Tyco Fire Products LP

PWSA Drinking Water Update

Potable Well Sampling Area Drinking Water Update
Tyco Fire Technology Center
2700 Industrial Parkway South
Marinette, WI 54143
BRRTS# 02-38-580694

September 27, 2022

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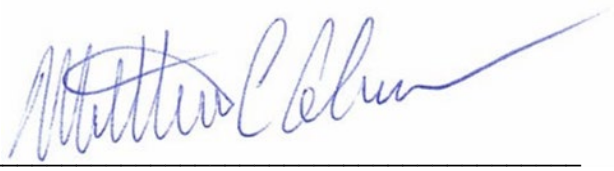

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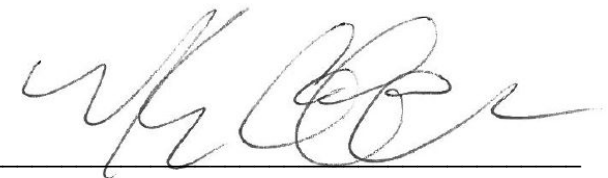

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Contents

Tables

Figures

Appendix

Acronyms and Abbreviations

AMSL	above mean sea level
Arcadis	Arcadis U.S., Inc.
bgs	below ground surface
FTC	Fire Technology Center
FOSA	perfluorooctanesulfonamide
H.E.	high efficiency
gpm	gallons per minute
pCi/L	picocuries per liter
PFAS	per- and poly-fluoroalkyl substances
PFOS	perfluorooctanesulfonic acid
POET	point-of-entry treatment
PWS	Public Water System
PWSA	Potable Well Sampling Area
R.O.	reverse osmosis
RAOR	Remedial Action Options Report
the Site	Fire Technology Center, 2700 Industrial, Parkway South in Marinette, Wisconsin
Tyco	Tyco Fire Products LP
USEPA	United States Environmental Protection Agency
WDNR	Wisconsin Department of Natural Resources
Wis Adm Code	Wisconsin Administrative Code
µg/L	micrograms per liter

Executive Summary

Tyco Fire Products LP (Tyco) continues to investigate per- and poly-fluoroalkyl substances (PFAS) potentially related to the Tyco Fire Technology Center (FTC) located at 2700 Industrial Parkway South in Marinette, Wisconsin (the Site). Since 2017, drinking water in an area southeast of the Site has been addressed on an interim basis by point-of-entry treatment systems and bottled water. Tyco is working with affected residents within the area to implement their preferred long-term drinking water solutions, namely new deep drinking water wells and potential extension of City of Marinette municipal water into part of the area.

This document presents a deep aquifer drinking water well design based on Wisconsin Administrative Code (Wis Adm Code) requirements and data collected as part of site investigation activities. This document also summarizes stakeholder outreach and feedback to date.

The proposed wells are planned to extend approximately 450 to 500 feet below ground surface (bgs) and tap into a deep bedrock aquifer that underlies the Marinette area. This water producing zone is below the vertical extent of the PFAS plume associated with the Site (Arcadis 2020) and is protected from future contamination by an aquitard in shallow bedrock. The private residential water supply wells will be constructed with the addition of an extended surface casing to prevent cross-contamination from the shallow aquifer system. Specifications will meet or exceed Wis Adm Code NR 812 for water supply wells. Each new well connection will be supplied with a high-efficiency water softener, a sediment filter, and an under-the-sink reverse osmosis (RO) treatment system for the kitchen. Each new well will be tested for PFAS and secondary water quality parameters (listed in **Section 3.4**) prior to and after connection to the residence, along with two additional sampling events for PFAS (a total of 4 sampling events over the course of one year). Long-term monitoring of the aquifer will be provided by a series of sentinel wells to safe-guard groundwater users against potential future changes in groundwater quality (Arcadis 2022c).

1. Introduction

On behalf of Tyco Fire Products LP (Tyco), Arcadis U.S., Inc. (Arcadis) prepared this Potable Well Sampling Area (PWSA) Drinking Water Update to describe and present the proposed deep aquifer bedrock well design that will replace existing private drinking water wells with new wells constructed into an aquifer that is not impacted by per- and poly-fluoroalkyl substances (PFAS) related to the Fire Technology Center located at 2700 Industrial Parkway South in Marinette, Wisconsin (Site) (**Figure 1**). This solution will provide residents and businesses in the area with a safe and reliable long-term source of drinking water. The PWSA described in this report includes the area shown on **Figure 1** south and southeast of the Site in the Town of Peshtigo. To date, PFAS-impacted drinking water has been addressed on an interim basis by point-of-entry treatment systems and bottled water. At the time of this report, some sections of the PWSA are considering a different long-term drinking water solution that includes annexation by the City of Marinette and expansion of the Marinette Municipal Water System.

1.1. Objectives

The objectives of constructing private bedrock wells in the PWSA are to accomplish the following:

- Eliminate the potential drinking water exposure pathway for potentially Site-related PFAS at existing homes and businesses within the PWSA.
- Provide an appropriate, safe, long-term drinking water supply for existing homes and businesses within the PWSA.

2. Background

The Site is a fire suppressant training, testing, research and development facility, occupying approximately 380 acres in southern Marinette. Background information relevant to this work plan is summarized below. More comprehensive background information is available in prior reports, most recently the Additional Site Investigation Work Plan (Arcadis 2022a).

2.1. Interim Drinking Water Solution

In 2017, Tyco completed site investigations that showed PFAS had migrated in shallow groundwater off-site to the northeast, east and southeast of the Site into parts of the City of Marinette and the Town of Peshtigo. Based on these data, Tyco initiated a potable well sampling program of approximately 140 private wells and offered cases of bottled water and bottled water services to community members within the area then defined as the PWSA. As sample analyses were completed, Tyco offered point-of-entry treatment (POET) systems to those locations where PFAS was detected and confirmed in potable well samples at concentrations exceeding the United States Environmental Protection Agency (USEPA) Lifetime Health Advisory Level. Working in conjunction with the Wisconsin Department of Natural Resources (WDNR), Tyco expanded the PWSA in January 2018, and began offering a POET system to any potable well with a confirmed detection of perfluorooctanoic acid (PFOA) or perfluorooctanesulfonic acid (PFOS) above the laboratory reporting limits for these compounds.

POET systems were installed in 47 locations within the PWSA and Tyco has tested 173 private wells. Currently 46 POET systems remain in use, and 166 potable wells within the PWSA are sampled as outlined in the Revised Long-Term Potable Well Sampling Plan (Arcadis 2021) that was approved by WDNR.

2.2. Remedial Action Options Report

While POET systems and routine monitoring have provided a safe interim approach to prevent PFAS exposure via drinking water to community members in the PWSA, the approach is a temporary solution. Tyco began evaluating long term drinking water solutions in 2018. Arcadis submitted a Remedial Action Options Report (RAOR) in May 2019 (Arcadis 2019a). In July of 2019, WDNR provided Tyco with feedback on the initial submission of the RAOR, which Tyco addressed in an updated RAOR submitted in September 2019 (Arcadis 2019b). The revised RAOR included an additional analysis of the City of Peshtigo as a source for the drinking water, evaluated water supply alternatives and provided conceptual-level information for comparison of the alternatives.

The RAOR evaluated a preliminary list of eight drinking water supply alternatives:

- **City of Marinette Public Water System (PWS) Expansion** - Connect residences in the PWSA to an expanded City of Marinette PWS as direct customers.
- **City of Peshtigo PWS Expansion** - Connect residences in the PWSA to an expanded City of Peshtigo PWS as direct customers.
- **Town of Peshtigo Sanitary District connected to City of Marinette PWS** - Develop a Town of Peshtigo Sanitary District, with a Public Water Distribution System operated and maintained by the Town of Peshtigo and connected to the City of Marinette Public Water Utility for purchasing water through a master water meter.

- **Town of Peshtigo Sanitary District connected to City of Peshtigo PWS** - Develop a Town of Peshtigo Sanitary District, with a Public Water Distribution System operated and maintained by the Town of Peshtigo and connected to the City of Peshtigo Public Water Utility for purchasing water through a master water meter.
- **Town of Peshtigo Public Water System** - Establish a new PWS for the PWSA with the source of water from new deep wells or Lake Michigan, and a new public water treatment system.
- **Private Special Casing Deep Water Supply Wells** – Replace existing private wells with new deep bedrock wells with sufficient casing to protect against leakage from the shallow aquifer.
- **Existing Private Wells with POET Systems** – Maintain current temporary treatment systems and existing private wells.
- **Combination of Water Supply Methods.**

Within the RAOR, the initial list of eight alternatives was screened down to the five that were determined to be the most feasible for providing a safe and reliable long-term drinking water supply within a reasonable period of time. The five selected alternatives were 1) Marinette PWS expansion, 2) City of Peshtigo PWS expansion, 3) Town of Peshtigo Sanitary District connecting to Marinette PWS, 4) Town of Peshtigo Sanitary District connecting to City of Peshtigo PWS, and 5) deep replacement wells.

The RAOR further evaluated the five selected alternatives against a range of selection criteria relating to their efficiency to implement, water quality and quantity, and long-term viability. Based on this assessment, the RAOR identified expansion of the City of Marinette Public Water System Expansion as the most favorable option. Deep replacement wells were also found to be a viable alternative but were ranked lower than extension of the existing City of Marinette public water service due to the additional effort required to site, drill, and monitor those wells, in addition to the anticipated need for household water treatment systems such as water softeners to address naturally occurring minerals in groundwater.

2.3. Outreach Efforts (2019-2021)

After Tyco submitted the RAOR, Tyco organized public outreach activities, including numerous meetings and other interactions with relevant stakeholders. These efforts included the submittal of preliminary construction plans for expansion of the City of Marinette's waterline to the Town of Peshtigo in the fall of 2019. Tyco agreed to reimburse the costs for consultants and environmental attorneys to review these designs for both the City of Marinette and the Town of Peshtigo. In addition to submitting the RAOR to WDNR, Tyco also communicated its proposal and financial commitment to the community. Tyco sent information to residents in the PWSA via direct mailings and placed announcements in local newspapers. Tyco representatives also participated in over 100 municipal and private residential meetings, and Tyco conducted an informal survey of 163 residents.

Tyco also provided funding for municipalities to independently study the long-term water solution options and participate in a facilitation regarding the long-term water solution described in more detail in the section below. For example, in June 2019, Tyco paid for the Town of Peshtigo to retain an expert consultant (Cedar Corporation) to review and provide feedback on the RAOR. Tyco also entered into a reimbursement agreement with the Town of Peshtigo to reimburse the costs of its legal counsel's review of the revised RAOR options. Tyco further agreed to reimburse the City of Marinette's costs for attorneys and consultants to review the RAOR.

Tyco also provided various opportunities for residents in the PWSA to learn more about the options through small group listening sessions and several large community meetings in February 2020 (before the COVID-19 pandemic curtailed these in-person outreach efforts). Tyco also maintained a website specifically designed to provide updates and information regarding its work in Marinette, including the work on the long-term drinking water supply.[1]

After no additional engagement by the Town of Peshtigo, Tyco sent a request in February 2021 to the Town of Peshtigo Board of Supervisors requesting the opportunity for Tyco and its technical experts to present an update on the steps necessary for implementing a long-term solution at a Town of Peshtigo public meeting. In the early summer, Tyco again requested multiple times and ultimately received, an invitation to attend a Town of Peshtigo public meeting to answer questions and provide information on a long-term, drinking water solution. On July 27, 2021, Tyco representatives participated in this meeting, answered questions and provided detailed follow-up responses to questions in writing.

In two letters on March 17, 2021 and April 13, 2021, Tyco requested that DNR get involved in catalyzing action towards the provision of a long-term water solution. Specifically, in an April 13, 2021 letter, Tyco requested that the DNR select a neutral facilitator to advance negotiations between the parties, and Tyco agreed to cover the associated costs. The DNR agreed and selected a facilitator in the summer of 2021.

The same summer, on July 6, 2021, the City of Marinette Common Council passed a resolution stating that "The City of Marinette is not interested in providing municipal water service or wholesale water to the Town of Peshtigo" and recommending that the Town of Peshtigo explore other options for obtaining water service for Town residents. In July and August of 2021, Tyco made statements at City of Marinette Common Council meetings asking the City to reconsider its resolution, but the City of Marinette reaffirmed its resolution on August 4, 2021. The City of Marinette, however, agreed to participate in the facilitation between the interested parties.

The Facilitation lead by the DNR-selected facilitator took place soon thereafter and included representatives from Tyco, the Town of Peshtigo, the City of Peshtigo, the DNR, and the City of Marinette. In addition, Tyco signed a new reimbursement agreement for continued technical and legal support for the Town of Peshtigo in September 2021. Pursuant to this Reimbursement Agreement, the Town of Peshtigo hired an environmental consultant (Strand) to conduct an additional independent evaluation of long-term solutions identified by the Town of Peshtigo. Tyco also reimbursed the City of Peshtigo's legal fees and technical fees to participate in the water solution facilitation and consider the feasibility of providing municipal water to the Town of Peshtigo. To date, Tyco has paid over $300,000 in technical and legal consultant fees for the City of Marinette, Town of Peshtigo, and City of Peshtigo related to consideration of the long-term water solution. Based on the facilitated discussions and the results of the many studies of water options, including the Town of Peshtigo's Strand report, Tyco focused on four potential options for a long-term solution: (1) municipal water from the City of Marinette, which would require annexation; (2) deep wells; (3) a hybrid of options 1 and 2; and (4) municipal water from the City of Peshtigo and began extensive efforts to obtain PWSA owner input on their preferred option.

[1]https://tycomarinette.com

2.4. Recent Outreach Efforts (2022)

Tyco announced its intention to speak directly to PWSA residents about four long-term water options in late February 2022 via an advertisement placed in the two local newspapers, as well as a mailing sent directly to PWSA residents, which included a fact sheet on each option. From early March to early May 2022, Tyco reached out to the owners in the PWSA and spoke to 75% of residents either by phone or in person to answer questions and get input on their preferences. During this time, Tyco also ran two advertisements in area newspapers answering frequently asked questions about the options. In late May 2022, Tyco ran an advertisement in the two area newspapers and sent a letter to PWSA residents sharing that PWSA owner feedback identified deep wells and City of Marinette water via annexation as the top two long-term water solution options. The advertisements and letters also announced that Tyco would pay 20 years of new costs associated with either option, and that Tyco planned to conduct additional research on the best approach to deep wells. It was also shared that a PWSA resident was planning to meet with neighbors to discuss options including possible annexation of part of the PWSA. During the summer of 2022, residents shared additional feedback with Tyco and spoke with the resident organizer about annexation. Ultimately, Tyco heard from about 90% of PWSA residents. In mid-August 2022, Tyco placed an advertisement and sent letters to PWSA residents about the progress being made in implementing the two possible solutions and announcing that new well agreements would be sent in September 2022 to residents outside the area considering annexation.

