MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
SOUTHEAST REGIONAL OFFICE
DRINKING WATER PROGRAM
SITE INSPECTION SUMMARY

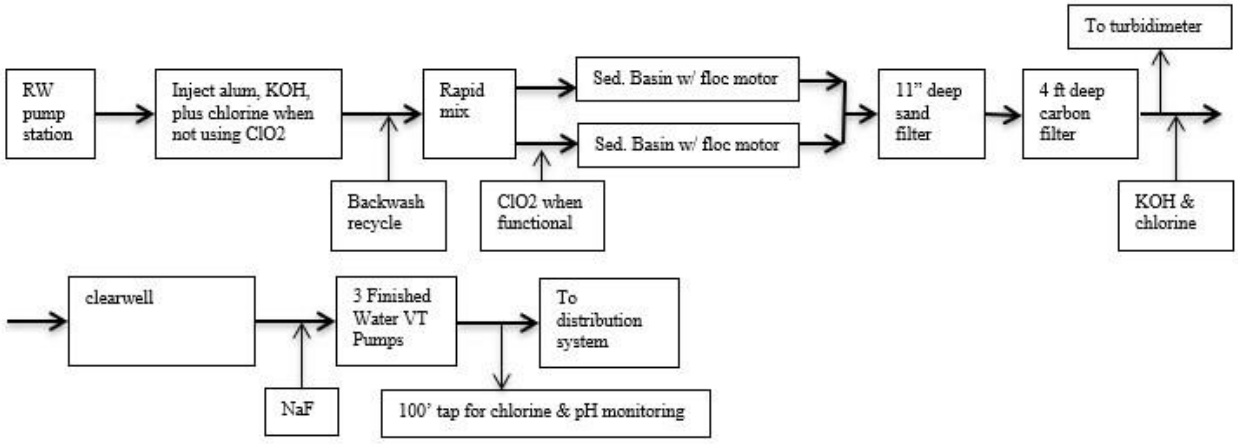
Public Water System (PWS):	Scituate Water Division Old Oaken Bucket Surface Water Treatment Plant 4 Old Oaken Bucket Road, Scituate, Massachusetts
PWS ID:	4264000
SUBJECT:	Inspection Of Old Oaken Bucket Surface Water Treatment Plant
DEP INSPECTORS:	Scott Sayers, EA IV; Kathryn Sousa, EA III/T4; William Schwartz, EAIII/T4.
INSPECTION DATE:	Wednesday, August 17, 2022
SCITUATE REPRESENTATIVES:	Sean Anderson, Water Superintendent Eric Langlan, Chief Treatment Operator, T3
SUMMARY REVIEWER:	Jim McLaughlin, SERO Drinking Water Program Chief
SUMMARY DATE:	Monday, August 29, 2022

PURPOSE:

The Massachusetts Department of Environmental Protection (MassDEP) Southeast Regional Office (SERO) Drinking Water Program (DWP) began receiving discolored water complaint calls and emails from Scituate residents on July 1, 2022. The Scituate Water Division (Scituate) stated that the discoloration is caused by high manganese levels in the reservoir associated with the Old Oaken Bucket (OOB) surface water treatment plant. Due to the long persistence of the problem, MassDEP SERO DWP conducted a technical assistance inspection on Wednesday, August 17, 2022. MassDEP inspectors included an Environmental Analyst with a decade of experience managing the Surface Water Treatment Rule (SWTR), and two Environmental Analysts who are each licensed as level 4 Drinking Water Treatment Operators with experience operating a large surface water treatment plant.

The MassDEP inspectors conducted a thorough review of the plant process. The plant was constructed in 1967 and has been modified since. The design of the plant lacks any redundancy, and the entire plant must be shut down for any major maintenance. The plant consists of a sedimentation basin followed by a single sand filter and a single carbon filter bed. Scituate cannot meet system demand, especially in the summer months, without operating the OOB Treatment Plant.

