RG-211
Revised May 2013

# Monthly Testing and Reporting at Surface Water Treatment Plants

**(Forms TCEQ-00102-C, -00103, -10276, -10277, and -10278)**

Water Supply Division

Texas Commission on Environmental Quality

printed on
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# Monthly Testing and Reporting at Surface Water Treatment Plants (Forms TCEQ-00102C, -00103, -10276, -10277, and -10278)

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RG-211
Revised May 2013

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# PREFACE

This publication contains guidance for public water systems (PWSs) that treat surface water (SW) or groundwater that is under the direct influence of surface water (GUI). These systems must ensure that the water they produce is safe to drink by removing and inactivating pathogens. Pathogen removal is determined by measuring turbidity, and pathogen inactivation is determined by measuring the amount of disinfectant in the water.

For systems that have on-line turbidimeters for each filter, the turbidity and disinfectant residual must be measured and reported using the Surface Water Monthly Operating Report (SWMOR) spreadsheet. A few small systems that have only one or two filters will report their data using the SWMOR2 spreadsheet. Both types of plants will submit the results of any special studies that are required on the Filter Profile Report or the Filter Assessment Report forms.

The specific reporting requirements for the values that must be reported on the SWMOR and SWMOR2 are contained in Title 30, Texas Administrative Code, Chapter 290 (30 TAC 290), Subchapter F: Drinking Water Standards Governing Drinking Water Quality and Reporting Requirements for Public Water Supply Systems. Sections 290.110 (relating to Disinfectant Residuals) and 290.111 (relating to Surface Water Treatment) contain the monitoring and reporting requirements for turbidity, disinfection, and disinfectant residuals. Section 290.112 (relating to Total Organic Carbon) contains the requirements for TOC monitoring, removal, and reporting. Section 290.122 (relating to Public Notification) contains the public-notification requirements described in this manual.

You can find links to the Secretary of State's official version of these rules at the TCEQ website:

www.tceq.texas.gov

From the home page, click on "**Rules**" and then use the links to view the rules online. The official version of these rules was published in the *Texas Register* on May 6, 2011.

### "We" and "You" in This Guide

"We" as used in this guide refers to the Texas Commission on Environmental Quality—specifically, the TCEQ's Water Supply Division.

In this guide, "you" means the person who must sign the SWMOR or SWMOR2 each month. Under the rules, this person must be the certified surface water treatment plant operator who is responsible for the daily supervision of the plant.

### Other Applicable Rules

Public water systems should also be aware of other rules about drinking water found in other parts of the Texas regulations. A public water system must comply with all the applicable requirements. Some examples of additional rules are given below:

**30 TAC Chapter 290, Subchapter D:** Rules and regulations for public water systems related to requirements for water treatment plant design, operation, and maintenance. If you have questions about Subchapter D, contact the TCEQ public drinking water program at 512-239-4691 or <PDWS@tceq.texas.gov>.

**30 TAC Chapter 290, Subchapter E:** Requirements regarding the Public Health Service (PHS) fees for public water systems. If you have questions about Subchapter E, contact the TCEQ's public drinking water program at 512-239-4691 or <PDWS@tceq.texas.gov>, attention "PHS Fees."

**30 TAC Chapter 290, Subchapter F:** Requirements regarding harmful or potentially harmful constituents for water systems that supply potable water to the citizens of Texas. If you have questions about Subchapter F, contact the TCEQ's public drinking water section at 512-239-4691 or <PDWS@tceq.texas.gov>.

**30 TAC Chapter 290, Subchapter H:** Rules and regulations for community public water systems related to Consumer Confidence Reports. If you have questions about Subchapter H, contact the TCEQ Public Drinking Water Section at 512-239-4691 or <PDWS@tceq.texas.gov>.

**30 TAC Chapter 291:** Rules and regulations for water utilities related to requirements for rates, capacity development, and Certificates of Convenience and Necessity for utilities. Contact the Water Utilities Rates and Districts Section at 512-239-6960 or <UTILDIST@tceq.texas.gov> if you have questions about these requirements.

**30 TAC Chapter 293:** Requirements for water districts. Contact the Water Utilities Rates and Districts Section at 512-239-6960 or <UTILDIST@tceq.texas.gov> if you have questions about these requirements.

**30 TAC Chapter 30, Subchapters A and K:** Requirements for licensing of water works operators. The TCEQ's Operator Licensing Division can answer questions about these requirements at 512-239-6133.

**30 TAC Chapter 25:** Requirements for laboratories used by public water systems. If you have questions about lab certification or accreditation, contact the TCEQ Quality Assurance Section at 512-239-5420.

**16 TAC Part 4, Chapter 76:** Requirements for water well drillers. If you have questions about these regulations, call 800-803-9202 or 512-463-8876 or <water.well@license.state.tx.us>.

The Department of State Health Services (DSHS) implements federal Food and Drug Administration and Texas regulations for water haulers, water bottlers, water vendors, restaurants, day-care facilities, hospitals, and other businesses and authorities that may own or operate public water systems. It is highly recommended that business owners and operators review the DSHS rules to determine whether they apply to them.

If you have questions about the rules in this guidance manual, contact the Texas Commission on Environmental Quality public drinking water program at 512-239-4691 or <PDWS@tceq.texas.gov>.

This “regulatory guidance” document does not take the place of the full, official TCEQ rules. The document is intended only as a general explanation about selected parts of 30 TAC Chapter 290 (or any other TCEQ rules that might be referred to.)

# GLOSSARY

**ACC—alternative compliance criteria:** A group of eight options that a plant can use to demonstrate that it has achieved optimum TOC removal even though it has been unable to achieve a Step 1 or Step 2 removal ratio of at least 1.0.

**baffling characteristics:** The design features of a disinfection contact basin that determine how effectively the basin prevents water from passing through it before being adequately disinfected.

**BWN—Boil Water Notice:** A notice sent by public water systems to their customers, informing them that they should boil their drinking water to kill potentially harmful bacteria. Public water systems that violate regulations related to the protection of potentially immediate health risks must send customers a BWN in addition to their required public notice for the violation.

**CAP—corrective-action plan:** A written plan to improve specific design, operational, maintenance, or administrative problems at a public water system. A CAP will fall into one of two categories: (1) a voluntary CAP that is prepared as soon as the water system identifies a problem, or (2) a mandatory CAP that must be prepared following a mandatory comprehensive performance evaluation. The voluntary CAP should include (and the mandatory CAP must include) specific actions that a water system will take to correct a problem and the schedule for implementing those changes.

**cell:** A spot on the spreadsheet where data can be recorded. It is the intersection of a specific row and column. For example, the first cell in a spreadsheet is cell "A1" and is located at the point where column "A" and row "1" intersect.

**CFE—combined filter effluent:** The water produced by all of the filters at a surface water treatment plant after it has been blended. The CFE is the combined water from the individual-filter-effluent (IFE) streams. At most plants, CFE measurements are conducted on the water entering the clearwell—although, at plants with more than one clearwell fill line, the samples may need to be collected at the outlet of the clearwell. A plant must obtain our approval to use a CFE turbidity monitoring point that is not located on the clearwell fill line. The CFE is also frequently called "treated" or "finished" water.

**comment box:** A note that is attached to a single cell in a spreadsheet. In the case of the SWMOR, the comment box contains useful information to help you enter the proper data in the cell.

**CPE—comprehensive performance evaluation:** An extensive analysis of the design, operation, maintenance, and administration of a surface water treatment plant that is conducted to identify the factors that are limiting the facility's ability to produce high-quality drinking water. A public water system may have a CPE conducted as part of a voluntary effort to improve the performance of its surface water treatment plant; these CPEs are referred to as voluntary, or optimization, CPEs (oCPEs). If a treatment plant has individual-filter-effluent turbidity readings that exceed 2.0 NTU for two consecutive months, we will require the water system to participate in a mandatory CPE conducted by a third party; this kind of CPE is called a mandatory, or compliance, CPE (mCPE). At plants that are allowed to monitor CFE instead of monitoring IFE, the exceedance is based on the turbidity level of the combined filter effluent instead of the turbidity level at the effluent of an individual filter.

**clearwell:** A storage unit, usually located at the plant site, that contains treated water before it is pumped to the distribution system. Some plants refer to their clearwells as "ground storage tanks."

**CT:** The result when the disinfection concentration at the end of a disinfection zone, C, is multiplied by the contact time, $T_{10}$, within the disinfection zone.

**CT study:** An evaluation of the disinfection protocol, or process, used at a treatment plant. The purpose of the CT study is to identify the number of disinfection zones at a plant; determine the effective contact time, or $T_{10}$, available in each zone; and define the minimum level of disinfection that must be provided at the plant.

**CT-study-approval letter:** The letter that the TCEQ sends when it approves a proposed disinfection protocol. The letter identifies the approved disinfection zones and establishes the relationship between the flow rate through that zone and the disinfectant contact time, or $T_{10}$, within the zone.

**CT-study template:** A Microsoft Excel workbook that contains the macros needed to define up to 10 disinfection zones. The workbook is used to evaluate alternative disinfection protocols and is submitted to the TCEQ when requesting permission to revise a plant's disinfection protocol.

**disinfection zone:** A segment of the treatment plant where disinfection occurs. A disinfection zone contains one or more treatment units and the associated piping. A disinfection zone is defined as that section of the plant starting at a disinfectant injection or monitoring point, and ending at the subsequent disinfectant injection or monitoring point. Every disinfectant injection point is the start of a new disinfection zone, even if it is not always used. Every injection point must have an associated monitoring point. However, a plant may have only one disinfectant point and choose to monitor at more than one point, creating multiple disinfection zones.

**distribution system:** The system of pipes that delivers treated water to customers. Typically, the distribution system does not begin until the water leaves the grounds of the treatment plant.

**effluent:** The point where water leaves a treatment unit, such as a filter.

**event:** A single isolated occasion when something (usually bad) happens. The event begins when the abnormal condition starts occurring and ends when normal conditions are reestablished. For example, a single elevated IFE turbidity event begins when the desired turbidity level is exceeded and does not end until the desired turbidity level is reached again.

**filter assessment:** A comprehensive evaluation of design, maintenance, operation, and performance of an individual filter and its associated facilities.

**filter exceedance:** In the context of this manual, a filter exceedance is an event when the water produced by an individual filter has a turbidity level above the performance goal established by the TCEQ for two consecutive 15-minute readings. One example of a filter exceedance is when the turbidity level in the water produced by an individual filter rises above 1.0 NTU for two consecutive 15-minute readings. A filter exceedance is not the same thing as a treatment-technique violation, but a severe exceedance on one or more filters may cause the plant to violate a treatment-technique requirement for treated-water turbidity levels. At plants that are allowed to monitor CFE instead of monitoring IFE, the exceedance is based on the turbidity level of the combined filter effluent instead of the turbidity level at the effluent of an individual filter.

**filter profile:** A graph that shows the turbidity level of the water produced by an individual filter for an entire filter run and explains the cause of every event where consecutive turbidity readings change by more than 0.1 NTU. At plants that are allowed to monitor CFE instead of monitoring IFE, the filter profile will be prepared using the combined filter effluent monitoring point instead of the monitoring points on individual filters.

**finished water:** The water leaving a treatment plant; water that has passed through all of the treatment units. Finished water is sometimes called treated water.

**HAA5—haloacetic acids (group of five):** The five haloacetic acid species used to determine compliance with the haloacetic acid maximum contaminant level (MCL). Haloacetic acids are formed when naturally-occuring organic material (NOM) is exposed to halogenated chemical disinfectants such as chlorine. The HAA5 group consists of monochloroacetic acid (MCAA), dichloroacetic acid (DCAA), trichloroacetic acid (TCAA), monobromoacetic acid (MBAA), and dibromoacetic acid (DBAA).

**IFE—individual-filter effluent:** The water produced by a single filter.

**IESWTR—Interim Enhanced Surface Water Treatment Rule:** The first federal regulation to require surface water treatment plants to begin producing treated water with a turbidity level of 0.3 NTU and to impose IFE monitoring requirements on these plants.

**inactivation ratio (IR):** The method used to determine if a surface water treatment plant has met the daily minimum disinfection requirements. The value of IR is determined by dividing the value of $CT_{actual}$ by that of $CT_{required}$. An inactivation ratio of 1.0 or above for both virus and *Giardia* is required to meet the disinfection requirements.

**individual filter:** A filtration unit that has its own influent and its own effluent.

**influent:** The point where water enters a treatment unit, such as a filter.

**LT1—Long-Term 1 Enhanced Surface Water Treatment Rule:** The federal regulation that required treatment plants serving fewer than 10,000 people to meet essentially the same monitoring and performance requirements as larger treatment plants.

**LT2—Long-Term 2 Enhanced Surface Water Treatment Rule:** The federal regulation that required additional treatment by plants with elevated *Cryptosporidium* concentration in their source water.

**macro:** A small computer program that automatically performs specific tasks. There are several macros in the SWMOR and SWMOR2 spreadsheets that do things like circling empty cells that should contain data.

**MD—missing data:** The value entered in a data-entry cell when a plant collected some, but not all, of the required data needed to complete part of the report. For example, if the plant only collected some of the individual filter effluent turbidity data that should have been collected on a given date (and none of the readings that were collected indicate that there was a filter problem), the operators would enter <MD> in the appropriate cell.

**monitoring requirement:** A test that must be run in order to meet minimum state and federal standards. For example, some of the monitoring requirements include tests for treated-water turbidity, individual filter turbidity, water temperature, and disinfectant residuals.

**monthly average:** The number obtained by dividing the sum of a set of values obtained during a given month by the number of values. The monthly average is calculated by adding all of the results obtained in a given month and then dividing the sum by the number of samples.

**ND—no data:** The value entered in a data entry cell when a plant failed to collect any of the required data needed to complete part of the report. For example, if the plant failed to measure the turbidity level of the finished water at one of the required sampling times, the operators would enter <ND> in the appropriate cell to indicate that the data point was not collected.

**NTU—Nephelometric Turbidity Unit:** The unit of measurement for turbidity.

**PODR—point of diminishing returns:** The point at which an additional 10 mg/L of alum results in the removal of no more than 0.3 mg/L of TOC when conducting a Step 2 jar test. The level of TOC removed in the jar where the PODR is reached is the value used to establish the required TOC removal for the treatment plant.

**protected cell:** A cell in the spreadsheet where you cannot enter data.

**quarterly average:** The weighted average of all the results obtained in a given calendar quarter. For tests run on a quarterly basis, the quarterly average is calculated by summing the results of all the samples analyzed in a given quarter and then dividing the sum by the number of samples. For tests run on a daily or monthly basis, the quarterly average is calculated by summing the three monthly averages obtained in a given calendar quarter and then dividing the sum by 3, the number of months in the quarter.

**RAA—running annual average:** The weighted average of all the results obtained during four consecutive calendar quarters. For tests run quarterly, monthly, or daily, the RAA is calculated by summing the quarterly averages for four consecutive quarters and then dividing the sum by 4. In the absence of quarterly results, the RAA will be calculated based on the available data.

**raw water:** The untreated water entering a treatment plant.

**reporting month:** The month during which you collected the data being reported.

**settled water:** The water leaving a sedimentation basin before it passes through the filter.

**spreadsheet:** An electronic file containing data that is arranged by rows and columns. In the case of the SWMOR and SWMOR2, it is an electronic file containing some of the performance data collected at a single surface water treatment plant during a single month.

**Stage 1 Disinfectants and Disinfection Byproducts Rule—DBP1:** The federal rule that required total organic carbon removal and monitoring plans for surface water treatment plants.

**Step 1 removal ratio:** A standard method used to evaluate the TOC removal achieved at a plant. The Step 1 removal ratio is determined by dividing the percentage of the raw water TOC that a plant actually removed by the percentage of TOC that the plant should be able to remove using enhanced coagulation.

**Step 2 removal ratio:** An alternative method used to evaluate the TOC removal achieved at a plant. The Step 2 removal ratio is determined by dividing the percentage of the raw water TOC that a plant actually removed by the percentage of TOC removed at the point of diminishing returns established through Step 2 jar testing.

**SUVA—specific ultraviolet-light absorbance**: An indirect indicator of whether the organic carbon in a sample of water is humic or non-humic in origin. SUVA is calculated by dividing a sample's ultraviolet absorption at a wavelength of 254 nm (UV254) (in inverse meters) by its concentration of dissolved organic carbon (DOC) (in milligrams per liter). It is more difficult to remove the TOC in water that has a SUVA value that is less than or equal to 2.0 L/mg-m.

**$T_{10}$:** The amount of time it takes for ten percent of the water that enters a disinfection zone at a given time to pass through the treatment units within that zone.

**TOC—total organic carbon:** A surrogate parameter used to evaluate the level of naturally-occuring organic matter (NOM) that will form disinfection by-products when exposed to a chemical disinfectant.

**TOC sample set:** A group of three samples that include a raw water alkalinity sample, a raw water TOC sample, and a treated water TOC sample which have all been collected at approximately the same time.

**TTHM—total trihalomethanes:** A group of disinfectant by-products that form when naturally-occuring organic materials (NOM) are exposed to halogenated chemical disinfectants such as chlorine. The four THMs of interest are chloroform (three chlorines, also called "trichloromethane"), dichlorobromomethane, dibromochloromethane, and bromoform (three bromines; also called "tribromomethane").

**train:** A series of treatment units that operate as a single unit within a treatment plant. Surface water treatment plants may contain one or more treatment trains that operate side by side. See Figure B-7 in Appendix B for more information.

**treated water:** The water leaving a treatment plant; water that has passed through all of the treatment units. Treated water is sometimes called finished water.

**treatment technique requirement:** A minimum level of treatment that must be achieved before the water meets minimum state and federal standards. Treatment technique requirements are equivalent to maximum contaminant levels (MCLs). However, the treatment technique requirement indirectly limits the risk posed by a specific contaminant, while the MCL limits the specific contaminant itself. For example, the treatment technique requirements for turbidity and disinfection have been set instead of setting MCLs for the pathogens *Cryptosporidium parvum*, *Giardia lamblia*, Legionella, and enteric viruses.

**worksheet:** One page of a spreadsheet. The SWMOR spreadsheet contains eight worksheets that produce as many as 16 printed pages and the SWMOR2 contains nine worksheets that have a total of 14 printed pages.

# 1. INTRODUCTION

## 1.1 PURPOSE AND APPLICABILITY

These rules require treatment plant operators at all surface water plants in Texas to complete one of three surface water monthly operating report each month and, if necessary, additional reports based on their daily individual filter effluent (IFE) or combined filter effluent (CFE) results. The specific spreadsheet an operator uses depends on the design of the water treatment plant and whether the system is subject to the additional requirements of the Long Term 2 Surface Water Treatment Rule (LT2).

The spreadsheets include:

- The SWMOR–version v14 spreadsheet (Form TCEQ-00102C) may only be used by conventional surface water plants that have turbidimeters on each filter and are not subject to the additional requirements of the LT2.
- The SWMOR–version v15 spreadsheet (Form TCEQ-00102D) must be used by plants that are subject to the provisions of the LT2 as well as any plant that uses unconventional, or alternative, treatment processes. Although this spreadsheet is commonly referred to as SWMOR-Alt, it can also be used by any plant that is required to report the data contained in the conventional SWMOR.
- The SWMOR2 spreadsheet (Form TCEQ-00103) must be used by plants that have no more than two filters and which continuously monitor the performance of the combined filter effluent but lack turbidimeters on each filter.
- The Filter Profile Report for Individual Filters, or FPR, spreadsheet (TCEQ Form 10276) must be submitted by any plant that has one or more filters which produce water with elevated turbidity levels.
- The Filter Assessment Report, or FAR, spreadsheet (TCEQ Form 10277), must be submitted by plants that have three or more turbidity exceedance events within any consecutive three month period.
- The Comprehensive Performance Evaluation Request (CPE Request) spreadsheet (TCEQ Form 10278) must be submitted if the plant produces filtered water with turbidity levels above 2.0 NTU during two consecutive months.

All of these spreadsheets are available on the TCEQ's website at:

www.tceq.texas.gov/goto/swtp/forms

With the exception of the SWMORv15 spreadsheet, this document contains the information that operators need to help them properly complete each of these reports. Information about the SWMORv15 spreadsheet and the guidance for how to complete that report is available in a separate document.

**_Does your well produce "surface water"?_**
Under TCEQ rules, surface water includes more than just rivers, lakes, and streams. Wells drilled into groundwater sources that are under the direct influence of surface water (GUI) are also considered to be sources of surface water.
If your system's well fits this description, you must complete the applicable SWMOR spreadsheet each month.

As Table 1.1 indicates, all of these surface water treatment reports are Excel spreadsheets that have been designed to work properly at plants that have Excel 2007 or a later edition of the Excel software. Although the TCEQ currently also provide copies of SWMORv14 and SWMOR2 in an Excel 2003 format, we no longer provide technical support for that format and expect to remove those files from our website in 2013.

**Table 1.1. Excel versions of the SWMOR.**

| Spreadsheet version | Form Number | Available in the following formats | |
|---|---|---|---|
| | | **Excel 2003** | **Excel 2007** |
| **SWMORv14 (MGD *and* gpm versions)** | 00102C | Yes | Yes |
| **SWMORv15 (std) (MGD *and* gpm versions)** | 00102D | No | Yes |
| **SWMOR2 (MGD *and* gpm versions)** | 00103 | Yes | Yes |
| **FPR** | 10276 | See Note below | Yes |
| **FAR** | 10277 | See Note below | Yes |
| **CPE Request Form** | 10278 | See Note below | Yes |

**Note:** TCEQ Forms 10276, 10277, and 10278 are available in an Excel 2007 format only. However, they contain no Visual Basic for Applications (VBA) macros and will run properly when using Excel 2003 *if* the plant has installed the Microsoft Office Compatibility Pack. This compatibility pack was available free of charge from the Microsoft Support website at the time this version of RG-211 was published.

## 1.2 How Is This Manual Organized?

Table 1.2 gives a summary of the chapters in this manual and what they cover.

## 1.3 How to Interpret the Symbols Used in This Manual

Because the SWMOR and SWMOR2 reports are electronic files, we have been able to place many instructions and comments directly in the two spreadsheets. Once you figure out how to use the SWMOR and SWMOR2 spreadsheets, those electronic comments will reduce or eliminate your dependence on this manual.

In this document, we have highlighted the calculated cells in the SWMOR and SWMOR2 using the symbol ***CALC***. We have also used the symbols to designate keys on the computer keyboard; for example, **<Y>** means the "Y" key and **<Tab>** means the "Tab" key. If you need to push two or more keys at the same time, we will use the **<->** + **<->** format, for example **<Shift>** + **<Tab>** means to press the **<Shift>** and **<Tab>** keys at the same time. If the spreadsheet has a “button” that you need to click in, the symbol is [ ]. For example, [OK] means you should move your cursor over the “OK” button and click once on your left mouse button. Table 1.3 summarizes the meaning of the symbols used in this document.

**Table 1.2. Chapters and descriptions.**

| Chapter | Topics |
|---|---|
| **1** | **Introduction**<br>This chapter tells you who has to submit the SWMOR, and goes over how to use this guidance manual. |
| **2** | **Customizing Your SWMOR or SWMOR2 Spreadsheet**<br>This chapter explains how you can customize your spreadsheet based on the design of your plant and how to prepare a monthly form that you can use to enter data. |
| **3** | **Entering Daily Data in the SWMOR**<br>This chapter goes through the steps of using the SWMOR spreadsheet. It also goes over the requirements for each of the water quality parameters you must measure. This is the chapter that you will reference most frequently. |
| **4** | **Filter-Profile Reports**<br>This chapter tells you how and when to fill out one of the additional reports that may be required based on the performance of your individual filters. |
| **5** | **Completing Filter-Assessment Reports**<br>This chapter tells you how and when to fill out the second of the additional reports that may be required based on the performance of your individual filters. |
| **6** | **Requesting a CPE**<br>This chapter tells you how and when to submit a request for a third-party CPE. |
| **7** | **Analytical Methods**<br>This chapter summarizes the laboratory procedures that you must use to measure the constituents that you report on the SWMOR. |
| **8** | **Public Notification**<br>If you violate one of the treatment-technique requirements, you will have to let your customers know. Instructions for how to go about notifying the public, and what you have to tell them, are in this chapter. |
| **9** | **Instructions for Completing the SWMOR2 Spreadsheet**<br>If your plant serves less than 10,000 people, has only two filters, and uses a CFE monitor instead of IFE monitors, you must use the SWMOR2 instead of the SWMOR spreadsheet. This chapter contains the special instructions for the SWMOR2 spreadsheet. |
| | **Appendixes**<br>The appendixes include an extensive background about why turbidity and disinfection are critical to public health. They also contain a variety of information that we refer to in the first five sections of the guidance manual |

**Table 1.3. Meaning of symbols used in this document.**

| Symbol | Meaning |
|---|---|
| *CALC* | This shows a cell that you can't type in, because the spreadsheet contains a formula for automatically calculating a value. |
| <CTRL> | White type on a black background, with pointy brackets is the symbol for a key on the computer keyboard. For instance, <Esc> means the Escape key. |
| <-> + <-> | Two keyboard symbols with a plus sign means you have to press the keys at the same time. |
| [ ] | Square brackets with a gray highlight means there is a button on the screen to click. |
| < > | Two pointy brackets with a gray highlight is the symbol for information you have to type in. For instance, <Plant> means you should type in the name of your plant. |
| **Heading** | We use words typed in this font to show that we are talking about an area on the SWMOR and SWMOR2 forms or a feature in the spreadsheets. For instance, **Plant Parameters** means we are describing an area of the report that is labeled "Plant Parameters." |

## 1.4 SWMOR AND SWMOR2 FEATURES

To facilitate reporting and reduce reporting errors, the two spreadsheets have built-in functions and macros that:

- customize the spreadsheet so that it accurately describes your plant
- limit the type, kind, and values of data that you can enter in certain cells
- create a special toolbar that allows you to cut and paste data without messing up the program's automated features
- perform CT calculations
- automatically determine if you have left any data off the form
- help you to avoid accidentally overwriting the reports for previous months
- compile a majority of the summary data

In addition, the SWMOR spreadsheet includes many enhancements that:

- improve the security of the spreadsheet to reduce the chance of accidentally damaging the spreadsheet features
- reduce reporting violations by preventing you from submitting an incomplete SWMOR
- speed spreadsheet execution by removing formulas and macros that are no longer relevant
- incorporate a summary of monitoring and reporting violations that occurred during the month and provide you with the specific dates that specific violations, if any, occurred
- provide a way for you to slightly reduce the amount of data that has to be entered each day
- allow us to identify treatment plants that are supposed to conduct additional monitoring because they have been granted an exception to one or more regulatory requirements

## 1.5 General Information about the Spreadsheets

As you work with the spreadsheets, you will find many features that make it easier for you to use. Chapters 2 and 3 provide specific information on how to fill out the spreadsheets. The following general information will help you use the spreadsheets.

### Worksheets

An Excel spreadsheet is also called a workbook which is made up of separate worksheets. After you open the workbook, you will find a series of tabs at the bottom of the screen. Each of these tabs identifies one of the worksheets in the workbook. When you click on one of these tabs, the tab will change from gray to white and the program will take you to the worksheet for the pages shown on the tab. The worksheet tabs for the SWMOR and SWMOR2 spreadsheets are shown in Figure 1.1.

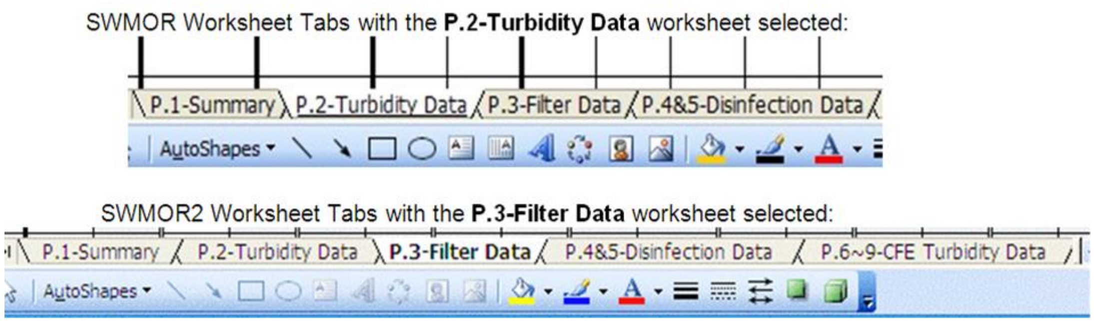



**Figure 1.1. Workbook tabs for SWMOR and SWMOR2.**

Each worksheet contains information about specific aspects of plant performance. Table 1.4 summarizes the SWMOR worksheets and their content.

**Table 1.4. Contents of the SWMOR.**

| Worksheet | Title | Contents |
|---|---|---|
| **1** | P.1-Summary | This worksheet contains a summary of your monthly data, and shows whether the plant was in compliance for the month. |
| **2** | P.2-Turbidity Data | This worksheet has the raw and treated water data, the combined filter effluent data, and the disinfectant residual entering the distribution system. |
| **3** | P.3-Filter Data | This worksheet has the individual filter effluent turbidity data. |
| **4** | P.4&5-Disinfection Data | These worksheets contain the data used for CT calculations and show the inactivation ratios achieved each day. |
| **5, 6, 7** | P.6-TOCMOR, P.7-TOC ACC, P.8-TOC Step2 | These worksheets contain the monthly report for total organic carbon (TOC) removal. |
| **21** | Imported data | This worksheet is used by plants that use SCADA data to import into the SWMOR workbook. |

The LT2 rule required some plants to achieve additional inactivation or removal of *Cryptosporidium*, and approved a number of various technologies for that purpose. A new version of the SWMOR that supports LT2 compliance will be available in 2012. The new version (version 15) will include additional worksheets to contain data for plants that use site-specific methods to remove or inactivate *Cryptosporidium*.

Table 1.5 summarizes these additional SWMOR-Alt worksheets and their content.

**Table 1.5. Additional contents of the SWMOR-Alt.**

| Worksheet | Title | Contents |
|---|---|---|
| **8** | Prefilters | This page contains data for plants that use prefilters to receive *Cryptosporidium* removal credit. |
| **9** | Enhanced IFE | This page contains data for plants that use enhanced IFE reporting. |
| **10** | Bag, Cartridge | This page contains data for plants that use bag or cartridge filters. |
| **11** | 2ndStageFilters | This page contains data for plants that use two-stage filtration. |
| **12** | MembranePBT | This page contains data for membrane filter plants that use turbidity for indirect integrity testing and pressure decay rate for direct integrity testing. |
| **13** | MembraneQBT | This page contains data for membrane filter plants that use turbidity for indirect integrity testing and air flow rate for direct integrity testing. |
| **14** | MembraneMBT | This page contains data for membrane filter plants that use turbidity for indirect integrity testing and marker or tracer tracking for direct integrity testing. |
| **15** | UV—ISA | This page contains data for plants that use ultraviolet light disinfection with the intensity set point approach. |
| **16** | UV—CDA | This page contains data for plants that use ultraviolet light disinfection filters with the calculated dose approach. |
| **17** | UV—Sensor Data | This page contains the sensor calibration data for plants that use ultraviolet light disinfection with the intensity set point or calculated dose approach. |
| **18** | UV—UVT Analyzer | This page contains benchtop analyzer calibration data for plants that use ultraviolet light disinfection. |
| **19** | CryptoCT | This page contains the calculation for *Cryptosporidium* inactivation using chemical disinfectants, related to pages 4 and 5, which contain similar information for *Giardia* and virus inactivation. |
| **20** | LT2 Summary | All of the data related to *Cryptosporidium* inactivation for compliance with LT2 is contained in this page. |
| **21** | Imported data | This page is used by plants that use SCADA data to import into the SWMOR workbook. |

Figure 1.2 shows the worksheet tabs of the SWMOR-Alt.


**Figure 1.2. Workbook tabs for SWMOR-Alt.**

> **ATTENTION SWMOR2 USERS**
> The SWMOR2 is organized in much the same way as the SWMOR. However, to avoid confusion, we have placed most of the discussion about SWMOR2 in Chapter 9, which deals entirely with that spreadsheet. Still, it would be helpful for you to read the rest of Chapter 1 because there are several cross-references to it in Chapter 9.

## Custom Toolbar

We have developed a custom toolbar for the SWMOR and SWMOR2 spreadsheets. This toolbar, which is located at the top of each worksheet, is created when you open the spreadsheet and remains active until you close the spreadsheet. The toolbar, shown in Figure 1.3 includes two special commands; the [Save As . . .] button and [Paste Values] button.

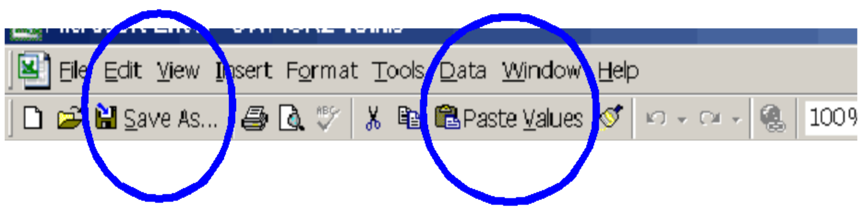



**Figure 1.3. Custom toolbar.**

The [Save As . . .] button helps you avoid accidentally overwriting data from a previous month by requiring you to confirm the proposed filename each time you save a file. It also helps you establish a standardized file structure that is based on the year, month, and location from which the data was collected. When you click on the button, the spreadsheet will suggest a filename that looks like:

**FileType_Year_Month_PWSID Number_PlantName**

In this filename:

- **FileType** means SWMOR if you are using the SWMOR spreadsheet or SWMOR2 if you are using the SWMOR2 spreadsheet
- **Year** means the year the data was collected
- **Month** means the number of the month the data was collected
- **PWSID** Number means the system's seven-digit PWS ID number
- **PlantName** means the name of the surface water treatment plant.

(*Note:* If **PlantName** is not entered, the spreadsheets will call the plant **SWTP**.)

If the proposed name is correct, just click the [OK] button. However, if you prefer to use another filename, enter the filename and then click the [OK] button.

The [Paste Values] button helps you avoid accidentally damaging the automated features of the spreadsheets by only pasting values when you cut and paste data.

### Red-Circling the Cells You Must Fill In

On each page, there are buttons that automatically draw a red circle around the cells in which you must enter data. Using this spreadsheet feature will help you find the cells your data goes in. Figure 1.4 shows that in the upper left corner of each worksheet are two buttons that look like this:


**Figure 1.4. Buttons.**

The first button will put red circles around all the cells you need to fill in, or that have errors. It will NOT circle cells you have already filled in correctly.

For instance, the cell that you type your system name in, on page 2, will change

from:


to:


so you know that this is a cell you need to type in.

To turn the red circles off, click the second button:

### Comments

Many of the cells in the spreadsheet have comments. You can tell if there is a comment attached to a cell if there is a little red triangle in its upper right corner. To see the comment, just move the cursor (the arrow) over the cell—a comment will appear that describes the data you need to enter, as shown in Figure 1.5.


**Figure 1.5. Comment boxes.**

### Drop-down Menus

Some cells in the spreadsheet have a drop-down list that supplies the acceptable options that you can put in that cell. You will know what cells have drop-down list because, when you move your cursor over them, a little downward-pointing arrow will appear.

For example, the month cell on page 2 of the spreadsheet looks like this:


But when you move your cursor over it, you see the downward-pointing arrow.


When you click the left mouse button once
on the downward-pointing arrow, the drop-down list shown in Figure 1.6 appears.

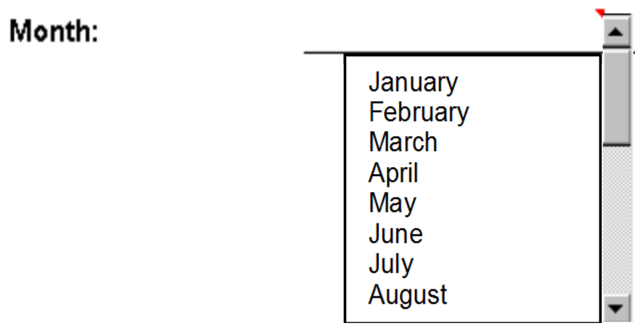



**Figure 1.6. Drop-down list.**

Now, you can move your cursor over the month you want to select and click your left mouse button again (once), and the month you selected will appear in the cell.


### Protected Cells

Some of the cells in the spreadsheet are “protected” so that you can’t type in them. You should not have any reason to try to type in a protected cell. For instance, if you only have two filters, and you try to input data for Filter 3, the spreadsheet won’t let you do it. Another example of a protected cell is one that has a formula for doing automatic calculations. When you click on a protected cell, you will see the following screen, as shown in Figure 1.7.


**Figure 1.7. Protected cell warning.**

Just click [OK], and the box will disappear.

### Viewing the Spreadsheet

You can change how big or how little the type appears on your computer screen by using the zoom function. To do this, click [View] in the Excel Menu, select [Zoom] at the bottom of the drop-down list, and select the size you want.

## Using the SWMOR and SWMOR2 Spreadsheets

Instead of going through the SWMOR page by page, this guidance manual is organized in the order that you complete the form. The sequence is summarized in Table 1.6.

**Table 1.6. Sequence for completing the SWMOR.**

| Step | Process |
|---|---|
| 0 | **Customize your SWMOR (see Sections 2.1 and 2.2):** Save the SWMOR with a new file name for that specific month. You only have to do this once for each plant. Make sure you save the file every time you update it. |
| 1 | **Create that month's file (Section 2.3):** Enter month, year, connections, and population. You must do this once a month for each plant. |
| 2 | **Enter each day's data (Chapter 3):** Flow, turbidity, residual, and so forth. You must do this each day for each plant. Complete the TOC MOR (RG-379). |
| 3 | **Fill out the summary page (Section 3.4):** You must do this at the end of each month for each plant. |
| 4 | **Fill out the summary addendum page (Section 3.5):** You must do this at the end of each month for each plant if there was at least one violation. |
| 5 | **Print, sign, and submit that month's SWMOR (Section 3.6):** You must do this at the end of each month for each plant. |
| 6 | **Submit MORs to the TCEQ** Attach the completed TOC MOR page(s) to your completed SWMOR and submit them together. |
| 7 | If your plant uses chlorine dioxide for disinfection, complete the CLO2 MOR form and attach them to your completed SWMOR. |
| 8 | If your plant uses non-conventional treatment to achieve inactivation/removal credit, complete the pages related to that technology. |

### How to Submit Additional Remarks

You will notice that the SWMOR and SWMOR2 spreadsheets contain no space for comments or general remarks. Therefore, you must use a separate sheet of paper if you need to provide us with information about your plant.

## 1.6 Other Reporting Requirements

The SWMOR is only one of the reports that a surface water treatment plant must send to the TCEQ. We have put many of these forms and instructions on our website so that you can download copies of them. You can access each of the forms discussed in this section (and many others) at:

www.tceq.texas.gov/goto/sw-mon

If you do not have access to the Internet, you may call the TCEQ public drinking water program at 512-239-4691—ask for the Surface Water Treatment Rule Coordinator—or by e-mail at <SWTPMOR@tceq.texas.gov>. We can send you copies of the materials.

### The Texas Optimization Program Monthly Operating Report (TOPMOR)

The Texas Optimization Program (TOP) is a voluntary program that recognizes surface water treatment plants that consistently produce high-quality drinking water. If you are participating in the TOP Recognition Program, you must submit the TOPMOR monthly. You can find more information about the TOP and download copies of the TOPMOR at the following Web address:

www.tceq.texas.gov/goto/sw-top

If you do not have access to the Internet, you may call the TCEQ at 512-239-4691, or e-mail <PDWS@tceq.texas.gov>, and request a copy of the information on a compact disk.

### Monitoring Plan

Every system must have a monitoring plan describing sampling in the plant and its distribution system. You have to submit a copy of this plan for our review and approval. You must also provide us with the updated copy of the plan if you make any revisions. We have published a separate guide, *How to Develop a Monitoring Plan for a Public Water System* (TCEQ publication RG-384). You can find more information about monitoring plan requirements at the following Web address:

www.tceq.texas.gov/goto/pws-monplans

If you do not have an Internet connection, call the TCEQ Public Drinking Water Section at 512-239-4691, or e-mail <PWSCHEM@tceq.texas.gov>, and request the monitoring plan guidance document.

### Special Study Reports for Individual Filters

Under certain conditions, you may be required to perform a special study on a filter, and send in a report with the results to the TCEQ. This manual discusses these special reports in Chapters 4 through 6.

### Chlorine Dioxide Monthly Operational Report (ClO2MOR)

If your plant uses chlorine dioxide, you must also submit a ClO2MOR each month. The report provides a place for you to record the chlorine dioxide and chlorite levels entering the distribution system each day and to report the number of chlorite samples collected from the distribution system each month. You can get a copy of the CLO2MOR and instructions on the Internet at:

www.tceq.texas.gov/goto/clo2mor

If you do not have an Internet connection, call the TCEQ Public Drinking Water Section at 512-239-4691, or e-mail <PWSCHEM@tceq.texas.gov>, and request the CLO2MOR form and instructions.

## 1.7 CT Study Template

The CT Study Template is an Excel 2003 (or Excel 2007) spreadsheet that you can customize to describe the disinfection process at your plant. This template helps you evaluate alternative disinfection protocols. It also provides a convenient place to record all of the information you will need when you request permission to change the disinfection practices at your plant. The CT Study Template can handle up to 10 disinfection zones/treatment trains with up to 10 treatment units in each zone.

You can download a copy of the template and its instruction manual at:

www.tceq.texas.gov/goto/ct-study

If you do not have access to the Internet, you may call the TCEQ Plan and Technical Review Section at 512-239-4691 to request a copy on compact disk. You may also obtain a disk via e-mail to <CTstudy@tceq.texas.gov>.

This template can be completed by public water system personnel; a professional engineer is not required. When the template is completed, copy the completed spreadsheet to CD and submit it with a cover letter stating the reason for the CT study revision request and the contact person who can answer any questions we may have. The template can be submitted to us through the United States Postal Service (USPS) at:

Technical Review and Oversight Team, MC-159, Attn: CT Study
TCEQ
PO Box 13087
Austin, TX 78711-3087

If you wish you may submit documents to our physical address at:

Technical Review and Oversight Team, MC-159
Attn: CT Study
TCEQ
12100 Park 35 Circle, Building F
Austin, TX 78753

You may also send us the completed template to a special e-mail account that we have established for this purpose: <CTstudy@tceq.texas.gov>. If you submit the CT study electronically, please be sure to include your name, title, and telephone number in the e-mail and to attach the completed template before sending it. We highly recommend that you retain proof of your submission in the form of a certified mail receipt, fax transmittal confirmation, or return e-mail from us.

# 2. CUSTOMIZING YOUR SWMOR OR SWMOR2 SPREADSHEET

In this chapter, we go through the steps you need to complete in order to customize the SWMOR and SWMOR2 spreadsheets for your specific plant. For help with a specific part of the report, scan for the name of the main section and then look for specific items within that section.

**ATTENTION SWMOR2 USERS**
The SWMOR2 is customized in exactly the same way as the SWMOR. Although we wrote Chapter 9 to help you fill out the SWMOR2 report, we did not repeat any of the information presented in Chapter 2. Therefore, you will need to read this chapter even if you are using the SWMOR2 spreadsheet.

## 2.1 CREATE YOUR SWMOR OR SWMOR2 MASTER FILE

The first time you use the SWMOR or SWMOR2 spreadsheet, you will enter the data that will customize it for your plant. After customizing the spreadsheet once, and saving the customized file, you may skip this step.

### FILE MANAGEMENT

If you don't have a system for saving electronic files, you should decide how you are going to save your data before you get too far. We recommend that you create a series of special folders (or subdirectories) so that you will know where all your MOR records are stored. Several plants have found the file structure shown in Figure 2.1 to be very useful.

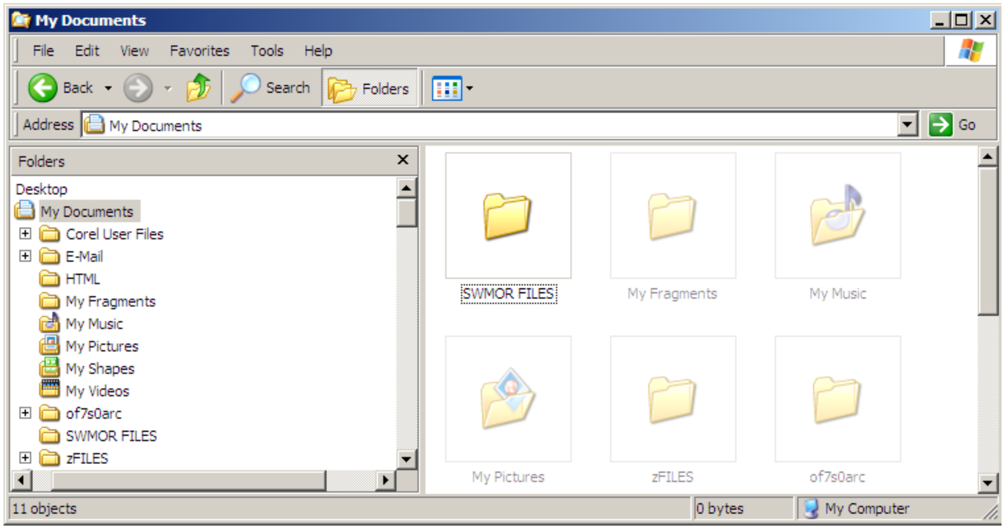



**Figure 2.1. Sample file structure.**

### Backing Up Your Data

Each copy of the SWMOR spreadsheet takes up about 2.5 megabytes. Although you will be able to store many months of data on your hard drive, you should always save a backup copy in case your hard drive crashes. You must maintain a copy of each monthly report for at least three years. We recommend that you back up each monthly report on a CD-ROM, or at least keep a printed copy of each report in your files.

### Enable Macros? Yes!

When you open the SWMOR file in Excel 2003, a dialog box will pop up to let you know that the workbook you are opening contains macros. In order for the spreadsheet to run properly, you must click the [Enable Macros] button every time you open the spreadsheet. Figure 2.2 shows the screen that appears, with the [Enable Macros] button in the bottom center.

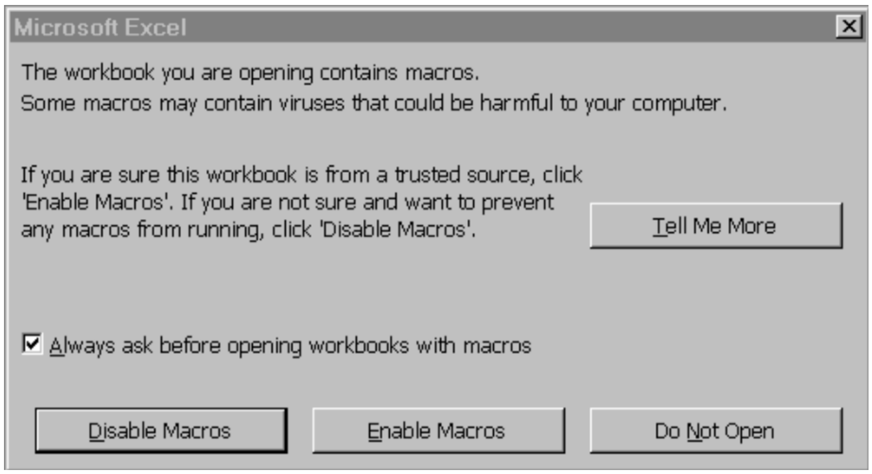



**Figure 2.2. Opening screen dialog box to enable macros in Excel 2003.**

When you open the SWMOR file in Excel 2007, a dialog box will pop up to provide options on how to open the file, as shown in Figure 2.3.

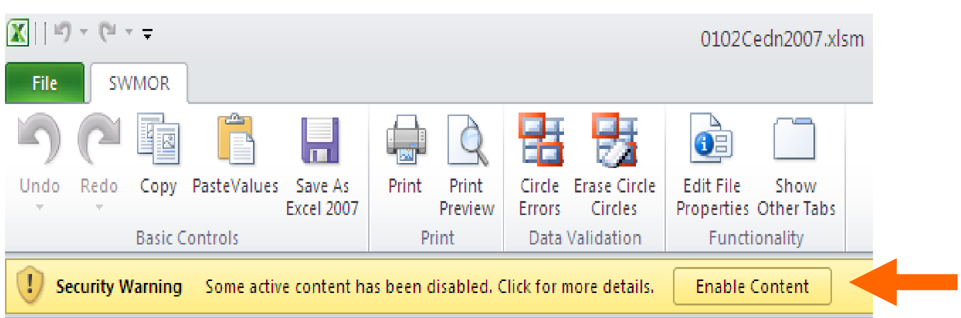



**Figure 2.3. Opening screen dialog box to enable options in Excel 2007.**

**WARNING ABOUT MACROS**
Macros are programs that will automatically execute when you open a file. Unless you are absolutely sure that you have obtained the file from a reliable source, you should be very wary about enabling a spreadsheet macro because hackers can hide viruses in the macro. If you have any doubts, scan the spreadsheet with an up-to-date antivirus program.

## 2.2 FILL OUT THE PLANT PARAMETERS DIALOG BOX

The next dialog box, **Plant Parameters**, will prompt you for the information needed to begin customizing the SWMOR or SWMOR2 for your plant. In order for the spreadsheet to run properly, you must complete the box. As you enter data in the dialog box, you may use the **<Tab>** key to move to the next cell, or data-entry spot, and the **<Shift>** + **<Tab>** keys to return to the previous cell.

Most of the information that you need to enter in the **Plant Parameters** dialog box (like the number of filters at the plant) relates to the layout of your plant. The other information (like number of disinfection zones) comes from your CT study approval letter, any letters that approve the design of your plant or—if you have an approved exception to one or more of our design requirements—the exception-approval letter.

### Number of Sedimentation Basins

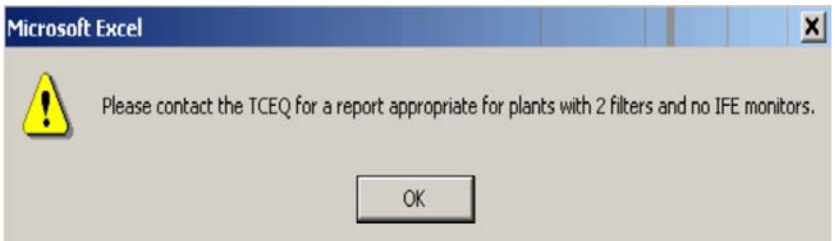
Enter the total number of sedimentation basins and clarifiers at your plant.

### Number of Filters

Enter the total number of filters at your plant. If you report that you have two filters, the SWMOR will ask you to confirm that you have a turbidimeter on the effluent of each filter (see Figure 2.4). If you do have IFE turbidimeters on both filters, click on the [Yes] button and continue entering data. If you do not have IFE turbidimeters on both filters, click on the [No] button.


**Figure 2.4. Two-filter confirmation for SWMOR in both Excel 2003 and 2007.**

**IMPORTANT**
If the answer to the question in the confirmation dialog box as shown in Figure 2.3 is “No,” it means that you should use SWMOR2 instead of SWMOR. Once you click on the [No] button, the instruction message box shown below will pop up. You have to click on the [OK] button before the macro will finish running. This macro adds a watermark to each of the worksheets stating “You have indicated that your plant has two filters but no IFE monitors. Therefore you must use the SWMOR2 spreadsheet. Contact the TCEQ for a copy of that report.” Although the spreadsheet is still functional, the watermark will be printed out on every page when you print the report and the report will not be accepted by the TCEQ. You should immediately close the spreadsheet without saving any changes and use SWMOR2 instead.




### Number of Disinfection Zones

Your CT–study-approval letter describes the disinfection zones and treatment trains that exist at your plant. The disinfection zones are numbered; for example, *D1*, *D2*, and so on. Enter the total number of disinfection zones that are defined in your plant’s CT-study-approval letter. If the letter no longer accurately describes your disinfection zones or if you want to change the disinfection zones, you need to submit a new CT study for our review.

### Number of Trains

After you enter the number of disinfection zones at your plant, hit **<Enter>** and the **Number of Trains** cell will pop up beside each of the zones you have at the plant. If there is more than one train in a zone, your CT approval letter will identify each train with a letter; for example, if disinfection zone D1 contains three trains, the trains will be identified as *D1A*, *D1B*, and *D1C*. For each disinfection zone, enter the number of treatment trains defined in your plant’s CT-study-approval letter. (See Appendixes A and B for more information on CT studies.) The treatment trains, if defined, are denoted by suffixes A, B, and so forth.

### Settled Water Turbidity Is Required

We typically require plants that were granted an exception to our requirements for detention-time design and surface-overflow rate to periodically monitor levels of settled-water turbidity. We occasionally impose this requirement for other reasons as well. For example, we sometimes require plants to conduct this monitoring as part of a mandatory corrective-action plan (CAP). If your plant does not have one of these exceptions or a mandatory CAP, we still recommend that you monitor settled-water turbidity levels, but seldom require it.

To place a check in the box, place the cursor on top of the box and then click the left mouse button. If we have required your plant to monitor settled-water turbidity, you must place a check in the **Settled Water Turbidity Is Required** box. If we have not required you to run these tests, you should leave the box empty even if you routinely monitor settled water turbidity levels.

Figure 2.5 shows an example of the **Plant Parameters** dialog box as it would be completed for the plant that received the approved CT study in Appendix A. The entries indicate that the plant has two sedimentation basins and six filters. The figure also shows that this plant has three disinfection zones, none containing more than one treatment train. Finally, the figure indicates that the plant has been required to monitor settled-water turbidity levels for some reason.

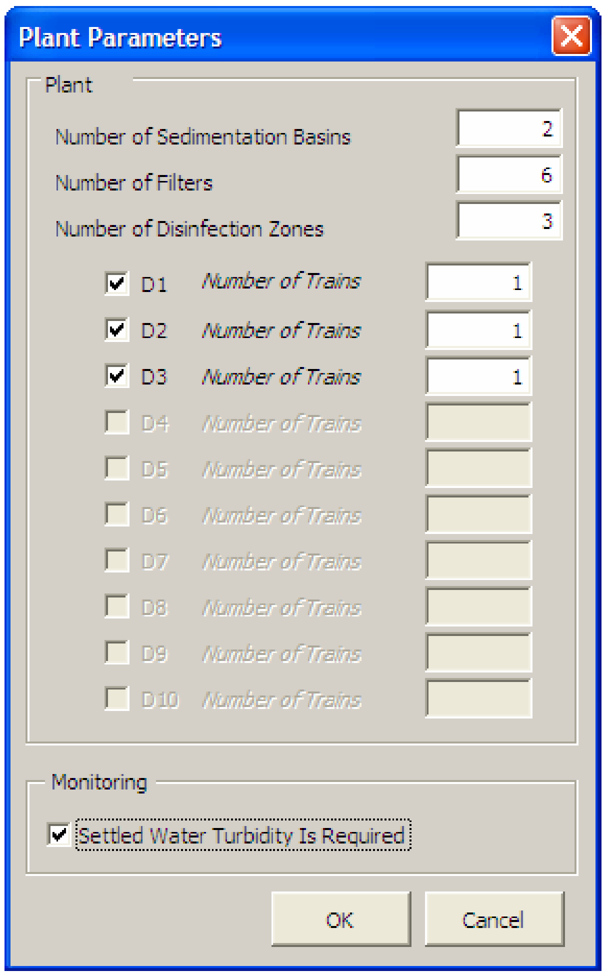



**Figure 2.5. Plant Parameters dialog box with sample data.**

Once you have entered the last piece of data in the **Plant Parameters** dialog box, click on the [OK] button. At this point, you will be able to enter the rest of the information from your CT study approval letter into the **Disinfection Process Parameters** dialog box.

**IMPORTANT**
If you click on the [OK] button, the SWMOR spreadsheet will execute the macro that updates appropriate cells on **P.2-Turbidity Data**, **P.3-Filter Data**, and **P.4&5-Disinfection Data** worksheets. Since this update process can take quite some time, you should press the [CANCEL] button if the **Plant Parameters** dialog box already properly describes your plant.

**BE PATIENT**
If you do need to change the information about your plant, it may take up to 3 minutes for this [OK] button's macro to finish running (or longer if depending on your plant's design and computer). In general, do not click buttons or type while you are waiting for the program to perform a calculation or run a macro.

## 2.3 FILL OUT THE DISINFECTION PROCESS PARAMETERS

The next dialog box, **Disinfection Process Parameters**, will prompt you for the information needed to continue customizing the SWMOR for your plant. You must complete this dialog box for the spreadsheet to run properly. As you enter data, you may use the **<Tab>** key to move to the next cell or data entry spot, and the **<Shift>** + **<Tab>** keys to move back to the previous cell.

Figure 2.6 shows a blank **Disinfection Process Parameters** dialog box. As the figure indicates, the dialog box is divided into two sections: **Residual Disinfectant** and **Approved CT Study Parameters**. You must complete both sections of the dialog box or the SWMOR spreadsheet will not work properly.

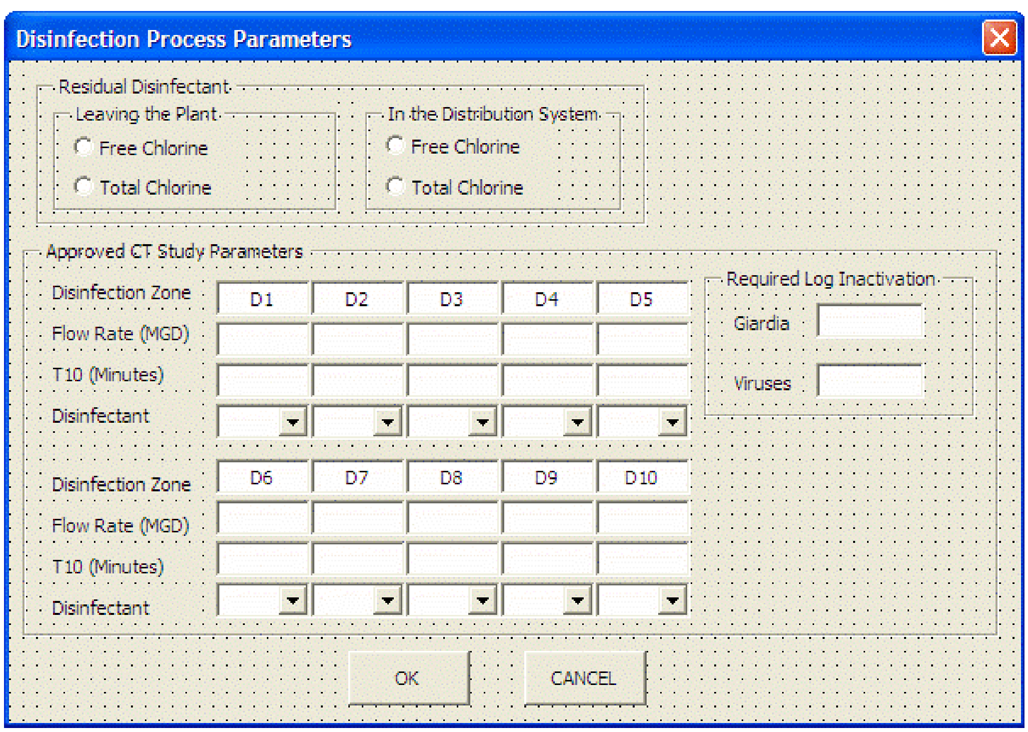



**Figure 2.6. Disinfection Process Parameters dialog box.**

Most of the information you need to complete the **Disinfection Process Parameters** dialog box will come directly from your CT study approval letter (see Appendix A for an example). The other information that you need to enter includes the disinfectant residual entering the distribution system and the disinfection residual in the distribution system.

Once you finish filling out the **Disinfection Process Parameters** dialog box, the SWMOR spreadsheet uses the information to complete parts of the **P.1-Summary** and the **P.4&5-Disinfection Data** worksheets.

## Residual Disinfectant

You must fill out this area of the **Disinfection Process Parameters** dialog box based on your plant's normal operating practices. If your plant normally adds ammonia at some point in the treatment process, or if you purchase and redistribute chloraminated water, you must select [Total Chlorine] as your default disinfectant. You must select [Free Chlorine] as your default disinfectant if your plant does not add ammonia to the water before it leaves the plant.

Although the water leaving the plant usually contains the same disinfectant as the water in the distribution system, the SWMOR spreadsheet will not prevent you from selecting one type of disinfectant for the water leaving the plant and a different disinfectant for the water in the distribution system. However, this treatment approach is highly unusual and you will get the dialog box shown in Figure 2.6 if the two selections do not match. Click on the [Yes] button if you really are using two different types of disinfectants and the [No] button if the same type of disinfectant is present in both the water leaving the plant and in the distribution system.

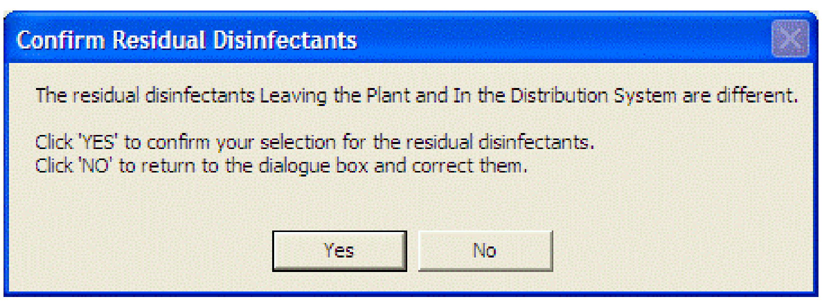



**Figure 2.7. Confirm Residual Disinfectants dialog box.**

### Leaving the Plant

The SWMOR uses the disinfectant you select in this part of the **Disinfection Process Parameters** dialog box to set the default residual level you must maintain in the water leaving the plant.

### IN the Distribution System

The SWMOR uses the information you select in this part of the **Disinfection Process Parameters** dialog box to set the default residual level you must maintain in the distribution system.

## Approved CT Study Parameters

Your CT-study-approval letter will describe three approved parameters for each of the disinfection zones and treatment trains it identifies:

- the flow rate,
- $T_{10}$, and
- disinfectant type.

The flow rate and $T_{10}$ information you need to complete this section of the dialog box appears in a table that is usually near the end of the letter. The information about the disinfectant usually used in each of the zones generally appears near the front of the letter where we describe the plant's general treatment and disinfection processes. (See Appendix A for an example of a CT-study-approval letter.)

### Flow Rate (MGD)

You must enter the flow rate for each disinfection zone and train defined by your plant's CT-study-approval letter in the appropriate cell in the dialog box. You must enter this value in million gallons per day (MGD).

### $T_{10}$ (minutes)

You must also enter the approved $T_{10}$ time for each disinfection zone and train defined by your plant's CT-study-approval letter in the appropriate cell in the dialog box. You must enter this value in minutes.

### Disinfectant

The **Disinfectant** boxes in this section of the **Disinfection Process Parameters** dialog box contain a drop-down list that contains all of the possible disinfectants that can be used in the disinfection zone or treatment train. Use the drop-down lists to select the type of disinfectant residual maintained in each of the disinfection zones and treatment trains identified in the CT-study-approval letter. The abbreviations for the possible disinfectants are shown in Table 2.1.

**Table 2.1. Abbreviations for disinfectants.**

| Abbreviation | Disinfectant |
|---|---|
| FCL | free chlorine |
| CLO2 | chlorine dioxide |
| O3 | ozone |
| CLA | chloramines |
| NA | the disinfection zone is not used |

**IMPORTANT**
The dialog box will not allow you to select <NA> for a given disinfection zone or treatment train unless:
• a disinfectant is routinely applied in any of the previous zones or trains,
or
• a disinfectant is routinely applied in a previous zone or train but
—some, but not all, of the parallel trains in a later zone are not routinely used and
—a disinfectant is identified for each of the remaining trains that are routinely used.

Our CT-study-approval letter also establishes performance standards for the disinfection process at your plant. Given the treatment processes for physical removal at the plant, the disinfection process is required to achieve a minimum number of log inactivations of *Giardia lamblia* cysts and viruses.

### Required Log Inactivation of *Giardia lamblia* Cysts

Enter the amount of *Giardia* inactivation that disinfection is required to achieve at your plant. Unless the TCEQ has established an alternative performance standard for the plant, your disinfection process must achieve a 0.5-log inactivation of *Giardia lamblia* cysts.

### Required Log Inactivation of Viruses

Enter the amount of viral inactivation that the disinfection process is required to achieve at your plant. Unless the TCEQ has established an alternative performance standard for the plant, your disinfection process must achieve a 2.0-log inactivation of viruses.

Once you have entered the last piece of data in the **Disinfection Process Parameters** dialog box, click on the [OK] button. At this point, the macro will finish running and create the customized SWMOR or SWMOR2 for your plant.

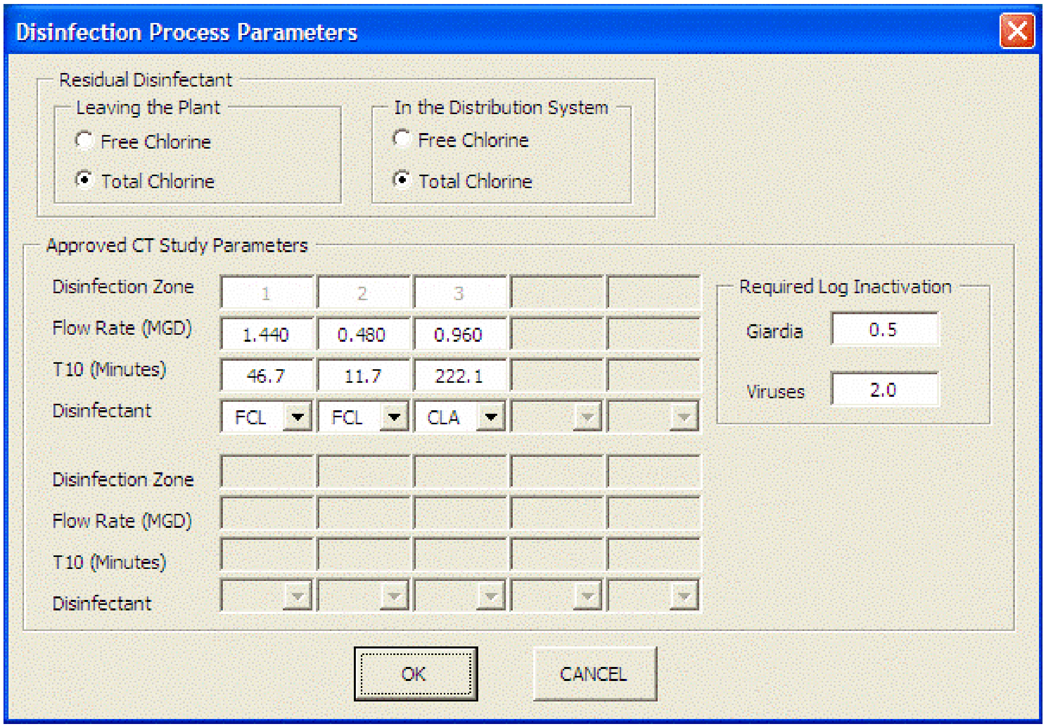
**IMPORTANT**
If you click the [OK] button, the SWMOR spreadsheet will execute the macro that updates appropriate cells on **P.1-Summary** and **P.4&5 Disinfection Data** worksheets. Since this update process can take quite some time, you should press the [CANCEL] button if the **Disinfection Process Parameters** dialog box already properly describes your plant.

**BE PATIENT**
If you do need to change the information about your plant, it may take up to two minutes for this [OK] button's macro to finish running (or longer, depending on your plant's design and computer). In general, do not click buttons or type while you are waiting for the program to perform a calculation or run a macro.

When the macro that tells the spreadsheet about your plant data finishes running, the spreadsheet will be ready for you to type in your plant information and data.

## Example 2-1: Entering Data in the Disinfection Process Parameters Dialog Box

How to complete the **Disinfection Process Parameters** dialog box for the plant with the CT-study-approval letter in Appendix A.




The approval letter's plant description (page A-1) indicates that liquid ammonium sulfate (LAS) is applied upstream of the clearwells. Therefore, the treatment plant is using chloramines as a residual disinfectant. Consequently, [Total Chlorine] is selected in the **Residual Disinfectant** section of the dialog box under **Leaving the Plant** and **In the Distribution System**.

The CT-study-approval letter also identified three disinfection zones for the plant. The [Flow Rate] and [T10] values for each of the three zones that are summarized in Table 2 of the CT study approval letter (page A-3) have been copied into the appropriate cell of the dialog box.

The plant description also indicates that there is a standby LAS injection point located just downstream of the rapid mix but, as noted previously, the primary LAS injection point is located upstream of the clearwells. Therefore, the dialog box indicates that free chlorine (FCL) is the primary disinfectant used in zones D1 and D2 and chloramines (CLA) are the primary disinfectant used in zone D3.

## Identify Your Plant (on Page 2)

After the **Disinfection Process Parameters** macro finishes running, you will need to enter additional information about the plant.

At the top of each page of the SWMOR and SWMOR2 spreadsheets, you will find cells for identifying your water system and your plant. However, we have locked all of these cells except for the ones on the **P.2-Turbidity Data** worksheet. The spreadsheet has been programmed so that when you fill out the water-system and plant information on page 2, the data will automatically be copied onto the other pages. In addition, when you open the spreadsheet, the program automatically takes you to the top of page 2 so that you can enter the name of your water system and other information. Figure 2.8 shows this part of the spreadsheet.

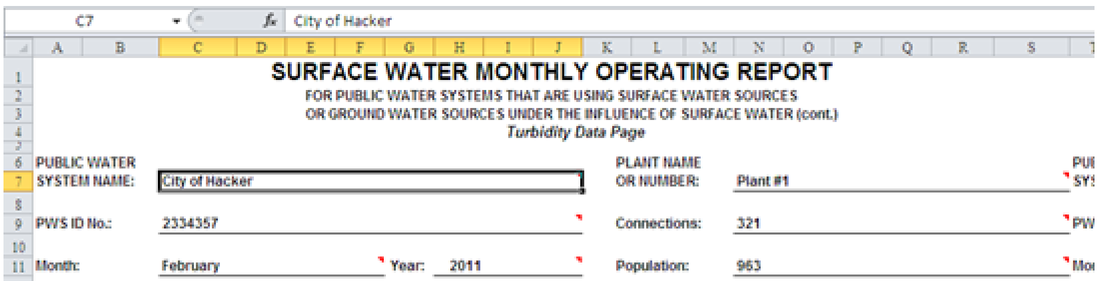



**Figure 2.8. Plant-description section of the SWMOR spreadsheet.**

### Public Water System Name

Enter the name of your public water system.

### Plant Name or Number

If your water system has more than one treatment plant, enter the name of the plant that collected the data contained in this specific report. You do not have to complete this cell if your water system has only one treatment plant.

***Special Case:*** Sometimes the treatment trains in a single plant are markedly different. In these cases, you may need to submit a separate SWMOR or SWMOR2 for each treatment train. If you think your plant should submit more than one report, call the public drinking water program at 512-239-4691 and ask for the Surface Water Treatment Rule Coordinator, or e-mail <SWTPMOR@tceq.texas.gov>, to be sure.

### PWS ID No.

Enter your water system's seven-digit PWS ID number.

# 2.4 Save Your Customized SWMOR Spreadsheet

After you have completed the two dialog boxes and entered the information on your system, we strongly recommend that you save the customized spreadsheet. That way, you will not have to re-enter all that data each time that you open the spreadsheet. In addition, you will be able to click on the [Cancel] button when the **Plant Parameters** and **Disinfection Process Parameters** dialog boxes open and avoid the delays that occur when running the customization macros. The only time that you will need to reenter any of the "customized" data is when something at the plant changes.

**NOTE**
If you are using the SWMOR, we recommend that you save the customized file using the following filename:
SWMOR_master_PWSIDNumber_PlantName

If you are using the SWMOR2, we recommend that you save the customized file using the following filename:
SWMOR2_master_PWSIDNumber_PlantName

In each case, PWSIDNumber is the PWS ID number of your system and PlantName is the name of your plant.

### Running the SWMOR after You Have Customized It

If you saved the customized spreadsheet, you will still need to click on the [Enable Macros] button in the Excel dialog box each time you open the spreadsheet. However, unless you need to edit the data in the **Plant Parameters** or the **Disinfection Process Parameters** dialog box, you may click on the [Cancel] button when those boxes open and avoid the extra delay that occurs when running the customization macro.

## 2.5 CREATING MONTHLY FILES

You should have already customized your SWMOR (or SWMOR2), as described in the previous sections. Then, every month, you will need to create a separate electronic file for that particular month. It is best to start each month with a new file created from your original **customized** file, rather than updating a previous month's file that already has data in it.

**IMPORTANT**
You are required to keep your SWMORs for at least three years. So, if you plan on keeping electronic copies of the SWMOR, be careful not to overwrite the file from a previous month. For this reason, it is best to start each month with a new file created from your original customized file, rather than updating a previous month's file that already has data in it.

We have added some automated features that reduce the chance that you will accidentally overwrite data from a previous month. However, this feature is not completely fail-safe and it is still possible for you to lose data if you are not careful.

#### Enable Macros? Yes!

When the **Enable Macros** dialog box pops up in Excel 2003, click [Enable Macros]. You need to enable the macros so that the spreadsheet can accurately perform its many calculations. In Excel 2007, the option to enable macros appears in a yellow ribbon above below the toolbar.

#### Plant Parameters and Disinfection Process Parameters? Cancel!

When the **Plant Parameters** and **Disinfection Process Parameters** dialog boxes pop up, click [Cancel]. The process you went through in Sections 2.2 and 2.3 created a customized spreadsheet that describes your plant. As long as you don't make changes to your plant (such as structural changes), you may skip this step when entering monthly data, thus saving time.

**IMPORTANT**
As noted above, we strongly recommend that you begin each month's report with a blank copy of your customized SWMOR. However, if you insist on using a completed report from a previous month as your starting point, you must click on the [OK] button rather than the [CANCEL] button, so that the SWMOR will reset the disinfectant types to your default values.

## Enter the Monthly Data about the Plant (on Page 2)

After you have customized your SWMOR file to describe your plant, you need to enter the plant data at the top of the **P2-Turbidity Data** worksheet as shown in Figure 2.9. The two spreadsheets copy whatever you type in these cells onto the other pages.

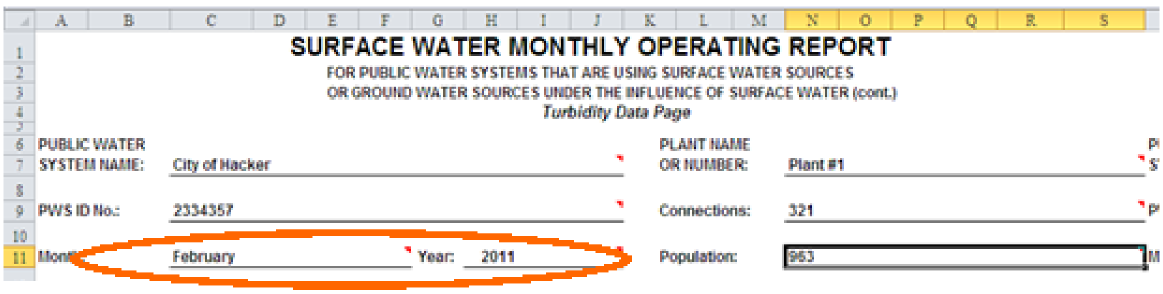



**Figure 2.9. Monthly data section of spreadsheet.**

### Month/Year

Use the drop-down lists to select the month and the year in which your plant collected the data.

**NOTE**
We have added a new feature that allows you to change the years in the drop-down list.

The value of the first year in the list can be changed by changing the value shown in cell AQ2 located on the right-hand side of the **P.2-Turbidity Data** worksheet.

### Connections (Community Systems)

This cell appears only on page 2 of the SWMOR. Enter the number of connections your water system serves.

You must complete this cell if your water system is a water-supply corporation, municipal water supplier, or other community water system. RV parks, industrial facilities, and other non-community water systems do not have to complete this cell.

### Population (Water Wholesalers and Non-community Systems)

This cell also appears only on page 2 of the SWMOR. Enter the maximum number of customers your water system serves during this reporting month.

You must complete this cell if your water system sells treated water to other public water systems or is a non-community water system. Community water systems that do not sell water to other public water systems do not have to complete this cell.

> **NOTE**
> The turbidity and disinfection requirements for surface water treatment plants are based on the total population served by the plant. Consequently, a system must report the approximate population that it serves through both the wholesale and retail connections that it supplies.

# 3. Entering Daily Data in the SWMOR

Each day that your plant treats water, you must monitor your plant's operations. Record the data you collect in the **Performance Data** tables on pages 2 through 5 of the SWMOR.

After you have prepared your monthly file as described in Chapter 2, you can enter the actual data. This section of the guidance manual describes the process in detail.

**SPECIAL INSTRUCTIONS FOR SWMOR2 USERS**

In many respects, entering data in the SWMOR2 spreadsheet is the same as entering data in SWMOR. For example, raw and treated water flow rates, raw water quality data, settled water turbidity, finished water residuals, and CT data are entered in exactly the same way on both reports.

Chapter 9 contains the instructions for entering data in SWMOR2. However, because specific parts of the two spreadsheets are similar, some of the information presented in Chapter 3 is not repeated in Chapter 9 in order to save space and paper.

The specific areas in Chapter 3 that you will need to use for SWMOR2 include:

- Section 3.1—except for the subsection "Turbidity (of the Finished Water)"
- Sections 3.3 through 3.5

### Enable Macros? Yes!

When the **Enable Macros** dialog box pops up, click [Enable Macros]. You need to enable the macros so that the spreadsheet can accurately perform its many calculations.

### Plant Parameters and Disinfection Process Parameters? Cancel!

When the **Plant Parameters** and the **Disinfection Process Parameters** dialog boxes pop up, click [Cancel]. The process you went through in Sections 2.2 and 2.3 created a customized spreadsheet that describes your plant. As long as you don't make changes to your plant (such as structural changes), you may skip this step when entering monthly data to save time.

**IMPORTANT**

We strongly recommend that you begin each month's report with a blank copy of your customized SWMOR. However, if you insist on using a completed report from a previous month as your starting point, you must click on the [OK] button rather than the [CANCEL] button so that the SWMOR will reset the disinfectant types to your default values.

## 3.1 ENTER DAILY PLANT-PERFORMANCE DATA (PAGE 2)

The **Performance Data** area of the form is used to summarize the performance of your plant each day. This data is entered on page 2 of both the SWMOR and SWMOR2.

To get to page 2, click on the **P.2-Turbidity Data** tab. 


Please note that you must enter some data on the **P.2-Turbidity Data** worksheet every day, even if your plant did not treat water.

Figure 3.1 shows the **Performance Data** table on page 2 as it might be completed for the plant that received the approved CT study in Appendix A. We will refer to the shaded entries in Figure 3.1 as we explain how to complete this table.

| PERFORMANCE DATA | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw Water Pumpage (MGD) | Treated Water Pumpage (MGD) | RAW WATER ANALYSES | | SETTLED WATER TURBIDITY (Mandatory Data) | | | | | | FINISHED WATER QUALITY | | | | | | | | | |
| | | | | | Basin No. | | | | | | Turbidity | | | | | | Lowest | |
| Date | | | NTU | Alk. | 1 | 2 | 3 | 4 | 5 | 6 | NTU1 | NTU2 | NTU3 | NTU4 | NTU5 | NTU6 | Residual | Time |
| 1 | 1.411 | 1.322 | 49 | 52 | 2.4 | 1.9 | | | | | X | 0.19 | 0.07 | 0.03 | 0.31 | ND | 2.4 | |
| 2 | 1.484 | 1.444 | 26 | 68 | 2.8 | 1.8 | | | | | X | 0.33 | 0.24 | 0.27 | 0.15 | 0.12 | 3.4 | |
| 3 | 1.598 | 1.511 | 12 | 59 | 2.1 | 2.2 | | | | | X | 0.23 | 0.08 | 0.12 | 0.17 | 0.26 | 3.1 | |
| 4 | 1.154 | 1.064 | 80 | 92 | 5.2 | 4.3 | | | | | X | 0.34 | 0.46 | 0.78 | 1.06 | 1.17 | 2.3 | |
| 5 | 0.000 | 0.889 | X | X | X | X | | | | | X | X | X | X | X | X | 1.1 | |
| 6 | 2.650 | 1.103 | 15 | 61 | 1.8 | 1.4 | | | | | X | X | 0.26 | 0.32 | 0.21 | 0.10 | 2.8 | |
| 7 | 1.302 | 1.239 | 73 | 55 | 2.3 | 2.0 | | | | | X | 0.13 | 0.28 | 0.38 | 0.34 | 0.30 | 3.0 | |
| 8 | 1.377 | 1.280 | 10 | 47 | 1.7 | 1.9 | | | | | X | 0.27 | 0.24 | 0.17 | 0.19 | 0.04 | 2.7 | |
| 9 | 1.701 | 1.687 | 24 | 53 | 1.9 | 1.6 | | | | | X | 0.24 | 0.32 | 0.25 | 0.18 | 0.12 | 0.3 | 0.75 |
| 10 | 1.408 | 1.397 | 16 | 44 | 1.2 | 1.1 | | | | | X | 0.33 | 0.08 | 0.07 | 0.21 | 0.11 | 1.9 | |
| 11 | 1.457 | 1.402 | 70 | 62 | 1.8 | 1.5 | | | | | X | 0.30 | 0.06 | 0.20 | 0.23 | 0.34 | 2.2 | |
| 12 | 1.537 | 1.522 | 98 | 43 | 3.2 | 2.3 | | | | | X | 0.29 | 0.08 | 0.16 | 0.14 | 0.27 | 3.1 | |
| 13 | 1.092 | 1.084 | 16 | 57 | 2.2 | 1.8 | | | | | X | 0.33 | 0.28 | 0.10 | 0.27 | 0.29 | 2.0 | |
| 14 | 1.564 | 1.506 | 68 | 48 | 2.0 | 1.7 | | | | | X | 0.23 | 0.26 | 0.31 | 0.28 | 0.03 | 1.4 | |
| 15 | 1.361 | 1.278 | 93 | 69 | 25.6 | 2.1 | | | | | X | 0.30 | 0.20 | 0.23 | 0.05 | 0.25 | 1.8 | |
| 16 | 1.879 | 1.794 | 10 | 55 | 2.1 | 1.9 | | | | | X | 0.31 | 0.21 | 0.17 | 0.28 | 0.22 | 1.5 | |
| 17 | 0.109 | 0.000 | 91 | 58 | 2.2 | X | | | | | X | 0.20 | 0.31 | 0.24 | 0.34 | 0.20 | X | |
| 18 | 0.230 | 0.050 | 95 | 64 | 2.5 | X | | | | | X | 0.17 | 0.13 | 0.16 | 0.32 | 0.28 | md | |
| 19 | | | | | | | | | | | | | | | | | | |

**Figure 3.1. Performance Data section on page 2 of the SWMOR or SWMOR2.**

## Raw and Settled Water Data

### Raw Water Pumpage

Each day, record the amount of raw water pumped to the plant for treatment in the **Raw Water Pumpage** column. Report this value in million gallons per day (MGD). The amount of raw water sent to the plant and treated may not be exactly the same as the volume of water sent to distribution. In this area, you should record the amount of raw water sent to the treatment plant, even if that water was not sent to distribution on the same day.

If no raw water was sent to the plant on a specific day, enter <0.000> in this column. If the plant did receive raw water on a specific day but you failed to record how much, enter <ND> in this column.

---

**Example 3.1: Raw Water Pumpage**

In Figure 3.1, the entry on the fifth day of the month shows that the plant did not receive any raw water on that day. Since no water was sent to the plant, the plant was not required to do the following:

- perform raw-water analyses
- monitor settled-, filtered-, or finished-water turbidity
- Collect disinfection-process data

Therefore, the SWMOR automatically entered <X> in all of the applicable cells for that date.

---

### Treated Water Pumpage

Each day, record the amount of treated water discharged to the distribution system in the **Treated Water Pumpage** column. Report this value in MGD. Do not record the meter reading. Instead, record the total amount of water pumped to the distribution system during the day.

If your plant did not pump treated water to distribution on a specific day, enter <0.000> in this column. If the plant sent treated water to the distribution system on a specific day but you failed to record how much, enter <ND> in this column.

---

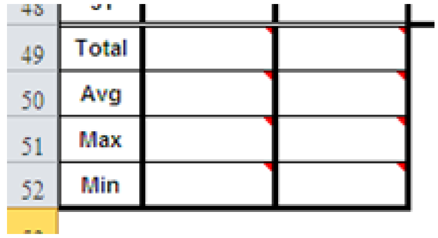
**Example 3.2: Treated Water Pumpage**

In Figure 3.1, the entry on the 17th of the month shows that the plant treated 109,000 gallons of raw water, but did not pump treated water to the distribution system that day. Since treated water was not pumped to distribution, the plant was not required to collect disinfectant residual data entering the distribution system. Therefore, the SWMOR automatically entered <X> in the **Lowest Residual** cell for that date.