In sum, Tyco's extensive 2022 community outreach included: communicating directly with almost all PWSA residents, three mailings, five ads, five fact sheets, and all key information posted on tycomarinette.com. Additionally, senior Tyco leadership were interviewed by local radio and newspapers, which resulted in multiple stories about the process.

2.5. Current Viable Long-term Water Supply Options

After multiple years of technical research and community dialogue, the feasible long-term water supply options preferred by owners in the PWSA are (1) City of Marinette Municipal Water, and (2) Deep (Bedrock) Replacement Wells. Annexation to the City of Marinette is required in order for residents to receive City of Marinette municipal water (City of Marinette Code of Ordinances 7.0129). Tyco's outreach efforts to citizens in the PWSA demonstrated that there may be sufficient interest to achieve annexation of part of the PWSA, but there is not sufficient interest to annex the entire PWSA[2]. As a result, Tyco anticipates that in any area that is not annexed to the City of Marinette, Tyco will install deep bedrock replacement wells as a long-term solution. And if an annexation effort is unsuccessful, Tyco will also provide deep bedrock replacement wells to that part of the PWSA.

[2] Before a petition for annexation can be presented to a City, the petition must be signed by the number of qualified electors residing in the area equal to at least the majority of the votes cast for governor in the area in the last gubernatorial election and either the owners of 50% of the land in the area or the owners of 50% of the assessed value in the area. See Wis. Stat. § 66.0217 (3).

3. Conceptual Approach for Private Bedrock Supply Wells

Deep sedimentary bedrock units are a known reliable source of drinking water in Marinette County and surrounding areas, forming the primary water supply for the cities of Peshtigo and Oconto and other smaller communities. This same deep bedrock aquifer is present beneath the PWSA, however, it is rarely used by private wells because (1) the overburden sand aquifer offers a sufficient water supply, and (2) it costs significantly more to drill wells into the deep aquifer at depths of 400 to 500 feet below ground surface (bgs). While PFAS is known to be present in the overburden aquifer in the PWSA, all evidence indicates that the deep aquifer remains unimpacted and that it is protected from future contamination by at least 200 feet of effectively impermeable strata in shallower bedrock. Replacement wells completed into the deep bedrock aquifer therefore offer a safe and effective long-term drinking water solution for residents in the PWSA.

To validate this approach, Tyco evaluated data to test its key assumptions. The data evaluations are provided in the Deep Aquifer Bedrock Well Design and Long-Term Monitoring Plan (Arcadis 2022c) and in the sections below. Findings based on the evaluated data include:

- **The deep aquifer is hydraulically separated from impacted shallow groundwater**. Replacement wells must draw water from a deeper aquifer that is hydraulically separated from overburden and shallow bedrock where PFAS may be present. Wells must also be constructed with permanent casings installed to prevent potential downward leakage within the wellbore.
- **Groundwater quality of the deep aquifer is suitable for drinking**. Groundwater in the deep aquifer must be of good quality for drinking and general household use, without potentially harmful constituents or cosmetically unpleasant characteristics that cannot be addressed with routine household water treatment.
- **The deep aquifer will provide a sufficient quantity of groundwater for household use.** Replacement wells must be constructed in an aquifer with reliable groundwater yield, sufficient for normal household uses.

A summary of previous studies and regional information addressing these topics is provided in the following sections.

3.1. Geologic Studies

The geology in the Marinette and Peshtigo area comprises unconsolidated glacial deposits overlying at least 700 feet of sedimentary bedrock consisting of dolomite, shale and sandstone. The current understanding of the geology is based on multiple resources including regional literature, well-driller and lithologic descriptions available in State of Wisconsin databases including the WiscLith database maintained by the Wisconsin Geological and Natural History Survey and drilling and geophysical logging completed by Tyco.

Based on these sources, the major components of the subsurface geology can be summarized as follows:

Summary of Geologic Units

Period	Lithology/Formation	Description and Approximate Thickness
Quaternary	Glacial Deposits	Mostly sand, with layers of silt and clay; till typically above bedrock surface. Highly permeable in sand zones. 30 to 125 feet thick.
Ordovician	Sinnipee Group (Galena, Decorah, and Platteville Formations)	Dolomite and shale. Unfractured to sparsely fractured with no significant permeability except at immediate bedrock surface. Up to 200-feet thick
	Ancell Group (Glenwood and St Peter Formations)	Sandstone with shale and dolomite. 25 to 50 feet thick
	Prairie du Chien Group	Mostly dolomite, with minor sandstone and shale. Vuggy and permeable near base of unit. 200 to 250 feet thick.
Cambrian	Trempealeau, Tunnel City and Elk Mound Groups	Mostly sandstone and dolomite, up to 500 feet thick. Portions highly permeable.
Precambrian	Crystalline rock	Igneous and metamorphic rocks. Negligible permeability.

Site-specific and regional evidence show that the bedrock of the Sinnipee Group acts as a major aquitard that permits no significant vertical transmission of groundwater from the overburden to the deeper aquifer. Available data also show that the first zone of significant groundwater production in the deep aquifer system is a 50-foot-thick zone of pitted and vuggy dolomite, interpreted to belong either to the basal Prairie du Chien or Trempealeau Groups. Regional geology and hydrostratigraphy, bedrock well drilling and logging results, and irrigation well profiling are all summarized in the Deep Aquifer Bedrock Well Design and Long-Term Monitoring Work Plan (Arcadis 2022c). The information summarized above and in the Deep Aquifer Bedrock Well Design and Long-Term Monitoring Work Plan demonstrates that the deep aquifer is hydraulically separated from impacted shallow groundwater, and the deep aquifer will provide a sufficient quantity of water for household use.

3.2. Municipal Usage of Deep Aquifer

The primary source of drinking water for many municipalities in Northeast Wisconsin is groundwater drawn from wells open to bedrock aquifers comprising the same or similar strata as the deep bedrock aquifer beneath the

PWSA. The high quality of bedrock groundwater in this region is demonstrated by the results of regular testing of those municipal wells, and the limited treatment required under Wis. Adm. Code including NR 108, NR 809, NR 810, and NR 811. The table below summarizes the municipal systems in Wisconsin closest to the PWSA.

Municipal Deep Well Water Supply Systems near PWSA

Municipality	Well ID | Depth[3]	Nature of Aquifer(s)[4]	Water Treatment Requirements[5]
Peshtigo Waterworks	2 | 695 3 | 650 4 | 720	Ordovician dolomite, Cambrian sandstone and dolomite	• Filtration (pressure sand) – iron and radionuclide removal • Permanganate – iron removal • Gaseous chlorination (pre) – disinfection, iron and manganese removal
Oconto Waterworks	5 | 639 7 | 531 8 | 632	Ordovician dolomite, Cambrian sandstone and dolomite	• Gaseous chlorination (post) – disinfection
Pound Waterworks	1 | 346	Cambrian sandstone and dolomite	• Gaseous chlorination (post) – disinfection
Coleman Waterworks	1 | 413 2 | 320	Cambrian sandstone	• Sequestration – iron removal • Gaseous chlorination (post) – disinfection
Crivitz Waterworks	1 | 50 2 | 172 3 | 185	Glacial outwash overburden, Cambrian sandstone	• Inhibitor (orthophosphate) – corrosion control • Gaseous chlorination (post) – disinfection
Lena Waterworks	1 | 500 2 | 496	Cambrian sandstone	• Filtration (pressure sand) – radionuclide removal • Permanganate – iron removal • Hypochlorination (pre) – disinfection

Publicly available water-quality reports show the high quality of groundwater in the region. Treatment is required in some instances to address some naturally occurring groundwater quality parameters (iron, radium 226 + 228, hardness). However, common naturally occurring constituents of concern (i.e., arsenic, barium, copper, lead, manganese) are not present at levels that require treatment.

[3] Information reported from 2021 Consumer Confidence Report(s)
[4] WDNR Wisconsin Well Driller Viewer (https://dnrmaps.wi.gov/H5/?viewer=Well_Driller_Viewer) accessed August 11, 2022
[5] WDNR Drinking Water System Portal (https://dnr.wi.gov/dwsviewer) accessed August 12, 2022

3.3. Summary of PFAS Sampling conducted in the Deep Bedrock Aquifer

As part of Tyco's ongoing monitoring obligations, 12 deep bedrock aquifer wells located within the PWSA have been sampled for PFAS 70 times between 2017 and 2022 for an average of six times at each well. PFOA and PFOS were not detected above the laboratory reporting limits in any samples. Of the other PFAS analyzed, none were present above reporting limits except FOSA, which was detected in six of the ten wells, at levels between 1.1 and 6.1 nanograms per liter. This compound is not associated with Tyco products, and its frequent presence at low concentrations in water supply well samples is likely the result of FOSA-containing components in the well pump or plumbing system. Residential well water quality is summarized in the Deep Aquifer Bedrock Well Design and Long-Term Monitoring Work Plan (Arcadis 2022c). The results of sampling completed at these wells since 2017 support use of the deep bedrock aquifer as a long-term drinking water solution.

3.4. Ambient Groundwater Parameters

In May and June 2022, Tyco collected groundwater samples from four wells completed in the deep bedrock aquifer for analyses of naturally occurring water quality parameters that may influence usability and to determine what potential water treatment options would be necessary for any replacement private well(s). Sampling included the following analyses:

- Metals (USEPA Methods 6020 & 7470).
- Major Ions (USEPA Method 9056).
- Alkalinity (USEPA Method 2320).
- Hardness (USEPA Method SM2340).
- Sulfur & Sulfides (USEPA Method 6010 & SM4500).
- Radium 226 + 228 (USEPA Method 903.0 & 904.0).
- Uranium (USEPA Method 6020).

The four sampled wells included two irrigation wells at the Marinette High School (IRR-01 and IRR-02) and two private water-supply wells located in the PWSA (WS-006 and WS-130). Well locations are shown on **Figure 2**. Grab samples from WS-006 and WS-130 were collected directly from an influent water line pre-treatment; these wells are 521 and 506 feet deep, respectively.

Samples from IRR-01 and IRR-02 (415 and 584 feet deep, respectively) were collected from multiple depths in the open borehole to evaluate potential variability in water chemistry entering the well from different zones in the rock. The samples were collected as depth-discrete grab samples while pumping at the top of the water column to induce flow from fractures and maintain upward flow throughout the wellbore. Samples are therefore flux biased (most representative of the highest yielding zones), and sequentially integrated from deep to shallow.

The sample results are summarized on **Table 1.** Key observations from these data include:

- Concentrations of nearly all constituents were highly similar across all samples, including those collected at various depths in IRR-01 and IRR-02. This likely indicates that the primary source of water in all wells was the

same (i.e., the deep bedrock aquifer zone), and that no significant variability is introduced by minor inflows from other depth zones intersected by the wells.

- The most common naturally occurring inorganic constituents of potential concern (e.g., arsenic, barium, boron, copper, lead, and manganese) were not detected at levels of concern.
- Levels of one parameter exceeded a listed USEPA MCL in all samples. The combined levels of radium 226 and 228 (common naturally occurring radiological compounds), were found at an average concentration of 22 picocuries per liter (pCi/L), which exceeds the MCL of 5 pCi/L.
- Levels of the metal strontium were detected in all samples at concentrations that ranged from 5,800 to 13,000 micrograms per liter (µg/L), which exceed the 1,500 µg/L enforcement standard recommended by the Wisconsin Department of Health Services in 2019. This enforcement standard was later not adopted by WDNR.
- Water in all samples was found to be hard, based on levels of calcium carbonate, magnesium, and calcium. Reported levels of hardness as calcium carbonate averaged 540 milligrams per liter, which is considered very hard. These levels are consistent with groundwater from a carbonate aquifer.

These data indicate that water from the deep aquifer is of high-quality but, as is common for water drawn from private wells in Wisconsin, the water will require softening and limited pre-treatment before use. Plans for water treatment are described in **Section 4.5**.

4. Well Design and Construction

4.1 Applicable Regulations and Permit Requirements

Methods and procedures used during well installation events will be conducted in accordance with Wis. Adm. Code and WDNR for water well installation, specifically standards set forth in NR 812 of the Chapter NR 800-Environmental Protection for Water Supply. All aspects of the well replacement activities will be discussed with the residents for final approval. Specifics on well construction activities will be outlined in subsequent sections below.

Well installation permits will be obtained per the WDNR water well permit process by the driller or applicable owner of the specific property for the replacement private well to be installed. Once the permit is submitted and all necessary information is filled in for the specific well location, WDNR will provide a permit for well installation. Each well location will need a permit submitted through the water well permit process on the WDNR website.

4.2 Well Siting and Utility Clearance

Drilling locations for all new wells will be selected in consultation with property owners and a Wisconsin Licensed water-well driller. Specific locations will be selected that meet the set-back requirements in NR 812.08, complying to the extent feasible with property owner requests. Utility clearance will be performed in accordance with the procedure described in the Final Quality Assurance Project Plan (QAPP; Arcadis 2021b). Prior to mobilization, Wisconsin One Call (i.e., Diggers Hotline) will be contacted. Clearance procedures will also include contracting a private utility locating service, conducting an in-person inspection of each location, reviewing available utility drawings, and consulting with the property owner. An air knife or hand auger may also be used to clear drilling areas, if needed.