The OOB Treatment Plant is operating in compliance with the Surface Water Treatment Rule (SWTR) and is generally adequate at removing total organic carbon (TOC) and pathogens, but was not designed for manganese removal. Testing has determined that manganese (Mn) is the source of the discolored water. The water quality in the OOB Reservoir is very poor due to high levels of naturally occurring manganese. The poor water quality is characterized by discolored water and levels of manganese above the Secondary Maximum Contaminant Level (SMCL) of 0.05 milligrams per liter (mg/L). SMCLs are guidance values issued by the U.S. Environmental Protection Agency (EPA) that are levels of chemicals or parameters above which the aesthetic properties of the water can be affected (e.g., taste, odor, color) or cosmetic effects may occur (e.g., skin or tooth discoloration). Manganese also has a Health Advisory level of 0.3 mg/l. (MassDEP recommends that infants up to 1 year of age should not be given water with manganese concentrations greater than 0.3 mg/L for more than a total of 10-days in a year, nor should the water be used to make formula for more than a total of 10-days in a year. The recommended water concentration limit for lifetime exposures to manganese is 0.3 mg/L.) The poor water quality has been exacerbated by a past practice of pumping a groundwater source (Well 17A), which is high in manganese, directly into the reservoir. The OOB Reservoir likely has a high manganese load in sediments because of this practice. Well 17A is currently treated at a newly constructed treatment plant that produces high quality water pumped directly into the distribution system.



INSPECTION FINDINGS:

- The treatment plant is supported by three reservoirs, Tack Factory Pond, The Reservoir, and Old Oaken Bucket Pond. Old Oaken Bucket Pond, the lowest reservoir where water is withdrawn for treatment, has a shallow water column at approximately 3 to 5 feet deep. The Reservoir, the upper and largest reservoir, is up to 15-feet deep. These water sources are along First Herring Brook.

- The system is restricted as to how much water can be transferred from the upper reservoir to fill the lower (OOB) reservoir to prevent flooding of properties near the lower reservoir. It is also important to maintain storage in the upper reservoir to augment supply during drought conditions.

- The intake to the treatment plant is a 12-inch stainless steel screened pipe that is just above the bottom of the lower reservoir. It is cleaned (blown off) via air scour once per week; however, it has never been visually inspected by underwater divers.

- There is an older (1960s original) parallel intake pipe of unknown condition that cannot be gated off from the intake wet well. The gate is original to the plant and does not operate. No blow off is possible and no visual inspection has been done.

- The manganese problem is most significant during the summer/warmer weather months.

- The OOB Reservoir is heavily vegetated along the shore which contributes organic matter to the reservoir from leaf litter, fall brush die-off, branches, etc.

- A May, 2003 report titled, "Town of Scituate Drinking Water Supply & Demand Analysis," by Comprehensive Environmental Inc., identified dredging feasibility for each of the three reservoirs. Dredging of the reservoir system was recommended by the report but never conducted by the Town.

- Operators conduct the necessary testing (jar testing) to get optimal flocculant (floc) formation in the sedimentation basin to remove solids.

- Primary disinfection with chlorine dioxide is accomplished by injection at the bottom of the beginning portion of the sedimentation basin. This is not ideal and may enhance the production of disinfection by-products. According to MassDEP's 2008 Comprehensive Performance Evaluation (CPE), it may be possible to achieve disinfection contact time with chlorine alone in the post-filter location.

- In order to remove sludge from the sedimentation basin, the plant must be shut down for the track vacuum sludge removal system to operate. After the track vacuum completes one round trip of the basin, it must be allowed to settle before the plant is brought back online. This is generally done overnight.

- The plant has three (3) 15,000-gallon backwash tanks.

- As part of the treatment, the water is passed through a four (4) foot deep carbon filter (regenerated in winter 2022), and an 11-inch deep sand filter (sand replaced in 2019).

- The sand filter cannot be adequately backwashed. There is no up-flow of clean water from the bottom of the filter to wash the media. Solids are removed from the top by a continuously cycling tracked suction system that vacuums water from the top of the filters. This water is recycled back to the head of the plant with no provision for the settling of solids. This increases the load on the plant.

- The clearwell is divided into two sections, the first beneath the carbon filter, and the second beneath the sand filter. The first section is not accessible and has never been inspected or cleaned. It is likely filled with precipitated manganese, filter media and other sludge and should be cleaned to reduce the level of manganese in the finished water.

- The effluent from the carbon filter (Figure 1) is clear and colorless in appearance. After chlorination, the clearwell effluent (Figure 2) has a noticeable yellow color. The color of the post chlorination sample is from manganese precipitating out of solution. The operators report that the degree of discoloration is variable and is sometimes much worse than pictured. Post chlorination for disinfection is required by the surface water treatment rule (SWTR) and cannot be eliminated.

