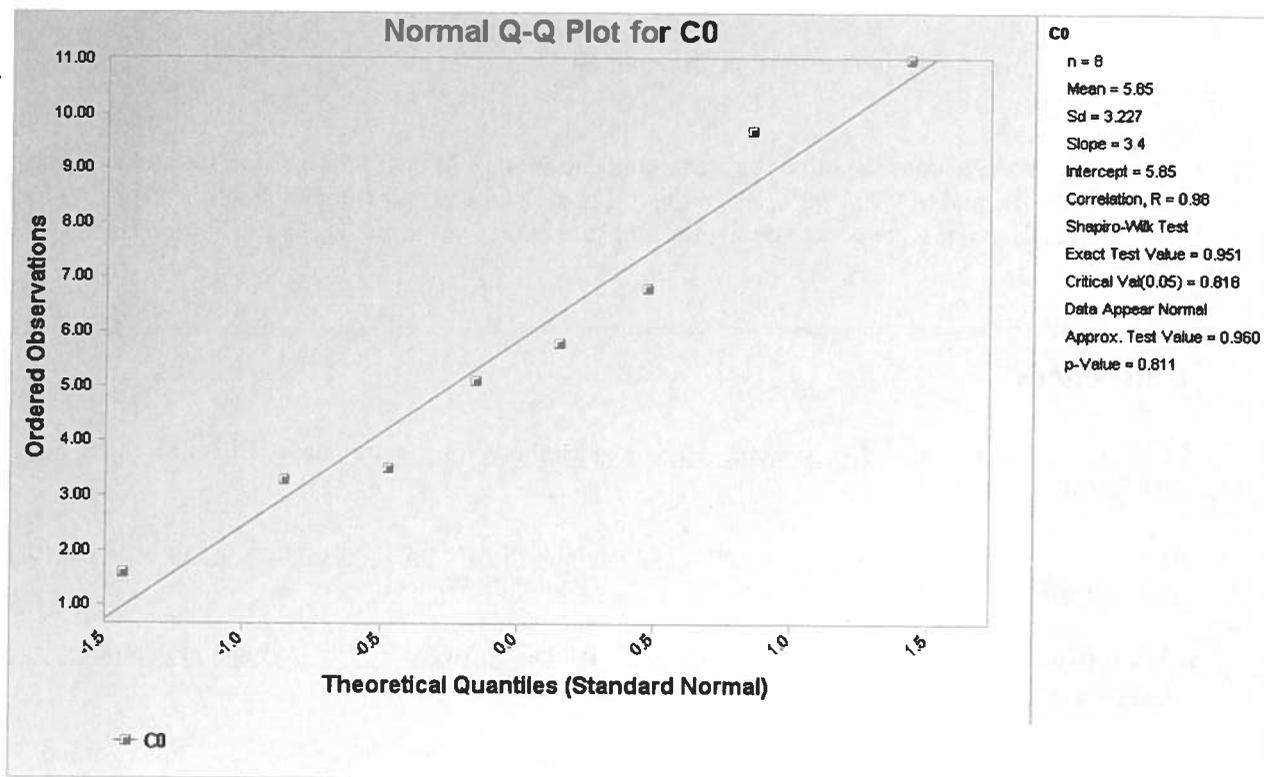
At the time of this writing, it is expected that staff will use ProUCL 4.1 (EPA 2010), a statistical package from EPA, to perform a Mann-Kendall trend test. Staff performing the Mann-Kendall trend test on water supply data will use a significance level of .05 (i.e. 95%) for evaluating trends. The null hypothesis in the Mann-Kendall test is that the data exhibit no trend. Provided that the water supply data show either a decreasing trend or no trend at the specified significance level, staff may proceed to evaluate the upper confidence limit of the mean.

Statistical Procedure for Determining the Upper Confidence Limit of a Sample Mean

Provided that the water supply data either show a decreasing trend or no trend at the specified confidence level, DEQ staff will compare the upper confidence limit (UCL) of the mean of at least the eight most recent raw water samples against the DEQ Storage Tank Program's RML concentration for that constituent.

The first step is to determine if the data set exhibits a type of distribution (e.g. normal, gamma) or appear to follow no type of distribution. The goodness of fit testing within the ProUCL statistical package should be used to evaluate the data distribution. First, staff should select the goodness of fit test for a normal distribution to determine if the data follow a normal distribution. The significance level in the statistical package should be set at 95% and the Shapiro-Wilk test should be used to check for normality. If the data appear to be normally distributed, staff should proceed with a UCL evaluation for normally distributed data. If the data are not normally distributed, staff should use the goodness of fit test in ProUCL to determine if the data appear to follow a gamma distribution. If the data follow a gamma distribution, staff should evaluate the UCL of the mean for gamma distributed data. If the data appear to

Example of a goodness of fit test for normality, ProUCL



Normal UCL Statistics for Full Data Sets (from ProUCL)

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	99%

C0

Number of Valid Observations	8
Number of Distinct Observations	8
Minimum	1.6
Maximum	11
Mean	5.85
Geometric Mean	5.01
Median	5.45
SD	3.227
Variance	10.41
Std. Error of Mean	1.141
Coefficient of Variation	0.552
Skewness	0.497
Shapiro Wilk Test Statistic	0.951

5% Shapiro Wilk Critical Value 0.818
Data appear Normal at 5% Significance Level

99% UCL (Assuming Normal Distribution)
Student's-t UCL 9.271

We are 99% confident that the mean concentration of MTBE in the Smith's water supply is less than or equal to 9.271 ug/l. Since this UCL of the mean is less than the RML of 12 ug/l for MTBE in a private water supply, the statistician may recommend removal of the CFU.