4.3 Well Construction

Replacement private wells will be drilled and installed by a Wisconsin-licensed water-well driller following a common design and the standards set forth in Wis. Adm. Code NR 812, with modifications as required based on local subsurface conditions. All replacement wells will meet or exceed code requirements. The common design specifications are illustrated on **Figure 3**. The principal design and construction elements are as follows:

General Well Construction Details

Design Element	Specifications	Required by WI Well Code
Upper borehole	10-inch diameter drilled by mud-rotary from the surface to approximately 75 feet below the bedrock surface	Minimum diameter is 4 inches greater than the nominal diameter of the casing (NR 812.13(7))
Surface casing	6-inch diameter carbon steel from approximately 2 feet above grade to 75 feet below bedrock surface	Minimum casing depth for wells in limestone or dolomite bedrock is 40 feet (NR 812.14(2)(c)1)

Surface casing seal	Neat cement grout injected from the base of the casing. Seal will be permitted a minimum of 24 hours to cure before drilling continues	
Lower borehole	6-inch diameter drilled by air rotary to approximately 500 feet bgs or at least 50 feet beyond the top of the transmissive zone, based on driller observations of water production	Minimum diameter is 6 inches (NR 812.14(1))
Pump	Approximately 1 horsepower submersible pump; deployed inside steel casing	No minimum horsepower required; properly sized to provide the volume of water necessary (NR 812.32(1))
Surface completion	Approximately 2-foot stick-up with a weather and vermin proof cap	Well casing pipe shall extend at least 12 inches above the final ground grade (NR 812.12(12))
Plumbing and electrical connections	Pitless adapter, with new water line plumbed directly into existing house system. Buried electrical conduit from house panel.	

The casing depth of 75 feet below the bedrock surface was selected to extend a conservative distance into the shallow bedrock aquitard to create an effective seal between the overburden flow system and deeper bedrock. This casing depth significantly exceeds NR 812 requirements which specify a minimum casing depth of 40 feet below the ground surface for wells in limestone or dolomite aquifer. Within the PWSA, the depths of the wells and casings are anticipated to vary by approximately 50 feet, depending on the ground surface elevation, depth to bedrock and depth to the deep aquifer transmissive zone.

General Well Construction Variations Expected Within the PWSA

Variable	Expected Range in PWSA
Ground surface elevation	590 to 615 feet above mean sea level (AMSL)
Depth to bedrock	75 to 125 feet
Depth of surface casing	150 to 200 feet bgs
Top elevation of the deep aquifer transmissive zone	440 to 495 feet bgs, sloping southeast
Total well depth	490 to 520 feet bgs

Replacement wells will be installed using a combination of mud rotary and air rotary drilling techniques. Mud rotary drilling methods will be used for the installation of the surface casings, including setting a permanent steel casing. A neat cement grout will be injected in the annular space surrounding the surface casing in order to seal it in place and displace any drilling fluids. This seal will cure for the necessary time as dictated by Wis. Adm. Code NR 812. Following surface casing drilling, the open hole interval of the wells will be completed to depth via air rotary drilling methods.

Upon completion of drilling at each replacement well, development will occur until the water is practicably clear and free of silt and sand by any one of the following methods: mechanical surging, air-lifting, jetting, or by any

combination of these methods per Wis. Adm. Code NR 812. Following development, a short-duration pumping test will be conducted to determine each well's stable yield and the water level drawdown.

Each replacement well will be disinfected/sanitized using a chlorine solution in accordance with Wis. Adm. Code NR 812. Once disinfected, final well analytical samples will be collected and analyzed by a certified laboratory for arsenic, coliform bacteria, and nitrate. Final testing results will be provided to the WDNR.

Well completion logs will be finalized and submitted to the WDNR following well installation.

All wastes generated during well construction and development (i.e., drill cuttings, rock, and water) will be containerized and transported to the Site to be stored pending characterization and disposal. Waste will be segregated into two separate streams:

- Waste material generated during drilling and installation of the surface casing (i.e., overburden and upper bedrock zones) will be treated as potentially containing PFAS and characterized for appropriate disposal.
- Waste generated from drilling the lower borehole (i.e., below the surface casing) will be characterized and be treated as construction waste.

To the extent possible, wastewater will be containerized and treated at the FTC via an appropriate on-site treatment system. Other containerized waste will be disposed either through an approved treatment facility or at an approved disposal facility.

4.4 Well Abandonment

Following successful installation and hookup of replacement private well, obsolete wells at each property will be abandoned in accordance with Wis. Adm. Code NR 812.

4.5 Water Treatment

Analytical testing completed during past investigations, as well as pre-installation activities, have established general bedrock aquifer chemistry in the PWSA. Based on these findings, and in conjunction with trusted local water treatment providers, a recommended final well treatment plan has been devised for each replacement private well to consist of the following components:

- A 45,000 grain capacity high efficiency water softener to primarily address hardness and secondarily radium and strontium. This system can treat water at approximately 500 to 1,000 mg/L of hardness (at pump influent, post pressure tank whole house).
- A sediment filter (at pump influent, post pressure tank whole house).
- A RO50 reverse osmosis treatment system consisting of sediment filter, carbon filter, membrane, and polishing filter. Reverse osmosis systems will feature a chrome faucet and 3-gallon storage tank (beneath the kitchen sink). The RO treatment system will address radium and strontium (personal communication with Anderson's Culligan August 2022). The owner's manual for the proposed system is included as **Appendix A**.

A detailed long-term operations and maintenance plan will be put in place and coordinated in partnership with a trusted local water treatment provider.

5. Monitoring

Private deep wells will be tested for PFAS four times in the first year following installation. Long-term PFAS monitoring of the deep aquifer will be completed through a sentinel monitoring well network as described in the Deep Aquifer Bedrock Well Design and Long-Term Monitoring Work Plan (Arcadis 2022).

5.1 Residential Well Monitoring

Private deep wells will be monitored for PFAS four times in the first year following installation. The initial sample will be taken from the well prior to connection to the home and will also include secondary water quality parameters (listed in **Section 3.4**) to verify naturally occurring elements and associated water treatment technology. There will be three additional water sampling events for the first year after installation. The second sampling event will be conducted after final plumbing connections are completed with the home and will include secondary water quality parameters in addition to PFAS. Sampling during this event will be conducted from the tap connected to the reverse osmosis unit to verify treatment efficacy. The remaining sampling events will be for PFAS only and will be conducted from the kitchen tap approximately 6- and 12-months after the initial sampling event. Sampling offers will be communicated via post cards with contact information for residents to call to schedule sampling. Long-term deep aquifer water quality will be monitored as described within the Deep Aquifer Bedrock Well Design and Long-Term Monitoring Work Plan (Arcadis 2022).

Monitoring results will be communicated to property owners and tenants (as appropriate) within 10 days of final data being received by Arcadis from the laboratory. The results will include a letter describing the monitoring activities, a summary table of sampling results, and relevant pages from the laboratory report(s). A copy of the results package will be provided to WDNR within 10 days of final data being received by Arcadis. If PFAS is detected above enforceable drinking water levels during any of the testing events or ongoing monitoring, Tyco will work in cooperation with property owner(s) and the WDNR to determine appropriate next steps to ensure safe drinking water.

6. References

Arcadis. 2018b. Revised Long-Term Potable Well Sampling Plan. Tyco Fire Technology Center, 2700 Industrial Parkway, Marinette, Wisconsin 54143. BRRTS# 02-38-580694. April 20.

Arcadis. 2018a. Site Investigation Report, Tyco Fire Technology Center Site, 2700 Industrial Parkway, Marinette, Wisconsin, BRRTS No. 02-38-580694. September 28.

Arcadis. 2019a. Remedial Action Options Report for Long-Term Drinking Water Supply, Town of Peshtigo, Wisconsin, Summary Report, Wisconsin Department of Natural Resources and Public Services Commission Submittal. May.

Arcadis. 2019b. Remedial Action Options Report for Long-Term Drinking Water Supply, Town of Peshtigo, Wisconsin, Summary Report, Wisconsin Department of Natural Resources and Public Services Commission Submittal. September.

Arcadis. 2020. Interim Site Investigation Report. Tyco Fire Technology Center, Marinette, Wisconsin, BRRTS No. 02-38-5806945. May 21.

Arcadis. 2021. Revised Long-Term Potable Well Sampling Plan, Tyco Fire Technology Center Site, 2700 Industrial Parkway, Marinette, Wisconsin, BRRTS No. 02-38-580694. October 1.

Arcadis. 2022a. Site Investigation Status Report, Tyco Stanton Street Facility, Marinette, Wisconsin, BRRTS No. 02-38-581955. March 22.

Arcadis. 2022b. Private Drinking Water Well Sampling Program Annual Summary Report – FTC Sampling Area, Tyco Fire Technology Center Site, 2700 Industrial Parkway, Marinette, Wisconsin 54143, BRRTS No. 02-38-580694. August.

Arcadis. 2022c. Deep Aquifer Bedrock Well Design and Long-Term Monitoring Work Plan, Tyco Fire Technology Center Site, 2700 Industrial Parkway South, Marinette, Wisconsin 54143, BRRTS No. 02-38-580694. September.

Tables

Table 1
Deep Well General Chemistry (Non-PFAS) Results
Deep Aquifer Bedrock Well Design and Long Term Monitoring Work Plan
Tyco Fire Products LP
Marinette, Wisconsin

	USEPA Primary MCL	WDNR NR 140 Enforcement Standard	Location	IRR-01	IRR-01	IRR-01	IRR-01	IRR-02	IRR-02	IRR-02
			Sample ID	IRR-01-42 (20220519)	IRR-01-170 (20220519)	DUP-01 (20220519)	IRR-01-374 (20220519)	IRR-02-50 (20220521)	IRR-02-180 (20220521)	DUP-02 (20220521)
			Depth	42	170	170	374	50	180	180
			Sample Date	5/19/2022	5/19/2022	5/19/2022	5/19/2022	5/21/2022	5/21/2022	5/21/2022
			Sample Type	N	N	FD	N	N	N	FD
			Unit							
Alkalinity	--	--	mg/L	100	100	100	110	100	110	100
Bicarbonate Alkalinity as CaCO3	--	--	mg/L	100	100	100	110	100	110	100
Carbonate Alkalinity as CaCO3	--	--	mg/L	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U
Hardness as calcium carbonate	--	--	mg/L	570	560	560	560	520	510	510
Sulfide	--	--	mg/L	0.89 J	<2.0 U	<1.8 U	<1.0 U	<1.0 U	<1.6 U	<1.5 U
Sulfur	--	--	mg/L	150	150	150	150	130	130	130
Aluminum	--	200	µg/L	<100 U	<100 U	<100 U	<100 U	<100 U	45 J	62 J
Iron	--	--	µg/L	260	210	310	470	260	1,300	1,600
Lead	15	15	µg/L	<0.50 U	0.28 J	0.22 J	0.26 J	0.20 J	0.49 J	1.4
Magnesium	--	--	µg/L	54,000	54,000	53,000	53,000	50,000	49,000	49,000
Manganese	--	300	µg/L	23	23	23	23	18	48	52
Nickel	--	100	µg/L	1.7 J	<2.0 U	<2.0 U	<2.0 U	<2.0 U	0.85 J	0.98 J
Potassium	--	--	µg/L	5,400	5,400	5,400	5,400	5,400	5,300	5,300
Silver	--	50	µg/L	<0.50 U	<0.50 U	<0.50 U	<0.50 U	<0.50 U	<0.50 U	<0.50 U
Sodium	--	--	µg/L	50,000	49,000	49,000	50,000	52,000	51,000	52,000
Strontium	--	--	µg/L	5,900 J	5,800 J	6,700 J	6,400 J	6,300 J	6,000 J	5,900 J
Thallium	2	2	µg/L	<2.0 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U
Antimony	6	6	µg/L	<3.0 U	<3.0 U	<3.0 U	<3.0 U	<3.0 U	<3.0 U	<3.0 U
Arsenic	10	10	µg/L	0.53 J	0.57 J	0.55 J	0.36 J	<1.0 U	0.60 J	0.78 J
Barium	2,000	2,000	µg/L	9.4	9.3	9.4	9.5	9.1	11	11
Beryllium	4	4	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Boron	--	1,000	µg/L	250	250	250	250	270	270	270
Cadmium	5	5	µg/L	<0.50 U	<0.50 U	<0.50 U	<0.50 U	<0.50 U	<0.50 U	<0.50 U
Chromium	100	100	µg/L	6.6	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U	1.1 J
Cobalt	--	40	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Copper	1,300	1,300	µg/L	<2.0 UB	<2.0 U	<2.0 UB	<2.0 UB	<2.0 U	1.8 J	2.8
Vanadium	--	30	µg/L	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U
Zinc	--	--	µg/L	12 J	<20 U	13 J	20	21	970	1200
Calcium	--	--	µg/L	140,000	140,000	140,000	140,000	130,000	120,000	120,000
Selenium	50	50	µg/L	<2.5 U	<2.5 U	<2.5 U	<2.5 U	<2.5 U	<2.5 U	<2.5 U
Uranium	30	--	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Mercury	2	2	µg/L	<0.20 U	<0.20 U	<0.20 U	<0.20 U	<0.20 U	<0.20 U	<0.20 U
Radium-226	--	--	pci/L	31.7	33.5	31.9	32.9	13.2	13.2	13.3
Radium-228	--	--	pci/L	1.97	1.02	1.53	0.972	<1.00 U	<1.00 U	1.12
Radium 226 and 228	5	--	pci/L	33.7	34.5	33.4	33.9	13.6	13.6	14.5
Nitrate as N	10	10	mg/L	<0.20 U	<0.20 U	<0.20 UJ-	<0.20 UJ-	0.30 J-	1.3 J-	0.081 J-
Nitrite as N	1	1	mg/L	<0.20 U	<0.20 U	<0.20 UJ-	<0.20 UJ-	<4.0 UJ-	<0.20 UJ-	<0.20 UJ-
Sulfate	--	--	mg/L	440	420	440	440	410	400	380
Chloride	--	--	mg/L	73	72	73	72	71	70	75
Fluoride	4	4	mg/L	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Bromide	--	--	mg/L	0.56	0.54	0.54	0.51	0.57	0.51	0.57
Orthophosphate as P	--	--	mg/L	<0.20 U	<0.20 U	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-

Notes on Page 3.