---

### Pumpage Summaries *CALC*

Figure 3.2 shows the spaces where the spreadsheet automatically enters the total amounts of raw and treated water pumped during the month as well as the average (**Avg**), maximum (**Max**), and minimum (**Min**) daily pumpage rates for raw and treated water. The spreadsheet fills in these results using the values for raw- and treated-water pumpage that you entered each day.



| | | | |
|---|---|---|---|
| 49 | Total | | |
| 50 | Avg | | |
| 51 | Max | | |
| 52 | Min | | |

**Figure 3.2. Pumpage Summary section of the spreadsheet.**

## Raw Water Analyses

Each day, record the turbidity and the alkalinity of the raw water treated by the plant in the **Raw Water Analyses** column. Record the turbidity of the raw water in the **NTU** column. Record the alkalinity of the raw water in the **Alk.** column. Report the alkalinity reading in milligrams per liter (mg/L of $CaCO_3$). You must measure the turbidity and the alkalinity of the raw water at least once each day when your plant treats water. If you conduct more than one set of tests during the day, record the average value for each parameter. See Table 7.1 in Chapter 7 of this manual to find the acceptable laboratory methods for measuring these values.

If your plant did not treat water on a specific day, enter <X> in each of the **NTU** and **Alk.** columns. If you treated water but did not collect turbidity or alkalinity data on a specific day, enter <ND> in each of the **NTU** and **Alk.** columns.

## Settled Water Turbidity

If we have required your plant to monitor levels of settled water turbidity, you must do so as often as we have specified in our approval letter. Even if such monitoring is optional for your plant, we recommend that you measure the turbidity of the settled water at the effluent of each sedimentation basin at least once each day. Data on settled-water turbidity data allows for valuable analysis of the performance of sedimentation and, in particular, the performance of each basin. See Table 7.1 in Chapter 7 of this manual to find the acceptable laboratory methods for measuring turbidity.

The **Performance Data** table on page 2 of the SWMOR contains six columns where you can enter the turbidity of the settled water from Basins Nos. 1 through 6. If your plant has more than six basins, six additional columns for recording the settled water turbidity from Basins Nos. 7 to 12 appear on the addendum page.

If your plant collects settled water turbidity data from each sedimentation basin, record the turbidity of the settled water from each basin in the corresponding column. If you conduct more than one set of tests during the day, record the maximum (highest) value for each basin. If a basin is not in operation on a specific day, enter <X> in the corresponding column. If settled water turbidity is mandatory and you did not collect the turbidity for an operational basin, you must enter <ND>. However, when settled water turbidity is optional, you may either leave the cell blank or enter <ND>.

**Example 3.3: Settled Water Turbidity**

The **SETTLED WATER TURBIDITY** section of Figure 3.1. reveals the following:

1. We have required the treatment plant to monitor the turbidity of the settled water.
2. The plant was offline on the fifth of the month.
3. Basin No. 2 was not in operation on the 17th and 18th of the month.
4. The operators tested the reading for settled-water turbidity from each basin at least once each day it was in service.

**SWMOR2 USERS**

You do not have to read the following subsection **Turbidity (Finished Water)**. We have repeated any information that applies to you in Chapter 9.

## Turbidity (Finished Water)

You must measure and record the turbidity of the combined filter effluent each day that your plant treats water. That means that you must record turbidity results each day that you show a raw water pumpage above 0.000 MGD.

***What Test to Run***: Using an acceptable method from Table 7.1, measure the turbidity of the finished water on a regular schedule.

***Where to Sample***: You should collect the CFE turbidity sample at the filter outlet header or the clearwell inlet line. However, the TCEQ occasionally approves other sampling sites, such as the clearwell outlet line or the service pump discharge line.

***When to Sample:*** The timing and number of CFE turbidity readings that you must record depends on the number of people that your water system serves. The specific requirements are:

**Systems Serving 500 or Fewer Persons:** If your system serves 500 or fewer persons each day, you must take this reading at least once each day. The reading must be taken at the same time each day.

**Systems Serving More than 500 Persons:** If your system serves more than 500 persons, you must take regular four-hour readings whenever the plant is in operation. For example, you may take these readings at 2 a.m., 6 a.m., 10 a.m., 2 p.m., 6 p.m., and 10 p.m. Use the same schedule each day. You may take these readings more frequently than once every 4 hours, but you must use only the readings made at the designated times to determine whether your plant is in compliance.

The TCEQ sets six standard four-hour periods each day: NTU1 is midnight to 4 a.m.; NTU2 is 4 a.m. to 8 a.m.; NTU3 is 8 a.m. to noon; NTU4 is noon to 4 p.m.; NTU5 is 4 p.m. to 8 p.m.; and NTU6 is 8 p.m. to midnight. Readings must be taken to represent each of the TCEQ's four-hour reporting periods when the plant is producing water for any portion of the time.

For example, if the treatment plant starts up at 7 a.m. and shuts down at 5 p.m. each day, the system must set a sampling schedule to represent the treated water for the four-hour periods from midnight to 8 a.m., from 8 a.m. to noon, from noon to 4 p.m., and from 4 p.m. to 8 p.m. An acceptable schedule would be to take turbidity readings at 7:30 a.m., 11:30 a.m., 3:30 p.m., and 5:00 p.m. The reading taken at 7:30 am would be entered in the NTU2 field; the reading collected at 11:30 am would be entered in the NTU3 field, the 3:30 reading would be entered in the NTU4 field, and the 5:00 pm reading would be entered in the NTU5 field, right before the plant shuts down.

Note that the interval between the last two readings in this example is less than four hours, which is acceptable in this case. However, it is never acceptable for the interval between samples to be longer than four hours.

**WHEN TO SAMPLE—SPECIAL CASES**

If you are using automated systems to operate or monitor your plant, there are some special requirements that you need to consider when reporting finished water turbidity data. For example:

- **Auto-cycling:** If your plant automatically cycles off and on, we consider the plant to be in continuous operation unless you have turned off the raw water pumps with the manual override. If your plant is not treating water when the sample is supposed to be collected, you must use the last reading that was collected when the plant was in operation. The clearwell and the service pump station may, however, continue to operate when the plant is not in operation because these facilities can continue to operate even if the plant is not filtering water.
- **Online turbidimeters:** If your plant uses a continuous turbidity analyzer, you may either take the turbidity data from the recorder chart or use the results of grab samples. If you choose to use data from the recorder chart, you must verify the accuracy of the turbidity monitor at least once each week. See Section 7.2, “Calibrating Instruments and Other Equipment,” for more information about calibrating continuous turbidity monitors and recorders.

**IMPORTANT**

Avoid calibrating your online turbidimeters immediately before a sample collection is scheduled. If there is a problem during calibration, you could end up recording an erroneous result. Allow at least 15–20 minutes to complete a calibration procedure so that you don’t end up missing a sample or accidentally reporting the value of the turbidity standard you are using.

If you do happen to be calibrating an online turbidimeter when a sample is supposed to be collected, we will allow you to report the level of finished-water turbidity using one of the following methods:

- a grab sample and benchtop turbidimeter
- the turbidity reading from the online meter that is recorded 15 minutes after the calibration process is completed
- the last turbidity reading recorded by the online turbidimeter before it was taken offline for calibration

***How to Enter Results*:** The SWMOR contains six columns for recording the turbidity of the finished water. Each column represents a four-hour period of the day. For example, the **NTU1** column represents midnight to 4 a.m., and the **NTU6**

column represents 8 p.m. to midnight. If your plant is in operation during any portion of the four-hour period, you must measure and record a turbidity reading and enter the result in the appropriate column. If your plant is offline during the entire four-hour period, enter <X> in the corresponding column. If the plant treated water at any time during a four-hour period but the required turbidity reading was not recorded at the required time, enter <ND> in the appropriate cell.

---

**Example 3-4: Finished Water Turbidity**

The finished water turbidity entries (columns NTU1 through NTU6) in Figure 3.1. give us this information:

1. The scheduled turbidity reading for each four-hour period when the plant was in operation even for part of that period.
2. The plant was always offline between midnight and 4 a.m. each day.
3. The plant was offline on the fifth day of the month.
4. The plant was also offline between 4 a.m. and 8 a.m. on the sixth day of the month.
5. The plant was in operation between 8 p.m. and midnight on the first day of the month, but no data on finished-water turbidity was collected.

---

## Lowest Residual (Finished Water)

You must measure and record the residual concentration of disinfectant, or "residual," in the water entering the distribution system each day that your plant pumps water to distribution. That means that you must record the disinfectant residual reading each day you show a treated water pumpage above 0.000 MGD.

***What Test to Run***: Using an acceptable method from Table 7.2, measure the disinfectant residual in the finished water on a regular schedule.

***Where to Sample***: You may collect the residual data at any location in the plant where the quality is representative of the water entering the distribution system. Common sampling sites include the clearwell outlet line and the service pump discharge line.

***When to Sample:*** The timing and number of finished water disinfectant residual readings that you must record depends on the number of people that your water system serves. The specific requirements are:

**Systems Serving 3,300 or Fewer Persons:** If your system serves 3,300 or fewer persons each day, you may use grab samples to test the residual entering the distribution system. You must collect the residual data at regular intervals throughout the daily period of operation.

Table 3.1 shows the sampling frequency depending on the number of persons the system serves.

Systems using grab samples must collect the residual data at least once every four hours if the residual entering the distribution system falls below the acceptable level. For systems maintaining a free-chlorine residual in the distribution system, the minimum acceptable level is 0.2 mg/L. For systems maintaining a chloramine residual, the minimum acceptable level is 0.5 mg/L.

**Table 3.1. Point-of-entry disinfectant-residual samples depending on system size.**

| Population | Number of disinfectant samples (entering distribution system) |
|---|---|
| 500 or fewer | 1 sample per day |
| 501–1,000 | 2 samples per day |
| 1,001–2,500 | 3 samples per day |
| 2,501–3,300 | 4 samples per day |

You may collect the residual data more frequently if you wish. This increased monitoring frequency must continue until the plant restores an acceptable residual.

**Systems Serving More than 3,300 Persons:** If your system serves more than 3,300 persons, you must equip the plant with equipment to continuously monitor residual disinfectant. The continuous analyzer must sample the plant effluent at least once every 30 minutes. Systems using continuous analyzers to monitor the disinfectant residual must take the data from the recorder chart. These analyzers must be calibrated at least once each month as described under “Chlorine Residual Analyzers” in Section 7.2, “Calibrating Instruments and Other Equipment.” A plant that experiences a failure in the continuous monitoring equipment may collect “grab samples” every 4 hours for no more than five working days. The plant must collect these samples at the same time when it collects the CFE turbidity samples.

**NOTE**
Most systems are required to provide a much higher residual than the allowable minimum so they can maintain an acceptable residual throughout the distribution system.

***How to Enter Results*:** Record the lowest residual reading of the day in the **Lowest Residual** column. Report this value in mg/L. If your plant did not pump treated water to distribution on a specific day, enter <X>. If it sent treated water to the distribution system at any time during the day but failed to collect any finished water disinfectant residual data at the distribution system entry point, you must enter <ND> in the applicable cell. If you recorded some, but not all of the required entry-point residual readings, then you must:

- enter the the lowest reading of the day if it was below the acceptable level of 0.2 mg/L free chlorine or 0.5 mg/L chloramines (measured as total chlorine)

*or*

- enter <MD> if you collected some, but not all of the required readings, but all of the readings that you do have were above the minimum required level.

### Time

Use the **Time** column to record the number of consecutive hours that the disinfectant residual entering the distribution system was below acceptable levels during the day. If the residual fell below the acceptable level more than once during the day, record the longest period of time involved. If the residual entering the distribution system was always above the acceptable level on a specific day, leave this column blank. Also, this column should be left blank if the **Lowest Residual** is recorded as either <ND> or <MD> on a specific day. If you did not record the period of time that the disinfectant residual was below the acceptable level on a specific day, enter <ND> in the corresponding column.

When calculating the duration of the event, the event begins when the reading falls below the acceptable level and concludes when the reading is equal to or greater than the acceptable level. For example, if the 4 p.m. reading was 0.5 mg/L free chlorine, the 8 p.m. reading was 0.1 mg/L free chlorine, and the midnight reading was 0.3 mg/L free chlorine, then the duration of the event was 4.00 hours (8 p.m. to midnight).

A plant may increase the monitoring frequency to more accurately determine the duration of an event. For example, if you collect residual data every 15 or 30 minutes after getting a low reading, you may report the duration of the event in ¼-hour or ½-hour increments. Therefore, an event lasting only 15 minutes will be reported as 0.25 hour, and one lasting 2 hours 45 minutes will be reported as 2.75 hours.

**IMPORTANT**
The time recorded in the **Time** column may not represent the duration of time that your plant has its lowest residual entering the distribution system. In other words, your entries in the **Lowest Residual** and **Time** columns do not necessarily represent the same event.

---

### Example 3-5: Disinfectant Entering Distribution System

The **Lowest Residual** entries in Figure 3.1. give us this information:

1. The lowest disinfectant residual entering the distribution system each day that the plant pumped water to distribution.
2. The plant did not pump any treated water to distribution on the 17th day of the month.
3. The lowest disinfectant residual entering the distribution system fell below the minimum acceptable level of 0.5 mg/L for total chlorine at least one time on the ninth day of the month. The longest duration of time that the residual was below the acceptable level was 45 minutes, or 0.75 hours.
4. The plant pumped water to distribution on the 18th day of the month, but the plant failed to continuously monitor the chlorine residual entering the distribution system. However, some of the data were recorded and all of those readings were above 0.5 mg/L.

---

**SWMOR2 USERS:**
You do not have to read Section 3.2. We have repeated any information that applies to you in Chapter 9.

# 3.2 ENTER DAILY DATA ON INDIVIDUAL-FILTER TURBIDITY PERFORMANCE

The **Filter Data** area of the form is where you will summarize the performance of each of your plant's individual filters. The data on individual-filter-effluent (IFE) turbidity is entered on page 3.

To get to page 3, click on the **P.3-Filter Data tab**. y Data \ P.3-Filter Data / P.4&5-D

You must enter information on page 3 of the SWMOR every day that your plant treats water. You must also enter some additional information at the end of the month about the performance of individual filters during previous months.

## Daily Data on Individual-Filter Performance

The **Performance Data** table on page 3 of the SWMOR contains columns for recording the turbidity of the filtered water from Filters No. 1-10. If your plant has more than 10 filters, additional columns for recording the filtered water turbidity from up to 50 filters are provided on the addendum pages.

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | PERFORMANCE DATA | | | | | | | | | | | | | | | | | |
| 12 | | INDIVIDUAL FILTER TURBIDITY | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | |
| 14 | | Filter No. 1 | | Filter No. 2 | | Filter No. 3 | | Filter No. 4 | | Filter No. 5 | | Filter No. 6 | | Filter No. 7 | | Filter No. 8 | | Filte |
| 15 | Date | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max |
| 16 | 1 | | | | | | | | | | | | | | | | | |
| 17 | 2 | | | | | | | | | | | | | | | | | |
| 18 | 3 | | | | | | | | | | | | | | | | | |

Figure 3.3 shows the portion of the SWMOR that is described in this section.


| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | PERFORMANCE DATA | | | | | | | | | | | | | | | | | |
| 12 | | INDIVIDUAL FILTER TURBIDITY | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | |
| 14 | | Filter No. 1 | | Filter No. 2 | | Filter No. 3 | | Filter No. 4 | | Filter No. 5 | | Filter No. 6 | | Filter No. 7 | | Filter No. 8 | | Filte |
| 15 | Date | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max |
| 16 | 1 | | | | | | | | | | | | | | | | | |
| 17 | 2 | | | | | | | | | | | | | | | | | |
| 18 | 3 | | | | | | | | | | | | | | | | | |


**Figure 3.3. Data section for individual-filter turbidity on page 3 of the SWMOR.**

After you review the information on the following several pages, Examples 3.6 and 3.7 show you how to complete and interpret the information contained in this portion of the SWMOR.

### Readings of Individual-Filter Turbidity

You must measure and record the turbidity of the water produced by a filter whenever it is sending water to the clearwell. That means that you must record at least one result for IFE turbidity for each day when you show a raw-water pumpage above 0.000 MGD.

***What Test to Run:*** You must use one of the acceptable methods from Table 7.1 to measure the turbidity of the water produced by each filter.

***Where to Sample:*** You must collect the IFE turbidity sample at the outlet of each filter before that water is mixed with the water from any other filter.

***When to Sample:*** You must record the IFE turbidity reading every 15 minutes whenever the filter is sending water to the clearwell. These readings must be collected on the quarter hour, for example, at 1:00 p.m., 1:15 p.m., 1:30 p.m., and 1:45 p.m.

The calibration of each continuous turbidity monitor must be verified at least once each week. See Section 7.2, “Calibrating Instruments and Other Equipment,” for information about calibrating the online monitors and recorders. A plant that experiences a failure in the continuous monitoring equipment may collect grab samples every 4 hours for no more than 5 working days. If the result of a grab sample is greater than 1.0 NTU, the plant must collect a confirmation sample 15 minutes later.

**SPECIAL CASE—FILTER TO WASTE**
A filter is in operation when it is discharging water that contributes to the combined filter effluent. A filter is not in operation if it is offline or filtering to waste.

**IMPORTANT**
Avoid calibrating your online turbidimeters immediately before a sample is scheduled to be collected. If there is a problem during the calibration procedure, you could end up recording an erroneous result. If you have a calibration problem that affects two consecutive 15-minute readings, you must either document that these readings were collected during a calibration procedure or you will need to fill out a filter-profile report as described in chapter 4.

***How to Enter Results:*** For each filter, record the maximum turbidity value that you recorded in the corresponding **Max** column. If you recorded the turbidity level four hours after starting a filter run, enter that data in the **4 Hrs** column. If a filter is not in operation on a specific day, enter <X> in both the **Max** and **4 Hrs** columns. If you were not required to collect a 4-hour reading, enter <X> in the **4 Hrs** column.

### Maximum IFE Turbidity

Record the maximum turbidity value from each filter in the corresponding **Max** column. If a filter is not in operation on a specific day, enter <X>. (See the **important note** below and Examples 3.7 and 3.8 that follow.) If you collected none of the required IFE 15-minute turbidity readings for a particular filter, you must enter <ND> in the applicable **Max** cell. If you recorded some, but not all of the required 15-minute readings, then you must:

- enter the the highest reading of the day if it was above 1.0 NTU

*or*

- enter <MD> if you recorded some, but not all of the required readings, but all of the readings that you have were 1.0 NTU or less.

> **IMPORTANT**
> Systems may be required to conduct additional monitoring if the turbidity level from a filter exceeds the 1.0 NTU or 2.0 NTU trigger level in two consecutive 15-minute readings. Do not report any turbidity reading above either trigger level unless a filter exceeds the trigger level in two consecutive 15-minute readings.
>
> If the turbidity level from a filter is greater than 2.0 NTU on a specific day, report the highest reading only if the reading collected 15 minutes before or after is also greater than 2.0 NTU. If the turbidity level is greater than 1.0 NTU, report the highest reading only if the preceding or following 15-minute reading is also greater than 1.0 NTU. If the turbidity level does not exceed either trigger level in two consecutive 15-minute readings, report the maximum reading no greater than 1.0 NTU.

### IFE Turbidity at 4 Hours

If your system serves fewer than 10,000 persons each day, you may leave the **4 Hrs** columns blank. If your system serves 10,000 or more persons, in the corresponding **4 Hrs** column, record the turbidity value from each filter at the end of four hours of continuous filter operation after the filter is returned to service from backwash or shutdown. If such an event occurs more than once for a filter during the day, enter the reading for the event with the maximum turbidity level at four hours. If no such event occurs for a filter on a specific day, enter <X>. If you failed to record required 4-hour turbidity readings for a particular filter, you must enter <ND> in the applicable **4 Hrs** cell. If you recorded some, but not all of the required readings on a given day, then you must:

- enter the the highest reading of the day if any of the 4-hour readings that you do have were above 0.5 NTU

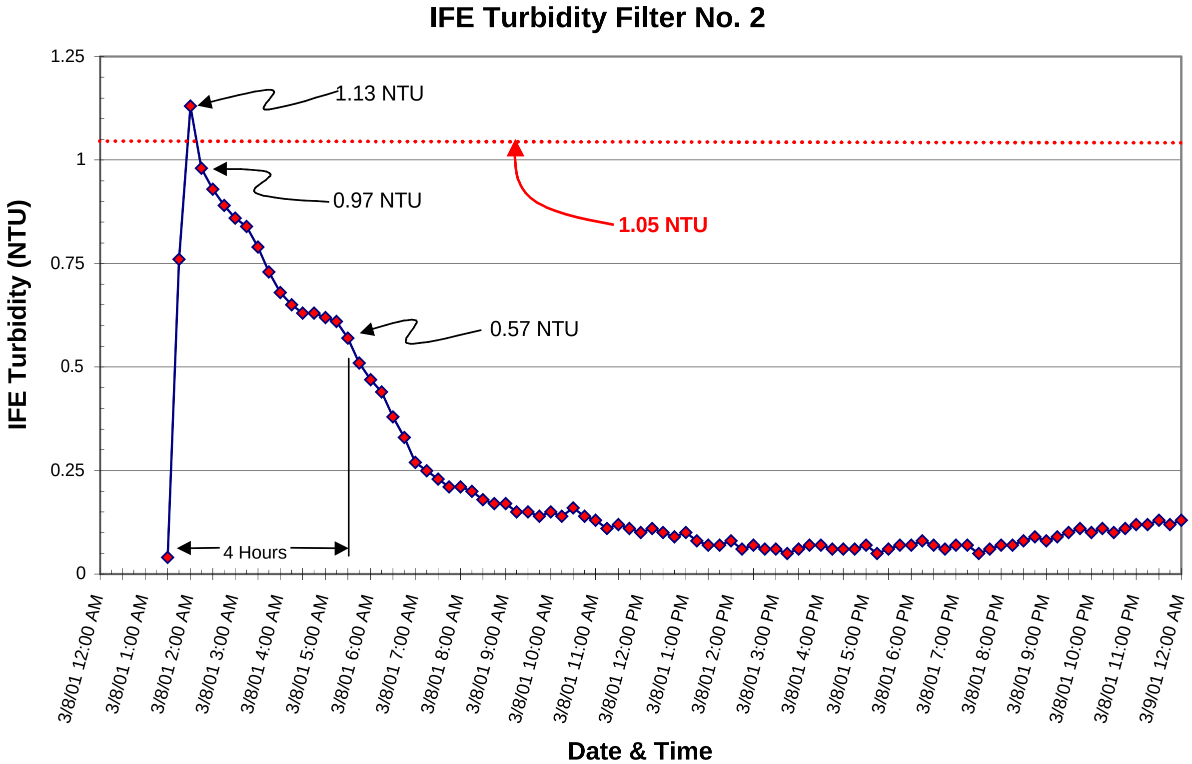
*or*

- enter <MD> if you recorded some, but not all of the required readings, but all of the readings that you do have were 0.5 NTU or less.

> **IMPORTANT**
> Systems serving fewer than 10,000 people are not required to report “4-hour” data. However, the SWMOR spreadsheet allows you to report the data if you wish. If you decide to include the data, the SWMOR spreadsheet will calculate the number of days when the **4 Hrs** column contains readings above 0.5 NTU but it automatically excludes the information when determining whether additional monitoring is required. Thus, there are no negative consequences to including the additional information.
>
> Systems serving 10,000 or more persons may be required to conduct additional monitoring if the turbidity level from a filter exceeds 0.5 NTU in two consecutive 15-minute readings at the end of four hours of continuous filter operation. Do not report any turbidity reading above 0.5 NTU unless a filter exceeds 0.5 NTU in two consecutive 15-minute readings at the end of four hours into a filter run. If the turbidity level from a filter is greater than 0.5 NTU at 4 hours, report that reading only if the preceding reading, that is, the reading at 3 hours 45 minutes, or the following reading—that is, the reading at 4 hours, 15 minutes—is also greater than 0.5 NTU. Otherwise, report the subsequent reading, that is, the reading at 4 hours, 15 minutes.

**Example 3.6: Maximum Daily and 4-Hour Individual Filter Effluent Turbidity**

The following figure shows the turbidity readings on samples collected at the effluent of Filter No. 2.




Filter No. 2 was backwashed the previous day and allowed to sit idle for three hours to pre-ripen. It was returned to service at 1:20 a.m. Since turbidity readings must be collected on the quarter hour, the first turbidity reading of the filter run occurs at 1:30 a.m.

Although the maximum daily turbidity reading from this filter was 1.13 NTU, the value was not confirmed by a second consecutive reading of 1.05 NTU or higher. Consequently, when completing page 3 of the SWMOR, the operator should record the 0.97 NTU reading in the **Max** space for March 8, 2001.

At 5:30 a.m., four hours after the first turbidity reading, the operator records a turbidity level of 0.57 NTU. Since this reading is above 0.50 NTU, the operator checks the readings at 5:15 and 5:45 a.m. to determine if at least one of those is also above 0.50 NTU. Since the reading at 5:15 is 0.55 NTU or higher, the operator records the 0.57 NTU reading in the **4 Hrs** space on the SWMOR.

### Example 3.7: IFE Turbidity

A surface water treatment plant submits an SWMOR containing the following data:

| PERFORMANCE DATA | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | INDIVIDUAL FILTER TURBIDITY | | | | | | | | | | | | | |
| | Filter No. 1 | | Filter No. 2 | | Filter No. 3 | | Filter No. 4 | | Filter No. 5 | | Filter No. 6 | | Filter No. 7 | |
| Date | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs | Max | 4 Hrs |
| 1 | 0.52 | X | 0.66 | 0.11 | 0.93 | 0.17 | 0.33 | X | 0.45 | X | 0.34 | X | | |
| 2 | 0.40 | 0.14 | 0.35 | 0.30 | ND | ND | 0.86 | 0.37 | 0.78 | 0.28 | X | X | | |
| 3 | 0.23 | ND | 0.65 | X | MD | 0.22 | 0.27 | X | 0.31 | X | 0.45 | 0.09 | | |
| 4 | 1.60 | 0.57 | 0.73 | 0.09 | 0.43 | X | 0.59 | 0.19 | 1.10 | ND | 0.26 | X | | |
| 5 | X | X | X | X | X | X | X | X | X | X | X | X | | |

The individual filter turbidity data gives us this information—

1. On the first day of the month:
   a. All six of the plant's filters were operated for some period of time.
   b. There are no 4-hour readings required for Filters No. 1, 4, 5, and 6. Consequently, they were either operated all day long or they were taken offline at some point during the day and were not restarted.
   c. Filters No. 2 and 3 were either taken offline or backwashed at least once during the day. The filters were then restarted and operated for a period of at least four hours.
2. On the second day of the month:
   a. No data was recorded for Filter No. 3.
   b. Filter No. 6 was not operated at all that day.
3. On the third day of the month,
   a. Filter No. 1 was taken out of service, backwashed, and then restarted at least once during the day. However, the operator did not record the turbidity level of the water four hours after beginning one of the production runs.
   b. The SCADA system failed to record all of the required 15-minute IFE turbidity readings from Filter No. 3. However, we know that none of the readings that were recorded were above 1.0 NTU (because, otherwise, the operator would have recorded the exceedance).
4. On the fourth day of the month:
   a. The turbidity level from Filters No. 1 and 5 exceeded 1.0 NTU in two consecutive 15-minute readings.
   b. The turbidity level from Filter No. 1 exceeded 0.5 NTU in two consecutive 15-minute readings at four hours after the filter was returned to service.
   c. The SCADA system failed to record the turbidity level produced by Filter No. 5 four hours after it began a filter run.
5. The plant was completely offline on the fifth of the month; the raw-water flow rate on page 2 of the SWMOR will be 0.00 MGD. (Note: The SWMOR will not let you enter Xs in all the filters unless the flow rate is 0.00 MGD.)
6. If the water system serves at least 10,000 people, the missing 4-hour turbidity readings on the first four days of the month will each result in a monitoring and reporting violation because these systems are required to collect this data. If the system serves fewer than 10,000 people, it is not required to collect this data and so the SWMOR will not treat the empty spaces as data-entry errors.

## Summary and Compliance Actions (Page 3)

The **Summary and Compliance Actions** table at the bottom of page 3 of the SWMOR contains columns for summarizing the historical performance of Filters No. 1–10. If your plant has more than 10 filters, additional columns for recording the IFE turbidity data turbidity for up to 50 filters are available on the addendum pages. Figure 3.4 shows the portion of the SWMOR that is described in this portion of the guidance manual.

SUMMARY & COMPLIANCE ACTIONS

| | Criteria | Filter No. | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 49 | Number of days with event(s) above 0.5 NTU at 4.0 hrs this month | | | | | | | |
| 50 | Number of days with event(s) above 1.0 NTU this month | | | | | | | |
| 51 | Number of days with event(s) above 1.0 NTU last month | | | | | | | |
| 52 | Number of days with event(s) above 1.0 NTU two months ago | | | | | | | |
| 53 | Total number of days with event(s) above 1.0 NTU in three months | | | | | | | |
| 54 | Number of days with event(s) above 2.0 NTU this month | | | | | | | |
| 55 | Number of days with event(s) above 2.0 NTU last month | | | | | | | |
| 56 | Does the filter/plant have an approved Corrective Action Plan? | | | | | | | |
| 57 | Is the plant required to submit a Filter Profile Report? | | | | | | | |
| 58 | Is the plant required to submit a Filter Assessment Report? | | | | | | | |
| 59 | Is the plant required to submit a Request for Compliance CPE? | | | | | | | |

**Figure 3.4. Summary & Compliance Actions section on page 3 of the SWMOR.**

After you review the information on the following several pages, Example 3.8 illustrates how to complete and interpret the information contained in this portion of the SWMOR.

### Number of days with event(s) above 0.5 NTU at 4.0 hours this month *CALC*

For each filter at the plant, the SWMOR counts the number of days when you entered a turbidity reading above 0.5 NTU in the **4 Hrs** column.

### Number of days with event(s) above 1.0 NTU this month *CALC*

For each filter at the plant, the SWMOR counts the number of days when you entered a turbidity reading above 1.0 NTU in the **Max** column.

### Number of days with event(s) above 1.0 NTU last month

For each filter at the plant, record the number of days during the last reporting month that you entered a turbidity level above 1.0 NTU. Pull this information from the row of last month's SWMOR labeled **Number of days with event(s) above 1.0 NTU this month**.

### Number of days with event(s) above 1.0 NTU two months ago

For each filter at the plant, record the number of days that you entered a turbidity level above 1.0 NTU during the reporting period two months ago. If you pull this information from the row of last month's SWMOR labeled **Number of days with event(s) above 1.0 NTU last month**, you will not have to look at the SWMOR from two months before.

### Total number of days with event(s) above 1.0 NTU in three months *CALC*

For each filter at the plant, the SWMOR calculates the total number of days that you entered a turbidity level above 1.0 NTU during the last three reporting months.

### Number of days with event(s) above 2.0 NTU this month *CALC*

The SWMOR analyzes the data that you entered for each filter at the plant and determines how many days there were with at least one turbidity reading above 2.0 NTU in the **Max** column.

### Number of days with event(s) above 2.0 NTU last month

Record the number of days during the last reporting month that you entered one or more turbidity reading values above 2.0 NTU. Pull this information from the **Number of days with event(s) above 2.0 NTU this month** row of last month's SWMOR.

### Does the filter/plant have an approved corrective action plan?

For each filter at the plant, use the drop-down list to indicate whether we have approved a corrective-action plan (CAP) that waives the additional monitoring requirements for a specific filter. If the filter has an approved CAP, select <Y>. If the filter does not have an approved CAP, select <N>.

Also use the drop-down list for the plant to show whether we have approved a CAP that waives the plant from the requirement to participate in a comprehensive performance evaluation.

**IMPORTANT**

You do not have an approved corrective-action plan unless we have written you a CAP-approval letter. These approval letters:

1. identify the specific filters or plant that is covered by the approved CAP
2. briefly describe the corrective actions that must be completed
3. establish a compliance schedule for implementing the improvements

Once the improvements are complete, the CAP expires and the approval letter is no longer valid.

We generally do not approve a CAP for an individual filter unless the plant has submitted a filter-assessment report (FAR) and proposed CAP on that specific filter. If you have not conducted and submitted an FAR for the filter, you probably do not have an approved CAP for that filter.

We generally do not approve a CAP for the plant unless the system has participated in a CPE that was conducted by the TCEQ or a third party.

### Is the plant required to submit a Filter Profile Report? *CALC*

For each filter at the plant, the SWMOR determines if the plant is required to conduct any filter profile on the filter and submit one or more filter-profile reports with the SWMOR.

**IMPORTANT**
Unless a filter has an approved corrective-action plan that waives the filter from additional monitoring requirements, you must either identify the cause of exceedance or produce a filter profile on the filter each time that the IFE turbidity level in the water produced by that filter exceeds 1.0 NTU in two consecutive 15-minute readings.

If your system serves 10,000 people or more, you must also identify the cause of exceedance or produce a filter profile each time that the IFE turbidity level exceeds 0.5 NTU in two consecutive 15-minute readings at four hours after the filter is returned to service.

### Is the plant required to submit Filter Assessment Report(s)? *CALC*

For each filter at the plant, the SWMOR determines if the plant is required to conduct any filter assessment on the filter and submit one or more filter-assessment reports with the SWMOR.

**IMPORTANT**
Unless a filter has an approved corrective-action plan that waives the filter from additional monitoring requirements, you must conduct an assessment on it each time that a filter exceeds 1.0 NTU in two consecutive 15-minute readings on three separate occasions during the last three reporting months.

### Is the plant required to submit a CPE Request Form? *CALC*

The SWMOR determines if the plant is required to participate in a third-party CPE and submit a request-for-compliance CPE with the SWMOR.

**IMPORTANT**
Unless the plant has an approved corrective-action plan that waives the CPE requirement, you must participate in a third-party CPE each time that a filter or any combination of filters exceeds 2.0 NTU in two consecutive 15-minute readings during the last two reporting months.

## Example 3.8: Individual Filter Effluent Summary & Compliance Section

This figure includes the **Summary and Compliance Action** areas of the June and July 2002 SWMORs for a treatment plant in Texas.

### July 2012 (This month's SWMOR)

SUMMARY & COMPLIANCE ACTIONS

| Criteria | Filter No. 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Plant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of days with event(s) above 0.5 NTU at 4.0 hrs this month | 0 | 0 | 0 | 1 | | | | | | | |
| Number of days with event(s) above 1.0 NTU this month | 1 | 0 | 0 | 0 | | | | | | | |
| Number of days with event(s) above 1.0 NTU last month | 1 | 1 | 2 | 0 | | | | | | | |
| Number of days with event(s) above 1.0 NTU two months ago | 1 | 1 | 1 | 0 | | | | | | | |
| Total number of days with event(s) above 1.0 NTU in three months | 3 | 2 | 3 | 0 | | | | | | | |
| Number of days with event(s) above 2.0 NTU this month | | | | | | | | | | | 0 |
| Number of days with event(s) above 2.0 NTU last month | | | | | | | | | | | 1 |
| Does the plant have an approved corrective action schedule? | N | N | Y | N | | | | | | | N |
| Is the plant required to submit a Filter Profile Report? | Y | N | N | Y | | | | | | | |
| Is the plant required to submit a Filter Assessment Report? | Y | N | N | N | | | | | | | |
| Is the plant required to submit a Request for Compliance CPE? | | | | | | | | | | | N |

### June 2012 (Last month's SWMOR)

SUMMARY & COMPLIANCE ACTIONS

| Criteria | Filter No. 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Plant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of days with event(s) above 0.5 NTU at 4.0 hrs this month | 0 | 0 | 0 | 0 | | | | | | | |
| Number of days with event(s) above 1.0 NTU this month | 1 | 1 | 2 | 0 | | | | | | | |
| Number of days with event(s) above 1.0 NTU last month | 1 | 1 | 1 | 0 | | | | | | | |
| Number of days with event(s) above 1.0 NTU two months ago | 0 | 0 | 0 | 0 | | | | | | | |
| Total number of days with event(s) above 1.0 NTU in three months | 2 | 2 | 3 | 0 | | | | | | | |
| Number of days with event(s) above 2.0 NTU this month | | | | | | | | | | | 1 |
| Number of days with event(s) above 2.0 NTU last month | | | | | | | | | | | 0 |
| Does the plant have an approved corrective action schedule? | N | N | Y | N | | | | | | | N |
| Is the plant required to submit a Filter Profile Report? | Y | Y | N | N | | | | | | | |
| Is the plant required to submit a Filter Assessment Report? | N | N | N | N | | | | | | | |
| Is the plant required to submit a Request for Compliance CPE? | | | | | | | | | | | N |

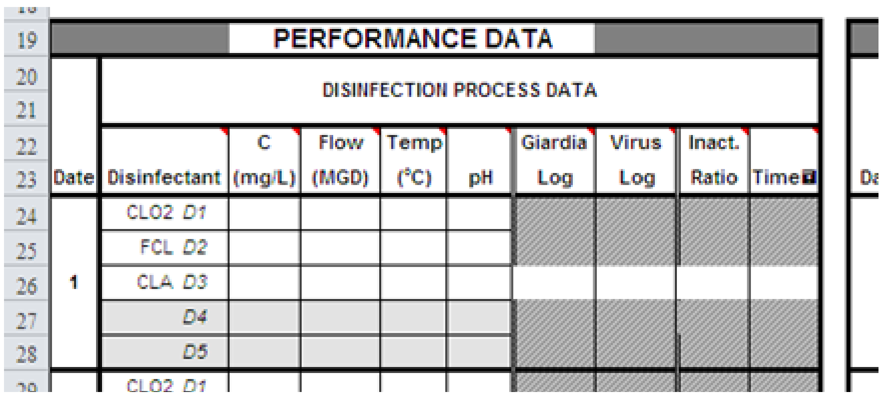
This example shows that:

1. You can use the preceding month's SWMOR to help you complete the information in these rows:
   - **a. Number of days with events above 1.0 NTU last month,**
   - **b. Number of days with events above 1.0 NTU two months ago, and**
   - **c. Number of days with events above 2.0 NTU last month.**
2. You will need to submit a Filter Profile Report on Filters No. 1 and 4 with the July SWMOR because:
   - a. there was one day when the maximum turbidity reported on Filter No. 1 was above 1.0 NTU,
   - b. there was one day when the turbidity level on Filter No. 4 was above 0.5 NTU exactly four hours after it was placed online, and
   - c. we have not yet approved a CAP on either of the filters.
3. You will need to submit a filter-assessment report on Filter No. 1 because the maximum turbidity level exceeded 1.0 NTU on a total of at least three days during the past three months and it has no approved CAP.
4. You have an approved CAP for Filter No. 3 and so you didn't have to submit a filter-assessment report on that filter in June (even though there was a total of three days when the turbidity level rose above 1.0 NTU).
5. You don't need to submit a filter-assessment report on Filter No. 3 in July for two reasons:
   - a. you have an approved corrective action plan on the filter, and
   - b. none of the three readings above 1.0 NTU occurred during the month of July.

# 3.3 DISINFECTION-PERFORMANCE DATA (PAGES 4 AND 5)

Disinfection-performance data is used to determine whether your plant achieved an adequate level of disinfection every day. This data is entered on pages 4 and 5. To get to pages 4 and 5, click on the **P.4&5-Disinfection Data** tab.


You must evaluate the effectiveness of the disinfection process at least once each day when your plant treats water. In other words you must evaluate the effectiveness of the disinfection process each day that you show a raw water pumpage above 0.000 MGD. Figure 3.5 shows the area on page 4 where you will record the disinfection data for your plant. This figure, the information on the next few pages, and Example 3.9 should help you complete this portion of the SWMOR and SWMOR2.



| PERFORMANCE DATA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DISINFECTION PROCESS DATA | | | | | | | | |
| Date | Disinfectant | C (mg/L) | Flow (MGD) | Temp (°C) | pH | Giardia Log | Virus Log | Inact. Ratio | Time |
| | CLO2 D1 | | | | | | | | |
| | FCL D2 | | | | | | | | |
| 1 | CLA D3 | | | | | | | | |
| | D4 | | | | | | | | |
| | D5 | | | | | | | | |
| | CLO2 D1 | | | | | | | | |

**Figure 3.5. Disinfection Process Performance Data section of the spreadsheet.**

***What Tests to Run:*** In order to evaluate the effectiveness of the disinfection process, you must measure the following operational data:

- Disinfectant residual concentration, C (mg/L)
- Flow rate, Flow (MGD)
- Temperature, Temp (°C)
- pH

See Tables 7.1 and 7.2 to find the acceptable laboratory methods for measuring residual concentration, water temperature, and pH.

***Where to Sample:*** You must collect the disinfection-process data at the end of each disinfection zone defined in your CT-study-approval letter. We require you to monitor each disinfection zone even if you can meet the minimum inactivation requirements using a fewer number of the zones. This data is needed so that we will be able to assess the overall impact of any changes you propose to make in the disinfection process.

***When to Sample:*** You must monitor each of the required parameters when the plant is operating at the peak hourly flow rate for the day. The peak hourly flow occurs at the plant's peak hour of production when the maximum volume of water flows through the plant during the one-hour period. If you reduce the flow rate during the day, you do not have to make another measurement. However, if you increase the flow rate during day, you must re-collect all the data.

***How to Enter Results:*** If you collected only one set of disinfection process data during the day, record that information in the **Disinfection Process Data** section.

If you collected more than one set of disinfection process data during the day, record the data from the set of readings that corresponds to the lowest total inactivation ratio for *Giardia* and viruses.

**IMPORTANT**
Do not mix the data collected from two or more data sets. For example, if you got one set of data at 10 a.m. and another set at 4 p.m., you must either use all the morning data or all the afternoon data. Do not use some data from each set.

### Disinfection Process Parameters

The **Disinfection Process Parameters** table at the top of pages 4 and 5 of the SWMOR and SWMOR2 spreadsheets include columns that show the plant's approved CT study parameters and performance standards you provided when completing the **Disinfection Process Parameters** dialog box. The tables contain five columns for the CT study parameters for disinfection zones 1 through 5 (or any combination of five zones/trains). If your plant has more than five zones, the program will automatically create addendum pages and add up to five additional columns for zones 6–10.

The SWMOR spreadsheet will automatically use the data you entered when completing the **Disinfection Process Parameters** dialog box to fill in the corresponding table at the top of pages 4 and 5. If you are using SWMOR2, you will have to enter the information manually using the same guidance we supplied in Section 2.3.

Figure 3.6 shows the **Disinfection Process Parameters** table from page 4 of the SWMOR spreadsheet. The values included in this figure are taken from Example 2.1 for the plant with the CT-study-approval letter described in Appendix A.

| DISINFECTION PROCESS PARAMETERS | | | | | | | |
|---|---|---|---|---|---|---|---|
| APPROVED CT STUDY PARAMETERS | | | | | | PERFORMANCE STANDARDS | |
| | Disinfection Zones | | | | | Log Inactivations | |
| Parameters | D1 | D2 | D3 | D4 | D5 | Giardia lamblia Cysts | Viruses |
| Flow Rate (MGD) | 1.440 | 0.480 | 0.960 | | | 0.5 | 2.0 |
| $T_{10}$ (minutes) | 47.0 | 12.0 | 122.0 | | | | |

**Figure 3.6. Disinfection Process Parameters section of the spreadsheet.**

### Disinfectant

The cells in the **Disinfectant** columns on pages 4 and 5 of the spreadsheets contain a drop-down list for each disinfectant zone identified in your plant's CT study approval letter. Each day the plant treats water, you can use the drop-down lists to select the type of disinfectant residual maintained in each of the disinfection zones. The abbreviations for the possible disinfectants are shown in Table 3.2.

**Table 3.2. Abbreviations for disinfectants.**

| Abbreviation | Disinfectant |
|---|---|
| FCL | free chlorine |
| CLO2 | chlorine dioxide |
| O3 | ozone |
| CLA | chloramines |
| NA | the disinfection zone was not used during the day; that is, the flow rate in the zone was 0.000 MGD or there was no disinfectant applied at or upstream of the zone |

**NOTE**
If you are using the SWMOR, the spreadsheet will automatically complete the **Disinfectant** columns on pages 4 and 5 with the information you entered in the **Disinfection Process Parameters** dialog box (described in Section 2.3). However, the spreadsheet also allows you to manually change the disinfectant you use in a given zone on daily basis. Since the SWMOR2 spreadsheet does not include a **Disinfection Process Parameters** dialog box, you must manually enter the data each day that your plant treats water.

Under certain operating conditions, the spreadsheets limit the options you have for selecting a disinfectant in one or more of the disinfection zones. For example, the spreadsheet will automatically do the following:

- enter <NA> in each of the disinfection zones for any day that you have entered <0.000> in the **Raw Water Pumpage (MGD)** column on page 2 of the SWMOR
- remove all of the options except <NA> from the drop-down list of disinfectants for a single zone if you enter a flow rate of <0.000> in the **Flow (MGD)** column for that zone
- remove <NA> from the drop-down list of disinfectants for any zone where you have entered any value in the **C (mg/L)**, **Temp (°C)**, or **pH** columns
- remove <NA> from the drop-down list of disinfectants for any zone downstream (or after) a zone where you have recorded a disinfectant residual (unless you indicate that the flow rate through the zone is 0.000 MGD)

Both spreadsheets will only allow you to select <NA> for a disinfection zone if the treatment train was not in operation or if no disinfectant had yet been applied in the treatment process.

**IMPORTANT**
As discussed in Section 2.3, the **Disinfection Process Parameters** dialog box will appear each time you open the SWMOR spreadsheet. If you click on the [OK] button, the SWMOR will use the information in the dialog box to replace any data that you have manually entered on pages 4 and 5 of the speadsheet. On the other hand, if you click the [CANCEL] button in this dialog box, the SWMOR does not update pages 4 and 5.

Therefore, you should use your blank customized SWMOR when you begin a report for a new month and you should click the [CANCEL] button if you are completing a report that you have already started.

### C (mg/L)—the Disinfectant Residual Concentration in the Disinfection Zone

You must measure the disinfectant concentration, C, at the end of each disinfection zone every day that you treated any water. Record the results in the **C (mg/L)** column. Report this value in mg/L. If you failed to measure the residual at the end of a disinfection zone, enter <ND> in the applicable **C (mg/L)** cell.

The spreadsheets will not allow you to enter a disinfectant residual result for a zone where you have selected <NA> from the drop-down list of disinfectants or where the **Raw Water Pumpage** value shown on page 2 is 0.000 MGD. If you try to enter a residual in this zone, you will get an error message.

**ATTENTION, CHLORAMINE USERS**
Remember that the DPD test for total chlorine will measure more than just monochloramine. Other combined chlorine compounds such as dichloramine, trichloramine, and organic chloramines can interfere with the colorimetric DPD test. Consequently, chloramine users that use DPD tests for reporting should periodically run process-control tests that are specific for monochloramine. Even if the results cannot be used for reporting, they can be used to adjust the treatment so that the desired monochloramine residual is maintained.

Plants that use ozone have some important special reporting requirements:

**ATTENTION, OZONE USERS**
The ozone concentration that you use for CT calculations depends on a number of factors. Specifically:

| If: | and the water flows: | the reported concentration is: |
|---|---|---|
| ozone is applied in the contactor cell | in the same direction that the ozone rises (concurrent flow) | the same as the measured concentration at the outlet of the cell |
| ozone is applied in the contactor cell | in the opposite direction as the ozone rises (countercurrent flow) | one-half of the measured concentration at the outlet of the cell |
| no ozone is applied in the contactor cell | any direction (reactive flow) | the same as the measured concentration at the outlet of the cell |

### Flow (MGD)—the Flow Rate through the Disinfection Zone

Record the flow rate going through each disinfection zone at the time you collected the data set. Enter the results in the **Flow (MGD)** column. Report this value in MGD.

If your plant has more than one treatment train, you must record the flow rate through each of the trains. If your plant meters the flow rate through each unit, you must record this data. If your plant does not have flowmeters on each of the trains, you must use an alternate method that we have approved in writing.

If, on a specific day, your plant does not treat any water, or disinfectant is not used in a disinfection zone, leave this column blank. If you failed to measure the flow rate through a disinfection zone on a day that you did treat water, enter <ND> in the applicable **Flow (MGD)** cell.

**IMPORTANT**

The flow rate values that you enter on pages 4 and 5 are the flow rates that are occurring in each disinfection zone at the time that the measurements were made. Unless your plant operates a constant production rate for an entire 24-hour day, the daily raw water flow shown on page 2 will not match the flow rate shown on pages 4 and 5 for that day.

If your plant operated for less than 24 hours during the day, the flow rates on pages 4 and 5 will usually be greater than flow rate shown on page 2 (unless the flow is split between two or more trains).

### Temperature

Record the water temperature in each disinfection zone in the **Temp (°C)** column. Report this value in degrees Celsius (°C). If you can show the water temperature is essentially constant throughout your treatment plant, you may use a single reading for all the disinfection zones.

If, on a specific day, your plant does not treat any water or disinfectant is not used in a disinfection zone, leave this column blank. However, if you did treat water but failed to measure the temperature of the water, enter <ND> in the applicable **Temp (°C)** cell.

### pH

Record the pH of the water in each disinfection zone in the **pH** column. Report this value in pH units.

If, on a specific day, your plant does not treat any water or disinfectant is not used in a disinfection zone, leave this column blank. However, if you did treat water but failed to measure the pH of the water at the end of a disinfection zone, enter <ND> in the applicable **pH** cell.

### Giardial Log Inactivations *CALC*
### Viral Log Inactivations *CALC*

The SWMOR and SWMOR2 spreadsheets both use a series of mathematical equations to determine the level of *Giardia* and viral inactivation obtained in each of the disinfection zones. The spreadsheet then totals the giardial and viral log inactivation and enters the results in the **Giardia Log** and **Virus Log** columns, respectively.

An asterisk (*) after the number indicates that the value is not representative of the total log inactivation for all disinfection zones, that is, you did not enter the disinfection process data for all zones. You can use the circle button ( ) to help identify which piece of data is missing.

### Inactivation Ratio *CALC*

The two spreadsheets calculate the total inactivation ratio for both *Giardia* and viruses, and then record the lower inactivation ratio in the **Inact. Ratio** column. The letter beneath the number tells you if the lower inactivation ratio is the one for *Giardia* or for viruses. “G” shows that *Giardia* produces the lower inactivation ratio; “V” indicates that viruses produce the lower ratio.

If the total inactivation ratio is greater than or equal to 1.00, your plant met both the minimum *giardial* and viral inactivation requirements for the day.

If the ratio is less than 1.00, you must collect the disinfection process data at least once every 4 hours. You may collect this data more frequently if you wish. You must continue this increased monitoring frequency until the inactivation ratio is no longer below 1.00.

### Time

In the **Time** column, record the number of consecutive hours that the total inactivation ratio is less than 1.00. If the inactivation ratio is 1.00 or greater during the day, leave this column blank. If the inactivation ratio falls below 1.00 more than once during the day, record the longest period of time that it was below 1.00. If the inactivation ratio fell below 1.00 during the day and you failed to determine how long it remained below 1.00, enter <ND> in the applicable **Time** cell.

A plant may increase the monitoring frequency to more accurately determine the duration of an event. For example, if you collect disinfection process data every 15 or 30 minutes after getting a low inactivation ratio, you may report the duration of the event in ¼-hour or ½-hour increments. Therefore, an event lasting only 15 minutes will be reported as 0.25 hour, and one lasting 2 hours 45 minutes will be reported as 2.75 hours.

**IMPORTANT**
The time recorded in this column may not represent the duration of time that your plant has its lowest inactivation ratio. That is, your entries in the **Inact. Ratio** and **Time** columns do not necessarily represent the same event.

### Log Inactivation Summaries CALC

Figure 3.7 shows the cells where the two spreadsheets automatically calculate the average (**Avg**), maximum (**Max**), and minimum (**Min**) daily inactivation ratios for both viruses and *Giardia*. They also calculate the standard deviation (**SD**) for each of the two averages. The spreadsheets fill in these results using the disinfection data that you entered each day.

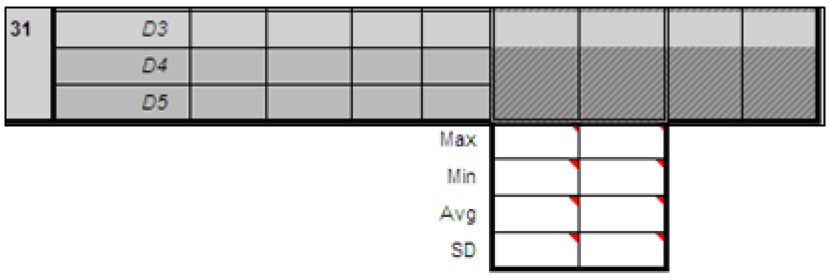



**Figure 3.7. Log Inactivation Summary section of the Disinfection Data spreadsheet.**

**IMPORTANT**
The spreadsheets will limit the amount of inactivation credit that your plant receives if one or more of the disinfection zones contain a free chlorine residual above 4.0 mg/L. If you exceeded this level on any day, the spreadsheets will place the following note next to the Log Inactivation Summary—

**Note: The log removal credits for this plant were restricted on at least one day this month due to high free-chlorine levels in one or more zones or trains.**

## Example 3.9: Disinfection Process Data

The following figure includes the **Disinfection Process Data** for the first three days of the month for one of the surface water treatment plants in Texas.

| PERFORMANCE DATA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DISINFECTION PROCESS DATA | | | | | | | | |
| Date | Disinfectant | C (mg/L) | Flow (MGD) | Temp (°C) | pH | Giardia Log | Virus Log | Inact. Ratio | Time= |
| | NA *D1* | | | | | | | | |
| | CLA *D2A* | 3.0 | 3.000 | 12.0 | 7.2 | | | | |
| 1 | CLA *D2B* | 3.0 | 3.000 | 12.0 | 7.4 | 0.81 | 1.97 | 0.85 | 1.40 |
| | CLA *D3* | 3.5 | 6.000 | 12.0 | 7.4 | | | (V) | |
| | *D4* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | NA *D2A* | | | | | | | | |
| 2 | NA *D2B* | | | | | NA | NA | NA | |
| | NA *D3* | | | | | | | | |
| | *D4* | | | | | | | | |
| | CLO2 *D1* | 0.2 | 3.000 | 12.0 | 7.2 | | | | |
| | CLA *D2A* | 2.8 | 3.000 | 12.0 | 7.5 | | | | |
| 3 | NA *D2B* | | | | | 1.78 | 4.83 | 2.39 | |
| | CLA *D3* | 3.5 | 3.000 | 12.0 | 7.5 | | | (V) | |
| | *D4* | | | | | | | | |

This example shows:

1. The CT Study approval letter for the plant identifies three disinfection zones and there are two treatment trains in zone D2.
2. On the first day of the month:
   - The plant was not feeding a disinfectant in zone D1 when this set of data was collected.
   - The plant was achieving a total 0.81 logs of *Giardia* inactivation and 1.97 logs of viral inactivation when this set of data was collected.
   - The minimum inactivation ratio for the day was 0.85 and was limited by the viral inactivation requirements.
   - The longest period of time that the inactivation ratio was below 1.00 was 1.4 hours.
3. On the second day of the month, the plant did not treat any water.
4. On the third day of the month, Train D2B was not in operation when the operator collected this set of data.

# 3.4 ENTER TOC DATA (PAGES 6, 7, 8, AND SUVA)

If your plant utilizes sedimentation or clarification treatment processes, you must collect total organic carbon (TOC) information each month. Depending on the treatment alternatives you choose, the information you collect will be recorded on one or more of the worksheets identified below.


If you indicated that you do not have any sedimentation basins when you completed the **Plant Parameters** dialog box, the spreadsheets will hide these four worksheets since you are not subject to the TOC monitoring requirements.

## P.6-TOCMOR

Every surface water treatment plant that has a sedimentation or clarification unit must submit the **P.6-TOCMOR** worksheet each month. The worksheet contains cells where you will describe the type of sedimentation or clarification basin you have, record your TOC data, and provide some basic information about the alternative compliance strategies you might be using.

**IMPORTANT**
The SWMOR and SWMOR2 spreadsheets will only display the **P.6-TOCMOR** if you indicated that your plant has at least one sedimentation basin when you completed the **Plant Parameters** dialog box. If you indicated that you have no sedimentation basins, the worksheet will be hidden.

### Conventional and Unconventional Plants

Indicate whether your treatment plant is classified as a **Conventional** or an **Unconventional** plant by entering <X> in the appropriate box shown in Figure 3.8. If the plant is **Unconventional**, you have to explain what makes it unconventional in the space provided.

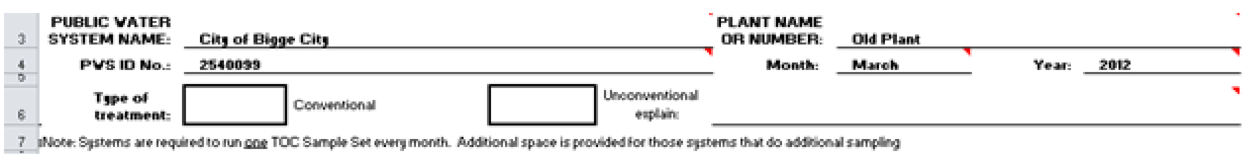



**Figure 3.8. Conventional or unconventional plant selection.**

Your plant is categorized as **Conventional** if you use gravity or pressure (granular media) filters and have any of the following:

- Flocculators and sedimentation basins
- Conventional solid-contact clarifiers such as slurry-recirculation clarifiers and sludge blank clarifiers
- High-rate clarifiers such as the Infilco-Degremont Pulsator and Superpulsator

If you use membrane filters, your plant is categorized as **Unconventional** regardless of whether or not you use a clarifier to pretreat your membrane feed water. However, a plant with granular media filters may also be classified as **Unconventional** if we have approved an exception allowing you to use alternative treatment technologies that have extremely high surface overflow rates and very short detention times. These technologies include devices such as the Microfloc Trident clarifier, the Roberts Filter clarifier, or the Actiflow clarifier. If your plant uses an unconventional clarifier, you must still comply with the TOC monitoring requirements.

## Monthly TOC Sample Set

You must collect at least one complete **TOC Sample Set** each month that the plant treats any water. A complete TOC sample set consists of the following three samples:

1. raw-water alkalinity
2. raw-water TOC
3. treated-water TOC

Although you must collect at least once complete TOC sample set each month, the worksheet provides enough cells for you to record sample set results once each day. You must report the results of all the complete TOC sample sets you collect during the month. Do not report the results unless you collected a complete sample set.

You must collect all three of the samples required for a complete TOC sample set within a 1-hour period so that you can properly characterize the TOC removal achieved by the plant. Furthermore, these samples should all be collected near the end of a long production run so that the plant will have had time to reach normal operating conditions.

> **NOTE**
> Your TOC sample set results must reflect the typical operating conditions that existed during the month. For example, if you change water sources, switch coagulants, or significantly alter the coagulant dose on the 10th of the month, you must collect at least one complete TOC sample set after making the change because data collected during the first 10 days of the month do not reflect the typical conditions that existed when you produced most of the water.
>
> We recommend that you evaluate raw-water or treated-water TOC levels each time source water quality or the treatment process changes significantly, even if you decide not to run a complete TOC sample set. Although incomplete data sets may not be reported, the information is still valuable for making process-control decisions.

Note: Systems are required to run one TOC Sample Set every month. Additional space is provided for those systems that do additional sampling

| Test No. | Test Date | Monthly TOC Sample Set | | | Actual % TOC Removed | Step 1 Required % Removal | Step 1 Removal Ratio | Optional data | | COMPLIANCE REMOVAL RATIO |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Raw Alkalinity | Raw TOC | Treated TOC | | | | Step 2 Required % Removal | Step 2 Removal Ratio | |
| | | Enter the Sample Set results | | | calculated | calculated from matrix | calculated | | | calculated |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |

**Figure 3.9. TOC data entry area in P.6-TOCMOR.**

### Test Date

Use the drop-down list in the appropriate **Test Date** cell to select the date that you collected a complete TOC sample set. Record the date you collected the first complete set in the first row, the date of the second set in the second row, and so on.

If you failed to collect at least one complete sample set during the month, select any of the dates from the drop-down list for the first row.

### Raw Alkalinity
### Raw TOC
### Treated TOC

Enter the results of the raw water alkalinity, raw water TOC, and treated water TOC tests in the appropriate **Raw Alkalinity, Raw TOC,** and **Treated TOC** cells. Record the date you collected the first complete set in the first row, the date you collected the second set in the second row, and so on.

If you failed to collect a complete sample set during the month, enter <ND> in each of these three cells on the first row.

> **IMPORTANT**
> Raw water samples must be collected prior to any treatment (including those for taste and odor control, predisinfection, and coagulation) and upstream of the site where you recycle reclaimed water (such as decant water from a lagoon or spent backwash water).
>
> Treated water samples may be collected at the effluent of the clarifiers, at the influent or effluent of the filters, or at the entry point to the distribution system.

### Actual % TOC Removed *CALC*
### Required Step 1 % Removal *CALC*
### Step 1 Removal Ratio *CALC*

The SWMOR and SWMOR2 spreadsheets will use the sample set data you entered to calculate each of these three values.

If the **Step1 Removal Ratio** is less than 1.0, you may need to determine if you can meet one of the Alternative Compliance Criteria or run a Step2 Jar Test.

### Step 2 Required % Removal *CALC*
### Step 2 Removal Ratio *CALC*

If you want to use the results of a Step 2 jar test to help ensure that you meet the TOC treatment technique requirements, you must complete the **P.8-TOC Step2** worksheet. The SWMOR and SWMOR2 spreadsheets will use the data recorded on that worksheet to complete these two cells.

### Compliance Removal Ratio *CALC*

The SWMOR and SWMOR2 spreadsheets will use the TOC sample results to complete these two cells. If you have not completed the **P.8-TOC Step2** worksheet, the compliance-removal ratio for each sample set will be copied from the corresponding **Step 1 Removal Ratio** cell. If you have entered data on the

**P.8-TOC Step2** worksheet, the compliance-removal ratio will be based on the higher of the two applicable step 1 and step 2 removal ratios. This ensures that you will always receive the highest credit possible for each complete sample set.

## TOTAL ORGANIC CARBON (TOC) REMOVAL SUMMARY

The **P.6-TOCMOR** worksheet contains a summary of the TOC data you have entered in your monthly report. All of the information in this area of the worksheet is calculated by the SWMOR and SWMOR2 spreadsheets.

| TOTAL ORGANIC CARBON (TOC) REMOVAL SUMMARY | | | | | |
|---|---|---|---|---|---|
| TOC Summary | | | | | Monthly Compliance Ratio |
| Raw Water Alkalinity | Raw Water TOC | Treated Water TOC | TOC % Removal | ACC # used | |
| | | | | | |

**Figure 3.10. TOC Data Summary area on P.6-TOCMOR.**

### Raw Water Alkalinity *CALC*
### Raw Water TOC *CALC*
### Treated Water TOC *CALC*
### TOC % Removal *CALC*

The SWMOR and SWMOR2 spreadsheets calculate the values shown in these cells based on respective averages from all of the TOC sample sets. Although this information gives us a general characterization of the plant conditions, we do not use the information to determine whether or not you have met the TOC-monitoring or treatment-technique requirements.

### ACC # Used *CALC*

The SWMOR and SWMOR2 spreadsheets will automatically complete this portion of the report. If your plant will benefit from using one of the alternative compliance criteria (ACC), the spreadsheets will use the information that you have recorded on this worksheet and on the **P.7-TOC ACC** worksheet to give you credit for meeting one of the ACCs. If you will not benefit from using the ACCs, the spreadsheets will enter <NA> in this cell.

### Monthly Compliance Ratio *CALC*

The SWMOR and SWMOR2 spreadsheets will automatically complete this portion of the report. If your average removal ratio for all of the complete sample sets is 1.0 or higher, the spreadsheets will enter that average value in this cell. If the average is less than 1.0, the spreadsheets will use the information you have supplied on the **P.6-TOCMOR** and the **P.7-TOC ACC** worksheets to determine if you have met one of the ACCs. If you have, the spreadsheets will assign you a monthly compliance ratio of 1.0.

**NOTE**
Compliance with the TOC treatment technique requirements is based on all of the TOC data you collected during the most recent four consecutive calendar quarters. For example, during the second quarter of 2010 (April, May, and June), we will use the data you collected during April 2009 through March 2010.

Since compliance is based on four quarters worth of data, you may not need to panic if you get a removal ratio of less than 1.0 every once in a while. However, you may want to investigate using one of the alternative compliance criteria or consider running a Step 2 jar test if your quarterly average removal ratio falls below 1.0.

## P.7-TOC ACC (Alternative Compliance Criteria)

**IMPORTANT**
The SWMOR and SWMOR2 spreadsheets will hide the **P.7-TOC ACC** worksheet if:

- you have entered the results of at least one complete TOC sample set on the **P.6-TOCMOR** worksheet, *and*
- the average compliance ratio for all the sample sets collected during the month is 1.0 or higher, *and*
- either:
    - the average source water TOC results for all the sample sets collected during the month is less than 2.0 mg/L

    *or*

    - the average source water TOC results for all the sample sets collected during the month is less than 2.0 mg/L

In other words, the spreadsheets will hide the **P.7-TOC ACC** worksheet unless it will help you comply with the TOC treatment technique requirements.

You only need to complete the **P.7-TOC ACC** worksheet if you want to use one of the alternative compliance criteria to meet your TOC treatment-technique requirements. Table 3.3 briefly describes each of the eight ACC options and indicates whether the ACCs can be met on an annual basis only or can be met on either an annual or month-to-month basis.

Most plants will tend to use the same option each month. This is especially true at plants using one of the annual compliance options. However, you may switch between ACCs if you think it is appropriate.

### ACC Selection

Before you can enter performance data in any of the ACC sections on the **P.7-TOC ACC** worksheet, you must select the ACC that you are using this month by entering an <X> in one of eight boxes for ACC near the top of the worksheet (see Figure 3.11). After you have selected the ACC that you will be using this month, the worksheet will automatically remove the data entry areas for all the other ACC options and show only the cells that you need to complete.

**Table 3.3. Brief Description of TOC ACCs.**

| ACC No. | Compliance Options | | Description |
|---|---|---|---|
| | Monthly | Annual[a] | |
| 1 | Yes | Yes | Source water TOC less than 2.0 mg/L |
| 2 | Yes | Yes | Treated water TOC less than 2.0 mg/L |
| 3 | No | Yes | All of the following:<br>source water TOC level less than 4.0 mg/L<br>source water alkalinity greater than 60 mg/L as $CaCO_3$<br>TTHM no greater than 0.040 mg/L<br>HAA5 no greater than 0.030 mg/L |
| 4 | No | Yes | All of the following:<br>TTHM no greater than 0.040 mg/L<br>HAA5 no greater than 0.030 mg/L<br>Free chlorine as the only disinfectant used to in both the plant and distribution system |
| 5 | Yes | Yes | Source water SUVA no greater than 2.0 L/mg-m |
| 6 | Yes | Yes | Treated water SUVA no greater than 2.0 L/mg-m |
| 7 | Yes | Yes | Treated water alkalinity less than 60 mg/L as $CaCO_3$ |
| 8 | Yes | Yes | Magnesium hardness removal no less than 10 mg/L as $CaCO_3$ |

[a] Based on the running annual average for all of the listed parameters.

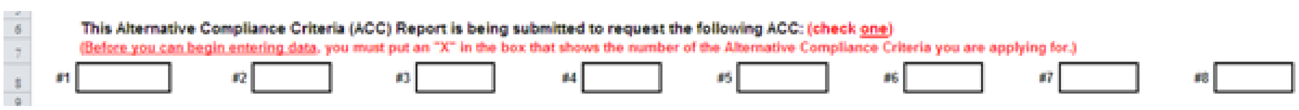



**Figure 3.11. ACC selection boxes on the P.7-TOC ACC worksheet.**

### ACC Data Entry Areas

After you have selected the ACC you want to use, the **P.7-TOC ACC** worksheet will allow you to enter the data for that ACC option. Except for ACC #3 and ACC #4, you can meet the ACC based on the data you collected during the reporting month or the data you collected during each of the previous four calendar quarters. If you meet the ACC requirement on either a monthly or annual basis, the spreadsheet will make appropriate changes to the **ACC # Used** and the **Monthly Compliance Ratio** cells on this month's **P.6-TOCMOR** worksheet.

***Current Month Data:*** If you collected the data needed to evaluate compliance with ACC requirement for the month covered by the report, enter the results in the applicable **Current Month** cell. If the monthly data meets the ACC requirement, the spreadsheets will hide the data entry area for the annual data.

***Historical Data:*** The SWMOR and SWMOR2 spreadsheets will only let you enter data for previous months if:

- you did not enter any data in the **Current Month** cell

*or*

- the data for the current reporting period does not meet the ACC requirement

If you did not meet the ACC requirement on a monthly basis, the spreadsheets will fill in the **Month/Year** cells to identify the months that you must use to evaluate compliance with the ACC requirement on an annual basis. After you have entered historical data for each of the three months in a given quarter, the spreadsheets will average the three values and insert the value in the appropriate **Quarterly Average** cell. Once you have entered the historical data for all four quarters, the spreadsheets will calculate the running annual average and insert the value in the appropriate **RAA** cell.

> **NOTE**
> Once you have entered 12 months of historical data, the SWMOR and SWMOR2 will not allow you to enter data in the **Current Month** cell unless the value in the **RAA** cell does not meet the ACC requirement.

**ACC #1—Source water TOC less than 2.0 mg/L**
**ACC #2—Treated water TOC less than 2.0 mg/L**

As Figure 3.12 indicates, these two ACC alternatives are available on both a monthly and an annual basis.

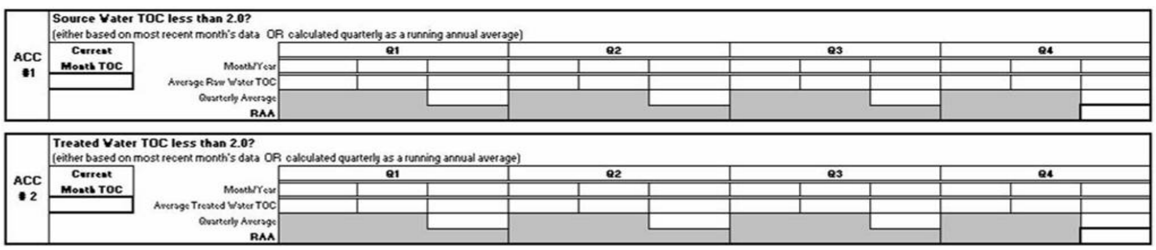



**Figure 3.12. TOC ACC #1 and ACC #2 data entry areas.**

The average monthly values for both raw and treated water TOC are copied from the **TOC Summary** area at the bottom of the **P.6-TOCMOR** worksheet. However, if either of these monthly results meets the respective ACC criterion, the SWMOR and SWMOR2 spreadsheets will hide the **P.7-TOC ACC** worksheet. If neither of these values is less than 2.0 mg/L, the spreadsheets will display the data-entry area for historical data for the ACC you selected.

To complete the historical-data table, you will need to have **P.6-TOCMOR** worksheets for each of the 12 months identified in the **Month/Year** row. Copy the value from the **Raw Water TOC** cell in the **TOC Summary** area at the bottom of the **P.6-TOCMOR** worksheet to the applicable cell in the historical data table.

**ACC # 3—Source water TOC less than 4.0 mg/L**

As Figure 3.13 indicates, ACC #3 can only be evaluated on an annual basis.

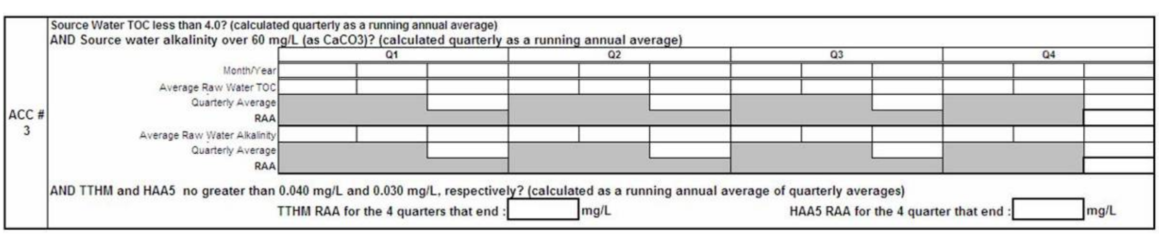



**Figure 3.13. TOC ACC #3 data entry area.**

To complete the historical data table, you will need to have **P.6-TOCMOR** worksheets for each of the 12 months identified in the **Month/Year** row. Copy the values from the **Raw Water TOC** and **Raw Water Alkalinity** cells in the **TOC Summary** area at the bottom of the **P.6-TOCMOR** worksheets to the appropriate cells in the historical data table.

You will also need to have the results from all of the TTHM and HAA samples that were collected during the 12 months identified in the **Month/Year** row of the historical data table. Use the following procedure to calculate the RAA values for the THM and HAA5 results and enter the results in the appropriate cell in the data entry area.

1. Add the TTHM results for all of the THM samples collected during a given quarter.
2. Calculate the average TTHM for the quarter by dividing the results from step 1 by the number of samples collected during the quarter.
3. Repeat steps 1 and 2 to calculate the quarterly TTHM average for the other three quarters.
4. Add the four quarterly TTHM averages and divide by four to get the TTHM RAA for the 12-month period.
5. Repeat steps 1–4 using the HAA5 results.

**ACC #4—TTHM and HAA5 no greater than 0.040 mg/L and 0.030 mg/L, respectively**
As Figure 3.14 indicates, ACC #4 can only be evaluated on an annual basis.

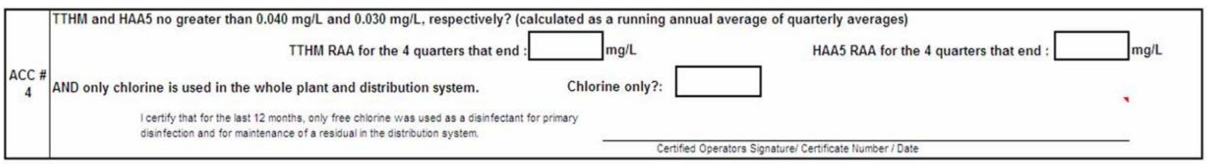
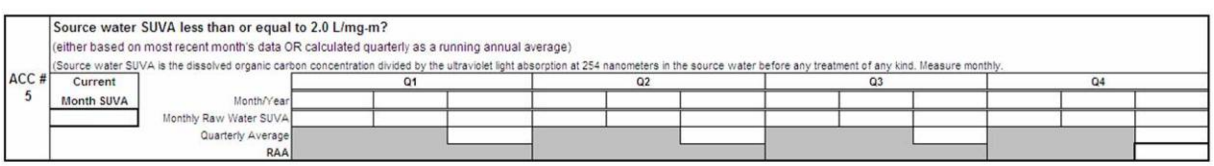

ACC # 4
TTHM and HAA5 no greater than 0.040 mg/L and 0.030 mg/L, respectively? (calculated as a running annual average of quarterly averages)
TTHM RAA for the 4 quarters that end : mg/L
HAA5 RAA for the 4 quarters that end : mg/L
AND only chlorine is used in the whole plant and distribution system.
Chlorine only?:
I certify that for the last 12 months, only free chlorine was used as a disinfectant for primary disinfection and for maintenance of a residual in the distribution system.
Certified Operators Signature/ Certificate Number / Date

**Figure 3.14. TOC ACC #4 data entry area.**

To complete this portion of the report, you will need the results from all of the TTHM and HAA samples that were collected during the previous four calendar quarters. Use the five steps outlined above to calculate the TTHM and HAA5 RRA values and enter them in the appropriate cell in the data-entry area.

You must also certify whether free chlorine was the only disinfectant that your system used during this 12-month period by entering <Yes> or <No> in the **Chlorine only?** cell and signing the form on the line provided.

**ACC #5— Source water SUVA less than or equal to 2.0 L/mg-m**
As Figure 3.15 indicates, this ACC alternative is available both monthly and annually.


ACC # 5
Source water SUVA less than or equal to 2.0 L/mg-m?
(either based on most recent month's data OR calculated quarterly as a running annual average)
(Source water SUVA is the dissolved organic carbon concentration divided by the ultraviolet light absorption at 254 nanometers in the source water before any treatment of any kind. Measure monthly.

| Current Month SUVA | | Q1 | | | Q2 | | | Q3 | | | Q4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month/Year | | | | | | | | | | | | |
| | Monthly Raw Water SUVA | | | | | | | | | | | | |
| | Quarterly Average | | | | | | | | | | | | |
| | RAA | | | | | | | | | | | | |

**Figure 3.15. TOC ACC #5 data entry area.**

If you ran a raw-water SUVA test during the reporting period, enter the results in the **Current Month SUVA** cell. If the value is no greater than 2.0 L/mg-m, the spreadsheet will hide the historical-data table, since you will not need historical data to meet the requirement. If you need to complete the historical-data table, you will have to use previous reports and copy the value for each the 12 months identified in the **Month/Year** row of the table to the appropriate **Monthly Raw Water SUVA** cell.

### ACC #6—Finished water SUVA less than or equal to 2.0 L/mg-m

As Figure 3.16 indicates, this ACC alternative is available both monthly and annually.

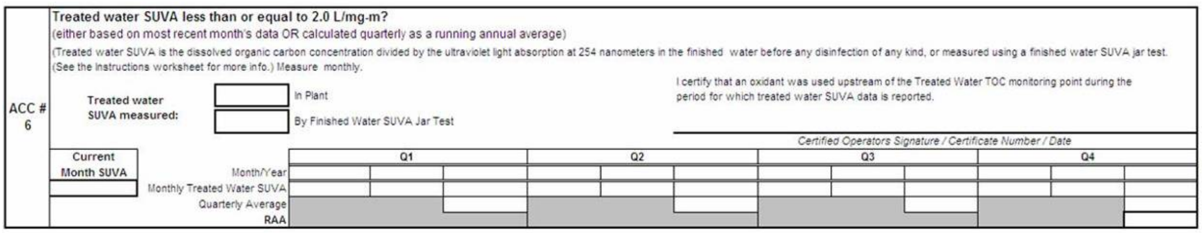

ACC # 6
Treated water SUVA less than or equal to 2.0 L/mg-m?
(either based on most recent month's data OR calculated quarterly as a running annual average)
(Treated water SUVA is the dissolved organic carbon concentration divided by the ultraviolet light absorption at 254 nanometers in the finished water before any disinfection of any kind, or measured using a finished water SUVA jar test. (See the Instructions worksheet for more info.) Measure monthly.
Treated water SUVA measured:
In Plant
By Finished Water SUVA Jar Test
I certify that an oxidant was used upstream of the Treated Water TOC monitoring point during the period for which treated water SUVA data is reported.
Certified Operators Signature / Certificate Number / Date
Current Month SUVA
Q1
Q2
Q3
Q4
Month/Year
Monthly Treated Water SUVA
Quarterly Average
RAA

**Figure 3.16. TOC ACC #6 data entry area.**

If you ran a treated-water SUVA test during the reporting period, enter the results in the **Current Month SUVA** cell. If the value is 2.0 L/mg-m or lower, the spreadsheet will hide the unneeded historical-data table. If you need to complete the historical data table, you will have to use previous reports and copy the monthly value for each the 12 months identified in the **Month/Year** row of the table to the appropriate **Monthly Treated Water SUVA** cell.

You must also certify whether the SUVA test was run on treated water produced by the plant or on a sample of water from a SUVA jar test. If the test was run on a sample of treated water, place an <X> in the **In Plant** cell. If the test was run on a sample of water obtained after running a SUVA jar test, place an <X> in the **By Finished Water SUVA Jar Test** cell. Be sure to sign the form on the line provided.

> **NOTE**
> If you place an <X> in the **By Finished Water SUVA Jar Test** cell, the spreadsheets will reveal a **SUVA Jar Test Worksheet**. We have included this worksheet to provide a convenient place for you to record the SUVA jar test results and the plant conditions at the time you ran the test. However, you do not have to include it when you submit your monthly report.

### ACC #7—Treated water alkalinity less than 60 mg/L as $CaCO_3$ (softening practiced) calculated quarterly as a running annual average

As Figure 3.17 indicates, this ACC alternative is available on both a monthly and an annual basis. However, it is only available to plants that practice lime softening.

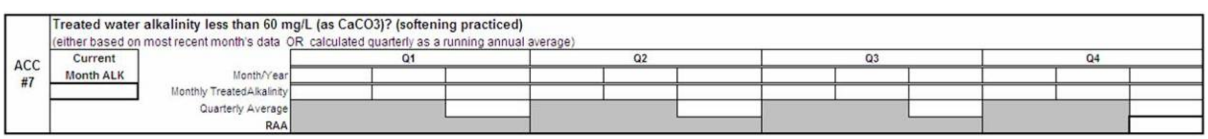

ACC #7
Treated water alkalinity less than 60 mg/L (as CaCO3)? (softening practiced)
(either based on most recent month's data OR calculated quarterly as a running annual average)
Current Month ALK
Q1
Q2
Q3
Q4
Month/Year
Monthly TreatedAlkalinity
Quarterly Average
RAA

**Figure 3.17. TOC ACC #7 data entry area.**

If you ran treated water alkalinity tests during the reporting period, enter the average of all your test results in the **Current Month ALK** cell. If the value is less than 60 mg/L, the spreadsheet will hide the unneeded historical-data table. If you need to complete the historical data table, you will have to use previous reports and copy the monthly value for each the 12 months identified in the **Month/Year** row of the table to the appropriate **Monthly Treated Alkalinity** cell.

**ACC #8—Magnesium hardness removal greater than or equal to 10 mg/L as $CaCO_3$ calculated quarterly as a running annual average**

As Figure 3.18 indicates, this ACC alternative is available both monthly and annually. However, it is only available to plants that practice lime softening.

**Magnesium hardness removal greater than or equal to 10 mg/L (as CaCO3)? (softening practiced)**
(either based on most recent month's data OR calculated quarterly as a running annual average)

| ACC # 8 | Current Month Mg Hardness | | Q1 | | | Q2 | | | Q3 | | | Q4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Month/Year | | | | | | | | | | | | |
| | | Monthly Raw Mg Hardness | | | | | | | | | | | | |
| | Treated | Monthly Treated Mg Hardness | | | | | | | | | | | | |
| | | Monthly Mg Removal | | | | | | | | | | | | |
| | Removal | Quarterly Average Removal | | | | | | | | | | | | |
| | | RAA Removal | | | | | | | | | | | | |

**Figure 3.18. TOC ACC #8 data entry area.**

If you measured the magnesium levels in both the raw and treated water water during the reporting period, enter the results in **Raw** and **Treated** cells in the **Current Month Mg Hardness** data entry area. The spreadsheets will calculate the amount of magnesium that you removed and, if you removed at least 10 mg/L, will hide the unneeded historical-data table. If you need to complete the table, you will have to use previous reports and copy the monthly value for each the 12 months identified in the **Month/Year** row of the table to the appropriate **Monthly Raw Mg Hardness** and **Monthly Treated Mg Hardness** cells. The spreadsheets will then calculate the amount of magnesium hardness removed each month as well as the quarterly and running annual average values.

## P.8-TOC Step2 (Jar Test Report)

You only need to complete the **P.8-TOC Step2** worksheet if you run a Step 2 jar test and want to use the results to help you meet your TOC treatment-technique requirement.

**IMPORTANT**

The results of a Step 2 jar test are normally valid for six consecutive months beginning with the first month of the calendar quarter when you ran the test and ending with the last month of the following calendar quarter. For example, the results of a Step 2 jar test conducted in March can be used from March through June. You can also apply the results retroactively by amending and resubmitting your monthly reports for January and February.

However, we may require you to conduct another Step 2 jar test if your raw water conditions change significantly during the six-month period. For example, we may require a new jar test if you switch to a new water source and the chemical matrices (TOC, alkalinity, etc) of the two sources differ significantly.

For more information about how to conduct a Step 2 jar test, please refer the *TOC Guidance Manual* (TCEQ publication RG-379).

## DATE OF JAR TEST

Before you can enter any other data on the worksheet, you must enter the date that you ran your Step 2 jar test in the **DATE OF JAR TEST** cell. This date may be no earlier than the first day of the previous calendar quarter and the last day of the current reporting period. For example, if you are submitting a report for March 2010, the date you enter may not be earlier than October 1, 2009 (the first day of the previous quarter) or later than March 31, 2010 (the last day of the current quarter).

## PLANT CONDITIONS

You must enter information about the operating conditions that exist in the "full-scale" treatment plant in the **PLANT CONDITIONS** area of the worksheet, shown in Figure 3.19.

| PLANT CONDITIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RAW WATER SOURCE(s) | COAGULANT | | COAGULANT AID | | FLOC AID | | pH ADJUSTMENT | |
| | Type | Dose (mg/L) | Type | Dose (mg/L) | Type | Dose (mg/L) | Type | Dose (mg/L) |
| | | | | | | | | |

**Figure 3.19. Plant Conditions area of TOC Step 2 Jar Test worksheet.**

If you conducted your Step 2 jar test during the current reporting period, record the operating conditions that existed on the day you ran the test. However, if you conducted your test during some other month, record the conditions that existed on the date when you collected your TOC sample set. If you collected more than one TOC sample set, report the conditions that you think most accurately reflect typical operational practices for the month.