References

EPA. 2006. Data Quality Assessment: Statistical Methods for Practitioners. EPA QA/G-9S. EPA/240/B-06/003.

EPA. 2010. ProUCL Version 4.1 (Draft). Statistical Software for Environmental Applications for Data Sets with and without Non-detect Observations. EPA/600/R-07/041.

EPA. 2010. ProUCL Version 4.1.00 (Draft). Statistical Software for Environmental Applications for Data Sets with and without Non-detect Observations. EPA/600/R-07/041.

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold. New York.

Figure B-1. Statistical procedure for evaluating water supply data

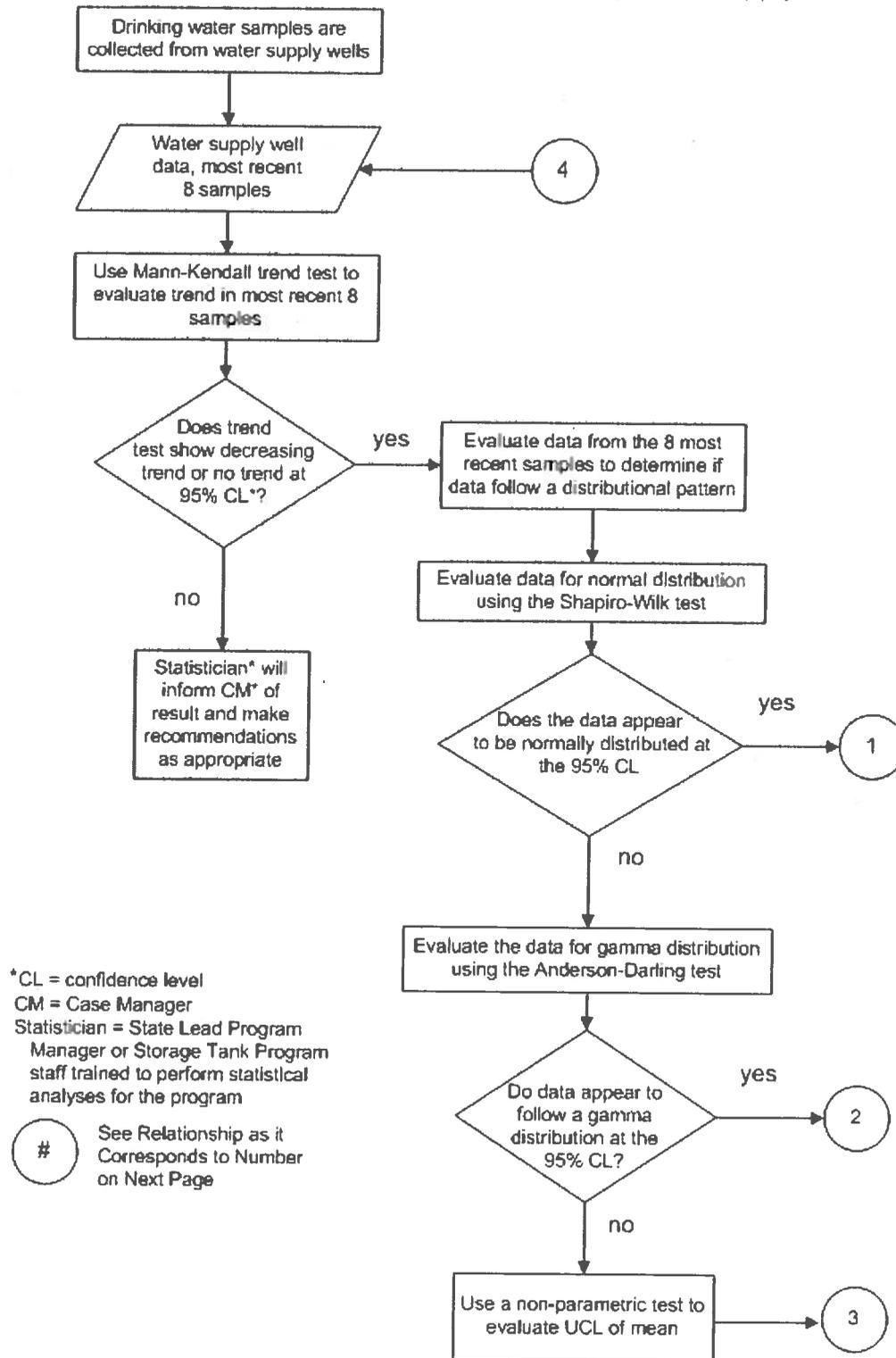


Figure B-1. Statistical procedure for evaluating water supply data, continued.