Table 1
Deep Well General Chemistry (Non-PFAS) Results
Deep Aquifer Bedrock Well Design and Long Term Monitoring Work Plan
Tyco Fire Products LP
Marinette, Wisconsin

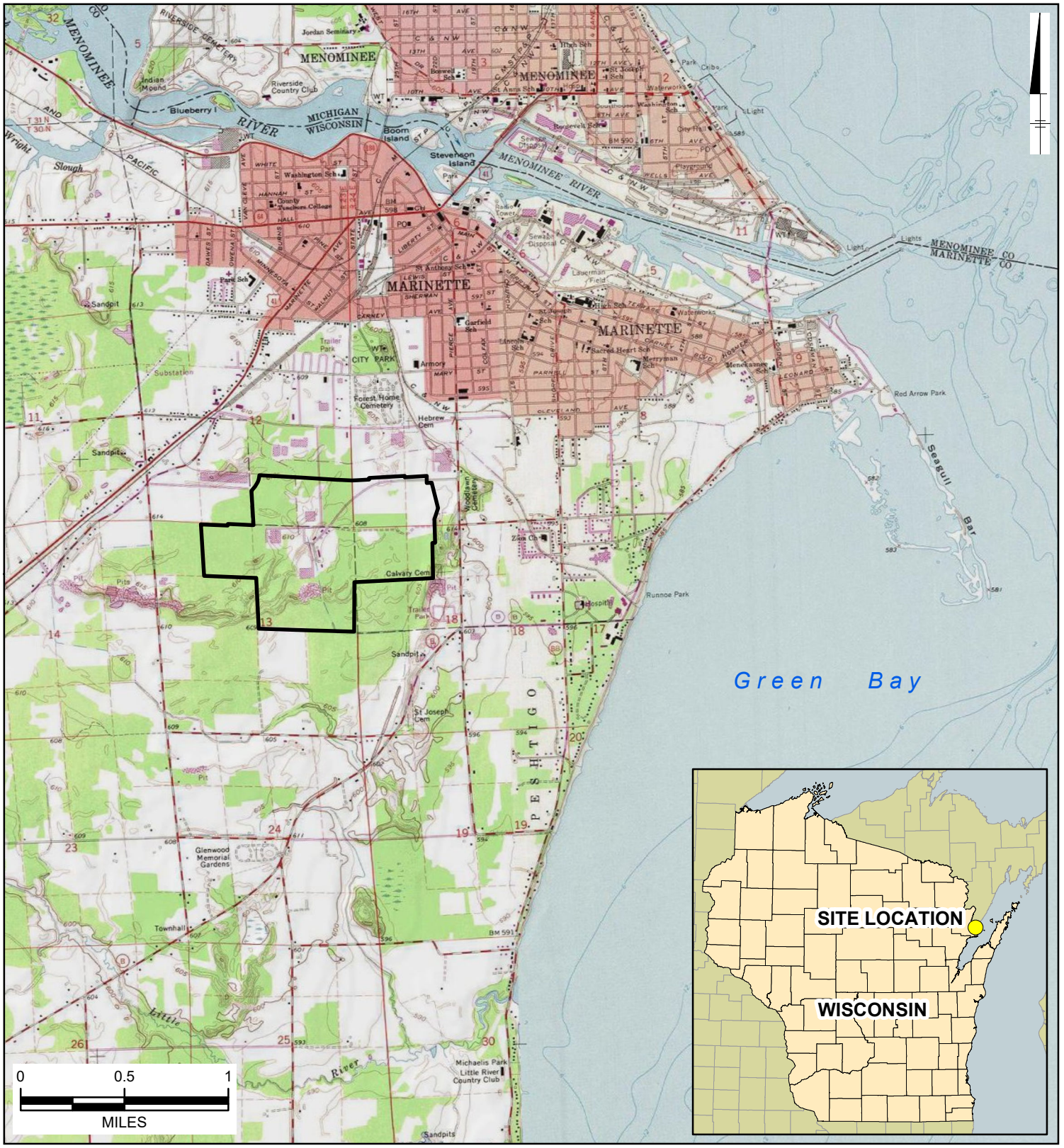
	USEPA Primary MCL	WDNR NR 140 Enforcement Standard	Location	IRR-02	IRR-02	IRR-02	WS-006	WS-130
			Sample ID	IRR-02-392 (20220521)	IRR-02-444 (20220521)	IRR-02-540 (20220521)	WS-006 (052322)	WS-130 (060722)
			Depth	392	444	540	521	506
			Sample Date	5/21/2022	5/21/2022	5/21/2022	5/23/2022	6/7/2022
			Sample Type	N	N	N	N	N
			Unit					
Alkalinity	--	--	mg/L	100	100	98	100	88
Bicarbonate Alkalinity as CaCO3	--	--	mg/L	100	100	98	100	88
Carbonate Alkalinity as CaCO3	--	--	mg/L	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U
Hardness as calcium carbonate	--	--	mg/L	510	510	500	480	600
Sulfide	--	--	mg/L	<1.4 U	0.84 J	<1.0 U	0.23 J	0.37 J
Sulfur	--	--	mg/L	120	140	130	140	180
Aluminum	--	200	µg/L	<100 U	34 J	53 J	<100 U	<100 U
Iron	--	--	µg/L	770	1,400	1,400	270	2500
Lead	15	15	µg/L	0.44 J	1.2	1.1	2.1	4.2
Magnesium	--	--	µg/L	49,000	48,000	47,000	45,000	62,000
Manganese	--	300	µg/L	35	47	55	11	44
Nickel	--	100	µg/L	<2.0 U	7.6	1.1 J	<2.0 U	2.9
Potassium	--	--	µg/L	5,300	5,100	5,200	9,700	6,600
Silver	--	50	µg/L	<0.50 U	<0.50 U	<0.50 U	<0.50 U	<0.50 U
Sodium	--	--	µg/L	52,000	51,000	51,000	54,000	57,000
Strontium	--	--	µg/L	6,100 J	5,900 J	5,700 J	11,000	13,000
Thallium	2	2	µg/L	<2.0 U	<2.0 U	<2.0 U	5.7	<2.0 U
Antimony	6	6	µg/L	<3.0 U	<3.0 U	<3.0 U	<3.0 U	<3.0 U
Arsenic	10	10	µg/L	0.42 J	0.45 J	0.29 J	<1.0 U	0.28 J
Barium	2,000	2,000	µg/L	12	12	20	13	20
Beryllium	4	4	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Boron	--	1,000	µg/L	270	260	250	240	270
Cadmium	5	5	µg/L	<0.50 U	<0.50 U	<0.50 U	0.38 J	<0.50 U
Chromium	100	100	µg/L	<5.0 U	1.1 J	<5.0 U	<5.0 U	<5.0 U
Cobalt	--	40	µg/L	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Copper	1,300	1,300	µg/L	1.0 J	4.7	2.7	16	95
Vanadium	--	30	µg/L	<5.0 U	<5.0 U	<5.0 U	<5.0 U	<5.0 U
Zinc	--	--	µg/L	480	500	300	41	250
Calcium	--	--	µg/L	120,000	120,000	120,000	120,000	140,000
Selenium	50	50	µg/L	<2.5 U	<2.5 U	<2.5 U	1.4 J	<2.5 U
Uranium	30	--	µg/L	<1.0 U	<1.0 U	<1.0 U	0.41 J	<1.0 U
Mercury	2	2	µg/L	<0.20 U	<0.20 U	<0.20 U	<0.20 U	<0.20 U
Radium-226	--	--	pci/L	11.9	12.7	14.9	18.9	23.9
Radium-228	--	--	pci/L	<1.00 U	<1.00 U	<1.00 U	1.77	1.34
Radium 226 and 228	5	--	pci/L	12.2	13	15.5	20.7	25.2
Nitrate as N	10	10	mg/L	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-
Nitrite as N	1	1	mg/L	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-
Sulfate	--	--	mg/L	380	390	370	370	500
Chloride	--	--	mg/L	72	70	73	63	82
Fluoride	4	4	mg/L	1.6	1.6	1.6	1.9	1.8
Bromide	--	--	mg/L	0.44	0.56	0.45	0.48	0.56
Orthophosphate as P	--	--	mg/L	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-	<0.20 UJ-	<0.20 UJ

Notes on Page 3.

Table 1
Deep Well General Chemistry (Non-PFAS) Results
Deep Aquifer Bedrock Well Design and Long Term Monitoring Work Plan
Tyco Fire Products LP
Marinette, Wisconsin

Notes:
< = Compound not detected at method detection limit.
-- = No standard
N = Normal sample
FD = Field Duplicate
J = The analyte was positively identified: however the associated numerical value is an estimated concentration only
J- =The result is an estimated quantity, but the results may be biased low
MCL = Maximum contaminant level
mg/L = Milligrams per liter
ngL = Nanograms per liter
pci/L = Picocuries per liter
U = The analyte was analyzed for but the result was not detected above the method detection limit
UB = Compound considered non-detect at the listed value due to associated blank contamination
USEPA = United States Environmental Protection Agency
WDNR = Wisconsin Department of Natural Resources

Figures



LEGEND:

APPROXIMATE SITE PROPERTY BOUNDARY

NOTES:

1. TOPOGRAPHIC MAP SOURCE: COPYRIGHT:© 2013 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED, ACCESSED SEPTEMBER 2022.

TYCO FIRE PRODUCTS LP
MARINETTE, WISCONSIN

SITE LOCATION

ARCADIS

FIGURE
1

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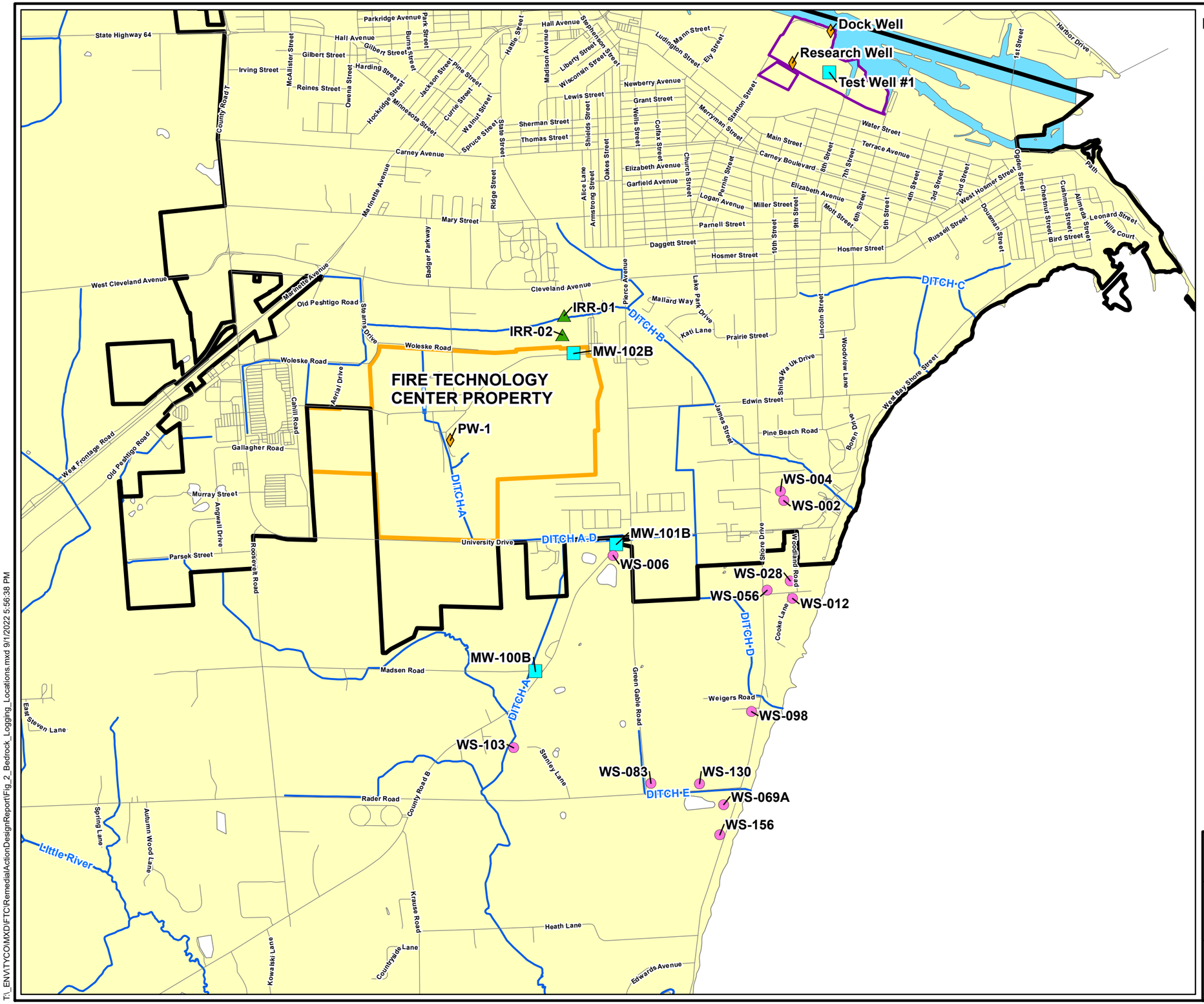


LEGEND:

- FORMER BEDROCK BOREHOLE
- FORMER BEDROCK PRODUCTION WELL
- IRRIGATION WELL
- RESIDENTIAL WELL
- STANTON STREET FACILITY BOUNDARY
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- WATERBODY
- DITCH OR STREAM
- ROAD