If you were not using one or more of the chemicals when you collected the operating data, enter <NA> in the applicable **Type** cell and leave the corresponding **Dose (mg/L)** cell blank.

## JAR TEST PARAMETERS

You must enter information about the dosing solutions, jars, and test conditions you used to conduct the Step 2 jar test in the **Step 2 JAR TEST PARAMETERS** area of the worksheet, shown in Figure 3.20.

| STEP 2 JAR TEST PARAMETERS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| COAGULANT | | BASE | | JAR SIZE | JAR TEST CONDITIONS | | | | |
| | | | | | Rapid Mix | | Flocculation | | Settling |
| Type | Stock Solution Concentration (g/L) | Type | Stock Solution Concentration (g/L) | Volume (liters) | Speed (rpm) | Duration (minutes) | Speed (rpm) | Duration (minutes) | Duration (minutes) |
| | | | | | | | | | |

**Figure 3.20. Jar Test Parameters area of the TOC worksheet.**

If you did not adjust the pH when you conducted the Step 2 Jar Test, enter <NA> in the **BASE Type** cell and leave the corresponding **Stock Solution Concentration** cell blank. All of the rest of the cells in this data entry area must contain the appropriate information.

**IMPORTANT**
Many water treatment plants in Texas do not need to add a base during their Step 2 jar test because they have source water with relatively high alkalinity. However, we may require you to use a base when conducting your Step 2 jar test if the pH drops rapidly in the first two or three jars or if the first jar contains a relatively high alum dose.

### JAR TEST RESULTS

You must record the results of your Step 2 jar test in the **JAR TEST RESULTS** area of the worksheet, shown in Figure 3.21.

| 19 | JAR TEST RESULTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Jar No. | COAGULANT | | BASE | | Alkalinity | pH | TOC | Incremental TOC Removal | Cumulative TOC Removal |
| 21–22 | | Dose (Alum eq.) (mg/L) | Volume (mL) | Dose (mg/L) | Volume (mL) | (mg/L as $CaCO_3$) | | (mg/L) | (mg/L TOC removed per 10 mg/L of alum) | (%) |
| 23 | RAW | | | | | | | | | |
| 24 | 1 | | | | | | | | | |
| 25 | 2 | | | | | | | | | |
| 26 | 3 | | | | | | | | | |
| 27 | 4 | | | | | Target pH | | | | |
| 28 | 5 | | | | | (based on | | | | |
| 29 | 6 | | | | | raw water | | | | |
| 30 | 7 | | | | | alkalinity) | | | | |
| 31 | 8 | | | | | | | | | |
| 32 | 9 | | | | | | | | | |
| 33 | 10 | | | | | | | | | |
| 34 | 11 | | | | | | | | | |
| 35 | 12 | | | | | | | | | |
| 37 | Has the TCEQ approved this source as "Not Amenable" to Treatment even though Target pH was not reached? | | | | | TOC, % Removal at Apparent PODR: | | | | |
| 38 | If "yes", provide the date of the TCEQ letter or e-mail. | | | | | | | | | |

**Figure 3.21. Jar Test Results data entry area.**

**IMPORTANT**
Although we have allowed room for you to enter the results for up to 12 jars, you may not need to run such an exhaustive test. You only need to test enough coagulant doses to reach either:

- a point of diminishing returns (PODR)
  *or*
- your target pH

***Coagulant Dose and Volume:*** Enter the coagulant dose (as mg/L of dry alum) used in each jar and the amount of dosing solution that you added to achieve that dose. If you used a coagulant other than dry alum to prepare your stock solution, be sure to report the dose in the proper units.

***Base Dose and Volume:*** If you adjusted the pH in any of the jars, enter the base dose used in each jar and the amount of dosing solution that you added to achieve that dose. If you did not add base to one or more of the jars, leave the applicable cells blank.

***Alkalinity and Target pH:*** Enter the alkalinity level of the raw water. After you enter the alkalinity reading, the worksheet will automatically complete the **Target pH** cell.

***pH and TOC:*** After you complete the test, measure and record the pH and TOC levels of the settled water in each of the jars in the appropriate cells.

***Incremental TOC Removal:*** After you have entered the TOC level of the settled water in each jar, the worksheet will calculate the incremental reduction that you achieved in each jar. The incremental value reported for each jar is the difference between the TOC levels in that jar and the previous one divided by $^{1}/_{10}$ of the increase in alum dose in those same two jars.

> **NOTE**
> If the TOC results indicate that the TOC level in a given jar is higher than the TOC level in the preceding jar, the incremental removal will be reported as a negative value. For example, if Jar 3 has a higher TOC level than Jar 2, the incremental removal for Jar 3 will have a negative value.

***Cumulative TOC Removal:*** After you enter the TOC level of the settled water in each jar, the worksheet will also calculate the cumulative TOC reduction that you achieved in each jar. The cumulative value reported for a given jar is the difference between the TOC level in that jar and the TOC level in the raw water divided by the raw water TOC level and is expressed as percent reduction.

> **NOTE**
> If the incremental TOC removal value for a jar is a negative number, the spreadsheet will report a value of [bad data point] in the **Cumulative TOC Removal** cell.

***TOC, % Removal at Apparent PODR:*** Based on the jar test data that you have entered, the SWMOR and SWMOR2 spreadsheets will automatically complete this cell with one of the following five values:

1. **A numerical value—**This result (a number) means that the Step 2 jar test identified one (and only one) point of diminishing returns. If this happens, the spreadsheets will copy the appropriate value from the cumulative TOC-removal data to this cell and use the result to determine your TOC removal ratio for each TOC sample set.

| | |
|---|---|
| TOC, % Removal at Apparent PODR: | **a numerical value** |
| | |

2. **Bad data point—**This result means that the Step 2 jar test identified one (and only one) point of diminishing returns. However, this PODR occurred in a jar that had negative **Incremental TOC Reduction**. If this happens, you need to contact the Surface Water Treatment Rule coordinator on the Drinking Water Protection Team at 512-239-4691, or by e-mail at <SWTPMOR@tceq.texas.gov> so that we can help you determine what follow-up is required.

| | |
|---|---|
| TOC, % Removal at Apparent PODR: | **bad data point** |
| | |

3. **Not Found**—This result indicates that your Step 2 jar test did not identify a point of diminishing returns. Usually, this means that you failed to reach the target pH in any of your jars. However, it could also mean the highest coagulant dose you used in the jar test produced a TOC reduction of 0.3 mg/L or higher for each 10 mg/L of alum in the last two jars. If you get this result, you will need to repeat the test using higher alum doses.

| | |
|---|---|
| TOC, % Removal at Apparent PODR: | **Not Found** |
| | |

4. **More than 1 PODR**—This result indicates that your Step 2 jar test produced a point of diminishing returns in two or more jars. If you get this result, you need to determine which of the PODR values best characterizes the jar-test findings and copy the appropriate value from the **Cumulative TOC Removal** cell to the empty cell below the **More than 1 PODR** notice.

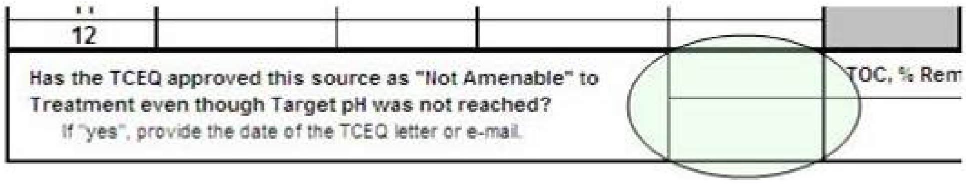
| | |
|---|---|
| TOC, % Removal at Apparent PODR: | **More than 1 PODR** |
| More than one PODR found; please enter correct PODR value: | |

Please contact our Surface Water Treatment Rule Coordinator on the Drinking Water Protection Team at 512-239-4691, or by e-mail at <SWTPMOR@tceq.texas.gov>, if you have any questions about which of the PODR values you should use.

5. **Not Amenable**—This result indicates that your Step 2 jar test revealed that you reached your target pH in at least one of the jars but that all the of the jars produced TOC reductions of less than 0.3 mg/L for each 10 mg/L of alum applied.

| | |
|---|---|
| TOC, % Removal at Apparent PODR: | **Not Amenable** |
| | |

If you get this result, you need to contact our Surface Water Treatment Rule Coordinator on the Drinking Water Protection Team at 512-239-4691, or by e-mail at <SWTPMOR@tceq.texas.gov>, so that we can review your jar test results. If we concur that the TOC in your source water is not amenable to treatment, we will send you a letter or e-mail confirming the finding. Once you have consulted with us, you will need to use the drop-down menu to enter <Yes> in the upper highlighted cell and enter the date of our correspondence in the lower one.




## SUVA Jar Test Worksheet

A SUVA (specific ultraviolet absorbance) jar test estimates the relative amount of humic substances present in the water. Water that contains higher amounts of humic material is generally more amenable to enhanced coagulation. Plants that produce treated water with SUVA levels below 2.0 L/mg-m are unlikely to remove significantly more TOC.

It is generally better to test the SUVA levels of the treated water actually produced by your plant. However, it is not possible to measure treated water SUVA levels at plants that use iron-based coagulants (such as ferric chloride and ferric sulfate) or chemical preoxidants (such as chlorine and sodium or potassium permanganate), because these compounds interfere with the SUVA analytical method. In order to estimate the level of humic materials in the treated water they produce, these plants must conduct a SUVA jar test.

**IMPORTANT**

During a SUVA jar test:

1. You cannot add any iron-based chemicals (such as ferric chloride or ferrous sulfate) or any oxidant (such as chlorine or permanganate).
2. You may (and should) add any organic polymers and pH-adjustment chemicals that are currently used in your plant prior to the sedimentation basin or clarifier. These kinds of chemicals include coagulant aid polymers, flocculant aid polymers, or acids and bases that you add to adjust the pH or alkalinity of the coagulation process.
3. You should not add any chemicals applied to settled or filtered water in your plant. These chemicals might include filter aid polymers, corrosion control chemicals such as caustic or phosphates, and fluoride.

Refer to our *TOC Guidance Manual* (RG-379) for more information on procedures for SUVA jar tests.

**NOTE**

If you enter an <X> in the **By Finished Water SUVA Jar Test** cell on the **P.7-TOC ACC** worksheet, the spreadsheets will reveal a **SUVA Jar Test Worksheet**. We have included this worksheet as a convenient place for you to record the test results and the plant conditions at the time of testing. However, you do not have to include it when you submit your monthly report.

Since the **SUVA Jar Test Worksheet** is not used for compliance, it is not protected and contains no automated calculations or formulas.

# 3.5 COMPILING SUMMARY DATA (PAGE 1)

You must compile summary data at the end of the reporting month—that is, after you have completed the **Performance Data** tables on pages 2 through 5 of the SWMOR. Click on the **Page 1-Summary** tab to get to this page.


There are three boxes on page 1: **Treatment Plant Performance, Distribution System,** and **Additional Reports & Worksheets.** Each is described in detail below.

## Treatment Plant Performance

The first box on page 1, **Treatment Plant Performance**, is divided into three sections by thin double lines. The top section of **Treatment Plant Performance** is a summary of turbidity data. The next section summarizes the CT data for the plant. The third section summarizes the disinfectant entering the distribution system.

## Turbidity

Figure 3.22 shows the portion of the **Treatment Plant Performance** section related to the turbidity level of the water produced by the plant. Most of the data in this section pertains to the CFE turbidity level of the finished water. However, two of the items, **Number of days when plant was on-line but individual filter turbidity data was not collected** and **IFE 95th percentile** are related to IFE information. The spreadsheet automatically answers most of the questions using the information you entered on Page 2 of the SWMOR or pages 6–9 of the SWMOR2.

| TREATMENT PLANT PERFORMANCE | | | |
|---|---|---|---|
| Total number of turbidity readings: | ______ | Number of 4-hour periods when plant was off-line: | ______ |
| Number of readings above 0.10 NTU: | ______ | Number of 4-hour periods when plant was on-line but turbidity data was not collected: | ______ |
| Number of readings above 0.3 NTU: | ______ | | |
| Number of readings above 0.5 NTU: | ______ | Number of days when plant was on-line but individual filter turbidity data was not collected: | ______ |
| Number of readings above 1.0 NTU: | ______ | | |
| Maximum allowable turbidity level: | ______ | Number of days with readings above 1.0 NTU: | ______ (2) |
| Percentage of readings above this limit: | ______ % (1) | Number of days with readings above 5.0 NTU: | ______ (3) |
| Statistical Summary | | | |
| Maximum turbidity reading: | ______ NTU | Average turbidity value: | ______ NTU |
| Minimum turbidity reading: | ______ NTU | Standard deviation: | ______ NTU |
| CFE 95$^{th}$ percentile value: | ______ NTU | IFE 95$^{th}$ percentile: | ______ NTU |

**Figure 3.22. Filter Effluent Summary on the Summary page.**

### Total number of turbidity readings *CALC*

The SWMOR counts the total number of finished water turbidity readings recorded in the **NTU1** through **NTU6** columns on page 2. The SWMOR2 does a similar calculation using the information entered on pages 6 through 9 of that spreadsheet.

### Number of readings above X.X NTU Triggers *CALC*

The SWMOR counts the number of finished water (CFE) turbidity readings that were above 0.10 NTU, above 0.3 NTU, above 0.5 NTU, and above 1.0 NTU in the **NTU1** through **NTU6** columns on page 2 and then enters the result on the appropriate line. The SWMOR2 does a similar calculation using the information entered on pages 6 through 9 of that spreadsheet.

### Maximum allowable turbidity level

In most cases, the two spreadsheets will automatically enter the maximum allowable turbidity level for your plant. However, if the cell is empty, you must use the drop-down list to select the maximum allowable turbidity level for your finished water. We strongly encourage all public water systems to keep turbidity as low as possible.

### Percentage of readings above this limit—Box (1) *CALC*

Both spreadsheets calculate the percentage of finished water (CFE) turbidity readings that were above the maximum allowable turbidity level.

> **NOTE**
> Box (1) is the first of several numbered boxes in the **Treatment Plant Performance** and **Distribution System** areas on page 1 on the SWMOR and the SWMOR2. The information in these boxes is related to one of the treatment-technique violations or monitoring and reporting violations that trigger a public-notice requirement. (See “Public Notification” in Chapter 8 for an explanation.) The data in these boxes is used to determine when a system is required to issue a public notice for one or more treatment-technique violations.

### Number of 4-hour periods when plant was offline *CALC*

If your system serves more than 500 persons, the SWMOR counts the number of 4-hour periods when the plant was offline, that is, the number of Xs that you entered in the **NTU1** through **NTU6** columns on page 2 of the SWMOR.

If your system serves 500 or fewer persons, the SWMOR counts the number of days when the plant was offline, meaning the number of days when the plant did not treat any water and the flow rate was “0.000” in the **Raw Water Pumpage** column on page 2 of the SWMOR.

> **SWMOR2 Users:**
> The SWMOR2 does a similar calculation but uses the 15-minute CFE turbidity readings that you enter on pages 6 through 9 of that report.

### Number of 4-hour periods when plant was online but turbidity data was not collected *CALC*

If your system serves more than 500 persons, the SWMOR counts the number of 4-hour periods when the plant was online but you did not enter CFE turbidity data, that is, the number of NDs you entered in the **NTU1** through **NTU6** columns on page 2.

If your system serves 500 or fewer persons, the SWMOR counts the number of days when the plant was online but you did not record at least one finished water turbidity reading, that is, the number of days when no turbidity reading was recorded in any of the **NTU1** through **NTU6** columns on page 2.

**SWMOR2 Users:**
The SWMOR2 does a similar calculation but uses the 15-minute CFE turbidity readings that you enter on pages 6 through 9 of that report. However, the SWMOR counts the number of blank cells, rather than the number of <ND> entries.

**IMPORTANT**
Unless a plant treats no water on a specific day, the plant must measure the turbidity of the finished water at regular four-hour intervals. Systems serving 500 or fewer persons may collect this data once a day.

If your SWMOR says there were some missed readings, please use the circle button () on page 2 of the SWMOR to locate the spots where data is missing. If there are any cells where the data is missing, you must enter a valid value or, if the required test was not conducted, an <ND>.

If your SWMOR2 says there were some missed readings, please use the circle button () on page 5 of the SWMOR2 to locate the spots where data is missing. Since the SWMOR2 spreadsheet does not allow you to enter <ND>, you will have to leave the cells empty if you did not collect the required data.
If your spreadsheet indicates that some of the turbidity data was not collected, you will have committed a monitoring and reporting violation and you will be required to notify your customers of the violation.

### Number of days when plant was online but individual filter turbidity data was not collected *CALC*

The SWMOR counts the number of days when the plant was online but you failed to report IFE turbidity data. Thus, the SWMOR will count the number of days when you entered <ND> because you failed to record any of the required readings, as well as days when you entered <MD> because you only collected some of the required 15-minute readings. If your system serves 10,000 or more persons, the SWMOR counts the number of days with missing turbidity data in either the **Max** or **4 Hrs** columns on page 3. If your system serves fewer than 10,000 persons, the SWMOR only counts the number of days with missing turbidity data in the **Max** columns. Note that most of the other items in the **Treatment Plant Performance** section refer to the overall plant performance, but this one question is related to the monitoring of individual filters.

**IMPORTANT**
You must record the turbidity of the filtered water from each filter every day that your plant treated any raw water. If your plant has IFE turbidimeters, you must continuously monitor the turbidity of the filtered water from each individual filter and record the readings every 15 minutes.
If your plant serves fewer than 10,000 people and has two filters but no IFE turbidimeters, you must collect at least one grab sample from each filter each day.
If your plant has only one filter and you are submitting the SWMOR2 report, the spreadsheet will automatically enter <NA> in this cell.

If your spreadsheet says that some readings were missed, please use the circle button ( ) on page 3 of the spreadsheet to locate the spots where data is missing. If your spreadsheet indicates that some of the turbidity data was not collected, you will have committed a monitoring and reporting violation and you will be required to notify your customers. Remember, SWMOR will not let you print your report unless the cells contain a valid reading or an <ND> or <MD> entry.

### Number of days with readings above NTU Triggers—Boxes (2) & (3) *CALC*

The SWMOR counts the number of days when one or more finished water (CFE) turbidity readings were above 1.0 NTU and 5.0 NTU in the NTU1 through NTU6 columns on page 2 of the SWMOR. The SWMOR2 does a similar calculation using the information entered on pages 6 through 9 of that spreadsheet.

### Statistical Summary *CALC*

The SWMOR performs statistical analyses on the finished water turbidity data that were recorded in the NTU1 through NTU6 columns on page 2 of the SWMOR to determine the maximum and minimum readings, the average value, the standard deviation, and the 95th percentile. The maximum IFE turbidity data on page 3 are also analyzed in this section for the 95th percentile. The SWMOR2 also does this calculation but uses the information entered on pages 6–9 of the spreadsheet.

## Microbial Inactivation (CT)

Figure 3.23 shows the portion of the **Treatment Plant Performance** section related to the disinfection data you collected. You do not have to enter any information in this section; the spreadsheet automatically answers the questions using the information you entered on pages 4 and 5 of your report.

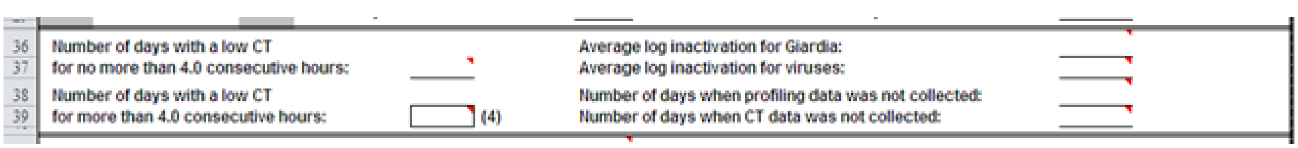



**Figure 3.23. Microbial Inactivation (CT) Summary section on the Summary page.**

### Number of days with a low CT for four hours or less *CALC*

A “low CT” occurs when a plant fails to meet the CT requirements, that is, when the inactivation ratio for *Giardia* or viruses falls below 1.00. The spreadsheets count the number of days when the total inactivation ratio in the **Inact. Ratio** column on pages 4 and 5 was less than 1.00 and the duration in the **Time** column was 4.0 hours or less.

### Number of days with a low CT for over four hours—Box (4) CALC

The spreadsheets also count the number of days when the total inactivation ratio in the **Inact. Ratio** column on pages 4 and 5 was less than 1.00 and the duration in the **Time** column was greater than 4.0 hours.

> **IMPORTANT**
> If you do not report the length of time that the inactivation ratio fell below 1.00, the spreadsheet assumes that the event lasted all day (24 hours).

### Average log inactivations for *Giardia* or viruses CALC

The two spreadsheets both automatically copy the average log inactivation for *Giardia* and viruses from the summary at the bottom of page 5 of the report.

### Number of days when profiling data was not collected CALC

The spreadsheets also count the number of days when the plant was online but failed to collect the disinfection-process data for all disinfection zones, such as the number of days with missing disinfection process data in the **C (mg/L)**, **Flow (MGD)**, **Temp ($^{o}$C)**, or **pH** columns on pages 4 and 5. Lacking such data, the spreadsheets will be unable to calculate the total *Giardia* and virus inactivation or will determine that the values they did calculate were not representative of the total log inactivations for all disinfection zones.

> **IMPORTANT**
> Unless a plant does not treat water on a specific day, the plant must collect at least one entire set of disinfection process data for each disinfection zone defined in the approved CT study at the plant's peak hourly flow rate.

### Number of days when CT data was not collected CALC

Each spreadsheet counts the number of days when the plant was online but failed to collect enough disinfection process data to calculate a CT value, that is, the number of days with missing disinfection process data in the **C (mg/L)**, **Flow (MGD)**, **Temp ($^{o}$C)**, or **pH** columns on pages 4 and 5 of the report. As a result, the **Inact. Ratio** column on pages 4 and 5 could not be calculated.

> **IMPORTANT**
> If your report says that there were some missed readings, use the circle button ( ) on page 4 of the spreadsheet to locate the spots where data is missing. Remember, the SWMOR will not let you print your report unless the cells contain a valid reading or an <ND> or <MD> entry.

## Disinfectant Entering Distribution System

Figure 3.24 shows the portion of the **Treatment Plant Performance** section related to the disinfectant residual in the finished water entering the distribution system. The SWMOR spreadsheet automatically records the type of residual disinfectant that you have selected on the **Disinfection Process Parameters** dialog box (Section 2.3). The spreadsheet automatically answers the rest of the questions using the information you entered on page 2. You do not have to enter any information in this section.

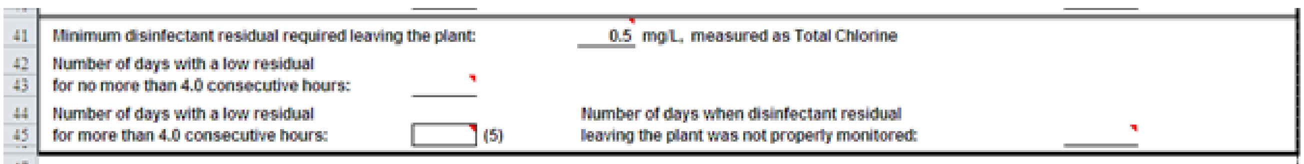

Minimum disinfectant residual required leaving the plant: 0.5 mg/L, measured as Total Chlorine
Number of days with a low residual for no more than 4.0 consecutive hours:
Number of days with a low residual for more than 4.0 consecutive hours: (5)
Number of days when disinfectant residual leaving the plant was not properly monitored:

**Figure 3.24. Disinfectant Residual Entering System section in the Summary page.**

### Minimum disinfectant residual required leaving the plant

The SWMOR and SWMOR2 spreadsheets will automatically answer this question based on the information you entered when completing the **Disinfection Process Parameters** dialog box (see Section 2.3). However, the spreadsheets also allow you to use the drop-down list to override the dialog-box selection if you need to.

If you need to, use the drop-down list to select the required minimum disinfectant residual leaving the plant. If your system uses free chlorine in the distribution system, select <0.2>. If your system injects ammonia at the plant, select <0.5>. The spreadsheets will use the residual you select to tell you whether you should be testing for free chlorine or for total chlorine.

**NOTE**
Most systems need to provide a much higher residual than the allowable minimum so that they can maintain an acceptable residual throught the distribution system.

### Number of days with a low residual for four hours or less *CALC*

The SWMOR spreadsheet will automatically count the number of days when the disinfectant residual leaving the plant in the **Lowest Residual** column on page 2 of the report was below the minimum requirement and when the duration in the **Time** column was 4.0 hours or less.

### Number of days with a low residual for more than four hours—Box (5) *CALC*

Your spreadsheet counts the number of days when the disinfectant residual in the finished water leaving the plant in the **Lowest Residual** column on page 2 was below the minimum requirement and the duration in the **Time** column was greater than 4.0 hours.

**IMPORTANT**
If you do not report the length of time that the residual falls below the minimum requirement, the SWMOR assumes that the event lasted all day (24 hours).

#### Number of days when disinfectant residual leaving plant was not properly monitored CALC

The SWMOR counts the number of days that the plant pumped treated water to distribution but failed to properly monitor the disinfectant residual in the finished water leaving the plant—that is, the number of days when no residual data was recorded in the **Lowest Residual** column on page 2 of the SWMOR.

> **IMPORTANT**
> Unless a plant does not pump treated water to distribution on a specific day, the plant must monitor the disinfectant residual entering the distribution system at the frequency shown in Table 3.1.
>
> If your report says that there were some missed readings, please use the circle button ( ) on page 2 of the spreadsheet to locate the spots where data is missing. If your report indicates that some of the disinfection data was not collected, you will have committed a monitoring-and-reporting violation and you will be required to notify your customers. Remember, the SWMOR will not let you print your report unless the cells contain a valid reading or an <ND> or <MD> entry.

### Distribution System

Figure 3.25 shows the portion of the **Summary** page that contains the disinfection data you collected in the distribution system. **You will have to enter most of the data in this section because this is the only area on the SWMOR where distribution information is required.**

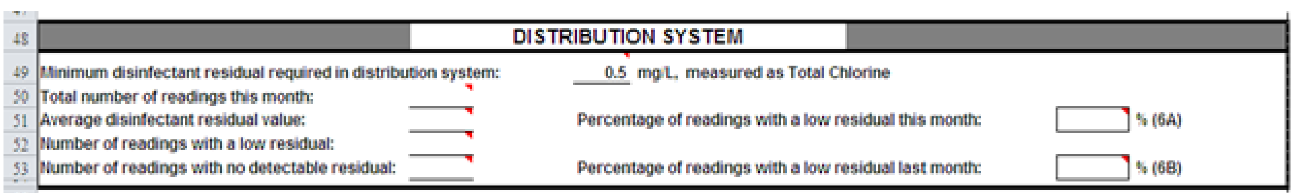



**Figure 3.25. Distribution System Summary section of the Summary page.**

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#### Minimum disinfectant residual required in distribution system

The SWMOR and SWMOR2 spreadsheets will automatically answer this question based on the information you entered when completing the **Disinfection Process Parameters** dialog box (see Section 2.3). However, the spreadsheets also allow you to use the drop-down list to override the dialog box selection if you need to.

If you need to, use the drop-down list to select the required minimum disinfectant residual leaving the plant. If your system uses free chlorine in the distribution system, select <0.2>. If your system injects ammonia at the plant, select <0.5>. The spreadsheets will use the residual you select to tell you whether you should be testing for free chlorine or for total chlorine.

#### Total number of readings this month

Record the total number of disinfectant residual tests you ran at designated sampling sites in the distribution system during this reporting month. If you have not tested disinfectant residual in the distribution system during the month, enter <0>. If you did perform tests, but failed to record the results, enter <ND>.

**IMPORTANT**
When completing this portion of your report, you must include the results of all samples you collected at a sampling site shown in your approved monitoring plan. See *How to Develop a Monitoring Plan for a Public Water System* (RG-384) for more information on how to prepare a monitoring plan and how to designate distribution residual sampling sites.

You must measure the disinfectant residual at least once each day at one or more of the sites specified in your system's monitoring plan. You must also check the residual each time you collect a bacteriological sample. Unless your system uses chloramine, you must test for free (not total) chlorine when monitoring the distribution system. See Table 7.2 on page 7-4 for the acceptable laboratory methods.

Do not forget that your monitoring plan may identify "residual sampling sites" in addition to the "bacteriological sampling sites" that you have designated for coliform testing. You may use either of these types of sites for your daily disinfectant residual sampling in the distribution system. Any sample collected at a designated sampling site must be included when filling out this part of the report. Although you may check the residual at other locations, you may not include these "other" results when you fill out the spreadsheet.

### Average disinfectant residual value

Calculate and record the average disinfectant residual value based on all the distribution samples you collected during the month at designated sampling sites. The average value is calculated by adding all the distribution residual readings, then dividing the sum by the "Total number of readings this month". See Example 3-10 for more information about calculating the average disinfectant residual. If **Total number of readings this month** is <0> or <ND>, enter <NA> or <ND>, respectively.

### Number of readings with a low residual

Record the number of readings when the distribution residual was below the minimum requirement during this reporting month. Remember to include only those samples collected at designated sites when answering this question. See Example 3-10 for more information about counting the number of distribution samples that contained a low disinfectant residual. If **Total number of readings this month** is <0> or <ND>, enter <NA> or <ND>, respectively.

### Number of readings with no detectable residual

Record the number of readings when the distribution residual was not detectable during this reporting month. Remember to include only those samples collected at designated sites. See Example 3.10 for more information about counting the number of distribution samples that contained a low disinfectant residual. If **Total number of readings this month** is <0> or <ND>, enter <NA> or <ND>, respectively.

### Percentage of readings with a low residual this month—Box (6A) ***CALC***

The SWMOR and SWMOR2 both calculate the percentage of readings in which the distribution residual was below the minimum requirement during this reporting month.

**Percentage of readings with a low residual last month—Box (6B)**

Record the percentage of readings that the distribution residual was below the minimum requirement during the last reporting month. Pull this information from Box 6A of your plant's report for the preceding month.

> **IMPORTANT**
> The SWMOR and SWMOR2 spreadsheets cannot determine if you have complied with the distribution system disinfection requirements unless you complete box 6B. If you do not complete this box, you will get an **error** message in the **Public Notification** section of the Summary worksheet and be cited for a monitoring and reporting violation.

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**Example 3.10: Distribution-System Residual Results**

The operators at a plant that does not use ammonia collected 31 chlorine residual samples at sampling sites shown on their approved monitoring plan. They also collected 8 coliform samples during the month. Finally, the operators collected 16 additional samples at sites that were not shown on their monitoring plan because they investigated some complaints during the reporting period. Because the plant does not use ammonia, the operator tested the samples using one of the approved methods for free chlorine. The results of these tests are shown in the table below.

| Sample Type | Location | Number of samples | Total of all the readings | Number below 0.2 mg/L | Number with no detectable residual |
|---|---|---|---|---|---|
| chlorine only | designated site | 31 | 30.8 | 3 | 1 |
| chlorine and coliform | designated site | 8 | 12.9 | 0 | 0 |
| chlorine only | not a designated site | 12 | 3 | 5 | 2 |
| chlorine and coliform | not a designated site | 4 | 1.8 | 1 | 1 |

The operator would complete the SWMOR or SWMOR2 in the following manner:

Step 1: Select the minimum required residual.
Because the plant is not adding ammonia, the operator should select 0.2 from the drop-down list.

Step 2: Determine the total number of readings during the month.
Because the 16 readings that were collected at sites that are not shown on the monitoring plan do not count, those test results are not included. Consequently, the total number of tests for the month was 39, that is, 31 + 8.

Step 3: Determine the average residual in the samples collected at designated sites.
The total residual in the 39 samples that count was 43.7 mg/L, that is, 30.8 + 12.9. So, the average result is 1.1 mg/L, that is, 43.7 mg/L divided by 39 samples.

Step 4: Count the number of tests that had low residual and no residual.
The 16 samples collected at sites that are not shown in the monitoring plan do not count. Therefore, there were 3 samples with low residual, that is, 3 + 0. One of these samples contained no detectable residual, that is, 1 + 0.

Step 5: Record the value shown in box 6A for the previous month in box 6B for this month.

---

## Additional Pages and Reports

Figure 3.26 shows the area on the **Summary Page** related to the supplemental pages and reports you need to include when you submit your SWMOR. The spreadsheet automatically supplies the information that you need to determine if additional information is required and that we need to determine if the report is complete. However, you will need to indicate which of the additional individual filter reports you are including with your SWMOR.

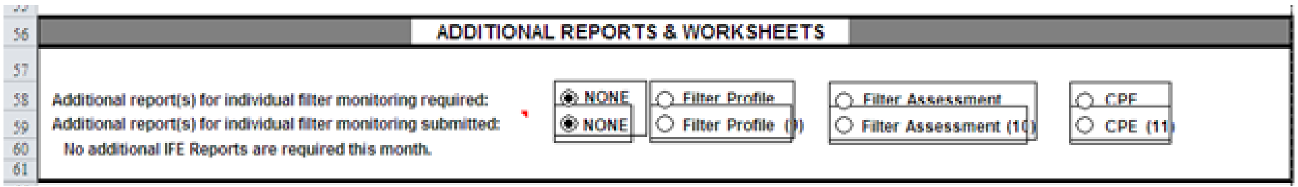



**Figure 3.26. Individual Filter Summary Section on the Summary page.**

### Statement for Page 1 Addendum *CALC*

The SWMOR spreadsheet automatically determines if any treatment technique or monitoring/reporting violations occurred during the reporting period. If there were any violations, the SWMOR spreadsheet will automatically display the following statement in bold, red letters:

> **The Page 1 Addendum (Public Notices) is required because there was at least one treatment technique or monitoring/reporting violation reported.**

In addition, the **Summary Page Addendum** will be automatically included when you print your report. If your SWMOR adds the above message, you must complete and submit the **Summary Page Addendum** when you submit your report.

If there were no violations during the month, the spreadsheet will automatically display the following statement:

> **The Page 1 Addendum (Public Notices) is not required because there were no treatment technique or monitoring/reporting violations reported.**

The spreadsheet will automatically exclude the **Summary Page Addendum** when you print your report.

### Additional report(s) for individual filter monitoring required *CALC*

The SWMOR also automatically determines whether your plant is required to conduct additional monitoring based on the data on filtered-water (IFE) turbidity you entered on page 3. The spreadsheet will indicate whether your plant is required to complete a filter-profile report, a filter-assessment report, or a CPE request form. If **None** is shown, the plant is not required to conduct additional monitoring or complete any of the additional reports.

**IMPORTANT**
The SWMOR spreadsheet cannot complete this portion of the report until you have entered all of the required data in the **Summary & Compliance Actions** section located at the bottom of page 3 of your spreadsheet. In some cases, the spreadsheet will replace the **Additional report(s)** heading on this line with a statement that reads:

**ERROR: Missing Data From Previous Months (on P.3-Filter Data)**

In other cases, the spreadsheet will simply leave all of the circles blank.

If your SWMOR does not fill out at least one of the four circles on the line **Additional report(s) for individual filter monitoring required**, use the circle button ( ) on page 3 of the spreadsheet to locate the spots where there is missing data.

### Additional report(s) for individual filter monitoring submitted

Click on the buttons for any additional report that your plant is submitting with this SWMOR. If no additional reports are being submitted with this SWMOR, select **None**.

**NOTE**
The SWMOR allows you to correct a data-entry mistake in this area. If you make a mistake and select a report that you are not going to submit, you will need to reset the buttons by selecting the [None] button. This will clear all the previous selections so that you can reenter correct data.

The SWMOR also allows you to submit a special report even if you are not required to. For example, if you are having problems with a specific filter, you can complete and submit a filter-assessment report and proposed corrective-action plan before you have your third event with IFE turbidity readings over 1.0 NTU.

### Statement for IFE Report *CALC*

The SWMOR compares the additional filter reports that you are required to submit with those that you indicate that you are submitting. If you do not indicate that you are submitting everything that is required, the spreadsheet will automatically display the following statement in bold, red letters:

**Additional IFE Reports are required this month.**

If you indicated that you are submitting the required reports or the SWMOR determined that no additional reports were required, the spreadsheet will automatically display the following statement:

**No additional IFE Reports are required this month.**

### Statement for Report Waive due to CAP CALC

The SWMOR uses the information you enter on the **P.3-Filter Data** worksheet to determine if your plant is exempt from one or more of the additional reports because you have an approved corrective-action plan. If you do not have an approved CAP, the SWMOR will leave this line blank. However, if an approved CAP is the only reason that you are not required to submit additional reports, the spreadsheet will automatically display the following statement in bold, red letters:

> **One or more additional reports have been waived due to an approved corrective-action plan.**

> **NOTE**
> We do not require you to submit a copy of the CAP with your report. However, we check our records to verify that you currently have a valid CAP that has been approved in writing, has not expired, and covers all specific filters that would have required an additional report. If we cannot verify that you have a valid CAP, you will be required to submit a corrected SWMOR and will be cited for a monitoring-and-reporting violation.

## 3.6 Public-Notification Data

You are required to notify both us and your customers if you fail to comply with minimum monitoring and reporting requirements or fail to meet minimum treatment technique requirements. The SWMOR automatically determines if you have violated one of the requirements and, as noted previously, tells you whether you have to include public notice information when you submit your report. If you do have to issue a public notice, you must submit a completed **Summary Page Addendum** with your SWMOR.

The **Summary Page Addendum** contains a **Public Notices** table that:

- Lists and describes the different types of violations that can occur
- Indicates whether or not a violation occurred
- Provides a space for you to enter all the dates when you notified us and your customers of the violation
- Identifies the dates or month of the violation

Figure 3.27 shows the header rows for the **Public Notification** table. If the **Summary Page** indicated that you must submit the **Summary Page Addendum**, you can use this table to determine which violation the SWMOR has detected.

**SURFACE WATER MONTHLY OPERATING REPORT**
FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
*Summary Page Addendum (Violations and Public Notices)*

| | | | |
|---|---|---|---|
| PUBLIC WATER SYSTEM NAME: | City of Bigge City | PLANT NAME OR NUMBER: | Old Plant |
| PWS ID No.: | 2540099 | Month: March | Year: 2012 |

| PUBLIC NOTICES | | | | | | |
|---|---|---|---|---|---|---|
| VIOLATION TYPE | DESCRIPTION OF VIOLATION | VIOLATION OCCURRED? | NOTICE TO TCEQ DATE OF NOTICE | NOTICE TO CUSTOMER * DATE OF NOTICE | PENDING | VIOLATION DATES |
| | Were more than 5.0% of the turbidity readings above the | | | | | |

**Figure 3.27. Summary Page Addendum (violations and public notices).**

## Violation Type

There are two general types of violations that can occur at surface water treatment plants: treatment-technique violations and monitoring-and-reporting violations.

**Treatment-technique violations** are the more severe of the two, because they reflect that your plant failed to meet at least one of the minimum treatment requirements during the reporting period. As a result, your plant may have exposed your customers to contaminated water. Figure 3.28 shows the area for reporting treatment-technique violations.

| PUBLIC NOTICES | | | | | | |
|---|---|---|---|---|---|---|
| VIOLATION TYPE | DESCRIPTION OF VIOLATION | VIOLATION OCCURRED? | NOTICE TO TCEQ DATE OF NOTICE | NOTICE TO CUSTOMER * DATE OF NOTICE | PENDING | VIOLATION DATES |
| TREATMENT TECHNIQUE | Were more than 5.0% of the turbidity readings above the acceptable level? - see (1) on the *Summary Page* | | | | | |
| | Were there any days with turbidity readings above 1.0 NTU? - see (2) on the *Summary Page* | | | | | |
| | Were there any days with turbidity readings above 5.0 NTU? - see (3) on the *Summary Page* | | | | | |
| | Were there any periods when the plant failed to meet the CT requirements for more than 4.0 consecutive hours? - see (4) on the *Summary Page* | | | | | |
| | Were there any periods when the residuals leaving the plant fell below the acceptable level for more than 4.0 consecutive hours? - see (5) on the *Summary Page* | | | | | |
| | Were more than 5.0% of the residuals in the distribution system below the acceptable level for two months in a row? - see (6A) and (6B) on the *Summary Page* | | | | | |

**Figure 3.28. Portion of the Summary page for treatment-technique violations.**

**Monitoring-and-reporting violations** are significant because they indicate that the operators failed to run all of the tests needed to detect treatment-technique problems. As a result, there were periods of time when the operators could not determine that the water being produced met all of the treatment requirements. The portion of the summary page where monitoring and reporting violations must be reported is shown in Figure 3.29.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 95 | | Were there any days when the plant failed to report all of the required Combined Filter Effluent (CFE) turbidity readings? - see the *Turbidity Data Page* | | | | | |
| 96 | | Were there any days when the plant failed to report all the CT data needed to evaluate the level of microbial inactivation achieved? - see the *Disinfection Data Page* | | | | | |
| 97 | | Were there any days when the plant failed to report the minimum disinfectant residual entering the distribution system? - see the *Turbidity Data Page* | | | | | |
| 98 | | Did the system fail to collect enough samples in the distribution system to meet the minimum disinfectant monitoring requirements? - see (8) on the *Summary Page* | | | | | |
| 99 | MONITORING & REPORTING | Were there any days when the plant failed to report the maximum individual filter effluent (IFE) turbidity level produced by each filter? - see the *Filter Data Page* | | | | | |
| 100 | | Were there any days when the plant failed to report the IFE turbidity level 4-hours after beginning a filter run? - see the *Filter Data Page* | | | | | |
| 101 | | Did the plant fail to submit a Filter Profile Report if one was required? - see (9) on the *Summary page* | | | | | |
| 102 | | Did the plant fail to submit a Filter Assessment Report if one was required? - see (10) on the *Summary Page* | | | | | |
| 103 | | Did the plant fail to submit a Comprehensive Performance Evaluation Request if one was required? - see (11) on the *Summary Page* | | | | | |
| 104 | | Did the plant fail to collect at least one Total Organic Carbon sample set? - *see TOCMOR Page* | | | | | |

105 ■ Treatment technique violation notices are due no later than the end of the next business day. Please include a copy if possible.

106 * Copies of each Public Notice must accompany this report if they have already been issued.

**Figure 3.29. Portion of the Summary page for monitoring-and-reporting violations.**

### Description of Violation

This portion of the **Public Notices** table contains brief descriptions of the six treatment-technique violations and the nine monitoring-and-reporting violations. It also tells you where in the SWMOR you can find the data the spreadsheet used to make the compliance determinations. In some cases, these references will direct you to one of the numbered items on the **Summary** page. In other cases, the references will direct you to another of the SWMOR's worksheets.

### Violation Occurred? *CALC*

The SWMOR will automatically tell you if one or more violations occurred during the reporting period. If the violation occurred, the spreadsheet will enter <Yes> next to the violation description. If the violation did not occur, the spreadsheet will report <No> next to the description.

### Notice to the TCEQ

You are required to inform us whenever a treatment-technique or monitoring violation occurs. The method you must use and the amount of time you have to contact us depends on the type and severity of the violation and whether or not we have to take any action. For example, you must notify us of treatment-technique violations soon after they occur while you can often notify us of monitoring violations when you submit your SWMOR. Chapter 8 contains much more information about the procedures you should use when notifying us of violations.

If you sent us an e-mail or faxed us a completed Public Drinking Water Violation Report form, TCEQ Form # 10449 (see Figure 8.1), enter the date that you sent the document. If possible, include a copy of the e-mail or the fax confirmation sheet with your SWMOR.

If you have not already sent us a separate notice, enter the date that you expect to mail your completed SWMOR.

### Notice to Customers

You are also required to notify your customers when a treatment-technique or monitoring violation occurs. Again, the methods you must use to issue the notice and the amount of time you have to issue it depends on the type and severity of the violation that has occurred. Chapter 8 contains much more information about the procedures you must follow when you issue a public notice.

The **Notice to Customer** section contains two columns, **Date of Notice** and **Pending**. If you have already issued your public notice, you must:

- enter the date that you notified your customers of the violation or violations
- include a sample copy of the exact language you included in each public notice
- include a complete copy of the certificate of delivery for the notice (see Figure 8.14)

If you have not yet issued any required public notice, you must confirm the fact that the notice is pending by selecting <Yes> from the drop-down list in the **PENDING** column.

> **NOTE**
> If you enter <No> in the **PENDING** cell, the SWMOR assumes that you have already issued the notice (because it is no longer "pending"). Therefore, you will not be able to print your report until you enter a date in the corresponding **DATE OF NOTICE** cell.
>
> Your SWMOR will allow you to answer <Yes> to **PENDING** even if you have entered a date in the **DATE OF NOTICE** cell. Although this situation is relatively uncommon, we recognize that there may be times when you have notified your customers of some, but not all, of the violations that occurred during the reporting period. In that case, the date shows when you issued the notices that were issued and the <Yes> indicates that some of the public notices are still pending.

### Violation Dates *CALC*

The SWMOR includes formulas which determine the dates when each violation has occurred. To help you make sure that your public notices are complete, we have programmed the SWMOR to list all of the violation dates or periods in the appropriate **Violation Dates** cell.

# 3.7 PRINT, SIGN, AND SUBMIT THE REPORT

When you have completed the SWMOR or SWMOR2, you must sign and date each page in ink to certify that the information in the report is complete and correct. Find these blanks at the top of page 1 and at the bottom of each subsequent page.

## Print the Report

You have to print each worksheet from the report. To print a particular worksheet, activate the worksheet by clicking on its tab, select [File] from the Excel menu, then click [Print].

If there are one or more invalid cells in a worksheet, the SWMOR will automatically terminate printing when you click [Print]. Thus, make sure that you have entered all the necessary information before you start printing. If you did not collect any necessary data, refer to an appropriate section of this manual to see whether the <MD> or <ND> option is available in the corresponding cell.

> **IMPORTANT**
> Much of the information contained on page 1 of the SWMOR report is based on data recorded on the later pages. Therefore, the information on page 1 can change any time that you make a change on a later page.
>
> We recommend that you print the rest of your SWMOR before you print the **P.1-Summary** worksheet. By printing page 1 last, you can be sure that you will be sending us the most complete and accurate summary of your results.
>
> If you decide to print the **P.1-Summary** worksheet first, you must remember to reprint the first page if you make any changes when reviewing and printing the rest of the report. If the information on page 1 of your report does not completely reflect the actual results, we mightcite you with a violation. While we can fix such problems, it is trouble for both you and us.

If you are certain that the worksheets contain no errors, you can use the [Print All] button located in the upper right corner of the **P.1-Summary** worksheet. Although this macro will automatically print all of the worksheets, it will also automatically interrupt the entire print job as soon as it detects an error on any of the pages. To help you resolve the problem, the macro will identify the worksheet where it detected the first error. You can then select that page and use the [Circle Errors] buttons in the upper left corner to locate the cells that need to be fixed.

## Sign the Report

The certified operator with responsibility for the plant must sign and date the SWMOR, certifying that the data is accurate, as shown in Figure 3.30.

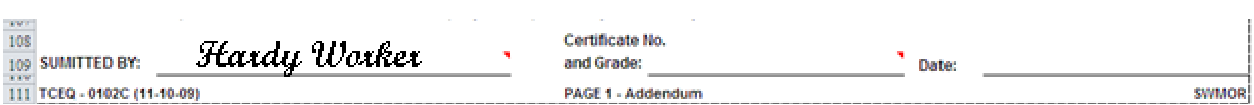



**Figure 3.30. Operator's Signature on the SWMOR.**

### Operator's Signature

The certified operator responsible for the day-to-day operation of the treatment plant must use a pen or permanent marker to sign each page of the report. This signature must be handwritten. Stamped signatures and typewritten names are not acceptable.

### Certificate No. and Grade

Enter the certificate number and the grade of the operator who signs the report. Fill out this blank on page 2 of the report; the other pages are linked to this page and the information you enter on page 2 will be automatically repeated on the other pages.

Example: WS12345678, WBS

### Date

Enter the date that the operator signs the report. Fill out this blank on page 2 of the report; the other pages are linked to this page and the information you provide on page 2 will be automatically repeated on the other pages. Remember, your report must be received by the TCEQ no later than the 10th day of the month following the reporting period.

## Mail the Report

Before you mail your report to the TCEQ, be sure you have included any related documents you may be required to send us. For example, if you are required to complete a filter-profile report, a filter-assessment report, or a CPE request form for this reporting month, you should include it with your report (see Chapters 4–6). You should also include a copy of each public notice your system is required to issue for this plant during this reporting month (see Chapter 8).

Send your completed report and related documents to:

Drinking Water Quality Team, MC-155, Attention: SWTR Coordinator
Water Supply Division
TCEQ
PO Box 13087
Austin, TX 78711-3087

If you wish you may submit documents to our physical address at:

Drinking Water Quality Team, MC-155, Building F
Attn: SWTR Coordinator, Water Supply Division
TCEQ
12100 Park 35 Circle
Austin, TX 78753

You may not submit your SWMOR by fax or e-mail because of legibility issues. We highly recommend that you retain proof of your submittal in the form of a certified mail receipt, fax transmittal confirmation, or return e-mail from us.

# 4. FILTER-PROFILE REPORTS

**SPECIAL INSTRUCTIONS FOR SWMOR2 USERS**

Throughout this chapter, we talk about monitoring requirements and results for individual filters. However, you are monitoring CFE turbidity levels instead of IFE turbidity levels. Consequently, we are really talking about your CFE monitoring requirements and results.

All of the statements regarding special filter studies and reports for individual filters contained in Chapter 4 apply to your CFE monitoring point. For example, when we say that a plant with IFE monitors must prepare a special report if:

- the turbidity level at the outlet of an individual filter exceeds 1.0 NTU in two consecutive 15-minute readings

it means that you must prepare the same report if:

- the turbidity level at your CFE monitoring point exceeds 1.0 NTU in two consecutive 15-minute readings

Because that would be the only difference between the two sets of instructions, this chapter applies to all surface water treatment plants.

If you get high IFE turbidity readings at the outlet of an individual filter, we may require you to complete one or more special studies to determine the cause. The type of special study that must be conducted depends on the size of your public water system, how high the turbidity level went, and how often high readings were recorded.

The filter profile is one of the special studies that you might need to conduct. You only have to complete the filter-profile report, or FPR, if *either*:

- the IFE turbidity level exceeds 1.0 NTU in two consecutive 15-minute readings at any time during the filter run

*or*

- your plant serves at least 10,000 people *and* the IFE turbidity level exceeds 0.5 NTU in two 15-minute readings at the end of the first four hours of continuous filter operation

Note that this second condition occurs only at plants that serve at least 10,000 people and only applies to the reading that is collected four hours after a filter (1) is returned to service following a backwash cycle or (2) was stopped and restarted for some other reason.

Both of these situations are generically referred to as “filter exceedances” throughout this chapter. Determining if you have to complete an FPR is not difficult, but it can be monotonous. Consequently, we have included a feature in the SWMOR and SWMOR2 spreadsheets that tells you if you have to include an FPR with your monthly report.

The FPR shares many common features with the SWMOR and SWMOR2 spreadsheets. For example:

- The FPR is an Excel spreadsheet that contains many comment boxes and drop-down menus. If you are unfamiliar with these spreadsheet features, you may learn more about them in Section 1.5
- You must complete the FPR electronically.
- You may download a copy of the FPR at our website, or we can send you a copy on the SWMOR CD-ROM.

In addition to the plant and operator information, the FPR contains two major sections: **Obvious Reasons** on page 1, and the **Narrative Description of Filter Profile** on page 2. If the IFE turbidity level at the outlet of an individual filter goes above 1.0 NTU for two consecutive 15-minute readings on several occasions, you may have to conduct more special studies and submit additional reports.

## 4.1 Plant and Operator Information

You will only need to complete the **plant** and **operator information** blanks on page 1 of the FPR. Once you fill in that information, it is copied into the corresponding cells on page 2.

### Public Water System Name

Enter the name of your public water system. The water system name on the SWMOR and FPR must be identical.

### Plant Name or Number

If your water system has more than one treatment plant, enter the name of the plant that collected the data contained in this specific report. You do not have to complete this blank if your water system has only one treatment plant. Again, to avoid confusion, please make sure that the plant name shown on the SWMOR or SWMOR2 matches the one you enter here.

### PWS ID No.

Enter your water system's seven-digit PWS ID number.

### Month/Year

Select from the drop-down lists the month and the year in which your plant collected the data.

### Operator's Signature

The operator who was in charge of producing the filter profile must sign each page of the FPR. This signature must be handwritten. Stamped signatures or typewritten names are not acceptable.

The operator who signs the FPR may or may not be the same person who is responsible for the daily operation of the plant. Consequently, the individual who signs the FPR might not be the same person who signs the SWMOR.

**Certificate No. and Grade**
Enter the certificate number and the grade of the operator who signs the FPR.

**Date**
Enter the date that the operator signs the FPR.

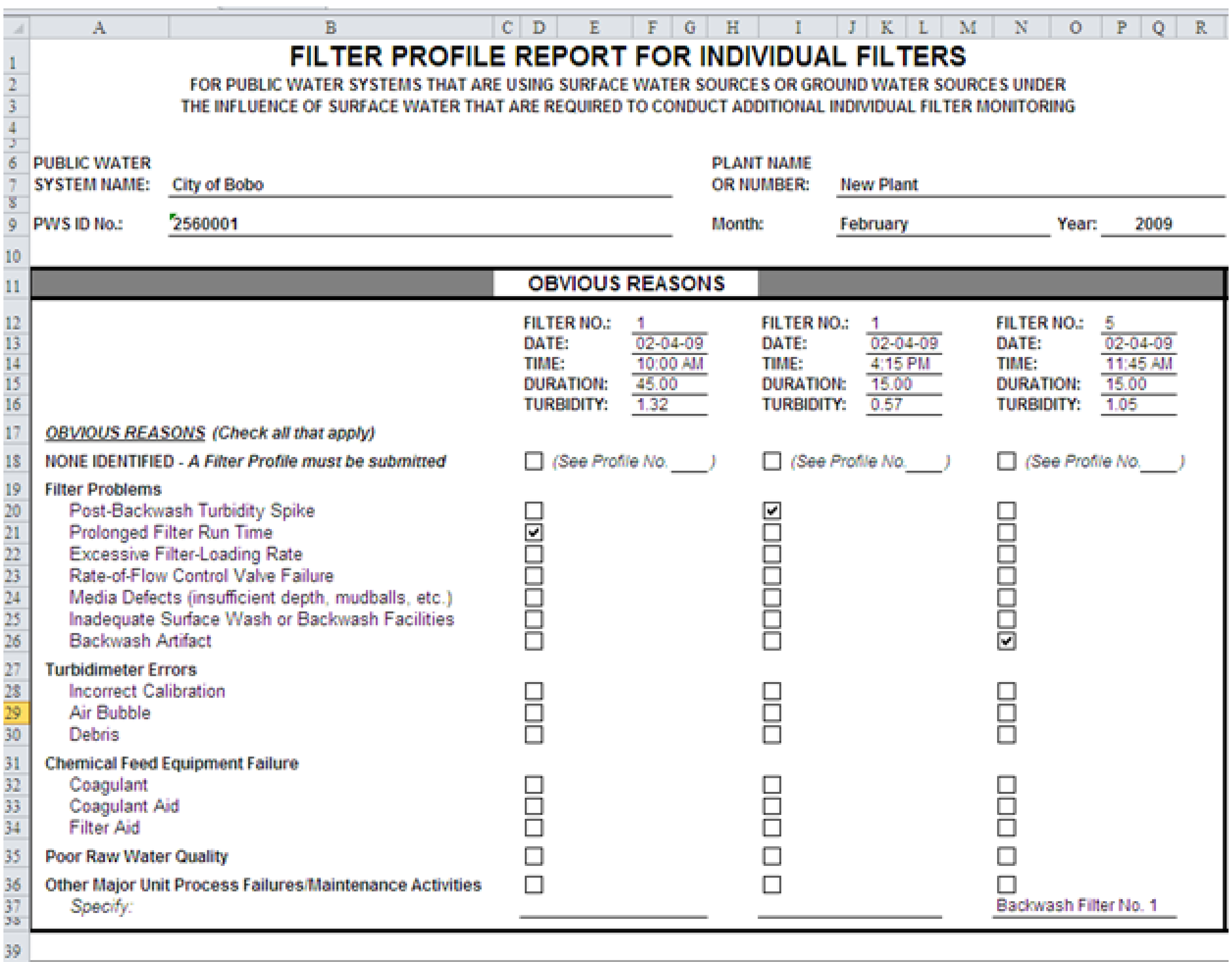
## 4.2 Obvious Reasons

Figure 4.1 shows the **Obvious Reasons** section of the **Filter Profile Report**. Unless we have approved a corrective-action plan for a specific filter, you must complete this portion of the FPR *if*:

- the IFE turbidity level at the outlet of an individual filter exceeds 1.0 NTU in two consecutive 15-minute readings at *any* time during the filter run

*or*

- your plant serves at least 10,000 people *and* the IFE turbidity level at the outlet of an individual filter exceeds 0.5 NTU in two 15-minute readings at the end of the first four hours of continuous filter operation



FILTER PROFILE REPORT FOR INDIVIDUAL FILTERS

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER THAT ARE REQUIRED TO CONDUCT ADDITIONAL INDIVIDUAL FILTER MONITORING

PUBLIC WATER SYSTEM NAME: City of Bobo    PLANT NAME OR NUMBER: New Plant

PWS ID No.: 2560001    Month: February    Year: 2009

OBVIOUS REASONS

| | | | |
|---|---|---|---|
| | FILTER NO.: 1 | FILTER NO.: 1 | FILTER NO.: 5 |
| | DATE: 02-04-09 | DATE: 02-04-09 | DATE: 02-04-09 |
| | TIME: 10:00 AM | TIME: 4:15 PM | TIME: 11:45 AM |
| | DURATION: 45.00 | DURATION: 15.00 | DURATION: 15.00 |
| | TURBIDITY: 1.32 | TURBIDITY: 0.57 | TURBIDITY: 1.05 |
| *OBVIOUS REASONS* *(Check all that apply)* | | | |
| NONE IDENTIFIED - *A Filter Profile must be submitted* | ☐ *(See Profile No. ___)* | ☐ *(See Profile No. ___)* | ☐ *(See Profile No. ___)* |
| Filter Problems | | | |
| Post-Backwash Turbidity Spike | ☐ | ☑ | ☐ |
| Prolonged Filter Run Time | ☑ | ☐ | ☐ |
| Excessive Filter-Loading Rate | ☐ | ☐ | ☐ |
| Rate-of-Flow Control Valve Failure | ☐ | ☐ | ☐ |
| Media Defects (insufficient depth, mudballs, etc.) | ☐ | ☐ | ☐ |
| Inadequate Surface Wash or Backwash Facilities | ☐ | ☐ | ☐ |
| Backwash Artifact | ☐ | ☐ | ☑ |
| Turbidimeter Errors | | | |
| Incorrect Calibration | ☐ | ☐ | ☐ |
| Air Bubble | ☐ | ☐ | ☐ |
| Debris | ☐ | ☐ | ☐ |
| Chemical Feed Equipment Failure | | | |
| Coagulant | ☐ | ☐ | ☐ |
| Coagulant Aid | ☐ | ☐ | ☐ |
| Filter Aid | ☐ | ☐ | ☐ |
| Poor Raw Water Quality | ☐ | ☐ | ☐ |
| Other Major Unit Process Failures/Maintenance Activities | ☐ | ☐ | ☐ |
| *Specify:* | | | Backwash Filter No. 1 |

**Figure 4.1. Obvious Reasons section of the filter-profile report.**

Completing the **Obvious Reasons** section of the FPR does two things. First, it identifies the filter that experienced the IFE exceedance; the date, time, and duration of the event; and the maximum turbidity level that was recorded during the event. Second, it gives you an opportunity to describe the condition or combination of conditions that led to the elevated turbidity level.

If you are able to identify the cause or causes of a particular exceedance, you will not be required to prepare a complete filter profile or to complete the **Narrative Description of Filter Profile** portion of the FPR. However, if you are not able to identify what caused the exceedance, you will need to prepare a filter profile and complete the rest of the FPR.
To complete this portion of the report, you must identify the event and check all boxes that apply. To check (or to uncheck a box that already contains a check), place your cursor over the box and click the left mouse button. Page 1 of the FPR contains enough room to discuss up to six elevated-turbidity events. If more than six events occurred during the month, you will need to submit additional pages to describe them. The FPR must describe each event that occurred during the month.

## Identifying the Filter and Exceedance

Each time an IFE turbidity level exceeds one of the triggers that we described earlier in this chapter, you will need to identify the filter, tell us when the event occurred, and summarize the severity and duration of the episode.

### Filter No.

Enter the number of the filter that did not meet the IFE turbidity requirements for individual filters. You must enter the number of the filter as it appears on page 3 of the SWMOR. For example, if page 3 of the SWMOR identifies the filter as Filter No. 6, the filter must be identified as Filter No. 6 on the FPR.

> **NOTE**
> Systems that use the SWMOR2 should enter <CFE> in these cells. However, you may also enter <1> or <2>; we will understand that it is really a CFE reading because the FPR form will accompany your SWMOR2.

### Date/Time

Enter the date and the time the IFE exceedance occurred.

### Duration

Enter the length of time, in hours, that the IFE exceedance lasted. Report the duration of the event in ¼-hour, or 0.25 hour, increments.

### Turbidity

Enter the maximum IFE turbidity level recorded during the event.

## None Identified

You should check the [NONE IDENTIFIED] box only if you cannot identify an obvious reason for the IFE exceedance. If the [NONE IDENTIFIED] box is checked, no other box in this portion of the report should be marked, and a filter profile must be produced within seven days of the exceedance. If you check this box you must also assign and record the profile number as a cross-reference to the narrative description of the filter profile on page 2. See Section 4.3 for more information about completing page 2 of the FPR.

## Filter Problems

Filter performance can be affected by the design, operation, and maintenance of a filter. Check the box next to any filter problem that resulted in (or even contributed to) the turbidity exceedance event that you are describing.

### Post-Backwash Turbidity Spike

Check this box if the IFE exceedance occurred during a post-backwash turbidity spike when the filter was returned to service after backwash or after a period of inactivity.

### Prolonged Filter Run Time

Check this box only if the IFE exceedance was caused by the filter being operated for a prolonged period of time that exceeded a typical filter run, *and* the prolonged filter run resulted in particle breakthrough.

### Excessive Filter-Loading Rate

You should check this box only if the event occurred during a period when the filter was being operated at a loading rate above the maximum loading rate allowed by the TCEQ. Typically, this excessive loading rate occurs during peak operating flow or when one or more other filters are taken offline.

### Rate-of-Flow Control Valve Failure

A malfunctioning rate-of-flow control valve can cause hydraulic surges in the filter. Sudden changes in hydraulic loading rates can force particles to surge through the filter media. Consequently, you should check this box if the elevated turbidity level was caused, in part or in whole, by a flow-control valve that was not working properly.

### Media Defects

Check this box if the elevated turbidity level was caused by problems with the condition and placement of the filter media or the support system. Media defects include, but are not limited to, the presence of mudballs, surface cracking, displaced media, insufficient media depths, poor media segregation (for dual-media and mixed-media filters), and damaged or disturbed support media and underdrains as evident from boils or vortexing during backwash.

### Inadequate Surface-Wash or Backwash Facilities

Filters that are not backwashed well can produce elevated turbidity readings. You should check this box if the filter is not being cleaned adequately during routine backwash. Backwash limitations include, but are not limited to:

- inadequate filter backwash rate or filter-bed expansion
- absence of a surface-wash or air-scour system
- a damaged surface-wash or air-scour system

### Backwash Artifact

Check this box if the IFE exceedance occurred during the backwash of another filter *and* you believe that the backwash procedure caused a hydraulic surge that resulted in an elevated turbidity reading in the filter you are evaluating.

## Turbidimeter Errors

The ability to accurately measure turbidity is absolutely essential. If the turbidimeter is not properly operated and maintained, you can get spurious readings that are not indicative of actual filter performance. Check the box next to any turbidimeter problem that you identified when you investigated the turbidity exceedance that you are describing in the FPR.

### Calibration Problems

Elevated IFE readings can occur during a calibration procedure and can be caused by improperly calibrated instruments. If you are certain that one of these problems caused the elevated readings, check this box. Be sure to verify that the error exists by verifying the instrument performance using primary or secondary standards, or by comparing the reading from the online unit with one from a properly calibrated turbidimeter. Calibration verification may also be completed using the instrument's built-in electronic diagnostics designed to assist in determining proper calibration. The turbidimeter should measure correctly after it is thoroughly cleaned and recalibrated with a primary standard.

### Air Bubble

A leak in the supply line may cause air to be introduced into the turbidimeter, resulting in an erroneous turbidity measurement. The instrument should measure correctly after the leak is fixed. Check this box only if you found a leak during your investigation and repairing the leak corrected the problem.

### Debris

Excessive debris can accumulate in the turbidimeter and contribute to an elevated IFE turbidity level. The instrument should measure correctly after it is thoroughly cleaned and recalibrated with a primary standard. You should check this box only if your investigation revealed an excessive accumulation of debris that you believe contributed to the elevated IFE readings.

## Chemical Feed Equipment Failure

Check one or more of these boxes if you discovered that the chemical feed pumps or equipment malfunctioned and caused a disruption in chemical feed, or resulted in an improper dosage of coagulant, coagulant aid, or filter aid *and* that failure contributed to the elevated turbidity readings you are investigating.

## Poor Raw Water Quality

Check this box if you have determined that the elevated IFE turbidity readings were the result of unusually poor raw-water quality, such as an elevated raw-water turbidity level or some unusual chemical makeup that made coagulation difficult.

### Other Major Unit Process Failures/Maintenance Activities

If some other major unit process failures or maintenance activities caused the filter exceedance, check this box and specify the cause on the line below the box.

## 4.3 NARRATIVE DESCRIPTION OF FILTER PROFILE

If you cannot identify any obvious reason for the abnormal filter performance, you must produce a filter profile within seven days of the IFE exceedance. A filter profile is a graphical representation of individual filter performance based on turbidity readings recorded at one-minute intervals for an entire filter run, from start-up to backwash. Although total particle counts may be used in conjunction with turbidity measurements to offer additional insights to filter performance, take care in interpreting particle counts. The interpretation should focus on the change in count levels as opposed to particular count numbers.

**IMPORTANT**
Do not calibrate your online turbidimeter while you are collecting filter-profile data. To ensure the accuracy of the data reported in the profile, we encourage you to calibrate the online turbidimeter, or at least verify its accuracy, before beginning the profile.

#### Filter No.

Enter the number of the filter on which the filter profile was produced. To avoid confusion, please make sure that the number you enter here matches the filter number on page 1.

#### Profile No.

Enter the number of the filter profile as assigned on page 1 of the FPR for cross-reference.

#### Date of Profile

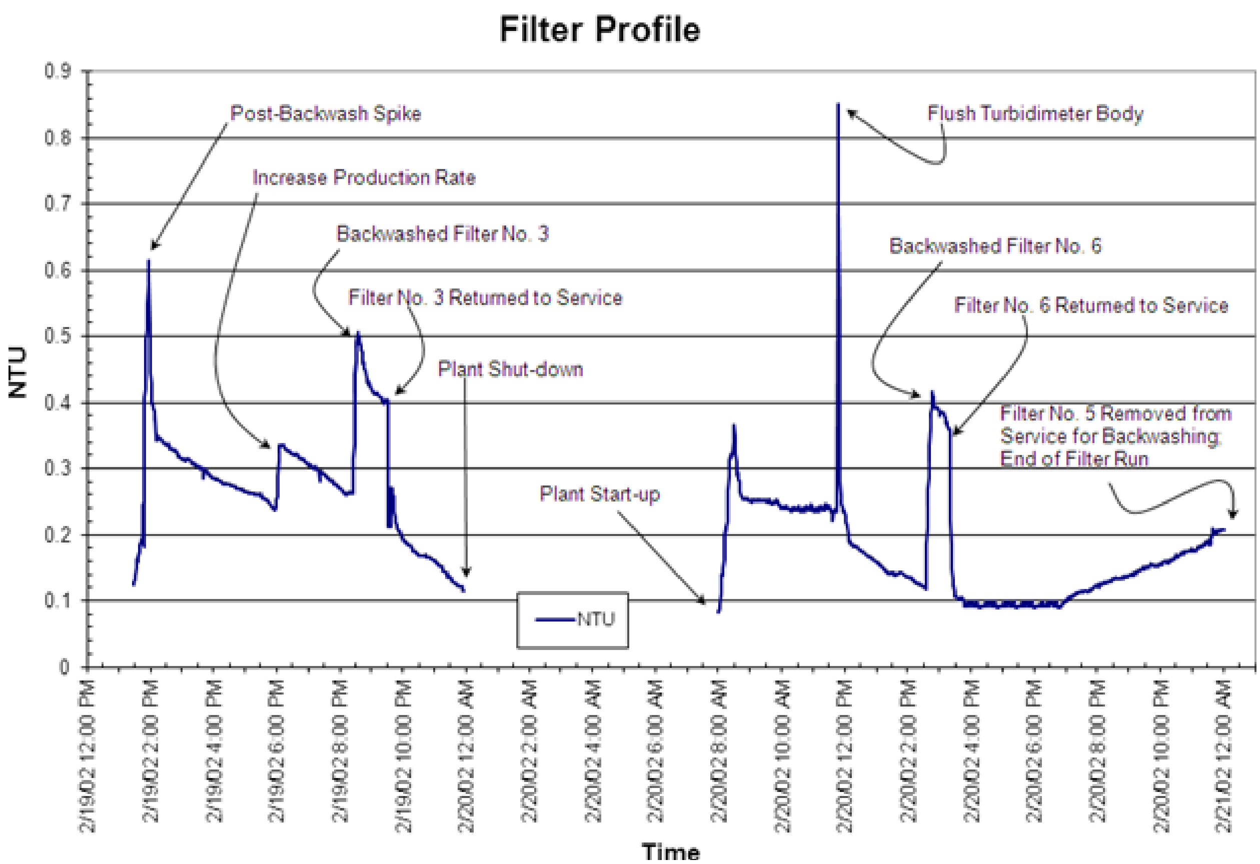
Enter the date on which you began conducting the filter profile.

#### Details

The filter profile must be based on turbidity readings recorded at one-minute intervals over an entire filter run, from start-up to backwash. The run length during this assessment should be representative of a typical filter run, and should encompass the period when another filter is being washed. The profile should include an explanation of the cause of any filter performance spikes during the run. It must be annotated to identify significant events, such as:

- filter start-up and shutdown
- filter backwash
- any filter-to-waste events and idle periods
- any changes in filter-loading rates
- any turbidity deviations over 0.1 NTU

**Example 4.1: Filter Profile**
An example of a filter profile. The filter run represents a typical plant filter run that includes the backwash of another filter. The profile has been annotated to identify significant events and explain turbidity spikes during the run.




# 4.4 SUBMITTING THE REPORT

The completed and signed FPR and, if applicable, the filter profile must be included when you mail your SWMOR to the TCEQ.

# 5. Completing Filter-Assessment Reports

**Attention SWMOR2 Users**
Since you are monitoring CFE turbidity levels instead of IFE turbidity levels, we require you to conduct a Filter Assessment based on your CFE readings instead of based on the IFE readings.

In addition, you will be unable to document which of your two filters is causing the problem since you do not have a turbidimeter on each filter. Consequently, we also require you to prepare a filter-assessment report for each of your two filters whenever your CFE turbidity levels exceed 1.0 NTU on three separate occasions.

Because the monitoring location for your plant would be the principle difference between the two sets of instructions for SWMOR and SWMOR2 users, this chapter applies to all surface water treatment plants.

If you have a filter that consistently produces water with an elevated turbidity level, you will need to conduct a special filter study called the Filter Assessment. It is important to note that you only have to complete the filter-assessment report if two consecutive 15-minute turbidity readings are above 1.0 NTU at the outlet of an individual filter on three separate occasions during any consecutive three months. For example, you would have to submit a completed FAR if *any* of the following situations has occurred:

- The IFE turbidity level at the outlet of Filter No. 3 was above 1.0 NTU on August 3, August 9, and August 20.
- The IFE turbidity level at the outlet of Filter No. 1 was above 1.0 NTU on September 20, October 3, and November 30.
- The IFE turbidity level at the outlet of Filter No. 6 was above 1.0 NTU on January 5, March 20, and March 22.

As our examples above suggest, there are several different combinations of events that can trigger a filter assessment. In order to help you comply with the rules, the SWMOR and SWMOR2 spreadsheets automatically determine if you need to conduct a filter assessment.

**IMPORTANT**
When you conduct a filter assessment, you will need to actually get down into the filter and make some physical measurements and excavate some of the media. Any time that you do these kinds of studies, be very careful to avoid injuring yourself or damaging the filter media. Therefore, you need to develop and document the procedures you will use before you actually begin the filter assessment. Appendix H contains an example of a standard operating procedure that was developed by plant operators during one of our technical-assistance pilot projects. Although your procedures may be significantly different from those developed for that plant, step-by-step procedures for conducting a filter assessment are essential.

The filter-assessment report, or FAR, shares many features with the SWMOR. For example:

- The FAR is an Excel spreadsheet that contains many comment boxes and drop-down menus. If you are unfamiliar with these spreadsheet features, you can learn more about them in Section 1.5.
- You must complete the FAR electronically.
- You can download a copy of the FAR at our website or we can send you a copy on the SWMOR CD-ROM.

The FAR contains several major sections. Except for the sections on the plant and operator information, each of these sections is titled and inside a box that is bordered with a thick, dark line. For example, page 1 of the FAR contains the **Design Specification** and the **Operating Procedures** sections, and page 2 contains the sections on **Current Conditions**, **Media Surface Conditions**, and **Backwash Conditions**.

### General Instructions

You will need to make several measurements during the filter assessment and record the results on the FAR spreadsheet. All of this data must be entered in a decimal format. For example, if one of the measurements results in a reading of 12 feet 6 inches, you will need to enter <12.5> on the FAR spreadsheet. Similarly, 6 feet 8 inches must be recorded as <6.67> feet.

## 5.1 PLANT AND OPERATOR INFORMATION

You will only need to complete the blanks for plant and operator information on page 1 of the FAR. Once you fill in this information, it is copied into the corresponding cells on pages 2, 3, and 4.

### Public Water System Name

Enter the name of your public water system. The water-system name shown on the SWMOR and the one you enter on the FAR must be identical.

### Plant Name or Number

If your water system has more than one treatment plant, enter the name of the plant that collected the data contained in this specific report. You do not have to complete this blank if your water system has only one treatment plant. Again, to avoid confusion, please make sure that the plant name shown on the SWMOR matches the one you enter here.

### PWS ID No.

Enter your water system's seven-digit PWS ID number.

### Filter Number

Enter the number of the filter that you are evaluating. You must enter the number of the filter as it appears on page 3 of the SWMOR, for example, Filter No. 6. We realize that this filter number may not correspond with the numbering system you use at your plant, so we have left enough space for you to add some information if you need to. For example, if Filter No. 6 corresponds to your Filter 3-West, the completed form might look like this:

| | |
|---|---|
| FILTER NUMBER: | **Filter No. 6 (our Filter No. 3-West)** |

### Operator's Signature

After the completed FAR form has been printed, the operator who was in charge of conducting the filter assessment must sign the bottom of page 1. This operator may or may not be the same person who is responsible for the daily operation of the plant. Consequently, the individual who signs the FAR form may not be the same person who signs the SWMOR. The signature must be handwritten in ink. Stamped signatures and typewritten names are not acceptable.

### Operator's Name (printed)

Enter the name of the operator who is signing the FAR.

### License No. and Class

Enter the license number and the type of license held by the operator who is signing the FAR.

### Date

Enter the date that the FAR was signed.

# 5.2 DESIGN SPECIFICATIONS

This portion of the FAR contains design information on the filter that you are evaluating. In order to complete this portion, you will need the following:

- Design information from a variety of sources including engineering drawings for the plant
- Specifications for the filter, its media, and its appurtenances
- Information from pump curves and other plant documentation

## Filter Type

Select the type of filter that you are evaluating from the drop-down list. Table 5.1 contains a general description of each type of filter contained in the drop-down list.

**Table 5.1. Filter Type drop-down list.**

| Item | Description |
|---|---|
| **Gravity** | If the top of the filter is open to the atmosphere, it is probably a gravity filter. In these filters, settled water usually flows by gravity from the clarifier or sedimentation basin into the filter. |
| **Pressure** | If the filter is completely enclosed, it is probably a pressure filter. A transfer pump is usually used to pump settled water into the filter. |
| **Permutit** | A proprietary gravity filter that is fully enclosed. The filter discharges to a backwash tank immediately above the filter bed. |
| **Other** | If you are not sure what kind of filter you have, select “Other” and then describe the filter in the Additional Remarks area or include a copy of the filter’s engineering drawings. |

## Operating Mode

Select the operating mode for the filter that you are evaluating from the drop-down list. Table 5.2 contains a general description of each operating mode contained in the drop-down list.

**Table 5.2. Operating Mode drop-down list.**

| Item | Description |
|---|---|
| **Constant Rate/ Constant Level** | The outlet of these filters is typically equipped with a mechanical rate-of-flow controller or a SCADA-controlled motorized flow control valve. As the head loss through the filter increases, the flow controller automatically opens more to maintain the preset flow rate. Typically the inlet to these filters is completely submerged, and the water level is essentially the same in all of the filters during the entire filter run. |
| **Constant Rate/ Variable Level** | The flow rate in these filters is typically controlled by a weir, a telescoping valve, or some other device located at the inlet of the filter rather than at its outlet. As the water passes though the flow-control device, it falls through an air gap into the filter inlet pipe. Once the water passes through the air gap, there is no way for it to be redirected to another filter. Consequently, as the head loss increases, the water level in the filter rises. The rising water level provides the additional head needed to maintain the desired flow rate. |
| **Declining Rate** | In this operating mode, the inlet piping to the filters is completely common and no attempt is made to maintain a uniform flow rate through the filter. At the beginning of filter run, the flow rate is limited by an orifice plate (or flow-control valve and flowmeter) located at the filter outlet. As the head loss in a filter increases, the flow rate decreases and water tends to be redirected to other, cleaner filters. |
| **Other** | If you are not sure what kind of filter you have, select <Other> and then describe the filter’s operating mode in the Additional Remarks area or on a separate page. |

# Media Bed Dimensions

## Diameter (ft), Length (ft), and Width (ft)

If you are conducting an assessment on a round filter, enter the diameter of the filter bed but leave the length and width boxes empty. If the filter has a rectangular bed, enter the length and width of the media bed, but leave the diameter box empty.

## Surface Area (ft$^2$) *CALC*

The spreadsheet will automatically calculate the surface area of the media bed if you entered the filter-bed dimensions correctly. However, if you have made a mistake entering the dimensions, the word “ERROR” will appear in the surface area cell.

## Freeboard (ft)

Measure the distance from the top of the filter bed to the upper edge of the backwash water trough.

## Max Head Loss (ft)

Enter the maximum available head loss for the filter, that is, the maximum head loss that can be achieved during a filter run. This information can often be obtained from engineering drawings or filter specifications. However, if these sources do not provide you with the information, you can use the method shown in Figure 5.1. When using this method, the maximum water level in the filter can be based on whichever design feature controls the maximum water level in the filter. For example, the controlling feature could be any one of the following:

- the overflow elevation of the filter wall
- the bottom of the filter overflow pipe
- the maximum water level that can be achieved in the clarifier

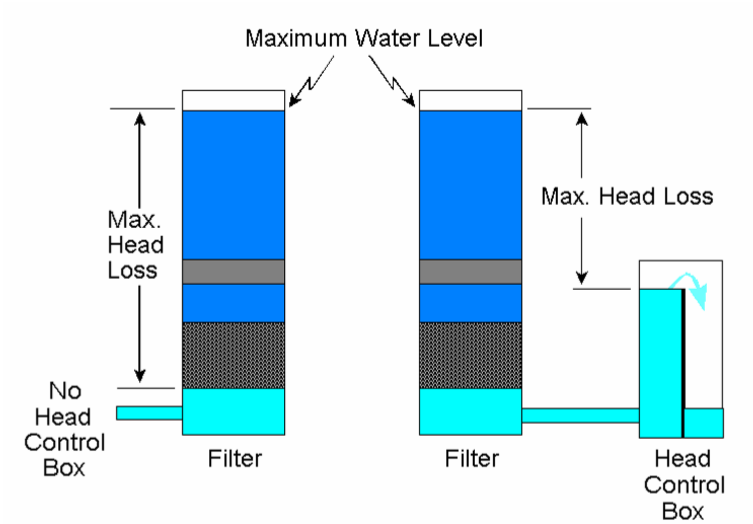



**Figure 5.1. Determining maximum available head loss.**

## Media Type

Using the drop-down list, select the type of media bed in the filter that you are evaluating based on the original filter design. This information should be based on information you obtain from the engineering drawings or filter specifications. *Do **not** answer this question based on information you obtain during a filter excavation.* Table 5.3 contains a general description of each media type contained in the drop-down list.

**Table 5.3. Media Type drop-down list.**

| Item | Description |
|---|---|
| **Multiple Media** | These filters contain at least three different media materials. The most common design uses garnet, sand, and anthracite media. |
| **Dual Media** | These filters contain exactly two different types of media. The most common design incorporates sand and anthracite. |
| **Rapid Sand** | This design utilizes only sand media. |
| **Deep-bed Mono Media** | This filter contains at least 48 inches of a single type of media. These filters commonly contain either anthracite or granular activated carbon. |
| **Other** | If this filter contains a media bed or material that is not adequately described by the other options in the drop-down list, select “Other” and then describe the filter’s media bed in the Additional Remarks area or on a separate page. |
| **Unknown** | Select this option if you cannot find any engineering drawings or media specifications describing the type of media used in the filter. |

### Media Specs

If you do not have the specifications for the media that was installed in the filter being evaluated, select <Unknown> for the material used in Layer 1 and leave the rest of this section blank.

### Material

Using the drop-down list, select the type of filter material in each layer in the filter bed. If the filter contains fewer than four layers, select the materials used in each layer that the filter does have and leave the other layers blank.

### Depth (inches)

Record the thickness of each media layer in inches.

### Min. Size (mm) and Max. Size (mm)

Look at the media specifications. If the specifications give a range of acceptable sizes for each layer, enter the minimum and maximum values for the size range. On the other hand, if the specifications give only a single size, enter that value in both the minimum and maximum spots.

### UC

Enter the uniformity coefficient for each of the media materials used in the filter. If the specifications do not include a uniformity coefficient value for one or more of the materials, enter <Unknown> in the appropriate boxes.

### Specific Gravity

If the media specifications include a specific gravity for the filter media, record the value in the appropriate box. If no specific-gravity specification is available, enter <Unknown>.

### Total Depth (inches) ***CALC***

If you have entered the depth of each media layer, the spreadsheet will automatically calculate the total depth. However, if you do not have the media specifications and selected <Unknown>for the material in Layer 1, the spreadsheet will automatically enter <Unknown> in this spot.

### L/D Ratio ***CALC***

The spreadsheet will use the information that you entered about media depth and size to automatically calculate the L/d ratio for the filter.

## Underdrain System

### Underdrain Type

Select the type of underdrain system that is being used in the filter that you are evaluating from the drop-down list.

### Support Gravel

#### No. of Grades

If your filter contains one or more layers of support gravel, enter the number of different sizes that are specified in the filter specs. If you are using one of the gravel-less underdrain systems and have no support gravel, enter <None> in the **No. of Grades** cell but leave the rest of the boxes in this area blank.

#### Min. Size (in) and Max. Size (in)

If your filter contains support gravel, record the maximum and minimum gravel sizes in the appropriate box.

#### Total Depth

Record the total thickness of the gravel support layer.

## Troughs

### Number

Record the number of backwash troughs in the filter that you are evaluating.

### Separation (inches)

Enter the distance (in inches) between the edges of two adjacent troughs. If the troughs are not the same distance apart, enter <Variable> in this spot and describe the arrangement in the **Additional Remarks** area of the form. Also, if the edge of the last trough is further from the filter wall than the distance between adjacent troughs, include this measurement in the **Additional Remarks** area.

## Suppl. Backwash

Using the drop-down list, select the type of supplemental backwash system used in the filter. Table 5.4 contains a general description of the items in the list.

**Table 5.4. Supplemental Backwash drop-down list.**

| Item | Description |
|---|---|
| **None** | If the filter contains no supplemental backwash equipment, select “None” from the list. Select “None” only if the filter does not contain any supplemental backwash facilities. Make other selections if the filter contains supplemental backwash equipment that is not used or if the equipment is broken. |
| **Surface Wash** | The filter has a supplemental backwash system with fixed or rotating arms that are designed to wash the surface of the media at the beginning of the filter backwash cycle. |
| **Subsurface Wash** | The filter has a fixed or rotating arm system that is designed to operate beneath the surface of the media when the bed has been expanded during the backwash cycle. |
| **Air Scour** | The filter was equipped with an integral air-scour backwash system during its initial construction or a major renovation. Usually, this choice applies whenever the air-scour system is incorporated into the design of the underdrain. |
| **Air Scour (retrofit)** | Select this choice if an air scour system has been installed in a filter after construction. Usually, these air scour systems are not an integral part of the underdrain design and utilize a network of laterals that are installed on top of the support gravel layers. |
| **Other** | If you are sure that you have a supplemental backwash system but do not know what kind it is, select “Other” and then describe the system in the Additional Remarks area or on a separate page. |

## Filter-to-Waste

Using the drop-down list, record whether the filter has the ability to filter to waste.