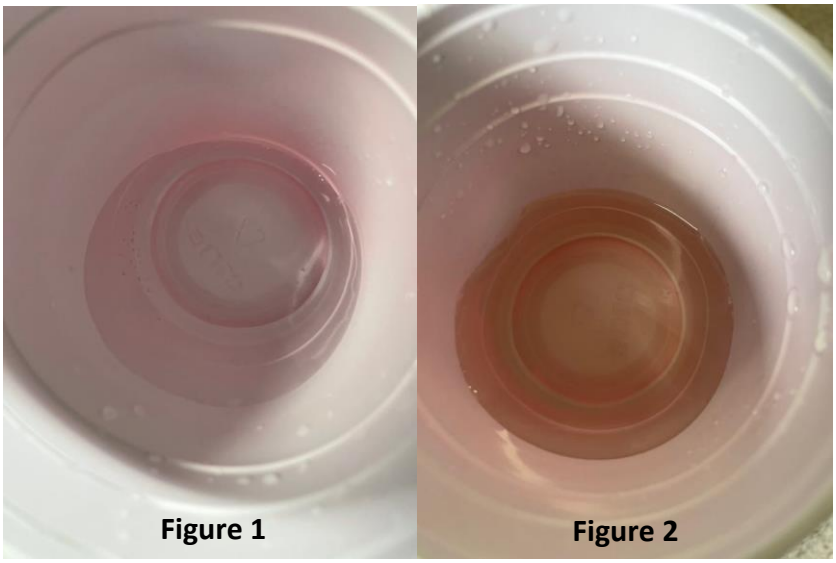


Figure 1 **Figure 2**

- The temporary greensand filtration vessels housed in the shop area and formerly used to treat the groundwater from Well 17A may be of use to further treat the effluent from the OOB Plant. That would require changing the media and may limit the flow rate of the plant. The post chlorination from the plant may enhance this filtration, and should the system achieve contact time post-filtration, it would be able to use contact time through the filters and the associated piping for that purpose.

- Maintaining a lower flow through the plant in combination with the proposed manganese filters may provide improved water quality for the costumers as an interim measure until new plant is built in three to four years.

- The system is currently replacing about 2 miles of old water main per year. Given their condition, the water mains are likely adversely affecting water quality.

- Flushing is done twice per year provided sufficient water is available. Water used for flushing is of generally poor quality due to the necessity of using the water from the OOB Plant.

- Distribution system tanks are cleaned out every 3 years, and generally thick sediment is found to have accumulated in the tanks.

CONCLUSIONS:

The inspection identified that the discolored water issues experienced by the customers of the Scituate Water Division are the result of the limitations of the Old Oaken Bucket Treatment Plant. The aging plant, with its outdated design and treatment process, is operating at or possibly beyond the limits of its capability. The operators of the plant are skilled at running the plant and their efforts are clearly prolonging its viability. A permanent solution to the water quality problems associated with the system requires the construction of a new surface water treatment plant which is currently under design and should be completed in three to four years. Updated technology will vastly improve water quality.

In the meantime, there are some interim measures that can be taken that may improve water quality until a new plant can be designed and constructed. MassDEP will work with the Scituate Water Division and their consultant to implement these measures as feasible (see recommendations below).

RECOMMENDATIONS SUMMARY:

The following actions are recommended short-term measures that could improve the water quality produced at the existing plant until the new plant is constructed and operational.

- Contract divers to visually inspect the intakes. Determine the status of the gate intake with cameras.
- Create and implement a vegetation management plan for the reservoir.
- Begin planning and permitting to dredge the reservoir system.
- Evaluate the effects of achieving contact time with chlorine rather than chlorine dioxide in the post-filter location and conduct tests to determine its impact on manganese precipitation.
- Consider reducing recycle water or redirect to a temporary settling basin.
- Consider mechanical cleaning of the sand filters where build up is present.
- Inspect and clean the first section of the clearwell.
- Continue the evaluation of using the temporary greensand filters with your engineers, Woodard & Curran, on a design for this process.
- Increase frequency of distribution system tank cleaning.