0 2,000 4,000

SCALE IN FEET

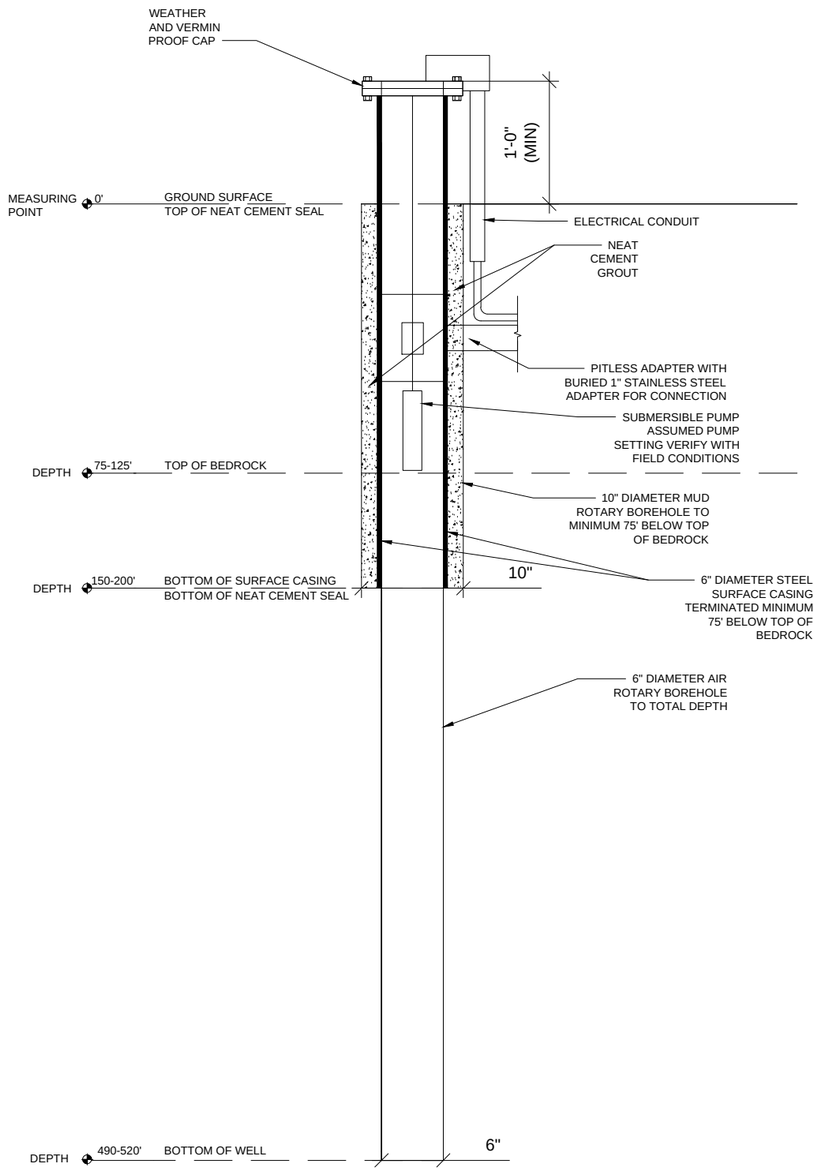
TYCO FIRE PRODUCTS LP
MARINETTE, WISCONSIN

EXISTING AND FORMER BEDROCK EXPLORATORY WELLS AND SAMPLING LOCATIONS

ARCADIS

FIGURE 2

T:_ENV\TYCO\MXD\FTC\RemedialActionDesignReport\Fig_2_Bedrock_Logging_Locations.mxd 9/1/2022 5:56:38 PM



A PRIVATE BEDROCK WELL DETAIL

NTS

No.	Date	Revisions	By	Ckd

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Professional Engineer's Name

Professional Engineer's No.

State	Date Signed	Project Mgr.
Designed by	Drawn by	Checked by

ARCADIS

ARCADIS U.S., INC.

TYCO FIRE PRODUCTS LP • MARINETTE, WI 54143-2542

PRIVATE BEDROCK WELL DETAIL

ARCADIS Project No.
30135605.00006

Date
AUGUST 2022

ARCADIS NA
126 NORTH JEFFERSON STREET
SUITE 400
MILWAUKEE, WISCONSIN 53202
TEL. 414.276.7742

FIGURE 3

Appendix A

Culligan Aqua-Cleer Advanced Drinking Water Systems Owners Guide

Culligan®

Culligan® Aqua-Cleer® Advanced Drinking Water Systems Owners Guide

THANK YOU

AND WELCOME TO YOUR NEW WORLD OF BETTER LIVING WITH CULLIGAN WATER.

Notice: Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. Systems certified for cyst reduction may be used on disinfected water that may contain filterable cysts.

For installations in Massachusetts: Massachusetts Plumbing Code 248 CMR shall be adhered to. Consult your licensed plumber for installation of this system. The use of saddle valves is not permitted in Massachusetts.

Check with your public works department for applicable local plumbing and sanitation codes. Follow your local codes if they differ from the standards used in this manual.

Operational, maintenance and replacement requirements are essential for this product to perform properly. Talk to you Culligan dealer about a service and maintenance program to ensure your filters are replaced in a timely manner and annual water tests are also recommended (especially on well water) to ensure the system is functioning properly.

Culligan International Company
9399 West Higgins Road
Rosemont, Il. 60018
1-800-Culligan
www.culligan.com

Table of Contents

About Your System

Thank you for choosing a Culligan Aqua-Cleer advanced drinking water system. Your new system is designed to bring you years of deliciously crystal-clear Culligan water. The best part is it comes right from the tap. No more lugging around bottles or waiting for pitchers to slowly fill up. With your continuous supply of great tasting water, not only can you get your 8 glasses a day but you can easily use it for cooking, coffee, juice, baby formula, ice cubes, anything you use water with.

The important thing to remember is to change out your filters on a regular basis. The quality of your water is only as good as the quality of your filters. Each filter is designed to last for 1,000 gallons (roughly 12 months). Membranes will last longer if used with pre-filtration. A flow monitor is available with your system to let you know when you have consumed 1,000 gallons of water through your system. If you did not purchase one with your system, you may consider asking your Culligan man about having one installed. Faucets with reminder lights are also available.

System Specifications:

Dimensions	Filter Assembly Standard Storage Tank Medium Storage Tank Large Storage Tank	13.8″ wide x 4.2″ deep x 15.5″ high 9″ diameter x 14″ high 11″ diameter x 14″ high 15.5: diameter x 24″ high
Storage Tank Capacity	Standard Medium Large	2 gallons 3 gallons 9 gallons
Reverse Osmosis Efficiency Rating	RO30 RO50	16.23% 15.79%
Reverse Osmosis Recovery Rating	RO30 RO50	30.41% 32.55%

Filtration Options:

Sequence of Filtration	Type of Filtration	Specification
Pre-Filtration	Sediment	1 2 3
	Carbon	Block Granulated Active Carbon Granulated Active Carbon - Large
Membrane	Reverse Osmosis	30 gpd 50 gpd
Advanced Filtration	Total Defense Arsenic	Speciality Carbon Block Specialty Media [1]
Remineralization	Mineral Boost	Specialty Media
Post-Filtration	Carbon	Granulated Activated Carbon Block

[1] Specialty media cartridges must be installed after the RO membrane and system must have a Performance Indicator Device (PID) installed to track gallon usage.

Purpose of each level of filtration:

Pre-Filtration:

Pre-filtration for this system is used to reducing large contaminants from the water before they reach either the reverse osmosis or nano filtration membrane. The use of pre-filtration cartridges helps extent the membrane's life. There are two types of pre-filtration available with this system: sediment filtration and carbon filtration.

Sediment Filtration: Sediment is defined as sand, dirt, silt, fine sand and or coarse sand that can be found in many water supplies.

Carbon Filtration: Carbon is used to reduce chlorine taste and odor. Most people often describe this taste as being slightly chemical or they equate their drinking water to that of the local pool. Municipalities use chlorine to disinfect the water on the way to your home. This is a necessary step to delivering safe water to your home but depending on the level of chlorine by the time it reaches your home the taste of your water may be unpalatable.

Membrane Technologies:

The Aqua-Cleer reverse osmosis membranes utilize a tightly woven membrane that acts as a barrier to contaminants. Water is pushed up against this membrane at pressure. Depending on the weave of the membrane only a certain percentage of contaminants can pass through. Reverse Osmosis can reduce up to 99% of contaminants.

Advanced Filtration:

The advanced filtration cartridges are specifically designed to reduce contaminants that reverse osmosis membranes are not efficient in removing.

Total Defense:

The Total Defense cartridge should be added to your system to deal with lead, mercury, aesthetic chloramines, aesthetic chlorine taste and odor, cysts, Volatile Organic Compounds (VOC) and MTBE.

- Chloramines have a stronger taste and are more difficult to remove than chlorine.
- Mercury is a toxin that can cause kidney damage.
- Lead is a toxin that can cause kidney problems or high blood pressure in adults and developmental problems in children.
- Cysts are a common cause of health issues. They can be found in some municipal water sources but more often found in wells under the influence of surface water.
- VOC is a name given to a wide range of organic contaminants, some are known to be carcinogenic.
- MTBE was used in gasoline to reduce emissions and is considered harmful.

Mineral Boost

The Mineral Boost cartridge adds healthy amounts of natural calcium minerals back into reverse osmosis water to create amazing tasting, optimally alkaline, pH balanced water. Benefits include:

- Raises RO water TDS by 20 ppm to 30 ppm
- Raises RO water pH by 1 to 2 pH

Arsenic:

Arsenic (As) is found naturally in some well water. Arsenic in water has no color, taste or odor. It must be measured by a lab test. Public water utilities must have their water tested for arsenic. You can get the result from your water utility. If you have your own well, you can have the water tested by an accredited lab. The local health department or the state environmental health agency can provide a list of certified labs. Culligan International is one such lab. For more information please contact your local Culligan dealer. For additional information about the arsenic in water can be found through the EPA's website at www.epa.gov/safewater/arsenic.html.

There are two forms of arsenic: pentavalent arsenic (As (V)) and trivalent arsenic (As (III)). Special sampling procedures are needed for a lab to determine what type and how much of each type of arsenic is in the water. In well water, arsenic may be pentavalent, trivalent, or a combination of both. Reverse osmosis membranes are effective at reducing pentavalent arsenic but not trivalent arsenic. The Arsenic specific cartridge was specifically designed to reduce trivalent arsenic.

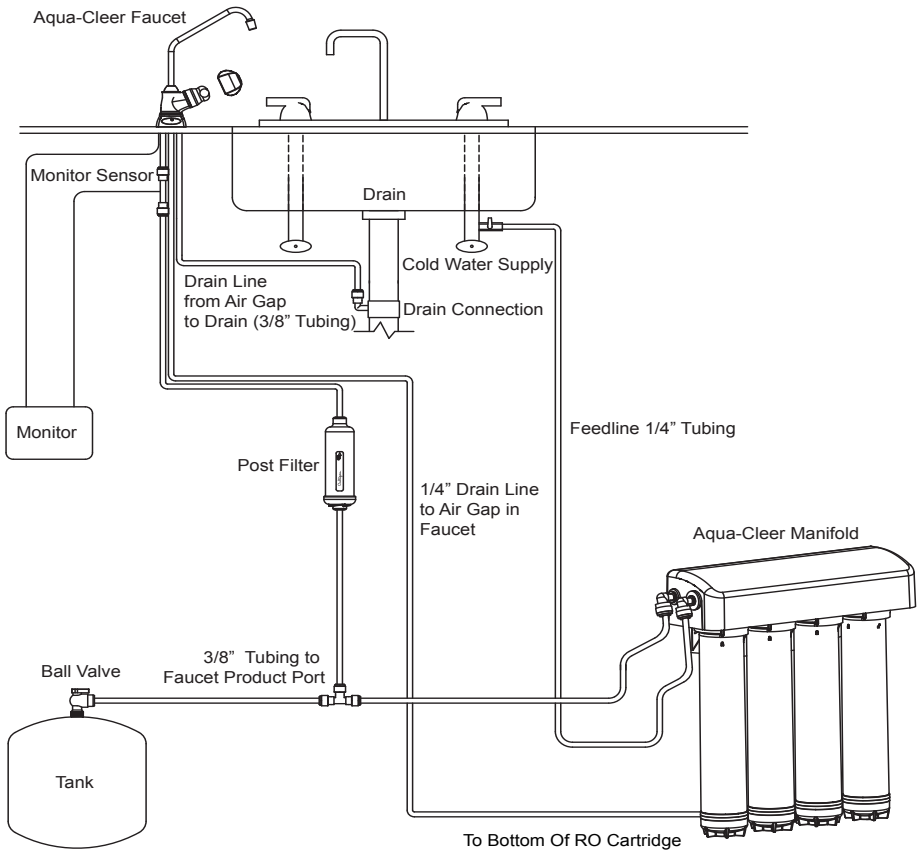


Figure 1.

NOTE Install the drain line so that it runs downward with no loops or low spots. Otherwise the unit will overflow at the air gap siphon break built into the faucet, or make irritating gurgling sounds. The 1/4" concentrate line that leads to the faucet should be installed in a straight vertical path to avoid making a gurgling noise. For installations in Massachusetts: Massachusetts Plumbing Code 248 CMR shall be adhered to. Consult your licensed plumber for installation of this system. The use of saddle valves is not permitted in Massachusetts.

This owner's guide provides visual assembly reference only. Since specialized skills are required in the assembly of the drinking water system, we recommend that you contact your local independently operated Culligan dealer to complete this installation.

Select Component Installation Locations

Dispenser Faucet

The Culligan® faucet is designed to be mounted on the rear lip of the sink. It may be installed in an existing sprayer attachment hole or in a hole drilled at the time of installation. It may also be mounted to an adjacent counter top. It should be positioned so that water is dispensed over the sink. A minimum 1-1/4" diameter hole is required. When installing the Aqua-Cleer® water quality monitor, refer to the installation instructions packaged with the monitor. Make certain the TDS level and/or gallons setting correspond to the desired water supply.

Important considerations:

- Access to the bottom (under sink) of the faucet is required for attachment of product water line.
- The faucet can be installed for left- or right-handed operation.
- There should be no under sink obstructions which would prevent smooth tubing runs to the drain connection, carbon post-filter, or RO module assembly.

Filter System Assembly

The filter system assembly is designed to be mounted on any rigid vertical surface such as a cabinet side-wall, sheetrock or exposed stud. It should be positioned such that there is access to an inlet water source and drain. The installation should also allow convenient access for servicing.

Inlet Water Supply Connection

Once a location is chosen for installation of the filter system assembly, select a nearby cold water line to provide the water source for the system. For under sink installations, the cold water faucet line can usually be tapped.

The Reservoir Tank

Position the reservoir tank near the faucet for optimum customer convenience. The standard and medium reservoir tank will weigh about 28 pounds (13 kg) when full of water, so it must be positioned on a stand or held securely by the optional mounting bracket. The reservoir operates best in the vertical position, but it will operate on its side. However, air will not escape readily and foaming may occur at the faucet nozzle. This should be explained to the customer prior to installation.