## Flow and Loading Rates

### Filter Flow Rate (gpm)

#### Regulatory Std *CALC*

The spreadsheet will automatically record the filter flow rate allowed by the TCEQ rules based on the surface area of the filter bed, the data you have entered in the **Filter Type** and **Operating Mode** boxes, and the maximum allowable filter loading rate.

#### Design

Enter the flow rate at which the filter is designed to operate.

#### Typical

Enter the typical flow rate through the filter when it is operating under normal conditions.

**During Backwash**
Enter the typical flow rate through the filter when one of the other filters is being backwashed.

**Maximum**
Enter the maximum flow rate that routinely occurs during a typical filter run.

**App'd Exception**
If your plant has received our written permission to operate a flow rate that is above the normal regulatory limit, enter the filtration rate that we have approved for the filter, and enter the date that we sent you the letter approving the higher flow rate in the **Additional Remarks** box. If you have not received written permission to operate at higher flow rates, leave this box empty.

### Loading Rate (gpm/ft$^2$)

**Regulatory Std** ***CALC***
The spreadsheet will automatically record the maximum filter loading rate allowed by our rules based on the data you have entered in the **Filter Type** and **Operating Mode** boxes.

**Design, Typical, During Backwash, and Maximum** ***CALC***
The spreadsheet will automatically calculate the filter loading rate for each of the operating conditions based on the size of the filter bed and the flow rate information you provided.

**App'd Exception**
If your plant has received our written permission to operate at a filter-loading rate that is above the normal regulatory limit, enter the rate we have approved for the filter, and enter the date that we sent you the letter approving the higher flow rate in the **Additional Remarks** box. If you have not received written permission to operate at higher flow rates, leave this box empty.

### BW Flow Rate (gpm)

**Regulatory Std** ***CALC***
The spreadsheet will automatically record the minimum backwash-water flow rate allowed by our rules and the maximum backwash water flow rate that we typically recommend. Both of these values are based on the reported surface area of the filter bed.

**Design**
Enter the maximum backwash-water flow rate that can be achieved during a backwash cycle. The "design" backwash rate can be limited by factors such as:

- the design capacity of the backwash pump
- the maximum flow rate that can be achieved through the remaining filters
- the hydraulic capacity of the backwash supply header

In some cases, it may not be possible to determine a "design" capacity of the backwash system. If you cannot determine the designed backwash water flow rate, enter <Unknown> in this cell.

#### Typical

Enter the typical backwash-water flow rate that occurs during a backwash cycle. If the backwash rate changes during a routine cycle, enter the rate that is maintained during the main part of the cycle. Do not enter the backwash rate during the surface wash or air-scour cycle unless that rate is maintained throughout the entire backwash cycle. If the backwash cycle includes “ramp up” and “ramp down” periods, do not record those values.

#### Maximum

Enter the maximum backwash water flow rate that routinely occurs during a typical filter backwash cycle.

### BW Loading Rate (gpm/ft$^2$)

#### Regulatory Std ***CALC***

The spreadsheet will automatically record the minimum backwash-water loading rate allowed by our rules and the maximum rate we typically recommend.

#### Design, Typical, and Maximum ***CALC***

The spreadsheet will automatically calculate the filter-loading rate for each of the operating conditions based on the size of the filter bed and the flow rate you provided.

## Filter Control and Monitoring Equipment

### Filter Influent

#### Controller

Select the type of flow rate controller used to control the rate of flow *into* the filter from the options shown in the drop-down list. When you answer this question, only consider those devices that are used to proportion or otherwise regulate the flow rate into the filter. Do not include the valves if they are only used to isolate the filter (that is, stop the settled water flowing into the filter) during a backwash cycle. Table 5.5 contains a general description of the items in the drop-down list.

#### Meter

Using the drop-down list, select the type of meter that is used to monitor the flow rate *into* the filter. Table 5.6 contains a general description of each meter contained in the drop-down list.

**Table 5.5. Rate-of-Flow Controller drop-down list.**

| Item | Description |
|---|---|
| **None** | Select this option if the inlet piping of the filter does not have a rate-of-flow control device. Also select this option if the filter inlet has a flow control valve that is only used to isolate the filter during backwash or one that is only used in the fully open or fully closed positions. |
| **Fix. Weir Splitter** | The flow rate into the filter inlet is controlled by a splitter box with a fixed weir or gate that was not designed to be raised or lowered. You should also select this option if the splitter box has drop pipes that control the distribution of water to the filters. |
| **Var. Weir Splitter** | This option applies if the flow rate to the filter inlet is controlled by a splitter box with a weir or gate that was designed to be raised or lowered. |
| **Man. Telescoping** | Select the manual telescoping valve option if the filter is supplied by a trough containing an adjustable telescoping valve. |
| **Man. Butterfly** | Choose this only if a manual butterfly valve is used to regulate the flow rate into the filter. Choose "None" if the valve is only used in the fully open or fully closed position. |
| **Mechanical ROFC** | This option applies if there is a mechanical rate-of-flow controller on the inlet piping to the filter. |
| **Mot. Valve (Auto.)** | Select this option if the filter has a motorized valve on its inlet pipe that automatically maintains the desired flow rate. |
| **Siphon Pipe** | Select this option if the feed rate into the filter is controlled by the size of a siphon pipe. This control mechanism is used in a proprietary design in the Greenleaf filter. |
| **Orifice Plate** | This option applies if the flow rate into the filter is limited by an orifice plate. |
| **Other** | If you are sure that you have a flow control valve on the inlet piping to the filter but you do not know what kind it is, select "Other" and then describe the device in the "Additional Remarks" area or on a separate page. |

### Turbidimeter

If the inlet of the filter is equipped with an online turbidimeter, enter its make and model number. If there is no online turbidimeter at the filter inlet, enter <None> in this box.

## Filter Effluent

### Controller

Select the type of flow-rate controller used to control the rate of flow *at the outlet* of the filter from the options shown in the drop-down list. When you answer this question, only consider those devices that are used to proportion or otherwise regulate the flow rate as it leaves the filter. Do not include the valves if they are only used to isolate the filter (that is, stop the flow of filtered water) during a backwash cycle. You can use Table 5.5 for a general description of the items in the drop-down list, but remember that this box applies to the flow-control devices at the outlet of the filter, rather than the one at its inlet.

**Table 5.6. Meter drop-down list.**

| Item | Description |
|---|---|
| **None** | This selection applies only if you have no way to determine the flow rate into the filter. |
| **Proportional** | Select this option only if both of these conditions apply:<br>The filter is equipped with a non-adjustable rate-of-flow controller such as a fixed weir, siphon tube, or orifice plate<br>The overall flow rate to the filter battery is metered at some point upstream of the filters |
| **Venturi**<br>**Orifice**<br>**Propeller**<br>**Nunating Disk**<br>**Paddle**<br>**V-notch Weir**<br>**Flat Weir**<br>**Parshall Flume** | If the inlet of the filter is equipped with a rate-of-flow indicator, select the appropriate type of device. |
| **Other** | If you are sure that you have a way of determining the flow rate into the filter but none of the other options adequately describe the method, select <Other> and then describe the method in the **Additional Remarks** area or on a separate page. |

### Meter

Using the drop-down list, select the type of meter that is used to monitor the flow rate *at the outlet* of the filter. You can use Table 5.6 for a general description of the items in the drop-down list; just remember that this box applies to the metering device located at the outlet of the filter rather than the one located at its inlet.

### Turbidimeter

If the outlet of the filter is equipped with an online turbidimeter, enter the make and model number of the unit. If there is no online turbidimeter at the filter outlet, enter <None> in this box.

### LOHG

Select the type of loss-of-head gauge used in the filter that you are evaluating from the drop-down list. Table 5.7 contains a general description of each item contained in the drop-down list.

### Turbidimeter

If the inlet of the filter is equipped with an online turbidimeter, enter its make and model number. If there is no online turbidimeter at the filter inlet, enter <None> in this box.

## Filter Effluent

### Controller

Select the type of flow-rate controller used to control the rate of flow *at the outlet* of the filter from the options shown in the drop-down list. When you answer this question, only consider those devices that are used to proportion or otherwise regulate the flow rate as it leaves the filter. Do not include the valves if they are only used to isolate the filter (that is, stop the flow of filtered water) during a backwash cycle. You can use Table 5.5 for a general description of the items in the drop-down list, but remember that this box applies to the flow-control devices at the outlet of the filter, rather than the one at its inlet.

**Table 5.7. Loss-of-Head Gauge (LOHG) drop-down list.**

| Item | Description |
|---|---|
| **None** | Select this option if you do not have any way to determine the head loss in the filter. |
| **Differential Gauge** | Your filter has a single gauge or indicator that gives a direct loss-of-head reading. This type of device is commonly incorporated into SCADA systems. |
| **Two Gauges** | Choose this option if you determine the head loss within your filter by manually subtracting the readings from two separate gauges. |
| **Water Lvl Indicator** | This option applies if filter head loss is determined using a ruled water level indicator. This type of device is commonly used on constant-rate, variable-level filters. |
| **Other** | If you are sure that you have a way of determining the head loss but none of the other options adequately describe the method, select <Other> and then describe the method in **Additional Remarks** or on a separate page. |

## Backwash Water

### Source

Using the drop-down list, describe the method used to deliver backwash water to the filter. Table 5.8 contains a general description of each item.

**Table 5.8. Backwash Water Source drop-down list.**

| Item | Description |
|---|---|
| **Filter Effluent** | Select this option if the only source of backwash water is the output of the other filters. This means that a filter cannot be backwashed unless the other filters are in operation. In some designs, the backwash water is supplied directly by the other filters. In other designs, the water enters a head control box, which then supplies the backwash water. |
| **Filters & Pump** | Select this option only if both of these conditions apply:<br>• The principal source of backwash water is the other filters<br>• The plant can augment the filter output with additional water from the clearwell or distribution system<br>Again, the filter cannot be backwashed unless the other filters are in operation. The clearwell/distribution system is only used to ensure an adequate backwash rate when the other filters are not producing enough water. |
| **Dedicated BW Pump** | The filter is backwashed using a dedicated backwash pump that draws water from a clearwell or filtered water sump. In this design, the other filters do not have to be in operation during a backwash cycle. The backwash pump has enough capacity to adequately backwash the filters whether or not the plant is treating water. |
| **Elevated BW Tank** | The plant has an elevated storage tank that it uses to supply backwash water for the filters. In this design, the elevated tank serves no other purpose than to backwash the filters; it is not connected to the distribution system. |
| **Service Pump** | This option applies if the backwash water is supplied by the same pumps that discharge to the distribution system. |
| **Distribution** | The plant uses the distribution system as the principal source of its backwash water. |
| **Other** | If none of the other options adequately describe the source of the backwash water, select <Other> and then describe the method in the **Additional Remarks** area or on a separate page. |

#### Controller

Select the type of rate-of-flow controller used to regulate the backwash water flow rate from the choices shown in the drop-down list. When you answer this question, only consider those devices that are used to regulate the flow rate of the backwash water. Do not include the valves if they are only used to isolate the filter—that is, to start and stop the flow of backwash water. You can use Table 5.5 for a general description of the items in the drop-down list, but you have to remember that this box applies to the flow-control devices on the backwash-water supply line rather than the one at the filter inlet.

#### Meter

Using the drop-down list, select the type of meter that is used to monitor the backwash water flow rate. Use Table 5.6 for a general description of the items in the drop-down list; just remember that this box applies to the metering device located on the backwash water supply line rather than the one located at the filter inlet.

#### Turbidimeter

If the filter is equipped with an online turbidimeter to measure the turbidity of the spent (dirty) backwash water, enter the make and model number of the unit. If the turbidity of the spent backwash water is not monitored using an online turbidimeter, enter <None> in this box.

### Additional Remarks

If you need to explain or clarify any of the information that you supplied in the **Filter Design** portion of the FAR, enter that information here. If you need more space, you can enter <See attached sheet.> in this box and include your remarks on a separate page.

## 5.3 OPERATING PROCEDURES

This portion of the FAR contains information about the way the filter is operated and maintained. Most of the information can be obtained from the plant's standard operating and maintenance procedures.

### Calibration

#### Method, Flowmeter
#### Method, Backwash Meter
#### Method, Mech. ROFC

Enter data in each of these boxes by selecting the appropriate item from the drop-down list. Table 5.9 contains a general description of the more common methods used to calibrate flowmeters and mechanical rate-of-flow controllers.

**Table 5.9. Flowmeter and Other Calibration Methods drop-down list.**

| Item | Description |
|---|---|
| **Unknown** | Select this option if you do not know what method was used to calibrate the flowmeters and rate-of-flow controllers the last time that they were calibrated. Only use this option when the calibration was checked or adjusted by a third-party contractor and you don't know what method was used. If you choose this option, enter the name of the company that performed the service in the **Additional Remarks** box. |
| **Weirs** | Select <Weirs> if you calibrated the device using a weir. |
| **Flume** | Select <Flume> if you calibrated the device using a flume. |
| **Ultrasonic** | This option applies if the device was calibrated using an ultrasonic meter. |
| **Time & Volume** | The flowmeter or ROFC was calibrated by measuring the volume of water that was discharged within a given period of time. |
| **Other** | If you or your third-party contractor used some other method to calibrate the flowmeter or rate-of-flow controller, select <Other> and then describe the method in the **Additional Remarks** area or on a separate page. |

### Method, NTU (primary)
### Method, NTU (secondary)

Use the drop-down list to select the type of primary and secondary standards used when calibrating the online turbidimeters. We are using the *primary standard* to mean the method used when conducting a full calibration of the turbidimeter, and s*econdary standard* to mean the method used when you are only checking the calibration of the online turbidimeter.

Table 5.10 contains a general description of the methods commonly used to calibrate online turbidimeters.

### Frequency (each device)

Record how often you calibrate each of the filter devices using the drop-down list.

### Date (each device)

Record the date that you calibrated each device the last time.

## Backwash

### Criteria

For each of the parameters listed in this area, enter the reading that would trigger a backwash cycle at your plant.

**Table 5.10. Turbidimeter Calibration Methods drop-down list.**

| Item | Description |
|---|---|
| **Formazin** | Select this option if you are preparing a calibration solution using a 4000 NTU formazin solution. This method requires you to make one or more dilute solutions, which are then used to calibrate the instrument. |
| **Stablized formazin** | You are using a prepared stabilized formazin product such as Hach's StablCal to calibrate the online turbidimeter. |
| **Polymer beads** | You use a polymer-bead product such as the AEPA's standard polystyrene to calibrate the turbidimeter. |
| **Gel** | You are using a prepared-gelatin standard such as Hach's Gelex to calibrate the turbidimeter. |
| **Comparison** | The online turbidimeter is calibrated based on the results from another turbidimeter. |
| **Proprietary device** | You are calibrating the online monitor with a manufacturer's proprietary device such as GLI's turbid glass calibration cube or Hach's ICE cube. |
| **Other** | If none of the typical methods describes the one that you are using to calibrate your online turbidimeter, select <Other> and then describe the method in the **Additional Remarks** area or on a separate page. |

### Monitoring Interval

Enter the frequency that you monitor each of the parameters. For example, if you monitor the turbidity every six minutes, enter <6 min.> in the **Turbidity (NTU)** space; and if you monitor the head loss once each 12-hour shift, enter <12 hrs> in the **LOH (ft)** space.

## Written Standard Operating Procedures (SOPs)

Select the item from the drop-down list that best describes the condition of each of the listed standard operating procedures. Table 5.11 contains a general description of each item contained in the drop-down list.

**Table 5.11. Drop-down list for the status of standard operating procedures.**

| Item | Description |
|---|---|
| **Complete** | This option applies only if the written SOP lists all of the steps and equipment needed to complete the specific task and is up-to-date. |
| **Partial** | The specific SOP is up to date but does not include all of the required steps or does not identify all of the equipment required to complete the listed task. |
| **Out-of-date** | The SOP is complete but does not accurately describe the procedures currently used by all of the operators. |
| **None** | Select this option only if the plant has no written procedures for completing the tasks or if none of the operators is following the SOP. |

## Additional Remarks

If you need to explain or clarify any of the information that you entered in the **Operating Procedures** portion of the FAR, enter that information here. If you need more space, you can enter <See attached sheet.> in this box and include your remarks on a separate page.

# 5.4 CURRENT CONDITIONS

In this portion of the FAR, you will describe the point in the filter run when you are conducting the filter assessment. You will also describe the condition of the filter and its appurtenances. In order to complete this portion of the report, you will need to physically inspect the filter and evaluate the performance of its monitoring and control devices.

## Operating Conditions

### **Date** and **Time**

Enter the date and time that you begin the filter assessment.

### Turbidity (NTU)

Enter the turbidity of the water leaving the filter at the beginning of the assessment.

### LOH (ft)

Record the head loss (loss of head, or LOH) immediately before taking the filter offline to begin the filter assessment.

### Flow Rate (gpm)

Record the flow rate through the filter immediately before beginning the assessment. If you cannot determine the flow rate through the individual filter, you should enter <Unknown> in this box.

### Run Time (hr)

If you monitor the length of time that the filter is in service between backwash cycles, record the number of hours that the filter has been in operation since the last backwash cycle. If you don't routinely keep track of this piece of information, just enter <Unknown> in the **RUN TIME (hr)** box.

### Run Volume (gal)

If you keep track of the amount of water produced during each filter run, record the volume of water that has been filtered since the last backwash cycle. If you don't routinely monitor this piece of information, just enter <Unknown> in the box.

## Physical Condition of Filter

### Walls and Troughs

Describe the physical condition of the filter walls and backwash troughs in the filters using the respective drop-down lists. Table 5.12 contains a general description of each item contained in the drop-down lists for the physical condition of the walls and troughs.

**Table 5.12. Drop-down list for Condition of Walls and Troughs.**

| Item | Description |
|---|---|
| **Excellent** | No rust or corrosion. Coating materials in "like new" condition. |
| **Good** | Slight corrosion or coating material damage that has no impact on filter performance or filter life. |
| **Minor Damage** | Minor corrosion or filter-wall damage that does not impair filter performance but requires repair during next scheduled filter renovation or repair. |
| **Moderate Damage** | Small leaks or other damage in troughs, walls, or other internal structural components that require immediate repair in order to ensure proper filter performance and avoid catastrophic filter failure. Describe the nature of this damage in the **Additional Remarks** area or on a separate page. |
| **Severe Damage** | Severe leaks. The filter is at or near the point of catastrophic failure and needs major renovation or replacement. Describe the nature of this damage in the **Additional Remarks** area or on a separate page. |
| **Other** | We have no idea why one of the previous options would not adequately describe the condition of the filter. However, you may select <Other> and then describe the situation in the **Additional Remarks** area or on a separate page. |

### Suppl. Backwash, Flowmeter, ROFC, etc.

Describe the operational condition of the filter appurtenances (equipment and attached devices) using the respective drop-down lists. Table 5.13 contains a general description of each item contained in the drop-down lists for the mechanical condition of the filter appurtenances.

## Additional Remarks

If you need to explain or clarify any of the information that you provided in the **CURRENT CONDITIONS** portion of the FAR, enter that information here. If you need more space, you can enter <See attached sheet.> in this box and include your remarks on a separate page.

**Table 5.13. Drop-down list for Condition of Filter Appurtenances.**

| Item | Description |
|---|---|
| **Fully Operational** | No apparent or detectable malfunction of any sort. |
| **Slight Malfunction** | The device has a slight malfunction that does not affect your ability to control or monitor filter performance. That is, the problem is detectable but does not apparently impair filter performance. Examples of slight malfunctions include:<br>• A surface wash arm that has one or two damaged or missing nozzles.<br>• A rate-of-flow contoller (ROFC) or flow control valve that butterflies slightly. That is, the device does not hold the desired setting for at least 10 minutes but only slight flow rate changes are produced and no apparent changes in the turbidity level result.<br>• A turbidimeter body contains a little sediment or precipitate. |
| **Moderate Malfunction** | The device is malfunctioning to the point that your ability to monitor or control the filter is impaired. Moderate malfunctions include:<br>• A rotating surface wash arm that has several damaged or missing nozzles but that will still rotate.<br>• An ROFC or flow control valve that butterflies consistently. That is, the device will not hold the desired setting for at least five minutes, and the resulting flow rate changes are severe enough to cause frequent fluctuations in turbidity levels.<br>• The turbidimeter is subject to intermittent air bubbles that compromise your confidence in the accuracy of the turbidity readings.<br>Describe the nature of this damage in the **Additional Remarks** area or on a separate page. |
| **Severe Malfunction** | The device is malfunctioning to the point that you are almost completely unable to monitor or control the filter. Severe malfunctions include:<br>• A rotating surface wash arm that will not rotate no matter whether there are any damaged or missing nozzles.<br>• An ROFC or flow control valve that butterflies continuously. That is, the device will not hold the desired setting for at least two minutes, and the flow changes are severe enough to produce continuous changes in the filtered water turbidity levels.<br>• The turbidimeter light bulb is burned out or the sampling line has stopped flowing,<br>Describe the nature of this damage in the **Additional Remarks** area or on a separate page. |
| **Other** | If the previous options would not adequately describe the condition of the appurtenances, you may select <Other> and then describe the situation in the **Additional Remarks** area or on a separate page. |

## 5.5 MEDIA SURFACE CONDITIONS

In this portion of the FAR, you will describe the appearance and condition of the media surface when you begin the assessment and after you backwash the filter. To complete this portion, you will need to get down into the filter and inspect the surface of the media. You must complete this portion of the filter assessment before you probe or excavate the filter.

**IMPORTANT**
When you get down into the filter to collect the data required by this section, you need to be very careful to avoid injuring yourself or damaging the filter. Therefore, you need to develop and document the procedures you will use before you actually begin the filter assessment. Appendix H contains an example of a standard operating procedure that was developed by plant operators during one of our technical assistance pilot projects. Although your procedures may be significantly different from those developed for that plant, step-by-step procedures for conducting a filter assessment are essential.

You will need to collect the **Before BW** data before you backwash the filters or conduct any other media measurements. The **After BW** information needs to be collected after you backwash the filter but before you begin probing or excavating the filter media. Consequently, the **Before BW** spaces will be completed before you complete the **BACKWASH CONDITIONS** portion of the FAR, while the **After BW** spaces will be completed after you collect the **BACKWASH CONDITIONS** data.

### Mounds

#### Number

Enter the number of mounds that you observe before and after backwashing the filter. Do not include mounds that rise less than one inch above the height of the surrounding media. If there are no mounds in the filter, you can enter <0> or <None> in the appropriate spot.

#### Length (inches)
#### Width (inches)
#### Height (inches)

Describe the size of the mounds. If none of the mounds were higher than 1 inch, you may either leave these spaces blank or enter <NA> in them.

**Example 5.1: Describing Mounds on the Filter Surface**
As you drain the filter, you identify seven mounds that are at least 1 inch higher than the other media in the filter. The largest mound is 36 inches long and 8 inches wide, and the smallest mound is 8 inches long and 8 inches wide. The mounds range in height from a minimum of 1.5 inches to a maximum of 3.5 inches.

As you prepare to excavate the filter (that is, after backwashing the filter and recording the information required in the **Backwash Conditions** portion of the FAR), you observe that only two mounds remain. Although both of the mounds are rather large (about 3.5 feet, or 42 inches, in diameter), neither is more than one inch high.

The report should look like this:

| | Before BW | After BW |
|---|---|---|
| **MOUNDS** | | |
| **Number** | 7 | 0 |
| **Length (inches)** | 8 - 36 | |
| **Width (inches)** | 8 - 8 | |
| **Height (inches)** | 1.5 - 3.5 | |

## Depressions

### Number

Enter the number of depressions that you observe before and after backwashing the filter. Do not include the depressions unless they extend more than one inch below the level of the surrounding media. If there are no depressions in the filter bed, enter <0> or <None> in the appropriate spot.

### Length (inches)
### Width (inches)
### Depth (inches)

Describe the size of the depressions. If none of the depressions were deeper than 1 inch, you may either leave these spaces blank or enter <NA> in them.

## Accumulated Floc

### Thickness

Enter the thickness of the floc mat before and after backwashing the filter. You may enter the information in either a decimal format or fraction. For example, if the floc mat is ⅜ inch thick, enter the value as either <0.375> or <3/8>. If the floc mat varies in thickness, enter the range of results. For example, if the floc mat ranges in depth from 0 inches to ¼ inch, enter <0–1/4> or <0–0.25>.

### Distribution

Select the item in the drop-down list that best describes how extensively the floc mat covers the surface of the filter media. Table 5.14 contains a general description of each item contained in the drop-down list. If there is no floc accumulation on the surface of the media, you may leave the space blank.

**Table 5.14. Floc Accumulation drop-down list.**

| Item | Description |
|---|---|
| **Uniform** | The floc mat seems to be evenly dispersed on the top of the filter (that is, it covers most of the media surface) and there is no area that seems unusually free of floc. |
| **Localized** | Most of the filter appears to have no accumulation of floc and whatever floc mat that is present seems to be isolated to a few areas within the filter. |
| **Other** | The floc mat seems to be relatively uniform but there are isolated, well-defined areas where there is an unusual absence of surface floc. Describe the condition in the **Additional Remarks** area or on a separate page. |

## Retraction

### Number

Enter the number of areas where the filter media has separated from the filter wall. Do not count the area unless the retraction is more than any of the following:

- 12 inches long
- ¼ inch wide
- ½ inch deep

If there are no areas where the filter media has retracted from the filter wall, enter <0> or <None> in the appropriate spot.

### Length (inches)
### Width (inches)
### Depth (inches)

Describe the size of the retractions. You may either leave these spaces blank or enter <NA> if none of the areas are more than any of the following:

- 12 inches long
- ¼ inch wide
- ½ inch deep

## Cracks

### Number

Enter the number of cracks in the filter media. Do not count the area unless the crack is more than any of the following:

- 12 inches long
- ¼ inch wide
- ½ inch deep

If there are no cracks in the media, enter <0> or <None> in the appropriate spot.

## Length (inches)

### Width (inches)

### Depth (inches)

Describe the size of the cracks. You may either leave these spaces blank or enter <NA> if none of the areas are more than any of the following:

- 12 inches long
- ¼ inch wide
- ½ inch deep

## Mudballs

### No. per $ft^2$

Enter the number of mudballs that are present on each square foot of media surface.

- If there are no mudballs on the surface of the media bed, enter <0> or <None> in the appropriate spot.
- If there are too many mudballs to count in one or more areas of the filter, enter <TNTC> which stands for “Too Numerous To Count.”
- If the distribution of mudballs is not uniform across the media bed, enter the minimum and maximum number that you observe. For example, <0–4>, <2–15>, and so forth.

### Size (inches)

Describe the size of the surface mudballs as follows:

- If there are no mudballs on the surface of the media bed, you may either leave the spaces blank or enter <NA> in each one
- If the mudballs are all less than ½ inch in diameter, you can enter < <½ >, which stands for “less than ½ inch,” in the appropriate space
- If the size of the mudballs exceeds 6 inches in diameter, you may enter < 6+ > or < >6 > in the appropriate space
- If the size of the mudballs varies, enter the maximum and minimum sizes. For example, < 0.25–1.5 >, or < <¼–6+ >, < 0.5–9.0 >, and so forth

### Distribution

Select the item in the drop-down list that best describes how the mudballs are spread across the surface of the filter media. Use the general descriptions contained in Table 5.14 to decide which item in the drop-down list best describes the mudball distribution in the filter.

## Additional Remarks

If you need to explain or clarify any of the information that you provided in the **MEDIA SURFACE CONDITIONS** portion of the FAR, enter that information here. If you need more space, enter <See attached sheet.> in this box and include your remarks on a separate page.

# 5.6 BACKWASH CONDITIONS

This portion of the FAR contains information about the backwash process used at the plant. Most of the information you need to complete this portion of the report will be based on observations that you make during the backwash process. Consequently, you *must not* begin collecting this data until you have collected the **Before BW** data needed to complete the **Media Surface Conditions** section of the FAR.

> **IMPORTANT**
> If you need to enter the filter to collect the required data, you must be very careful to avoid injuring yourself or damaging the filter media. Therefore, you need to develop and document the procedures you will use before you actually begin the filter assessment. Appendix H contains an example of a standard operating procedure that was developed by plant operators during one of our technical-assistance pilot projects. Although your procedures may differ significantly from those developed for that plant, step-by-step procedures for conducting a filter assessment are essential.

## Rate and Duration

### BW Flow Rate (gpm)

Enter the backwash-water flow rate that was maintained during the main part of this backwash cycle. Do not enter the initial backwash rate, the final backwash rate, or the flow rate that was maintained during a simultaneous air-water backwash cycle unless this was also the flow rate used during the main part of the water-only backwash cycle.

### Rise Rate (inches/minute) *CALC*

The spreadsheet will automatically calculate the rise rate that was achieved during **this** backwash cycle. This calculation will be based on the surface area of the filter and the backwash water flow rate you entered above.

### Loading Rate (gpm/ft$^2$) *CALC*

The spreadsheet will also automatically calculate the backwash loading rate. This calculation will be based on the backwash water flow rate you entered above and the surface area of the filter bed.

### Duration (minutes)

Record the length of time that you backwashed the filter **at the flow rate you entered in the BW FLOW RATE (gpm) space above**.

### Total Volume (gallons)

Record the total volume of backwash water used during the backwash cycle. When entering this number, include water used during any “ramp up” and “ramp down” periods and any water used by supplemental backwash facilities.

# Troughs

## Levelness

Select the item in the drop-down list that best describes how level the filter troughs are. Table 5.15 contains a description of each item.

**Table 5.15. Drop-down list for Trough Levelness.**

| Item | Description |
|---|---|
| **Level** | The backwash water comes over the top of all the weirs at about the same time. |
| **Slightly Unlevel** | The backwash water comes over the top of one weir or over one end of the weirs before it comes over the rest of the weirs. However, the water ultimately comes over the entire top of all of the weirs before the maximum backwash water flow rate is achieved. |
| **Moderately Unlevel** | The backwash water comes over one weir or the ends of the weirs and the problem persists until the maximum backwash-water flow rate is achieved. |
| **Severely Unlevel** | Even at the maximum backwash-water flow rate, water is not flowing over the entire length of all of the weirs. For example, water doesn’t flow over both sides of one or more weirs, or water doesn’t flow over one end of one or more weirs. |

## Flooding

Select the item in the drop-down list that best describes any flooding that occurs during the backwash cycle. Table 5.16 contains a general description of each item.

**Table 5.16. Drop-down list for Trough Flooding.**

| Item | Description |
|---|---|
| **None** | There is no flooding in any of the weirs. |
| **Slight** | There is some flooding on one end of weirs but the weirs are not completely flooded, and the flow of spent backwash water does not appear to be obstructed. |
| **Moderate** | There is significant flooding on one or more weirs, and the flow of spent backwash water appears to be affected. However, no part of any weir is completely submerged, and the velocity and direction of the floc particles in the area of the flooding appear to be unaffected. |
| **Severe** | One or more weirs are almost completely submerged. The flow of spent backwash water is clearly obstructed. Floc particles in the area of the flooding are not moving at the same velocity and in the same direction as the floc particles throughout the filter. |
| **Complete** | All of the weirs are completely submerged. The backwash water flow rate is restricted and floc particles are not being effectively removed from the filter. |

# Suppl. Backwash

### Duration (minutes)

Record how long the supplemental backwash facilities were operated during the backwash cycle.

### Effectiveness

Select the item in the drop-down list that best describes how effective you think the supplemental backwash facilities are. Table 5.17 contains a general description of each item contained in the drop-down list.

**Table 5.17. Supplemental Backwash Effectiveness drop-down list.**

| Item | Description |
|---|---|
| **Excellent** | The supplemental backwash facilities are completely effective in breaking up the floc throughout the entire filter bed. |
| **Adequate** | The supplemental backwash facilities are very effective but do not affect all of the filter bed. Most of the large floc particles are broken into smaller ones that can be removed during the main part of the backwash cycle. However, the supplemental facilities appear to be less effective in the corners of the filter or on one side of the filter. |
| **Poor** | The supplemental backwash facilities are only somewhat effective. Large floc particles remain in the filter even after the completion of the supplemental backwash cycle. Even in the area where the supplemental backwash facilities appear to be fully operational, large floc is not broken into smaller particles that can be efficiently removed during the main backwash cycle. |
| **Ineffective** | The supplemental backwash process seems to have minimal effect on the size of the floc particles. It just seems a waste of time and effort. |

# Jetting

### No. of Sites

Enter the number of areas where significant jets are noted during the main part of the backwash cycle. During the initial phases of the cycle, some jetting may occur as the filter bed is expanded. Do not count these sites *unless* they continue to be noticeable during the main part of the backwash cycle *or* appear in the same spot each time that a backwash cycle is initiated.

### Severity

Select the item in the drop-down list that best describes how severe you think that the jetting problem is. Table 5.18 contains a general description of each item contained in the drop-down list.

**Table 5.18. Drop-down list for Backwash Jetting.**

| Item | Description |
|---|---|
| **Slight** | You can see jets in the media during the backwash cycle, but they are small and do not seem to be affecting the overall effectiveness of the backwash cycle. |
| **Moderate** | The jets are rather large and you can see the media in the jetting area rising above the media in the adjacent areas. However, the media in the other areas of the filter is being effectively aggitated, the filter grains are still moving well in all areas of the filter, and the floc particles are being effectively removed from all areas of the filter. |
| **Severe** | The jets are large, and the filter media in the jet is clearly rising above the rest of the media surface. The jet appears to be causing lower media layers to reach the surface of the expanded bed, or the jetting has reached a point where the media in other areas of the filter is not being agitated sufficiently, and the floc particles in the other areas of the filter are not being removed effectively. |

## BW Water Distribution

Select the item in the drop-down list that best describes how effective you think the supplemental backwash facilities are. Table 5.19 contains a general description of each item contained in the drop-down list.

**Table 5.19. Drop-down list for Backwash Water Distribution.**

| Item | Description |
|---|---|
| **Uniform/Even** | The backwash water appears to be evenly distributed throughout the filter. The turbulence in the expanded filter bed appears to be relatively uniform everywhere in the filter. |
| **Uneven** | Some areas of the expanded filter bed appear significantly more turbulent than others. Still, there is some media motion in all areas of the filter and floc is rising in all areas. |
| **Inadequate** | Some areas of the filter bed appear to have adequate turbulence while other areas have no motion at all. The floc in some areas of the filter is being effectively removed while the floc in other areas remains virtually motionless. |
| **Other** | Describe the condition in the Additional Remarks area or on a separate page. |

## Spent BWW Turbidity

Collect a water sample from above the filter media after you finish the backwash cycle. Measure the turbidity level of this spent backwash water sample, and record the result (in NTU) in the **SPENT BWW TURBIDITY** space.

## Expansion and Yield

### Expansion (inches)

You must make two measurements to determine the inches of expansion that was obtained during the backwash cycle. The first number is the distance from a fixed reference point (such as the top of the filter wall) to the top of the expanded filter bed. This first measurement must be made when backwashing at the maximum backwash water flow rate. The second measurement is made after the backwash cycle is over and is the distance from that same reference point to the top of the unexpanded (settled media) filter bed. The expansion is then calculated by subtracting the first reading from the second, that is:

$$\text{expansion (inches)} = \text{distance to unexpanded bed (inches)} - \text{distance to expanded bed (inches)}$$

### Expansion (percent) CALC

The spreadsheet will automatically calculate the percentage of bed expansion based on the inches of expansion that you achieved during the backwash cycle and the average media depth that you measured as you probed the backwashed filter.

### Yield (percent) CALC

The spreadsheet will automatically calculate the percentage of filtered water that was sent to the distribution system during this filter run. This value is calculated based on the volume of filtered water you produced during the filter run (**RUN VOLUME**) and the total amount of water that you used to backwash the filter (**TOTAL VOLUME**).

## Additional Remarks

If you need to explain or clarify any of the information that you provided in the **BACKWASH CONDITIONS** portion of the FAR, enter that information here. If you need more space, enter <See attached sheet>in this box and include your remarks on a separate page.

# 5.7 FILTER PROBE

This portion of the FAR contains information that you will obtain as you probe the filter to measure the thickness of the media layer and the levelness of the media support system. Before conducting this portion of the filter assessment, you must have already collected the data required to complete the **Media Surface Conditions** and the **Backwash Conditions** sections of the FAR.

**IMPORTANT**
When you conduct a filter assessment, you will need to actually get down into the filter and make some physical measurements. Any time that you do these kinds of studies, you need to be very careful to avoid injuring yourself or damaging the filter media. Therefore, you need to develop and document the procedures you will use before you actually begin the filter assessment. Appendix H contains an example of a standard operating procedure that was developed by plant operators during one of our technical assistance projects. Although your procedures may significantly differ from those developed for that plant, step-by-step procedures for conducting a filter assessment are essential.

## Number of Sites

Enter the number of sites where you probed the filter to measure the thickness of the filter bed and to assess the levelness of the support gravel or underdrain.

The space between the measurements may not exceed 2 feet, and you must reduce the spacing between measurements if significant differences are detected between adjacent measurements for either (1) the distance to the support gravel or (2) the media depth. If the distance or depth:

- Between adjacent measurements varies by more than 2 inches, make an additional set of measurements at the midpoint between the points
- Continues to vary by more than two inches, continue to measure at midpoints until the distance between the measurements is only 3 inches

### Media
### Max. Thickness (inches)
### Min. Thickness (inches)

Enter the maximum and minimum readings that you got when probing the filter to determine the thickness of the filter media.

### Typ. Thickness (inches)

Enter the typical thickness of the media layer. You may determine this value by averaging the results of all of the thickness measurements. If most of the readings you got by probing the filter were the same, you can also use this value to avoid having to calculate the average thickness. For example, if you probed the filter at 60 sites and 46 of the readings were the same, and the other readings varied by as much as several inches, you may enter the value that you got 46 times without calculating the average thickness.

## Support Material

To determine the elevation of the support gravel (or underdrain), you must determine the distance from the top of the backwash troughs (or some other fixed reference point) to the top of the support gravel. You can determine this distance by either of the following two methods.

1. You can measure the distance (C) from the top of the backwash trough to the top of the support gravel directly. This method may require a probe that is at least 7 or 8 feet long.
2. You can measure from the top of the backwash trough to the surface of the media (A), measure the thickness of the media (B), then add the two readings to determine the total distance to the top of the support gravel.

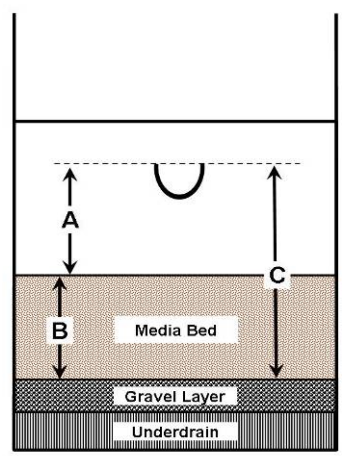



**Figure 5.2. Filter media cross-section.**

**Max. Elevation (inches)**
**Min. Elevation (inches)**
Enter the maximum and minimum readings that you got when probing the filter to determine the distance to the top of the support gravel.

**Typ. Elevation (inches)**
Enter the typical distance to the top of the support gravel. You may determine this value by averaging the results of all of the measurements. If most of the readings you got by probing the filter were the same, you may also use this value to avoid having to calculate the average thickness. For example, if you probed the filter at 60 sites and 46 of the readings were the same, you may enter the value that you got 46 times without calculating the "true" average distance—even if the other readings varied by as much as several inches.

### Additional Remarks
If you need to explain or clarify any of the information that you gave in the **FILTER PROBE** portion of the FAR, enter that information here. If you need more space, you can enter <See attached sheet.> in this box and include your remarks on a separate page.

## 5.8 FILTER EXCAVATION
This portion of the FAR is where you will summarize the results of filter excavations.

- **You must complete at least one excavation for each 100 square feet of filter surface**. For example, a filter bed that is 20 feet long and 30 feet wide has 600 square feet of surface area and you must excavate the media in at least six locations.
- **You must excavate the media at every site where you observe a significant filter problem**. Table 5-20 describes the criteria for determining whether a site should be excavated based on a filter problem.

The FAR spreadsheet provides space for you to enter data for up to 12 excavation sites. If you need to excavate fewer sites, you only have to enter data for sites you excavated. For example, if you excavate eight sites, you should leave the spaces for sites 9 though 12 empty. If you need to excavate more than 12 sites, include a comment in the **ADDITIONAL REMARKS** box and attach a separate page showing the additional data.

**Site Characteristics**
You must excavate the media in at least one site where no filter problems were observed. This first site is termed the **reference** site. The number and location of the remaining sites depends on the number, severity, and location of any filter or backwash problems that you identified during previous steps in the filter assessment.

For each excavation site, use the drop-down list to describe the reason that you chose the site. Table 5.20 contains a general description of each item contained in the drop-down list.

**Table 5.20. Drop-down list for Excavation Site Characteristics.**

| Item | Explanation<br>You MUST excavate . . . |
|---|---|
| **Normal** | No filter problems were observed at the excavation site.<br>Excavate *at least one site* where no filter problems were observed. If no such site exists, you must excavate a site where the filter media appears to be in the best possible condition. |
| **Media Mound** | A media mound was present on the surface of the filter *after* the backwash cycle.<br>Excavate *each site* where the mound is *at least 2 inches* above the surface of the rest of the filter. |
| **Media Depression** | A depression was present on the surface of the media *before or after* the backwash cycle.<br>Excavate *each site* where the depression is *at least 2 inches* below the surface of the rest of the filter. |
| **Crack** | A crack was observed in the surface of the filter *after* the backwash cycle.<br>Excavate *each site* where you observe a crack that is at least *12 inches long, at least ½ inch wide, or at least 1 inch deep*. |
| **Retraction** | The filter media retracted from the filter wall *after* the backwash cycle.<br>Excavate *each site* where the retraction is *at least 12 inches long, at least ½ inch wide, or at least 1 inch deep*. |
| **Floc. Accumul.** | There was an excessive floc accumulation on the surface of the media *before* the backwash cycle.<br>Excavate *the site* where you observed *the heaviest accumulation* of floc. |
| **Gravel Mound** | The filter probe indicated a possible gravel mound under the media.<br>Excavate *each site* where the mound rises *at least 2 inches above* the rest of the support gravel. |
| **Gravel Depression** | The filter probe indicated a possible depression in the gravel layer beneath the media.<br>Excavate *each site* where the gravel layer drops *at least 2 inches lower* than the rest of the support gravel. |
| **Poor Suppl. BW** | The supplemental backwash facilities seemed significantly less effective in the area of the excavation site.<br>*If you characterized the effectiveness of the supplemental backwash facilities as "poor" or "ineffective,"* you must excavate *at least one site* where the supplemental backwash system seemed particularly ineffective. |
| **Jetting** | A jet was observed during the backwash procedure.<br>Excavate *every site* where you identified *"severe" jetting* during the backwash cycle. If there were no severe jets identified, you must excavate *at least one site* where *"moderate" jetting* was observed. |

| | | |
|---|---|---|
| **Poor BW Distr.** | There was little if any media movement at the excavation site during the backwash cycle. |
| | If you characterized the backwash water distribution as “inadequate,” you must excavate the *each area* where there was *no media movement and the floc was not being removed* from the filter. |
| **Other** | None of the other items adequately describe the reason that you excavated the site. For example, you excavated the site because there was no floc accumulation at the site while the rest of the filter had a ⅜-inch accumulation. Whatever the “other” reason, describe the condition in the **Additional Remarks** area or on a separate page. |
| | Excavate *each site* where you think that some other observation suggests that a *severe filter problem* exists. |

## Media Layers and Interfaces

**Layer 1**
**Interface 1**
**Layer 2** and so on

Starting at the surface of the filter, enter the depth and material in each of the media layers you identify during the excavation. For example:

| | REFERENCE |
|---|---|
| CONDITION | **Normal** |
| **LAYER 1 (Top Layer)** | 18 in. anthracite |
| **INTERFACE 1** | 4 inches |
| **LAYER 2** | 10 in. sand |
| **INTERFACE 2** | 1 inch |
| **LAYER 3** | 3 in. garnet |
| **INTERFACE 3** | |
| **LAYER 4** | |

18 inches of anthracite
4 inches of mixed anthracite and sand
10 inches of sand
1 inch of sand-garnet mixture
3 inches of garnet
No fourth layer so no interface 3

## Mudballs

Using the drop-down list, select the item that most accurately describes how many mudballs you found when excavating the site.

**Max. Size (inches)**
**Min. Size (inches)**

Record the maximum and minimum sizes of any mudballs that you found during the filter excavation.

**Max. Depth (inches)**

Enter the maximum depth to which the mudballs have penetrated into the filter bed. Measure the distance from the surface of the media.

# Media Condition

## Sharpness

Using the drop-down list, select the item that best describes the sharpness of the filter grains. Table 5.21 contains a general description of each item in the list.

**Table 5.21. Media Sharpness drop-down list.**

| Item | Description |
|---|---|
| **Excellent** | The media in each of the layers is irregularly-shaped and has sharp edges. Its size, shape, and feel are very much like those of new media. |
| **Good** | The media grains in one or more layers have begun to lose their sharp edges but continue to have irregular shapes. The material is still about the same size and shape as new media but no longer looks and feels that way. |
| **Worn** | The media in one or more of the layers has worn to the point that it no longer has sharp edges. The grains have worn to the point where they have essentially the same shape. The grains no longer have the size and shape of new media. |
| **Other** | Different media materials frequently wear out at different rates. For example, one of the materials (for example, the anthracite) may be “Worn” while another material (for example, the sand) is still in “Good” shape. If you believe that a single media layer is contributing to poor filter performance, select the <Other> item and describe the condition of each media layer in the Additional **Remarks** area or on a separate page. |

## Encrustation

Select the item from the drop-down list that best describes the degree to which the filter grains are coated with precipitate. Table 5.22 contains a general description of each item contained in the drop-down list.

**Table 5.22. Media Encrustation drop-down list.**

| Item | Description |
|---|---|
| **None** | There is no apparent precipitate coating on the filter grains. The media looks and feels like new media. |
| **Slight** | There is visible coating on the filter grains in the upper layers of the filter. However, the shape of the media in the upper layers is not changed. There is little, if any, coating on the media in the lower levels. |
| **Moderate** | There is significant coating on the media throughout the filter. Some of the media has begun to be so encrusted that the filter grains are beginning to change shape due to the encrustation. However, most of the media is still in pretty good shape. |
| **Heavy** | The problem has become so severe that the different media materials have begun to have a common color and shape. |

### Uniformity

When evaluating the uniformity of the filter grains, you should compare the size of larger and smaller grains with the size of typical grains. However, you should not pick the absolutely largest and smallest grains to make this comparison.

Select the item from the drop-down list that best describes how uniform the size of the media grains is in each filter layer. Table 5.23 contains a general description of each item contained in the drop-down list.

**Table 5.23. Media Uniformity drop-down list.**

| Item | Description |
|---|---|
| **Good** | The media grains in each layer of the filter are almost the same size as each other. |
| **Marginal** | There is a significant range in the size of the media grains in one or more layers. The size of the larger (and smaller) grains is noticeably different from the size of the typical grain. However, there are few fine grains in the layer. |
| **Poor** | The sizes of the media grains in one or more layers vary so much that it is difficult to select a typical grain size for the layer. |
| **Other** | Different media materials frequently wear out at different rates. For example, harder materials (such as garnet) may have “Good” uniformity while softer materials (such as GAC) have “Poor” uniformity. If you believe that a single media layer is contributing to poor filter performance, you may select <Other> and describe the condition of each media layer in the **Additional Remarks** area or on a separate page. |

## Additional Remarks

If you need to clarify any of the information that you gave in the **FILTER EXCAVATION** portion of the FAR, enter that clarification here. If you need more space, enter <See attached sheet> in this box and include your remarks on a separate page.

# 5.9 ADDITIONAL STUDIES

## Filter Profile Attached?

Select <Yes> or <No> from the drop-down list. We have included this item on the FAR just to remind you you must include a filter profile when you submit this report.

## Percent Mudballs

You must determine and report the percentage of mudballs in the filter if one or more of the excavation sites contained “Several” or “Many” mudballs. If you only found a “Few” mudballs when excavating the media, the study is optional. If you found no mudballs at any of the excavation sites, the study is unnecessary.

If several of the excavation sites contained more than a few mudballs, you should mix the media from several of the sites before determining the mudball concentration in the composite sample. On the other hand, if the mudballs seem to be concentrated in one area of the filter, you may want to focus on that area of the filter when you prepare your composite sample.

If you are measuring the mudball concentration, you must separate the mudballs from the media. Then you must measure the volume of the mudballs and the volume of the (mudball-free) media.

#### Media Volume (ml)

Enter the volume of the mubdall-free media that you recovered from the excavation site (or sites) in this space.

#### Mudball Volume (ml)

Enter the volume of the mudballs that you recovered from the excavation site (or sites) in this space.

#### % Mudballs *CALC*

Once you have entered the **Mudball Volume** and the **Media Volume** in the appropriate spaces, the spreadsheet will automatically calculate the percentage of mudballs present in the sample.

### Additional Remarks

If you need to explain or clarify any of the information that you provided in the **ADDITIONAL STUDIES** portion of the FAR, enter that information here. If you need more space, you can enter <See attached sheet > in this box and include your remarks on a separate page.

Also, if you conduct any other special studies such as a media solubility test or a media sieve analysis, you can enter the results here. If you need more space, you can enter <See attached sheet> in this box and include your results on a separate page.

## 5.10 CONCLUSIONS

If you were able to determine what caused the filter performance problems in the past, you **must** explain your conclusions. If you have developed a plan to prevent the problems from occurring in the future, you *may* also give us that information although we do not require it. If you need more space, enter <See attached sheet> in this box and include your findings on a separate page.

### Corrective Action Plan Attached?

If you have developed a corrective-action plan that you would like to share with us, select <Yes> from the drop-down list and attach a copy of the plan to the report. You should select <No> from the drop-down list if either one of the following applies:

- you have not developed a plan
- you have developed a plan but would prefer to keep it confidential

If you have decided what corrective actions you are going to take and have developed a schedule for making the changes, we encourage you to give us the information. If we agree with your proposal, we will prepare a bilateral agreement. Once you and we both have signed the agreement, we will waive additional assessments on this filter for as long as you fulfill your part of the agreement.

### Would You Like Some Technical Assistance from the TCEQ?

If you have been unable to determine why the filter is malfunctioning and would like some technical assistance from the TCEQ, select <Yes> from the drop-down list. If you would prefer to deal with this performance problem using other technical resources, select <No>.

Please be aware that our availability to give technical assistance is very limited. Nevertheless, if you would like our help, please indicate so on the FAR. We will be happy to assist you if we are able.

## 5.11 Filter Schematic

You must include a simple filter schematic with your FAR. On the schematic, you must show the following information:

- the location of backwash troughs and supplemental backwash facilities
- the location of any filter-media anomalies such as mounds, depressions, cracks, retraction, excessive or unusually light floc accumulation, or large accumulations of surface mudballs
- the location of any significant backwash anomalies such as jetting or unusually low media movement
- the sites where you probed the filter and the measurements you collected at each site
- the sites where you excavated the filter

Page 4 of the FAR provides space for you to prepare the schematic. We realize that this is not much room to record all of the data we require if the filter is very large. If you need more room, you may prepare the filter schematic on another (larger) sheet of paper or you may make a copy of page 4, and put part of the information on each page. If you decide to use a separate piece of paper to draw the filter diagram, be sure to enter <See attached page> in the box on page 4.

## 5.12 Submitting the Report

The completed and signed FAR (including the annotated filter-profile graph) must be included when you mail your SWMOR to the TCEQ.

# 6. REQUESTING A CPE

**ATTENTION SWMOR2 USERS**
Since you are monitoring CFE turbidity levels instead of IFE turbidity levels, we require you to request a comprehensive performance evaluation based on your CFE readings instead of your IFE readings.

Because the monitoring location for your plant would be the principal difference between the two sets of instructions for SWMOR and SWMOR2 users, this chapter applies to all surface water treatment plants.

If your filters intermittently produce water with an extremely elevated turbidity level, you must participate in an intensive, thorough evaluation called the mandatory comprehensive performance evaluation, or mCPE. This mCPE must be conducted by a third party, that is, a team of individuals who are not employees of your water system. Usually, the mCPE will be conducted by our staff.

You only have to participate in the mCPE if *two consecutive* 15-minute IFE turbidity readings are above 2.0 NTU on two separate occasions during any two consecutive months. For example, you would have to participate in an mCPE if either of the following situations occurs:

1. The IFE turbidity level at the outlet of Filter No. 4 was above 1.0 NTU on August 3 and Sept. 20.
2. The IFE turbidity level at the outlet of Filter No. 1 was above 2.0 NTU on March 20, and the turbidity level at the outlet of Filter No. 8 was above 2.0 NTU on April 30.

As our examples above suggest, there are several different combinations of events that can trigger an mCPE. In order to help you comply with the rules, the SWMOR spreadsheet automatically determines if you need to undergo an mCPE. To initiate the process of getting an mCPE, you must prepare and submit a CPE-request form. An example of a completed CPE-request form is shown in Appendix I.

If your water system serves 10,000 people or more, the mCPE must be conducted within 90 days of the second reading above 2.0 NTU. If your system serves fewer than 10,000 people, there is a 120-day deadline. In either case, you should fax us a copy of the request form as soon as you get the second reading. Once we receive your request, we will contact you to schedule the mCPE.

During the mCPE, a team of trained evaluators will review the design, operation, maintenance, and administration of your treatment plant. The purpose of the CPE is to identify factors that limit the ability of your facility to produce high-quality drinking water. Once the CPE team has completed the evaluation, they will prepare an mCPE Report. Copies of the report will be submitted to both you and us.

If we conduct the mCPE, we will prepare a corrective-action plan (CAP) that sets forth the improvements you must make and a compliance schedule for making them. Usually, you will have the opportunity to review and comment on a draft of the CAP before we issue it.

If a third-party contractor conducted the mCPE, we will notify you of the factors which you must address in a CAP after we review the mCPE Report. You must then prepare a CAP describing the improvements that you propose to make and providing the schedule for making them. You must then submit the CAP to us for review and approval.

**IMPORTANT**
If you fail to prepare an acceptable CAP following an mCPE, or if you fail to meet the approved improvement schedule it contains, we are required by federal regulations to initiate an enforcement action against your system. In this regard, the CAP that results from an mCPE differs from any corrective-action plan that you prepare after a filter assessment. The improvement plan prepared after a filter assessment is not required by state or federal regulations and, barring other regulatory violations, it is unlikely that an enforcement action will result from failing to prepare or implement such a plan.

## 6.1 Plant and Operator Information

### Public Water System Name
Enter the name of your public water system. The water system name shown on the SWMOR and the one you enter on the CPE-request form must be identical.

### PWS ID No.
Enter your water system's seven-digit PWS ID number.

### Plant Name or Number
If your water system has more than one treatment plant, enter the name of the treatment plant that collected the data contained in this specific report. You do not have to complete this blank if your water system has only one treatment plant. Again, to avoid confusion, please make sure that the plant name shown on the SWMOR matches the one you enter here.

### Signature
After the completed CPE-request form has been printed, a senior official of the water system must sign the bottom of the form. This individual may be:

- The operator who is in charge of the entire treatment plant. This operator may or may not be the same person who is responsible for the daily operation of the plant. Consequently, the individual who signs the CPE-request form may or may not be the same person who signs the SWMOR.
- The utilities director, general manager, or similar water-system official. Since the mCPE process will involve senior water-system officials, it may be useful to have the form signed by a water-system official rather than the operator who is in charge of the plant.

Do not forget that the signature must be handwritten in ink. Stamped signatures and typewritten names are not acceptable.

### Name (printed)

Type the name of the individual who is signing the CPE-request form.

### License No. and Class

If the person who is signing the form is a licensed water-works operator, enter the license number and the type of license held by that person. If the individual who signs the CPE-request form does not hold a license, you may leave the line blank or enter <NA>.

### Date

Enter the date the form was signed.

## 6.2 EVENTS THAT PROMPTED THE CPE REQUEST

This portion of the CPE-request form identifies the events that prompted you to request a CPE, and provides us with some background information on what steps you might have already taken in response to poor filter performance.

### Filter Number

Enter the number of the filter that produced two consecutive 15-minute turbidity readings above 2.0 NTU. You must enter the number of the filter as it appears on page 3 of the SWMOR—for example, Filter No. 6. We realize that this filter number may not correspond with the numbering system you use at your plant, so we have left enough space for you to add some information if necessary. For example, if Filter No. 6 corresponds to your Filter 3-West, the completed form might look like this:

| | |
|---|---|
| FILTER | |
| NUMBER: | **Filter No. 6 (our Filter No. 3-West)** |

### Date of Event

Enter the date when the event occurred.

### FAR Prepared?

Using the drop-down list, tell us whether you have completed a filter-assessment report for the filter.

### CAP Prepared?

Using the drop-down list, tell us whether you have an approved corrective-action plan for the filter.

## 6.3 PUBLIC WATER SYSTEM PREFERENCES

This portion of the CPE-request form provides us with some information to help us schedule the CPE at your plant.

### Preferred Dates for the CPE

Identify the weeks that would be most convenient for us to conduct the CPE. When you select the dates, be aware of the following requirements:

- If your plant serves 10,000 people or more, the CPE must be conducted within 90 days of the second event that prompted the request.
- If your plant serves fewer than 10,000 people, the CPE must be conducted within 120 days of the second event that prompted the request.
- Key plant personnel must be available during the CPE. These people include the plant superintendent, chief operator, each shift supervisor, and most of the operators.
- Key administrative personnel must be available during the CPE. These people may include the public works director, utilities director, mayor, district president, owner, and financial officer. Whatever their titles, the people with responsibility for high level planning and decision making must be available.
- If capital improvements are planned, the water system's engineer must be available during the CPE.

### Contact Information

You must supply us with some critical information about the individuals that you want us to contact when making arrangements for the CPE.

#### Administrative Contact

The administrative contact will usually be the mayor, chief administrator, utilities director or similar individual who can help us schedule administrative interviews and can make sure that all of the necessary financial and administrative information is compiled before our arrival. You can see who we have on file as the administrative contact on the Web, at Texas Drinking Water Watch:

dww.tceq.texas.gov/DWW/

You can update this and other information related to the points of contact for your system and plant by calling the Public Drinking Water Section at 512-239-4691 and asking for a member of the inventory group, or by e-mailing <PWSINVEN@tceq.texas.gov>.

#### Plant Contact

The plant contact will usually be the plant superintendent or similar individual who can make sure that the plant staff will be available for the CPE and compile the plant schematics, the engineering plan and specifications, and the operational and maintenance records that we will require during the CPE.

#### Name

Enter the full name of the administrative and plant contacts.

### Title

Enter the title of the position that the contact holds at the public water system. For example, the title could be the water and wastewater utilities director or surface water treatment plant manager.

### Phone
### Fax

Enter the telephone number and, if applicable, the fax number for each of the individuals.

### Address

Enter the mailing address for each of the individuals. If the mailing address for the administrative and plant contacts are identical, you may enter <Same> on the first line of the address for the plant.

## 6.4 Submitting the Request

The completed and signed CPE-request form must be included when you mail your SWMOR to the TCEQ. A copy should also be faxed to the Technical Review and Oversight Team as soon as possible to increase the time available to complete the CPE.

# 7. ANALYTICAL METHODS

### Introduction

To ensure that the water you produce is safe for drinking, your plant must be able to accurately measure several important performance parameters. The parameters include:

- the flow rate of the raw and treated water
- the turbidity level of the raw, settled, IFE, and CFE waters
- the total organic carbon level of the raw and CFE waters
- the temperature in each disinfection zone
- the pH in each disinfection zone
- the disinfectant residual at the end of each disinfection zone
- the disinfectant residual leaving the plant
- the disinfectant residual in the distribution system

If you are using innovative treatment like membranes or ultraviolet light disinfection, you may be required to analyze additional parameters.

Because performance monitoring is so important to public health protection, we require you to develop a monitoring plan for your plant and its distribution system. We also require that you submit a copy of this plan for our review and approval, and send us a copy of any revisions that you make to the plan. Since every public water system in Texas is required to develop this plan, we have published a separate guidance document entitled *How to Develop a Monitoring Plan for a Public Water System* (TCEQ publication RG-384). Please call 512-239-4691 or e-mail <PWSCHEM@tceq.gov> to obtain copies of this and other TCEQ publications.

All testing to meet our minimum monitoring and reporting requirements must be performed at a laboratory that we approve. In order to get your laboratory approved, you must use one of our approved methods to run each test, your equipment must be properly calibrated and maintained, and you must use proper laboratory techniques and maintain acceptable records.

## 7.1 ACCEPTABLE ANALYTICAL METHODS

In order to maintain consistency throughout the state, we are requiring that you use certain methods to conduct your turbidity, temperature, pH, and disinfectant residual tests. The approved methods are shown in Table 7.1 and 7.2.

Tables 7.1 and 7.2 also list examples of commercially available test kits or lab equipment. These lists are not all-inclusive. If you find that a commercial product we have listed here is no longer available, ask the manufacturer which products would offer the same sensitivity.

**Table 7.1. Acceptable laboratory methods for measuring turbidity, temperature, and pH.**

| Parameter | Minimum Accuracy[a] | Acceptable Methods[b] | Examples of Commercial Test Kits or Equipment[c] |
|---|---|---|---|
| **Turbidity** | ± 0.05 NTU | Nephelometric (SM 2130 B)<br>Nephelometric (EPA 180.1) | Hach 2100N and 2100AN<br>HF Scientific Micro 100 and Micro 1000<br>Hanna HI88703<br>Orion AQ4500<br>Hach 1720D or E (online monitors)<br>HF Scientific MicroTol (online monitor)<br>LaMotte 2020 ClearTrace (online monitor) |
| | | Great Lakes Instruments Method 2 | Great Lakes Accu4 (online monitor)<br>Orion AQ4500 |
| | | AMI Turbiwell | Swan AMI Turbiwell with LED (online monitor) |
| | | Mitchell M5331 | |
| | | Orion AQ4500 | Orion AQ4500 |
| | ± 50 mNTU | Hach FilterTrak Method 10133 | Hach FilterTrak 660 (online monitor) |
| | | Mitchell M5271 | (online monitor) |
| **Temperature** | ± 0.5°C | Thermometric (SM 2550) | Any good mercury-filled thermometer, but thermocouples are acceptable |
| **pH** | ± 0.01 pH unit | Electrometric (SM 4500-H+)<br>Electrometric (EPA 150.1&2) | Hach H series, HQ series, & sensION series<br>Orion A series, 300 series, & "Star" series<br>Hanna HI220, 2200, 3200, and 4200 series<br>LaMotte pHPlus<br>Oakton 310 series, 510 series, & 700 series |

[a] This value is the minimum accuracy needed to comply with TCEQ requirements. The value shown may differ from the value in the EPA's *Standard Methods* (see following note) or EPA procedures.

[b] SM—*Standard Methods*, 22nd Edition; EPA—EPA methods.

[c] This is neither a complete list of all commercially available test kits nor an endorsement of any specific product.

**Table 7.2. Acceptable laboratory methods for measuring residual disinfectant.**

| Parameter | Minimum Accuracy[a] | Acceptable Methods[b] | Examples of Commercial Test Kits or Equipment[c] |
|---|---|---|---|
| **Free chlorine ($Cl_2$)** | ± 0.1 mg/L | Amperometric titration[d] (SM 4500-Cl D) | Hach Amperometric Titrator and AutoCAT 9000<br>Fischer-Porter 17T200<br>Wallace and Tiernan Series A790 |
| | | DPD-ferrous titration (SM 4500-Cl F) | LaMotte 6806/DT<br>LaMotte 3176-01DT-DR |
| | | DPD, colorimetric[e] (SM 4500-Cl G) | Hach DR100, DR800, and DR/2000 series<br>Hach Pocket Colorimeter<br>LaMotte DC-1100CL<br>LaMotte SMART Colorimeter<br>Hach CL17 (online monitor) |
| | | Syringaldizine (FACTS) (SM 4500-Cl H) | |
| **Chloramine ($NH_2Cl$)** | ± 0.1 mg/L | Amperometric titration[d] (SM 4500-Cl D) | Hach Amperometric Titrator<br>Fischer-Porter 17T200<br>Wallace & Tiernan Series A790 |
| | | DPD-ferrous titration (SM 4500-Cl F) | LaMotte 6806/DT<br>LaMotte 3176-01DT-DR |
| | | DPD, colorimetric[e] (SM 4500-Cl G) | Hach DR100, DR700, and DR/2000<br>Hach Pocket Colorimeter<br>LaMotte DC-1100CL<br>LaMotte SMART Colorimeter<br>Hach CL17 (online monitor) |
| **Chlorine dioxide ($ClO_2$)** | ± 0.05 mg/L | Amperometric titration[f] (SM 4500-ClO2 C) | Hach Amperometric Titrator<br>Fischer-Porter 17T200<br>Wallace & Tiernan Series A790 |
| | | Amperometric titration[f] (SM 4500-ClO2 E) | |
| | | Colorimetric (EPA Method 327.0) | |
| **Ozone ($O_3$)** | ± 0.02 mg/L | Indigo method[g] (SM 4500-O3 B) | Hach DR/2000 and DR/4000 |
| **MIOX** | ± 0.1 mg/L | Absent EPA recommendations, any acceptable method for free chlorine | |

[a] This value is the minimum accuracy needed to comply with TCEQ requirements. The value shown may differ from the value in the EPA's *Standard Methods* or EPA procedures.
[b] SM—Standard Methods, 22nd Edition; EPA—EPA Methods.
[c] This is neither a complete list of all commercially available test kits nor an endorsement of any specific product.
[d] On the date of publication, there were no online instruments using the EPA-approved amperometric titration method. Although there are online amperometric instruments, all of them use proprietary direct amperometric measurement methods rather than the titrimetric method specified by the EPA. However, the EPA is working with instrument manufacturers to approve individual instruments case by case. Contact us for the latest information if you are interested in using one of the online amperometric monitors that are currently available.
[e] Color comparator test kits, such as Hach's color wheels and LaMotte's Octet comparator, are not acceptable for in-plant testing. These test kits may be used for distribution testing, although more sophisticated colorimetric meters are recommended.
[f] Platinum-platinum electrodes are required.
[g] A spectrophotometric procedure is required.

# 7.2 CALIBRATING INSTRUMENTS AND OTHER EQUIPMENT

Before you can effectively use your performance data, it must be accurate. One of the most important ways to ensure this accuracy is to keep your instruments and equipment properly calibrated and maintained. Consequently, we have established some minimum calibration requirements for lab equipment and flowmeters.

## Turbidity Meters

Once every three months, you must calibrate your turbidimeter in accordance with the manufacturer's directions. This quarterly calibration must be conducted using primary turbidity standards. If you are using a benchtop turbidimeter, you must restandardize your secondary standards each time that you calibrate the unit with primary standards.

If you are using a benchtop turbidimeter to collect data that you report to us, you must check its calibration with a primary or secondary standard each time that you run a series of samples. If the unit is not giving an accurate reading, you must recalibrate it with primary standards.

If you are using online turbidimeters to collect data that you report to us, you must also check the calibration of your turbidimeter once per week using a primary or a secondary standard, the manufacturer's proprietary calibration device, or by using the following procedure:

1. Check the calibration of the bench-scale turbidity meter with a primary or secondary standard.
2. Record the turbidity reading shown on the online monitor.
3. Collect a sample from the inlet or outlet of the online monitor.
4. Measure and record the turbidity of the sample from the online monitor.
5. Compare the turbidity readings from the two instruments.
    a. If the values differ by more than 0.10 NTU:*
        i. Follow the manufacturer's instructions and recalibrate both the online and bench turbidimeters using primary turbidity standards.
        ii. Repeat Steps 1–6. If the values still differ by more than 0.10 NTU,* contact the instrument's manufacturer for further instructions.
    b. If the values differ by no more than 0.10 NTU,* complete calibration of the units is not required.
6. If a continuous recorder is used, compare the value reported by the recorder with the value reported by the monitor.
    a. If the values differ by more than 0.05 NTU,* adjust the recorder.
    b. If the values differ by 0.05 NTU,* or less, no adjustment of the recorder is needed.

* If the comparison is conducted when turbidity levels are above 1.0 NTU, you may accept differences of up to 10% when comparing the results of two turbidimeters and of up to 5% when comparing the recorder results with that of the turbidimeter.

Regardless of which method you use to check the calibration of the online turbidimeter, you must recalibrate the unit using primary standards if the unit is not providing an accurate reading.

## Chlorine Residual Analyzers

If you are using a manual method to test your disinfectant residuals, you must check the accuracy of your instrument and method at least once every 30 days. This check must be conducted using a chlorine solution with a known concentration, a chlorine standard, or a similar method recommended by your instrument manufacturer. If the instrument and method are not providing an accurate reading, you must recalibrate the instrument (if possible) or take other corrective action to improve the accuracy of the results.

If you are using an online disinfectant analyzer to collect data that you report to us, you must calibrate the instrument at least once every 90 days using a chlorine solution with a known concentration or a similar method recommended by the instrument manufacturer in the instrument's owner's manual. You must also check the accuracy of your instrument and method at least once every 30 days using a chlorine solution with a known concentration or by using the following procedure:

1. Record the chlorine residual reading shown on the online monitor.
2. Collect a sample from the inlet of the online monitor.
3. Measure and record the chlorine residual of the sample collected from the online monitor using an EPA-approved manual method such as:
    a. titration (for example, DPD-ferrous)
    b. colorimetry (for example, Hach DR100)
    c. spectrophotometry (for example, Hach DR2000)
4. Compare the two chlorine residual readings.
    a. If the values differ by more than 10% or 0.10 mg/L, whichever is greater:
        i. Follow the manufacturer's instructions and recalibrate the online chlorine residual monitor.
        ii. Repeat Steps 1–3. If the values still differ by more than 10% or 0.10 mg/L, whichever is greater, contact the instrument's manufacturer for further instructions.
    b. If the values differ by no more than 10% or 0.10 mg/L, whichever is greater, a complete calibration of the online monitor is not required.
5. If a continuous recorder is used, compare the value reported by the recorder with the value reported by the monitor.
    a. If the values differ by more than 0.10 mg/L, adjust the recorder.
    b. If the values differ by 0.10 mg/L or less, no adjustment of the recorder is needed.

## pH Meters

If you are using a benchtop pH meter, you must calibrate the unit in accordance with the manufacturer's specifications at least once each day using at least two buffers. You must also check its calibration with at least one buffer each time you run a series of samples. If the pH meter is not accurately reading the buffer, you must recalibrate the unit.

If you have an online pH meter, you must calibrate the unit in accordance with the manufacturer's specifications at least once every 30 days. The calibration of online pH meters must also be checked at least once each week with a buffer solution or by comparing the results from the online unit with the results from a properly calibrated benchtop unit. If necessary, the online unit needs to be recalibrated with primary standards.

### Thermometers

We have not established any minimum calibration procedures for checking the calibration of your thermometer. However, we recommend that you check it about once each 90 to 180 days by stirring the thermometer in an ice bath; after two minutes or so in the ice bath, the thermometer should read 0ºC (32ºF).

### Flowmeters

You must check the calibration of your raw and treated water flowmeters at least once every 12 months. The flowmeters can be checked using a pitot tube, a calibrated ultrasonic flowmeter, or similar calibration device. The accuracy of the meters can also be checked by filling or draining a known volume with water into (or from) a basin. If the meter is not reading within the accuracy range specified by the manufacturer, you must repair, recalibrate, or replace the meter.

## 7.3 Laboratory Records

### Records Retention

Our record-keeping requirements vary depending on the type of data being collected. Although there are other records (such as your CT approval letter, your engineering drawings, and others) that you must maintain, the following are some of the important *laboratory* records you must keep.

- You must retain all your calibration records for at least three years.
- IFE turbidity readings must be maintained for at least three years.
- CFE turbidity readings must be kept for at least 10 years.
- Copies of the SWMOR must be kept for 10 years.
- A copy of the up-to-date laboratory-approval form must be maintained with your approved monitoring plan.

### Laboratory-Approval Form and Instructions

The current requirements for laboratory approval are contained in the TCEQ’s Regulatory Guidance 384: How to Develop a Monitoring Plan for a Public Water System. Please refer to that document for detailed instructions on completing the form.

A copy of the laboratory-approval form must be attached to the system’s monitoring plan. For information on monitoring plans and laboratory approval forms, contact the TCEQ’s Drinking Water Quality Team at 512-239-4691 or by e-mail at <PWSCHEM@tceq.texas.stateailt>. On the monitoring plan, the system must attach documentation showing that any outside labs it uses are approved or accredited, as appropriate.

If you send approved-lab analytes to a commercial lab, that system's lab must be approved by the TCEQ to conduct the appropriate analysis. You must attach a copy of that lab's Laboratory Approval Form to your monitoring plan.

## 7.4 ROUNDING NUMBERS ON YOUR SWMOR

Your plant can probably measure water quality data to a very high level of precision. However, we do not want the SWMOR or SWMOR2 to show so many decimal places that we cannot read the report. Still, you should probably record as many decimal places as possible on your daily log, and you may enter as many digits as you can when entering data in the two spreadsheets.

To ensure that we can read the form when you submit it, the SWMOR and SWMOR2 are both designed to automatically round any value you enter to the proper number of decimal places. Don't be surprised if your spreadsheet doesn't show or print all of the decimal places that you entered when you filled out the report. Table 7.3 shows how the two spreadsheets round the values that you enter.

The two spreadsheets also do some additional rounding when they perform some of their automatic determinations. For example, if you enter a reading for filtered-water turbidity of <0.346> NTU, your report will display and print a reading of 0.35 NTU, but it will not count the reading as being above 0.3 NTU, since the actual value that you entered was not higher than 0.35 NTU. Therefore, it is beneficial to enter actual results and let the spreadsheet program do all the rounding for you.

# Drinking Water Laboratory Approval Form

Public Water System Name: ____________ Plant Name or Number: ____________

PWS ID No.: ____________ Date: ____________

*I certify that I am familiar with the information contained in this report and that, to the best of my knowledge, this information is true, complete, and accurate.*

Operator's Signature:* ____________

Certificate No. and Grade:* ____________

* Or, for Labs, the Lab Analyst's signature, name, title, and phone number.

| Analyte | Method (& Analyzer Type) | Accuracy | | Calibration | |
|---|---|---|---|---|---|
| | | | | Frequency | Method |
| Turbidity | | ± | NTU | | |
| pH | | ± | pH unit | | |
| Temperature | | ± | C | | |
| TOC | | ± | mg/L | | |
| $UV_{254}$ | | ± | cm -1 | | |
| Alkalinity | | ± | mg/L | | |
| Disinfectant | | | | | |
| Free Chlorine | | ± | mg/L | | |
| Total Chlorine | | ± | mg/L | | |
| Chlorine Dioxide | | ± | mg/L | | |
| Chlorite at point of entry | | ± | mg/L | | |
| Calcium | | ± | mg/L | | |
| Phosphate | | ± | mg/L | | |

Please see reverse for brief instructions.

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**Figure 7.1. Laboratory-approval form.**

**Table 7.3. How the SWMOR and SWMOR2 round the readings you enter.**

| Type of Value | The Reports Round to Nearest … | Examples | | Comments |
|---|---|---|---|---|
| | | Entered Value | Displayed Value | |
| **Raw-water turbidity** | 1 NTU | 124.3<br>75.834 | 124<br>76 | |
| **Settled-water turbidity** | 0.1 NTU | 3.43<br>1.856 | 3.4<br>1.9 | |
| **Filtered-water turbidity** | 0.10 NTU | 0.544<br>0.546<br>1.044<br>1.046<br>2.043<br>2.053 | 0.54<br>0.55<br>1.04<br>1.05<br>2.04<br>2.05 | • For values less than 0.1, round to the nearest 0.01 NTU.<br>• For values that exceed a trigger level, the SWMOR counts only those values that are above that trigger level based on the value you entered and after rounding—not the values displayed. |
| **Treated water turbidity** | 0.1 NTU | 0.349<br>0.350<br>1.049<br>1.050 | 0.3<br>0.4<br>1.0<br>1.1 | • For values less than 0.1, round to the nearest 0.01 NTU.<br>• For values that exceed a limit, the SWMOR counts only those values that are above that limit based on the values you entered and after rounding—not the values displayed. |
| **Chlorine or chloramine residual** | 0.1 mg/L | 0.445<br>0.75 | 0.4<br>0.8 | |
| **Chlorine dioxide residual** | 0.05 mg/L | 0.45<br>0.12 | 0.5<br>0.1 | |
| **Ozone Residual** | 0.02 mg/L | 0.43<br>0.12 | 0.44<br>0.12 | |
| **pH** | 0.1 unit | 7.843<br>8.456 | 7.8<br>8.5 | |
| **Temperature** | 0.1ºC | 14.74<br>26.55 | 14.7<br>26.6 | Convert temperatures measured in degrees Fahrenheit to degrees Celsius. |
| **Time** | 0.25 hour | 35 min<br>40 min | 0.50 hour<br>0.75 hour | |
| **Percentage** | 0.1% | 5.045<br>5.052 | 5.0<br>5.1 | |

# 8. PUBLIC NOTIFICATION

Notifying your customers of a problem with your treatment plant's operations is a serious responsibility. The law requires you to notify both the TCEQ and your customers whenever certain circumstances occur. Summaries of the conditions that require public notice appear in Table 8.1 and Table 8.2.

**Table 8.1. Treatment-technique violations requiring public notification.**

| Type of Violation | Description of Violation |
|---|---|
| **Daily turbidity** (8.1, 8.5 and 8.6) | The turbidity level of the finished water (the CFE turbidity level) exceeds 1.0 NTU at any time during any day. |
| **Daily CT** (8.2 and 8.7) | Your plant fails to meet the inactivation requirements (for *Giardia* and viruses) for more than 4.0 consecutive hours. |
| **Daily low residual** (8.2 and 8.7) | The residual of the finished water entering the distribution system falls below acceptable levels for more than 4.0 consecutive hours. |
| **Monthly turbidity** (8.3 and 8.7) | For the month, more than 5.0% of the finished water (CFE) turbidity readings are above 0.3 NTU. |
| **Monthly residual** (8.3 and 8.7) | For the second month in a row, more than 5.0% of the residuals in the distribution system fall below the acceptable level. |

As Table 8.1 indicates, treatment technique violations can occur on a daily or monthly basis. When you recognize that one of these six events has occurred—or that you cannot avoid one of these events—you must contact the TCEQ. Do not wait for the event to actually happen if you know that it cannot be avoided.

There are several good reasons to contact us before you issue a violation notice to your customers. For example:

- We want to be able to review the data, discuss the situation with you, and figure out whether or not a public notice is required.
- If a public notice is required, we want to be sure that you have all the information that you need to issue the notice in the right way.
- We do not want to begin receiving calls from your customers or the press without first knowing what is going on.

Some of the treatment-technique violations can pose a high risk of waterborne disease, called an acute threat. Others can pose a short-term, lower-risk threat to public health. The nature of the treatment-technique violation and its severity will dictate how and when you will have to notify us and your customers.

The public notification process involves a series of several steps—

Step 1: Notify us of the violation. This process is described in sections 8.1 through 8.4 of this chapter.

Step 2: Notify your customers of the violation. This process is described in sections 8.5 through 8.8 of this chapter.

Step 3: Notify us when the violation has ended.

Step 4: Send us proof that you notified your customers. This process is described in section 8.9 of this chapter.

Table 8.2 shows each type of monitoring or reporting violation. Once you finished entering the monthly data in the worksheet, you may realize there have been monitoring or reporting violations during the month. In general, many of these monitoring or reporting violations can only be determined at the end of a month. Thus, you can notify us of monitoring and reporting violations by submitting the monthly report.

**Table 8.2. Monitoring and reporting violations requiring public notification.**

| Type of Violation | Description of Violation |
|---|---|
| **CFE turbidity reporting** | The plant fails to report all of the required CFE turbidity readings. |
| **Daily CT reporting** | The plant fails to report all the CT data needed to evaluate microbial inactivations. |
| **Disinfectant residual of finished water monitoring** | The plant fails to properly monitor the disinfectant residual level of the finished water. |
| **Disinfectant residual in distribution system** | The plant fails to monitor or report the required number of measurements in the distribution system. |
| **Maximum individual filter effluent turbidity** | The plant fails to monitor or report the reading for daily maximum turbidity of individual filter effluent. |
| **4-hour individual filter effluent turbidity** | The plant fails to monitor or report one or more of the turbidity readings 4 hours after the start of a filter run. |
| **Filter-profile report** | The plant fails to submit a FPR when it is required. |
| **Filter-assessment report** | The plant fails to submit a FAR when it is required. |
| **Comprehensive performance evaluation** | The plant fails to submit a CPE-request form when it is required. |

## 8.1 How and When to Notify The TCEQ of a Daily Turbidity Violation (Finished-water-turbidity readings above 1.0 NTU)

As shown in Table 8.1, a daily turbidity violation occurs if any of the CFE turbidity readings are above 1.0 NTU. This section tells how to notify us of such a violation.

## When to Contact Us

The LT1 requires you to consult with us each time that the turbidity level of the finished water (the CFE turbidity) rises above 1.0 NTU. This consultation must occur within 24 hours of the high reading. Following this consultation, we will be able to determine if the violation poses an acute risk to public health and tell you what type of public notice you must issue.

**IMPORTANT**

Finished water (CFE) turbidity readings above 1.0 NTU are different from the other daily violations in the following three ways:

1. You must consult with us (and not just notify us) following this violation.
2. You must consult with us within 24 hours.
3. If you do not consult with us within 24 hours, you must assume that the violation poses an acute public-health threat and issue the public notice accordingly.

### Which Readings Were "above 1.0 NTU"?

The SWMOR and SWMOR2 count only the readings that were above 1.0 NTU *after* rounding to the nearest 0.1 NTU. Readings from 1.001 to 1.049 are rounded *down* to 1.0. Any reading from 1.050 to 1.099 is rounded up to 1.1. Consequently, a reading is not counted as above 1.0 NTU unless you enter a value that is 1.050 NTU or above.

## How to Contact Us

Consultation can begin with a fax, an e-mail, or a phone call. In order of our preference, the options are:

1. faxing us a completed violation-report form at 512-239-6050
2. Scanning and e-mailing the completed violation-report form to <PDWS@tceq.texas.gov>, attention "SWMOR"
3. telephoning us at 512-239-4691 and asking to speak to the Surface Water Treatment Rule Coordinator on the Drinking Water Quality Team
4. telephoning your local TCEQ office and asking to speak with a surface water treatment-plant investigator

We have developed a fax form that you can use to notify us of a turbidity (or other) violation. A blank copy of this appears in Figure 8.1. It contains most of the information that we need to know. Therefore, you should complete this form even if you decide to call us with the information rather than fax us a copy of the form. An electronic copy of the form can be downloaded from the TCEQ website at the following address:

www.tceq.texas.gov/goto/swtp/forms

You must actually consult with us following a daily turbidity violation. Consequently, you must call us so that we can discuss the situation—even if you fax or e-mail us a violation notice.

# Public Drinking Water Violation Report

**To: Texas Commission on Environmental Quality**
**Water Supply Division**

**Public Water System Name:** ______________________________ **PWS ID No.:** ______________

**Plant Name or Number:** ______________________________

**Type of Violation(s):** ______________________________
**(for example, turbidity above 5.0 NTU, turbidity between 1.0 and 5.0 NTU, turbidity above 0.3 NTU, low CT value, low residual leaving the plant, low distribution system residual, $ClO_2$ residual above 0.8 mg/L at the plant discharge, $ClO_2$ residual above 0.8 mg/L in distribution, etc.)**

**Date and Time that the Violation was Detected:** ______________________

**Duration of the Violation (if known):** ______________________
**(for example, 5 hours, 1 day, 2 months, etc.)**

**Other Data: (for SWTPs only)** **Finished Water Turbidity Level:** ______ **NTU** **Highest IFE Turbidity Level:** ______ **NTU** ***Giardia* Inactivation:** ______ **Viral Inactivation:** ______

**Corrective Action Taken:** ______________________________

**Reported By:** ______________________ **Date:** ______________

**Telephone No.:** ( ) ______________ **Fax No.:** ( ) ______________

**Fax this violation report to TCEQ/Water Supply Division at (512) 239-6050**

**For TCEQ Use**

TCEQ-10449 (10/04) Violation Rep

**Figure 8.1. Violation report form.**

## How We Decide How You Will Notify Your Customers

There are public notices for a daily turbidity violation:

- *both an Boil Water notice and an Acute Violation*—issued when there has been a severe failure in several treatment processes at the plant and customers need to boil water to kill potential pathogens
- *just an Acute Violation Notice*—issued when there has been a severe failure in one or two of the plant's treatment processes but boiling water is not necessary
- *a Non-Acute Violation notice*—issued when there has been a failure in only one of the plant's major treatment processes without a resulting immediate health risk to customers

The notice you will issue and the procedure that you will use depends on the severity of the violation.

### Acute Violation and Boil Water Notice (BWN)

You are required to issue both an Acute Violation notice and a Boil Water notice (BWN) any time that we believe there is a severe threat to the public health. Historically, the most common reason that we require BWNs to be issued has been the catastrophic failure of the filtration facilities. Conditions that we believe constitute catastrophic filter failures are described in the following box.

**IMPORTANT**

*Any* CFE turbidity reading above 5.0 NTU at a plant with conventional filters poses an immediate, acute risk to public health and you must notify your customers of the violation and issue a BWN within 24 hours of the reading. Although we would like to talk with you before you issue the public notice and Boil Water notice, you *must* notify your customers within 24 hours—even if you are unable to reach us first.

If you are using membrane filters, a similar public health threat exists at CFE turbidity levels above 1.0 NTU. Consequently, if the turbidity of the water leaving your membrane filter plant exceeds 1.0 NTU, you *must* notify your customers of the violation and issue a BWN within 24 hours.

Please refer to Section 8.5 for information about issuing an Acute Violation and BWN to your customers.

### Acute Violation Notices

As noted in Section 8.1, you must consult with us within 24 hours of having a CFE turbidity reading over 1.0 NTU. This consultation process allows us to determine if the violation poses an acute threat to public health. If the CFE turbidity level is not above the level which requires a BWN, you must use the procedures described in section 8.6 to issue your public notice if:

- we determine that the turbidity violation poses an acute risk
- you do not consult with us within 24 hours of having the high reading

The TCEQ has determined that each of five following conditions poses a potential acute threat to public health.

1. CFE turbidity levels above 1.0 NTU occurred during a period when the disinfection protocol did not achieve an inactivation ratio of at least 2.0 for both *Giardia* and viruses.
2. CFE turbidity levels above 1.0 NTU occurred during a period that individual filter-effluent (IFE) turbidity levels were above 2.0 NTU at one or more filters.
3. CFE turbidity levels above 1.0 NTU occurred at plants that are required to have IFE turbidimeters but failed to properly monitor or record IFE turbidity data during the period when the CFE turbidity level was above 1.0 NTU.
4. CFE turbidity levels above 2.0 NTU occurred at plants that have only two filters, are not required to continuously monitor the IFE turbidity level at the effluent of each filter, and did not happen to collect IFE turbidity grab samples during the period when CFE levels were above 1.0 NTU.
5. CFE turbidity levels above 1.0 NTU occurred at plants that use membrane technology. In this situation, the TCEQ will also require the public water system to issue a BWN in conjunction with the public notice issued for the treatment technique violation.

Acute threats to public health may exist under conditions other than those identified above. Consequently, we may require acute violation notices to be issued in other situations.

If you are unable to talk with us within 24 hours, you can use the above list to help you determine if your violation poses an acute risk.

### Non-Acute-Violation Notices

If we believe that the daily turbidity violation does not pose an immediate threat to public health, we will allow you to use the procedure described in Section 8.7 to issue your public notice. Our decision to allow you to use this procedure will be based on our belief that the disinfection levels achieved at the plant will afford a reasonable level of public health protection despite elevated CFE turbidity levels. In the absence of some unusual source-water quality problem, we determine that this criterion can be met if the plant achieves an inactivation ratio of at least 2.0 when the CFE turbidity level is above 1.0 NTU. An IR of 2.0 means that the plant is inactivating twice as much *Giardia* and virus as required by our rules.

## Example 8.1: Determining When to Notify the TCEQ of a Daily Violation

A surface water treatment plant collects the following data during the first week in February 2004. The plant feeds ammonia at some point during the treatment process and maintains a chloramine residual in the distribution system.

| PERFORMANCE DATA | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw Water Pumpage (MGD) | Treated Water Pumpage (MGD) | RAW WATER ANALYSES | | SETTLED WATER TURBIDITY (Optional Data) | | | | | | FINISHED WATER QUALITY | | | | | | | | |
| | | | | | Basin No. | | | | | | Turbidity | | | | | | Lowest | | |
| Date | | | NTU | Alk. | 1 | 2 | 3 | 4 | 5 | 6 | NTU1 | NTU2 | NTU3 | NTU4 | NTU5 | NTU6 | Residual | Time= |
| 1 | 2.300 | 2.210 | 45 | 112 | 1.4 | 1.5 | | | | | X | 0.03 | 0.05 | 0.13 | 0.21 | 0.19 | 1.2 | |
| 2 | 2.100 | 1.988 | 53 | 116 | 1.9 | 2.5 | | | | | X | 0.13 | 0.25 | 0.11 | 0.07 | | 2.1 | |
| 3 | 1.900 | 1.658 | 48 | 111 | 2.2 | 2.4 | | | | | X | 0.25 | 0.32 | 0.21 | 0.16 | 0.09 | 2.1 | |
| 4 | 4.500 | 4.654 | 66 | 101 | 1.8 | 1.3 | | | | | X | 0.47 | 0.55 | 0.24 | 0.11 | 0.31 | 1.8 | |
| 5 | 3.100 | 2.440 | 56 | 112 | 3.1 | 2.8 | | | | | X | 0.54 | 1.16 | 1.03 | 1.40 | 0.42 | 1.3 | |
| 6 | 2.300 | 2.232 | 45 | 110 | 2.2 | 1.9 | | | | | X | 0.22 | 0.08 | 0.04 | 0.05 | 0.09 | 1.9 | |
| 7 | 2.500 | 2.445 | 48 | 115 | 2.5 | 2.7 | | | | | X | 0.11 | 0.14 | 0.08 | 0.09 | 0.11 | 0.3 | 2.25 |

In this example:

Two CFE (finished-water) turbidity readings on Thursday, February 5, were above 1.0 NTU: the reading in NTU3 was 1.16 and the one in NTU5 was 1.4. As soon as the first of these readings was confirmed to be correct, the system had a daily violation. Because the CFE turbidity level was above 1.0 NTU, the plant was required to consult with us by noon on February 6, using one of the methods described in this section, and then notify its customers in the manner we approve. (Note: If you did not consult with us by noon on February 6, the plant would have been required to notify its customers of the violation as described in Section 8.6 since the turbidity level was above 1.0 NTU but not above 5.0 NTU.)

The total chlorine residual entering the distribution system dropped as low as 0.3 mg/L on Saturday, February 7, and was below 0.5 mg/L for as long as 2 hours, 15 minutes. Since the longest period of time that the residual was below 0.5 mg/L was less than 4.0 hours, the system did not violate the treatment technique requirements and was not required to notify either the TCEQ or its customers of the problem. (However, if the residual had been below 0.5 mg/L for more than 4.0 hours, the system would have violated the rule and would have had to notify the TCEQ of the violation no later than 5 p.m. on Monday, February 9, by one of the methods described in Section 8.2. The system would have also been required to notify its customers as described in Section 8.7.)

## 8.2 How and When to Notify the TCEQ of a Daily CT or Low-Residual Violation

As shown in Table 8.1, a daily CT violation occurs any day that the inactivation ratio falls below 1.0 for more than four consecutive hours. Table 8.1 also shows that a daily low-residual violation occurs any day that the disinfectant residual leaving the plant falls below acceptable levels for more than 4 consecutive hours. This section describes the process for notifying us of such violations. The procedures that you must follow to notify your customers of these two violations are discussed in Section 8.7.

### When to Contact Us

The LT1ESWTR and LT2ESWTR do not change the notification requirements for these types of daily violations. Consequently, if you have one of these daily violations, you must notify us by 5 p.m. on the next business day after the violation occurred.

### How to Contact Us

You can notify us of a daily CT or low residual violation with either a fax or a phone call. In order of our preference, the options are:

1. Faxing us a completed Violation Report Form at 512-239-6050
2. Telephoning us at 512-239-4691 and asking to speak to the Surface Water Treatment Rule Coordinator on the Drinking Water Protection Team
3. Telephoning your local TCEQ office and asking to speak with a surface water treatment–plant investigator

We have developed a fax form that you can use to notify us of a turbidity (or other) violation. A blank copy of this is shown in Figure 8.1. A properly completed form contains most of the information that we need to know. Therefore, you should complete this form even if you decide to call us with the information rather than fax us a copy of the form. An electronic copy of the form can be downloaded from the TCEQ website at the following address:

www.tceq.texas.gov/goto/sw-violation

The rules do not require you to consult with us following these specific daily violations, so you do not need to call us after faxing the completed violation report. However, we will call you to discuss the situation if we need more information and to discuss the specific public notice that you must give your customers.

## Example 8.2: Determining When to Notify the TCEQ of a CT Violation

The graphic below shows a portion of a surface water treatment plant's SWMOR for February 2004.

| PERFORMANCE DATA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DISINFECTION PROCESS DATA | | | | | | | | |
| Date | Disinfectant | C (mg/L) | Flow (MGD) | Temp ($^oC$) | pH | Giardia Log | Virus Log | Inact. Ratio | Time= |
| | NA *D1* | | | | | | | | |
| | FCL *D2A* | 0.2 | 3.000 | 12.0 | 7.4 | | | | |
| 7 | NA *D2B* | | | | | 0.48 | 11.33 | 0.96 | 2.25 |
| | CLA *D3* | 0.3 | 3.000 | 14.0 | 7.5 | | | (G) | |
| | *D4* | | | | | | | | |

| PERFORMANCE DATA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DISINFECTION PROCESS DATA | | | | | | | | |
| Date | Disinfectant | C (mg/L) | Flow (MGD) | Temp ($^oC$) | pH | Giardia Log | Virus Log | Inact. Ratio | Time= |
| | NA *D1* | | | | | | | | |
| | FCL *D2A* | 0.6 | 2.000 | 14.0 | 7.7 | | | | |
| 15 | FCL *D2B* | 0.8 | 2.000 | 14.0 | 7.4 | 2.36 | 58.46 | 4.72 | |
| | CLA *D3* | 2.7 | 4.000 | 14.0 | 7.7 | | | (G) | |
| | *D4* | | | | | | | | |

In this example:

1. The plant has three disinfection zones and zone D2 contains two treatment trains.
2. Disinfection zones D1 and D2B were not being used on Friday, February 6. This means that:
   a. Since all of the water must flow through zone D1 and zone D1 shows "NA" for the disinfectant, no disinfectant was being used in that zone.
   b. Since all of the water must flow through zone D3, the plant was being operated at a flow rate of 3.000 MGD when this sample set was collected.
   c. Since all of the water must flow through zones D2A and D2B and the flow rate through zone D2B was 3.000 MGD, no water was flowing through zone D2A. Since there was no flow in zone D2A, the operator selected "NA" as the disinfectant.
3. When the sample set on Friday, February 6, was collected, the inactivation ratio for *Giardia* was 0.96. The maximum period of time that the inactivation ratio was below 1.0 was 2 hours, 15 minutes. Since the longest period of time that the inactivation ratios were below 1.0 was *less* than 4.0 hours, the system did not violate the treatment technique requirements and was not required to notify either the TCEQ or its customers about the problem.

   (However, if the inactivation ratio had been below 1.0 for *more* than 4.0 hours, the system would have had a violation that required it to notify the TCEQ no later than 5 p.m. on Monday, February 9, by one of the methods described in Section 8.2. The system would have also been required to notify its customers as described in Section 8.7.)

# 8.3 How and When to Notify the TCEQ of a Monthly Violation

While daily violations are based on the results of only one or two readings obtained during a single day, monthly violations are based on all of the data accumulated over a period of one or two months. However, you may be able to tell in the middle of a month that it will be impossible to avoid a violation no matter what the data looks like for the rest of the month. Once a monthly violation becomes unavoidable, you have to notify us—even it is before the end of the month.

Consequently, if you are having an operational problem that could result in a violation, you *cannot* wait until the end of the month to review your records and decide whether you should contact the TCEQ and notify the public. As soon as you realize that a monthly violation has occurred or cannot be avoided, you have 24 hours notify us of the violation.

This section describes the procedures that you should use to notify us of a monthly treatment-technique violation. The procedures that you must follow to notify your customers of these two daily treatment-technique violations appear in Section 8.7.

## High Finished-Water Turbidity (more than 5.0 percent of the CFE readings above 0.3 NTU)

### When to Contact Us

You are required to inform us by the end of the next business day if more than 5.0% of the CFE turbidity readings for the month are going to be above 0.3 NTU. When to contact the TCEQ depends on the answers to these two questions:

1. Which CFE readings were counted as being “above 0.3”?
2. When could you *first* tell that 5.0% of the CFE readings taken during the month would be “above 0.3”?

#### Which Readings Were “above 0.3”?

The SWMOR counts only the readings that were above 0.3 NTU *after* rounding to the nearest 0.1 NTU. Readings from 0.301 to 0.349 are rounded *down* to 0.3. Any reading from 0.350 to 0.399 is rounded up to 0.4. Consequently, a reading is not counted as “above 0.3 NTU” unless you enter a value that is 0.350 NTU or above.

#### When Could You First Tell?

The number of readings that you can have above 0.3 NTU depends on the total number of turbidity readings that you collect during the month. Since no more than 5.0% of the readings can be above 0.3 NTU, use Table 8.3 to determine the maximum number of readings that you can have.

**Table 8.3. Maximum allowable number of readings above 0.3 NTU.**

| Total number of turbidity readings during the month | Maximum allowable number of readings above 0.3 NTU | A monthly violation occurs when you have this number of readings above 0.3 NTU |
|---|---|---|
| 1–19 | 0 | 1 |
| 20–39 | 1 | 2 |
| 40–59 | 2 | 3 |
| 60–79 | 3 | 4 |
| 80–99 | 4 | 5 |
| 100–118 | 5 | 6 |
| 119–138 | 6 | 7 |
| 139–158 | 7 | 8 |
| 159–178 | 8 | 9 |
| 179–186 | 9 | 10 |

Based on Table 8.3, the most important factors are: (1) how many days there are during the month, and (2) how many readings you routinely collect each day. For example, if your plant serves at least 500 people and is on line continuously throughout the day, you must record the turbidity of the finished water every 4 hours and you will have six readings per day. This means that:

1. During every month (except February), you will record either 180 or 186 readings depending on whether the month has 30 or 31 days. In either case, you will have a monthly turbidity violation as soon as you record the 10th reading above 0.3 NTU.
2. In February, you will record either 168 or 176 readings depending on whether or not it is a leap year. In either case, you will have a monthly turbidity violation as soon as you record the 9th reading above 0.3 NTU.

There are other important factors—such as the number of offline periods and the number of missing readings—that you must consider when determining the maximum number of readings above 0.3 NTU that you can have.

For example, a large treatment plant that is taken offline from 11 p.m. until 7 a.m. each day would collect 31 fewer turbidity readings during the month of January. Therefore, the plant will have 155 turbidity readings during the month (that is, 186 – 31 = 155). As Table 8.3 indicates, under these circumstances, the 8th reading above 0.3 NTU would result in a monthly violation instead of the 10th reading.

## How to Contact Us

You may notify us of a monthly turbidity violation with either a fax or a phone call. In order of our preference, the options are:

1. faxing us a completed Violation Report Form at 512-239-6050
2. e-mailing us a scanned Violation Report Form to <PDWS@tceq.texas.gov>, attention "SWMOR Violation"
3. telephoning us at 512-239-4691 and asking to speak the Surface Water Treatment Rule Coordinator on the Drinking Water Protection Team
4. telephoning your local TCEQ office and asking to speak with a surface water treatment–plant investigator

We have developed a fax form that you may use to notify us of a turbidity (or other) violation. A blank copy of this appears in Figure 8.1. A properly completed form contains most of the information that we need to know. Therefore, you should complete this form even if you decide to call us with the information rather than fax us a copy of the form. An electronic copy of the form can be downloaded from the TCEQ website at:

www.tceq.texas.gov/goto/sw-violation

The rules do not require you to consult with us following these specific daily violations, so you do not need to call us after faxing the completed violation report. However, we will call you to discuss the situation if we need more information and to discuss the specific public notice that you must provide to your customers.

# Low Distribution Residuals

It is very important to maintain an acceptable disinfectant residual throughout the distribution system at all times. You must measure the residual at a designated sampling site at least once each day and should use this data to make appropriate operational adjustments on a daily basis. Failure to maintain an adequate residual at all times is a violation of our rules. However, you will only have to notify your customers if more than 5.0% of the disinfectant residuals in the distribution system fall below the acceptable level during each of two consecutive months.

Unless you collect a very large number of distribution samples, you may use Table 8.4 to determine the maximum number of readings that can be below acceptable levels before you might be required to issue a public notice for low distribution residuals.

**Table 8.4. Number of low distribution-residual readings that could trigger a public notice.**

| Total number of distribution residual readings during the month | You might have to issue a public notice if you have this number of readings below acceptable levels |
|---|---|
| 0–19 | 1 |
| 20–39 | 2 |
| 40–59 | 3 |
| 60–79 | 4 |
| 80–99 | 5 |
| 100–118 | 6 |
| 119–138 | 7 |
| 139–158 | 8 |
| 159–178 | 9 |
| 179–198 | 10 |
| 199–217 | 11 |

## When to Contact Us

Since the public-notification requirement for distribution system violations is based on all of the data collected during two consecutive months, you may be certain that no public notice will be required this month if at least 95% of the samples collected last month had an adequate residual.

There is no limit on the number of tests that you may run in the distribution system each month. Consequently, we realize that you probably will not be able to tell whether you are going to fail in more than 5.0% of the samples until the last day of the month. Therefore, we do not require you to notify us of this particular problem until the first business day of the following month. However, we recommend that you contact us as soon as you become aware that you are having some trouble maintaining an acceptable residual throughout the distribution system.

You may notify us of a monthly turbidity violation with either a fax or a phone call. In order of our preference, the options are:

1. faxing us a completed Violation Report Form at 512-239-6050
2. e-mailing a copy of the scanned, completed, Violation Report Form to us at <PDWS@tceq.texas.gov>, attention “SWMOR Violation”
3. telephoning us at 512-239-4691 and asking to speak to the Surface Water Treatment Rule Coordinator on the Drinking Water Protection Team
4. telephoning your local TCEQ office and asking to speak with a surface water treatment plant investigator

A properly completed Public Drinking Water Violation Report Form (TCEQ-10449) contains most of the information that we need to know. Therefore, you should complete this form even if you decide to call us with the information rather than fax us a copy. For your convenience, we included a blank copy of the Violation Report form in Figure 8.1. An electronic copy of the form can be downloaded from the TCEQ website at the following address:

www.tceq.texas.gov/goto/sw-violation

The rules do not require you to consult with us following this violation so you do not need to call us after faxing the Violation Report. We will call you to discuss the situation if we need more information and to discuss the specific public notice that you must give your customers.

## 8.4 How and When to Notify the TCEQ of a Monitoring-and-Reporting Violation

The SWMOR and SWMOR2 spreadsheets automatically report if you have a monitoring-and-reporting (M&R) violation. You will notify us of an M&R violation when you send us your completed SWMOR or SWMOR2. You do not have to take any special steps to notify us of an M&R violation.

An overview of the public notification procedures for M&R violations appears in Section 8.8. You can also get forms and instructions on our web site at:

www.tceq.texas.gov/goto/sw-violation

## 8.5 When and How to Notify Your Customers of a Turbidity Violation that Requires a Boil Water Notice

There are two situations when you must always include a Boil Water notice with your public notice for a treatment-technique violation. We require you to take this step if either of the following conditions occurs:

- If your plant uses conventional media filters (either gravity or pressure filters) and *any* of the readings for finished-water (CFE) turbidity is above 5.0 NTU
- If your plant uses membrane filters and *any* of the readings for finished-water turbidity is above 1.0 NTU

### When to Issue the Boil Water Notice for an Acute Treatment-Technique Violation

If your plant uses conventional filters and *any* of the readings for finished-water turbidity readings is above 5.0 NTU, you must notify your customers of the violation and issue a BWN within 24 hours of the reading.

If your plant uses membrane filters and *any* of the readings for finished-water turbidity is above 1.0 NTU, you must notify your customers of the violation and issue a BWN within 24 hours of the reading.

Contact us immediately at (512) 512-239-4691 if any of the finished-water-turbidity readings is above 5.0 NTU. Although we would like to talk with you before you issue the public notice and BWN, you *must* notify your customers within 24 hours even if you are unable to reach us first.

Contact us immediately at 512-239-4691 if any of the finished-water-turbidity readings is above 5.0 NTU. In addition, you may e-mail us at <PDWS@tceq.texas.gov> and fax us at 512-239-6050. You should document your contact with TCEQ; print and save a copy of the fax confirmation or e-mail to show regional investigators upon request.

## How to Issue an Acute Violation with BWN

A community water system must issue the Acute Violation notice and BWN using both electronic and printed media. Specifically, a community water system must do both of the following:

- Furnish a copy of the notice to the radio and television stations serving the area served by the public water system.
- Publish the notices in a daily newspaper of general circulation in the area served by the system. If the area is not served by a daily newspaper of general circulation, notice must instead be delivered by hand or by continuously posting the notice in conspicuous places within the area served by the system. The notice must remain posted for at least seven days *and* for as long as the violation continues.

A non-community system must continuously post the notice in conspicuous places in the area served by the system. Again, the notice must remain posted for at least seven days *and* for as long as the violation exists. A non-community water system is not required to issue the acute violation notice using electronic media or to publish the notice in a local paper.

### Information that you must include in the Acute Violation notice and BWN

When you issue the Acute Violation and BWN, you *must* include the wording shown in Figure 8.2. If you serve a significant Spanish-speaking population, you must also include the wording shown in Figure 8.3.

## Boil Water Notice and Acute Surface Water Turbidity Violation Notice

The Texas Commission on Environmental Quality (TCEQ) sets minimum water quality standards for public drinking water. One of these standards is a turbidity limit. Turbidity by itself has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may also indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headaches. These symptoms can be particularly severe in people who are not as resistant to infections as most of the population. If you experience severe symptoms, please consult with your doctor to determine what actions you should take.

The **[enter the name of your public water system here]** failed to meet the minimum treatment technique requirements on **[enter the date or dates that the turbidity level exceeded 5.0 NTU]**. Specifically, the turbidity level of our treated water was above 5.0 Nephelometric Turbidity Units.

Due to the nature and severity of this violation, the TCEQ has required us to issue this public notice and to tell all our customers that they should boil their water prior to consumption.

To ensure destruction of all harmful bacteria and other microbes, any water that you use for drinking, cooking, or ice making should be boiled prior to consumption. The water should be brought to a vigorous rolling boil and then boiled for two minutes. (Be sure to let it cool before drinking it.) In lieu of boiling, you may purchase bottled water or obtain water from some other suitable source. When it is no longer necessary to boil the water, we will notify you.

> **[See "Optional Paragraphs" below. Add them here if you wish.]**

If you want more information about the nature and significance of this violation, you may contact **[enter the name of the individual <u>at your system</u> that you want your customers to call]** at **[enter the person's telephone number]**.

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

---

### Optional Paragraphs

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

> The **[enter the name of your public water system here]** has taken the following corrective actions to prevent a recurrence of the violations:
>
> > **[list the actions you have taken]**.

---

### Ending Paragraph

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

TCEQ-20621 rev. 1/18/12

**Figure 8.2. Mandatory English wording for a turbidity violation that requires a BWN with an acute turbidity violation notice.**

## Aviso de Hervir Agua y
## Aviso de Violación Aguda de Turbidez de Agua Superficial

La Comisión de Calidad Ambiental de Texas (TCEQ) establece normas mínimas de calidad de agua para agua potable pública. Una de esas normas es el límite de turbidez. La turbidez por sí misma no tiene efectos en la salud. Sin embargo, la turbidez puede dificultar la desinfección y proporcionar un medio propicio para el crecimiento de microbios. La turbidez podría también indicar la presencia de organismos causantes de enfermedades. Estos organismos incluyen bacterias, virus y parásitos que podrían causar síntomas tales como náusea, calambres y diarrea. Estos síntomas pueden ser particularmente severos en individuos que no sean tan resistentes a las infecciones como la mayoría de la población. Si usted experimenta síntomas severos, por favor consulte a su médico para determinar cuáles medidas debería tomar usted.

El **[enter the name of your public water system here]** no cumplió con los requisitos mínimos en la técnica de tratamiento en **[enter the date or dates that the turbidity level exceeded 5.0 NTU]**. Específicamente, el nivel de turbidez de nuestra agua tratada fue mayor de 5.0 Unidades Nefelométricas de Turbidez.

Debido a la naturaleza y la gravedad de esta violación, la TCEQ nos ha exigido emitir esta notificación pública y decirles a todos nuestros clientes que deberían hervir el agua antes de consumirla.

Para asegurar la destrucción de toda bacteria dañina y otros microbios, cualquier agua que se use para beber, cocinar o hacer hielo debe ser hervida primero. El agua debe llegar a hervir vigorosamente y dejar hervirse por dos minutos. (Asegúrese de dejar el agua enfriarse antes de tomarla.) En lugar de hervir el agua, usted puede comprar agua embotellada u obtener agua de alguna otra fuente adecuada. Cuando deje de ser necesario hervir el agua, le avisaremos.

**[See “Optional Paragraphs” below. Add them here if you wish.]**

Si desea más información sobre la naturaleza y el significado de esta violación, puede llamar a **[enter the name of the individual <u>at your system</u> that you want your customers to call]** al **[enter the person’s telephone number]**.

**[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

---

### Optional Paragraphs

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

El **[enter the name of your public water system here]** ha realizado las siguientes medidas correctivas para prevenir la repetición de las violaciones:

**[list, in Spanish, the actions you have taken]**.

---

### Ending Paragraph

Por favor comparta esta información con todas las demás personas que toman esta agua, especialmente aquellas que quizás no hayan recibido este aviso directamente (por ejemplo, personas en departamentos, casas de reposo, escuelas y negocios). Puede hacer esto colocando este aviso en un lugar público o distribuyendo copias a mano o por correo.

TCEQ-20621/esp rev. 1/18/12

**Figure 8.3. Mandatory Spanish wording for a turbidity violation that requires a BWN with an acute turbidity violation notice.**

## Return-to-Compliance Notification for an Acute Violation and BWN

If you ever have to issue an Acute Violation or BWN, you must keep your customers informed about the status of the violation and let them know when the threat to public health has passed. Before issuing *any* of the additional notices, you must contact us so that we can discuss the action you propose to take.

Following the initial notice, you must:

1. Issue a public notice lifting the BWN. *Before* you tell your customers that they no longer need to boil their water, you must contact us at 512-239-4691 and receive our approval to lift the BWN. You may not lift the BWN without our prior approval.

   When you issue the notice to tell your customers that the violation has been corrected and that they no longer need to boil their water, you must issue the notice in the same manner that you issued the original notice. This means that:
   a. If you notified radio or television stations of the violation, you must inform each of these organizations that the violation has been corrected.
   b. If you published the original notice in local papers, you must publish the follow-up notice in each of those papers.
   c. If you delivered the original notice by hand, you must hand-deliver the follow-up notice.
   d. If you issued the original notice by posting it in conspicuous places, you must post the follow-up notice in the same places.

2. Send a copy of the original notice to each customer within 45 days of the violation. This notice can be delivered by hand, mailed with the water bill, or mailed in a separate envelope.

   Before you issue these individual notices, you should contact us at 512-239-4691. We can waive this requirement if the violation has been corrected within this 45-day period. However, we are required by both state and federal rules to issue this waiver in writing, so it is very important that you call us so that we can send you a letter.

3. Send us a copy of each of the notices that you issued to radio and television stations, published in newspapers, and sent to your customers. A signed copy of the Certificate of Delivery shown in section 8.9 and a copy of the original BWN and acute violation notice must be attached to your SWMOR. The copies of the follow-up notices must mailed to us within 10 days of the date that they are issued and must be mailed to:

   Drinking Water Quality Team, MC-155
   Attention: SWTR Coordinator
   Water Supply Division
   TCEQ
   PO Box 13087
   Austin, TX 78711-3087

If you wish you may submit documents to our physical address at:

Drinking Water Quality Team, Building F
Water Supply Division
Attention: SWTR Coordinator
TCEQ
12100 Park 35 Circle
Austin, TX 78753

## 8.6 When and How to Notify Your Customers of Other Acute Turbidity Violations

As noted in Section 8.1, you must consult with us within 24 hours of having a finished-water turbidity reading over 1.0 NTU. This consultation allows us to determine if the violation poses an acute threat to public health. You must use the procedures in this section to issue your public notice if:

- We determine that the turbidity violation poses an acute risk
- You fail to consult with us within 24 hours of having the high reading

The TCEQ has determined that each of five following conditions poses a potential acute threat to public health.

1. CFE turbidity levels above 1.0 NTU occurred during a period when the disinfection protocol did not achieve an inactivation ratio of at least 2.0 for both *Giardia* and viruses.
2. CFE turbidity levels above 1.0 NTU occurred during a period that IFE turbidity levels were above 2.0 NTU at one or more filters.
3. CFE turbidity levels above 1.0 NTU occurred at plants that are required to have IFE turbidimeters but failed to properly monitor or record IFE turbidity data during the period when the CFE turbidity level was above 1.0 NTU.
4. CFE turbidity levels above 2.0 NTU occurred at plants that have only two filters, are not required to continuously monitor the turbidity level at the effluent of each filter, and did not happen to collect IFE turbidity grab samples during the period when CFE levels were above 1.0 NTU.
5. CFE turbidity levels above 1.0 NTU occurred at plants that use membrane technology. In this situation, the TCEQ will also require the public water system to issue a Boil Water notice in conjunction with the public notice issued for the treatment-technique violation.

Acute threats to public health may exist under conditions other than those identified above. Consequently, we may require Acute Violation notices to be issued in other situations.

If you are unable to talk with us within 24 hours, you can use the above list to help you determine if your violation poses an acute risk.

### When to Issue the Public Notice for an Acute Turbidity Violation

You must issue the public notice for an acute turbidity violation within 24 hours of the reading.

## How to Issue the Public Notice for an Acute Turbidity Violation

A community water system must issue the public notice for an acute turbidity violation using both electronic and printed media. Specifically, a community water system must do both of the following:

- Furnish a copy of the notice to the radio and television stations serving the area served by the public water system.
- Publish the notice in a daily general-circulation newspaper in the area served by the system. (If the area is not served by a daily general-circulation newspaper, notice must instead be delivered by hand or continuously posted in conspicuous places within the area served by the system. The notice must remain posted for at least seven days *and* for as long as the violation exists.)

A non-community systems must continuously post the notice in conspicuous places in the area served by the system. Again, the notice must remain posted for at least seven days *and* for as long as the violation exists. A non-community water system is not required to issue the acute violation notice using electronic media or to publish the notice in a local paper.

### Information that you must include in the Public Notice for an Acute Turbidity Violation

When you issue the acute violation notice, you must include the wording shown in Figure 8.4. If you serve a significant Spanish-speaking population, you must also include the wording shown in Figure 8.5.

## Additional Notification Requirements for an Acute Turbidity Violation

You must keep your customers informed about the status of the violation and let them know when the public health threat passes. Before issuing *any* of the additional notices, you must contact us so that we can discuss the action you propose to take.

Following the initial notice, you must:

1. Issue the notice to tell your customers that the violation has been corrected. You must issue the notice in the same manner that you issued the original notice. This means that:
   a. If you notified radio or television stations of the violation, you must inform each of these organizations that the violation has been corrected.
   b. If you published the original notice in local papers, you must publish the follow-up notice in each of those papers.
   c. If you delivered the original notice by hand, you must hand-deliver the follow-up notice.
   d. If you issued the original notice by posting it in conspicuous places, you must post the follow-up notice in the same places.

2. Send a copy of the original notice to each customer within 45 days of the violation. This notice can be delivered by hand, mailed with the water bill, or mailed in a separate envelope.

## Notice of Acute Surface Water Turbidity Violation

The Texas Commission on Environmental Quality (TCEQ) sets minimum water quality standards for public drinking water. One of these standards is a turbidity limit. Turbidity by itself has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may also indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headaches. These symptoms can be particularly severe in people who are not as resistant to infections as most of the population. If you experience severe symptoms, please consult with your doctor to determine what actions you should take.

The **[enter the name of your public water system here]** failed to meet the minimum treatment technique requirements on **[enter the date or dates that the turbidity level exceeded 1.0 NTU]**. Specifically, the turbidity level of our treated water was above 1.0 Nephelometric Turbidity Unit.

> **[See "Optional Paragraphs" below. Add them here if you wish.]**

If you want more information about the nature and significance of this violation, you may contact **[enter the name of the individual <u>at your system</u> that you want your customers to call]** at **[enter the person's telephone number]**.

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

---

### Optional Paragraphs

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

> The **[enter the name of your public water system here]** has taken the following corrective actions to prevent a recurrence of the violations:
>
> > **[list the actions you have taken]**.

---

### Ending Paragraph

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

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**Figure 8.4. Mandatory English wording for an acute turbidity violation.**

**Aviso de Violación Aguda de Turbidez de Agua Superficial**

La Comisión de Calidad Ambiental de Texas (TCEQ) establece normas mínimas de calidad de agua para agua potable pública. Una de esas normas es el límite de turbidez. La turbidez por sí misma no tiene efectos en la salud. Sin embargo, la turbidez puede dificultar la desinfección y proporcionar un medio propicio para el crecimiento de microbios. La turbidez podría también indicar la presencia de organismos causantes de enfermedades. Estos organismos incluyen bacterias, virus y parásitos que podrían causar síntomas tales como náusea, calambres y diarrea. Estos síntomas pueden ser particularmente severos en individuos que no sean tan resistentes a las infecciones como la mayoría de la población. Si usted padece de síntomas severos, por favor consulte a su médico para determinar cuáles medidas debería tomar usted.

El **[enter the name of your public water system here]** no cumplió con los requisitos mínimos en la técnica de tratamiento en **[enter the date or dates that the turbidity level exceeded 1.0 NTU]**. Específicamente, el nivel de turbidez de nuestra agua tratada fue mayor de 1.0 Unidad Nefelométrica de Turbidez.

**[See "Optional Paragraphs" below. Add them here if you wish.]**

Si desea más información sobre la naturaleza y el significado de esta violación, puede llamar a **[enter the name of the individual at your system that you want your customers to call]** al **[enter the person's telephone number]**.

**[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

**Optional Paragraphs**

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

El **[enter the name of your public water system here]** ha realizado las siguientes medidas correctivas para prevenir la repetición de las violaciones:

**[list, in Spanish, the actions you have taken]**.

**Ending Paragraph**

Por favor comparta esta información con todas las demás personas que toman esta agua, especialmente aquellas que quizás no hayan recibido este aviso directamente (por ejemplo, personas en departamentos, casas de reposo, escuelas y negocios). Puede hacer esto colocando este aviso en un lugar público o distribuyendo copias a mano o por correo.

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**Figure 8.5. Mandatory Spanish wording for an acute turbidity violation.**

Before you issue these individual notices, you should contact us at 512-239-4691. We can waive this requirement if the violation has been corrected within this 45-day period. However, we are required by both state and federal rules to issue this waiver in writing, so it is very important that you call us so that we can send you a letter.

3. Send us a copy of each of the notices that you issued to radio and television stations, published in newspapers, and sent to your customers. A signed copy of the certificate of delivery shown in Section 8.9 and a copy of the original Acute Violation notice must be attached to your SWMOR. The copies of the follow-up notices must be mailed to us within 10 days of the date that they are issued and must be mailed to:

   Drinking Water Quality Team, MC-155
   Water Supply Division, Attention: SWTR Coordinator
   TCEQ
   PO Box 13087
   Austin, TX 78711-3087

   If you wish you may submit documents to our physical address at:

   Drinking Water Quality Team, Building F
   Water Supply Division, Attention: SWTR Coordinator
   TCEQ
   12100 Park 35 Circle
   Austin, TX 78753

## 8.7 When and How to Notify Your Customers of Other Treatment-Technique Violations

The information presented in this section applies to all treatment-technique violations that do not pose an acute threat to public health. However, if some unique combination of conditions results in an acute public health threat to your customers, we will require you to issue the notice in the manner described in Section 8.6.

The treatment-technique violations that do not generally pose an acute threat include:

- certain readings for finished-water turbidity above 1.0 NTU (see Section 8.6 for more details on acute turbidity violations)
- failure to meet minimum *Giardia* and viral inactivation requirements for more than four consecutive hours
- failure to maintain an acceptable disinfectant residual leaving the plant for more than four consecutive hours
- more than 5% of the finished water turbidity readings were above 0.3 NTU for the month
- more than 5% of the disinfectant residual tests in the distribution system were below acceptable levels for two months in a row

## When to Issue a Public Notice for Non-Acute Treatment-Technique Violations

You must notify your customers of any treatment-technique violation as soon as possible after notifying us of the violation. However, the initial notice must be issued no later than 30 days after the date that the violation occurred even if you have not contacted us.

## How to Issue a Public Notice for Non-Acute Treatment-Technique Violations

A community water system must issue the public notice for a non-acute treatment-technique violation in a manner that is likely to reach all of the customers served by the water system. Specifically, a community water system must:

1. Mail (or deliver directly via some other method) a copy of the notice to each customer that receives a bill and to other service connections to which water is delivered by the public water system.
2. Use some other method that is likely to reach other persons regularly served by the system—these typically include house renters, apartment dwellers, university students, nursing-home patients, prison inmates, and others who do not receive a bill from the water system. Other methods may include:
    a. Publishing the notice in a local newspaper.
    b. Delivering multiple copies of the notice to customers that supply drinking water to others (e.g., apartment-building owners or large private employers).
    c. Delivering the notice to community organizations.
    d. Continuously posting the notice in conspicuous public places within the area served by the system or on the Internet. The notice must remain posted for at least seven days or for as long as the violation continues, whichever is longer.

A non-community water system must post the notice in conspicuous places in the area served by the system. Again, the notice must remain posted for at least seven days or for as long as the violation continues, whichever is longer.

### Information That You Must Include in the Public Notice

When you issue the public notice for a treatment-technique violation, you *must* include the appropriate mandatory wording. If you serve a significant Spanish-speaking population, you *must also* issue a Spanish version of the notice.

The English and Spanish versions of the public notification language for daily treatment-technique violations appear in Figures 8.6 and 8.7, respectively.

The English and Spanish versions of the public-notification wording for monthly treatment-technique violations appear in Figures 8.8 and Figure 8.9, respectively.

## Notice of Surface Water Treatment-Technique Violation (Daily)

The Texas Commission on Environmental Quality (TCEQ) sets minimum water quality standards for public drinking water. These standards include enforceable treatment technique requirements for drinking water. Inadequately treated water may contain disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea and associated headaches.

The **[enter the name of your public water system here]** failed to meet the minimum treatment technique requirements on **[enter the date or dates that the violation occurred]**. Specifically, our water system **[using the "Daily Violation List" below, enter the type of daily violation that occurred]**.

> **[You may add optional information here if you wish. See "Optional Paragraphs" below.]**

If you want more information about the nature and significance of this violation, you may contact [**enter the name of the individual <u>at your system</u> that you want your customers to call]** at **[enter the person's telephone number]**.

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

---

### Daily Violation List

Use one or more of these statements (as needed) when you enter the "type of daily violation" information:

- allowed the turbidity of the filtered water to exceed 1.0 Nephelometric Turbidity Units
- failed to properly disinfect the drinking water for a period of more than four hours
- allowed the disinfectant residual of the water entering the distribution system to fall below the acceptable level for more than four hours

---

### Optional Paragraphs

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

> The **[enter the name of your public water system here]** has taken the following corrective actions to prevent a recurrence of the violations:
>
> > **[list the actions you have taken]**.

---

### Ending Paragraph

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

TCEQ-20622 rev. 1/18/12

**Figure 8.6. Mandatory English wording for a daily treatment-technique violation.**

## Aviso de Violación de Técnicas de Tratamiento de Agua Superficial (Diario)

La Comisión de Calidad Ambiental de Texas (TCEQ) establece normas mínimas de calidad de agua para agua potable pública. Estas normas incluyen requisitos exigibles para técnicas de tratamiento para agua potable. El agua tratada en forma inadecuada puede contener organismos causantes de enfermedades. Estos organismos incluyen bacterias, virus y parásitos que podrían causar síntomas tales como náusea, calambres y diarrea.

El **[enter the name of your public water system here]** no cumplió con los requisitos técnicos mínimos de tratamiento en **[enter the date or dates that the violation occurred]**. Específicamente, nuestro sistema de agua **[using the "Daily Violation List" below, enter the type of daily violation that occurred]**.

> **[You may add optional information here if you wish. See "Optional Paragraphs" below.]**

Si desea más información sobre la naturaleza y el significado de esta violación, puede llamar a **[enter the name of the individual <u>at your system</u> that you want your customers to call]** al **[enter the person's telephone number]**.

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

### Daily Violation List

Use one or more of these statements (as needed) when you enter the "type of daily violation" information:

- permitió que la turbidez del agua filtrada sobrepasara 1.0 Unidad Nefelométrica de Turbidez
- dejó de desinfectar bien el agua potable por un período de más de cuatro horas
- permitió que el desinfectante residual del agua entrando al sistema de distribución cayera por debajo del nivel aceptable por más de cuatro horas

### Optional Paragraphs

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

> El **[enter the name of your public water system here]** ha realizado las siguientes medidas correctivas para prevenir la repetición de las violaciones:
>
> > **[list, in Spanish, the actions you have taken]**.

### Ending Paragraph

Por favor comparta esta información con todas las demás personas que toman esta agua, especialmente aquellas que quizás no hayan recibido este aviso directamente (por ejemplo, personas en departamentos, casas de reposo, escuelas y negocios). Puede hacer esto colocando este aviso en un lugar público o distribuyendo copias a mano o por correo.

TCEQ-20622/esp rev. 1/18/12

**Figure 8.7. Mandatory Spanish wording for a daily treatment-technique violation.**

## Notice of Surface Water Treatment Technique Violation (Monthly)

The Texas Commission on Environmental Quality (TCEQ) sets minimum water quality standards for public drinking water. These standards include enforceable treatment technique requirements for drinking water. Inadequately treated water may contain disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea and associated headaches.

The [enter the name of your public water system here] failed to meet the minimum treatment technique requirements for the month of **[enter the month and year that the violation occurred]**. Specifically, our water system **[using the "Monthly Violation List" below, enter the type of daily violation that occurred]**.

> **[You may add optional information here if you wish. See "Optional Paragraphs" below.]**

If you want more information about the nature and significance of this violation, you may contact **[enter the name of the individual <u>at your system</u> that you want your customers to call]** at **[enter the person's telephone number]**.

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

---

**Monthly Violation List**

Use one or both of these statements (as needed) when you enter the "type of monthly violation" information:

- allowed the turbidity of the filtered water to exceed 0.3 Nephelometric Turbidity Units in more than 5.0 percent of the measurements made during the month
- failed to maintain an acceptable disinfectant residual throughout the distribution system for two consecutive months

---

**Optional Paragraphs**

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

> The **[enter the name of your public water system here]** has taken the following corrective actions to prevent a recurrence of the violations:
>
> > **[list the actions you have taken]**.

---

**Ending Paragraph**

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

TCEQ-20623 rev. 1/18/12

**Figure 8.8. Mandatory English wording for a monthly treatment-technique violation.**

**Aviso de Violación de Técnicas de Tratamiento de Agua Superficial (Mensual)**

La Comisión de Calidad Ambiental de Texas (TCEQ) establece normas mínimas de calidad de agua para agua potable pública. Estas normas incluyen requisitos exigibles para técnicas de tratamiento para agua potable. El agua tratada en forma inadecuada puede contener organismos causantes de enfermedades. Estos organismos incluyen bacterias, virus y parásitos que podrían causar síntomas tales como náusea, calambres y diarrea.

El **[enter the name of your public water system here]** no cumplió con los requisitos técnicos mínimos de tratamiento en el mes de **[enter the month and year that the violation occurred]**. Específicamente, nuestro sistema de agua **[using the "Monthly Violation List" below, enter the type of daily violation that occurred]**.

> **[You may add optional information here if you wish. See "Optional Paragraphs" below.]**

Si desea más información sobre la naturaleza y el significado de esta violación, puede llamar a **[enter the name of the individual <u>at your system</u> that you want your customers to call]** al **[enter the person's telephone number]**.

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

---

**Monthly Violation List**

Use one or both of these statements (as needed) when you enter the "type of monthly violation" information:

- permitió que la turbidez del agua filtrada sobrepasara 0.3 Unidades Nefelométricas de Turbidez en más del 5.0 por ciento de las medidas hechas durante el mes
- dejó de mantener un residuo aceptable del desinfectante a través de todo el sistema de distribución por dos meses seguidos

---

**Optional Paragraphs**

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

> El **[enter the name of your public water system here]** ha realizado las siguientes medidas correctivas para prevenir la repetición de las violaciones:
>
> > **[list, in Spanish, the actions you have taken]**.

---

**Ending Paragraph**

Por favor comparta esta información con todas las demás personas que toman esta agua, especialmente aquellas que quizás no hayan recibido este aviso directamente (por ejemplo, personas en departamentos, casas de reposo, escuelas y negocios). Puede hacer esto colocando este aviso en un lugar público o distribuyendo copias a mano o por correo.

TCEQ-20623/esp rev. 1/18/12

**Figure 8.9. Mandatory Spanish wording for a monthly treatment-technique violation.**

## Additional Notification Requirements for Other Treatment-Technique Violations

If you ever have to issue a public notice for a treatment-technique violation, you must keep your customers informed about the status of the violation and let them know when it is corrected. Before issuing *any* of the additional notices, you must contact us so that we can discuss its content.

Following the initial public notice, you must:

1. Send a copy of the original notice to each customer within 45 days of the violation. This notice can be delivered by hand, mailed with the water bill, or mailed in a separate envelope.

   Before you issue these individual notices, you should contact us at 512-239-4691. We can (and routinely do) waive this requirement if the violation has been corrected within this 45-day period. However, we are required by both state and federal rules to issue this waiver in writing. Therefore, it is very important that you call us so that we can send you a letter.

2. Issue a notice telling your customers that the violation has been corrected. You must issue the notice in the same manner that you issued the original notice. This means that:
   a. If you published the original notice in local papers, you must publish the follow-up notice in each of those papers
   b. If you delivered the original notice by hand, you must hand-deliver the follow-up notice
   c. If you issued the original notice by posting it in conspicuous places, you must post the follow-up notice in the same places

3. Send us a signed copy of the certificate of delivery shown in Section 8.9 and a copy of each notice that you published in local newspapers or sent to your customers. If possible, the materials should be attached to your SWMOR. The copies of the follow-up notices must mailed to us, within 10 days of the date they are issued, at:

   Drinking Water Quality Team, MC 155
   Water Supply Division
   Attention: SWTR Coordinator
   TCEQ
   PO Box 13087
   Austin, TX 78711-3087

   You may submit documents to our physical address at:

   Drinking Water Quality Team, Building F
   Water Supply Division
   Attention: SWTR Coordinator
   TCEQ
   12100 Park 35 Circle
   Austin, TX 78753

## 8.8 When and How to Notify Your Customers of Monitoring-and-Reporting Violations

We have included several automated features in the SWMOR and SWMOR2 spreadsheets to reduce the number of reporting violations. However, if you do not run all of the tests required during the month, the spreadsheets will inform you that you have a monitoring-and-reporting (M&R) violation. If that happens, you must notify your customers of the violation. The information presented in this section applies to all M&R violations associated with the various surface water treatment rules.

Depending on the severity of the M&R violation, we will require you to issue one of two different public notices. Although the notices say essentially the same thing, one is designed for plants that did very little (or none) of the required testing while the other is designed for plants that only missed a few of the tests.

### When to Issue a Public Notice for M&R Violations

You must notify your customers of any M&R violation as soon as possible after notifying us of the violation. However, the initial notice must be issued no later than 90 days after the date that the violation occurred.

### How to Issue a Public Notice for M&R Violations

A community water system that has an M&R violation must publish the notice in a daily newspaper of general circulation in the area served by the system. If the area is not served by a daily newspaper, the notice shall instead be published in a weekly newspaper of general circulation serving the area. If the area is not served by either a daily or weekly newspaper, notice shall instead be given by direct delivery or by continuous posting in conspicuous places within the area served by the system. The posted notice must remain posted for at least seven days or for as long as the violation exists, whichever is longer.

A non-community water system must post the notice in conspicuous places in the area served by the system. Again, the notice must remain posted for at least seven days or for as long as the violation exists, whichever is longer.

#### Information That You Must Include in the Public Notice

The public notices issued following an M&R violation do not have to contain any mandatory health effect language. However, the notice *must* identify each specific test that you failed to run and the month or days when you did not run all of the required tests. If you serve a significant Spanish-speaking population, you *must also* issue a Spanish version of the notice.

The English and Spanish versions of the suggested public notification language for a major M&R violation are shown in Figures 8.10 and 8.11, respectively. The English and Spanish versions of the suggested public notification language for a minor M&R violation are shown in Figures 8.12 and 8.13, respectively.

## Notice of Surface Water Monitoring or Reporting Violation (Major)

The Texas Commission on Environmental Quality (TCEQ) requires public water systems to monitor drinking water for specific contaminants on a regular basis. Results of regular monitoring are an indicator of whether or not your drinking water meets health standards. During **[enter the month and year that the monitoring violation occurred]**, the **[enter the name of your public water system]** did not conduct the proper testing for:

> **[list the test(s) you did not run]**,

We cannot be sure of the quality of your drinking water during that time.

> **[You may add optional information here if you wish. See "Optional Paragraphs" below.]**

If you want more information about the nature and significance of this violation, you may contact **[enter the name of the individual at your system that you want your customers to call]** at **[enter the person's telephone number]**.

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

### Identifying the Test(s)

Identify the areas where you did not run all of the required tests. For example:

- The turbidity of the treated water
- The turbidity of the water produced by each of the plant's filters
- The disinfection process
- The disinfectant residual leaving the plant
- The disinfectant residual in our service area

### Optional Paragraphs

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

> The **[enter the name of your public water system here]** has taken the following corrective actions to prevent a recurrence of the violations:
>
> > **[list the actions you have taken]**.

### Ending Paragraph

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

TCEQ-20618 rev. 1/18/12

**Figure 8.10. Mandatory English wording for a major M&R violation.**

## Aviso de Violación de Requisitos de Monitoreo o de Informe de Agua Superficial (Mayor)

La Comisión de Calidad Ambiental de Texas (TCEQ) requiere que los sistemas públicos de agua hagan monitoreo regular del agua potable para la presencia de contaminantes específicos. Los resultados de monitoreo regular son indicadores de si su agua potable cumple o no con las normas de salud. Durante **[enter the month and year that the monitoring violation occurred]**, el **[enter the name of your public water system]** no realizó la prueba apropiada para:

> **[list the test(s) you did not run].**

Por lo tanto, no podemos asegurar la calidad de su agua potable durante ese período.

> **[You may add optional information here if you wish. See "Optional Paragraphs" below.]**

Si desea más información sobre la naturaleza y el significado de esta violación, puede llamar a **[enter the name of the individual <u>at your system</u> that you want your customers to call]** al **[enter the person's telephone number].**

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

---

### Identifying the Test(s)

Identify the areas where you did not run all of the required tests. For example:

- la turbidez del agua tratada
- la turbidez del agua producida en cada filtro de la planta
- el proceso de desinfección
- el residuo de desinfectante saliendo de la planta
- el residuo de desinfectante en nuestra área de servicio

---

### Optional Paragraphs

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

> El **[enter the name of your public water system here]** ha realizado las siguientes medidas correctivas para prevenir la repetición de las violaciones:
>
> > **[list, in Spanish, the actions you have taken]**.

---

### Ending Paragraph

Por favor comparta esta información con todas las demás personas que toman esta agua, especialmente aquellas que quizás no hayan recibido este aviso directamente (por ejemplo, personas en departamentos, casas de reposo, escuelas y negocios). Puede hacer esto colocando este aviso en un lugar público o distribuyendo copias a mano o por correo.

TCEQ-20618esp rev. 1/18/12

**Figure 8.11. Mandatory Spanish wording for a major M&R violation.**

## Notice of Surface Water Monitoring or Reporting Violation (Minor)

The Texas Commission on Environmental Quality (TCEQ) requires public water systems to monitor drinking water for specific contaminants on a regular basis. Results of regular monitoring are an indicator of whether or not your drinking water meets health standards. **[Identify the appropriate monitoring interval from the list below]**, the **[enter the name of your public water system]** only completed some of the tests needed to monitor for: **[list the test(s) you did not run]**

We cannot be sure of the quality of your drinking water during the times we did not properly monitor.

> **[You may add optional information here if you wish. See "Optional Paragraphs" below.]**

If you want more information about the nature and significance of this violation, you may contact **[enter the name of the individual <u>at your system</u> that you want your customers to call]** at **[enter the person's telephone number].**

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

---

**Identifying the Monitoring Interval**

If the violation occurred on just a couple of days, you may say

"On **[date1]**, **[date2]**, and **[date3]**, the . . . . "

If the violations occurred on several days, you may say

"During the month of **[Month]**, **[Year]**, the . . . . "

---

**Identifying the Test(s)**

Identify the areas where you ran most but not all of the required tests. For example:

- The turbidity of the treated water
- The turbidity of the water produced by each of the plant's filters
- The disinfection process
- The disinfectant residual leaving the plant
- The disinfectant residual in our service area

---

**Optional Paragraphs**

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

Although we missed some of our tests, the other results indicated that the water was safe to drink.

OR

We have taken the following actions to correct the problem: **[list the actions you have taken].**

---

**Ending Paragraph**

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

TCEQ-20619 rev. 1/18/12

**Figure 8.12. Mandatory English wording for a minor M&R violation.**

## Aviso de Violación de Requisitos de Monitoreo o de Informe de Agua Superficial (Menor)

La Comisión de Calidad Ambiental de Texas (TCEQ) requiere que los sistemas públicos de agua hagan monitoreo regular del agua potable para la presencia de contaminantes específicos. Los resultados de monitoreo regular son indicadores de si su agua potable cumple o no con las normas de salud. **[Identify the appropriate monitoring interval from the list below]**, el **[enter the name of your public water system]** sólo completó algunas de las pruebas necesarias para monitorear:

> **[list the test(s) you did not run]**.

Por lo tanto, no podemos asegurar la calidad de su agua potable durante los períodos que no monitoreamos adecuadamente.

> **[You may add optional information here if you wish. See "Optional Paragraphs" below.]**

Si desea más información sobre la naturaleza y el significado de ésta violación, puede llamar a **[enter the name of the individual <u>at your system</u> that you want your customers to call]** al **[enter the person's telephone number]**.

> **[Unless you are certain that each person you serve is getting a copy of this notice, you must add the "Ending Paragraph" below.]**

---

**Identifying the Monitoring Interval**

If the violation occurred on just a couple of days, you may say
"En **[fecha 1]**, **[fecha 2]**, y **[fecha 3]**, el ...."
If the violations occurred on several days, you may say
"Durante el mes de **[mes]**, **[año]**, el..."

---

**Identifying the Test(s)**

Identify the areas where you did not run all of the required tests. For example:

- la turbidez del agua tratada
- la turbidez del agua producida en cada filtro de la planta
- el proceso de desinfección
- el residuo de desinfectante saliendo de la planta
- el residuo de desinfectante en nuestra área de servicio

---

**Optional Paragraphs**

You may add other language if you want to. The added statements must appear in one or more separate paragraphs and must be both pertinent and factual. For example,

> Aunque se nos pasaron algunas de nuestras pruebas, los otros resultados indicaron que el agua era segura para el consumo.

OR

> Hemos tomado las siguientes medidas para corregir el problema:
> **[list, in Spanish, the actions you have taken]**.

---

**Ending Paragraph**

Por favor comparta esta información con todas las demás personas que toman esta agua, especialmente aquellas que quizás no hayan recibido este aviso directamente (por ejemplo, personas en departamentos, casas de reposo, escuelas y negocios). Puede hacer esto colocando este aviso en un lugar público o distribuyendo copias a mano o por correo.

TCEQ-20619/esp rev. 1/18/12

**Figure 8.13. Mandatory Spanish wording for a minor M&R violation.**

## Proving to Us That You Issued Your Public Notice Properly

You must send us a copy of any public notice that you issue so that we can make sure it contained the required information. To ensure that the notices were issued in the proper manner, you must also complete, sign, and submit a copy of the certificate of delivery shown in Figure 8.14. An electronic copy of the form can be downloaded from the TCEQ website at the following address:

www.tceq.texas.gov/goto/swtp/forms

On that web page, click on “Monitoring and Reporting for Surface Water Systems” in order to find the needed forms. The public notification materials must mailed to us within 10 days of the date when the notice is issued. If possible, they should be attached to your SWMOR. The public-notice information for violations of surface water treatment rules must be mailed to:

Drinking Water Quality Team, MC 155
Water Supply Division
Attention: SWTR Coordinator
TCEQ
PO Box 13087
Austin, TX 78711-3087

You may submit documents to our physical address at:

Drinking Water Quality Team, Building F
Water Supply Division
Attention: SWTR Coordinator
TCEQ
12100 Park 35 Circle
Austin, TX 78753

PWS / ____________ / CO

Texas Commission on Environmental Quality

CERTIFICATE OF DELIVERY OF PUBLIC NOTICE TO CUSTOMERS: TIER I

Public Notice to be posted within **24 hours** of initial violation notification

Public Water System (PWS) name: ______________________________________________

PWS ID: ______________________ Month / Year of violation(s): ____________________

Type of Total Coliform Rule, Ground Water Rule, or Surface Water Treatment Rule violation(s) or situation(s):

____ Acute Maximum Contaminant Level (AMCL) coliform violation in distribution
____ *E. coli* or other fecal indicators in a raw groundwater source sample
____ Treatment technique violation (Surface Water Treatment Rule)

30 TAC 290.122(a) requires that your PWS make an adequate, good-faith effort to reach all consumers served by the system by appropriate methods (check all below that apply):

**COMMUNITY WATER SYSTEM:**

____ Provide a copy of the acute notice to the radio and television stations serving the area surrounding the public water system

**And:**

____ Publish the acute notice in local newspaper

**If no newspaper is available:**

____ Deliver the acute notice directly to each customer, or
____ Post the acute notices in conspicuous places within the water system

**NONCOMMUNITY WATER SYSTEM:**

____ Mail or directly deliver PN to each customer and service connection, or
____ Post PN in conspicuous places within the water system

“I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.”

Certified by: (print name): ______________________________ Title: ____________________

Date of Delivery to Customers: _________________ Phone: ____________________________

Signature: ______________________________________________ Date: _________________

**Fax to (512) 239-3666 or mail a copy of this completed form, AND copies of the Public Notices given to your customers to: TCEQ–Public Drinking Water Section MC-155, Attn: Public Notice, P. O. Box 13087, Austin, TX 78711-3087.**

TCEQ Form 20615 Revised 1/18/12

**Figure 8.14. Certificate of delivery for 24-hour SWMOR public notices.**

PWS / ____________ / CO

Texas Commission on Environmental Quality

CERTIFICATE OF DELIVERY OF PUBLIC NOTICE TO CUSTOMERS: TIER II

Public Notice to be posted within **30 days** of initial violation notification

Public Water System (PWS) name: ________________________________________________

PWS ID: ________________________ Month / Year of violation(s): _____________________

Type of Total Coliform Rule, Ground Water Rule, or Surface Water Treatment Rule violation(s) or situation(s):

- ____Non-Acute Maximum Contaminant Level coliform violation (MCL) in distribution
- ____Non-compliance with Corrective Action Plan or Schedule for a fecal indicator-positive raw groundwater source sample or Significant Deficiency
- ____Treatment technique violation (Ground Water or Surface Water Treatment Rule)

30 TAC 290.122(b) requires that your PWS make an adequate, good-faith effort to reach all consumers served by the system by appropriate methods (check all below that apply):

**COMMUNITY WATER SYSTEM:**

- ____Mail or directly distribute PN to each customer receiving a bill and to other service connections to which water is delivered by the public water system

**and at least one of the following methods if direct delivery may not reach all persons regularly served by the system:**

- ____ Publish PN in local newspaper
- ____ Continuous posting in conspicuous places
- ____ Deliver multiple PNs to single-bill addresses serving several persons (e.g., apartment building owners or large private employers)
- ____ Deliver PN to community organizations
- ____ Post PN on the Internet at: *www.*________________________________________

**NONCOMMUNITY WATER SYSTEM:**

- ____Mail or directly deliver PN to each customer and service connection, or
- ____Post PN in conspicuous places within the water system

**and at least one of the following methods if direct delivery or public posting may not reach all persons regularly served by the system:**

- ____ Publish PN in local newspaper or newsletter
- ____ Send e-mail to notify students or employees
- ____ Deliver PN to central locations (for example, community centers)

***SIGNATURE REQUIRED ON REVERSE SIDE***

TCEQ Form 20616 TWO-PAGE FORM: COMPLETE BOTH SIDES Revised 1/18/12

**Figure 8.15a. Certificate of delivery for 30-day SWMOR public notices, first page.**

PWS / ___________ / CO

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

Certified by: (print name): ____________________ Title: ___________________

Date of Delivery to Customers: _________ Phone: ________________________

Signature: _____________________________________ Date: _____________

**Fax to (512) 239-3666 or mail a copy of this completed form, AND copies of the Public Notices given to your customers to: TCEQ–Public Drinking Water Section MC-155, Attn: Public Notice, P. O. Box 13087, Austin, TX 78711-3087.**

***BOTH SIDES OF THIS FORM, PLUS THE COMPLETED MANDATORY LANGUAGE, MUST BE DELIVERED TO THE TCEQ FOR PUBLIC NOTICE COMPLIANCE.***

TCEQ Form 20616 TWO-PAGE FORM: COMPLETE BOTH SIDES Revised 1/18/12

**Figure 8.15b. Certificate of delivery for 30-day SWMOR public notices, second page.**

PWS / ___________ / CO

Texas Commission on Environmental Quality
CERTIFICATE OF DELIVERY OF PUBLIC NOTICE TO CUSTOMERS: TIER III
Public Notice to be posted within **90 days** of initial violation notification

Public Water System (PWS) name: ________________________________________________
PWS ID: _______________________ Month / Year of violation(s): ____________________

Type of Total Coliform Rule, Ground Water Rule, or Surface Water Treatment Rule violation(s) or situation(s):

- ___ Distribution Coliform Routine Monitoring or Temporary Increased Routine Monitoring violation
- ___ Repeat Coliform Monitoring violation
- ___ Triggered Source Monitoring (raw groundwater source sample) violation
- ___ Surface Water Treatment Rule Monitoring or Reporting violation

30 TAC 290.122(b) requires that your PWS make an adequate, good-faith effort to reach all consumers served by the system by appropriate methods (check all below that apply):

**COMMUNITY WATER SYSTEM:**

- ____Mail or directly distribute PN to each customer receiving a bill and to other service connections to which water is delivered by the public water system

**and at least one of the following methods if direct delivery may not reach all persons regularly served by the system:**

- ____ Publish PN in local newspaper
- ____ Post PN in public places
- ____ Deliver multiple PNs to single-bill addresses serving several persons (e.g., apartment building owners or large private employers)
- ____ Deliver PN to community organizations
- ____ Post PN on the Internet at: *www.*_________________________________

**NONCOMMUNITY WATER SYSTEM:**

- ____Mail or directly deliver PN to each customer and service connection, or
- ____Post PN in conspicuous places within the water system

**and at least one of the following methods if direct delivery or public posting may not reach all persons regularly served by the system:**

- ____Publish PN in local newspaper
- ____Deliver multiple PNs for distribution by customers that provide their drinking water to others (e.g. apartment building owners or large private employers)
- ____Post PN in public places
- ____Deliver PN to community organizations
- ____Post PN on the Internet at: *www.*______________________________

***SIGNATURE REQUIRED ON REVERSE SIDE***

TCEQ Form 20617 TWO-PAGE FORM: COMPLETE BOTH SIDES Revised 1/18/12

**Figure 8.16a. Certificate of delivery for 90-day SWMOR public notices, first page.**

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

Certified by: (print name): ______________________________ Title: ____________________

Date of Delivery to Customers: ________________ Phone: ____________________________

Signature: ______________________________________________ Date: _________________

**Fax to (512) 239-3666 or mail a copy of this completed form, AND copies of the Public Notices given to your customers to: TCEQ–Public Drinking Water Section MC-155, Attn: Public Notice, P. O. Box 13087, Austin, TX 78711-3087.**

***BOTH SIDES OF THIS FORM, INCLUDING THE COMPLETED MANDATORY LANGUAGE, MUST BE DELIVERED TO THE TCEQ FOR PUBLIC NOTICE COMPLIANCE.***

TCEQ Form 20617 TWO-PAGE FORM: COMPLETE BOTH SIDES Revised 1/18/12

**Figure 8.16b. Certificate of delivery for 90-day SWMOR public notices, second page.**

# 9. INSTRUCTIONS FOR COMPLETING THE SWMOR2 SPREADSHEET

We allow some small surface water treatment plants to operate without a turbidimeter on each filter—only if they meet *all* of the following five requirements:

1. The public water system operating the plant must serve fewer than 10,000 people including those served through wholesale connections.
2. The plant must have no more than two filters.
3. The filters must have been constructed prior to October 2000.
4. The filters must not have (and may never have had) Individual Filter Effluent (IFE) turbidimeters.
5. The plant must have a combined-filter-effluent (CFE) turbidimeter installed prior to the clearwell.

The monitoring and reporting requirements for plants that only have CFE turbidimeters are very different from the requirements for plants that have IFE turbidimeters. Consequently, we have prepared a different spreadsheet, the SWMOR2, for the plants that do not have IFE turbidimeters. **These plants, and only these plants, should use the SWMOR2 instead of the SWMOR.**

The SWMOR2 and the SWMOR spreadsheets share many features and are very similar in appearance. However, it is important for you to know the differences, for additional instructions are necessary for completing the SWMOR2. **Plants that have (or are supposed to have) IFE turbidimeters do not need to read this chapter.**

## 9.1 INTRODUCTION

This section serves as a supplement to Chapter 1. However, this section focuses on the differences between the SWMOR2 and the SWMOR. We do not repeat much of the information contained in Chapter 1 if it applies to both spreadsheets. Consequently, you need to be familiar with the information in Chapter 1 to use the SWMOR2 spreadsheet.

**NOTE**
This chapter contains several cross-references to earlier chapters and sections in this manual. When we tell you that a particular part of Chapter 9 serves as a supplement to an earlier section, we are telling you that we are not repeating all of the information we discussed earlier. If you have any questions about the information we include in this chapter, you will need to review the earlier information.
The SWMOR2 has nine pages instead of five. That is because you must report much more finished-water turbidity data than you would if you had a turbidimeter on each filter. In fact, you will be reporting 16 times as much CFE turbidity data as you would if you had IFE meters.

One of the next things you will probably notice is that the SWMOR2 seems to run much slower than the SWMOR. It takes longer to open the file, change worksheets, and save the file. This apparent “slowness” in the SWMOR2 is because the SWMOR2 is actually running more than 40 times as many compliance determinations on the turbidity data as the SWMOR runs.

## SWMOR2 Spreadsheet Features

You must complete the SWMOR2 electronically. We developed the SWMOR2 using Microsoft Excel 2003. Some of the new macro commands used in this spreadsheet do not exist in earlier versions of Excel. Consequently, you must have Excel 2000 or a later version to use this form. SWMOR2 has built-in functions and macros that serve the same roles as those in SWMOR. Please refer to Section 1.5 for a general description of these features.

## How the SWMOR2 Is Organized

The SWMOR2 spreadsheet has five separate worksheets that contain a total of nine pages. You must submit all nine pages when you submit the report. Table 9.1 summarizes the pages of the SWMOR2 and their content.

**Table 9.1. Contents of the SWMOR2.**

| Page | Worksheet Title | Contents |
|---|---|---|
| 1 | Summary | This page contains a summary of your monthly data, and shows whether the plant was in compliance for the month. |
| 2 | Turbidity Data | This page has the raw- and treated-water data, and the disinfectant residual entering the distribution system. You will not use this page to report your CFE turbidity results. |
| 3 | Filter Data | This page has the grab-sample turbidity data, along with a CFE summary and compliance actions. |
| 4–5 | Disinfection Data | These pages contain the data about daily microbial inactivation. |
| 6–9 | CFE Turbidity Data | These pages have the CFE turbidity data. |
| 10-12 | TOC MOR | These pages have TOC removal data |

The sequence of completing the form is very similar to that for the SWMOR (Table 9.2).

**Table 9.2. Sequence for completing the SWMOR2.**

| Step | Process |
|---|---|
| **0** | **Customize your SWMOR2** (see Section 9.2) and save it with a sensible file name. You only have to do this once for each plant. |
| **1** | **Create that Month's File** (see Section 9.2):<br>Enter Month, Year, Connections, and Population and then save the file for that specific month. You must do this once a month for each plant. |
| **2** | **Enter Each Day's Data** (see Section 9.3):<br>Flow, turbidity, residual, total organic carbon, and so forth. You must do this each day for each plant. |
| **3** | **Fill out the Summary page** (see Section 9.3):<br>You must do this at the end of each month for each plant. |
| **4** | **Print, Sign, and Submit that month's SWMOR2** (see Section 9.3):<br>You must do this at the end of each month for each plant. |

# 9.2 Customizing Your SWMOR2

This section serves as a supplement to Chapter 2. You create and customize the SWMOR2 in much the same manner that other plants create and customize their SWMOR spreadsheet. It is very important that you be familiar with the material in Chapter 2 before you proceed.

## Fill Out the Plant Parameters Dialog Box

The directions we provide in Section 2.2 for filling out the SWMOR's plant parameters dialog box also apply to the SWMOR2. The only differences between the two spreadsheets are related to the number of filters and what will happen when you finish entering the data and click on the [OK] button.

We designed the SWMOR2 for plants that only have one filter and for plants that have two filters, a CFE turbidimeter, and no IFE turbidimeters. Consequently, SWMOR2 will give you the error message shown in Figure 9.1 if you tell it you have more than two filters.

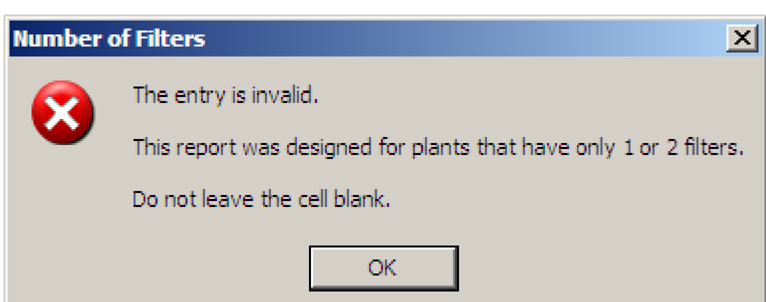



**Figure 9.1. Error message box for the SWMOR2.**

If you get this error message, click the [OK] button to return to the dialog box and reenter the proper number of filters. If you have more than two filters, you are using the wrong spreadsheet; you need to be using the SWMOR report.

If you report that you have two filters, the SWMOR2 will ask you to confirm that you have a turbidimeter on the combined filter effluent but do not have a turbidimeter on each filter. If this is correct, click on the [Yes] button and continue entering data. If this is not correct, click on the [No] button.

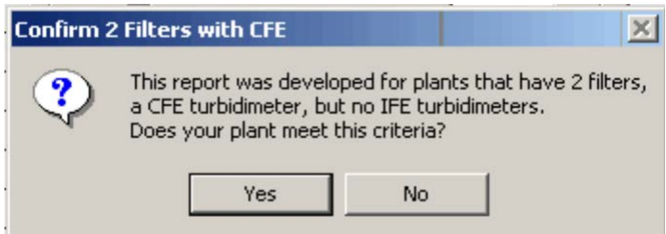
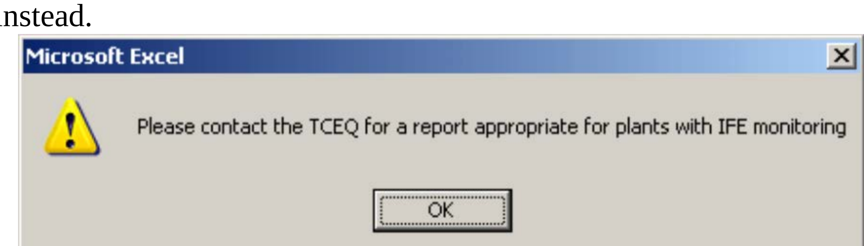



**Figure 9.2. Two-filter confirmation box for the SWMOR2.**

**IMPORTANT**
If the answer to the question in the confirmation dialog box shown as Figure 9.2 is "No," it means that you should use SWMOR instead of SWMOR2. Once you click the [No] button, the box shown below will pop up. You have to click the [OK] button before the macro will finish running. This macro adds a watermark to each of the worksheets stating *"You have indicated that your plant uses Individual Filter Effluent monitors. Therefore you must use the regular SWMOR. Contact the TCEQ for this report."* Although the spreadsheet is still functional, the watermark will be printed on every page when you print the report and the TCEQ will not accept the report. You should immediately close the spreadsheet without saving any changes and use the SWMOR instead.




Once you have finished entering all the data and click [OK] button, one of the two boxes shown in Figure 9.3 will pop up and ask you to confirm that you are eligible to use the SWMOR2 report. If the answer is yes, then click [Yes] and the macro will finish running and create the customized SWMOR2 for your plant. This procedure may take a while (generally less than 180 seconds) but it takes longer than with the SWMOR. As explained in Section 2.2, touching any button during this waiting period might cause serious problems. When the macro finishes running, you will be in the spreadsheet and ready to enter data.

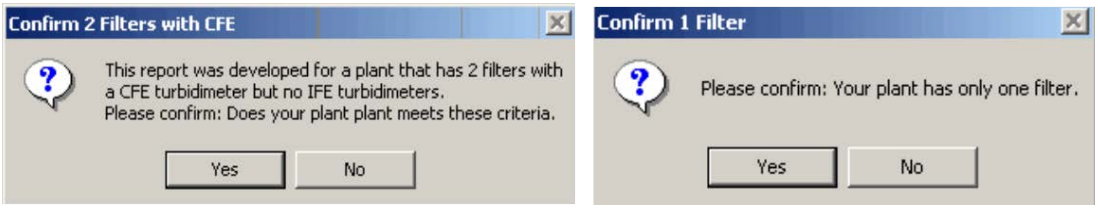



**Figure 9.3. Final confirmation boxes for the SWMOR2.**

After the plant parameters macro finishes running, you will still need to finish customizing the SWMOR2 for your plant and then save the customized spreadsheet. This process is exactly the same as it is for the SWMOR spreadsheet. Please refer to Section 2.2 for identifying your plant on page 2, entering **Disinfection Process Parameters** data on page 4, and saving your customized spreadsheet.

### Creating Monthly Files

Please refer to Section 2.3, which also applies to the SWMOR2, for instructions on creating monthly files.

## 9.3 Entering Monthly Data on the SWMOR2

Every day that your plant treats water or sends water to the distribution system, you must monitor plant operations and record the data you collect in the tables on pages 2 through 9 of the SWMOR2. Although this section covers some of the important differences in the way that data is entered on the two forms, it does not repeat the information that is the same for the two reports. This section supplements the information presented in Chapter 3. Please refer to the beginning of Chapter 3 for help on how to enable the macros and (in virtually all cases) cancel the plant parameters dialog box. The specific areas in Chapter 3 that you will need to use for SWMOR2 include:

- Section 3.1—except for the subsection “Turbidity (of the Finished Water)”
- Sections 3.3 through 3.5

### Enter Daily Performance Data (Page 2)

The only difference between page 2 of the SWMOR and page 2 of the SWMOR2 has to do with where you will enter the plant’s data on finished-water turbidity; in the SWMOR2 spreadsheet, the CFE turbidity data is entered on pages 6 through 9 rather than on page 2.

All the turbidity columns have been grayed out in the SWMOR2 spreadsheet. You cannot enter data there now. The finished water turbidity section has been modified and moved to pages 6 through 9 of the SWMOR2. You should enter all of your finished water turbidity data on pages 6 though 9 of the SWMOR2.

All of the other data on page 2 are entered in the same way on both reports. Section 9.3.2 (located below) contains the instructions for entering the CFE turbidity data on SWMOR2. For help on entering the other data on page 2, refer to the applicable part of Section 3.1. For example:

- For information on entering raw- and settled-water data, refer to Subsection 3.1.1 of this manual.

- For information on entering information about the disinfectant residual in the treated water, refer to Subsection 3.1.3 of this guidance manual.

## Enter Finished Water Turbidity Data (Pages 6–9)

Data on finished-water turbidity is entered on pages 6 through 9. To get there, click on the **P.6~9 CFE Turbidity Data** tab at the bottom of the spreadsheet, as shown in Figure 9.4.

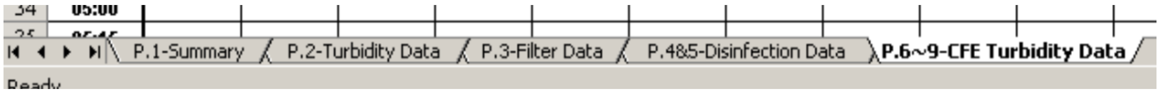



**Figure 9.4. SWMOR2 tabs.**

You must measure the turbidity of the finished water each day that your plant treats water and record the data on pages 6 through 9 of the SWMOR2. These pages serve the same role as the **Turbidity** columns on page 2 in the SWMOR.

***What Test to Run*:** Using an acceptable method from Table 7.1, measure the turbidity of the finished water on a regular schedule using an online turbidimeter. You must check the calibration of the turbidity monitor at least once each week. See Section 4.2 for more information about calibrating continuous turbidity monitors and recorders.

**IMPORTANT**
Try to avoid calibrating your turbidimeters immediately before a sample is scheduled to be collected. If there is a problem during calibration, you could end up recording an erroneous result. To avoid this problem, you need to calibrate the meter when the plant is offline so that you don't end up missing a sample.

***Where to Sample*:** All samples must be collected at a point between the filters and the clearwell. The TCEQ will not approve other sampling sites for plants that do not have turbidimeters on each filter. For plants using two filters, the sampling point must also be located downstream of (after) the water leaving the two filters has been blended.

***When to Sample*:** Turbidity readings must be collected at regular 15-minute intervals whenever the plant is in operation using an online turbidity monitor. For example, you may take these readings at midnight, 00:15, 00:30, 00:45, and so on to 23:45. Use the same schedule every day. Only the readings made at the designated times can be used to determine whether your plant is in compliance.

A plant that experiences a failure in the continuous monitoring equipment may collect grab samples every four hours for no more than 14 working days. If the result of a grab sample is greater than 1.0 NTU, the plant must collect a confirmation sample 15 minutes later.

***How to Enter Results*:** The SWMOR2 contains 31 columns and 96 rows for recording the turbidity of the finished water. Each column represents a different day of the month and each row represents a different 15-minute period of the day—for example, the midnight row represents midnight to 00:15. If your plant is in operation during any portion of the 15-minute period, you must measure and record a turbidity reading and enter the result in the appropriate row. If your plant is offline during the entire 15-minute period, enter <X> in the corresponding row.

## Enter Daily IFE Turbidity Data and CFE Summary Data (Page 3)

If your plant has two filters, you must collect at least one grab sample from each of the two filters at least once each day that the filter is in service. The **Performance Data** table on page 3 of the SWMOR2 contains columns for recording the turbidity of the grab sample of the two filters. Figure 9.5 shows the portion of the SWMOR2 that is described in this portion of the manual.

| PERFORMANCE DATA | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | INDIVIDUAL FILTER GRAB SAMPLE TURBIDITY | | | | | | | | | | | | | |
| | Filter No. 1 | | Filter No. 2 | | | | | | | | | | | |
| Date | Grab Sample | | Grab Sample | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | |

**Figure 9.5. Individual Filter Turbidity data section of the SWMOR2.**

***What Test to Run:*** You must use one of the acceptable methods from Table 7.1 to measure the turbidity of the water produced by each filter.

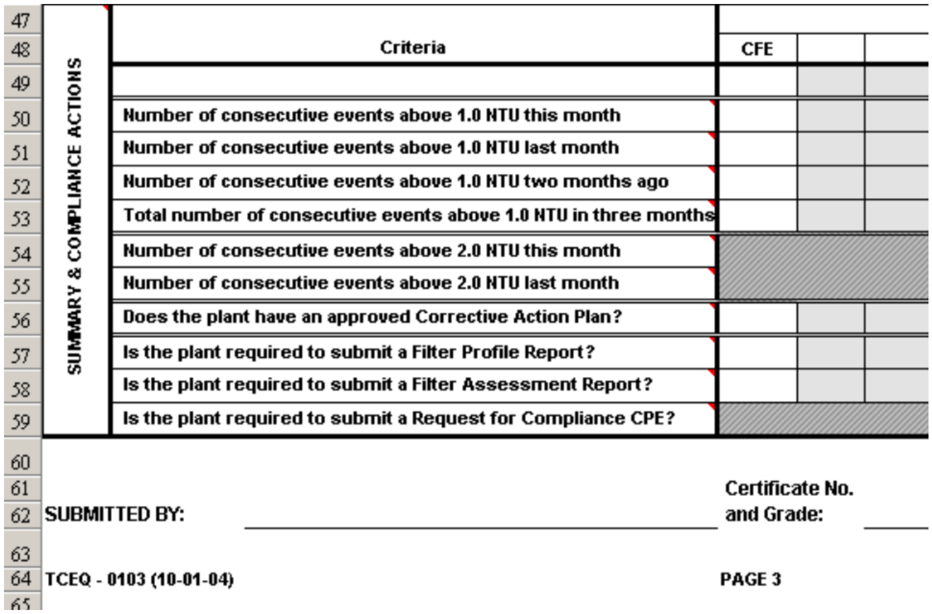
***Where to Sample:*** You must collect the IFE turbidity sample at the outlet of each filter before that water is mixed with the water from any other filter.

***When to Sample:*** If your system serves fewer than 10,000 people, you must measure and record the turbidity level from each filter that is in operation at least once during the day. The sample must be collected when the filter is in a normal operation mode and is sending filtered water to the clearwell. **Do not** collect the sample when the filter is being backwashed, when it is idle, when it is operating in a filter-to-waste mode, or during the first 15 minutes of a filter run.

***How to Enter Results:*** You must measure and record the turbidity of the grab sample for the two filters each day that your plant treats water. That means that you must record turbidity results each day that you show a raw water pumpage above 0.000 MGD.

### Summary and Compliance Actions (page 3)

The **Summary and Compliance Actions** table at the bottom of page 3 of the SWMOR2 contains columns for summarizing the historical finished water turbidity data (i.e., the CFE data from the full current month and the previous two months). Figure 9.6 shows this portion of the SWMOR2, and specific instructions about each line are given below. For reporting months January and February 2005, appropriate cells have been disabled because of the lack of historical data.



| | | | |
|---|---|---|---|
| 47 | | | |
| 48 | SUMMARY & COMPLIANCE ACTIONS | Criteria | CFE |
| 49 | | | |
| 50 | | Number of consecutive events above 1.0 NTU this month | |
| 51 | | Number of consecutive events above 1.0 NTU last month | |
| 52 | | Number of consecutive events above 1.0 NTU two months ago | |
| 53 | | Total number of consecutive events above 1.0 NTU in three months | |
| 54 | | Number of consecutive events above 2.0 NTU this month | |
| 55 | | Number of consecutive events above 2.0 NTU last month | |
| 56 | | Does the plant have an approved Corrective Action Plan? | |
| 57 | | Is the plant required to submit a Filter Profile Report? | |
| 58 | | Is the plant required to submit a Filter Assessment Report? | |
| 59 | | Is the plant required to submit a Request for Compliance CPE? | |
| 60 | | | |
| 61 | | | Certificate No. |
| 62 | SUBMITTED BY: | | and Grade: |
| 63 | | | |
| 64 | TCEQ - 0103 (10-01-04) | | PAGE 3 |
| 65 | | | |

**Figure 9.6. Summary and Compliance Actions section on page 3 of the SWMOR2.**

.

### Number of events above 1.0 NTU this month CALC

The SWMOR2 counts the number of events when two or more consecutive 15-minute turbidity readings were above 1.0 NTU. The SMWOR2 bases this calculation on the CFE turbidity data you entered on pages 6 through 9.

> **NOTE**
> An uninterrupted series of readings above 1.0 NTU is considered to be a single event. For example:
> - An event that started at 4:15 a.m. with a reading of 1.1 NTU and ended at 5:15 am with a reading of 0.93 NTU will be considered a single event.
> - An event that started at 11:30 p.m. with a reading of 1.3 NTU and ended with a reading of 0.79 NTU at 1:15 a.m. the following morning will be considered a single event.

### Number of events above 1.0 NTU last month

In this cell, record the number of events above 1.0 NTU during the last reporting month. Pull this information from the cell **Number of events above 1.0 NTU this month** on last month's SWMOR2.