Drain Connection

The most convenient entry to the drain is directly above the P-trap of the kitchen sink. However, the concentrate water from the system can be connected to adjacent sinks or a floor drain. Extra care should be taken when entering drains near dishwashers or food waste disposals as back flow may occur through the air gap and cause flooding. See plumbing diagram on page 7 for proper air gap installation to waste connection.

Installation of Filter System Assembly

The mounting bracket contains three mounting slots. The holes are sized to accept #10 round head wood screws (not supplied). Some types of surfaces such as particle board or drywall may require the use of plastic screw anchors or toggle bolts to provide adequate support for the unit.

Install Filter Cartridges

1. Lightly lubricate the cartridge O-ring with silicone lube and insert the sediment filter cartridge into the manifold.
2. Twist the cartridge to lock it into the manifold. See Figure 2.

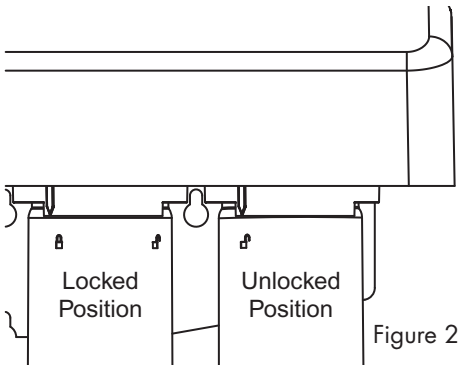


Figure 2.

3. Repeat steps 1-2 and install the flushed activated carbon filter cartridge into housing and the RO membrane element. Be sure the drain adapter is in place.

NOTE 1) The RO cartridge must be inserted into the 2nd, 3rd, or 4th position on the RO manifold.

NOTE 2) If only three cartridges are to be inserted into the manifold, the bypass plug cartridge must be inserted in the 4th position. See Figure 3.

NOTE The activated carbon, reverse osmosis, and polishing filter cartridges must be conditioned as follows prior to installation into the Aqua-Cleer system. Your Culligan man will do these important procedures at the time of purchase.

- **Activated Carbon Cartridge - 10 minute flush to remove carbon dust**
- **RO Membrane - Minimum 24 hour flush to remove preservative solution**
- **Polishing Filter - 10 minute flush to remove carbon dust**
- **Mineral Boost Cartridge - 10 minute flush to remove mineral particulates**

Factors Which Affect Performance

Performance of the reverse osmosis membrane is affected by several factors which must be considered when judging the condition of the system. The main factors which affect system performance are pressure, temperature, total dissolved solids level, recovery and pH.

Pressure

Water pressure affects both the quantity and quality of the water produced by the RO membrane. Generally, the more water pressure, the better the performance of the system. Be careful not to exceed 120 psi, the maximum operating pressure of the Aqua-Cleer system.

Temperature

The reverse osmosis process slows with decreasing temperature. To compensate, a temperature correction factor is used to adjust the actual performance of the RO membrane filter to the standard temperature of 77°F (25°C). This allows the performance of the unit to be accurately gauged against Culligan's published standards. Temperature does not affect the concentrate flow rate.

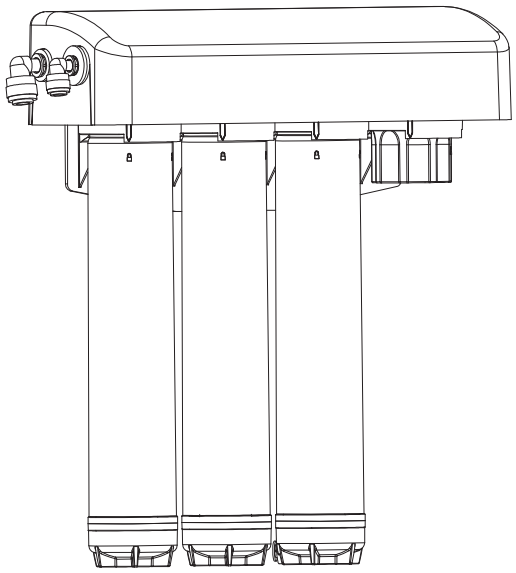


Figure 3.

Total Dissolved Solids

The minimum driving force which is necessary to stop or reverse the natural osmosis process is termed osmotic pressure. As the total dissolved solids level of the feed water increases, the amount of osmotic pressure increases and acts as back pressure against the reverse osmosis process. Osmotic pressure becomes significant at TDS levels above 500 mg/L (ppm).

Hardness

Hardness is the most common membrane foulant. If ignored, this relatively harmless component of feed water will plug a membrane over time. Use of a softener will reduce the fouling effect on a membrane. One way to detect too much hardness in the feed water is the weight of a membrane installed for a period of time. A fouled membrane (dried) will weigh significantly more than a new membrane. The increase in weight is a result of precipitated hardness inside the membrane.

Iron

Iron is another common membrane foulant. There are a variety of types of iron, some of which cannot be removed by an iron filter. Clear water iron can be removed more effectively by a softener. Particulate iron can be removed more effectively by a 1 micron filter. Organic-bound iron can be removed only by activated carbon or macroporous anion resin. If there is enough iron to exceed the EPA secondary drinking water standard and softening the water is not an option and the iron is soluble, then an iron filter is appropriate. If none of these are an option then regular replacement of membranes will have to be accepted.

Product Water Recovery

Product water recovery plays an important role in determining membrane and system performance. Recovery refers to the amount of water produced in relation to the amount of water sent to drain. The standard calculation is:

% Recovery = Product Water ÷ (Product Water + Waste Water) x 100

The Aqua-Cleer uses a flow control assembly to restrict the flow of waste water to the drain. This restriction helps maintain pressure against the membrane. The sizing of the flow control assembly determines the recovery rating of the system. The Aqua-Cleer is manufactured with a recovery rating designed to be around 30% -40%. Depending on temperature, pressure and tolerances the actual recovery value may be slightly different for each system.

How to Maintain Your System

To keep the Aqua-Cleer® system operating properly, it is necessary to change the filters and sanitize the system periodically. Typically, this should be done on an annual basis. Service frequency may vary depending on local water conditions. High sediment, chlorine, turbidity, or hardness levels may require more frequent service. Use the following as a guide.

As needed:

Clean the faucet with a soft cloth, avoid abrasive cleaners

It is recommended that you do the following annually:

(Contact your local Culligan dealer for replacement cartidges and maintenance)

1. Sanitize the System
2. Replace:
   - Sediment Filter
   - Activated Carbon Filter
   - Polishing Filter
   - Any Advanced Filtration Cartridge
   - Mineral Boost Cartridge
3. Check:
   - RO Membrane
   - Flow control assembly
   - TDS Reduction Performance
   - Flow Rates (including air gap)
   - Drain tubing for back-up

Perform the following steps in the order shown to sanitize your system

It is recommended to have your local Culligan dealer perform the sanitization process. Your local Culligan man has been specifically trained to test the water quality and efficiency of the system in order to determine when the RO membrane should be replaced and ensure the system is working properly.

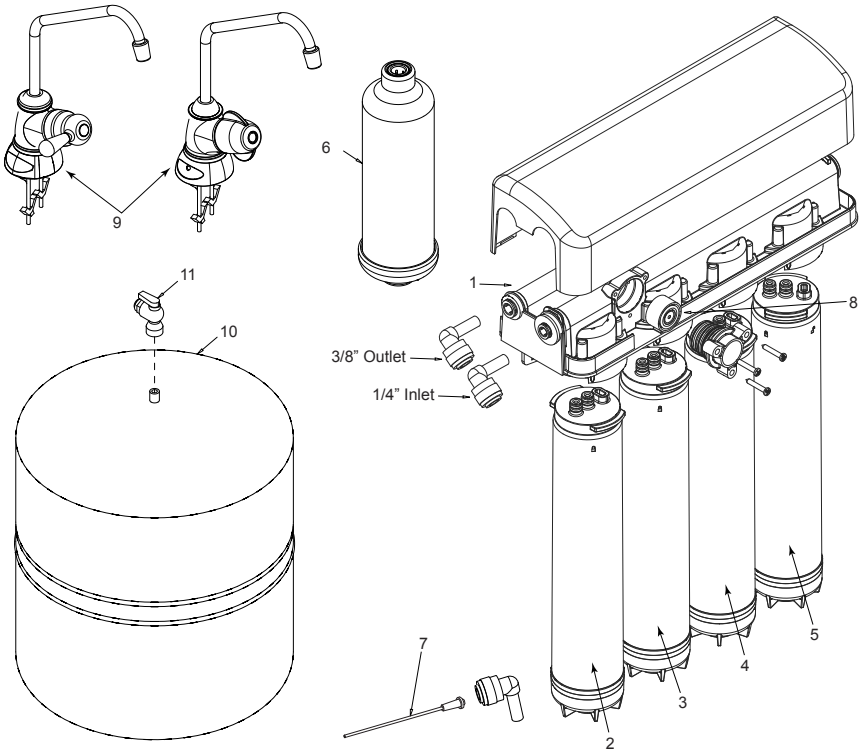
Preliminary Steps:

1. Check for any leaks that may exist from tubing connections or the faucet.
2. Check for flow to the drain. If flowing, close tank shut-off so you can check auto shut-off operation
3. Test and record product TDS from faucet. Also observe if faucet stem is stiff to move.
4. Test and record feed TDS, and then calculate rejection percentage.
5. If rejection is acceptable - Shut off storage tank, remove tank supply tubing to collect and record product flow, and water temperature.
6. Record feed pressure if needed by attaching a pressure gauge to feed line. Use the recorded feed pressure and water temperature to check product flow rate against the supplied chart. Membrane okay? Low production could be the result of partially plugged prefilters. If so retest after filters are changed.
7. With feed line off begin draining tank.

The Aqua-Cleer RO manifold assembly may be sanitized with 5-1/4% liquid chlorine unscented bleach.

1. Shut off water supply then remove all filters. Put bypass plugs in ports 2, 3 and 4.
2. Pour two tablespoons liquid chlorine bleach into the sanitizer cartridge and place in port 1.
3. Turn on the water supply valve and the RO faucet to allow the system to fill with water. Allow the water to flow through until the entire system for about 10 minutes or until the sanitizing solution is through.
4. Install new filters, including the post carbon filter, and membrane if needed, or reuse existing membrane. Some filters require flushing before use to remove dust and fines. If an in-plant flush was not performed, use the single head assembly to perform this using the feed line and drain lines available. Don't flush using the RO manifold.
5. Replace the battery in the quality monitor if applicable.
6. Discard the first glass of water from the faucet.
7. Thoroughly check for leaks.

Parts List



Item	Description
1	Manifold Assembly
2	SED1 Filter
	SED2 Filter
	SED3 Filter
3	Carbon Block Filter
	Granular Activated Carbon Filter
	Granular Activated Carbon Filter - Large
4	30 GPD Reverse Osmosis Membrane
	50 GPD Reverse Osmosis Membrane
5	Arsenic Filter
	Carbon Block Filter (MTBE, VOC)
	Mineral Boost
6	Post Carbon Filter
7	Flow Control
8	Automatic Shut-off Valve
9	Faucet
10	2 Gallon Storage Tank
	3 Gallon Storage Tank
	9 Gallon Storage Tank
11	Ball Valve
*Monitor (Not Shown)	

Performance Data Sheet

Important Notice: Read this Performance Data Sheet and compare the capabilities of this system with your actual water treatment needs. It is recommended that, before installing a water treatment system, you have your water supply tested to determine your actual water treatment needs.

Culligan knows the more informed you are about your water treatment systems, the more confident you will be about its performance. It's because of this and more than seventy years of commitment to customer satisfaction that Culligan is providing this Performance Data Sheet to its customers.

Company: **Culligan International Company**
9399 West Higgins Road, Suite 1100
Rosemont, IL 60018 USA
(847) 430-2800
www.culligan.com

Product: Culligan Aqua-Cleer Advanced Drinking Water Systems

Use Guidelines:

- Working Pressure: 40 – 120 psig (280-827 kPa)
- Do not allow exposure to temperature below 33°F (1°C)
- Maximum operating temperature: 100°F (38°C)
- These systems must be installed according to local plumbing codes on the cold water line.
- This system requires regular replacement of all filters to maintain proper operation. Depending on usage and influent water quality, the carbon, Mineral Boost and particulate filters should be changed at least annually and the reverse osmosis membrane should be replaced every 3-5 years. Varying chlorine, sediment or TDS levels may affect replacement frequency.

CAUTION! Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. Systems certified for cyst reduction may be used on disinfected water that may contain filterable cysts.

Total Defense (TD, P/N 01020274)

The Total Defense has been tested according to NSF/ANSI 42, 53 and 401 for the reduction of the substances listed below. The concentration of the indicated substances in the water entering the system was reduced to a concentration less than or equal to the permissible limit for water leaving the system, as specified in NSF/ANSI 42, 53 and 401.

NSF/ANSI Standard 42

Substance	Influent Challenge Concentration	Maximum Permissible Product water Concentration	Reduction Requirements	Minimum Reduction	Average Reduction
Aesthetic Chlorine	2.0 mg/L + 10%		>50%	96.0%	97.9%
Aesthetic Chloramines	3.0 mg/L + 10%	0.5 mg/L		96.0%	97.9%
Particulate (0.5 - < um) Class I	At least 10,000 particles/mL		>85%	99.9%	99.9%

Flow Rate = 0.5 gpm (1.89 Lpm)
Capacity = 1,000 gallons (3786 L)

NSF/ANSI Standard 53

Substance	Influent Challenge Concentration	Maximum Permissible Product water Concentration	Reduction Requirements	Average Reduction
MTBE	0.015 + 20%	0.005 mg/L		96.4%
Cyst †	Minimum 50,000/L		99.95%	99.99%
Turbidity	11 mg/L + 1 NTU	0.5 NTU		99.1%
Lead (pH 6.5)	0.15 mg/L + 10%	0.010 mg/L		99.3%
Lead (pH 8.5)	0.15 mg/L + 10%	0.010 mg/L		99.3%
Mercury (pH 6.5)	0.006 mg/L + 10%	0.002 mg/L		96.7%
Mercury (pH 8.5)	0.006 mg/L + 10%	0.002 mg/L		95.9%
Chloroform (VOC surrogate chemical)	0.300 mg/L + 10%	0.015 mg/L		99.6%
Perfluooroctanoic acid (PFOA) and Perfluorooctane sulfonate (PFOS)	1.5 µg/L ± 10%	0.07 µg/L		> 95.8%

Flow Rate = 0.5 gpm (1.89 Lpm)
Capacity = 1,000 gallons (3786 L)
† Based on the use of microspheres or Cryptospordium parvum oocysts
Testing was performed under standard laboratory conditions, actual performance may vary.