### Number of events above 1.0 NTU two months ago

Record the number of events above 1.0 NTU that occurred during the reporting period two months ago. If you pull this information from the **Number of events above 1.0 NTU last month** cell of last month's SWMOR2, you will not have to look at the SWMOR2 from two months ago.

### Total number of events above 1.0 NTU in three months CALC

The SWMOR2 calculates the total number of events above 1.0 NTU during the last three reporting months using the information in the three cells above.

### Number of consecutive events above 2.0 NTU this month CALC

The SWMOR2 counts the number of events when two or more consecutive 15-minute turbidity readings were above 2.0 NTU. The SWMOR2 again bases this calculation on the CFE turbidity data you entered on pages 6 through 9.

### Number of consecutive events above 2.0 NTU last month

You will need to record the number of consecutive events above 2.0 NTU during the last reporting month. Pull this information from the cell **Number of consecutive events above 2.0 NTU last month** of last month's SWMOR2.

### Does the plant have an approved Corrective Action Plan?

Using the drop-down lists, indicate whether the plant has an approved corrective-action plan. The SWMOR2 will automatically create the appropriate drop-down list based on the data that you have entered on this worksheet and pages 6 through 9. However, you will need to select the answer that applies to your plant. For example:

- If your plant will not be required to conduct any additional monitoring this month, the SWMOR2 will give you the option of <NA> or <Y> from the drop-down list.
  If your plant does not have an approved CAP, select <NA>.
  If it does have an approved CAP, select <Y>.
- If your plant will be required to complete any additional monitoring, the SWMOR2 will give you the option of selecting <Y> or <N> from the drop-down list.
  If your plant does have an approved CAP, select <Y> because there is no need to complete the special study and develop a new CAP.
  If it does not have an approved CAP, select <N> from the drop-down list and the SWMOR2 will tell you what follow-up action to take.

**IMPORTANT**

There are two different types of corrective-action plans. The first type is a CAP that the plant staff develops itself based on the results of special studies conducted by plant staff or a contractor. The second type of CAP is developed by our staff following a mandatory comprehensive performance evaluation (mCPE) that we conduct.

The mCPE is a more comprehensive evaluation than those typically conducted by plant staff. Consequently, the action plan we prepare following a mCPE can be used for both CAPs while the CAP prepared by the plant staff cannot.

### Is the plant required to submit a Filter Profile Report? CALC

The SWMOR2 determines if the plant is required to conduct a filter profile study and submit a filter-profile report with the SWMOR2; a built-in function will automatically insert a <Y> or <N> in this box. Refer to Section 3.2 for more information.

### Is the plant required to submit Filter Assessment Report? CALC

The SWMOR2 determines if the plant is required to conduct any filter assessment and submit a filter-assessment report with the SWMOR2; a built-in function will automatically insert a <Y> or <N> in this box. Refer to Section 3.2 for more information.

**Is the plant required to submit a Request for Compliance CPE?** ***CALC***
The SWMOR2 determines if the plant is required to participate in a third-party comprehensive performance evaluation and submit a request-for-compliance CPE with the SWMOR2; a built-in function will automatically insert a <Y> or <N> in this box. Refer to Section 3.2 for more information.

---

## Example 9.1: Individual Filter Summary and Compliance Section

The following figure includes the **Summary and Compliance Action** areas of the June and May 2006 SWMORs for a treatment plant in Texas.

June 2006 (this month's SWMOR2)

SUMMARY & COMPLIANCE ACTIONS

| Criteria | Combined Filter Summary: CFE | Plant |
|---|---|---|
| | | |
| Number of events above 1.0 NTU this month | 2 | |
| Number of events above 1.0 NTU last month | 4 | |
| Number of events above 1.0 NTU two months ago | 1 | |
| Total number of events above 1.0 NTU in three months | 7 | |
| Number of events above 2.0 NTU this month | | 0 |
| Number of events above 2.0 NTU last month | | 2 |
| Does the plant have an approved Corrective Action Plan? | N | NA |
| Is the plant required to submit a Filter Profile Report? | Y | |
| Is the plant required to submit a Filter Assessment Report? | N | |
| Is the plant required to submit a Request for Compliance CPE? | | N |

May 2006 (last month's SWMOR2)

SUMMARY & COMPLIANCE ACTIONS

| Criteria | Combined Filter Summary: CFE | Plant |
|---|---|---|
| | | |
| Number of events above 1.0 NTU this month | 4 | |
| Number of events above 1.0 NTU last month | 1 | |
| Number of events above 1.0 NTU two months ago | 1 | |
| Total number of events above 1.0 NTU in three months | 6 | |
| Number of events above 2.0 NTU this month | | 2 |
| Number of events above 2.0 NTU last month | | 0 |
| Does the plant have an approved Corrective Action Plan? | N | NA |
| Is the plant required to submit a Filter Profile Report? | Y | |
| Is the plant required to submit a Filter Assessment Report? | Y | |
| Is the plant required to submit a Request for Compliance CPE? | | N |

This example shows:

1. How to use the preceding month's SWMOR2 to help you complete the information in the:
   a. **Number of events above 1.0 NTU last month** row
   b. **Number of events above 1.0 NTU two months ago** row
   c. **Number of events above 2.0 NTU last month** row
2. You will need to submit a **Filter Profile Report** (FPR) with your June SWMOR2 because:
   a. There was at least one event when the CFE turbidity readings were above 1.0 NTU, or
   b. We have not yet approved a CAP for the plant.
3. You do not need to submit a filter-assessment report with your June SWMOR2 even though the plant does not have a CAP. An FAR was not required because:

   a. The CFE turbidity level did not exceed 1.0 NTU on at least three occasions this month
   b. An FAR was required last month because the CFE turbidity level exceeded 1.0 NTU on four occasions.
      Note: Once an FAR is required, the three-event counter resets to zero and a new count begins.
4. You were required to submit both an FPR and an FAR with your May SWMOR2 because:
   a. An FPR was required because at least one event when the CFE turbidity readings were above 1.0 NTU
   b. An FAR was required because there were at least three events in May when the CFE turbidity level rose above 1.0 NTU
   c. We have not yet approved a CAP for the plant

---

### Enter Disinfection Performance Data (Pages 4 and 5)

Refer to Section 3.3 for the information about Pages 4 and 5.

### Compile Summary Data (Page 1)

The **p.1-Summary** worksheets for SWMOR and SWMOR2 are identical in almost every respect. The only real difference is that the SWMOR2 bases its compliance calculations on the results of 15-minute CFE readings instead of those from 4-hour readings. Please refer to Section 3.4 for information about the data you need to enter on the **p1-Summary** worksheet of SWMOR2.

## 9.4 PRINT, SIGN, AND SUBMIT THE REPORT

Refer to Section 3.5 for instructions on printing, signing, and submitting the report.

# APPENDIXES

Appendix A: Example of a CT-Study-Approval Letter

Appendix B: Multiple-Barrier Treatment and CT Studies

Appendix C: Inactivation Calculations

Appendix D: CT Tables

Appendix E: Example of a Completed SWMOR

Appendix F: Example of a Completed Filter-Profile Report

Appendix G: Example of a Completed Filter-Assessment Report

Appendix H: Example of a Standard Operating Procedure for Conducting a Filter Inspection

Appendix I: Example of a Completed CPE-Request Form

# Appendix A: Example of a CT-Study-Approval Letter

March 23, 2010

Mr. I.M. Smart
Grenn and Barrett Consultants
1500 Downtown Boulevard
Big City, Texas 12345-6789

Subject: Public Drinking Water Supply
Approval of Revised CT Study for Schwartz Treatment Plant
Aguaville WSC—PWS ID No. 9876543
Rural County, Texas

Dear Mr. Smart:

We have completed the review of the CT study template and nine engineering drawings that were submitted with your letter of January 18, 2004. The materials describe proposed changes to the disinfection protocol at the Aguaville Water Supply Corporation’s Schwartz Surface Water Treatment Plant. Revisions to the CT study were needed because the WSC recently installed baffle walls in each of its clearwells and has received permission to begin using chloramines. Based on our review, we are approving the updated CT study with a few minor revisions to incorporate the additional information we received from Allen Gammage, the Chief Operator, during our telephone call on March 5, 2004, and the changes you and I discussed during our telephone call on March 13, 2004. The information in this letter will replace, not supplement, the CT study approved in our letter of February 25, 1993.

The Schwartz Surface Water Treatment Plant is supplied by a raw-water pump station located near the Lake Schwartz Dam. The station consists of two 1000-gpm and one 1,500-gpm raw-water pumps which discharge to a 24-inch raw-water transmission line that supplies the SWTP. The 2,000-gpm SWTP is located about one-half mile from the lake and consists of an in-line rapid mix, a splitter box, a pair of 0.150 MG solids-contact, slurry-recirculation clarifiers, a filter splitter box and channel, six mixed-media gravity filters, a head control box, a filtered-water transfer pump station containing three 1,000-gpm transfer pumps, three 0.50-MG baffled clearwells that operate in parallel, and a high-service pump station.

The proposed disinfection protocol uses a standby chlorine application point located upstream of the in-line rapid mix, a primary chlorine injection point at the inlet to the filter splitter box, and a booster chlorination point at the high service pump station. There is a standby injection point for liquid ammonium sulfate (LAS) located just downstream of the rapid mix and a primary injection point at the header which supplies the three clearwells.

A disinfection zone is a segment of the treatment process that begins at a disinfectant application point and ends at the subsequent disinfectant application or residual sampling point. Each disinfectant application point, regardless of the frequency of use, represents the beginning of a separate disinfection zone. Based on the proposed disinfection protocol, three disinfection zones are defined for the plant. The first disinfection zone (D1) begins at the standby prechlorination point at the rapid mix. The second disinfection zone (D2) begins at the filter influent and ends at the ammonia application point downstream of the filters. The last disinfection zone (D3) includes the clearwell.

CT calculations are used to evaluate the disinfection process. Based on the data provided in the CT study, $T_{10}$ values were developed for individual components of the treatment process. These values are summarized in Table A-1.

**Table A-1. Approved $T_{10}$ table for Aguaville WSC's Schwartz Surface Water Treatment Plant.**

| Disinfection Zone | Treatment Unit | Volume (gallons) | Flow Rate [(1)] | Baffling Factor | $T_{10}$, Unit (min) | $T_{10}$, Zone (min) |
|---|---|---|---|---|---|---|
| D1 | Raw-water line | 2,800 [(2)] | 2,000 gpm (2.880 MGD) | 1.0 [(3)] | 1.4 | 46.7 |
| | Splitter box | 1,800 [(4)] | 2,000 gpm | 0.1 [(5)] | 0.1 | |
| | Clarifiers (2) | 150,700 [(6)] | 1,000 gpm | 0.3 [(7)] | 45.2 | |
| D2 | Filters (6) | 4,300 [(8)] | 333 gpm | 0.7 [(9)] | 9.0 | 11.7 |
| | Head Control Box | 3,250 [(10)] | 2,000 gpm | 0.1 [(5)] | 0.5 | |
| | Piping | 4,400 [(11)] | 2,000 gpm | 1.0 [(3)] | 2.2 | |
| D3 | Clearwells (3) | 211,500 [(12)] | 667 gpm | 0.7 [(13)] | 222.1 | 222.1 |

**Notes:**

1. The flow rates used in this CT study are based on the cumulative capacity of the raw water pumps with the largest unit out of service and assume that flow is equally distributed to treatment units operating in parallel.
2. Based on 120 feet of 24-inch pipe from the rapid mix to the splitter box.
3. Assumes that "plug flow" hydraulic conditions exist in the pipeline.
4. Based on a basin with dimensions of 6.0 feet by 6.0 feet and a 6.0-foot side water depth.
5. In the absence of empirical data, assumes "unbaffled" hydraulic conditions exist in basins with mixers and in unbaffled basins that can have a high level of short-circuiting.
6. Based on the volume of a single solids contact clarifier with a 45.0-foot diameter, a 12.0-foot side water depth, and a center water depth of 14.0 feet.
7. Assumes that "poor" hydraulic conditions exist in a solids-contact, slurry-recirculation clarifier.
8. Based on the volume of a single filter which has a media bed with dimensions of 10.0 feet by 8.0 feet, a total depth of 3.67 feet, and an underdrain that is 1.0 feet deep. Assumes that the average porosity of the filter bed and gravel support system is 50%. Also assumes that a minimum water depth of 4.33 feet is maintained above the surface of the media by the head control box.
9. Assumes that "superior" hydraulic conditions exist in the filter and underdrain.
10. Based on a head control box with dimensions of 6.0 feet by 12.0 feet and a side water depth of 9.0 feet in front of the weir wall and a minimum 3.0-foot side water depth in the compartment that supplies the transfer pumps.
11. Based on 120 feet of 30-inch pipe from the head control box to the ammonia-injection point.
12. Based on the volume of a clearwell with a 60.0-foot diameter and a 24.0-foot side water depth. Assumes a minimum water level of 10.0 feet, or 42% of the nominal tank capacity.
13. Assumes superior hydraulic conditions in the clearwell due to the presence of a perforated internal riser with diffusion plates and four internal baffle walls.

As you review the $T_{10}$ table, you will observe that no disinfection credit was allowed for the filter influent channel, which runs the length of the filter battery, because water is diverted from the channel at six different locations along its length. In addition, the volume of the head control box was based on the average water level maintained in the two-compartment structure rather than on the volume maintained in the first compartment. Finally, the worst-case—instead of the maximum—operating level was used to estimate the volume of variable-level contact basins, such as clearwells.

Note that multiple flow rates were used to determine the $T_{10}$ values for individual units in two of the three disinfection zones. Although this approach is clearly the most versatile, it is not well suited for evaluating the performance of the plant on a daily basis and complying with the reporting requirements. As a result, we have prepared another table to help the operators complete their SWMORs. In Table A-2, we have characterized the $T_{10}$ available in each of the three disinfection zones based on the flow rate through the units that contribute most to the disinfection process within that zone. We have also provided the operators with the disinfection requirements that they must meet on an ongoing basis.

**Table A-2. Disinfection parameters for Aguaville WSC's Schwartz SWTP.**

| APPROVED CT-STUDY PARAMETERS | | | | | | PERFORMANCE STDs | |
|---|---|---|---|---|---|---|---|
| Parameters | Disinfection Zones | | | | | Log Inactivation | |
| | D1 | D2 | D3 | D4 | D5 | *Giardia* | Viruses |
| Flow rate (MGD) | 1.440 | 0.480 | 0.960 | NA | NA | 0.5 | 2.0 |
| $T_{10}$ time (minutes) | 46.7 | 11.7 | 222.1 | NA | NA | | |

As you review Table A-2, you will note that we have based the $T_{10}$ time for zone D1 on the volume of, and flow rate through, an individual clarifier. Similarly, $T_{10}$ times for zones D2 and D3 are based on a single filter and a clearwell, respectively. We have taken this approach because it allows the plant to continue to operate when one of the respective units is out of service for backwashing, inspection, or repair.

Please ensure that the operators understand that they need to base their CT calculations for zone D1 on the maximum flow rate through an individual clarifier and the calculations for zones D2 and D3 on the filter and clearwell that are experiencing the highest flow rate, respectively. If the flow rate through individual treatment units is not being measured, the operators should assume an equal distribution of water in parallel treatment units.

If you have any questions concerning our evaluation or if we may be of other assistance, please contact us by e-mail at <CTstudy@tceq.texas.gov>, by phone at 512-239-4691 or at the TCEQ's address.

Sincerely,

*Ima Competent, P.E.*

Ima Competent, P.E.
Public Drinking Water Section, MC 155
Water Supply Division

Enclosure: Printout of the CT Study Template for the PDWS SWTP

# Enclosure A

Printout from March 23, 2011 CT-Study Spreadsheet
for the Aguaville Water Supply Corporation's
Schulze Surface Water Treatment Plant

# CT STUDY

**FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)**

***Description Worksheet***

| | | | |
|---|---|---|---|
| **PUBLIC WATER SYSTEM NAME:** | **Aguaville WSC** | **PWS ID No.:** | **7654321** |
| **PLANT NAME OR NUMBER:** | **Schulze Plant** | **Month:** | **March** |
| | | **Day:** | **23** |
| | | **Year:** | **2011** |

**Enter a detailed narrative description of the plant treatment processes and disinfection protocol.**

The Aguaville WSC's Schulze Surface Water Treatment Plant (SWTP) is supplied by a raw water pump station located near the Lake Allen R. Gammage Dam. The raw water pump station consists of two 1000-gpm and one 1,500-gpm raw water pumps which discharge to a 24-inch raw water transmission line that supplies the SWTP which is located about 1/2 mile from the Lake.

The design capacity of the Schulze SWTP is 2,000 gpm. The SWTP consists of an in-line rapid mix, a splitter box, a pair of 0.150 MG solids-contact, slurry-recirculation clarifiers, a filter splitter box/channel, six mixed-media gravity filters, a head control box, three 1,000 gpm transfer pumps, and three 0.50-MG baffled clearwells that operate in parallel.

The proposed disinfection protocol utilizes a standby chlorine application point located upstream of the in-line rapid mix; a primary chlorine injection point at the inlet to the filter splitter box; and a booster chlorination point at the high service pump station. There is a standby injection point for liquid ammonium sulfate (LAS) located just downstream of the rapid mix and a primary injection point at the header which supplies the three clearwells.

The disinfection process utilizes the following three disinfection zones:
- D1 - the clarifiers
- D2 - the six filters, head control box, and piping
- D3 - the three clearwells

The proposed disinfection protocol involves pre-chlorination followed by LAS addition to form chloramines so a total chlorine residual enters the distribution system.
In D1, the clarifiers, no disinfectant residual is normally maintained.
In D2, chlorine will be injected at the inlet to the filter splitter box, with a free chlorine residual maintained through the filters and head control box. The sample location for D2 is at the head control box.
LAS will be added about 120 feet downstream of the chlorine residual sampling point at the head control box. A chloramine residual will be maintained in D3, the clearwells.

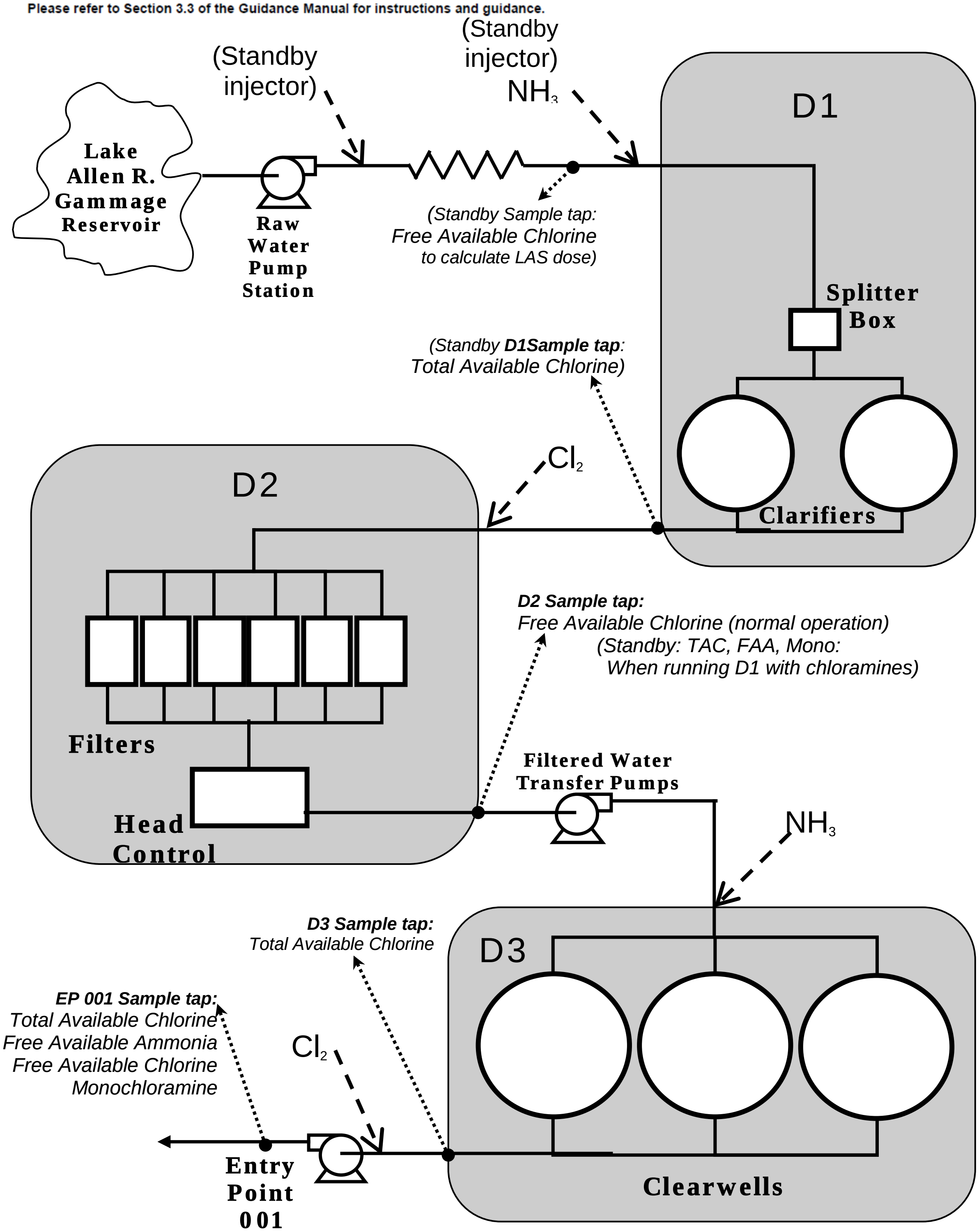
# CT STUDY

**FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)**

*Schematic Worksheet*

| | | | |
|---|---|---|---|
| **PUBLIC WATER SYSTEM NAME:** | Aguaville WSC | **PLANT NAME OR NUMBER:** | Schulze Plant |
| **PWS ID No.:** | 7654321 | **Date:** | March 23, 2011 |

**Use this worksheet to create your plant schematic with the Microsoft Drawing Tools.**
**If you are not familiar with the drawing tools, you may create your schematic using any other suitable medium.**
**Please refer to Section 3.3 of the Guidance Manual for instructions and guidance.**



# CT STUDY

**FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)**

**T10 Details Worksheet**

**PUBLIC WATER SYSTEM NAME:** Aguaville WSC **PWS ID No.:** 7654321

**PLANT NAME OR NUMBER:** Schulze Plant **Date:** March 23, 2011

**Treatment Plant Capacity** 2.880 mgd
2,000 gpm

**Disinfection Zone:** D1 **Disinfectant:** Free Chlorine

**Unit - 1** Type: **Piping** Shape: **Pipe**

Further Description: Water to splitter box after rapid mix

| Characteristic | | | Comments |
|---|---|---|---|
| Number of Units | 1 | | Dimensions reported by Grenn & Barrett Consultants in 2/3/11 submission |
| Diameter | 24 | in | Dimensions reported by Grenn & Barrett Consultants in 2/3/11 submission |
| Length | 120 | ft | Dimensions reported by Grenn & Barrett Consultants in 2/3/11 submission |
| Volume (each) | 2,820 | gal | |
| Flow Rate (each) | 2,000 | gpm | |
| Detention Time | 1.4 | min | |
| Baffling Factor | 1.0 | | Piping |
| | | | Baffling Characteristics: Perfect |
| | | | Approved Baffling Factor: |
| **$T_{10}$** | **1.4** | **min** | |

**Unit - 2** Type: **Other** Shape: **Rectangular**

Further Description: Coagulated water splitter box

| Characteristic | | | Comments |
|---|---|---|---|
| Number of Units | 1 | | Dimensions reported by Grenn & Barrett Consultants in 2/3/11 submission |
| Length | 6 | ft | Dimensions reported by Grenn & Barrett Consultants in 2/3/11 submission |
| Width | 6 | ft | Dimensions reported by Grenn & Barrett Consultants in 2/3/11 submission |
| Side Water Depth | 6 | ft | Dimensions reported by Grenn & Barrett Consultants in 2/3/11 submission |
| Volume (each) | 1,616 | gal | |
| Flow Rate (each) | 2,000 | gpm | |
| Detention Time | 0.8 | min | |

# CT STUDY

## FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

### T10 Details Worksheet

| | | | |
|---|---|---|---|
| Baffling Factor | 0.1 | | |
| | | | Baffling Characteristics: Unbaffled |
| | | | Approved Baffling Factor: |
| **$T_{10}$** | **0.1** | **min** | |

**Unit - 3** Type: **Clarifier** Shape: **Circular**

Further Description: Solids contact clarifiers

| Characteristic | | | Comments |
|---|---|---|---|
| Number of Units | 2 | | Dimensions reported by Grenn & Barrett Consultants in 2/3/11 submission |
| Diameter | 45 | ft | Top of mixing chamber has a 15 foot diameter per G&B sheet 3 of 9 |
| Side Water Depth | 12 | ft | Dimensions reported by Grenn & Barrett Consultants, 2/3/11, page 4 of 9 |
| Center Water Depth | 14 | ft | Dimensions reported by Grenn & Barrett Consultants, 2/3/11, page 4 of 9 |
| Volume (each) | 150,718 | gal | |
| Flow Rate (each) | 1,000 | gpm | HDT = 150.7 minutes and SOR(sed) = 0.71 gpm per square foot |
| Detention Time | 150.7 | min | |
| Baffling Factor | 0.3 | | Slurry recirculation with skirt |
| | | | Baffling Characteristics: Poor |
| | | | Approved Baffling Factor: |
| **$T_{10}$** | **45.2** | **min** | |

| | | |
|---|---|---|
| **D1 FLOW RATE** | **1.440** | **mgd** |

| | | |
|---|---|---|
| **T10 SUM FOR D1** | **46.7** | **min** |

**Disinfection Zone:** **D2** **Disinfectant:** **Free Chlorine**

**Unit - 1** Type: **Filter** Shape: **Rectangular**

Further Description: Six multimedia filters: sand/anthracite

| Characteristic | | | Comments |
|---|---|---|---|
| Number of Units | 6 | | 1/29/98 G&B engineering drawings, p. 2 of 9 |
| Length | 10 | ft | G&B engineering drawings, 4 of 9 |
| Width | 8 | ft | " |
| Media Depth | 3.67 | ft | G&B engineering drawings, 45 of 9 |
| Underdrain Depth | 1 | ft | " |
| Minimum Water Depth Over Media | 4.33 | ft | " |
| Average Porosity | 50 | % | Assumed |
| Volume (each) | 4,288 | gal | |

# CT STUDY

**FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)**

**T10 Details Worksheet**

| | | | |
|---|---|---|---|
| Flow Rate (each) | 333 | gpm | Assumes equal flow to each filter operating in parallel with all filters in service. Filter Loading Rate = 4.2 gpm/ft2 |
| Detention Time | 12.9 | min | |
| Baffling Factor | 0.7 | | Filter |
| | | | Baffling Characteristics: Superior |
| | | | Approved Baffling Factor: |
| **$T_{10}$** | **9.0** | **min** | |
| **D2 FLOW RATE** | **0.480** | **mgd** | |
| **T10 SUM FOR D2** | **9.0** | **min** | |

**Disinfection Zone:** **D3** **Disinfectant:** **Chloramines**

**Unit - 1** Type: **Clearwell** Shape: **Circular**

Further Description:

| Characteristic | | | Comments |
|---|---|---|---|
| Number of Units | 3 | | |
| Diameter | 60 | ft | |
| Side Water Depth | 24 | ft | |
| Center Water Depth | 24 | ft | |
| Maximum Volume (each) | 507,683 | gal | |
| Minimum Operating Level | 10 | ft | |
| Worst Case Volume (each) | 211,534 | gal | |
| Percent of Maximum Volume | 42 | % | |
| Worst Case Volume (each) | 211,534 | gal | |
| Flow Rate (each) | 667 | gpm | |
| Detention Time | 317.1 | min | |
| Baffling Factor | 0.7 | | |
| | | | Baffling Characteristics: Superior |
| | | | Approved Baffling Factor: |
| **$T_{10}$** | **222.0** | **min** | |
| **D3 FLOW RATE** | **0.960** | **mgd** | |
| **T10 SUM FOR D3** | **222.0** | **min** | |

**Disinfection Zone:** **D4** **Disinfectant:**

**Disinfection Zone:** **D5** **Disinfectant:**

# CT STUDY

**FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)**

***Summary Worksheet***

**PUBLIC WATER SYSTEM NAME:** Aguaville WSC **PWS ID No.:** 7654321

**PLANT NAME OR NUMBER:** Schulze Plant **Date:** March 23, 2011

| Disinfection Zone | Treatment Unit | Volume* (each) (gal) | Flow Rate* (each) (MGD) | Baffling Factor* | $T_{10}$* (min) Unit | $T_{10}$* (min) Zone |
|---|---|---|---|---|---|---|
| D1 | Water to splitter box after rapid mix (1) | 2,820 | 2.880 | 1 | 1.410 | 46.71 |
| | Coagulated water splitter box (1) | 1,616 | 2.880 | 0.1 | 0.081 | |
| | Solids contact clarifiers (2) | 150,718 | 1.440 | 0.3 | 45.215 | |
| D2 | Six multimedia filters: sand/anthracite (6) | 4,288 | 0.480 | 0.7 | 9.015 | 9.01 |
| D3 | Clearwell (3) | 211,534 | 0.960 | 0.7 | 222.000 | 222.00 |

* These values are calculated on the T10 Details Sheet

TCEQ - (09-01-11) CT STUDY

# Appendix B: MULTIPLE-BARRIER TREATMENT AND CT STUDIES

## B.1 MULTIPLE-BARRIER TREATMENT

Surface water treatment plants must take a raw water source of variable quality and consistently produce high-quality finished water. Plants employ a series of treatments to remove and inactivate disease-causing organisms such as cysts, viruses, and bacteria. Each individual process represents a barrier to prevent the passage of microorganisms through the plant. By employing several barriers, the plant progressively reduces the number of organisms passing through each barrier. This multi-barrier approach minimizes the likelihood that microorganisms will pass through the entire treatment system and survive in the water supplied to the public.

The two main barriers that a surface water treatment plant must use are removal and inactivation. The combination of removal and inactivation must meet the requirements of the EPA's and TCEQ's surface water treatment rules. Removal means taking particles out of the water; inactivation means disinfecting the pathogens so they can't reproduce.

The effectiveness of the overall treatment process is often evaluated based on the percentage of pathogenic organisms that are removed or inactivated by the plant. It is hard to directly calculate the total "percent removal and/or inactivation" achieved because that involves subtracting and multiplying fractions. On the other hand, it is easy to calculate the overall effectiveness of the treatment plant by simply adding the log percent removal and inactivation achieved during each treatment step.

### Log Removal and Inactivation

*Log removal* or *inactivation* expresses the percent of organisms removed or inactivated in terms of powers of 10, or *logs*. For example, in the second row of Table B-1, a "1-log inactivation" means a $10^1$-fold, or 10-fold, reduction in the numbers of viable disease-causing organisms and, in the table's fourth row, a "2-log inactivation" means a $10^2$-fold, or 100-fold, reduction. Table B-1 contains other inactivation numbers commonly used and shows what they mean. In mathematical terms, the log removal or inactivation for a specific treatment is the negative of the base-10 logarithm of the fraction of the pathogen that remains after the treatment step.

**Table B-1. Removal and inactivation levels and their significance.**

| Removal or Inactivation Level Achieved | Reduction Factor (Fold Reduction) | % of Original Organisms | | Significance |
|---|---|---|---|---|
| | | Removed or Inactivated | Still Infectious | |
| 0.5-log | 3.16 | 68.4 | 31.6 | |
| 1.0-log | 10 | 90 | 10 | |
| 1.5-log | 31.6 | 96.8 | 3.16 | |
| 2.0-log | 100 | 99 | 1 | Minimum removal requirement for *Cryptosporidium* |
| 2.5-log | 316 | 99.7 | 0.3 | |
| 3.0-log | 1000 | 99.9 | 0.1 | Minimum removal or inactivation requirement for *Giardia lamblia* cysts |
| 4.0-log | 10,000 | 99.99 | 0.01 | Minimum removal or inactivation requirement for viruses |
| 5.0-log | 100,000 | 99.999 | 0.001 | |
| 6.0-log | 1,000,000 | 99.9999 | 0.0001 | |
| 7.0-log | 10,000,000 | 99.99999 | 0.00001 | |

## Turbidity Removal: The First Step

Multiple treatment processes (coagulation, flocculation, sedimentation, and filtration) occur in series to remove turbidity, cysts, and other disease-causing microorganisms. Removal of turbidity is an important measure of a plant's ability to produce a safe water supply because disease-causing organisms are small particles (bacteria, cysts, and viruses) within the size range normally considered as turbidity. Effective turbidity removal is an essential part of overall treatment because some of the pathogenic microorganisms are extremely resistant to chemical disinfection.

### Settled Water

We do not require you to monitor the turbidity of the water leaving your clarifier or sedimentation basin. However, the settled-water turbidity level can provide you with critical information about the operation of your plant. Specifically, testing settled water turbidity can help you evaluate the effectiveness of coagulation, flocculation, and sedimentation. Consequently, we strongly recommend that you test settled-water turbidity at the outlet of each sedimentation basin or clarifier at least once per day. We also recommend that you monitor the levels of settled-water turbidity 2 to 6 hours after you change your chemical dose or you experience a significant change in raw water quality.

We have not set turbidity limits for settled water. However, you should try to keep your settled-water turbidity level of each sedimentation basin below 1.0 NTU if your raw-water turbidity level is 10 NTU or less. If your raw-water turbidity level is higher than 10 NTU, you should try to keep the settled water turbidity of each basin below 2.0 NTU. Lower settled-water turbidity levels typically mean that you can produce longer filter runs and better filtered-water quality.

### Individual Filter Effluent, or Filtered Water

You are required to test levels of individual-filter-effluent (IFE) turbidity. IFE turbidity monitoring is crucial because a single filter's poor performance can be hard to detect if you are only monitoring the turbidity of the water as it leaves the entire filter bank or the clearwell.

The IFE monitoring requirements depend on the size of your system and the design of the plant. For example, if your plant uses more than two conventional filters (such as a gravity or pressure filter containing sand, anthracite, or any other granular media), it must monitor and record the turbidity level of the water produced by each filter once every 15 minutes that the filter is sending water to the clearwell. It doesn't matter how many people your plant serves; if it has more than two conventional filters, each filter must have an online turbidimeter and recorder. Figure B-1 shows the monitoring requirements for these plants.

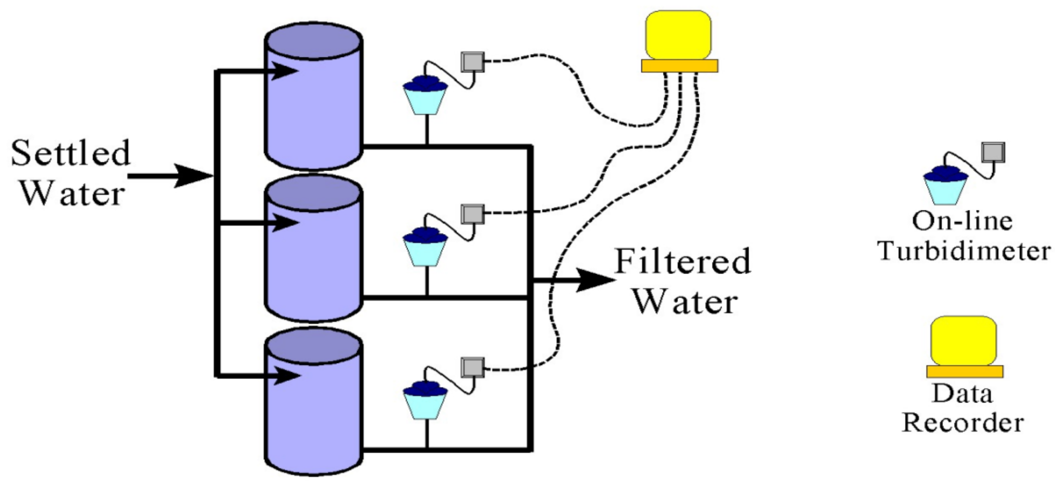



**Figure B-1. Schematic showing IFE-monitoring requirements for plants with more than two conventional filters.**

If your plant has only two conventional filters, the monitoring requirements depend on how many people your plant serves. If your plant serves 10,000 people or more (including those served through your wholesale connections), you must monitor and record the turbidity level of each filter at least once every 15 minutes. Option 1 in Figure B-2 represents the monitoring requirements for those larger plants. If your plant serves fewer than 10,000 people (including those served through your wholesale connections), you must either:

- monitor and record the turbidity level of each filter at least once every 15 minutes OR
- monitor and record the turbidity level of blended water entering the clearwell at least once every 15 minutes AND monitor the turbidity level leaving each filter at least once each day.

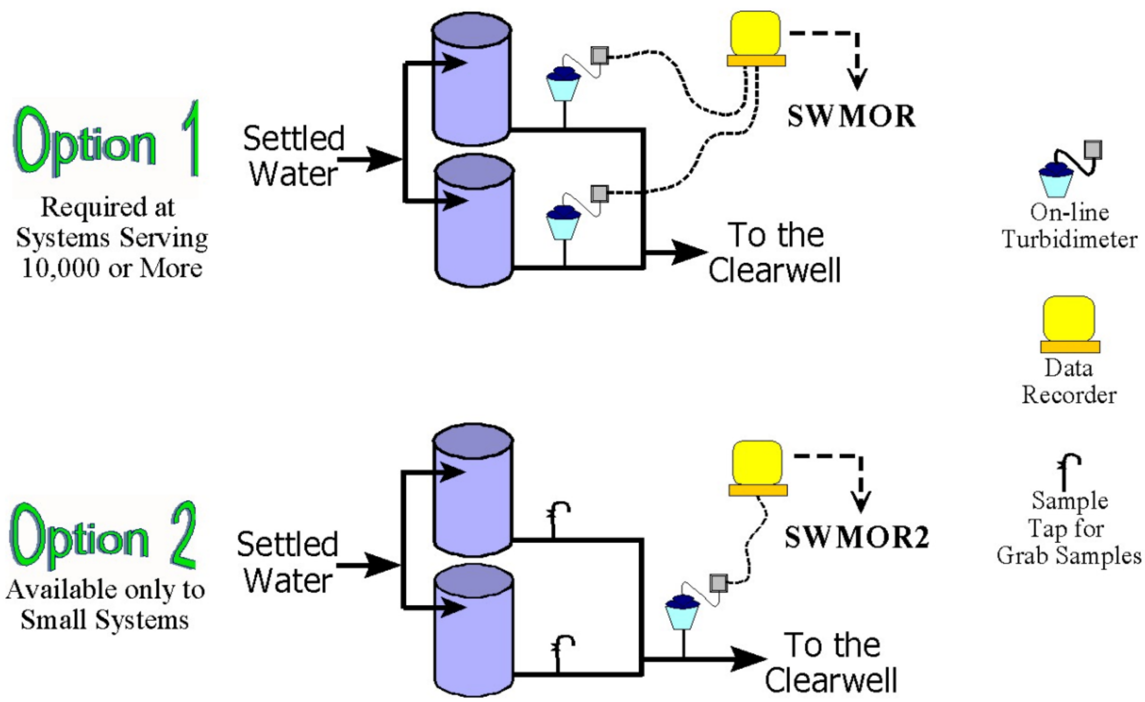



**Figure B-2. Schematic showing IFE-monitoring requirements for plants with only two conventional filters.**

Plants that use cartridge filters may have even more IFE monitoring options (Figure B-3). The information in Figure B-3 is based on the monitoring options that existed at the time that this document was published. However, some of these options may be restricted or eliminated as we revise our implementation policies and regulatory requirements in response to new federal rules or guidance from the EPA. To keep aware of the latest developments, you should periodically check the EPA's drinking-water Web pages:

water.epa.gov/drink/index.cfm

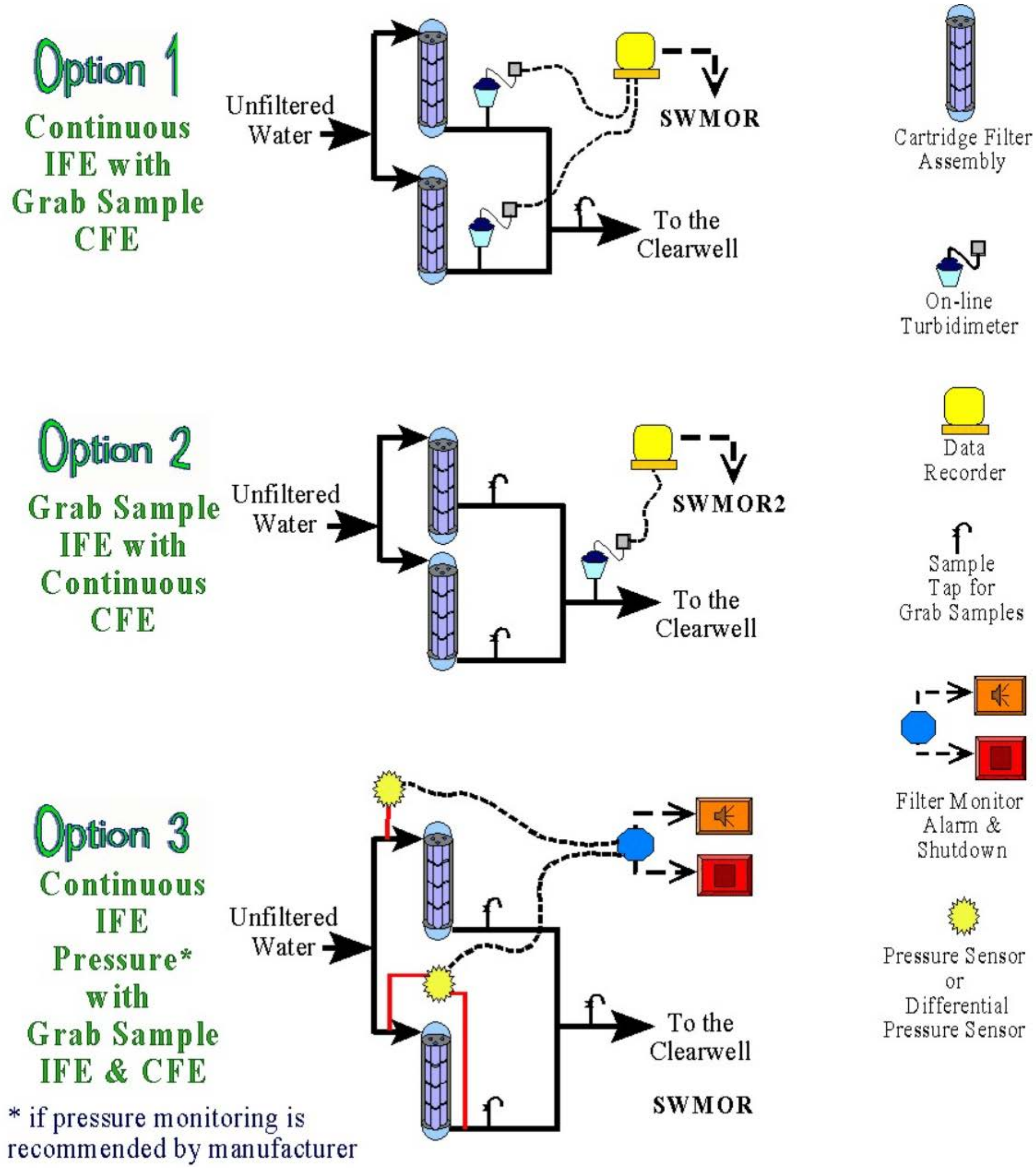



**Figure B-3. Schematic showing IFE-monitoring requirements for plants with cartridge filters.**

Plants that use membrane filters must continuously monitor the turbidity level or particle count in the water produced by each rack, or bank, of membrane modules or units. Figure B-4 shows the IFE monitoring requirements for a plant using 10 membrane units that are configured in two racks of five modules each.

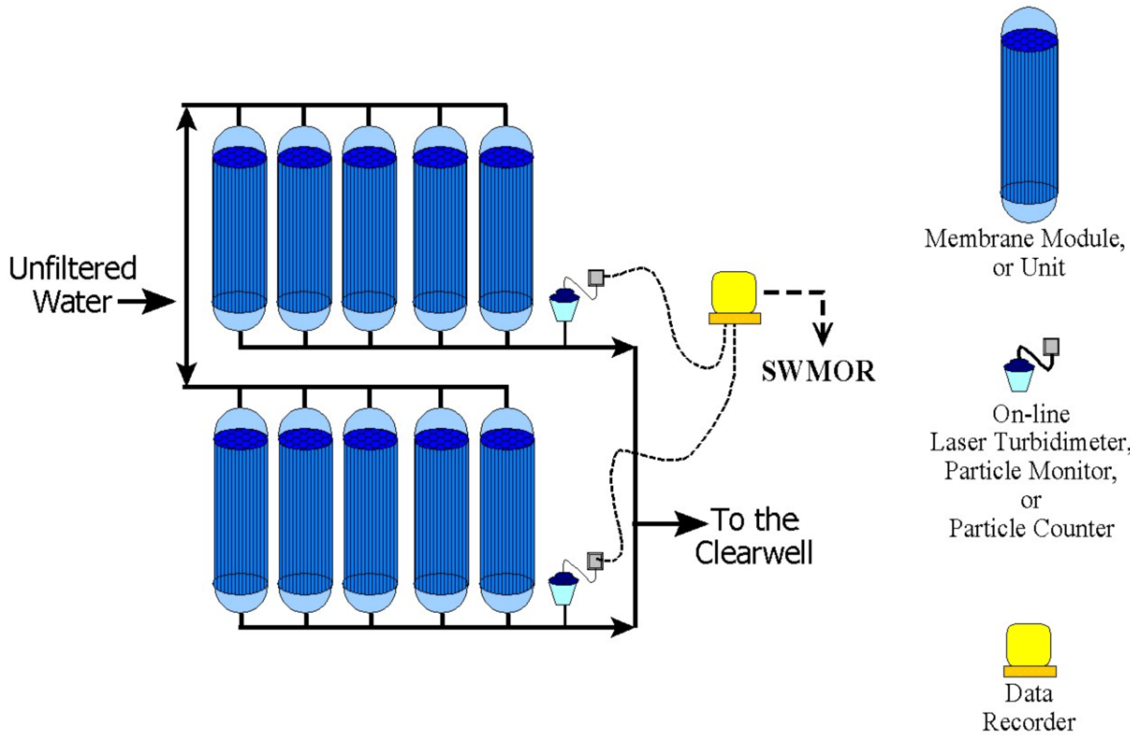



**Figure B-4. Schematic showing IFE-monitoring requirements for a plant with membrane filters.**

Plants that use membranes may use one of three types of devices to continuously monitor membrane performance. These devices include a laser turbidimeter such as the Hach FilterTrac 660, a particle monitor, or a particle counter. Since membrane units are often backwashed many times each day, we normally require membrane plants to collect and record performance data at least once every 5 minutes instead of once every 15 minutes. The monitoring and reporting requirements for membrane plants are likely to change dramatically over the next few years in response to federal mandates and technological developments. To keep aware of the latest developments, you should periodically check this TCEQ Web page:

www.tceq.texas.gov/drinkingwater/swmor

You may find it particularly useful to visit the Web page that contains our Public Drinking Water Program staff guidance statements:

www.tceq.texas.gov/goto/dw-staff

### Special Filter Studies

If your filters are equipped with IFE turbidimeters, we require you to investigate and report the cause of any IFE turbidity readings that are above 1.0 NTU. If your system serves at least 10,000 people, we also require you to investigate any instance when an IFE turbidity level is greater than 0.5 NTU exactly 4 hours after the filter has been placed into, or returned to, service.

The specific type of investigation you must conduct depends on the severity and frequency of the malfunction. Some examples follow.

- Each time that two consecutive 15-minute IFE turbidity readings exceed 1.0 NTU, you must either (1) identify the cause of the elevated readings, or (2) profile the filter. Whichever of these two investigations you perform, send us the results.
- If a specific filter exceeds 1.0 NTU on three separate occasions during any consecutive three-month period, you must also conduct a filter assessment. Again, you must supply us with the results of the assessment.
- If a single filter or any combination of filters ever produces an IFE turbidity level above 2.0 NTU during two consecutive months, you must arrange for a third-party investigator to conduct a comprehensive performance evaluation at your plant. You must provide us with the CPE results and a corrective action plan to address any performance-limiting factor that the evaluator identified.

We realize that these are very complex rules, but they are very important to prevention of waterborne disease. Consequently, we developed the series of special report forms that are described in Chapters 4, 5, and 6.

If your system (1) serves fewer than 10,000 people, (2) has no more than two filters, and (3) continuously monitors blended water entering the clearwell instead of the water leaving each filter, you must conduct special studies based on your CFE turbidity readings instead of the daily grab samples that you collect from each filter.

### Combined Filter Effluent, or Treated Water

Combined filter effluent is the water that is produced by the plant after it has combined all the water produced by individual filters. We have traditionally referred to your plant's CFE as its "treated water." However, at some plants, additional treatment steps like pH adjustment, rechlorination, or fluoride addition occur after the point where the filtered water is combined. Even if your plant does not perform post-filtration treatment, the turbidity levels of the CFE and treated water may differ because the sediment that tends to accumulate in a clearwell may occasionally end up raising the turbidity level in the treated water.

We strongly encourage you to install a CFE sampling point for the reasons described above. This sampling point *must* be located after all of the filtered water from individual filters has been combined and *should* be located upstream of any post-filtration treatment process. However, if your plant design limits your ability to install or use that sampling point, we will allow you to monitor the level of treated-water turbidity in lieu of monitoring CFE turbidity.

Our rules currently require you to produce water with a CFE turbidity level of 0.3 NTU or lower in at least 95% of the tests you conduct each month, and limits the turbidity level for each individual CFE sample to 1.0 NTU. If your CFE readings exceed these levels, you will be required to notify your customers that you have failed to produce water of acceptable quality.

As we stated earlier, lower turbidity levels generally indicate better plant performance, higher-quality drinking water, and lower risk for waterborne diseases. Consequently, the TCEQ strongly encourages public water systems to keep turbidity as low as possible. A properly designed, operated, and maintained treatment plant should be able to produce water with a turbidity level consistently below 0.1 NTU.

## Disinfection: The Second Step

A typical surface water treatment plant cannot possibly remove all of the disease-causing organisms that might be present in the raw water. Therefore, the treatment must include disinfection to kill or inactivate the pathogens that are not removed.

The effectiveness of disinfection depends on several factors:

1. **The type of disinfectant that the plant uses.** Some disinfectants are stronger than others. The stronger disinfectants will typically require a lower dose to achieve the desired level of inactivation. However, some of the strongest disinfectants, like ozone, do not produce long-lasting residuals.
2. **The concentration of the disinfectant.** Whichever disinfectant you use at your plant, raising the disinfectant residual generally improves the effectiveness of the disinfection process. However, while increasing the residual increases the number of organisms that you kill, it can also increase your disinfection by-product levels.
3. **The amount of time that the disinfectant is in contact with the water**. Obviously, the longer that you expose a pathogen to a disinfectant, the more likely it is that you will kill it.
4. **The pH of the water.** Some disinfectants are affected by the pH of the water. Chlorine is particularly affected because it changes from its hypochlorous acid form to its less effective hypochlorite ion form as the pH rises. Chlorine dioxide, on the other hand, is less effective at low pH levels than above pH 7.5.
5. **The temperature of the water.** Disinfectants are less effective at lower than at higher temperatures because chemical reactions occur more slowly at lower temperatures, and because many pathogens tend to become inactive when the temperature drops. This is generally not a problem unless your water temperature drops below 5°C (41°F).

Some of these factors, like residual concentration and pH, can be controlled to a great extent by the operator. Other factors, like the type of disinfectant and the contact time, are limited by the design of the plant and water demands.

### CT and $CT_{required}$

The type of disinfectant that a plant uses and the pH and temperature of its water tend to remain relatively constant on a day-to-day basis. Consequently, we tend to evaluate the disinfection process using the concentration and time factors. Often, we describe the relationship between the disinfectant concentration and time using the term “CT” and the following equation.

$$CT = \text{Concentration of disinfectant (mg/L)} \times \text{Time (minutes)} \qquad \text{(Equation B-1)}$$

Basically, the less time you have to disinfect, the more disinfectant you have to apply to maintain the same CT value.

Just as turbidity levels and particle counts are used to evaluate the effectiveness of physical removal processes, *CT values* are used to assess the performance of chemical disinfection processes. The actual CT value for a disinfection zone is obtained by multiplying the actual disinfectant concentration, "C", by the time, "T", that the disinfectant was in contact with the water. The actual CT value (that is, $CT_{actual}$) is then compared to the CT required to achieve the desired level of pathogen inactivation (that is, $CT_{required}$). The log inactivation achieved during the disinfection process can be calculated as shown below:

$$\text{Log inactivation achieved} = \frac{\text{Actual CT}}{\text{CT required for N-logs of inactivation}} \times \text{N-logs} \qquad \text{(Equation B-2)}$$

Although the overall CT concept may seem simple and straightforward, applying the approach is complicated because:

- The actual contact time available at your plant is affected by the amount of short-circuiting that occurs within your contact basins.
- The required CT varies based on:
  - the pathogen being inactivated,
  - the number of log inactivations, or N-logs, that you are required to achieve,
  - the actual plant operating conditions, that is, the pH and temperature of the water, and
  - the type and concentration of the disinfectant.
- Your plant may use several disinfectant-application points and may even adjust the pH level during the process.

Because applying this CT approach can be so difficult and time-consuming, we have incorporated a small Visual Basic computer program in the SWMOR spreadsheet. This program uses several complex mathematical equations to calculate $CT_{actual}$ based on the information you enter on your report.

## Distribution-System Residual: The Final Step

To ensure that the treated drinking water stays safe to drink, you must make sure that it does not become contaminated before reaching the customer's glass. To achieve this goal, water systems keep pathogens out of the water supply, maintain adequate water pressure throughout the system, prevent cross-connections to untreated water supplies, and ensure that there is enough disinfectant everywhere in the distribution system. This disinfectant concentration in the distribution system is often referred to as the *distribution residual*.

# B.2 CT Studies and the CT-Study-Approval Letter

The CT study is an evaluation of your plant's disinfection process. Its purposes are to:

- identify the number of disinfection zones at your plant
- determine the effective contact time, or $T_{10}$, in each zone
- define the minimum level of disinfection that must be attained at the plant

Every treatment plant that uses surface water or groundwater that is under the direct influence of surface water must have a current, TCEQ-approved CT study. You must submit changes to your CT study if you make a significant change to your disinfection practice. You may not make a change to your disinfection process without our prior written approval. Significant changes to disinfection practice include any of the following:

- changing the type of disinfectant
- moving the point of disinfectant addition
- changing physical facilities in such a way that more or less effective contact time is used
- changing the approved capacity of the plant
- any other change that we consider significant

Every plant is required to have a CT-study-approval letter on file to document that we have reviewed and approved the plant's CT study and its current disinfection process. See Appendix A for a sample CT letter like the one for your plant.

In order to understand the importance of the CT-study-approval letter, you need to understand how we evaluate the disinfection process at your plant. The critical factors we evaluate are:

- the number of disinfection zones and treatment trains at the plant
- the maximum flow rate though each zone
- the baffling characteristics of each disinfectant contact unit
- the $T_{10}$ time in each zone

## Disinfection Zones and Treatment Trains

A *disinfection zone* is defined as that section of the plant starting at a disinfectant injection or monitoring point, and ending at the subsequent disinfectant injection or monitoring point. A disinfection zone contains one or more treatment units and the associated piping. Every disinfectant-injection point is the start of a new disinfection zone, even if it is not always used. Every injection point must have an associated monitoring point. However, a plant may have only one disinfectant point and choose to monitor at more than one point, creating multiple disinfection zones.

The starting point for analyzing your disinfection process is to identify the unit processes and the disinfection injection and monitoring points. It is usually helpful to prepare a sketch or schematic of the plant. A drawing, like the ones shown in Figures B-5 though B-7, may help in defining disinfection zones.

Figure B-5 shows a small plant with pre- and post-disinfectant application points for chlorine. Even at this small plant, the operator has some choices regarding disinfection. For example:

- The operator can choose to use a single chlorine-monitoring point for the pre-disinfection application point. In this case, the upper schematic shows that there will be a single pre-disinfection zone that:
    - o starts at the chlorine-injection point located in the pipe between the raw water pumps and the sedimentation basin and
    - o ends at the monitoring point after the filters.
- The operator can choose to use two or more monitoring points for the pre-disinfectant. The lower schematic shows that this monitoring strategy creates two pre-disinfection zones instead of one.

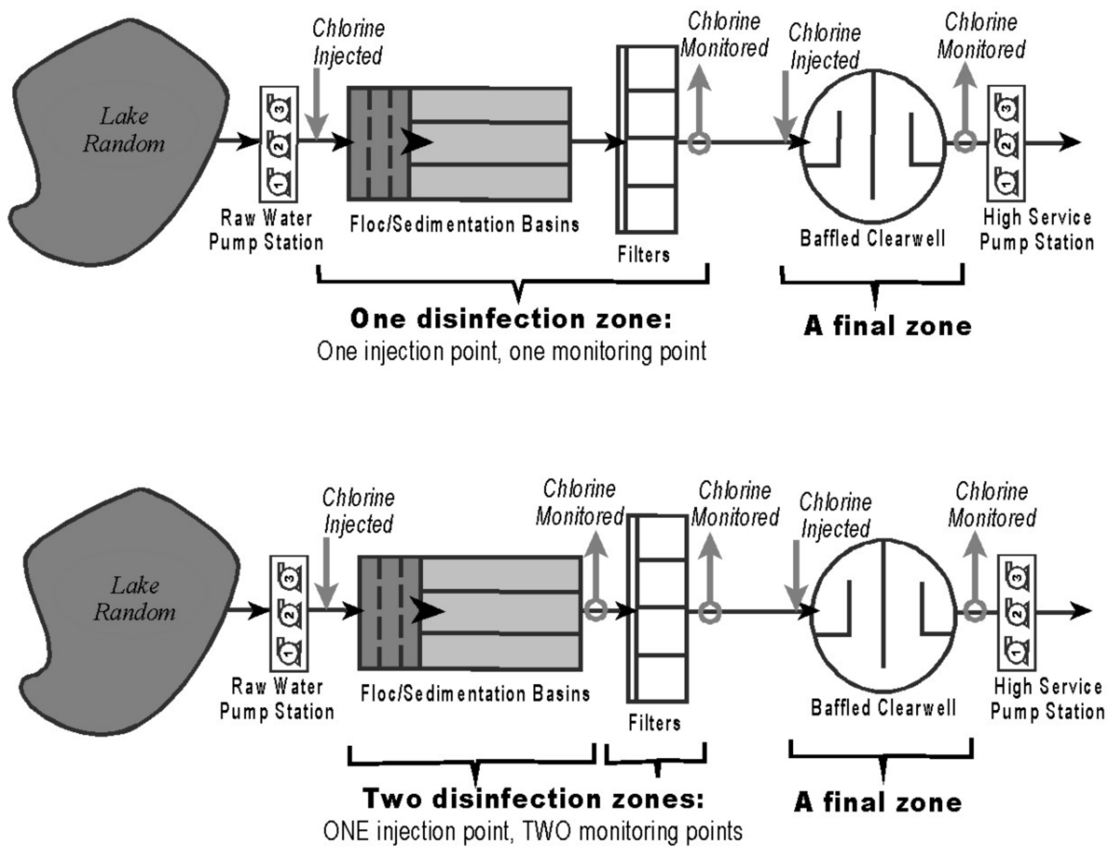



**Figure B-5. Plant schematic of an SWTP with one chlorine-injection point.**

Figure B-6 contains the schematic for a plant that has multiple chlorine injection points and uses several different types of disinfectants. The figure shows how the disinfection zones might be defined in this complex design.

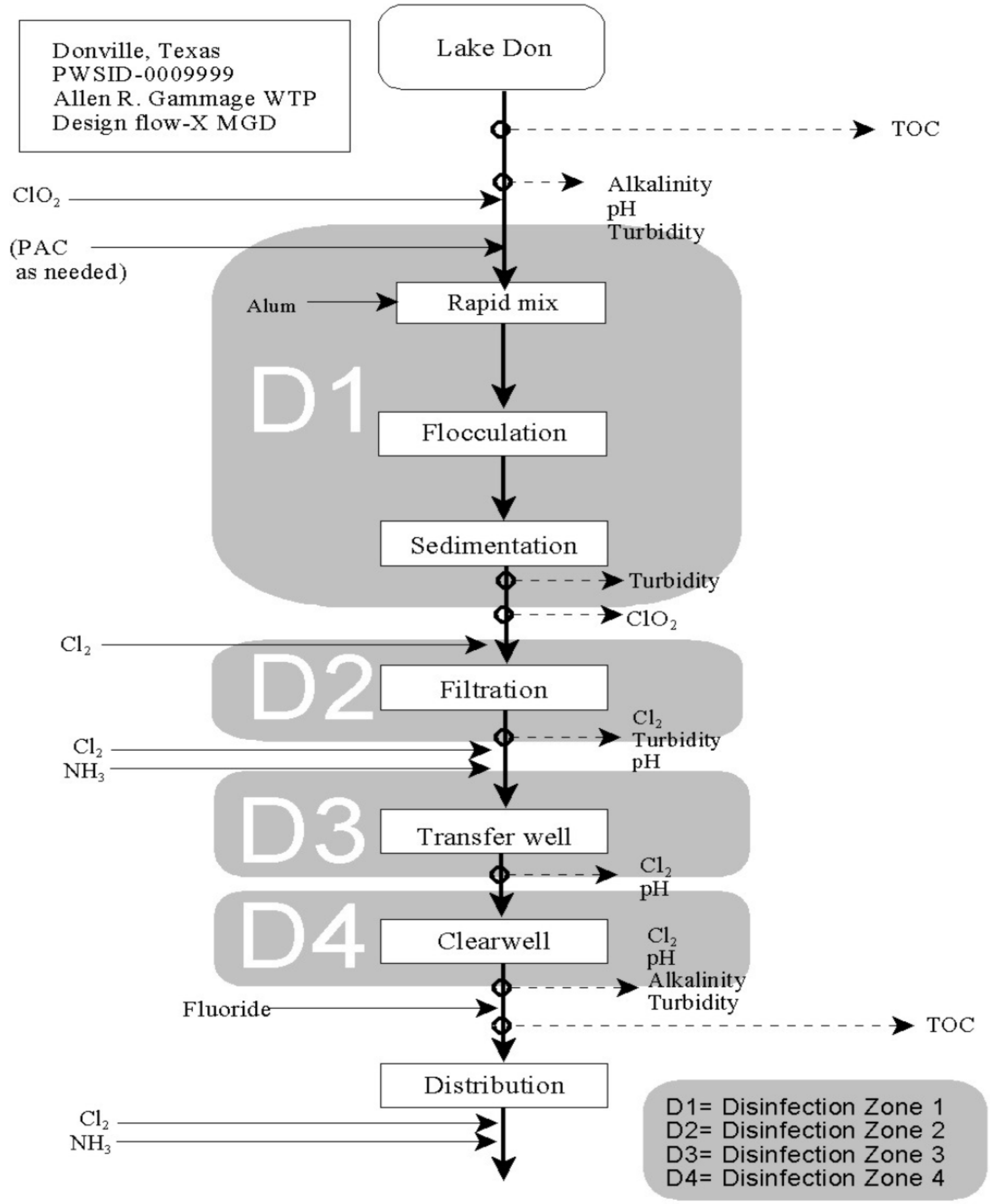
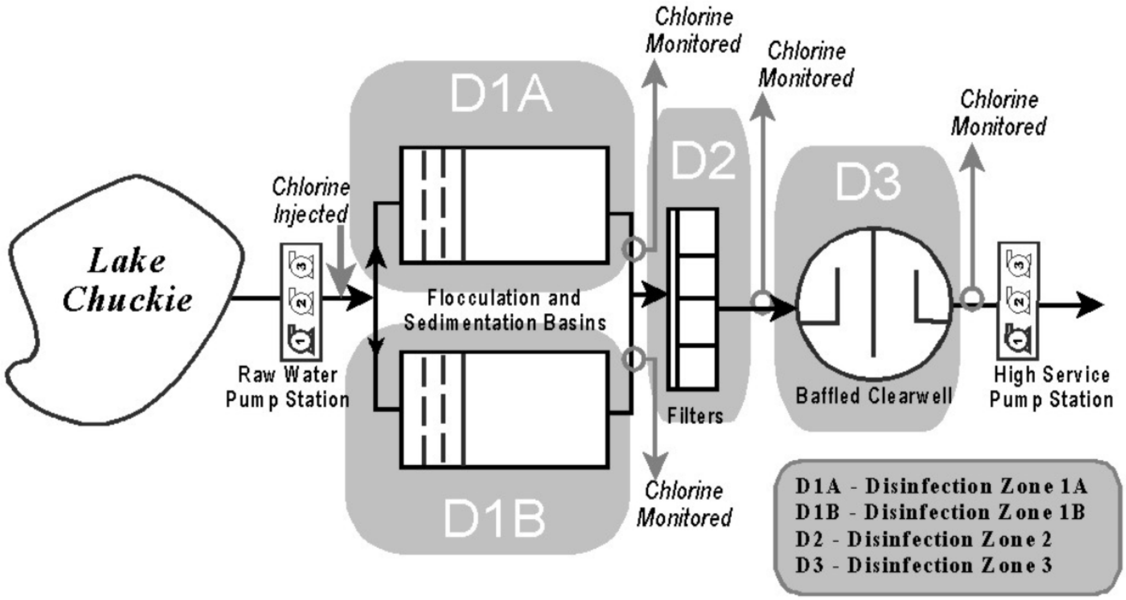
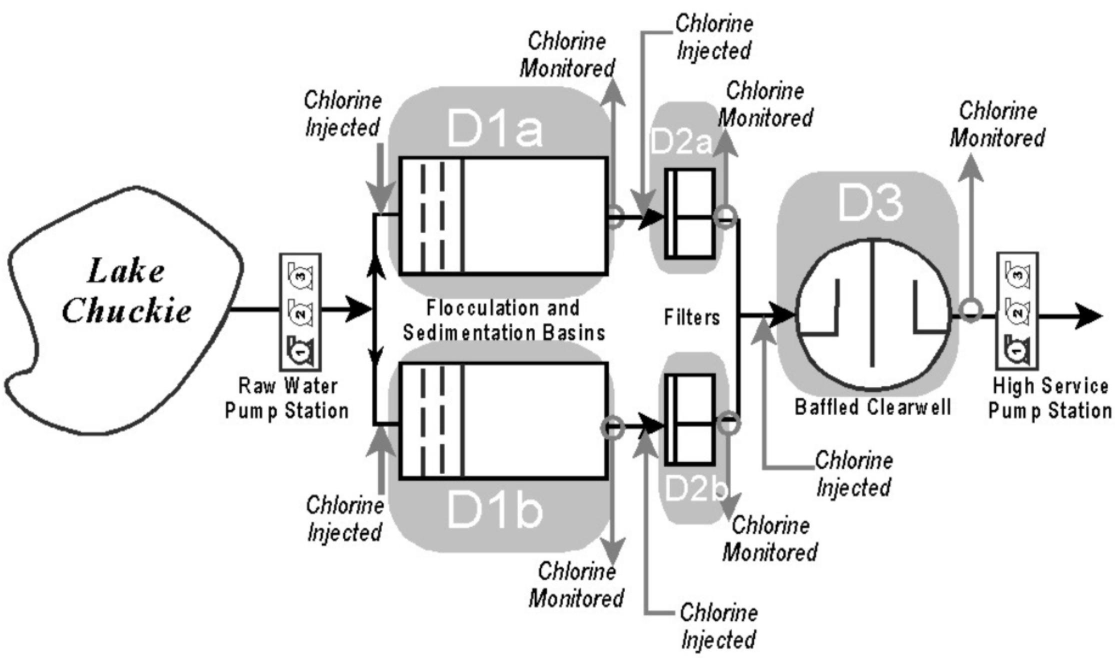



**Figure B-6. Schematic of an SWTP with multiple disinfectant-application points.**

Plants with multiple treatment trains may have parallel disinfection zones. The analysis of multiple treatment trains is not that much harder than the one for a single treatment train **if** the treatment trains are identical, they share a common disinfectant application point, and flow is split equally. If the treatment trains are very different, it may be more appropriate to treat the treatment trains as separate plants. Figure B-7 shows the schematics of two treatment plants. Figure B-7 shows a plant where it would be appropriate to define two trains. The complexity of the plant in the following schematic suggests that it might be more appropriate to redefine the facility as two plants instead of two trains.




**One SWTP with two parallel treatment trains in zone D1**




**Two SWTPs with a common zone D3**

**Figure B-7. Schematic of an SWTP with multiple treatment trains.**

## Flow Rate and Effective Contact Time, $T_{10}$

The theoretical contact time in a basin is easily calculated by dividing the actual volume of the basin by the flow rate through it. When the flow rate increases, the time the water spends in the plant decreases. Therefore, we try to use the maximum flow rate through the disinfection zone when evaluating your disinfection process. If possible, we use your historical operational data to determine the peak hourly flow rate through the zone. If this information is not available, we may base the peak flow rate on the maximum raw water pump capacity or some other design feature of the plant.

**IMPORTANT**
The flow rate we used in our CT approval letter may be greater than the rated capacity of your plant. However, unless the letter specifically grants an exception to one or more of our minimum design requirements, the letter does not authorize you to operate above your regulatory design capacity. The only purpose the letter serves is to document that we have approved the disinfection protocol that you are using at your plant—even if you violate our other design criteria.

The theoretical contact time is dependent only on the volume of the basin and the flow rate of the water. However, the actual contact time depends on these two factors as well as on the hydraulic characteristics of the basin, that is, how much **short-circuiting** occurs within the basin. Short-circuiting occurs when individual drops of water do not remain in a basin for the same amount of time. Short-circuiting exists to a significant degree in basins that have inadequate baffling and in basins where mixing occurs.

## Baffling Factors and Effective Contact Time, $T_{10}$

The effective contact time ($T_{10}$) in each disinfection zone is a function of the hydraulics of the basin. The flow through a pipe or a well-baffled basin is very different from the flow through a storage tank or a poorly baffled basin.

Consider the two sets of basins shown in Figure B-8. These two basins have the same shape and size and the only difference between them is that one is well baffled and the other is poorly baffled. Assume that flow rate of the water through each basin is the same and that a food-grade dye is injected at each of the inlets for one minute. In the well-baffled basin, the dyed water moves though the basin as though the water was a solid plug, that is, the dyed water that enters the basin first will leave the basin first. In the poorly-baffled basin, some of the dyed water moves through the basin faster than the rest of the water, that is, some of the dyed water that entered the basin last may exit before some of the water that entered first. As Figure B-8 shows, in an extreme case, much of the dyed water in a poorly-baffled basin will be discharged before any of the dyed water in the well-baffled basin even reaches the outlet.

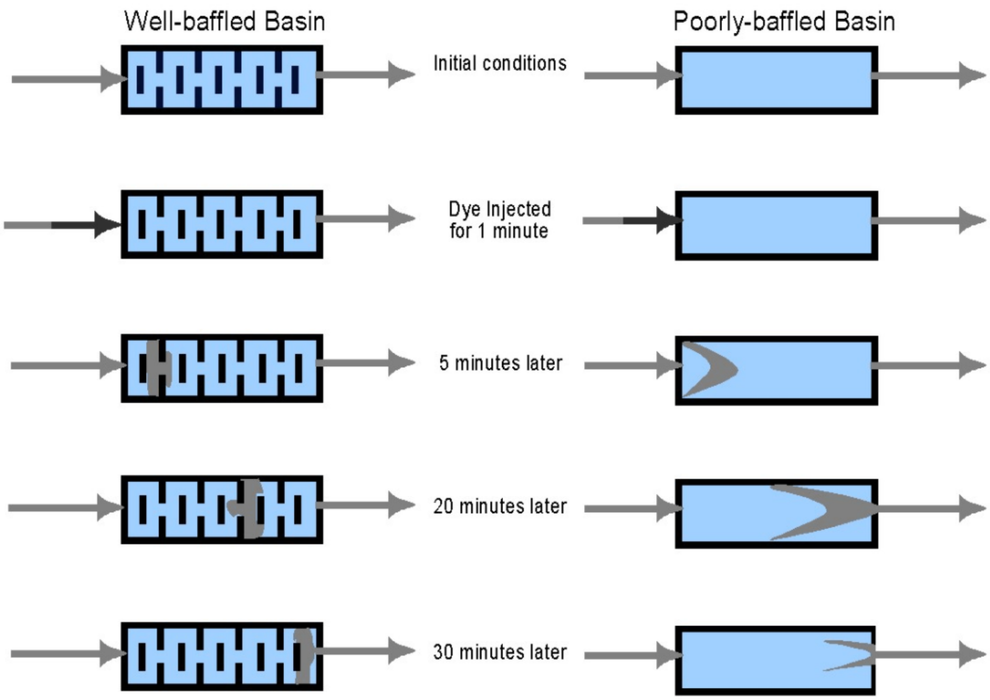



**Figure B-8. Comparison of the flow patterns in well-baffled and poorly baffled basins.**

Now consider the two treatment units shown in Figure B-9. The longest path a particle can take through a pipeline is not that different from the shortest path. It is different for an unbaffled mixing tank. In the case of a tank, one particle may flow through directly from the influent to the effluent. This short-circuiting particle will be in contact with the disinfectant for a relatively short time.

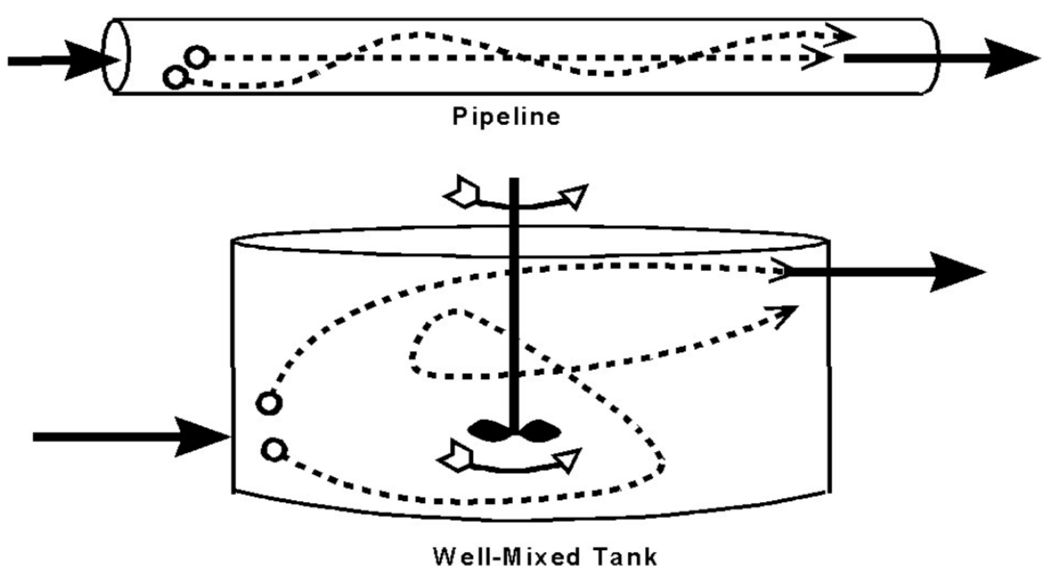



**Figure B-9. Comparison of the flow patterns in a pipe and a well-mixed tank.**

Although basins with mixers and poor baffling exhibit high levels of short-circuiting, some short-circuiting exists in all basins. The question becomes "How much short-circuiting do we allow before we determine the actual contact time?" To answer this question, a number of research studies were conducted on pilot plants and at full-scale facilities. Based on the results of these studies and a theoretical analysis of the problem, the EPA determined that only 10% short-circuiting should be allowed when determining the actual contact time.

Under those conditions, 10% of the water would receive slightly less disinfection than desired but the rest of the water would receive more than enough disinfection to meet the objectives. Since the actual contact time is based on a 10% short-circuiting allowance, the term *$T_{10}$ time* is used to describe the actual disinfectant contact time at your full-scale plants. It should be noted that using the $T_{10}$ time for CT calculations is a very conservative approach: in many cases 50% of the water actually receives twice the required level of disinfection, and 10% of the water might receive as much as four times more disinfection than required.

The next question becomes "How do we determine the $T_{10}$ time for a given operating condition?" The best way to determine the $T_{10}$ time in a disinfectant contact chamber is to run several tracer tests at different flow rates. During each of the tracer tests, you actually introduce a tracer, or marker, compound (such as a dye, fluoride, or other soluble material) into the water as it enters the contactor. You then run a series of tests to determine how long it takes for 10% of this tracer to reach the end of the basin. By running the tests at several different flow rates, you can determine if the hydraulic properties of the basin change as the flow rate changes.

The differences in hydraulics are described by the *baffling factor* (BF)—defined as the ratio of the effective contact time ($T_{10}$) to the theoretical detention time (TDT). The results of the tracer studies are used to determine a baffling factor that characterizes the hydraulic short-circuiting within the treatment unit. The relationship between the baffling factor, $T_{10}$, and the theoretical contact time can be expressed using the following equation:

$$\text{Baffling Factor} = \frac{T_{10}}{T_{10,\ \text{Theoretical}}} \qquad \text{(Equation B-3)}$$

$$= T_{10} \times \frac{\text{Flow rate during the tracer test}}{\text{Volume during the tracer test}}$$

The baffling factor is important because it is then used to calculate the $T_{10}$ times at flow rates other than the ones used during the tracer study. The $T_{10}$ can be calculated for any given operating condition using the following equation:

$$T_{10\ Current} = T_{10,\ Theoretical,\ Current} \times \ Baffling\ Factor$$

$$= \frac{Current\ Volume}{Current\ Flow\ Rate} \times \ Baffling\ Factor$$

(Equation B-4)

You are probably aware that there are no spaces on pages 4 and 5 of the SWMOR for you to enter the volume and baffling factor for each disinfection zone. This is because we made two additional assumptions in order to significantly reduce the amount of data that you need to collect each day.

- First, we use a minimum water level when calculating the $T_{10}$ for the treatment unit. By using a minimum volume, we ensure that the contact time under all operating conditions will be greater than the value that we are approving—and more time means more kill.
- Second, we assume that the water level never exceeds the water level we used when we approve the CT study. This assumption allows us to conclude that the flow rate into the unit is equal to the flow rate out of the unit. (If that were not true, the water level would continue to fall or start to rise.) The assumption allows us to base the detention time in the clearwell (and other variable-level contact basins) on the rate that water is being treated rather than the peak flow rate of the service or transfer pumps. While this assumption may underestimate the contact time in tanks where the water level falls rapidly (such as at plants with very small clearwells or very large service pumps), it gives a conservative estimate for most of the plants in Texas.

Although these assumptions are a minor inconvenience for systems that closely monitor the water level in their clearwell and storage tanks, they significantly simplify the SWMOR for the majority of plants because it is no longer necessary to determine the water volume in each treatment unit each time you collect a CT data set. By making these assumptions, we can combine Equations B-3 and B-4 to obtain:

$$T_{10\ Current} = T_{10,\ Theoretical,\ Current} \times \ Baffling\ Factor$$

$$= \frac{Current\ Volume}{Current\ Flow\ Rate} \times \frac{CT\ Study\ Flow\ Rate}{CT\ Study\ Volume} \times T_{10,\ CT\ Study}$$

(Equation B-5a)

$$= \frac{Current\ Volume}{CT\ Study\ Volume} \times \frac{CT\ Study\ Flow\ Rate}{Current\ Flow\ Rate} \times T_{10,\ CT\ Study}$$

Since we have assumed that the Current Volume and the CT Study Volume are the same, the first term cancels out and you can calculate the actual $T_{10}$ for any operational flow rate using Equation B-5b:

$$T_{10\ Current} = \frac{CT\ Study\ Flow\ Rate}{Current\ Flow\ Rate} \times T_{10\ CT\ Study} \qquad \text{(Equation B-5b)}$$

Although tracer tests are the best way to determine the actual contact time ($T_{10}$) in a basin, tracer studies are time-consuming, expensive, and difficult to conduct. Therefore, you or your engineer may have chosen to estimate the baffling factor (that is, use a theoretical baffling factor) for your basins rather than conducting an actual tracer study to determine an empirical (that is, a data-based) value.

The theoretical baffling factors that we use when reviewing CT studies are based on the baffling characteristics (that is, the design) of a basin and use data obtained from many research studies. The theoretical baffling factors that we approve are relatively conservative and may actually underestimate the $T_{10}$ in a basin. Consequently, if your plant is using a theoretical baffling factor, you are probably providing slightly more disinfection than you think.

**Table B-2. Theoretical baffling factors.**

| Condition | Baffling Factor | Baffling Description | Typical Unit Process |
|---|---|---|---|
| **Unbaffled** | 0.1 | None; agitated basin; high inlet and outlet flow velocities; variable water level | Clearwell or storage tank, without baffling; with no perforated inlet or outlet and with inlet and outlet submerged |
| **Poor** | 0.3 | Single or multiple unbaffled inlets or outlets; no intrabasin baffles | Many conventional sedimentation basins. Storage tanks with two or three baffles |
| **Average** | 0.5 | Baffled inlet or outlet with some intrabasin baffling | Some (few) sedimentation basins. Highly-baffled storage tanks |
| **Superior** | 0.7 | Perforated inlet baffle, serpentine or perforated intrabasin baffles, and outlet weir | Filters; contact tanks with serpentine baffling |
| **Plug Flow** | 1 | Pipeline flow | Sections of pipe 10 times longer than their diameters |

A system must estimate the theoretical baffling factors for each piece of the plant in which disinfection occurs. For instance, in a length of pipe, there is plug flow. A step-dose tracer test in a pipe would show that all the material you put in comes out at the theoretical hydraulic detention time of the pipe. Therefore, the correct theoretical baffling factor to use for a pipe is 1.0. On the other hand, in a tank like an unbaffled clearwell, some of the tracer material in a step-dose test would come out almost immediately. Because of this short-circuiting, the appropriate baffling factor for an unbaffled clearwell is 0.10.

## Disinfection Zones and Effective Contact Time, $T_{10}$

The total $T_{10}$ for a disinfection zone is the sum of the $T_{10}$s for the individual units in the zone. These individual units can include several sections of pipe, a tank or basin, or any other treatment unit that allows time for the disinfectant to work. Equation B-6 summarizes this relationship.

$$T_{10,\,Zone} = \sum_{Unit\ 1}^{Unit\ n} T_{10,\,Unit} \qquad \text{(Equation B-6)}$$

$$= T_{10,Unit\ 1} + T_{10,Unit\ 2} + \ldots + T_{10,Unit\ n}$$

Example B-1 demonstrates how you should use your CT-study-approval letter to determine $T_{10}$ for each of your disinfection zones.

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### Example B-1: Determining the Total $T_{10}$ for a Disinfection Zone

The following is an excerpt from the $T_{10}$ Table contained in the CT-approval letter shown in Appendix A. (Footnotes have been omitted.)

**Table A-1. Approved $T_{10}$ Table for Aguaville WSC's Schwartz Surface Water Treatment Plant.**

| Disinfection Zone | Treatment Unit | Volume (gallons) | Flow Rate | Baffling Factor | $T_{10}$, Unit (min) | $T_{10}$, Zone (min) |
|---|---|---|---|---|---|---|
| D1 | Raw-water line | 2,800 | 2,000 gpm (2.880 MGD) | 1.0 | 1.4 | 46.7 |
| | Splitter box | 1,800 | 2,000 gpm | 0.1 | 0.1 | |
| | Clarifiers | 150,700 | 1,000 gpm | 0.3 | 45.2 | |

From this portion of the table, you can see that:

- The $T_{10}$ times for the raw-water line, splitter box, and clarifiers are 1.4 minutes, 0.1 minutes, and 45.2 minutes, respectively.
- The total $T_{10}$ for Zone D1 is 1.4 + 0.1 + 45.2 = 46.7 minutes.

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# B.3 Submitting a Revised CT Study to the TCEQ

As noted in Section B.2, you may not make any significant change to your disinfection process without our prior written approval. In order to get your proposed change approved, you must conduct a CT study to evaluate the impact of the proposed change. The principal purpose of the CT study is to develop the new $T_{10}$ for each zone. You may determine the $T_{10}$ either by running a tracer study or by using theoretical baffling factors. When you send us the data for our review, you must supply all of the following information:

- a plant schematic showing disinfectant injection and monitoring points
- the dimensions (the length, width, depth, and diameter) and volume of each basin, tank, and large pipe in the disinfection zone

- the peak hourly flow rate through each disinfection zone and a justification for using that specific flow rate to determine $T_{10}$
- all of the empirical tracer study information if you ran a tracer test
- the baffling factor that you are proposing for each unit and the justification for using that specific baffling factor to determine $T_{10}$
- the $T_{10}$ for each treatment unit and the total $T_{10}$ for each disinfection zone

If you have no more than 10 disinfection zones, you can use the CT Study template to prepare your revised CT study. The CT Study template is an Excel spreadsheet that can be customized to fit your plant. This template has a place for you to enter all of the information mentioned above. We used the template to prepare the CT study shown in Appendix A. The appendix also contains a copy of the printout from the template for this imaginary plant.