NSF/ANSI Standard 401

Substance	Common Names	Influent Challenge Concentration	Maximum Permissible Product water Concentration	Average Reduction
Phenytoin	Dilantin[1]	200 ng/L ± 20%	30 ng/L	> 95.6%
Ibuprofen	Motrin[1]	400 ± 20%	60 ng/L	> 95.4%
Naproxen	Aleve[1]	140 ± 20%	20 ng/L	> 96.4%
Estrone	Estrogen	140 ± 20%	20 ng/L	> 96.5%
Bisphenol A	BPA	2,000 ± 20%	300 ng/L	> 98.9%
Nonylphenol	Surfactant	1,400 ± 20%	200 ng/L	> 97.5%

Flow Rate = 0.5 gpm (1.89 Lpm)
Capacity = 1,000 gallons (3786 L)
NSF/ANSI Standard 401 are considered incidental contaminants and emerging compounds.
[1]Dilantin is a registered trademark of Pfizer Inc. Motrin is a registered trademark of Johnson & Johnson Consumer Inc. Aleve is a registered trademark of Bayer.

Organic Chemicals Included in Surrogate Testing:

Applies to Total Defense (TD) only.

Substance	Influent Challenge Concentration mg/L	Maximum permissible product water concentration mg/L
Alachor	0.050	0.001
Atrazine	0.100	0.003
Benzene	0.081	0.001
Carbofuran	0.190	0.001
Carbon Tetrachloride	0.078	0.002
Chlorbenzene	0.077	0.001
Chlorpicrin	0.015	0.000
2,4-d	0.110	0.002
Dibromochloropropane (Dbcp)	0.052	0.000
O-Dichlorobenzene	0.080	0.001
P-Dichlorobenzene	0.040	0.001
1,2-Dichloroethane	0.088	0.005
1,1-Dichloroethylene	0.083	0.001
Cis-1,2-Dichloroethylene	0.170	0.001
Trans-1,2-Dichloroethylene	0.086	0.001
1,2-Dichloropropane	0.080	0.001
Cis-1,3-Dichloropropylene	0.079	0.001
Dinoseb	0.170	0.000
Endrin	0.053	0.001
Ethylbenzene	0.088	0.001
Ethylene Dibromide (Edb)	0.044	0.000
Haloacetonitriles (Han):		
Bromochloroacetonitrile	0.022	0.001
Dibromoacetonitrile	0.024	0.001
Dichloroacetonitrile	0.001	0.000
Trichloracetonitrile	0.015	0.000
Haloketones (Hk):		
1,1-Dichloro-2-propane	0.007	0.000
1,1,1-Trichloro-2-propane	0.008	0.000
Heptachlor	0.250	0.000
Heptachlor Epoxide	0.011	0.000
Hexachlorobutadiene	0.044	0.001
Hexachlorocyclopentadiene	0.060	0.000
Lindane	0.055	0.000
Methoxychlor	0.050	0.000
Pentachloophenol	0.096	0.001
Simazine	0.120	0.004

Substance	Influent Challenge Concentration mg/L	Maximum permissible product water concentration mg/L
Styrene	0.150	0.001
1,1,2,2-Tetrachloroethane	0.081	0.001
Tetrachloroethylene	0.081	0.001
Toluene	0.078	0.001
2,4,5-tp (Silvex)	0.270	0.002
Tribromoacetic Acid	0.042	0.001
1,2,4-Trichlorobenzene	0.160	0.001
1,1,1-Trichloroethane	0.084	0.005
1,1,2-Trichloroethane	0.150	0.001
Trichloroethylene	0.180	0.001
Trihalomethanes (Includes):		
Chloroform (Surrogate Chemical)		
Bromoform	0.300	0.015
Bromodichloromethane		
Chlorodibromomethane		
Xylenes (Total)	0.070	0.001

AS3 (P/N P1020272)

The AS3 has been tested according to NSF/ANSI 53 for the reduction of the substances listed below. The concentration of the indicated substances in the water entering the system was reduced to a concentration less than or equal to the permissible limit for water leaving the system, as specified in NSF/ANSI 53. Conforms to NSF/ANSI Standard 53 for arsenic (pentavalent) reduction. See Arsenic Fact section for an explanation of reduction performance.

Substance	Influent Challenge Concentration mg/L	Maximum Permissible Product water Concentration mg/L	Reduction Requirements	Minimum Reduction	Average Reduction
Standard 53					
Pentavalent Arsenic	0.050 + 10%	0.010			97.4%

Flow Rate = 0.035 gpm (0.13 Lpm)
Capacity = 1000 gallons (3786 L)
1000 gallon capacity is only for use with PID
Testing was performed under standard laboratory conditions, actual performance may vary

RO30 (P/N 01020268)

This system has been tested according to NSF/ANSI 58 for the reduction of the substances listed below. The concentration of the indicated substances in water entering the system was reduced to a concentration less than or equal to the permissible limit for water leaving the system, as specified in NSF/ANSI 58.

This system is acceptable for treatment of influent concentrations of no more than 27 mg/L nitrate and 3 mg/L nitrite in combination measured as N and is certified for nitrate/nitrite reduction only for water supplies with a pressure of 280 kPa (40 psig) or greater.

Substance Reduction[1]

Contaminant	Average Influent Concentration mg/L	Average Effluent Concentration mg/L	Average Percent Reduction	Maximum Effluent Concentration mg/L
Arsenic (Pentavalent)[2]	0.053	0.001	97.6%	0.003
Barium	11.0	0.37	96.6%	0.49
Cadmium	0.031	0.0004	98.7%	0.0005
Hexavalent Chromium	0.31	0.011	96.4%	0.014
Trivalent Chromium	0.31	0.005	98.5%	0.007
Copper	3.0	0.02	99.3%	0.033
Fluoride	8.2	0.4	94.5%	0.7
Lead	0.16	0.002	99.0%	0.002
Nitrate/ Nitrite (both as N)	30 +/- 10%		79.1%	
Nitrate[5]	27.0 +/- 10%	10.0	79.6%	
Nitrite	3.0 +/- 10%	1.0	72.6%	
Radium 226/228[3]	25pCi/L	5pCi/L	80.0%	5pCi/L
Selenium	0.097	0.003	97.3%	0.004
Cyst[4]	>50,000/mL		99.99%	
Turbidity	11 NTU	0.1 NTU	99.1%	0.1 NTU

[1] While testing was performed under standard laboratory conditions, actual performance may vary depending on water pressure, temperatures and other substances, which may be found in your water.
[2] This system has been tested for the treatment of water containing pentavalent arsenic (also known as As(V), As(+5) or arsenate) at concentrations of 0.050 mg/L or less. This system reduces pentavalent arsenic, but may not remove other forms of arsenic. This system is to be used on water supplies containing a detectable free chlorine residual at the system inlet or on water supplies that have been demonstrated to contain only pentavalent arsenic. Treatment with chloramines (combined chlorine) is not sufficient to ensure complete conversion of trivalent arsenic to pentavalent arsenic. Please see the Arsenic Facts Sheet for further information.
[3] Based upon testing methods using Barium as a surrogate. All concentrations in pCi/L pico curie/L.
[4] Includes Giardia lamblia, Entamoeba histolyca and Cryptosporidium.
[5] Units are not certified on water supplies with a pressure less than 40 psi (280 kPa). A booster pump is strongly recommended.

RO50 (P/N 01020270)

This system has been tested according to NSF/ANSI 58 for the reduction of the substances listed below. The concentration of the indicated substances in water entering the system was reduced to a concentration less than or equal to the permissible limit for water leaving the system, as specified in NSF/ANSI 58.

This system is acceptable for treatment of influent concentrations of no more than 27 mg/L nitrate and 3 mg/L nitrite in combination measured as N and is certified for nitrate/nitrite reduction only for water supplies with a pressure of 280 kPa (40 psig) or greater.

Substance Reduction[1]

Contaminant	Average Influent Concentration mg/L	Average Effluent Concentration mg/L	Average Percent Reduction	Maximum Effluent Concentration mg/L
Arsenic (Pentavalent)[2]	0.053	0.001	97.6%	0.003
Barium	11.0	0.37	96.6%	0.49
Cadmium	0.031	0.0004	98.7%	0.0005
Hexavalent Chromium	0.31	0.011	96.4%	0.014
Trivalent Chromium	0.31	0.005	98.5%	0.007
Copper	3.0	0.02	99.3%	0.033
Fluoride	8.2	0.4	94.5%	0.7
Lead	0.16	0.002	99.0%	0.002
Nitrate/ Nitrite (both as N)	30 +/- 10%		83.5%	
Nitrate[5]	27.0 +/- 10%	10.0	84.3%	
Nitrite	3.0 +/- 10%	1.0	74.6%	
Radium 226/228[3]	25pCi/L	5pCi/L	80.0%	5pCi/L
Selenium	0.097	0.003	97.3%	0.004
Cyst[4]	>50,000/mL		99.99%	
Turbidity	11 NTU	0.1 NTU	99.1%	0.1 NTU

[1] While testing was performed under standard laboratory conditions, actual performance may vary depending on water pressure, temperatures and other substances, which may be found in your water.
[2] This system has been tested for the treatment of water containing pentavalent arsenic (also known as As(V), As(+5) or arsenate) at concentrations of 0.050 mg/L or less. This system reduces pentavalent arsenic, but may not remove other forms of arsenic. This system is to be used on water supplies containing a detectable free chlorine residual at the system inlet or on water supplies that have been demonstrated to contain only pentavalent arsenic. Treatment with chloramines (combined chlorine) is not sufficient to ensure complete conversion of trivalent arsenic to pentavalent arsenic. Please see the Arsenic Facts Sheet for further information.
[3] Based upon testing methods using Barium as a surrogate. All concentrations in pCi/L pico curie/L.
[4] Includes Giardia lamblia, Entamoeba histolyca and Cryptosporidium.
[5] Units are not certified on water supplies with a pressure less than 40 psi (280 kPa). A booster pump is strongly recommended.

Output (Total Dissolved Solids (TDS) Reduction and Output Production)[1] – RO30

Tank Size	2 gallon	3 gallon	9 gallon
Product System Daily Prod. Rate To Pressurized Storage Tank	11.27 gpd	11.27 gpd	11.27 gpd
Prod. Rate without Storage Tank To Atmosphere	36 gpd	36 gpd	36 gpd
Efficiency Rating[2]	16.23%	16.23%	16.23%
Recovery Rating[3]	30.41%	30.41%	30.41%
Influent Challenge Concentration (Mg/L)	770	770	770
Max. Permissible Product Water Concentration (Mg/L)	187	187	187
Minimum Percent Removal	95.5%	95.5%	95.5%
Average Percent Removal	96.0%	96.0%	96.0%

[1] This is a factory specification for membrane production. Actual production rate and TDS rejection will depend on temperature, water pressure, TDS level, membrane variation and usage pattern.

[2] Efficiency rating means the percentage of the influent water to the system that is available to the user are reverse osmosis treated water under operating conditions that approximate daily usage.

[3] Recovery rating means the percentage of the influent water to the membrane portion of the system that is available to the user as reverse osmosis treated water when the system is operated without a storage tank or when the storage tank is bypassed.

Output (Total Dissolved Solids (TDS) Reduction and Output Production)[1] – RO50

Tank Size	2 gallon	3 gallon	9 gallon
Product System Daily Prod. Rate To Pressurized Storage Tank	13.93 gpd	13.93 gpd	13.93 gpd
Prod. Rate without Storage Tank To Atmosphere	50 gpd	50 gpd	50 gpd
Efficiency Rating[2]	15.79%	15.79%	15.79%
Recovery Rating[3]	32.55%	32.55%	32.55%
Influent Challenge Concentration (Mg/L)	770	770	770
Max. Permissible Product Water Concentration (Mg/L)	187	187	187
Minimum Percent Removal	94.4%	94.4%	94.4%
Average Percent Removal	96.8%	96.8%	96.8%

[1] This is a factory specification for membrane production. Actual production rate and TDS rejection will depend on temperature, water pressure, TDS level, membrane variation and usage pattern.

[2] Efficiency rating means the percentage of the influent water to the system that is available to the user are reverse osmosis treated water under operating conditions that approximate daily usage.

[3] Recovery rating means the percentage of the influent water to the membrane portion of the system that is available to the user as reverse osmosis treated water when the system is operated without a storage tank or when the storage tank is bypassed.

Testing Conditions (Complete System)

Temperature: 77° F + 2° F

pH: 7.5 + 0.5

Pressure: 50 psi

Turbidity: <1 NTU

This system has been tested and shown to operate at its calculated recovery rating under standard laboratory conditions.

This reverse osmosis system contains a replaceable component critical to the efficiency of the system. Replacement of the reverse osmosis component should be with one of identical specifications, as defined by the manufacturer, to assure the same efficiency and contaminant reduction performance.

The Aqua-Cleer Advanced Drinking Water System with CB, GAC, or GAC-L cartridge has been certified by IAPMO R&T against NSF/ANSI Standard 42 and CSA B483.1 for the effective reduction of aesthetic Chlorine Taste and Odor.[1]

The Aqua-Cleer Advanced Drinking Water System with TD cartridge has been certified by IAPMO R&T against CSA B483.1 and NSF/ANSI Standard 42 for the effective reduction of aesthetic Chlorine Taste and Odor and Nominal Particulate Class 1, against NSF/ANSI Standard 53 for the effective reduction of Cyst, Lead, Mercury, VOC, MTBE, Turbidity, Perfluorooctanoic acid (PFOA) and Perfluorooctane sulfonate (PFOS), against NSF/ANSI Standard 401[2] for the effective reduction of Phenytoin, Ibuprofen, Naproxen, Estrone, Bisphenol A and Nonylphenol.

The Aqua-Cleer Advanced Drinking Water System with RO30 or RO50 has been certified by IAPMO R&T against NSF/ANSI Standard 58 and CSA B483.1 for the effective reduction of TDS, pentavalent arsenic, barium, cadmium, hexavalent and trivalent chromium, copper, lead, nitrate/nitrite, radium 226/228 and selenium.[3]

The Aqua-Cleer Advanced Drinking Water System with AS3 has been certified by IAPMO R&T against NSF/ANSI Standard 53 and CSA B483.1 for the effective reduction of arsenic (pentavalent) when following an RO.

The Aqua-Cleer Advanced Drinking Water System with Mineral Boost cartridge has been certified by IAPMO R&T against NSF/ANSI 42 and CSA B483.1 for material safety and structural integrity only.

Refer to your Installation and Operating Instructions and printed limited Warranties (01020485) for more specific product information. To avoid contamination from improper handling and installation, your system should only be installed and serviced by your Culligan Man. Performance will vary based on local water conditions. The substances reduced by these systems are not necessarily in your water.

To maintain product certification and ensure uniform performance, the product is retested on a consistent basis.

[1]Reduction claims and capacity not applicable when used as a prefilter to the Aqua-Cleer RO system.

[2]NSF/ANSI Standard 401 are considered incidental contaminants and emerging compounds.

[3]The concentration of the indicated substances in water entering the system was reduced to a concentration less than or equal to the permissible limit for water leaving the system as specified in NSF/ANSI 58

The following Aqua-Cleer Advanced Drinking Water System models are registered for sale with the State of California and/or the State of Iowa.

Model	Registration Number	
	California	Iowa
Aqua-Cleer Advanced Drinking Water System with RO30 with a 2 gallon tank	1954	20526
Aqua-Cleer Advanced Drinking Water System with RO30 with a 3 gallon tank	1928	20526
Aqua-Cleer Advanced Drinking Water System with RO30 with a 9 gallon tank	1955	20526

Model	Registration Number	
	California	Iowa
Aqua-Cleer Advanced Drinking Water System with RO30 and TD catridge with a 2 gallon tank	1958	20527
Aqua-Cleer Advanced Drinking Water System with RO30 and TD catridge with a 3 gallon tank	1944	20527
Aqua-Cleer Advanced Drinking Water System with RO30 and TD catridge with a 9 gallon tank	1959	20527
Aqua-Cleer Advanced Drinking Water System with TD catridge with a 2 gallon tank	1956	20530
Aqua-Cleer Advanced Drinking Water System with a TD catridge with a 3 gallon tank	1947	20530
Aqua-Cleer Advanced Drinking Water System with TD catridge with a 9 gallon tank	1957	20530
Aqua-Cleer Advanced Drinking Water System with RO30 and AS3 catridge with a 2 gallon tank	1960	20531
Aqua-Cleer Advanced Drinking Water System with RO30 and AS3 catridge with a 3 gallon tank	1948	20531
Aqua-Cleer Advanced Drinking Water System with RO30 and AS3 catridge with a 9 gallon tank	1961	20531
Aqua-Cleer Advanced Drinking Water System with RO30, TD cartridge and AS3 catridge with a 2 gallon tank	1962	20532
Aqua-Cleer Advanced Drinking Water System with RO30, TD cartridge and AS3 catridge with a 3 gallon tank	1949	20532
Aqua-Cleer Advanced Drinking Water System with RO30, TD cartridge and AS3 catridge with a 9 gallon tank	1963	20532
Aqua-Cleer Advanced Drinking Water System with RO30 and PER catridge with a 2, 3 or 9 gallon tank	Not Available for Sale	20533
Aqua-Cleer Advanced Drinking Water System with RO30, TD cartridge and PER catridge with a 2, 3 or 9 gallon tank	Not Available for Sale	20534
Aqua-Cleer Advanced Drinking Water System with RO50 with a 2, 3 or 9 gallon tank	Not Available for Sale	20528
Aqua-Cleer Advanced Drinking Water System with RO50 and TD catridge with a 2, 3 or 9 gallon tank	Not Available for Sale	20529
Aqua-Cleer Advanced Drinking Water System with RO50 and AS3 catridge with a 2, 3 or 9 gallon tank	Not Available for Sale	20535
Aqua-Cleer Advanced Drinking Water System with RO50, TD cartridge and AS3 catridge with a 2, 3 or 9 gallon tank	Not Available for Sale	20536
Aqua-Cleer Advanced Drinking Water System with RO50 and PER catridge with a 2, 3 or 9 gallon tank	Not Available for Sale	20537
Aqua-Cleer Advanced Drinking Water System with RO50, TD cartridge and PER catridge with a 2, 3 or 9 gallon tank	Not Available for Sale	20538

Arsenic Fact Sheet

Arsenic (abbreviated As) is found naturally in some well water. Arsenic in water has no color, taste or odor. It must be measured by a lab test. Public water utilities must have their water tested for arsenic. You can get the results from your water utility. If you have your own well, you can have the water tested. The local health department or the state environmental health agency can provide a list of certified labs. The cost is typically $15 - $30. Information about arsenic in water can be found on the internet at the US Environmental Protection Agency website: www.epa.gov/safewater/arsenic.html.

There are two forms of arsenic: pentavalent arsenic (also called As (v), As (+5), and arsenate) and trivalent arsenic (also called As (III), As (+3), and arsenite). In well water, arsenic may be pentavalent, trivalent, or a combination of both. Special sampling procedures are needed for a lab to determine what type and how much of each type of arsenic is in the water. Check with the labs in your area to see if they can provide this type of service.

Reverse osmosis (RO) water treatment systems do not remove trivalent arsenic from water very well. RO systems are very effective at removing pentavalent arsenic. A free chlorine residual will rapidly convert trivalent arsenic to pentavalent arsenic. Other water treatment chemicals such as ozone and potassium permanganate will also change trivalent arsenic to pentavalent arsenic. A combined chlorine residual (also called chloramine) may not convert all the trivalent arsenic. If you get water from a public water utility, contact the utility to find out if free chlorine or combined chlorine is used in the water system.

The Aqua-Cleer system is designed to remove pentavalent arsenic. It will not convert trivalent arsenic to pentavalent arsenic. The system was tested in a lab. Under those conditions, the system reduced 0.050 mg/L (ppm) pentavalent arsenic to 0.010 mg/L (ppm) (the USEPA standard for drinking water) or less. The performance of the system may be different at your installation. Have the treated water tested for arsenic to check if the system is working properly.

The RO component of the Aqua-Cleer system must be replaced every 3-5 years to ensure the system will continue to remove pentavalent arsenic. The component identification and locations where you can purchase the component are listed in the installation/operation manual.

The system has been tested for the treatment of water containing pentavalent arsenic (also known as As (V), As (III), or arsenate) at concentrations of 0.050 mg/L or less. This system reduces pentavalent arsenic, but may not remove other forms of arsenic. This system is to be used on water supplies containing a detectable free chlorine residual or on water supplies that have been demonstrated to contain only pentavalent arsenic. Treatment with chloramine (combined chlorine) is not sufficient to ensure complete conversion of trivalent arsenic to pentavalent arsenic. Please see the Arsenic Fact section of the Performance data Sheet for further information.

Arsenic (As) is a naturally occurring contaminant found in many ground waters. It generally occurs in two forms (valences or oxidation states): pentavalent arsenic (also known as As(V), As(+5), and arsenate) and trivalent arsenic (also known as As(III), As(+3), and arsenite). In natural ground water, arsenic may exist as trivalent arsenic, pentavalent arsenic, or a combination of both. More information about arsenic and its toxicity can be found at the Agency for Toxic Substances and Disease Registry Toxicological Profile on Arsenic website at http://www.atsdr.cdc.gov/toxprofiles/phs2.html, and at the U.S. Environmental Protection Agency website at http://www.epa.gov/safewater/arsenic.html.

Arsenic does not generally impart color, taste, or smell to water; therefore, it can only be detected by a chemical analytical test. Public water supplies are required to monitor delivered water for arsenic (trivalent arsenic plus pentavalent arsenic) and the results are available to the public from the utility. Consumers using private water sources will need to make arrangements for testing. An arsenic test usually costs about $15-30, and it is recommended that the test be conducted by a certified laboratory. Local health departments or environmental protection agencies can help provide consumers with a list of certified laboratories. Some laboratories may also be able to analyze specifically for (speciate) the form(s) of arsenic present in a water sample if requested.

The Aqua-Cleer system with AS3 following an RO is designed to reduce arsenic: both pentavalent and trivalent forms of arsenic. This treatment system was tested under laboratory condition as defined in NSF/ANSI 53 Drinking Water Treatment Units - Health Effects and was found to reduce [influent arsenic challenge concentration 0.050 mg/L] arsenic consisting of either pentavalent or trivalent arsenic in the test water to less than 0.010 mg/L, for [tested treatment capacity] gallons of delivered water, the life of the system under standard testing conditions. Actual performance of the system may vary depending on specific water quality conditions at the consumer's installation. Following installation of this system, the consumer should have the treated water tested for arsenic to verify that arsenic reduction is being achieved and the system is functioning properly.

The arsenic removal component of this system must be replace at the end of its useful life of 1,000 gallons. The replacement components, AS3, RO30, RO50 can be purchased from your local Culligan dealer.

Water Volume and Quality		
Symptom	**Condition**	**Action**
No product water	Water supply is turned OFF	Turn water ON
	Catridge or bypass plug is not in place	Make sure every cartridge position is filled
Not enough product water	Low water pressure	Check source water line pressure
	Inlet water supply valve is blocked	Clear restriction
	Storage tank valve is closed	Open storage tank valve
	Storage tank is depleted	Increase product water storage capacity and/or install membrane with higher output rating
	Clogged pre-filter cartridge(s)	Replace pre-filter cartridge(s)
	Storage tank air pressure charge is low	Empty water from storage tank (product water faucet must remain open while adjusting pressure) and adjust pressure to 55 kPa (8 psig)
System does not shut off	shut-off valve is not closing	Contact your Culligan® dealer
No drain water when system is on	Clogged flow control	Replace flow control (Item 6) in parts list and contact your Culligan® dealer
Water has offensive taste and/or odor	Carbon post-filter is depleted	Drain storage tank, sanitize system, and replace carbon post-filter cartridge
	Membrane depleted or fouled	Quality Monitor reads yellow or if TDS test is unsatisfactory, drain sotrage tank, sanitize system, and replace membrane
	Sanitizer not flushed out	Drain storage tank and let it refill overnight

Leakage		
Symptom	**Probable Cause**	**Solution**
Leak at fitting	Tubing not pushed completely into fitting	Push tube into fitting past O-ring seal
	Defective tube	Cut damaged area from tube or replace tube
	Tubing makes a too-tight bend near fitting	Run the tubing to reduce the bend
Leak at filter housings	O-ring has not seated properly	Remove O-ring and inspect O-ring groove for debris. Clean groove, lubricate, and reset O-ring
	O-ring has nicks or scratches	Replace O-ring
Leak from air ap in faucet	Restricted drain tube	Clear restriction
	Tubing from air gap to drain is routed incorrectly	Reroute tubing so tubing run vertically with no sharp bends or loops

Quality Monitor Status Indications and Common Solutions

Leakage		
Indication	**Condition**	**Action**
Green Light	System operating manually	None
Amber Light	Membrane exhausted	Replace membrane
No Monitor lights	Light assembly is not connected	Plug connector into phone jack
	Battery voltage low	Replace battery
	Battery is not connected	Connect battery

Service Log

Model ______________________ Serial No. ______________________

Date Installed ______________________

For Service Call Culligan at: ______________________

Date Serviced	Cartridge(s) Changed				Sanitized	Specialty Cartridge
	Sediment Filter	Activated Pre-Carbon Filter	RO Membrane	Activated Post-Carbon Filter		

Culligan Lifetime Limited Warranty

Culligan Aqua-Cleer Advanced Drinking Water System

You have just purchased one of the finest drinking water systems made. As an expression of our confidence in Culligan products, your drinking water system is warranted to the original end-user, when installed in accordance with Culligan International Company specifications, against defects in material and workmanship from the date of original installation, as follows:

For the LIFETIME of the original end-user	The entire reverse osmosis water conditioning unit, EXCLUDING THE EXPENDABLE FILTER CARTRIDGES AND REVERSE OSMOSIS MEMBRANE FILTER USED IN THE UNIT.
For a period of ONE YEAR	The Culligan brand reverse osmosis membrane filter.

If a part described above is found defective within the specified period, you should notify your independently operated Culligan dealer and arrange a time during normal business hours for the dealer to inspect the drinking water system on your premises. Any part found defective within the terms of this warranty will be repaired or replaced by the dealer. You pay only freight from our factory and local dealer charges.

Damage caused by accident, fire, flood, freezing, Act of God, misuse, misapplication, neglect, alteration, installation or operation contrary to our printed instructions, or by the use of accessories or components which do not meet Culligan specifications, is not covered by this warranty.

Our product performance specifications are furnished with each drinking water system. TO THE EXTENT PERMITTED BY LAW, CULLIGAN DISCLAIMS ALL IMPLIED WARRANTIES INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE; TO THE EXTENT REQUIRED BY LAW, ANY SUCH IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE ONE-YEAR PERIOD SPECIFIED ABOVE FOR THE PARTS DESCRIBED IN THIS LIMITED WARRANTY. As manufacturer, we do not know the characteristics of your water supply or the purpose for which you are purchasing a drinking water system. Please understand that the quality of water supplies may vary seasonally or over a period of time, and that your water usage rate may vary as well. Water characteristics can also change considerably if your drinking water system is moved to a new location. For these reasons, we assume no liability for the determination of the proper equipment necessary to meet your requirements, and we do not authorize others to assume such obligations for us. Further, we assume no liability and extend no warranties, express or implied, for the use of this product on a non-potable water source. OUR OBLIGATIONS UNDER THIS WARRANTY ARE LIMITED TO THE REPAIR OR REPLACEMENT OF THE FAILED PARTS OF THE DRINKING WATER SYSTEM, AND WE ASSUME NO LIABILITY WHATSOEVER FOR DIRECT, INCIDENTAL, CONSEQUENTIAL, SPECIAL, GENERAL, OR OTHER DAMAGES, WHETHER FROM CORROSION OR OTHER CAUSES.

CONSUMERS:

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. Similarly, some states do not allow the exclusion of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. Consult your telephone directory for your local independently-operated Culligan dealer, or write Culligan International Company, for warranty and service information.

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