You can download a copy of the template and its instruction manual from the TCEQ website at:

www.tceq.texas.gov/drinkingwater/swmor

or you can call us at 512-239-4691 to request a copy on a CD.

This template can be completed by the public water system staff—a professional engineer is not required. When the template is completed, copy the completed spreadsheet to a CD and just submit it with a cover letter stating the reason for the CT study revision request and the contact person who can answer any questions we may have. The template can be submitted to us at:

Technical Review and Oversight Team, MC 159
Water Supply Division
Attention: CT Study Coordinator
TCEQ
PO Box 13087
Austin, TX 78711-3087

Alternatively, you may submit documents to our physical address at:

Technical Review and Oversight Team, Building F
Water Supply Division
Attention: CT Study Coordinator
TCEQ
12100 Park 35 Circle
Austin, TX 78753

You may also send us the completed template to a special e-mail account that we have established for this purpose. If you submit the CT study electronically, please be sure to include your name, title, and telephone number in the e-mail and to attach the completed template before the e-mail is sent. The e-mail address that you should use is <CTstudy@tceq.texas.gov>.

# Appendix C: INACTIVATION CALCULATIONS

Water systems using surface water, or groundwater under the influence of surface water, must achieve a 3.0-log reduction of *Giardia lamblia* cysts and a 4.0-log reduction of viruses. Given the treatment processes for physical removal at the plant, the disinfection process is required to achieve a minimum number of log inactivations of *Giardia lamblia* cysts and viruses.

As noted in our discussion of the disinfection process on page B-8, the effectiveness of the disinfection process for inactivating *Giardia lamblia* cysts and viruses depends on five factors:

- the type of disinfectant used
- the disinfectant residual concentration
- the time the water is in contact with the disinfectant
- the water temperature
- the water pH

The best way to be sure that the plant is meeting the disinfection requirements is to calculate the CT value for the plant and compare the result to the CT required to achieve effective disinfection. The SWMOR and SWMOR2 both have built-in functions to perform these calculations.

Nevertheless, it is possible to evaluate your disinfection process using other methods. For example, you can use the CT calculator that is built into the CT Study template or you can complete the evaluation manually. To complete this evaluation manually, you must:

1. calculate the current contact time in each disinfection zone
2. calculate the CT value for each disinfection zone
3. determine the value of $CT_{required}$ for each zone
4. calculate the inactivation ratio for each zone
5. add all of the inactivation ratios

The rest of this appendix describes the process you may use to evaluate your disinfection.

**IMPORTANT**
The SWMOR, SWMOR2, and CT Study spreadsheets use several complex mathematical equations to determine the value of $CT_{required}$. Consequently, under certain operating conditions, the procedure described in this section will give you slightly different results than the one you will get using the spreadsheets. Although the difference between the two readings is typically less than 5%, it can have a significant impact if you are operating very close to your minimum acceptable inactivation requirements—especially the one for viruses.

## C.1 CALCULATING THE CONTACT TIME, $T_{10}$, FOR THE CURRENT FLOW RATE

Using the information from your CT-approval letter and the current flow rate through each disinfection zone, calculate $T_{10}$, in minutes, for each zone using Equation C-1.

$$T_{10\,Actual} = \frac{CT\ Study\ Flow\ Rate}{Actual\ Flow\ Rate} \times T_{10\,CT\,Study} \qquad \text{(Equation C-1)}$$

## C.2 CALCULATING THE $CT_{ACTUAL}$ VALUES FOR THE CURRENT OPERATING CONDITIONS

The CT value is the product of the residual concentration of a disinfectant, C, in milligrams per liter, and the contact time, $T_{10}$, in minutes. Using the $T_{10}$ value you calculated above and the disinfectant residual you measured at the end of each disinfection zone, calculate the CT value for each zone using Equation C-2.

$$CT = C\ (mg/L) \times T_{10\,Actual}\ (minutes) \qquad \text{(Equation C-2)}$$

## C.3 DETERMINING THE REQUIRED CT, $CT_{REQUIRED}$, FOR THE CURRENT OPERATING CONDITIONS

To find the value of $CT_{required}$, you can use either of two methods: approximation or interpolation.

- Approximation is much easier than interpolation, requires no mathematical calculations, and produces fewer errors. Although this method is convenient, it does not give you the exact value of $CT_{required}$. Approximation somewhat underestimates the actual effectiveness of your plant's disinfection process.
- To determine the exact value of $CT_{required}$, you may use interpolation. In this method, you use a series of mathematical calculations to find CT values under conditions that fall between adjacent values in a CT table.

Interpolation is particularly useful when the disinfectant is chlorine dioxide, ozone, or chloramine. Because the CT tables for these disinfectants apply to a wide range of disinfectant concentrations and pH values, you would need to interpolate between temperature values only. In one step, you can find the exact value of $CT_{required}$ for your disinfection zone.

Using interpolation for free chlorine is much more complicated. You must interpolate for each of three factors: temperature, pH, and concentration. Finding the exact $CT_{required}$ would take you as many as seven separate interpolations! Unless you are very comfortable with math, we don't recommend that you use interpolation for free chlorine.

**IMPORTANT**
The SWMOR, SWMOR2, and CT Study template all use several complex mathematical equations to determine the value of $CT_{required}$. The approximation method will never give you the same $CT_{required}$ as the spreadsheets. Even if you use the interpolation method to get the more accurate $CT_{required}$ value, the result may still differ slightly from the value calculated by the spreadsheets. This discrepancy occurs because interpolation assumes a linear relationship between adjacent points on the CT tables. Unfortunately, the relationship between operating conditions and $CT_{required}$ is not truly linear.

## Finding $CT_{required}$ by Approximation

Examples C-1 through C-3 show how to find the value of $CT_{required}$ using the approximation method.

---

### Example C-1: Finding $CT_{required}$ for *Giardia lamblia* When Using Free Chlorine

Problem: Find $CT_{required}$ at 19°C, pH 7.2, and a chlorine concentration of 1.1 mg/L when a 0.5-log inactivation of *Giardia* is needed.

1. In Appendix D, find the CT tables for *Giardia* inactivation using free chlorine.

2. Find the table for the temperature that is equal to or slightly below the actual temperature of the water.

   For a temperature of 19°C, use the table for 15ºC: Table D-1.4.

3. Go to the section of this table for the pH that is equal to or slightly above the actual pH of the water.

   For a pH of 7.2, use the section for pH = 7.5.

4. Find the column for the log inactivations needed.

   This plant must achieve a 0.5-log *Giardia* inactivation, so use the "0.5-log" column.

5. Look at the far left side of the table and find the chlorine concentration that is equal to or slightly above the actual free chlorine concentration.

   In our example, the chlorine concentration is 1.1 mg/L, so use the "1.2 mg/L" row.

6. The value shown at the intersection of the concentration row and the inactivation column is the value of $CT_{required}$.

   In this example, $CT_{required}$ is 15.

---

## Example C-2: Finding $CT_{required}$ for Viruses When Using Free Chlorine

Problem: Find $CT_{required}$ at 8°C and pH 7.2 when chlorine is used to obtain a 2.0-log inactivation of viruses.

1. Go to the CT table for viral inactivation using free chlorine (Table D-1.7).

2. Find the section of the table for the log inactivations needed.

   This plant is required to achieve a 2.0-log viral inactivation, so use one of the two columns under the 2.0-log inactivation section.

3. Go to the column for the pH range that is equal to or slightly above the actual pH of the water.

   For a pH of 7.2, use the "pH = 5.5–9.49" column.

4. Look at the far left side of the table and find the temperature that is equal to or slightly below the actual temperature of the water.

   For a temperature of 8°C, use the "5°C" row.

5. The value shown at the intersection of the temperature row and the pH column is the value of $CT_{required}$.

   In this example, $CT_{required}$ is 4.

### Example C-3: Finding $CT_{required}$ When Using Chlorine Dioxide, Ozone, or Chloramine

The CT tables for chlorine dioxide, ozone, and chloramine are found in Appendix D (in Sections D-2, D-3, and D-4, respectively.) Because each of these tables has the same format, you can use the procedure described for chloramine below for any one of these three disinfectants.

Because these disinfectants are less sensitive than chlorine to the effects of pH, you will find no pH sections in these tables. Instead, each table applies to a broad pH range. Make sure the pH of the disinfection zone is within the pH range for the table you use.

Problem: Find $CT_{required}$ when using chloramine to obtain a 0.5-log inactivations of *Giardia* at 19°C.

1. Find the proper CT table for the disinfectant used in the zone. For example, use Table D-4.1 to determine the *Giardia* CT requirement when using chloramine.

2. Find the column for the temperature that is equal to or slightly below the actual temperature of the water.
   For a temperature of 19°C, use the "15°C" column.

3. Look at the far left side of the table and find the row for the required log inactivations.
   This plant is required to achieve a 0.5-log *Giardia* inactivation, so use the "0.5-log" row.

4. The value shown at the intersection of the inactivation row and the temperature column is the value of $CT_{required}$.
   In this example, $CT_{required}$ is 250.

## Finding $CT_{required}$ by Interpolation

Example C-4 shows how to determine the value of $CT_{required}$ using the linear interpolation method. Since the process is identical for all of the disinfectants, Example C-4 demonstrates the process for chlorine dioxide and the target organism *Giardia lamblia*.

It should be noted, however, that using this method for free chlorine requires you to repeat this process three times; once for temperature, once for pH, and once for residual. Because of the complexity of the process for free chlorine, we recommend that you use the approximation method when working with this disinfectant.

## Example C-4: Finding $CT_{required}$ for *Giardia* When Using Chlorine Dioxide

Problem: Find the exact value of $CT_{required}$ to obtain a 0.5-log inactivations of *Giardia* when using chlorine dioxide at 17°C and a pH of 7.6.

**Part 1: Selecting the Table to Use for Interpolation**

1. Find the proper CT table or tables for the disinfectant used in the zone.

   For this example, use Table D-2.1 to determine the *Giardia* CT requirement when using chlorine dioxide.

   Once you have found this table, make sure that the pH of the zone is within the pH range of the table. If not, no inactivation credits can be given. A pH of 7.6 is within the range of Table D-2.1 (5.5 through 9.49).

2. Find the columns for the two temperatures that are immediately above and below the actual temperature of the water.

   For example, the temperature is 17°C, so use the "15°C" and "20°C" columns.

3. Look at the far left side of the table and find the row for the required log inactivations.

   This plant is required to achieve a 0.5-log *Giardia* inactivation, so use the "0.5-log" row.

4. The value shown at the intersection of the inactivation row and the temperature columns are the $CT_{required}$ values to be used in the interpolation.

   In this example, the two $CT_{required}$ values are 3.2 and 2.5.

**Part 2: Calculating $CT_{required}$ by Linear Interpolation**

1. Subtract the $CT_{required}$ value for the higher temperature from the $CT_{required}$ value for the lower temperature:

   3.2 – 2.5 = 0.7

2. Subtract the lower temperature from the higher temperature:

   20 – 15 = 5

3. Divide the result of step 5 by the result of step 6:

   0.7 / 5 = 0.14

4. Subtract the actual water temperature from the higher temperature:

   20 – 17 = 3

5. Multiply the result of step 7 by the result of step 8 and round to the same number of decimal places used in the CT table you are using:

   3 × 0.14 = 0.42 (which you then round to 0.4 since the CT values for chlorine dioxide are listed to the tenths decimal place)

6. Add the result of step 9 to the $CT_{required}$ value for the higher temperature:

   2.5 + 0.4 = 2.9

This is the value of $CT_{required}$ for the actual water temperature in this plant: 17°C.

## C.4 CALCULATING THE INACTIVATION RATIO FOR EACH DISINFECTION ZONE

The inactivation ratio is a measure of how effective the disinfection has been under actual operating conditions. To find the inactivation ratio in a disinfection zone, divide the CT value achieved in that zone, or CT, by the CT value required for effective disinfection, or $CT_{required}$, as shown in Equation C-3.

$$Inactivation\ Ratio = \frac{CT_{Actual}}{CT_{Required}} \qquad \text{(Equation C-3)}$$

## C.5 DETERMINING THE TOTAL INACTIVATION RATIO FOR THE PLANT

To find the overall inactivation ratio for the plant, you add up the inactivation ratios of the disinfection zones in the plant. Disinfection is sufficiently effective when this overall inactivation ratio is 1.00 or greater.

$$Total\ Inactivation\ Ratio = \sum_{Zone\ D1}^{Zone\ Dn} Inactivation\ Ratio_{Zone\ Dn} \qquad \text{(Equation C-4)}$$

$$= Inactivation\ Ratio_{D1} + Inactivation\ Ratio_{D2} + \ \ldots\ + Inactivation\ Ratio_{Dn}$$

# Appendix D:
# CT TABLES

## D.1 CT TABLES FOR DISINFECTION WITH $CL_2$

This appendix contains the CT tables you should use when inactivating *Giardia lamblia* and viruses with free chlorine. The information used to generate these tables and the associated notes was derived from Appendixes E and F of the EPA's *Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources*, Office of Drinking Water,Washington D.C., (March 1991) available at:

water.epa.gov/lawsregs/rulesregs/sdwa/swtr/upload/guidsws.pdf

**Table D-1.1. CT values required for inactivation of *Giardia* cysts at 0.5°C or lower.**

| Chlorine Concentration (mg/L) | pH ≤ 6.0 | | | | | | pH = 6.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 23 | 46 | 69 | 91 | 114 | 137 | 27 | 54 | 82 | 109 | 136 | 163 |
| 0.6 | 24 | 47 | 71 | 94 | 118 | 141 | 28 | 56 | 84 | 112 | 140 | 168 |
| 0.8 | 24 | 48 | 73 | 97 | 121 | 145 | 29 | 57 | 86 | 115 | 143 | 172 |
| 1.0 | 25 | 49 | 74 | 99 | 123 | 148 | 29 | 59 | 88 | 117 | 147 | 176 |
| 1.2 | 25 | 51 | 76 | 101 | 127 | 152 | 30 | 60 | 90 | 120 | 150 | 180 |
| 1.4 | 26 | 52 | 78 | 103 | 129 | 155 | 31 | 61 | 92 | 123 | 153 | 184 |
| 1.6 | 26 | 52 | 79 | 105 | 131 | 157 | 32 | 63 | 95 | 126 | 158 | 189 |
| 1.8 | 27 | 54 | 81 | 108 | 135 | 162 | 32 | 64 | 97 | 129 | 161 | 193 |
| 2.0 | 28 | 55 | 83 | 110 | 138 | 165 | 33 | 66 | 99 | 131 | 164 | 197 |
| 2.2 | 28 | 56 | 85 | 113 | 141 | 169 | 34 | 67 | 101 | 134 | 168 | 201 |
| 2.4 | 29 | 57 | 86 | 115 | 143 | 172 | 34 | 68 | 103 | 137 | 171 | 205 |
| 2.6 | 29 | 58 | 88 | 117 | 146 | 175 | 35 | 70 | 105 | 139 | 174 | 209 |
| 2.8 | 30 | 59 | 89 | 119 | 148 | 178 | 36 | 71 | 107 | 142 | 178 | 213 |
| ≥ 3.0 | 30 | 60 | 91 | 121 | 151 | 181 | 36 | 72 | 109 | 145 | 181 | 217 |
| **Chlorine Concentration (mg/L)** | **pH = 7.0** | | | | | | **pH = 7.5** | | | | | |
| | **Log inactivations** | | | | | | **Log inactivations** | | | | | |
| | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** |
| ≤ 0.4 | 33 | 65 | 98 | 130 | 163 | 195 | 40 | 79 | 119 | 158 | 198 | 237 |
| 0.6 | 33 | 67 | 100 | 133 | 167 | 200 | 40 | 80 | 120 | 159 | 199 | 239 |
| 0.8 | 34 | 68 | 103 | 137 | 171 | 205 | 41 | 82 | 123 | 164 | 205 | 246 |
| 1.0 | 35 | 70 | 105 | 140 | 175 | 210 | 42 | 84 | 127 | 169 | 211 | 253 |
| 1.2 | 36 | 72 | 108 | 143 | 179 | 215 | 43 | 86 | 130 | 173 | 216 | 259 |
| 1.4 | 37 | 74 | 111 | 147 | 184 | 221 | 44 | 89 | 133 | 177 | 222 | 266 |
| 1.6 | 38 | 75 | 113 | 151 | 188 | 226 | 46 | 91 | 137 | 182 | 228 | 273 |
| 1.8 | 39 | 77 | 116 | 154 | 193 | 231 | 47 | 93 | 140 | 186 | 233 | 279 |
| 2.0 | 39 | 79 | 118 | 157 | 197 | 236 | 48 | 95 | 143 | 191 | 238 | 286 |
| 2.2[a] | 40 | 81 | 121 | 161 | 202 | 242 | 50 | 99 | 149 | 198 | 248 | 297 |
| 2.4 | 41 | 82 | 124 | 165 | 206 | 247 | 50 | 99 | 149 | 199 | 248 | 298 |
| 2.6 | 42 | 84 | 126 | 168 | 210 | 252 | 51 | 101 | 152 | 203 | 253 | 304 |
| 2.8 | 43 | 86 | 129 | 171 | 214 | 257 | 52 | 103 | 155 | 207 | 258 | 310 |
| ≥ 3.0 | 44 | 87 | 131 | 174 | 218 | 261 | 53 | 105 | 158 | 211 | 263 | 316 |

[a] The values shown in Table D-1.1 for pH = 7.5 and $Cl_2$ = 2.2 were precisely reproduced from the manual despite the apparent errors.

Table D-1.1 continues on the next page.

**Table D-1.1—Continued**

| Chlorine Concentration (mg/L) | pH = 8.0 | | | | | | pH = 8.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 46 | 92 | 139 | 185 | 231 | 277 | 55 | 110 | 165 | 219 | 274 | 329 |
| 0.6 | 48 | 95 | 143 | 191 | 238 | 286 | 57 | 114 | 171 | 228 | 285 | 342 |
| 0.8 | 49 | 98 | 148 | 197 | 246 | 295 | 59 | 118 | 177 | 236 | 295 | 354 |
| 1.0 | 51 | 101 | 152 | 203 | 253 | 304 | 61 | 122 | 183 | 243 | 304 | 365 |
| 1.2 | 52 | 104 | 157 | 209 | 261 | 313 | 63 | 125 | 188 | 251 | 313 | 376 |
| 1.4 | 54 | 107 | 161 | 214 | 268 | 321 | 65 | 129 | 194 | 258 | 323 | 387 |
| 1.6 | 55 | 110 | 165 | 219 | 274 | 329 | 66 | 132 | 199 | 265 | 331 | 397 |
| 1.8 | 56 | 113 | 169 | 225 | 282 | 338 | 68 | 136 | 204 | 271 | 339 | 407 |
| 2.0 | 58 | 115 | 173 | 231 | 288 | 346 | 70 | 139 | 209 | 278 | 348 | 417 |
| 2.2 | 59 | 118 | 177 | 235 | 294 | 353 | 71 | 142 | 213 | 284 | 355 | 426 |
| 2.4 | 60 | 120 | 181 | 241 | 301 | 361 | 73 | 145 | 218 | 290 | 363 | 435 |
| 2.6 | 61 | 123 | 184 | 245 | 307 | 368 | 74 | 148 | 222 | 296 | 370 | 444 |
| 2.8 | 63 | 125 | 188 | 250 | 313 | 375 | 75 | 151 | 226 | 301 | 377 | 452 |
| ≥ 3.0 | 64 | 127 | 191 | 255 | 318 | 382 | 77 | 153 | 230 | 307 | 383 | 460 |

| Chlorine Concentration (mg/L) | pH = 9.0 | | | | | |
|---|---|---|---|---|---|---|
| | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 65 | 130 | 195 | 260 | 325 | 390 |
| 0.6 | 68 | 136 | 204 | 271 | 339 | 407 |
| 0.8 | 70 | 141 | 211 | 281 | 352 | 422 |
| 1.0 | 73 | 146 | 219 | 291 | 364 | 437 |
| 1.2 | 75 | 150 | 226 | 301 | 376 | 451 |
| 1.4 | 77 | 155 | 232 | 309 | 387 | 464 |
| 1.6 | 80 | 159 | 239 | 318 | 398 | 477 |
| 1.8 | 82 | 163 | 245 | 326 | 408 | 489 |
| 2.0 | 83 | 167 | 250 | 333 | 417 | 500 |
| 2.2 | 85 | 170 | 256 | 341 | 426 | 511 |
| 2.4 | 87 | 174 | 261 | 348 | 435 | 522 |
| 2.6 | 89 | 178 | 267 | 355 | 444 | 533 |
| 2.8 | 91 | 181 | 272 | 362 | 453 | 543 |
| ≥ 3.0 | 92 | 184 | 276 | 368 | 460 | 552 |

*Note:*

No disinfection credit for *Giardia* cysts is allowed when using free chlorine if the pH within the disinfection zone is greater than 9.0.

## Table D-1.2. CT values required for inactivation of *Giardia* cysts at 5°C.

| Chlorine Concentration (mg/L) | pH ≤ 6.0 | | | | | | pH = 6.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** |
| **≤ 0.4** | 16 | 32 | 49 | 65 | 81 | 97 | 20 | 39 | 59 | 78 | 98 | 117 |
| **0.6** | 17 | 33 | 50 | 67 | 83 | 100 | 20 | 40 | 60 | 80 | 100 | 120 |
| **0.8** | 17 | 34 | 52 | 69 | 86 | 103 | 20 | 41 | 61 | 81 | 102 | 122 |
| **1.0** | 18 | 35 | 53 | 70 | 88 | 105 | 21 | 42 | 63 | 83 | 104 | 125 |
| **1.2** | 18 | 36 | 54 | 71 | 89 | 107 | 21 | 42 | 64 | 85 | 106 | 127 |
| **1.4** | 18 | 36 | 55 | 73 | 91 | 109 | 22 | 43 | 65 | 87 | 108 | 130 |
| **1.6** | 19 | 37 | 56 | 74 | 93 | 111 | 22 | 44 | 66 | 88 | 110 | 132 |
| **1.8** | 19 | 38 | 57 | 76 | 95 | 114 | 23 | 45 | 68 | 90 | 113 | 135 |
| **2.0** | 19 | 39 | 58 | 77 | 97 | 116 | 23 | 46 | 69 | 92 | 115 | 138 |
| **2.2** | 20 | 39 | 59 | 79 | 98 | 118 | 23 | 47 | 70 | 93 | 117 | 140 |
| **2.4** | 20 | 40 | 60 | 80 | 100 | 120 | 24 | 48 | 72 | 95 | 119 | 143 |
| **2.6** | 20 | 41 | 61 | 81 | 102 | 122 | 24 | 49 | 73 | 97 | 122 | 146 |
| **2.8** | 21 | 41 | 62 | 83 | 103 | 124 | 25 | 49 | 74 | 99 | 123 | 148 |
| **≥ 3.0** | 21 | 42 | 63 | 84 | 105 | 126 | 25 | 50 | 76 | 101 | 126 | 151 |
| **Chlorine Concentration (mg/L)** | **pH = 7.0** | | | | | | **pH = 7.5** | | | | | |
| | **Log inactivations** | | | | | | **Log inactivations** | | | | | |
| | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** |
| **≤ 0.4** | 23 | 46 | 70 | 93 | 116 | 139 | 28 | 55 | 83 | 111 | 138 | 166 |
| **0.6** | 24 | 48 | 72 | 95 | 119 | 143 | 29 | 57 | 86 | 114 | 143 | 171 |
| **0.8** | 24 | 49 | 73 | 97 | 122 | 146 | 29 | 58 | 88 | 117 | 146 | 175 |
| **1.0** | 25 | 50 | 75 | 99 | 124 | 149 | 30 | 60 | 90 | 119 | 149 | 179 |
| **1.2** | 25 | 51 | 76 | 101 | 127 | 152 | 31 | 61 | 92 | 122 | 153 | 183 |
| **1.4** | 26 | 52 | 78 | 103 | 129 | 155 | 31 | 62 | 94 | 125 | 156 | 187 |
| **1.6** | 26 | 53 | 79 | 105 | 132 | 158 | 32 | 64 | 96 | 128 | 160 | 192 |
| **1.8** | 27 | 54 | 81 | 108 | 135 | 162 | 33 | 65 | 98 | 131 | 163 | 196 |
| **2.0** | 28 | 55 | 83 | 110 | 138 | 165 | 33 | 67 | 100 | 133 | 167 | 200 |
| **2.2** | 28 | 56 | 85 | 113 | 141 | 169 | 34 | 68 | 102 | 136 | 170 | 204 |
| **2.4** | 29 | 57 | 86 | 115 | 143 | 172 | 35 | 70 | 105 | 139 | 174 | 209 |
| **2.6** | 29 | 58 | 88 | 117 | 146 | 175 | 36 | 71 | 107 | 142 | 178 | 213 |
| **2.8** | 30 | 59 | 89 | 119 | 148 | 178 | 36 | 72 | 109 | 145 | 181 | 217 |
| **≥ 3.0** | 30 | 61 | 91 | 121 | 152 | 182 | 37 | 74 | 111 | 147 | 184 | 221 |

Table D-1.2 continues on the next page.

**Table D-1.2—Continued**

| Chlorine Concentration (mg/L) | pH = 8.0 | | | | | | pH = 8.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 33 | 66 | 99 | 132 | 165 | 198 | 39 | 79 | 118 | 157 | 197 | 236 |
| 0.6 | 34 | 68 | 102 | 136 | 170 | 204 | 41 | 81 | 122 | 163 | 203 | 244 |
| 0.8 | 35 | 70 | 105 | 140 | 175 | 210 | 42 | 84 | 126 | 168 | 210 | 252 |
| 1.0 | 36 | 72 | 108 | 144 | 180 | 216 | 43 | 87 | 130 | 173 | 217 | 260 |
| 1.2 | 37 | 74 | 111 | 147 | 184 | 221 | 45 | 89 | 134 | 178 | 223 | 267 |
| 1.4 | 38 | 76 | 114 | 151 | 189 | 227 | 46 | 91 | 137 | 183 | 228 | 274 |
| 1.6 | 39 | 77 | 116 | 155 | 193 | 232 | 47 | 94 | 141 | 187 | 234 | 281 |
| 1.8 | 40 | 79 | 119 | 159 | 198 | 238 | 48 | 96 | 144 | 191 | 239 | 287 |
| 2.0 | 41 | 81 | 122 | 162 | 203 | 243 | 49 | 98 | 147 | 196 | 245 | 294 |
| 2.2 | 41 | 83 | 124 | 165 | 207 | 248 | 50 | 100 | 150 | 200 | 250 | 300 |
| 2.4 | 42 | 84 | 127 | 169 | 211 | 253 | 51 | 102 | 153 | 204 | 255 | 306 |
| 2.6 | 43 | 86 | 129 | 172 | 215 | 258 | 52 | 104 | 156 | 208 | 260 | 312 |
| 2.8 | 44 | 88 | 132 | 175 | 219 | 263 | 53 | 106 | 159 | 212 | 265 | 318 |
| ≥ 3.0 | 45 | 89 | 134 | 179 | 223 | 268 | 54 | 108 | 162 | 216 | 270 | 324 |

| Chlorine Concentration (mg/L) | pH = 9.0 | | | | | |
|---|---|---|---|---|---|---|
| | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 47 | 93 | 140 | 186 | 233 | 279 |
| 0.6 | 49 | 97 | 146 | 194 | 243 | 291 |
| 0.8 | 50 | 100 | 151 | 201 | 251 | 301 |
| 1.0 | 52 | 104 | 156 | 208 | 260 | 312 |
| 1.2 | 53 | 107 | 160 | 213 | 267 | 320 |
| 1.4 | 55 | 110 | 165 | 219 | 274 | 329 |
| 1.6 | 56 | 112 | 169 | 225 | 281 | 337 |
| 1.8 | 58 | 115 | 173 | 230 | 288 | 345 |
| 2.0 | 59 | 118 | 177 | 235 | 294 | 353 |
| 2.2 | 60 | 120 | 181 | 241 | 301 | 361 |
| 2.4 | 61 | 123 | 184 | 245 | 307 | 368 |
| 2.6 | 63 | 125 | 188 | 250 | 313 | 375 |
| 2.8 | 64 | 127 | 191 | 255 | 318 | 382 |
| ≥ 3.0 | 65 | 130 | 195 | 259 | 324 | 389 |

*Note:*

No disinfection credit for *Giardia* cysts is allowed when using free chlorine if the pH within the disinfection zone is greater than 9.0.

### Table D-1.3. CT values required for inactivation of *Giardia* cysts at 10°C.

| Chlorine Concentration (mg/L) | pH ≤ 6.0 | | | | | | pH = 6.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** |
| **≤ 0.4** | 12 | 24 | 37 | 49 | 61 | 73 | 15 | 29 | 44 | 59 | 73 | 88 |
| **0.6** | 13 | 25 | 38 | 50 | 63 | 75 | 15 | 30 | 45 | 60 | 75 | 90 |
| **0.8** | 13 | 26 | 39 | 52 | 65 | 78 | 15 | 31 | 46 | 61 | 77 | 92 |
| **1.0** | 13 | 26 | 40 | 53 | 66 | 79 | 16 | 31 | 47 | 63 | 78 | 94 |
| **1.2** | 13 | 27 | 40 | 53 | 67 | 80 | 16 | 32 | 48 | 63 | 79 | 95 |
| **1.4** | 14 | 27 | 41 | 55 | 68 | 82 | 16 | 33 | 49 | 65 | 82 | 98 |
| **1.6** | 14 | 28 | 42 | 55 | 69 | 83 | 17 | 33 | 50 | 66 | 83 | 99 |
| **1.8** | 14 | 29 | 43 | 57 | 72 | 86 | 17 | 34 | 51 | 67 | 84 | 101 |
| **2.0** | 15 | 29 | 44 | 58 | 73 | 87 | 17 | 35 | 52 | 69 | 87 | 104 |
| **2.2** | 15 | 30 | 45 | 59 | 74 | 89 | 18 | 35 | 53 | 70 | 88 | 105 |
| **2.4** | 15 | 30 | 45 | 60 | 75 | 90 | 18 | 36 | 54 | 71 | 89 | 107 |
| **2.6** | 15 | 31 | 46 | 61 | 77 | 92 | 18 | 37 | 55 | 73 | 98 | 110 |
| **2.8** | 16 | 31 | 47 | 62 | 78 | 93 | 19 | 37 | 56 | 74 | 93 | 111 |
| **≥ 3.0** | 16 | 32 | 48 | 63 | 79 | 95 | 19 | 38 | 57 | 75 | 94 | 113 |

| Chlorine Concentration (mg/L) | pH = 7.0 | | | | | | pH = 7.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** |
| **≤ 0.4** | 17 | 35 | 52 | 69 | 87 | 104 | 21 | 42 | 63 | 83 | 104 | 125 |
| **0.6** | 18 | 36 | 54 | 71 | 89 | 107 | 21 | 43 | 64 | 85 | 107 | 128 |
| **0.8** | 18 | 37 | 55 | 73 | 92 | 110 | 22 | 44 | 66 | 87 | 109 | 131 |
| **1.0** | 19 | 37 | 56 | 75 | 93 | 112 | 22 | 45 | 67 | 89 | 112 | 134 |
| **1.2** | 19 | 38 | 57 | 76 | 95 | 114 | 23 | 46 | 69 | 91 | 114 | 137 |
| **1.4** | 19 | 39 | 58 | 77 | 97 | 116 | 23 | 47 | 70 | 93 | 117 | 140 |
| **1.6** | 20 | 40 | 60 | 79 | 99 | 119 | 24 | 48 | 72 | 96 | 120 | 144 |
| **1.8** | 20 | 41 | 61 | 81 | 102 | 122 | 25 | 49 | 74 | 98 | 123 | 147 |
| **2.0** | 21 | 41 | 62 | 83 | 103 | 124 | 25 | 50 | 75 | 100 | 125 | 150 |
| **2.2** | 21 | 42 | 64 | 85 | 106 | 127 | 26 | 51 | 77 | 102 | 128 | 153 |
| **2.4** | 22 | 43 | 65 | 86 | 108 | 129 | 26 | 52 | 79 | 105 | 131 | 157 |
| **2.6** | 22 | 44 | 66 | 87 | 109 | 131 | 27 | 53 | 80 | 107 | 133 | 160 |
| **2.8** | 22 | 45 | 67 | 89 | 112 | 134 | 27 | 54 | 82 | 109 | 136 | 163 |
| **≥ 3.0** | 23 | 46 | 69 | 91 | 114 | 137 | 28 | 55 | 83 | 111 | 138 | 166 |

Table D-1.3 continues on the next page.

**Table D-1.3—Continued**

| Chlorine Concentration (mg/L) | pH = 8.0 | | | | | | pH = 8.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 25 | 50 | 75 | 99 | 124 | 149 | 30 | 59 | 89 | 118 | 148 | 177 |
| 0.6 | 26 | 51 | 77 | 102 | 128 | 153 | 31 | 61 | 92 | 122 | 153 | 183 |
| 0.8 | 26 | 53 | 79 | 105 | 132 | 158 | 32 | 63 | 95 | 126 | 158 | 189 |
| 1.0 | 27 | 54 | 81 | 108 | 135 | 162 | 33 | 65 | 98 | 130 | 163 | 195 |
| 1.2 | 28 | 55 | 83 | 111 | 138 | 166 | 33 | 67 | 100 | 133 | 167 | 200 |
| 1.4 | 28 | 57 | 85 | 113 | 142 | 170 | 34 | 69 | 103 | 137 | 172 | 206 |
| 1.6 | 29 | 58 | 87 | 116 | 145 | 174 | 35 | 70 | 106 | 141 | 176 | 211 |
| 1.8 | 30 | 60 | 90 | 119 | 149 | 179 | 36 | 72 | 108 | 143 | 179 | 215 |
| 2.0 | 30 | 61 | 91 | 121 | 152 | 182 | 37 | 74 | 111 | 147 | 184 | 221 |
| 2.2 | 31 | 62 | 93 | 124 | 155 | 186 | 38 | 75 | 133 | 150 | 188 | 225 |
| 2.4 | 32 | 63 | 95 | 127 | 158 | 190 | 38 | 77 | 115 | 153 | 192 | 230 |
| 2.6 | 32 | 65 | 97 | 129 | 162 | 194 | 39 | 78 | 117 | 156 | 195 | 234 |
| 2.8 | 33 | 66 | 99 | 131 | 164 | 197 | 40 | 80 | 120 | 159 | 199 | 239 |
| ≥ 3.0 | 34 | 67 | 101 | 134 | 168 | 201 | 41 | 81 | 122 | 162 | 203 | 243 |

| Chlorine Concentration (mg/L) | pH = 9.0 | | | | | |
|---|---|---|---|---|---|---|
| | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤0.4 | 35 | 70 | 105 | 139 | 174 | 209 |
| 0.6 | 36 | 73 | 109 | 145 | 182 | 218 |
| 0.8 | 38 | 75 | 133 | 151 | 188 | 226 |
| 1.0 | 39 | 78 | 117 | 156 | 195 | 234 |
| 1.2 | 40 | 80 | 120 | 160 | 200 | 240 |
| 1.4 | 41 | 82 | 124 | 165 | 206 | 247 |
| 1.6 | 42 | 84 | 127 | 169 | 211 | 253 |
| 1.8 | 43 | 86 | 130 | 173 | 216 | 259 |
| 2.0 | 44 | 88 | 133 | 177 | 221 | 265 |
| 2.2 | 45 | 90 | 136 | 181 | 226 | 271 |
| 2.4 | 46 | 92 | 138 | 184 | 230 | 276 |
| 2.6 | 47 | 94 | 141 | 187 | 234 | 281 |
| 2.8 | 48 | 96 | 144 | 181 | 239 | 287 |
| ≥ 3.0 | 49 | 97 | 146 | 195 | 243 | 292 |

*Note:*

No disinfection credit for *Giardia* cysts is allowed when using free chlorine if the pH within the disinfection zone is greater than 9.0.

**Table D-1.4. CT values required for inactivation of *Giardia* cysts at 15°C.**

| Chlorine Concentration (mg/L) | pH ≤ 6.0 | | | | | | pH = 6.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 8 | 16 | 25 | 33 | 41 | 49 | 10 | 20 | 30 | 39 | 49 | 59 |
| 0.6 | 8 | 17 | 25 | 33 | 42 | 50 | 10 | 20 | 30 | 40 | 50 | 60 |
| 0.8 | 9 | 17 | 26 | 35 | 43 | 52 | 10 | 20 | 31 | 41 | 51 | 61 |
| 1.0 | 9 | 18 | 27 | 35 | 44 | 53 | 11 | 21 | 32 | 42 | 53 | 63 |
| 1.2 | 9 | 18 | 27 | 36 | 45 | 54 | 11 | 21 | 32 | 43 | 53 | 64 |
| 1.4 | 9 | 18 | 28 | 37 | 46 | 55 | 11 | 22 | 33 | 43 | 54 | 65 |
| 1.6 | 9 | 19 | 28 | 37 | 47 | 56 | 11 | 22 | 33 | 44 | 55 | 66 |
| 1.8 | 10 | 19 | 29 | 38 | 48 | 57 | 11 | 23 | 34 | 45 | 57 | 68 |
| 2.0 | 10 | 19 | 29 | 39 | 48 | 58 | 12 | 23 | 35 | 46 | 58 | 69 |
| 2.2 | 10 | 20 | 30 | 39 | 49 | 59 | 12 | 23 | 35 | 47 | 58 | 70 |
| 2.4 | 10 | 20 | 30 | 40 | 50 | 60 | 12 | 24 | 36 | 48 | 60 | 72 |
| 2.6 | 10 | 20 | 31 | 41 | 51 | 61 | 12 | 24 | 37 | 49 | 61 | 73 |
| 2.8 | 10 | 21 | 31 | 41 | 52 | 62 | 12 | 25 | 37 | 49 | 62 | 74 |
| ≥ 3.0 | 11 | 21 | 32 | 42 | 53 | 63 | 13 | 25 | 38 | 51 | 63 | 76 |
| **Chlorine Concentration (mg/L)** | **pH = 7.0** | | | | | | **pH = 7.5** | | | | | |
| | **Log inactivations** | | | | | | **Log inactivations** | | | | | |
| | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** |
| ≤ 0.4 | 12 | 23 | 35 | 47 | 58 | 70 | 14 | 28 | 42 | 55 | 69 | 83 |
| 0.6 | 12 | 24 | 36 | 48 | 60 | 72 | 14 | 29 | 43 | 57 | 72 | 86 |
| 0.8 | 12 | 24 | 37 | 49 | 61 | 73 | 15 | 29 | 44 | 59 | 73 | 88 |
| 1.0 | 13 | 25 | 38 | 50 | 63 | 75 | 15 | 30 | 45 | 60 | 75 | 90 |
| 1.2 | 13 | 25 | 38 | 51 | 63 | 76 | 15 | 31 | 46 | 61 | 77 | 92 |
| 1.4 | 13 | 26 | 39 | 52 | 65 | 78 | 16 | 31 | 47 | 63 | 78 | 94 |
| 1.6 | 13 | 26 | 40 | 53 | 66 | 79 | 16 | 32 | 48 | 64 | 80 | 96 |
| 1.8 | 14 | 27 | 41 | 54 | 68 | 81 | 16 | 33 | 49 | 65 | 82 | 98 |
| 2.0 | 14 | 28 | 42 | 55 | 69 | 83 | 17 | 33 | 50 | 67 | 83 | 100 |
| 2.2 | 14 | 28 | 53 | 57 | 71 | 85 | 17 | 34 | 51 | 68 | 85 | 102 |
| 2.4 | 14 | 29 | 43 | 57 | 72 | 86 | 18 | 35 | 53 | 70 | 88 | 105 |
| 2.6 | 15 | 29 | 44 | 59 | 73 | 88 | 18 | 36 | 54 | 71 | 89 | 107 |
| 2.8 | 15 | 30 | 45 | 59 | 74 | 89 | 18 | 36 | 55 | 73 | 91 | 109 |
| ≥ 3.0 | 15 | 30 | 46 | 61 | 76 | 91 | 19 | 37 | 56 | 74 | 93 | 111 |

Table D-1.4 continues on the next page.

**Table D-1.4—Continued**

| Chlorine Concentration (mg/L) | pH = 8.0 | | | | | | pH = 8.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 17 | 33 | 50 | 66 | 83 | 99 | 20 | 39 | 59 | 79 | 98 | 118 |
| 0.6 | 17 | 34 | 51 | 68 | 85 | 102 | 20 | 41 | 61 | 81 | 102 | 122 |
| 0.8 | 18 | 35 | 53 | 70 | 88 | 105 | 21 | 42 | 63 | 84 | 105 | 126 |
| 1.0 | 18 | 36 | 54 | 72 | 90 | 108 | 22 | 43 | 65 | 87 | 108 | 130 |
| 1.2 | 19 | 37 | 56 | 74 | 93 | 111 | 22 | 45 | 67 | 89 | 112 | 134 |
| 1.4 | 19 | 38 | 57 | 76 | 95 | 114 | 23 | 46 | 69 | 91 | 114 | 137 |
| 1.6 | 19 | 39 | 58 | 77 | 97 | 116 | 24 | 47 | 71 | 94 | 118 | 141 |
| 1.8 | 20 | 40 | 60 | 79 | 99 | 119 | 24 | 48 | 72 | 96 | 120 | 144 |
| 2.0 | 20 | 41 | 61 | 81 | 102 | 122 | 25 | 49 | 74 | 98 | 123 | 147 |
| 2.2 | 21 | 41 | 62 | 83 | 103 | 124 | 25 | 50 | 75 | 100 | 125 | 150 |
| 2.4 | 21 | 42 | 64 | 85 | 106 | 127 | 26 | 51 | 77 | 102 | 128 | 153 |
| 2.6 | 22 | 43 | 65 | 86 | 108 | 129 | 26 | 52 | 78 | 104 | 130 | 156 |
| 2.8 | 22 | 44 | 66 | 88 | 110 | 132 | 27 | 53 | 80 | 106 | 133 | 159 |
| ≥ 3.0 | 22 | 45 | 67 | 89 | 112 | 134 | 27 | 54 | 81 | 108 | 135 | 162 |

| Chlorine Concentration (mg/L) | pH = 9.0 | | | | | |
|---|---|---|---|---|---|---|
| | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 23 | 47 | 70 | 93 | 117 | 140 |
| 0.6 | 24 | 49 | 73 | 97 | 122 | 146 |
| 0.8 | 25 | 50 | 76 | 101 | 126 | 151 |
| 1.0 | 26 | 52 | 78 | 104 | 130 | 156 |
| 1.2 | 27 | 53 | 80 | 107 | 133 | 160 |
| 1.4 | 28 | 55 | 83 | 110 | 138 | 165 |
| 1.6 | 28 | 56 | 82 | 133 | 141 | 169 |
| 1.8 | 29 | 58 | 87 | 115 | 144 | 173 |
| 2.0 | 30 | 59 | 89 | 118 | 148 | 177 |
| 2.2 | 30 | 60 | 91 | 121 | 151 | 181 |
| 2.4 | 31 | 61 | 92 | 123 | 153 | 184 |
| 2.6 | 31 | 63 | 94 | 125 | 157 | 188 |
| 2.8 | 32 | 64 | 96 | 127 | 159 | 191 |
| ≥ 3.0 | 33 | 65 | 98 | 130 | 163 | 195 |

*Note:*

No disinfection credit for *Giardia* cysts is allowed when using free chlorine if the pH within the disinfection zone is greater than 9.0.

**Table D-1.5. CT values required for inactivation of *Giardia* cysts at 20°C.**

| Chlorine Concentration (mg/L) | pH ≤ 6.0 | | | | | | pH = 6.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 6 | 12 | 18 | 24 | 30 | 36 | 7 | 15 | 22 | 29 | 37 | 44 |
| 0.6 | 6 | 13 | 19 | 25 | 32 | 38 | 8 | 15 | 23 | 30 | 38 | 45 |
| 0.8 | 7 | 13 | 20 | 26 | 33 | 39 | 8 | 15 | 23 | 31 | 38 | 46 |
| 1.0 | 7 | 13 | 20 | 26 | 33 | 39 | 8 | 16 | 24 | 31 | 39 | 47 |
| 1.2 | 7 | 13 | 20 | 27 | 33 | 40 | 8 | 16 | 24 | 32 | 40 | 48 |
| 1.4 | 7 | 14 | 21 | 27 | 34 | 41 | 8 | 16 | 25 | 33 | 41 | 49 |
| 1.6 | 7 | 14 | 21 | 28 | 35 | 42 | 8 | 17 | 25 | 33 | 42 | 50 |
| 1.8 | 7 | 14 | 22 | 29 | 36 | 43 | 9 | 17 | 26 | 34 | 43 | 51 |
| 2.0 | 7 | 15 | 22 | 29 | 37 | 44 | 9 | 17 | 26 | 35 | 43 | 52 |
| 2.2 | 7 | 15 | 22 | 29 | 37 | 44 | 9 | 18 | 27 | 35 | 44 | 53 |
| 2.4 | 8 | 15 | 23 | 30 | 38 | 45 | 9 | 18 | 27 | 36 | 45 | 54 |
| 2.6 | 8 | 15 | 23 | 31 | 38 | 46 | 9 | 18 | 28 | 38 | 46 | 55 |
| 2.8 | 8 | 16 | 24 | 31 | 39 | 47 | 9 | 19 | 28 | 37 | 47 | 56 |
| ≥ 3.0 | 8 | 16 | 24 | 31 | 39 | 47 | 10 | 19 | 29 | 38 | 48 | 57 |

| Chlorine Concentration (mg/L) | pH = 7.0 | | | | | | pH = 7.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 9 | 17 | 26 | 35 | 43 | 52 | 10 | 21 | 31 | 41 | 52 | 62 |
| 0.6 | 9 | 18 | 27 | 36 | 45 | 54 | 11 | 21 | 32 | 43 | 53 | 64 |
| 0.8 | 9 | 18 | 28 | 37 | 46 | 55 | 11 | 22 | 33 | 44 | 55 | 66 |
| 1.0 | 9 | 19 | 28 | 37 | 47 | 56 | 11 | 22 | 34 | 45 | 56 | 67 |
| 1.2 | 10 | 19 | 29 | 38 | 48 | 57 | 12 | 23 | 35 | 46 | 58 | 69 |
| 1.4 | 10 | 19 | 29 | 39 | 48 | 58 | 12 | 23 | 35 | 47 | 58 | 70 |
| 1.6 | 10 | 20 | 30 | 39 | 49 | 59 | 12 | 24 | 36 | 48 | 60 | 72 |
| 1.8 | 10 | 20 | 31 | 41 | 51 | 61 | 12 | 25 | 37 | 49 | 62 | 74 |
| 2.0 | 10 | 21 | 31 | 41 | 52 | 62 | 13 | 25 | 38 | 50 | 63 | 75 |
| 2.2 | 11 | 21 | 32 | 42 | 53 | 63 | 13 | 26 | 39 | 51 | 64 | 77 |
| 2.4 | 11 | 22 | 33 | 43 | 54 | 65 | 13 | 26 | 39 | 52 | 65 | 78 |
| 2.6 | 11 | 22 | 33 | 44 | 55 | 66 | 13 | 27 | 40 | 53 | 67 | 80 |
| 2.8 | 11 | 22 | 34 | 45 | 56 | 67 | 14 | 27 | 41 | 54 | 68 | 81 |
| ≥ 3.0 | 11 | 23 | 34 | 45 | 57 | 68 | 14 | 28 | 42 | 55 | 69 | 83 |

Table D-1.5 continues on the next page.

**Table D-1.5—Continued**

| Chlorine Concentration (mg/L) | pH = 8.0 | | | | | | pH = 8.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| **≤ 0.4** | 12 | 25 | 37 | 49 | 62 | 74 | 15 | 30 | 45 | 59 | 74 | 89 |
| **0.6** | 13 | 26 | 39 | 51 | 64 | 77 | 15 | 31 | 46 | 61 | 77 | 92 |
| **0.8** | 13 | 26 | 40 | 53 | 66 | 79 | 16 | 32 | 48 | 63 | 79 | 95 |
| **1.0** | 14 | 27 | 41 | 54 | 68 | 81 | 16 | 33 | 49 | 65 | 82 | 98 |
| **1.2** | 14 | 28 | 42 | 55 | 69 | 83 | 17 | 33 | 50 | 67 | 83 | 100 |
| **1.4** | 14 | 28 | 43 | 57 | 71 | 85 | 17 | 34 | 52 | 69 | 86 | 103 |
| **1.6** | 15 | 27 | 44 | 58 | 73 | 87 | 18 | 35 | 53 | 70 | 88 | 105 |
| **1.8** | 15 | 30 | 45 | 59 | 74 | 89 | 18 | 36 | 54 | 72 | 90 | 108 |
| **2.0** | 15 | 30 | 46 | 61 | 76 | 91 | 18 | 37 | 55 | 73 | 92 | 110 |
| **2.2** | 16 | 31 | 47 | 62 | 78 | 93 | 19 | 38 | 57 | 75 | 94 | 113 |
| **2.4** | 16 | 32 | 48 | 63 | 79 | 95 | 19 | 38 | 58 | 77 | 96 | 115 |
| **2.6** | 16 | 32 | 49 | 65 | 81 | 97 | 20 | 39 | 59 | 78 | 98 | 117 |
| **2.8** | 17 | 33 | 50 | 66 | 83 | 99 | 20 | 40 | 60 | 79 | 99 | 119 |
| **≥ 3.0** | 17 | 34 | 51 | 67 | 84 | 101 | 20 | 41 | 61 | 81 | 102 | 122 |

| Chlorine Concentration (mg/L) | pH = 9.0 | | | | | |
|---|---|---|---|---|---|---|
| | Log inactivations | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| **≤ 0.4** | 18 | 35 | 53 | 70 | 88 | 105 |
| **0.6** | 18 | 36 | 55 | 73 | 91 | 109 |
| **0.8** | 19 | 38 | 57 | 75 | 94 | 113 |
| **1.0** | 20 | 39 | 59 | 78 | 98 | 117 |
| **1.2** | 20 | 40 | 60 | 80 | 100 | 120 |
| **1.4** | 21 | 41 | 62 | 82 | 103 | 123 |
| **1.6** | 21 | 42 | 63 | 84 | 105 | 126 |
| **1.8** | 22 | 43 | 65 | 86 | 108 | 129 |
| **2.0** | 22 | 44 | 66 | 88 | 110 | 132 |
| **2.2** | 23 | 45 | 68 | 90 | 113 | 135 |
| **2.4** | 23 | 46 | 69 | 92 | 115 | 138 |
| **2.6** | 24 | 47 | 71 | 94 | 118 | 141 |
| **2.8** | 24 | 48 | 72 | 95 | 119 | 143 |
| **≥ 3.0** | 24 | 49 | 73 | 97 | 122 | 146 |

*Note:*

No disinfection credit for *Giardia* cysts is allowed when using free chlorine if the pH within the disinfection zone is greater than 9.0.

**Table D-1.6. CT values required for inactivation of *Giardia* cysts at 25°C.**[a]

| Chlorine Concentration (mg/L) | pH ≤ 6.0 Log inactivations | | | | | | pH = 6.5 Log inactivations | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 4 | 8 | 12 | 16 | 20 | 24 | 5 | 10 | 15 | 19 | 24 | 29 |
| 0.6 | 4 | 8 | 13 | 17 | 21 | 25 | 5 | 10 | 15 | 20 | 25 | 30 |
| 0.8 | 4 | 9 | 13 | 17 | 22 | 26 | 5 | 10 | 16 | 21 | 26 | 31 |
| 1.0 | 4 | 9 | 13 | 17 | 22 | 26 | 5 | 10 | 16 | 21 | 26 | 31 |
| 1.2 | 5 | 9 | 14 | 18 | 23 | 27 | 5 | 11 | 16 | 21 | 27 | 32 |
| 1.4 | 5 | 9 | 14 | 18 | 23 | 27 | 6 | 11 | 17 | 22 | 28 | 33 |
| 1.6 | 5 | 9 | 14 | 19 | 23 | 28 | 6 | 11 | 17 | 22 | 28 | 33 |
| 1.8 | 5 | 10 | 15 | 19 | 24 | 29 | 6 | 11 | 17 | 23 | 28 | 34 |
| 2.0 | 5 | 10 | 15 | 19 | 24 | 29 | 6 | 12 | 18 | 23 | 29 | 35 |
| 2.2 | 5 | 10 | 15 | 20 | 25 | 30 | 6 | 12 | 18 | 23 | 29 | 35 |
| 2.4 | 5 | 10 | 15 | 20 | 25 | 30 | 6 | 12 | 18 | 24 | 30 | 36 |
| 2.6 | 5 | 10 | 16 | 21 | 26 | 31 | 6 | 12 | 19 | 25 | 31 | 37 |
| 2.8 | 5 | 10 | 16 | 21 | 26 | 31 | 6 | 12 | 19 | 25 | 31 | 37 |
| ≥ 3.0 | 5 | 11 | 16 | 21 | 27 | 32 | 6 | 13 | 19 | 25 | 32 | 38 |
| **Chlorine Concentration (mg/L)** | **pH = 7.0 Log inactivations** | | | | | | **pH = 7.5 Log inactivations** | | | | | |
| | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
| ≤ 0.4 | 6 | 12 | 18 | 23 | 29 | 35 | 7 | 14 | 21 | 28 | 35 | 42 |
| 0.6 | 6 | 12 | 18 | 24 | 30 | 36 | 7 | 14 | 22 | 29 | 36 | 43 |
| 0.8 | 6 | 12 | 19 | 25 | 31 | 37 | 7 | 15 | 22 | 29 | 37 | 44 |
| 1.0 | 6 | 12 | 19 | 25 | 31 | 37 | 8 | 15 | 23 | 30 | 38 | 45 |
| 1.2 | 6 | 13 | 19 | 25 | 32 | 38 | 8 | 15 | 23 | 31 | 38 | 46 |
| 1.4 | 7 | 13 | 20 | 26 | 33 | 39 | 8 | 16 | 24 | 31 | 39 | 47 |
| 1.6 | 7 | 13 | 20 | 27 | 33 | 40 | 8 | 16 | 24 | 32 | 40 | 48 |
| 1.8 | 7 | 14 | 21 | 27 | 34 | 41 | 8 | 16 | 25 | 33 | 41 | 49 |
| 2.0 | 7 | 14 | 21 | 27 | 34 | 41 | 8 | 17 | 25 | 33 | 42 | 50 |
| 2.2 | 7 | 14 | 21 | 28 | 35 | 42 | 9 | 17 | 26 | 34 | 43 | 51 |
| 2.4 | 7 | 14 | 22 | 29 | 36 | 43 | 9 | 17 | 26 | 35 | 43 | 52 |
| 2.6 | 7 | 15 | 22 | 29 | 37 | 44 | 9 | 18 | 27 | 35 | 44 | 53 |
| 2.8 | 8 | 15 | 23 | 30 | 38 | 45 | 9 | 18 | 27 | 36 | 45 | 54 |
| ≥ 3.0 | 8 | 15 | 23 | 31 | 38 | 46 | 9 | 18 | 28 | 37 | 46 | 55 |

[a] For temperatures above 25°C, $CT_{required}$ drops by a factor of two for each 10°C rise in temperature—that is, the $CT_{required}$ at 30°C is one-half the $CT_{required}$ at 20°C.

Table D-1.6 continues on the next page.

**Table D1.6—continued**

| Chlorine Concentration (mg/L) | pH = 8.0 | | | | | | pH = 8.5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log inactivations | | | | | | Log inactivations | | | | | |
| | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** |
| **≤º0.4** | 8 | 17 | 25 | 33 | 42 | 50 | 10 | 20 | 30 | 39 | 49 | 59 |
| **0.6** | 9 | 17 | 26 | 34 | 43 | 51 | 10 | 20 | 31 | 41 | 51 | 61 |
| **0.8** | 9 | 18 | 27 | 35 | 44 | 53 | 11 | 21 | 32 | 42 | 53 | 63 |
| **1.0** | 9 | 18 | 27 | 36 | 45 | 54 | 11 | 22 | 33 | 43 | 54 | 65 |
| **1.2** | 9 | 18 | 28 | 37 | 46 | 55 | 11 | 22 | 34 | 45 | 56 | 67 |
| **1.4** | 10 | 19 | 29 | 38 | 48 | 57 | 12 | 23 | 35 | 46 | 58 | 69 |
| **1.6** | 10 | 19 | 29 | 39 | 48 | 58 | 12 | 23 | 35 | 47 | 58 | 70 |
| **1.8** | 10 | 20 | 30 | 40 | 50 | 60 | 12 | 24 | 36 | 48 | 60 | 72 |
| **2.0** | 10 | 20 | 31 | 41 | 51 | 61 | 12 | 25 | 37 | 49 | 62 | 74 |
| **2.2** | 10 | 21 | 31 | 41 | 52 | 62 | 13 | 25 | 38 | 50 | 63 | 75 |
| **2.4** | 11 | 21 | 32 | 42 | 53 | 63 | 13 | 26 | 39 | 51 | 64 | 77 |
| **2.6** | 11 | 22 | 33 | 43 | 54 | 65 | 13 | 26 | 39 | 52 | 65 | 78 |
| **2.8** | 11 | 22 | 33 | 44 | 55 | 66 | 13 | 27 | 40 | 53 | 67 | 80 |
| **≥ 3.0** | 11 | 22 | 34 | 45 | 56 | 67 | 14 | 27 | 41 | 54 | 68 | 81 |

| Chlorine Concentration (mg/L) | pH = 9.0 | | | | | |
|---|---|---|---|---|---|---|
| | Log inactivations | | | | | |
| | **0.5** | **1** | **1.5** | **2** | **2.5** | **3** |
| **≤º0.4** | 12 | 23 | 35 | 47 | 58 | 70 |
| **0.6** | 12 | 24 | 37 | 49 | 61 | 73 |
| **0.8** | 13 | 25 | 38 | 50 | 63 | 75 |
| **1.0** | 13 | 26 | 39 | 52 | 65 | 78 |
| **1.2** | 13 | 27 | 40 | 53 | 67 | 80 |
| **1.4** | 14 | 27 | 41 | 55 | 68 | 82 |
| **1.6** | 14 | 28 | 42 | 56 | 70 | 84 |
| **1.8** | 14 | 29 | 43 | 57 | 72 | 86 |
| **2.0** | 15 | 29 | 44 | 59 | 73 | 88 |
| **2.2** | 15 | 30 | 45 | 60 | 75 | 90 |
| **2.4** | 15 | 31 | 46 | 61 | 77 | 92 |
| **2.6** | 16 | 31 | 47 | 63 | 78 | 94 |
| **2.8** | 16 | 32 | 48 | 64 | 80 | 96 |
| **≥ 3.0** | 16 | 32 | 49 | 65 | 81 | 97 |

*Note:*
No disinfection credit for *Giardia* cysts is allowed when using free chlorine if the pH within the disinfection zone is greater than 9.0.

**Table D-1.7. CT values required for inactivation of viruses.**[a,b]

| Temperature | Log inactivations 2 pH 5.5–9.49 | 2 pH 9.5–10.49 | 3 pH 5.5–9.49 | 3 pH 9.5–10.49 | 4 pH 5.5–9.49 | 4 pH 9.5–10.49 |
|---|---|---|---|---|---|---|
| **0.5°C** | 6 | 45 | 9 | 66 | 12 | 90 |
| **5°C** | 4 | 30 | 6 | 44 | 8 | 60 |
| **10°C** | 3 | 22 | 4 | 33 | 6 | 45 |
| **15°C** | 2 | 15 | 3 | 22 | 4 | 30 |
| **20°C** | 1 | 11 | 2 | 16 | 3 | 22 |
| **25°C** | 1 | 7 | 1 | 11 | 2 | 15 |

[a] No disinfection credit is allowed for pH above 10.49.
[b] For temperatures above 25°C, $CT_{required}$ drops by a factor of two for each 10°C rise in temperature—that is, the $CT_{required}$ at 30°C is one-half the $CT_{required}$ at 20°C.

# D.2 CT TABLES FOR DISINFECTION WITH $ClO_2$

This appendix contains the CT tables you should use when inactivating *Giardia lamblia* and viruses with chlorine dioxide. The information used to generate these tables and the associated notes was derived from Appendixes E and F of the EPA's *Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources*, Office of Drinking Water, Washington (March 1991), available at:

water.epa.gov/lawsregs/rulesregs/sdwa/swtr/upload/guidsws.pdf

**Table D-2.1. CT values required for inactivation of *Giardia* cysts at pH between 6.0 and 9.49.**[a]

| | **Temperature (°C)** | | | | | |
|---|---|---|---|---|---|---|
| **Inactivation** | **≤ 1** | **5** | **10** | **15** | **20** | **25** |
| **0.5-log** | 10.0 | 4.3 | 4.0 | 3.2 | 2.5 | 2.0 |
| **1.0-log** | 21.0 | 8.7 | 7.7 | 6.3 | 5.0 | 3.7 |
| **1.5-log** | 32.0 | 13.0 | 12.0 | 10.0 | 7.5 | 5.5 |
| **2.0-log** | 42.0 | 17.0 | 15.0 | 13.0 | 10.0 | 7.3 |
| **2.5-log** | 52.0 | 22.0 | 19.0 | 16.0 | 13.0 | 9.0 |
| **3.0-log** | 63.0 | 26.0 | 23.0 | 19.0 | 15.0 | 11.0 |

[a] No disinfection credit is allowed for pH above 9.49.

**Table D-2.2. CT values required for inactivation of viruses at pH between 6.0 and 9.49.**[a,b]

| | **Temperature (°C)** | | | | | |
|---|---|---|---|---|---|---|
| **Inactivation** | **≤ 1** | **5** | **10** | **15** | **20** | **25** |
| **2-log** | 8.4 | 5.6 | 4.2 | 2.8 | 2.1 | 1.4 |
| **3-log** | 25.6 | 17.1 | 12.8 | 8.6 | 6.4 | 4.3 |
| **4-log** | 50.1 | 33.4 | 25.1 | 16.7 | 12.5 | 8.4 |

[a] No disinfection credit is allowed for pH above 9.49.
[b] For temperatures above 25°C, $CT_{required}$ drops by a factor of two for each 10°C rise in temperature—that is, the $CT_{required}$ at 30°C is one-half the $CT_{required}$ at 20°C.

# D.3 CT TABLES FOR DISINFECTION WITH $O_3$

This appendix contains the CT tables you should use when inactivating *Giardia lamblia* and viruses with ozone. The information used to generate these tables and the associated notes was derived from Appendixes E and F of the EPA's *Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources*, Office of Drinking Water, Washington (March 1991), available at:

water.epa.gov/lawsregs/rulesregs/sdwa/swtr/upload/guidsws.pdf

**Table D-3.1. CT values required for inactivation of *Giardia* cysts at pH between 6.0 and 9.49.**[a,b]

| | **Temperature (ºC)** | | | | | |
|---|---|---|---|---|---|---|
| **Inactivation** | **≤ 1** | **5** | **10** | **15** | **20** | **25** |
| **0.5-log** | 0.48 | 0.32 | 0.23 | 0.16 | 0.12 | 0.08 |
| **1.0-log** | 0.97 | 0.63 | 0.48 | 0.32 | 0.24 | 0.16 |
| **1.5-log** | 1.50 | 0.95 | 0.72 | 0.48 | 0.36 | 0.24 |
| **2.0-log** | 1.90 | 1.30 | 0.95 | 0.63 | 0.48 | 0.32 |
| **2.5-log** | 2.40 | 1.60 | 1.20 | 0.79 | 0.60 | 0.40 |
| **3.0-log** | 2.90 | 1.90 | 1.43 | 0.95 | 0.72 | 0.48 |

[a] No disinfection credit is allowed for pH above 9.49.
[b] For temperatures above 25°C, $CT_{required}$ drops by a factor of two for each 10°C rise in temperature—that is, the $CT_{required}$ at 30°C is one-half the $CT_{required}$ at 20°C.

**Table D-3.2. CT values required for inactivation of viruses at pH between 6.0 and 9.49.**[a,b]

| | **Temperature (ºC)** | | | | | |
|---|---|---|---|---|---|---|
| **Inactivation** | **≤ 1** | **5** | **10** | **15** | **20** | **25** |
| **2-log** | 0.90 | 0.60 | 0.50 | 0.30 | 0.25 | 0.15 |
| **3-log** | 1.40 | 0.90 | 0.80 | 0.50 | 0.40 | 0.25 |
| **3-log** | 1.80 | 1.20 | 1.00 | 0.60 | 0.50 | 0.30 |

[a] No disinfection credit is allowed for pH above 9.49.
[b] For temperatures above 25°C, $CT_{required}$ drops by a factor of two for each 10°C rise in temperature—that is, the $CT_{required}$ at 30°C is one-half the $CT_{required}$ at 20°C.

# D.4 CT TABLES FOR $NH_2Cl$ (CHLORAMINES)

This appendix contains the CT tables you should use when inactivating *Giardia lamblia* and viruses with chloramine. The information used to generate these tables and the associated notes was derived from Appendixes E and F of the EPA's *Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources*, Office of Drinking Water, Washington (March 1991), available at:

water.epa.gov/lawsregs/rulesregs/sdwa/swtr/upload/guidsws.pdf

**Table D-4.1. CT values required for inactivation of *Giardia* cysts at pH between 6.0 and 9.49.**[a,b]

| | Temperature (ºC) | | | | | |
|---|---|---|---|---|---|---|
| **Inactivation** | **≤ 1** | **5** | **10** | **15** | **20** | **25 ≥** |
| **0.5-log** | 635 | 365 | 310 | 250 | 185 | 125 |
| **1.0-log** | 1270 | 735 | 615 | 500 | 370 | 250 |
| **1.5-log** | 1900 | 1100 | 930 | 750 | 550 | 375 |
| **2.0-log** | 2535 | 1470 | 1230 | 1000 | 735 | 500 |
| **2.5-log** | 3170 | 1830 | 1540 | 1250 | 915 | 625 |
| **3.0-log** | 3800 | 2200 | 1850 | 1500 | 1100 | 750 |

[a] Table D-4.1 applies only if a well-mixed chlorine residual is present prior to the application of ammonia in the treatment process.
[b] No disinfection credit is allowed for pH above 9.49.

**Table D-4.2. CT values required for inactivation of viruses at pH between 6.0 and 9.49.**[a,b,c]

| | Temperature (ºC) | | | | | |
|---|---|---|---|---|---|---|
| **Inactivation** | **≤ 1** | **5** | **10** | **15** | **20** | **25** |
| **2-log** | 1245 | 857 | 643 | 428 | 321 | 214 |
| **3-log** | 2063 | 1423 | 1067 | 712 | 534 | 356 |
| **4-log** | 2883 | 1988 | 1491 | 994 | 746 | 497 |

[a] Table D-4.2 applies only if a well-mixed chlorine residual is present prior to the application of ammonia in the treatment process.
[b] No disinfection credit is allowed for pH above 9.49.
[c] For temperatures above 25°C, $CT_{required}$ drops by a factor of two for each 10°C rise in temperature—that is, the $CT_{required}$ at 30°C is one-half the $CT_{required}$ at 20°C.

# Appendix E:
# EXAMPLE OF A COMPLETED SWMOR

**SURFACE WATER MONTHLY OPERATING REPORT**
**FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER**
***Summary Page***

**PUBLIC WATER SYSTEM NAME:** Aguaville PWS **PLANT NAME OR NUMBER:** Schwartz Plant

I certify that I am familiar with the information contained in this report and that, to the best of my knowledge, the information is true, complete, and accurate.

**PWS ID No.:** 1234567 **Operator's Signature:** Hardy Worker

**Report for the Month of:** February 2011 **Certificate No. & Grade:** WS1234567, BS **Date:** March 9, 2011

**TREATMENT PLANT PERFORMANCE**

| | | | |
|---|---|---|---|
| Total number of turbidity readings: | 133 | Number of 4-hour periods when plant was off-line: | 34 |
| Number of readings above 0.10 NTU: | 114 | Number of 4-hour periods when plant was on-line but turbidity data was not collected: | 1 |
| Number of readings above 0.3 NTU: | 5 | | |
| Number of readings above 0.5 NTU: | 3 | Number of days when plant was on-line but individual filter turbidity data was not collected: | 1 |
| Number of readings above 1.0 NTU: | 2 | | |
| Maximum allowable turbidity level: | 0.3 | Number of days with readings above 1.0 NTU: | 1 (2) |
| Percentage of readings above this limit: | 3.8 % (1) | Number of days with readings above 5.0 NTU: | 0 (3) |

| Statistical Summary | | | | |
|---|---|---|---|---|
| | Maximum turbidity reading: | 1.17 NTU | Average turbidity value: | 0.23 NTU |
| | Minimum turbidity reading: | 0.03 NTU | Standard deviation: | 0.149 NTU |
| | CFE 95th percentile value: | 0.34 NTU | IFE 95th percentile: | 0.484 NTU |

| | | | |
|---|---|---|---|
| Number of days with a low CT for no more than 4.0 consecutive hours: | 1 | Average log inactivation for Giardia: | 3.26 |
| | | Average log inactivation for viruses: | 61.43 |
| Number of days with a low CT for more than 4.0 consecutive hours: | 0 (4) | Number of days when profiling data was not collected: | 1 |
| | | Number of days when CT data was not collected: | 0 |

| | | | |
|---|---|---|---|
| Minimum disinfectant residual required leaving the plant: | 0.5 mg/L, measured as Total Chlorine | | |
| Number of days with a low residual for no more than 4.0 consecutive hours: | 1 | | |
| Number of days with a low residual for more than 4.0 consecutive hours: | 0 (5) | Number of days when disinfectant residual leaving the plant was not properly monitored: | 1 |

**DISTRIBUTION SYSTEM**

| | | | |
|---|---|---|---|
| Minimum disinfectant residual required in distribution system: | 0.5 mg/L, measured as Total Chlorine | | |
| Total number of readings this month: | 116 (at least 28 required) (8) | | |
| Average disinfectant residual value: | 2.12 | Percentage of readings with a low residual this month: | 2.6 % (6A) |
| Number of readings with a low residual: | 3 | | |
| Number of readings with no detectable residual: | 1 | Percentage of readings with a low residual last month: | 1.4 % (6B) |

**ADDITIONAL REPORTS & WORKSHEETS**

The Page 1 Addendum (Public Notices) is required because there was at least one treatment technique or monitoring/reporting violation reported.

| | | | | |
|---|---|---|---|---|
| Additional report(s) for individual filter monitoring required: | ○ NONE | ◉ Filter Profile | ◉ Filter Assessment | ○ CPE |
| Additional report(s) for individual filter monitoring submitted: | ◉ NONE | ○ Filter Profile (9) | ○ Filter Assessment (10) | ○ CPE (11) |

Additional IFE Reports are required this month.

***SURFACE WATER MONTHLY OPERATING REPORT***
**TEXAS COMMISSION ON ENVIRONMENTAL QUALITY**
**WATER SUPPLY DIVISION/PUBLIC DRINKING WATER SECTION (MC-155)**
**P.O. BOX 13087, AUSTIN, TEXAS 78711-3087**

TCEQ - 0102C (07-19-10, Excel 2007) PAGE 1 SWMOR

# SURFACE WATER MONTHLY OPERATING REPORT

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
*Summary Page Addendum (Violations and Public Notices)*

PUBLIC WATER SYSTEM NAME: Aguaville PWS

PLANT NAME OR NUMBER: Schwartz Plant

PWS ID No.: 1234567

Month: February

Year: 2011

| PUBLIC NOTICES | | | | | | |
|---|---|---|---|---|---|---|
| VIOLATION TYPE | DESCRIPTION OF VIOLATION | VIOLATION OCCURRED? | NOTICE TO TCEQ ■ DATE OF NOTICE | NOTICE TO CUSTOMER * DATE OF NOTICE | PENDING | VIOLATION DATES |
| TREATMENT TECHNIQUE | Were more than 5.0% of the turbidity readings above the acceptable level? - see (1) on the *Summary Page* | No | | | | |
| | Were there any days with turbidity readings above 1.0 NTU? - see (2) on the *Summary Page* | Yes | 02/05/11 | | YES | 4, |
| | Were there any days with turbidity readings above 5.0 NTU? - see (3) on the *Summary Page* | No | | | | |
| | Were there any periods when the plant failed to meet the CT requirements for more than 4.0 consecutive hours? - see (4) on the *Summary Page* | No | | | | |
| | Were there any periods when the residuals leaving the plant fell below the acceptable level for more than 4.0 consecutive hours? - see (5) on the *Summary Page* | No | | | | |
| | Were more than 5.0% of the residuals in the distribution system below the acceptable level for two months in a row? - see (6A) and (6B) on the *Summary Page* | No | | | | |
| MONITORING & REPORTING | Were there any days when the plant failed to report all of the required Combined Filter Effluent (CFE) turbidity readings? - see the *Turbidity Data Page* | Yes | 03/09/11 | | YES | 1, |
| | Were there any days when the plant failed to report all the CT data needed to evaluate the level of microbial inactivation achieved? - see the *Disinfection Data Page* | No | | | | |
| | Were there any days when the plant failed to report the minimum disinfectant residual entering the distribution system? - see the *Turbidity Data Page* | Yes | 03/09/11 | | YES | 18, |
| | Did the system fail to collect enough samples in the distribution system to meet the minimum disinfectant monitoring requirements? - see (8) on the *Summary Page* | No | | | | |
| | Were there any days when the plant failed to report the maximum individual filter effluent (IFE) turbidity level produced by each filter? - see the *Filter Data Page* | Yes | 03/09/11 | | YES | 12, |
| | Were there any days when the plant failed to report the IFE turbidity level 4-hours after beginning a filter run? - see the *Filter Data Page* | Yes | 03/09/11 | | YES | 12, |
| | Did the plant fail to submit a Filter Profile Report if one was required? - see (9) on the *Summary page* | Yes | 03/09/11 | | YES | February 2011 |
| | Did the plant fail to submit a Filter Assessment Report if one was required? - see (10) on the *Summary Page* | Yes | 03/09/11 | | YES | February 2011 |
| | Did the plant fail to submit a Comprehensive Performance Evaluation Request if one was required? - see (11) on the *Summary Page* | No | | | | |
| | Did the plant fail to collect at least one Total Organic Carbon sample set? - *see TOCMOR Page* | No | | | | |

■ Treatment technique violation notices are due no later than the end of the next business day. Please include a copy if possible.
* Copies of each Public Notice must accompany this report if they have already been issued.

SUMITTED BY: *Hardy Worker*

Certificate No. and Grade: WS1234567, BS

Date: March 9, 2011

TCEQ - 0102C (11-10-09) PAGE 1 - Addendum SWMOR

# SURFACE WATER MONTHLY OPERATING REPORT

**FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES**
**OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)**
***Turbidity Data Page***

**PUBLIC WATER SYSTEM NAME:** Aguaville PWS
**PLANT NAME OR NUMBER:** Schwartz Plant

**PWS ID No.:** 1234567
**Connections:** 4,321

**Month:** February **Year:** 2011
**Population:** 13,500

## PERFORMANCE DATA

| Date | Raw Water Pumpage (MGD) | Treated Water Pumpage (MGD) | RAW WATER ANALYSES | | SETTLED WATER TURBIDITY (Optional Data) Basin No. | | | | | | FINISHED WATER QUALITY Turbidity | | | | | | Lowest Residual | Time* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NTU | Alk. | 1 | 2 | 3 | 4 | 5 | 6 | NTU1 | NTU2 | NTU3 | NTU4 | NTU5 | NTU6 | | |
| 1 | 1.411 | 1.322 | 49 | 52 | 2.4 | 1.9 | | | | | X | 0.19 | 0.07 | 0.03 | 0.31 | ND | 2.4 | |
| 2 | 1.484 | 1.444 | 26 | 68 | 2.8 | 1.8 | | | | | X | 0.33 | 0.24 | 0.27 | 0.15 | 0.12 | 3.4 | |
| 3 | 1.598 | 1.511 | 12 | 59 | 2.1 | 2.2 | | | | | X | 0.23 | 0.08 | 0.12 | 0.17 | 0.26 | 3.1 | |
| 4 | 1.154 | 1.084 | 80 | 92 | 5.2 | 4.3 | | | | | X | 0.34 | 0.46 | 0.78 | 1.06 | 1.17 | 2.3 | |
| 5 | 0.000 | 0.889 | X | X | X | X | | | | | X | X | X | X | X | X | 1.1 | |
| 6 | 2.650 | 1.103 | 15 | 61 | 1.8 | 1.4 | | | | | X | X | 0.26 | 0.32 | 0.21 | 0.10 | 2.8 | |
| 7 | 1.302 | 1.239 | 73 | 55 | 2.3 | 2.0 | | | | | X | 0.13 | 0.28 | 0.38 | 0.34 | 0.30 | 3.0 | |
| 8 | 1.337 | 1.280 | 10 | 47 | 1.7 | 1.9 | | | | | X | 0.27 | 0.24 | 0.17 | 0.19 | 0.04 | 2.7 | |
| 9 | 1.701 | 1.687 | 24 | 53 | 1.9 | 1.6 | | | | | X | 0.24 | 0.32 | 0.25 | 0.18 | 0.12 | 0.3 | 0.75 |
| 10 | 1.408 | 1.397 | 16 | 44 | 1.2 | 1.1 | | | | | X | 0.04 | 0.08 | 0.07 | 0.21 | 0.11 | 1.9 | |
| 11 | 1.457 | 1.402 | 70 | 62 | 1.8 | 1.5 | | | | | X | 0.33 | 0.06 | 0.20 | 0.23 | 0.34 | 2.2 | |
| 12 | 1.537 | 1.522 | 98 | 43 | 3.2 | 2.3 | | | | | X | 0.29 | 0.08 | 0.16 | 0.14 | 0.27 | 3.1 | |
| 13 | 1.092 | 1.084 | 16 | 57 | 2.2 | 1.8 | | | | | X | 0.33 | 0.28 | 0.10 | 0.27 | 0.29 | 2.0 | |
| 14 | 1.564 | 1.506 | 68 | 48 | 2.0 | 1.7 | | | | | X | 0.23 | 0.26 | 0.31 | 0.28 | 0.03 | 1.4 | |
| 15 | 1.361 | 1.278 | 93 | 69 | 2.6 | 2.1 | | | | | X | 0.30 | 0.20 | 0.23 | 0.05 | 0.25 | 1.8 | |
| 16 | 1.879 | 1.794 | 10 | 55 | 2.1 | 1.9 | | | | | X | 0.31 | 0.21 | 0.17 | 0.28 | 0.22 | 1.5 | |
| 17 | 0.109 | 0.000 | 91 | 58 | 2.2 | X | | | | | X | 0.20 | 0.31 | 0.24 | 0.34 | 0.20 | X | |
| 18 | 0.230 | 0.050 | 95 | 64 | 2.5 | X | | | | | X | 0.17 | 0.13 | 0.16 | 0.32 | 0.28 | MD | |
| 19 | 1.630 | 1.557 | 26 | 53 | 3.0 | 2.5 | | | | | X | 0.22 | 0.09 | 0.15 | 0.16 | 0.11 | 2.6 | |
| 20 | 1.293 | 1.272 | 21 | 39 | 2.3 | 2.4 | | | | | X | 0.16 | 0.11 | 0.19 | 0.08 | 0.05 | 2.6 | |
| 21 | 1.249 | 1.210 | 80 | 61 | 2.9 | 2.5 | | | | | X | 0.29 | 0.26 | 0.12 | 0.05 | 0.31 | 2.9 | |
| 22 | 1.913 | 1.894 | 91 | 71 | 2.7 | 2.0 | | | | | X | 0.14 | 0.17 | 0.04 | 0.05 | 0.33 | 1.6 | |
| 23 | 1.926 | 1.834 | 95 | 66 | 2.4 | 1.8 | | | | | X | 0.23 | 0.17 | 0.26 | 0.27 | 0.24 | 3.0 | |
| 24 | 1.018 | 0.930 | 23 | 54 | 1.5 | 1.6 | | | | | X | 0.19 | 0.16 | 0.14 | 0.22 | 0.32 | 2.2 | |
| 25 | 1.104 | 1.016 | 60 | 47 | 2.2 | 1.4 | | | | | X | 0.20 | 0.24 | 0.21 | 0.18 | 0.15 | 2.3 | |
| 26 | 1.934 | 1.896 | 25 | 48 | 1.7 | 1.5 | | | | | X | 0.25 | 0.17 | 0.27 | 0.29 | 0.14 | 3.2 | |
| 27 | 1.337 | 1.321 | 50 | 37 | 2.6 | 2.2 | | | | | X | 0.18 | 0.30 | 0.28 | 0.33 | 0.27 | 1.7 | |
| 28 | 1.909 | 1.893 | 64 | 47 | 2.5 | 1.9 | | | | | X | 0.21 | 0.19 | 0.26 | 0.15 | 0.12 | 2.3 | |
| 29 | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | | | | |
| Total | 38.587 | 36.415 | | | | | | | | | | | | | | | | |
| Avg | 1.378 | 1.301 | | | | | | | | | | | | | | | | |
| Max | 2.650 | 1.896 | | | | | | | | | | | | | | | | |
| Min | 0.000 | 0.000 | | | | | | | | | | | | | | | | |

**NOTE: ONLY use the "Time*" column to show the length of time that the disinfectant residual entering the distribution system fell below the acceptable level.**

**SUBMITTED BY:** Hardy Worker
**Certificate No. and Grade:** WS1234567, BS
**Date:** March 9, 2011

# SURFACE WATER MONTHLY OPERATING REPORT

**FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)**

***Filter Data Page***

**PUBLIC WATER SYSTEM NAME:** Aguaville PWS

**PLANT NAME OR NUMBER:** Schwartz Plant

**PWS ID No.:** 1234567

**Month:** February **Year:** 2011

**PERFORMANCE DATA**

**INDIVIDUAL FILTER TURBIDITY**

| | Filter No. 1 | | Filter No. 2 | | Filter No. 3 | | Filter No. 4 | | Filter No. 5 | | Filter No. 6 | | Filter No. 7 | | Filter No. 8 | | Filter No. 9 | | Filter No. 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Max** | **4 Hrs** | **Max** | **4 Hrs** | **Max** | **4 Hrs** | **Max** | **4 Hrs** | **Max** | **4 Hrs** | **Max** | **4 Hrs** | **Max** | **4 Hrs** | **Max** | **4 Hrs** | **Max** | **4 Hrs** | **Max** | **4 Hrs** |
| 1 | 0.37 | 0.19 | 0.18 | 0.11 | 0.22 | 0.14 | 0.31 | 0.16 | 0.42 | 0.22 | 0.35 | 0.18 | | | | | | | | |
| 2 | 0.38 | 0.21 | 0.21 | 0.13 | 0.25 | 0.11 | 0.33 | 0.13 | 0.47 | 0.23 | 0.40 | 0.13 | | | | | | | | |
| 3 | 0.41 | 0.27 | 0.23 | 0.15 | 0.21 | 0.13 | 0.29 | 0.13 | 0.39 | 0.26 | 0.27 | 0.19 | | | | | | | | |
| 4 | 1.32 | 0.57 | 0.72 | 0.34 | 0.67 | 0.26 | 0.87 | 0.48 | 1.05 | 0.52 | 0.84 | 0.40 | | | | | | | | |
| 5 | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | |
| 6 | 0.27 | 0.16 | 0.27 | 0.14 | 0.29 | 0.09 | 0.42 | 0.20 | 0.46 | 0.19 | 0.37 | 0.12 | | | | | | | | |
| 7 | 0.35 | 0.22 | 0.17 | 0.09 | 0.23 | 0.12 | 0.37 | 0.16 | 0.49 | 0.23 | 0.33 | 0.18 | | | | | | | | |
| 8 | 0.33 | 0.17 | 0.22 | 0.12 | 0.17 | 0.08 | 0.32 | 0.13 | 0.38 | 0.17 | 0.26 | 0.17 | | | | | | | | |
| 9 | 0.28 | 0.15 | 0.16 | 0.08 | 0.24 | 0.10 | 0.41 | 0.14 | 0.34 | 0.18 | 0.29 | 0.10 | | | | | | | | |
| 10 | 0.21 | 0.19 | 0.14 | 0.07 | 0.11 | 0.05 | 0.26 | 0.15 | 0.41 | 0.21 | 0.32 | 0.23 | | | | | | | | |
| 11 | 0.24 | 0.17 | 0.18 | 0.11 | 0.30 | 0.16 | 0.34 | 0.14 | 0.28 | 0.16 | 0.25 | 0.16 | | | | | | | | |
| 12 | 0.36 | 0.20 | 0.19 | 0.10 | MD | ND | 0.42 | 0.21 | 0.48 | 0.24 | 0.38 | 0.20 | | | | | | | | |
| 13 | 0.19 | 0.12 | 0.10 | 0.06 | 0.26 | 0.11 | 0.33 | 0.17 | 1.24 | 0.48 | 0.22 | 0.15 | | | | | | | | |
| 14 | 0.29 | 0.18 | 0.23 | 0.09 | 0.18 | 0.10 | 0.35 | 0.16 | 0.40 | 0.20 | 0.29 | 0.13 | | | | | | | | |
| 15 | 0.42 | 0.21 | 0.22 | 0.13 | 0.16 | 0.06 | 0.28 | 0.12 | 0.37 | 0.15 | 0.31 | 0.19 | | | | | | | | |
| 16 | 0.26 | 0.17 | 0.15 | 0.08 | 0.27 | 0.15 | 0.32 | 0.19 | 0.39 | 0.15 | 0.36 | 0.21 | | | | | | | | |
| 17 | 0.34 | X | 0.25 | 0.12 | X | X | X | X | X | X | X | X | | | | | | | | |
| 18 | 0.18 | 0.16 | 0.24 | 0.14 | X | X | X | X | X | X | X | X | | | | | | | | |
| 19 | 0.26 | 0.18 | 0.14 | 0.08 | 0.23 | 0.14 | 0.32 | 0.17 | 0.46 | 0.26 | 0.32 | 0.16 | | | | | | | | |
| 20 | 0.25 | 0.15 | 0.20 | 0.11 | 0.27 | 0.17 | 0.38 | 0.18 | 0.39 | 0.24 | 0.26 | 0.13 | | | | | | | | |
| 21 | 0.41 | 0.24 | 0.23 | 0.10 | 0.18 | 0.12 | 0.33 | 0.15 | 0.32 | 0.19 | 0.38 | 0.20 | | | | | | | | |
| 22 | 0.39 | 0.22 | 0.19 | 0.13 | 0.20 | 0.13 | 0.29 | 0.20 | 0.42 | 0.23 | 0.23 | 0.17 | | | | | | | | |
| 23 | 0.32 | 0.19 | 0.18 | 0.09 | 0.26 | 0.18 | 0.41 | 0.23 | 0.37 | 0.18 | 0.33 | 0.12 | | | | | | | | |
| 24 | 0.27 | 0.17 | 0.22 | 0.15 | 0.28 | 0.11 | 0.39 | 0.19 | 0.40 | 0.25 | 0.37 | 0.18 | | | | | | | | |
| 25 | 0.22 | 0.15 | 0.21 | 0.12 | 0.14 | 0.08 | 0.31 | 0.20 | 0.35 | 0.20 | 0.35 | 0.20 | | | | | | | | |
| 26 | 0.26 | 0.21 | 0.16 | 0.07 | 0.17 | 0.08 | 0.29 | 0.16 | 0.45 | 0.27 | 0.30 | 0.15 | | | | | | | | |
| 27 | 0.31 | 0.25 | 0.25 | 0.11 | 0.21 | 0.12 | 0.36 | 0.14 | 0.41 | 0.28 | 0.27 | 0.11 | | | | | | | | |
| 28 | 0.29 | 0.20 | 0.16 | 0.09 | 0.19 | 0.10 | 0.30 | 0.18 | 0.38 | 0.22 | 0.29 | 0.13 | | | | | | | | |
| 29 | | | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | | | | | | |

**SUMMARY & COMPLIANCE ACTIONS**

| | Filter No. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Criteria** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Plant** |
| Number of days with event(s) above 0.5 NTU at 4.0 hrs this month | 1 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Number of days with event(s) above 1.0 NTU this month | 1 | 0 | 0 | 0 | 2 | 0 | | | | | |
| Number of days with event(s) above 1.0 NTU last month | 0 | 0 | 0 | 0 | 1 | 1 | | | | | |
| Number of days with event(s) above 1.0 NTU two months ago | 1 | 0 | 2 | 3 | 1 | 1 | | | | | |
| Total number of days with event(s) above 1.0 NTU in three months | 2 | 0 | 2 | 3 | 4 | 2 | | | | | |
| Number of days with event(s) above 2.0 NTU this month | | | | | | | | | | | 0 |
| Number of days with event(s) above 2.0 NTU last month | | | | | | | | | | | 0 |
| Does the filter/plant have an approved Corrective Action Plan? | N | N | N | N | N | N | | | | | N |
| Is the plant required to submit a Filter Profile Report? | Y | N | N | N | Y | N | | | | | |
| Is the plant required to submit a Filter Assessment Report? | N | N | N | N | Y | N | | | | | |
| Is the plant required to submit a Request for Compliance CPE? | | | | | | | | | | | N |

**SUBMITTED BY:** Hardy Worker

**Certificate No. and Grade:** WS1234567, BS

**Date:** March 9, 2011

TCEQ - 0102C (07-19-10, Excel 2007) PAGE 3 SWMOR

# SURFACE WATER MONTHLY OPERATING REPORT

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
*Disinfection Data Page*

| | | | |
|---|---|---|---|
| PUBLIC WATER SYSTEM NAME: | Aguaville PWS | PLANT NAME OR NUMBER: | Schwartz Plant |
| PWS ID No.: | 1234567 | Month: | February Year: 2011 |

## DISINFECTION PROCESS PARAMETERS

| APPROVED CT STUDY PARAMETERS | | | | | | PERFORMANCE STANDARDS | |
|---|---|---|---|---|---|---|---|
| | Disinfection Zones | | | | | Log Inactivations | |
| Parameters | D1 | D2 | D3 | D4 | D5 | Giardia lamblia Cysts | Viruses |
| Flow Rate (MGD) | 45.000 | 0.480 | 0.960 | | | 0.5 | 2.0 |
| $T_{10}$ (minutes) | 46.7 | 11.7 | 222.1 | | | | |

## PERFORMANCE DATA

DISINFECTION PROCESS DATA

| Date | Disinfectant | C (mg/L) | Flow (MGD) | Temp (°C) | pH | Giardia Log | Virus Log | Inact. Ratio | Time= |
|---|---|---|---|---|---|---|---|---|---|
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 3.4 | 0.480 | 13.1 | 7.5 | | | | |
| 1 | CLA *D3* | 3.2 | 0.960 | 13.1 | 7.6 | 2.26 | 39.37 | 4.51 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.9 | 2.000 | 11.2 | 7.5 | | | | |
| 2 | CLA *D3* | 3.1 | 2.000 | 11.2 | 7.6 | 0.75 | 7.73 | 1.50 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.6 | 0.480 | 9.3 | 7.3 | | | | |
| 3 | CLA *D3* | 2.4 | 0.960 | 9.3 | 7.2 | 1.49 | 23.10 | 2.98 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | FCL *D1* | 0.4 | 1.440 | 8.9 | 6.8 | | | | |
| | FCL *D2* | 2.5 | 0.480 | 8.9 | 7.2 | | | | |
| 4 | CLA *D3* | 2.2 | 0.960 | 8.9 | 7.3 | 19.04 | 421.51 | 38.09 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | NA *D2* | | | | | | | | |
| 5 | NA *D3* | | | | | NA | NA | NA | |
| | *D4* | | | | | | | | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 1.8 | 0.480 | 10.2 | 7.5 | | | | |
| 6 | CLA *D3* | 2.1 | 0.960 | 10.2 | 7.6 | 1.25 | 17.35 | 2.49 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.9 | 0.480 | 9.3 | 7.6 | | | | |
| 7 | CLA *D3* | 2.4 | 0.960 | 9.3 | 7.6 | 1.47 | 25.58 | 2.94 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 3.2 | 0.480 | 8.6 | 7.2 | | | | |
| 8 | CLA *D3* | 3.3 | 0.960 | 8.6 | 7.4 | 1.88 | 27.32 | 3.76 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |

## PERFORMANCE DATA

DISINFECTION PROCESS DATA

| Date | Disinfectant | C (mg/L) | Flow (MGD) | Temp (°C) | pH | Giardia Log | Virus Log | Inact. Ratio | Time= |
|---|---|---|---|---|---|---|---|---|---|
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 1.9 | 0.480 | 7.9 | 7.1 | | | | |
| 9 | CLA *D3* | 3.4 | 0.960 | 7.9 | 7.3 | 1.64 | 16.37 | 3.29 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.1 | 0.260 | 8.9 | 7.7 | | | | |
| 10 | CLA *D3* | 2.3 | 0.520 | 8.9 | 7.6 | 2.32 | 33.96 | 4.65 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.4 | 0.260 | 9.2 | 7.8 | | | | |
| 11 | CLA *D3* | 2.3 | 0.520 | 9.2 | 8.0 | 2.41 | 39.21 | 4.83 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 3.1 | 0.480 | 10.3 | 7.5 | | | | |
| 12 | CLA *D3* | 2.9 | 0.960 | 10.3 | 7.2 | 1.79 | 29.55 | 3.58 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 3.3 | 0.480 | 9.5 | 7.5 | | | | |
| 13 | CLA *D3* | 2.9 | 0.960 | 9.5 | 7.2 | 1.75 | 29.63 | 3.50 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.6 | 0.480 | 10.5 | 7.8 | | | | |
| 14 | CLA *D3* | 2.6 | 0.960 | 10.5 | 7.5 | 1.54 | 25.26 | 3.08 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.4 | 0.480 | 8.7 | 7.3 | | | | |
| 15 | CLA *D3* | 2.4 | 0.960 | 8.7 | 7.4 | 1.41 | 20.58 | 2.82 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| | FCL *D1* | 0.2 | 1.440 | 6.1 | 6.8 | | | | |
| | FCL *D2* | 3.1 | 0.480 | 6.1 | 7.2 | | | | |
| 16 | CLA *D3* | 2.9 | 0.960 | 6.1 | 7.3 | 8.79 | 186.80 | 17.59 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |

NOTES: = ONLY use the "Time=" column to show the length of time that the total inactivation ratio was less than 1.00.
* Not representative of total log inactivation(s) and/or total inactivation ratio for all disinfection zones; Excluded from statistical summary calculations.

SUBMITTED BY: Hardy Worker    Certificate No. and Grade: WS1234567, BS    Date: March 9, 2011

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# SURFACE WATER MONTHLY OPERATING REPORT

**FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)**

***Disinfection Data Page (cont.)***

| | | | |
|---|---|---|---|
| **PUBLIC WATER SYSTEM NAME:** | Aguaville PWS | **PLANT NAME OR NUMBER:** | Schwartz Plant |
| **PWS ID No.:** | 1234567 | **Month:** | February **Year:** 2011 |

## DISINFECTION PROCESS PARAMETERS

| APPROVED CT STUDY PARAMETERS | | | | | | PERFORMANCE STANDARDS | |
|---|---|---|---|---|---|---|---|
| | Disinfection Zones | | | | | Log Inactivations | |
| Parameters | D1 | D2 | D3 | D4 | D5 | Giardia lamblia Cysts | Virus |
| Flow Rate (MGD) | 45.000 | 0.480 | 0.960 | | | 0.5 | 2.0 |
| $T_{10}$ (minutes) | 46.7 | 11.7 | 222.1 | | | | |

## PERFORMANCE DATA

**DISINFECTION PROCESS DATA**

| Date | Disinfectant | C (mg/L) | Flow (MGD) | Temp (°C) | pH | Giardia Log | Virus Log | Inact. Ratio | Time= |
|---|---|---|---|---|---|---|---|---|---|
| 17 | FCL *D1* | 0.3 | 0.720 | 4.3 | 7.0 | | | | |
| | FCL *D2* | 2.8 | 0.480 | 4.3 | 7.5 | | | | |
| | CLA *D3* | 2.9 | 0.720 | 4.3 | 7.8 | 19.21 | 442.55 | 38.42 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| 18 | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.5 | 0.480 | 8.1 | 7.6 | | | | |
| | CLA *D3* | 2.6 | 0.960 | 8.1 | 7.7 | 1.39 | 20.63 | 2.79 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| 19 | NA *D1* | | | | | | | | |
| | FCL *D2* | 3.1 | 0.480 | 9.9 | 7.5 | | | | |
| | CLA *D3* | 2.9 | 0.960 | 9.9 | 7.5 | 1.75 | 28.75 | 3.51 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| 20 | NA *D1* | | | | | | | | |
| | FCL *D2* | 3.0 | 0.480 | 10.3 | 7.2 | | | | |
| | CLA *D3* | 2.7 | 0.960 | 10.3 | 7.4 | 1.78 | 28.52 | 3.57 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| 21 | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.8 | 0.480 | 11.2 | 7.7 | | | | |
| | CLA *D3* | 2.9 | 0.960 | 11.2 | 7.6 | 1.77 | 28.64 | 3.54 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| 22 | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.1 | 0.480 | 10.9 | 7.4 | | | | |
| | CLA *D3* | 1.9 | 0.960 | 10.9 | 7.5 | 1.30 | 20.82 | 2.60 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| 23 | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.6 | 0.480 | 12.4 | 7.3 | | | | |
| | CLA *D3* | 2.8 | 0.960 | 12.4 | 7.3 | 1.92 | 28.99 | 3.83 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| 24 | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.8 | 0.480 | 13.6 | 7.6 | | | | |
| | CLA *D3* | 2.7 | 0.960 | 13.6 | 7.5 | 1.95 | 33.63 | 3.90 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |

## PERFORMANCE DATA

**DISINFECTION PROCESS DATA**

| Date | Disinfectant | C (mg/L) | Flow (MGD) | Temp (°C) | pH | Giardia Log | Virus Log | Inact. Ratio | Time= |
|---|---|---|---|---|---|---|---|---|---|
| 25 | NA *D1* | | | | | | | | |
| | FCL *D2* | 0.0 | 0.480 | 10.8 | 7.8 | | | | |
| | CLA *D3* | 2.1 | 0.960 | 10.8 | 7.7 | 0.80 | 1.63 | 0.81 | 0.75 |
| | *D4* | | | | | | | (V) | |
| | *D5* | | | | | | | | |
| 26 | NA *D1* | | | | | | | | |
| | FCL *D2* | 3.0 | 0.480 | 10.3 | 7.3 | | | | |
| | CLA *D3* | 3.2 | 0.960 | 10.3 | 7.3 | 1.94 | 28.90 | 3.88 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| 27 | NA *D1* | | | | | | | | |
| | FCL *D2* | 2.6 | 0.260 | 11.4 | 7.6 | | | | |
| | CLA *D3* | 2.8 | 0.520 | 11.4 | 7.5 | 3.21 | 49.94 | 6.42 | |
| | *D4* | | | | | | | (G) | |
| | *D5* | | | | | | | | |
| 28 | NA *D1* | | | | | | | | |
| | FCL *D2* | ND | 0.480 | 12.6 | 7.6 | | | | |
| | CLA *D3* | 2.7 | 0.960 | 12.6 | 7.7 | 1.11* | 2.37* | 1.18 | |
| | *D4* | | | | | | | (V) | |
| | *D5* | | | | | | | | |
| 29 | *D1* | | | | | | | | |
| | *D2* | | | | | | | | |
| | *D3* | | | | | | | | |
| | *D4* | | | | | | | | |
| | *D5* | | | | | | | | |
| 30 | *D1* | | | | | | | | |
| | *D2* | | | | | | | | |
| | *D3* | | | | | | | | |
| | *D4* | | | | | | | | |
| | *D5* | | | | | | | | |
| 31 | *D1* | | | | | | | | |
| | *D2* | | | | | | | | |
| | *D3* | | | | | | | | |
| | *D4* | | | | | | | | |
| | *D5* | | | | | | | | |

| | Giardia Log | Virus Log |
|---|---|---|
| Max | 19.21 | 442.55 |
| Min | 0.75 | 1.63 |
| Avg | 3.26 | 61.43 |
| SD | 4.71 | 109.67 |

**NOTES:** = ONLY use the "Time=" column to show the length of time that the total inactivation ratio was less than 1.00.

* Not representative of total log inactivation(s) and/or total inactivation ratio for all disinfection zones; Excluded from statistical summary calculations.

**SUBMITTED BY:** Hardy Worker **Certificate No. and Grade:** WS1234567, BS **Date:** March 9, 2011

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# MONTHLY TOTAL ORGANIC CARBON REMOVAL REPORT (TOCMOR)

FOR SURFACE WATER OR GROUND WATER UNDER THE INFLUENCE OF SURFACE WATER SYSTEMS

PUBLIC WATER SYSTEM NAME: Aguaville PWS    PLANT NAME OR NUMBER: Schwartz Plant

PWS ID No.: 1234567    Month: February    Year: 2011

Type of treatment: X Conventional    [ ] Unconventional explain:

Note: Systems are required to run one TOC Sample Set every month. Additional space is provided for those systems that do additional sampling

| Test No. | Test Date | Monthly TOC Sample Set | | | Actual % TOC Removed | Step 1 Required % Removal | Step 1 Removal Ratio | Optional data | | COMPLIANCE REMOVAL RATIO |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Raw Alkalinity | Raw TOC | Treated TOC | | | | Step 2 Required % Removal | Step 2 Removal Ratio | |
| | | Enter the Sample Set results | | | calculated | calculated from matrix | calculated | Please attach the p3-Step2 worksheet | calculated | calculated |
| 1 | 2/8 | 136 | 4.20 | 3.30 | 21.4 | 25 | 0.86 | 22.7 | 0.9 | 0.94 |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |
| Avg | | 136.00 | 4.20 | 3.30 | 21.43 | | 0.86 | | 0.9 | 0.94 |
| Max | | 136.00 | 4.20 | 3.30 | 21.43 | | 0.86 | | 0.9 | 0.94 |
| Min | | 136.00 | 4.20 | 3.30 | 21.43 | | 0.86 | | 0.9 | 0.94 |

## TOTAL ORGANIC CARBON (TOC) REMOVAL SUMMARY

| TOC Summary: Don't forget to include a copy of your P.7-TOC ACC worksheet with your report. | | | | | Monthly Compliance Ratio |
|---|---|---|---|---|---|
| Raw Water Alkalinity | Raw Water TOC | Treated Water TOC | TOC % Removal | ACC # used | |
| 136 | 4.20 | 3.30 | 21.4 | 6 RAA | 1.00 |

I certify that I am familiar with the information contained in this report and that, to the best of my knowledge, the information is true, complete, and accurate.

Operator's Signature: Hardy Worker    Certificate No. and Grade: WS1234567, BS    Date: March 9, 2011

***Submit the report by the 10th of the month following the reporting period to:***
**TEXAS COMMISSION ON ENVIRONMENTAL QUALITY**
**WATER SUPPLY DIVISION/PUBLIC DRINKING WATER SECTION (MC-155)**
**P.O. BOX 13087, AUSTIN, TEXAS 78711-3087**

TCEQ - 0879 (09-01-09)    TOCMOR, Page 1 - Summary    TOCMOR

## TOC ALTERNATIVE COMPLIANCE CRITERIA REPORT

FOR SURFACE WATER OR GROUND WATER UNDER THE INFLUENCE OF SURFACE WATER SYSTEMS

PUBLIC WATER SYSTEM NAME: Aguaville PWS

PWS ID No.: 1234567

PLANT NAME OR NUMBER: Schwartz Plant

Month: February  Year: 2011

This Alternative Compliance Criteria (ACC) Report is being submitted to request the following ACC: (check one)
(Before you can begin entering data, you must put an "X" in the box that shows the number of the Alternative Compliance Criteria you are applying for.)

| #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 |
|---|---|---|---|---|---|---|---|
| | | | | | X | | |

ACC #1

ACC # 2

ACC # 3

ACC # 4

ACC # 5

ACC # 6

**Treated water SUVA less than or equal to 2.0 L/mg-m?**
(either based on most recent month's data OR calculated quarterly as a running annual average)

(Treated water SUVA is the ultraviolet light absorption at 254 nanometers divided by the dissolved organic carbon concentration in the finished water before any disinfection of any kind, or measured using a finished water SUVA jar test. Measure monthly.)

**Treated water SUVA measured:**

[ ] In Plant

[X] By Finished Water SUVA Jar Test (Be sure to sign the certification)

I certify that an oxidant was used upstream of the Treated Water TOC monitoring point during the period for which treated water SUVA data is reported.

*Certified Operators Signature / Certificate Number / Date*

**Current Month SUVA:**

| | Q1 | | | Q2 | | | Q3 | | | Q4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month/Year | 01/2010 | 02/2010 | 03/2010 | 04/2010 | 05/2010 | 06/2010 | 07/2010 | 08/2010 | 09/2010 | 10/2010 | 11/2010 | 12/2010 |
| Monthly Treated Water SUVA | 2.02 | 2.00 | 2.12 | 1.90 | 1.98 | 2.01 | 1.80 | 1.94 | 1.91 | 2.06 | 1.98 | 1.89 |
| Quarterly Average | | | 2.05 | | | 1.96 | | | 1.88 | | | 1.98 |
| **RAA** | | | | | | | | | | | | 1.97 |

ACC #7

ACC # 8

I certify that I am familiar with the information contained in this report and that, to the best of my knowledge, the information is true, complete, and accurate.

Operator's Signature: Hardy Worker  Certificate No. and Grade: WS1234567, BS  Date: March 9, 2011

TCEQ - 0879 (09-01-09)  TOCMOR, Page 2 - ACC Attachment  TOCMOR

# STEP 2 JAR TEST REPORT

FOR SURFACE WATER OR GROUND WATER UNDER THE INFLUENCE OF SURFACE WATER SYSTEMS

PUBLIC WATER SYSTEM NAME: Aguaville PWS

PLANT NAME OR NUMBER: Schwartz Plant

PWS ID No.: 1234567

DATE OF JAR TEST: December 13, 2010

**PLANT CONDITIONS**

| RAW WATER SOURCE(s) | COAGULANT Type | COAGULANT Dose (mg/L) | COAGULANT AID Type | COAGULANT AID Dose (mg/L) | FLOC AID Type | FLOC AID Dose (mg/L) | pH ADJUSTMENT Type | pH ADJUSTMENT Dose (mg/L) |
|---|---|---|---|---|---|---|---|---|
| Allen R. Gammage Reservoir and Lake Schwartz | Alum | 45.00 | Cationic polymer | 0.50 | NA | | NA | |

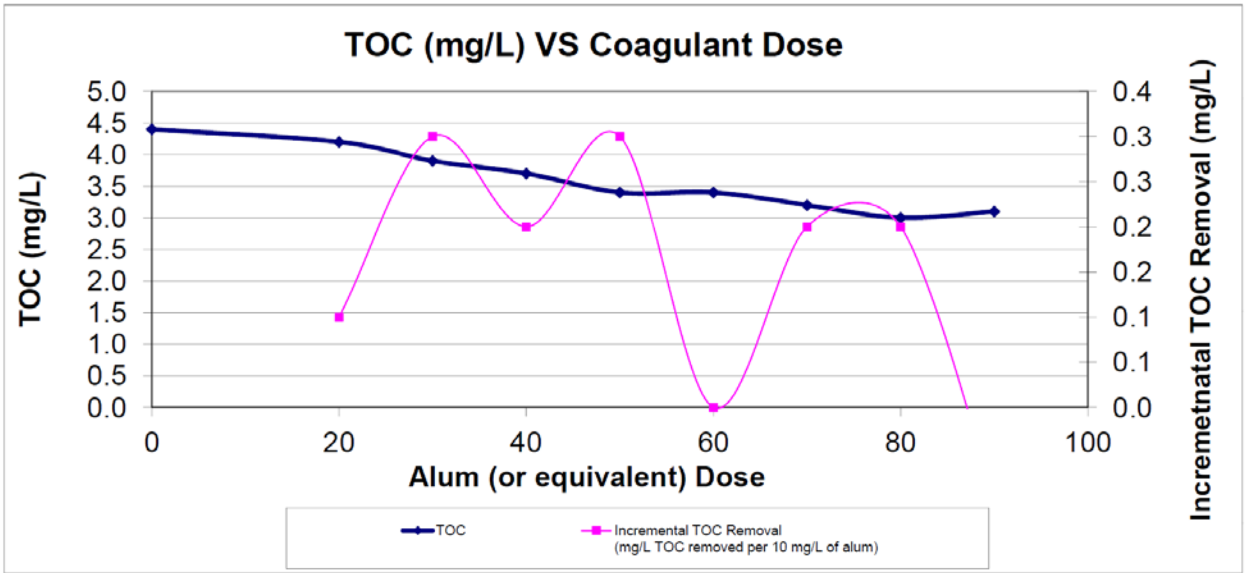
**STEP 2 JAR TEST PARAMETERS**

| COAGULANT Type | COAGULANT Stock Solution Concentration (g/L) | BASE Type | BASE Stock Solution Concentration (g/L) | JAR SIZE Volume (liters) | Rapid Mix Speed (rpm) | Rapid Mix Duration (minutes) | Flocculation Speed (rpm) | Flocculation Duration (minutes) | Settling Duration (minutes) |
|---|---|---|---|---|---|---|---|---|---|
| Alum | 2 | NA | | 2 | 325.0 | 0.5 | 50, 30, 15 | 3.0, 3.0, 3.0 | 20.0 |

**JAR TEST RESULTS**

| Jar No. | COAGULANT Dose (Alum eq.) (mg/L) | COAGULANT Volume (mL) | BASE Dose (mg/L) | BASE Volume (mL) | Alkalinity (mg/L as $CaCO_3$) | pH | TOC (mg/L) | Incremental TOC Removal (mg/L TOC removed per 10 mg/L of alum) | Cumulative TOC Removal (%) |
|---|---|---|---|---|---|---|---|---|---|
| RAW | 0 | | | | 144 | 7.6 | 4.4 | | |
| 1 | 20 | 2.00 | | | | 7.5 | 4.2 | 0.1 | 4.5 |
| 2 | 30 | 3.00 | | | | 7.5 | 3.9 | 0.3 | 11.4 |
| 3 | 40 | 4.00 | | | | 7.4 | 3.7 | 0.2 | 15.9 |
| 4 | 50 | 5.00 | | | Target pH | 7.4 | 3.4 | 0.3 | 22.7 |
| 5 | 60 | 6.00 | | | (based on | 7.3 | 3.4 | 0.0 | 22.7 |
| 6 | 70 | 7.00 | | | raw water | 7.3 | 3.2 | 0.2 | 27.3 |
| 7 | 80 | 8.00 | | | alkalinity) | 7.1 | 3.0 | 0.2 | 31.8 |
| 8 | 90 | 9.00 | | | 7.0 | 6.9 | 3.1 | -0.1 | bad data point |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |

| | | | |
|---|---|---|---|
| Has the TCEQ approved this source as "Not Amenable" to Treatment even though Target pH was not reached? If "yes", provide the date of the TCEQ letter or e-mail. | | TOC, % Removal at Apparent PODR: | More than 1 PODR |
| | | More than one PODR found; please enter correct PODR value: | 22.7% |




I certify that I am familiar with the information contained in this report and that, to the best of my knowledge, the information is true, complete, and accurate.

Operator's Signature: Hardy Worker

Certificate No. and Grade: WS1234567, BS

TCEQ - 0879 (09-01-09) TOCMOR, Page 3 - Step 2 Jar Test Attachment TOCMOR

# Appendix F:
# EXAMPLE OF A COMPLETED FPR AND FAR

# EXAMPLE OF A COMPLETED FPR

## FILTER PROFILE REPORT FOR INDIVIDUAL FILTERS

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER THAT ARE REQUIRED TO CONDUCT ADDITIONAL INDIVIDUAL FILTER MONITORING

PUBLIC WATER SYSTEM NAME: Aguaville WSC

PLANT NAME OR NUMBER: Schwartz Water Treatment Plant

PWS ID No.: 1234567

Month: February Year: 2010

**OBVIOUS REASONS**

| | | | |
|---|---|---|---|
| | FILTER NO.: 1 | FILTER NO.: 1 | FILTER NO.: 5 |
| | DATE: 02-04-10 | DATE: 02-04-10 | DATE: 02-04-10 |
| | TIME: 10:00 AM | TIME: 4:15 PM | TIME: 11:45 AM |
| | DURATION: 45.00 | DURATION: 15.00 | DURATION: 15.00 |
| | TURBIDITY: 1.32 | TURBIDITY: 0.57 | TURBIDITY: 1.05 |
| *OBVIOUS REASONS* *(Check all that apply)* | | | |
| **NONE IDENTIFIED** - ***A Filter Profile must be submitted*** | ☐ *(See Profile No. ____ )* | ☐ *(See Profile No. ____ )* | ☐ *(See Profile No. ____* |
| **Filter Problems** | | | |
| Post-Backwash Turbidity Spike | ☐ | ☑ | ☐ |
| Prolonged Filter Run Time | ☑ | ☐ | ☐ |
| Excessive Filter-Loading Rate | ☐ | ☐ | ☐ |
| Rate-of-Flow Control Valve Failure | ☐ | ☐ | ☐ |
| Media Defects (insufficient depth, mudballs, etc.) | ☐ | ☐ | ☐ |
| Inadequate Surface Wash or Backwash Facilities | ☐ | ☐ | ☐ |
| Backwash Artifact | ☐ | ☐ | ☑ |
| **Turbidimeter Errors** | | | |
| Incorrect Calibration | ☐ | ☐ | ☐ |
| Air Bubble | ☐ | ☐ | ☐ |
| Debris | ☐ | ☐ | ☐ |
| **Chemical Feed Equipment Failure** | | | |
| Coagulant | ☐ | ☐ | ☐ |
| Coagulant Aid | ☐ | ☐ | ☐ |
| Filter Aid | ☐ | ☐ | ☐ |
| **Poor Raw Water Quality** | ☐ | ☐ | ☐ |
| **Other Major Unit Process Failures/Maintenance Activities** | ☐ | ☐ | ☐ |
| *Specify:* | | | Backwash Filter No. 1 |

**OBVIOUS REASONS**

| | | | |
|---|---|---|---|
| | FILTER NO.: 5 | FILTER NO.: | FILTER NO.: |
| | DATE: 02-13-10 | DATE: | DATE: |
| | TIME: 2:15 PM | TIME: | TIME: |
| | DURATION: 15.00 | DURATION: | DURATION: |
| | TURBIDITY: 1.24 | TURBIDITY: | TURBIDITY: |
| *OBVIOUS REASONS* *(Check all that apply)* | | | |
| **NONE IDENTIFIED** - ***A Filter Profile must be submitted*** | ☑ *(See Profile No. 1 )* | ☐ *(See Profile No. ____ )* | ☐ *(See Profile No. ____ )* |
| **Filter Problems** | | | |
| Post-Backwash Turbidity Spike | ☐ | ☐ | ☐ |
| Prolonged Filter Run Time | ☐ | ☐ | ☐ |
| Excessive Filter-Loading Rate | ☐ | ☐ | ☐ |
| Rate-of-Flow Control Valve Failure | ☐ | ☐ | ☐ |
| Media Defects (insufficient depth, mudballs, etc.) | ☐ | ☐ | ☐ |
| Inadequate Surface Wash or Backwash Facilities | ☐ | ☐ | ☐ |
| Backwash Artifact | ☐ | ☐ | ☐ |
| **Turbidimeter Errors** | | | |
| Incorrect Calibration | ☐ | ☐ | ☐ |
| Air Bubble | ☐ | ☐ | ☐ |
| Debris | ☐ | ☐ | ☐ |
| **Chemical Feed Equipment Failure** | | | |
| Coagulant | ☐ | ☐ | ☐ |
| Coagulant Aid | ☐ | ☐ | ☐ |
| Filter Aid | ☐ | ☐ | ☐ |
| **Poor Raw Water Quality** | ☐ | ☐ | ☐ |
| **Other Major Unit Process Failures/Maintenance Activities** | ☐ | ☐ | ☐ |
| *Specify:* | | | |

SUBMITTED BY: Hardy Worker

Certificate No. and Grade: 123-45-6789, BSW

Date: 24-Feb-10

TCEQ - 10276 (10-02-00) PAGE 1 FPR

# FILTER PROFILE REPORT FOR INDIVIDUAL FILTERS

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER THAT ARE REQUIRED TO CONDUCT ADDITIONAL INDIVIDUAL FILTER MONITORING

**PUBLIC WATER SYSTEM NAME:** Aguaville WSC **PLANT NAME OR NUMBER:** Schwartz Water Treatment Plant

**PWS ID No.:** 1234567 **Month:** February **Year:** 2010

## NARRATIVE DESCRIPTION OF FILTER PROFILE

**FILTER NO.:** 5
**PROFILE NO.:** 1 **DATE OF PROFILE:** February 19, 2010

**DETAILS:** The filter profile on Filter No. 5 began at 1:28 pm on Tuesday, February 19 following a routine backwash and our typical 45-minute idle time that we allow for filter pre-ripening. The filter profile ended at 12:03 am on Thursday, February 21, when the plant was taken off-line for the day. Filter No. 5 was backwashed and returned before the plant was returned to service the following morning. Some specific observations we made during the filter profile include:

1) there was a significant increase in the IFE turbidity level at 6:00 pm on the 19th when the plant's production rate was increased from 9.6 MGD to 13.2 MGD.
2) the 4-hour IFE turbidity level on Filter No. 5 was recorded at 12:30 pm and was 0.262 NTU.
3) a turbidity spike was observed when Filter No. 3 was taken off-line and backwashed at 8:28 pm on the 19th.
4) the maximum daily 15-minute IFE reading from Filter No. 5 occurred at 8:30 pm on the 19th while backwashing Filter No. 3
5) the plant was shut off for the night at 11:55 pm and was not started up again until 8:00 on Wednesday, February 20th.
6) the short-but severe turbidity spike that occurred at 11:46 am on the 20th was an unusual reading that occurred when we flushed the turbidimeter body as part of our routine maintenance activities.
7) the 4-hr IFE reading for Filter No. 5 occurred at 12:00 noon and was 0.235 NTU
8) at 2:35 pm on the 20th, we took Filter No. 6 off-line for backwashing
9) the maximum daily 15-minute reading for the 20th (on Filter No. 5) was 0.394 NTU and occurred while Filter No. 6 was still off-line

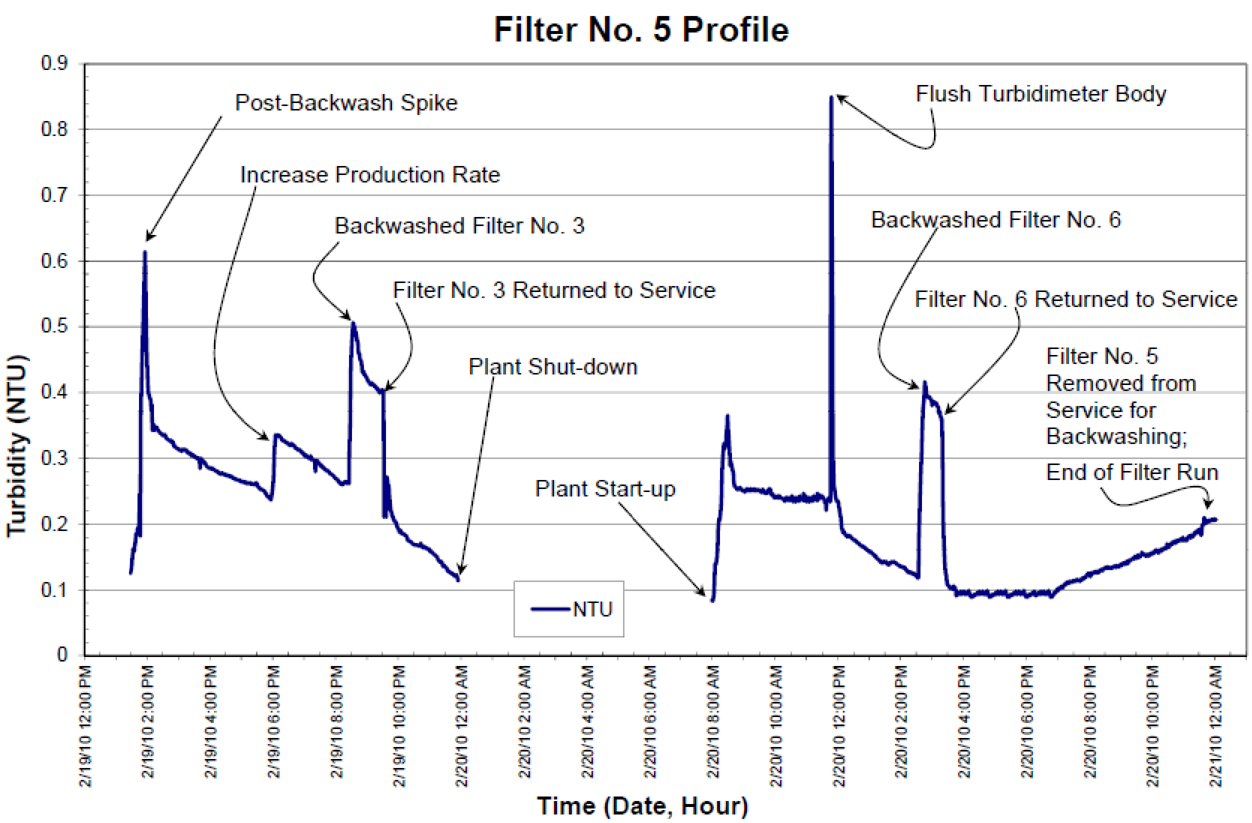
## NARRATIVE DESCRIPTION OF FILTER PROFILE

**FILTER NO.:** ______
**PROFILE NO.:** ______ **DATE OF PROFILE:** ______

**DETAILS:**

**SUBMITTED BY:** Hardy Worker **Certificate No. and Grade:** 123-45-6789, BSW **Date:** February 24, 2010

TCEQ - 10276 (10-02-00) PAGE 2 FPR



Filter No. 5 Profile
Turbidity (NTU)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Post-Backwash Spike
Increase Production Rate
Backwashed Filter No. 3
Filter No. 3 Returned to Service
Plant Shut-down
Plant Start-up
Flush Turbidimeter Body
Backwashed Filter No. 6
Filter No. 6 Returned to Service
Filter No. 5 Removed from Service for Backwashing;
End of Filter Run
NTU
2/19/10 12:00 PM
2/19/10 2:00 PM
2/19/10 4:00 PM
2/19/10 6:00 PM
2/19/10 8:00 PM
2/19/10 10:00 PM
2/20/10 12:00 AM
2/20/10 2:00 AM
2/20/10 4:00 AM
2/20/10 6:00 AM
2/20/10 8:00 AM
2/20/10 10:00 AM
2/20/10 12:00 PM
2/20/10 2:00 PM
2/20/10 4:00 PM
2/20/10 6:00 PM
2/20/10 8:00 PM
2/20/10 10:00 PM
2/21/10 12:00 AM
Time (Date, Hour)

# Example of a Completed FAR

## FILTER ASSESSMENT REPORT FOR INDIVIDUAL FILTERS

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER THAT ARE REQUIRED TO CONDUCT AN INDIVIDUAL FILTER ASSSESSMENT

PUBLIC WATER SYSTEM NAME: **Aguaville WSC**

PLANT NAME OR NUMBER: **Schwartz Water Treatment Plant**

PWS ID No.: **1234567**

FILTER NUMBER: **Filter No. 5**

### DESIGN SPECIFICATIONS

| | | | | | | |
|---|---|---|---|---|---|---|
| FILTER TYPE | Gravity | | OPERATING MODE | Constant Rate/Variable Level | | |
| | Diameter (ft) | Length (ft) | Width (ft) | Surface Area (ft$^2$) | Freeboard (ft) | Max Head Loss (ft) |
| MEDIA BED DIMENSIONS | | 12.00 | 24.00 | 288.00 | 3.25 | 13.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| MEDIA TYPE | Multiple Media | | | | | |
| MEDIA SPECS | Material | Depth (inches) | Min. Size (mm) | Max. Size (mm) | UC | Specific Gravity |
| Layer 1 Material | Anthracite | 24.00 | 0.90 | 1.20 | 1.60 | Unknown |
| Layer 2 Material | Sand | 12.00 | 0.45 | 0.55 | 1.40 | Unknown |
| Layer 3 Material | Garnet | 3.00 | 0.20 | 0.35 | 1.40 | Unknown |
| Layer 4 Material | | | | | | |
| TOTAL DEPTH (inches) | 39.00 | | | | | |
| L/D RATIO | 1206.4 | | | | | |

| | | | | |
|---|---|---|---|---|
| UNDERDRAIN TYPE | Type-S with gravel | | | |
| | No. of Grades | Min. Size (in) | Max. Size (in) | Total Depth (in) |
| SUPPORT GRAVEL | 4 | 0.25 | 1.50 | 12.00 |

| | | | |
|---|---|---|---|
| TROUGHS | | SUPPL. BACKWASH | Air Scour (retrofit) |
| Number. | 5 | | |
| Separation (inches) | 39.00 | FILTER-TO-WASTE | No |

| | Regulatory Std | Design | Typical | During Backwash | Maximum | App'd Exception |
|---|---|---|---|---|---|---|
| FILTER FLOW RATE (gpm) | 1440 | 1400 | 1111 | 1333 | 1833 | None |
| LOADING RATE (gpm/ft$^2$) | 5.0 | 4.86 | 3.86 | 4.63 | 6.36 | None |
| BW FLOW RATE (gpm) | 3600 - 6278 | 5000 | 3800 | | 5000 | |
| BW LOADING RATE (gpm/ft$^2$) | 12.5 - 21.8 | 17.36 | 13.19 | | 17.36 | |

| | Source | Controller | Meter | Turbidimeter | LOHG |
|---|---|---|---|---|---|
| FILTER INFLUENT | | Fix. weir Splitter | Proportional | None | |
| FILTER EFFLUENT | | None | None | Hach 1720D | Water Lvl Indicator |
| BACKWASH WATER | Filters & Pump | Mot. Valve (Auto.) | Ultrasonic | None | |

**ADDITIONAL REMARKS**: There flow distribution to the filter is controlled with a fixed-weir splitter box and a valve that is completely opened when the filter is on-line and is completely closed when the filter is out of service during backwash and the subsequent idle period.

### OPERATING PROCEDURES

| CALIBRATION | Flow Meter | Backwash Meter | Mech. ROFC | NTU (Primary) | NTU (Secondary) |
|---|---|---|---|---|---|
| Method | Ultrasonic | Ultrasonic | | Formazin | Comparison |
| Frequency | Annual | Annual | | Quarterly | Weekly |
| Date of Last | June 13, 2010 | June 13, 2011 | | January 24, 2012 | February 14, 2012 |

| BACKWASH | Turbidity (NTU) | LOH (ft) | Run Time (hr) | Run Volume (gal) | Filtration Rate |
|---|---|---|---|---|---|
| Criteria | 1.0 NTU | 10.00 | 48.00 | NA | NA |
| Monitoring Interval | 5 min | 8 hrs | Each Shift | | |

| WRITTEN SOPs | |
|---|---|
| Plant Start-up | Complete |
| Filter Start-up | Complete |
| Plant Shutdown | Partial |
| Filter Shutdown | Partial |
| Filter Backwash | Complete |
| Filter Inspection | None |

**ADDITIONAL REMARKS**: We are creating a Filter Inspection SOP as part of this Filter Assessment.

I certify that I am familiar with the information contained in this report and that, to the best of my knowledge, the information is true, complete, and accurate.

Operator's Signature: Más Papeleo

Operator's Name (printed): Más Papeleo

Certificate No. and Class: 987-65-4321

Date: February 23, 2012

Submit Report to TCEQ/Water Supply Division (MC-159), ATTN: SWTR Coordinator, P.O. Box 13087, Austin, TX 78711-3087
The report is due the 10th of the following month

TCEQ - 10277 (10-02-00) PAGE 1 Filter Assessment Report

# FILTER ASSESSMENT REPORT FOR INDIVIDUAL FILTERS

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER THAT ARE REQUIRED TO CONDUCT AN INDIVIDUAL FILTER ASSSESSMENT

| | | | |
|---|---|---|---|
| PUBLIC WATER SYSTEM NAME: | Aguaville WSC | PLANT NAME OR NUMBER: | Schwartz Water Treatment Plant |
| PWS ID No.: | 1234567 | FILTER NUMBER: | Filter No. 5 |

**CURRENT CONDITIONS**

| DATE | TIME | TURBIDITY (NTU) | LOH (ft) | FLOW RATE (gpm) | RUN TIME (hr) | RUN VOLUME (gal) |
|---|---|---|---|---|---|---|
| 17-Feb-12 | 6:00 AM | 0.32 | 7.00 | 1,100 | 18.75 | Unknown |

| PHYSICAL CONDITION | |
|---|---|
| Walls | Good |
| Troughs | Minor Damage |
| Suppl. Backwash | Fully Operational |
| Flow Meter | |
| ROFC | Fully Operational |
| Flow Control Valve | Fully Operational |
| Turbidimeter | Fully Operational |
| LOHG | Slight Malfunction |

**ADDITIONAL REMARKS:** Some of the indicator marks on the LOHG ruler are not legible.

**MEDIA SURFACE CONDITIONS**

| | Before BW | After BW |
|---|---|---|
| **MOUNDS** | | |
| Number | 3 | 1 |
| Length (inches) | 6 - 12 | 12 |
| Width (inches) | 6 - 9 | 12 |
| Height (inches) | 1 - 2.5 | 1.0 |
| **DEPRESSIONS** | | |
| Number | 6 | 0 |
| Length (inches) | 18 - 36 | |
| Width (inches) | 5 - 6 | |
| Depth (inches) | 1.5 -3.75 | |
| **ACCUMULATED FLOC** | | |
| Thickness (inches) | 0 - 0.25 | Minimal |
| Distribution | Uniform | Uniform |

| | Before BW | After BW |
|---|---|---|
| **RETRACTION** | | |
| Number | 1 | 0 |
| Length (inches) | 18 | |
| Width (inches) | 1 | |
| Depth (inches) | 1.5 | |
| **CRACKS** | | |
| Number | 6 | 0 |
| Length (inches) | 6 - 15 | |
| Width (inches) | 0 - 0.5 | |
| Depth (inches) | 0 - 0.5 | |
| **MUDBALLS** | | |
| No. per $ft^2$ | >10 | 0 |
| Size (inches) | 0.25 - 0.75 | |
| Distribution | Localized | |

**ADDITIONAL REMARKS**: The largest depressions are located adjacent to the backwash troughs. With the exception of one slight mound in the southwest corner of the filter, all of the anomalies were eliminated by the backwash cycle.

**BACKWASH CONDITIONS**

| | |
|---|---|
| BW FLOW RATE (gpm) | 2800 |
| RISE RATE (inches/minute) | 15.60 |
| LOADING RATE (gpm/$ft^2$) | 9.72 |
| DURATION (minutes) | 12.00 |
| TOTAL VOLUME (gallons) | 39,200 |
| **TROUGHS** | |
| Levelness | Slighly Unlevel |
| Flooding | None |
| **SUPPL. BACKWASH** | |
| Duration (minutes) | 5.0 |
| Effectiveness | Adequate |
| **JETTING** | |
| No. of Sites | 2 |
| Severity | Moderate |
| BW WATER DISTRIBUTION | Even/Uniform |
| SPENT BWW TURBIDITY | 2.98 |
| EXPANSION (inches) | 12.00 |
| EXPANSION (percent) | 35.29411765 |
| YIELD (percent) | Unknown |

**ADDITIONAL REMARKS**: In one area of the filter, a severe jet was observed but we classified it as moderate because it did not seem to affect the backwash effectiveness in other parts of the filter.

Submitted by: Más Papeleo

Date: February 23, 2012

TCEQ - 10277 (10-02-00) PAGE 2 Filter Assessment Report

# FILTER ASSESSMENT REPORT FOR INDIVIDUAL FILTERS

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER THAT ARE REQUIRED TO CONDUCT AN INDIVIDUAL FILTER ASSSESSMENT

PUBLIC WATER SYSTEM NAME: Aguaville WSC

PLANT NAME OR NUMBER: Schwartz Water Treatment Plant

PWS ID No.: 1234567

FILTER NUMBER: Filter No. 5

## FILTER PROBE

| | |
|---|---|
| NUMBER OF SITES | 121 |
| MEDIA | |
| Max. Thickness (inches) | 37.00 |
| Min. Thickness (inches) | 26.00 |
| Typ. Thickness (inches) | 34.00 |
| SUPPORT MATERIAL | |
| Max. Elevation | 70.00 |
| Min. Elevation | 77.00 |
| Typ. Elevation | 75.00 |

**ADDITIONAL REMARKS**: One relatively large gravel mound was detected in the northeast corner of the filter.

## FILTER EXCAVATION

| | REFERENCE | SITE 2 | SITE 3 | SITE 4 | SITE 5 | SITE 6 |
|---|---|---|---|---|---|---|
| SITE CHARACTERISTIC | **Normal** | Normal | Normal | Media Mound | Gravel Mound | Crack |
| LAYER 1 (Top Layer) | 18.00 | 19.00 | 18.00 | 21.00 | 14.00 | 18.00 |
| INTERFACE 1 | 2.50 | 2.00 | 2.00 | 1.50 | 1.25 | 2.50 |
| LAYER 2 | 11.00 | 12.00 | 11.00 | 11.00 | 10.00 | 12.00 |
| INTERFACE 2 | 0.75 | 0.50 | 0.75 | 0.50 | 0.50 | |
| LAYER 3 | 4.00 | 4.00 | 3.75 | 3.00 | 0.00 | |
| INTERFACE 3 | | | | | | |
| LAYER 4 | | | | | | |
| MUDBALLS | Few | None | None | Few | None | Few |
| Max. Size (inches) | 0.75 | | | 0.50 | | 0.50 |
| Min. Size (inches) | 0.25 | | | 0.13 | | 0.25 |
| Max. Depth (inches) | 4.00 | | | 5.00 | | 3.00 |

| | SITE 7 | SITE 8 | SITE 9 | SITE 10 | SITE 11 | SITE 12 |
|---|---|---|---|---|---|---|
| SITE CHARACTERISTIC | Retraction | Jetting | | | | |
| LAYER 1 (Top Layer) | 18.00 | 18.00 | | | | |
| INTERFACE 1 | 2.00 | 4.75 | | | | |
| LAYER 2 | 12.00 | 8.00 | | | | |
| INTERFACE 2 | 1.00 | 2.50 | | | | |
| LAYER 3 | 3.00 | 2.00 | | | | |
| INTERFACE 3 | | | | | | |
| LAYER 4 | | | | | | |
| MUDBALLS | Several | None | | | | |
| Max. Size (inches) | 0.75 | | | | | |
| Min. Size (inches) | 0.25 | | | | | |
| Max. Depth (inches) | 7.00 | | | | | |

| | |
|---|---|
| MEDIA CONDITION | |
| Sharpness | Good |
| Encrustation | Slight |
| Uniformity | Marginal |

**ADDITIONAL REMARKS**: The sand and garnet seemed in very good shape. The anthracite seemed slightly worn and encrusted. The anthracite grains did not seem very uniform in shape or size.

## ADDITIONAL STUDIES

| | |
|---|---|
| FILTER PROFILE ATTACHED? | Yes |

*Note: A Filter Profile must be attached to this report.*

| | |
|---|---|
| PERCENT MUDBALLS | |
| Media Volume (ml) | 1680 |
| Mudball Volume (ml) | 14 |
| % Mudballs | 0.8% |

**ADDITIONAL REMARKS**: Several of the mudballs were placed in a chlorine solution (200 ppm, pH=4.5) for 12 hours and the mudballs dissolved. A representative sample of filter media was dried in an oven, weighed, and then placed in the acidified chlorine solution. After 12 hours, the media was removed, rinsed several times, dried and reweighed. The media lost 12% of its mass. The chlorine solution had a brownish tint so we neutralized the chlorine with thiosulfate and ran iron and manganese tests on the material. The manganese result was 0.55 mg/L and the iron result was 0.2 mg/L.

## CONCLUSIONS

**CONCLUSIONS: We have lost 5-6 inches of our anthracite and the anthracite that remains seems to no longer meet manufacturer's specifications. There is also a large gravel mound in one area of the filter. The presence of the severe backwash jet and the degree that the media layers were intermixed suggests that there is some underdrain damage in that part of the filter. The filter profile that was run on February 19th suggests that the performance of Filter No. 5 is adversely affected by sudden flow rate changes.**

CORRECTIVE ACTION PLAN ATTACHED? **Yes**

WOULD YOU LIKE SOME TECHNICAL ASSISTANCE FROM THE TCEQ? **No**

Submitted by: Más Papeleo

Date: February 23, 2012

TCEQ - 10277 (10-02-00) PAGE 3 Filter Assessment Report

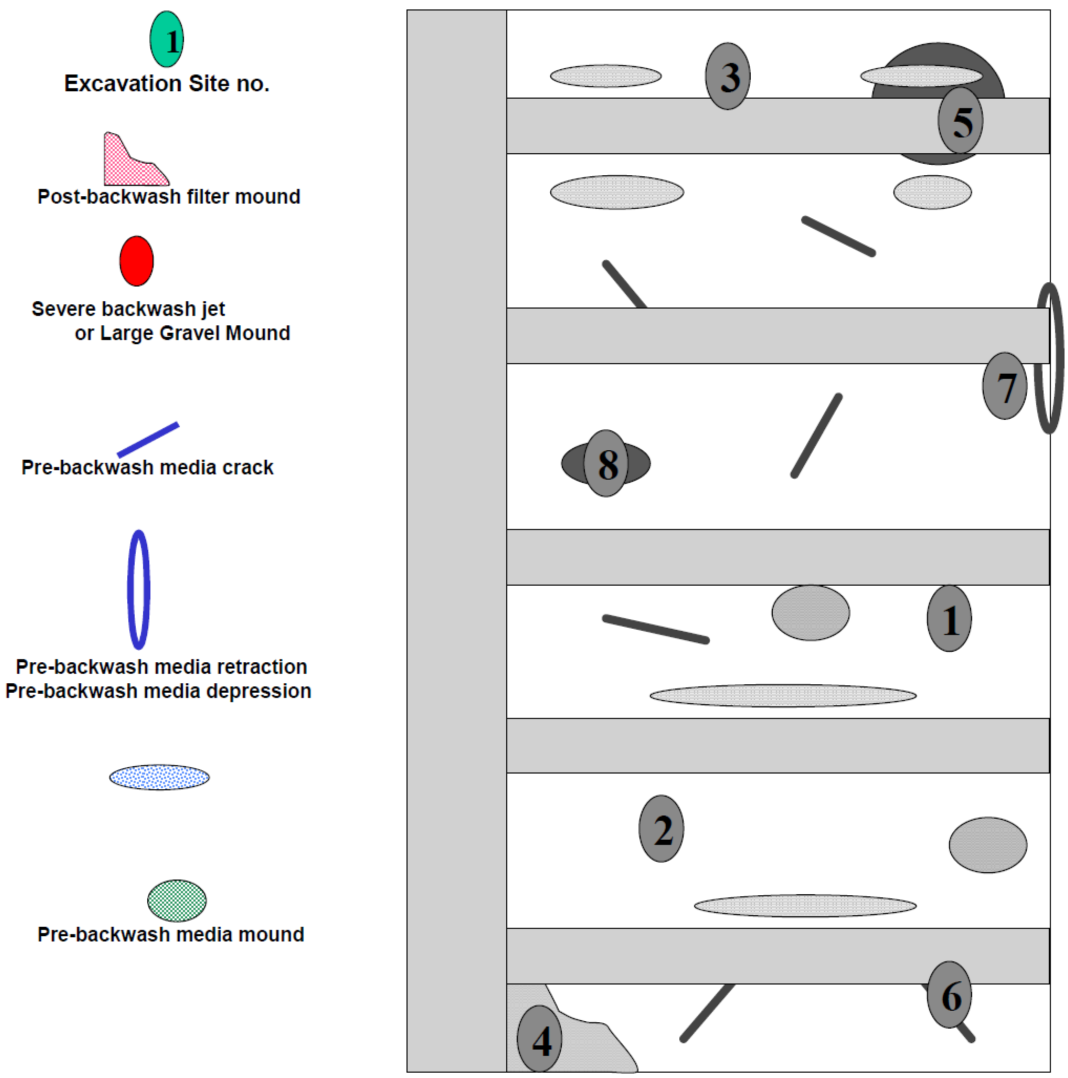
# FILTER ASSESSMENT REPORT FOR INDIVIDUAL FILTERS

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER THAT ARE REQUIRED TO CONDUCT AN INDIVIDUAL FILTER ASSSESSMENT

| | | | |
|---|---|---|---|
| PUBLIC WATER SYSTEM NAME: | Aguaville WSC | PLANT NAME OR NUMBER: | Schwartz Water Treatment Plant |
| PWS ID No.: | 1234567 | FILTER NUMBER: | Filter No. 5 |

## FILTER SCHEMATIC

PREPARE A SIMPLE FILTER SCHEMATIC SHOWING THE LOCATION OF BACKWASH WATER TROUGHS, OBSERVED ANOMALIES, AND EXCAVATION SITES.




Submitted by: Más Papeleo

Date: February 23, 2012

TCEQ - 10277 (10-02-00) PAGE 4 Filter Assessment Report

## CORRECTIVE-ACTION PLAN

**Task:** Improve the performance of Filter No. 5 by addressing the operational and filter defects identified during the filter assessment.

Plant: Aguaville WSC, Schwartz WTP

Date: February 25, 2012

| Step No. | Activity | Description | By Whom | By When |
|---|---|---|---|---|
| 1 | Gather additional information | Submit 1.0 $ft^3$ of media to the Water Plant Sand Company to determine the size range, uniformity coefficient, and condition of each type of media material. | Plant manager | 3/1/12 |
| | | Submit 1.0 $ft^3$ of media to Water Plant Reference Labs, Inc. to determine the composition of the material that appears to be deposited on the anthracite media. | Plant manager | 3/1/12 |
| | | Contact our consulting engineer to discuss potential solutions to Filter No. 5 problem. | Plant manager | 3/1/12 |
| | | Get a cost estimate for new media from the Water Plant Sand Company. | Plant manager | 3/5/12 |
| | | Staff meeting to identify other concerns about Filter No. 5 and to discuss possible changes in plant SOPs. | Plant staff | 3/5/12 |
| 2 | Modify SOPs | Backwash SOP: Limit production rate to a maximum of 9.6 MGD when backwashing a filter. | Shift supervisors and operator IIs | 3/15/12 |
| | | Plant start-up SOP: If the clearwell has more than 10 feet of water, backwash one of the filters before starting a production run. | | |
| | | Normal operations SOP: If possible, avoid operating plant above 9.6 MGD. | | |
| 3 | Submit report to the Board. | Develop report summarizing the historical filter performance for past three months, filter assessment results, and laboratory findings, and operational changes implemented to reduce IFE turbidity levels. | Plant manager | 4/5/12 |
| | | Staff Meeting to discuss findings, develop staff recommendations, and finalize the report. | Plant staff and general manager | 4/9/12 |
| | | Discuss the report conclusions (Filter No. 5 renovation; and the need for additional filtration capacity or three operating shifts) and the new SOPs with the Board President. | Plant manager and general manager | 4/11/12 |
| | | Request approval to renovate Filter No. 5. | Board meeting | 4/20/12 |

| Step No.: | Activity: | Description: | By Whom: | By When: |
|---|---|---|---|---|
| 4 | Rebuild Filter No. 5. | Purchase required media and gravel. | General manager | 5/15/12 |
| | | Remove old media and gravel. | contractor | 5/15/12 |
| | | Check condition of underdrain and repair if necessary. | Engineer and contractor | 6/1/12 |
| | | Install gravel and media. | Contractor with plant-manager inspection | 06/15/12 (see note) |

*Note:* If we cannot complete the renovation of Filter No. 5 by June 20, 2012, we must delay the project until the fall. Because we are currently limited to a 16-hour production day, we are unable to meet our maximum daily demand (which typically occurs in July or August) with only five filters.

# Appendix G:
# EXAMPLE OF A STANDARD OPERATING PROCEDURE FOR CONDUCTING A ROUTINE FILTER INSPECTION

This appendix contains an example of a standard operating procedure (SOP) based on an SOP developed by the staff at a surface water treatment plant (SWTP) in Texas. The SOP was developed during an on-site technical-assistance visit conducted as part of a TCEQ pilot project.

**IMPORTANT**
Do not use the example SOP until you have:

- reviewed the document
- customized the SOP to fit your specific plant;
- ensured that the SOP conforms with the existing standard operations, maintenance, and safety requirements of the water system;
- documented approval; and
- distributed it to plant staff.

# City of Aguaville Surface Water Treatment Plant (SWTP)
# EXAMPLE Standard Operating Procedure SOP No. 7
# ROUTINE FILTER INSPECTIONS

**Date Adopted:** September 23, 1999

**Date Revised:** January 7, 2012

**Background:** This example standard operating procedure (SOP) is Number 7 in a coordinated series of SOPs for operating the City of Aguaville SWTP. SOPs 1 through 6 would cover topics such as:

- Routine filter backwash procedure
- Turbidity monitoring
- Disinfection level monitoring

Every SWTP should have SOPs that are kept up to date. All the operators should use the SOPs. That is how you can ensure that things are done the same way each time.

**Reason for Revision:** To reformat the SOP and add a pre-backwash filter-inspection step, and some additional safety precautions, and insert Equation 7.3.

**Summary:** This SOP contains the procedures for conducting a routine filter inspection. The procedures for conducting a variety of special filter studies are found in other SOPs. The process for conducting a routine filter inspection requires at least two staff members and involves a series of steps:

1. preparing a filter diagram;
2. partially draining the filter and measuring the filtration rate;
3. observing the (pre-backwash) condition of the filter media surface;
4. looking for any unusual conditions during a routine filter backwash;
5. draining the filter;
6. observing the (post-backwash) condition of the filter media surface;
7. making several filter bed measurements, including
    a. the levelness of the filter media surface,
    b. the depth of the filter media, and
    c. the levelness of the support gravel and underdrain;
8. excavating the media to identify any unusual filter conditions;
9. backwashing the filter again to
    a. restratify the media and
    b. measure the bed expansion and backwash water flow rate at the maximum backwash rate; and
10. returning the filter to service.

## IMPORTANT

Use **extreme caution** to ensure operator safety, especially in the case of the large filters at Plant No. 2 where confined spaces and high backwash water flow rates exist. In addition, **extreme caution** is also required to prevent damage to the washwater troughs, filter underdrain and support gravel, and filter media.

Filter evaluations require a team of at least two licensed water works operators. At least one of the operators must hold a valid Class C Surface Water license.

**Failure to comply with the requirements of this SOP is grounds for disciplinary action up to and including termination.**

**Equipment Needed:**

One filter probe
One 1-inch wide tape measure or a 1-inch wide yardstick
Four 2 ft × 2 ft pieces of ¼-inch plywood
One 2 ft × 3 ft piece of ⅜-inch plywood
One stopwatch
One 8 ft to 10 ft length of 2 × 4
One 1 ft × 1 ft × 2.5 ft (H) plexiglass excavation box
One 2-inch diameter PVC filter-coring tool will be needed if special studies will be conducted following the routine inspection

## Procedure:

### Step 1—Prepare a Filter Diagram

Prepare a diagram of the filter showing the location of the filter inlets, outlets, and backwash trough. Although the diagram does not have to be exactly to scale, it is helpful if the diagram is drawn as large as possible and looks like the filter.

### Step 2—Partially Draining the Filter and Measuring Filtration Rate

1. Close the filter influent valve completely.
2. Leave the filter effluent valve open.
3. Record the filtered-water flow rate from the filter’s flowmeter.
4. Measure and record the amount of time that it takes for the water level to fall 6 inches. If possible, make this measurement while the water level is at least 6 inches above the top of the backwash trough. If the water level is not at least 6 inches above the top of the backwash trough, wait until the water level is below the top of the trough to begin the measurement.
5. Leave the filter effluent valve open until the water reaches the surface of the filter media.

*Step 2—Partially Draining the Filter and Measuring Filtration Rate, continued*

6. When the water reaches the surface of the filter media, take one of the two following actions:
    A. At Plant No. 1 (which does not have filter-to-waste facilities), leave the filter effluent valve open for three minutes after the water level reaches the surface of the filter media, and then completely close the valve.
    B. At Plant No. 2 (which does have filter-to-waste facilities):
        i. Completely close the filter effluent valve.
        ii. Open the filter-to-waste valve for eight minutes.
        iii. Completely close the filter-to-waste valve.
7. Determine and record the wetted surface area of the filter.
    A. If the drawdown was measured above the wash water trough, calculate the surface area of the filter.
    B. If the drawdown was measured below the top of the trough, determine the total area between the troughs.
8. Calculate the filtration rate using Equation 7.1 shown on the following page.
9. Compare the calculated filtration rate with the filtration rate shown on the filtered water flowmeter.

***Equation 7.1: Calculating the filtration rate***

$$\text{Filtration rate (gpm)} = \frac{\text{drawdown (inches)} \times \text{surface area (ft}^2\text{)} \times \left(\frac{\text{ft}}{\text{12 in}}\right) \times \left(\frac{\text{7.48 gal}}{\text{ft}^3}\right)}{\text{time (minutes)}}$$

$$= \frac{\text{drawdown (inches)} \times \text{surface area (ft}^2\text{)} \times 0.6233}{\text{time (minutes)}}$$

**IMPORTANT**

This part of the filter evaluation requires an operator to climb down into the filter. **Operators must take the following precautions to avoid injury and filter damage.**

1. At least two licensed operators must be present any time that an operator enters a filter. One of the operators must carefully enter the filter and make the measurements while the other remains outside the filter to record the data. Class D operators **may not** enter the filter.
2. Filter surfaces are often wet and slippery. Any operator who enters the filter must wear slip-resistant shoes.
3. We have designated all of the filters at Plant No. 2 as "confined spaces" because they are very deep filter boxes and some of them are partially covered. Consequently, any operator who enters those filters must:
   a. have a signed Confined Space Entry Request form prior to entering the filter,
   b. wear a safety harness, and
   c. be secured by a safety rope whenever he or she is inside the filter.
4. Operators are encouraged to take identical precautions when entering the filters at Plant No. 1.
5. Operators **must not** stand or walk in the fiberglass backwash troughs at Plant No. 1 because the troughs can be severely damaged.
6. The ¼-inch plywood boards **must** be used to distribute and support the weight of the operator whenever they are walking or standing on the filter media.

1. Lower the ladder into the filter using one of the following procedures:
   A. At Plant No. 1 (which uses lightweight fiberglass backwash troughs), the troughs **will not** support the weight of an individual. Consequently, the following procedure **must** be used on Filters No. 1–4:
   B. Lower the ⅜-inch plywood into the filter and place it directly on the filter media near the wall where the operator will enter. This board will then be used as the support footing for the ladder.
   C. Lower the ladder into the filter and center its feet on the piece of plywood.
   D. At Plant No. 2 (which has concrete backwash troughs), the troughs will support the weight of an individual. Consequently, when inspecting Filters No. 5–8, operators can either use the procedure described in item A above, or they can lower the ladder so that its feet are securely positioned directly in the backwash trough.

2. Secure the top of the ladder to the top of the filter or the filter railing using a strong rope or chain.
3. If a safety harness is being used, secure the end of the lanyard to the filter railing at a location where the operator standing outside the filter can reach it.
4. The operator who will be making the measurements must **carefully** enter the filter. The operator who will be recording the data **must** remain outside the filter as a safety precaution.
5. Lower the tape measure, the ¼-inch plywood pieces, the straight 2 × 4, and other equipment into the filter.
6. Observe the surface of the filter media for the following media conditions.
    A. **Thickness of the floc mat:** Measure the thickness of the floc mat at several locations throughout the filter.
    B. **Distribution of floc mat:** Specifically, look for areas where the floc has accumulated to an unusual depth or has not accumulated to the same degree as in the rest of the filter.
    C. **Mudballs:** Specifically, look for areas where mudballs appear to be accumulating on the surface of the media.
    D. **Significant media mounds or depressions:** Specifically, look for areas where the depressions or mounds exceed 1½ inches in depth or height.
    E. **Filter cracks:** Specifically, look for cracks that are more than 6 inches long, more than ¼-inch wide, or more than ½-inch or so deep. Some small cracks may form as the filter dewaters, but larger cracks suggest that the filter media has been coated with an excessive coagulant layer.
    F. **Separation from filter wall:** Specifically, look for areas where the media has separated from the wall more than ¼ inch, the length of the separation exceeds 6–8 inches, or the separation is more than 1 inch deep. Some separation from the filter wall may occur as the filter dewaters, but separations that exist before the filters dewater suggest that the filter media has been coated with an excessive coagulant layer.
7. On the filter diagram, record the location of any unusual conditions seen on the media surface and describe the condition in detail on a separate sheet of paper.
8. Remove any equipment that was taken into the filter.
9. Exit the filter and remove the ladder and the ¼-inch plywood piece if it was used.

### Step 4—Looking for Unusual Conditions during a Backwash Cycle

1. Make sure that none of the equipment used while observing the filter media surface during Step 3 remains in the filter.
2. Open the filter backwash valve **slightly** and allow that water to rise to 6–8 inches below the bottom of the backwash-water trough.

*Step 4—Looking for Unusual Conditions during a Backwash Cycle, continued*

3. Complete a routine backwash of the filter following the backwash procedure in the City's other SOPs describing routine filter backwash procedures. During the backwash cycle, observe the condition of the filter for the following unusual backwash conditions:
   A. **Levelness of the backwash trough:** Specifically, look at the top of the backwash water troughs to determine if water flows over some sections of the trough sooner than others.
   B. **Trough flooding:** Specifically, look for areas where flooding is occurring in one or more of the troughs.
   C. **Media boils and jets:** Specifically, look for areas where the backwash is producing a significantly more vigorous rolling action in the media. Pay particular attention to areas along the filter wall.
   D. **Media loss:** Specifically, look for media carryover into the backwash water troughs. Pay particular attention to areas where the carryover appears to be localized.
   E. **Lack of media agitation:** Specifically, look for areas where the media is moving very little. Again, pay particular attention to the areas along the filter wall and in the corners of the filter.
4. Record the location of any undesirable backwash conditions on the filter diagram, and describe the condition in detail on a separate sheet of paper.
5. Record the turbidity level of the spent backwash water at the end of the backwash cycle.

**Step 5—Draining the Filter**

1. Make sure that the influent and filter backwash are completely closed.
2. Open the filter effluent valve and wait approximately 45 minutes to allow the filter to completely discharge to the clearwell.
3. At Plant No. 2 (which is equipped with filter-to-waste facilities), open the filter-to-waste valve after 15 minutes.

**Step 6—Observing the (Post-Backwash) Surface of the Filter Media**

1. Repeat the filter-surface-inspection process described in Step 3.
2. Using the filter diagram, record the location of any unusual conditions seen on the media surface, and describe the condition in detail on a separate sheet of paper.

**Step 7—Filter-Bed Measurements**

**IMPORTANT**

**Avoid injury; be safe. This part of the filter evaluation requires an operator to climb down into the filter. Operators must take the following precautions to avoid injury and filter damage.**

1. At least two licensed operators must be present any time that an operator enters a filter. One of the operators must carefully enter the filter and make the measurements while the other remains outside the filter to record the data. Class D operators may not enter the filter.
2. Filter surfaces are often wet and slippery. Any operator who enters the filter must wear slip-resistant shoes.
3. We have designated all of the filters at Plant No. 2 as “confined spaces” because they are very deep filter boxes and some of them are partially covered. Consequently, any operator who enters those filters must:
   a. have a signed Confined Space Entry Request form prior to entering the filter,
   b. wear a safety harness, and
   c. be secured by a safety rope whenever he or she is inside the filter.
4. Operators are encouraged to take identical precautions when entering the filters at Plant No. 1.
5. Operators **must not** stand or walk in the fiberglass backwash troughs at Plant No. 1 because the troughs can be severely damaged.
6. The ¼-inch plywood boards **must** be used to distribute and support the weight of the operator whenever they are walking or standing on the filter media.

1. Close the filter effluent valve.
2. Lower the ladder into the filter using one of the following procedures:
   A. At Plant No. 1 (which uses lightweight fiberglass backwash troughs), the troughs **will not** support the weight of an individual. Consequently, the following procedure **must** be used at Plant No. 1:
      i. Lower the ⅜-inch plywood into the filter and place it directly on the filter media near the wall where the operator will enter. This board will then be used as the support footing for the ladder.
      ii. Lower the ladder into the filter and center its feet on the piece of plywood.
   B. At Plant No. 2 (which has concrete backwash troughs), the troughs will support the weight of an individual. Consequently, the operators can either use the procedure described in item A above, or they can lower the ladder so that its feet are securely positioned directly in the backwash trough.
3. Secure the top of the ladder to the top of the filter or the filter railing using a strong rope or chain.
4. If a safety harness is being used, secure the end of the lanyard to the filter railing at a location where the operator standing outside the filter can reach it.
5. The operator who will be making the measurements must **carefully** enter the filter. The operator who will be recording the data **must** remain outside the filter as a safety precaution.
6. Lower (do not drop) the filter probe, the straight 2 × 4, the ¼-inch plywood pieces, and other equipment into the filter.

**Notes**

1. Lay the straight 2 × 4 across the tops of adjacent troughs so that it spans the space between the troughs and provides a reference point for the measurements between the filter troughs.
2. Operators **must not** stand or walk directly on the surface of the filter media.
   a. At Plant No. 1 (which has fiberglass troughs), the operator **must** conduct the procedure while standing on the ¼-inch plywood pieces placed directly on the filter bed.
   b. At Plant No. 2 (which has concrete backwash troughs), the operator can either make the measurements while standing and walking in the troughs or by using the method described for plant No. 1 above. However, if the operator cannot reach the area between the troughs, the Plant No. 1 method must be used.

7. Keeping the probe perpendicular, probe the filter at two-foot intervals.
   A. Determine the levelness of the media surface by measuring the distance from the top of the filter trough to the surface of the media.
      i. Lower the probe until it just touches the top of the filter media.
      ii. Record the distance (to the nearest inch or less) directly on the filter diagram.
   B. Measure the depth of the media bed to the top of the gravel support layer or, if the filter uses a gravel-less underdrain, to the top of the underdrain.

**IMPORTANT:**
Do not push the probe into the gravel layer. Be **extremely** careful not to press the probe so far down that it damages the filter underdrain.

      i. Press the probe down into the media until a change in resistance is felt or until the sound of the probe passing through the media changes.
      ii. Record the depth (to the nearest inch or less) directly on the filter diagram.
8. Determine levelness of the support gravel/underdrain.
   A. Either:
      i. measure the distance from the top of the backwash trough to the surface of the support gravel or gravel-less underdrain; or
      ii. measure the depth of the media layer and the distance from the media surface to the top of the backwash trough and add the two readings.
   B. Record the result directly on the filter diagram.
9. Reduce the interval if significant differences are detected between adjacent measurements for either (1) the distance to the media surface, or (2) the media depth.
   A. If the distance or depth between adjacent measurements varies by more than 2 inches vertically, make an additional set of measurements at the midpoint of the two points.
   B. If the distance or depth continues to vary by more than two inches vertically, continue to measure at midpoints until the distance between the measurements is only three inches horizontally.
10. Probe the filter at each site where an undesirable filter backwash or media-surface condition was identified.

**Step 8—Excavating the Filter**

**IMPORTANT:**

**Be safe. Operators must take some extremely important precautions to avoid injury and filter damage.**

1. Operators must comply with all of the safety requirements described in Step 7.
2. Do not disturb the gravel support bed when excavating the media at each site.
    a. Excavation at each site must be stopped as soon as the operator detects small gravel (that is, ¼- to ⅛-inch gravel).
    b. The upper 75% of the filter bed can be excavated by hand or with a small shovel.
    c. The lower 25% of the filter bed **must** be excavated by hand.
3. Do not walk or stand directly on the filter media.
4. If the filter design does not allow the filter to be completely drained, do not attempt excavation below the remaining water level without an excavation box.

**Notes:**

1. During the filter excavation, note and record the following information:
    a. If mudballs are present, note their size and shape and how far they have penetrated into the media bed.
    b. If the filter contains more than one type of media, note how distinct the interface is between the different media layers, that is, the degree of stratification.
    c. If the filter contains more than one type of media, note how much intermixing of the media layers is present.
2. If the excavation cannot be completed because of the presence of subsurface standing water or other conditions that cause the walls of the excavation hole to collapse, it may be useful, or even necessary, to use the excavation box. **Do not force the excavation box so deep that it penetrates into the gravel layer.**

1. Make sure that all of the filter bed measurement activities required in Step 7 have been completed.
2. Place the ¼-inch plywood pieces on the filter media about a foot from the area to be excavated.
3. Clean a 3 $ft^2$ area on the opposite side of the excavation site by scraping off the top ¼-inch of filter media and placing it in a pile on one end of the scraped area.
4. Excavate a 6- to 8-inch diameter hole in the filter bed.
5. Excavate the top 3 to 6 inches of the media bed.
    A. If mudballs are present, note their size and shape and the depth of penetration.
    B. Place the excavated media in a pile at one end of the scraped area.
6. Excavate the remainder of the upper media layer.
7. If mudballs are present, note their size and shape and the depth of penetration. For example, “pancake-shaped mudballs with a diameter of ½ to ¾ inches have penetrated three inches into the anthracite layer.”
8. Place this layer of excavated media in a pile adjacent to the previous pile.

*Step 8—Excavating the Filter, continued*

9. If the filter contains multiple media materials, describe the interface between the layers. For example, “14 inches of clean anthracite is located above a 2-inch layer of intermixed sand and anthracite that contains about 40% sand and 60% anthracite.”
10. If the filter bed contains more than one media layer, continue the excavation—that is, repeat step 5 until all the layers between the surface of the media and the upper gravel layer have been excavated and described.

**IMPORTANT:**
Stop the excavation as soon as the samples contain more than about 10% gravel; **do not** excavate the gravel layer.

11. Replace the media after completing the excavation.
    A. Return the media to the hole in the opposite order that it was removed. That means last out = first in.
    B. Pack each layer slightly by hand as it is replaced.
    C. If there is media left over after filling the excavation hole, spread it around in the general area of the excavation site and the cleared area.
12. Repeat steps 1–7 in each area where unusual backwash or media conditions were observed or noted during the media probing.
13. Collect “Core Samples” as described in the SWTP's other SOPs that describe how to perform special filter studies if any special studies are to be conducted on the filter media.
14. Remove the filter probe, tape measure, plywood squares, and any other equipment from the filter.
15. Close the filter-to-waste valve.

**Step 9—Measuring Bed Expansion and Backwash Water Flow Rate**

**IMPORTANT**

During the backwash process, large volumes of water are used and high water velocities exist in the backwash troughs and spent backwash water channel. Consequently, whenever possible, the evaluation team should collect the data required in this step without being in the filter during the backwash cycle. **However, if an operator needs to be in the filter during a backwash cycle, the following precautions must be taken to avoid injury.**

1. At least two licensed operators must present any time that an operator enters a filter. One of the operators must carefully enter the filter and make the measurements while the other remains outside the filter to record the data. Class D operators may **not** enter the filter.
2. Filter surfaces are often wet and slippery—any operator who enters the filter must wear slip-resistant shoes.
3. Any operator who is inside the filter box during a backwash procedure must wear a safety harness that is securely anchored to the filter wall or some other similarly immovable object. The lanyard, or safety rope, must be short enough to prevent the operator from becoming submerged in the filter bed, backwash trough, or spent backwash water channel.
4. Operators must stand at a location that will minimize the possibility of injury of filter damage.
   a. At Plant No. 1, the operators must stand on the top of the wall of the spent-backwash-water channel. Operators **must not** stand on the top of fiberglass backwash troughs at Plant No. 1 because they can be severely damaged.
   b. At Plant No. 2, the operator may either stand on the top of the wall of the spent-backwash-water channel or on the top of a backwash trough where it connects to the wall of the filter box.

1. Make sure that all of the filter excavation activities required in Step 8 have been completed.
2. The operator who will be making the measurements must get the Secchi disk. The operator who will be recording the data **must** remain outside the filter as a safety precaution.
3. Find a place to stand that has good footing, and use the lanyard to secure the safety harness to the filter wall or other similarly immovable object.
4. Remove the ladder and the ⅜-inch plywood piece if it was used.
5. Complete a routine backwash of the filter following the backwash procedure in this example facility's SOP for routine filter backwash procedures.
6. Determine if there are still any unusual backwash conditions that were observed in Step 4. If there are, record their location on the filter diagram.
7. Measure the height of the expanded media bed at the maximum backwash flow rate routinely used during the backwash cycle.
   A. Lower a Secchi disk into the filter media until a small amount of filter media from the expanded bed begins collecting on the top of the disk.
   B. Measure the distance from the top of the filter wall to the surface of the fluidized (that is, expanded) media bed.
   C. Record the result on the filter diagram.

*Step 9—Measuring Bed Expansion and Backwash Water Flow Rate, continued*

8. Measure the maximum backwash-water flow rate routinely used to backwash the filters.
    A. At the maximum backwash-water flow rate, record the flow rate that is being shown on the backwash-water flowmeter.
    B. At the maximum backwash-water flow rate, close the backwash waste drain valve.
    C. Measure and record the amount of time that it takes for the water level to rise 6 inches.
    D. Open the backwash waste valve.
9. Complete the backwash cycle as described in the WSC's routine filter backwash SOP.
10. Return the filter to service using the procedure described in the WSC's routine filter backwash SOP.
11. Measure the height of the unexpanded filter bed using the same process as described in item 7.
12. Lower the ladder into the filter using one of the following procedures:
    A. At Plant No. 1 (which uses lightweight fiberglass backwash troughs), the troughs **will not** support the weight of an individual. Consequently, the following procedure **must** be used on Filters No. 1–4:
        i. Lower the ⅜-inch plywood into the filter and place it directly on the filter media near the wall where the operator will enter. This board will then be used as the support footing for the ladder.
        ii. Lower the ladder into the filter and center its feet on the piece of plywood.
    B. At Plant No. 2 (which has concrete backwash troughs), the troughs will support the weight of an individual. Consequently, when inspecting Filters No. 5–8, operators can either use the procedure described in item A above, or they can lower the ladder so that its feet are securely positioned directly in the backwash trough.
13. Secure the top of the ladder to the top of the filter or the filter railing using a strong rope or chain.
14. Take the Secchi disk, carefully exit the filter, and remove the ladder and the ⅜-inch plywood piece if it was used.
15. Calculate backwash water flow rate using equation 7.2.

***Equation 7.2: Calculating the backwash water flow rate***

$$\textit{Backwash rate (gpm)} = \frac{\textit{rise (inches)} \times \textit{surface area } (ft^2) \times \left[\frac{ft}{12\ in}\right] \times \left[\frac{7.48\ gal}{ft^3}\right]}{\textit{time (minutes)}}$$

$$= \frac{\textit{rise (inches)} \times \textit{surface area } (ft^2) \times 0.6233}{\textit{time (minutes)}}$$

*Step 9—Measuring Bed Expansion and Backwash Water Flow Rate, continued*

Calculate the percent bed expansion using equation 7.3.

***Equation 7.3: Calculating the percent bed expansion***

$$\%\ Expansion = \frac{\text{“height” of unexpanded bed (inches)} - \text{“height” of expanded bed (inches)}}{\text{total depth of media bed (inches)}} \times 100$$

------ End of Example SWTP SOP No. 7—Routine Filter Inspections -----

# Appendix H:
# EXAMPLE OF A COMPLETED CPE-REQUEST FORM

# COMPREHENSIVE PERFORMANCE EVALUATION REQUEST FORM

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER THAT ARE REQUIRED TO CONDUCT A COMPREHENSIVE PERFORMANCE EVALUATION

PUBLIC WATER SYSTEM NAME: Aguaville WSC PWS ID No.: 9876543

PLANT NAME OR NUMBER: Schulze Surface Water Treatment Plant

**EVENTS THAT TRIGGERED THE CPE REQUEST**

| | EVENT NUMBER 1 | | EVENT NUMBER 2 |
|---|---|---|---|
| Filter Number: | 5 | Filter Number: | 3 |
| Date of Event: | April 5, 2011 | Date of Event: | May 13, 2011 |
| FAR Prepared? | | FAR Prepared? | |
| CAP Prepared? | | CAP Prepared? | |

**PUBLIC WATER SYSTEM PREFERENCES**

PREFERRED DATES FOR CPE:

(1) Week of: June 10, 2011
(2) Week of: June 17, 2011
(3) Week of: July 15, 2011

| ADMINISTRAVE CONTACT INFORMATION: | | PLANT CONTACT INFORMATION: | |
|---|---|---|---|
| Name: | Haile Paide | Name: | Mas Papeleo |
| Title: | General Manager | Title: | Plant Superintendent |
| Phone: | (123) 456-7890 | Phone: | (123) 456-8907 |
| Fax: | (123) 456-7809 | Fax: | (123) 456-7809 |
| Address: | Aguaville WSC<br>RR 4, Box Z<br>Aguaville, TX 78900 | Address: | Aguaville WSC<br>RR 5, Box A<br>Aguaville, TX 78900 |

I certify that I am familiar with the information contained in this report and that, to the best of my knowledge, the information is true, complete, and accurate.

Operator's Signature: ______________ Date: May 12, 2011

Name (printed): Haile Paide

If applicable, Certificate No. and Class: NA

The request must be submitted with your Monthly Operational Report and a copy should be faxed to the Drinking Water Section at (512) 239-6050 as soon as it is signed.

TCEQ/WSD/Public

Reserved for TCEQ Use Only

TCEQ - 10278 (01-22-02) CPE Request Form