

# CEI Manganese in Groundwater Survey

## July 2013



Manganese has been a nuisance contaminant in drinking waters for many years and over time seems to be impacting more and more groundwater wells. The nuisance effects of manganese in drinking water include staining laundry and water use fixtures, causing metallic or vinyl taste, clogging water filters, and causing objectionable color. Most recently, there have been renewed concerns about the potential health impacts of manganese. For more information about the effects of manganese and potential health impacts, refer to the Informational Fact Sheets and Presentations on the Comprehensive Environmental Inc. (CEI) Innovation webpage dedicated to manganese found under Water Supply using the following link:  
<http://www.ceiengineers.com/innovation.php>

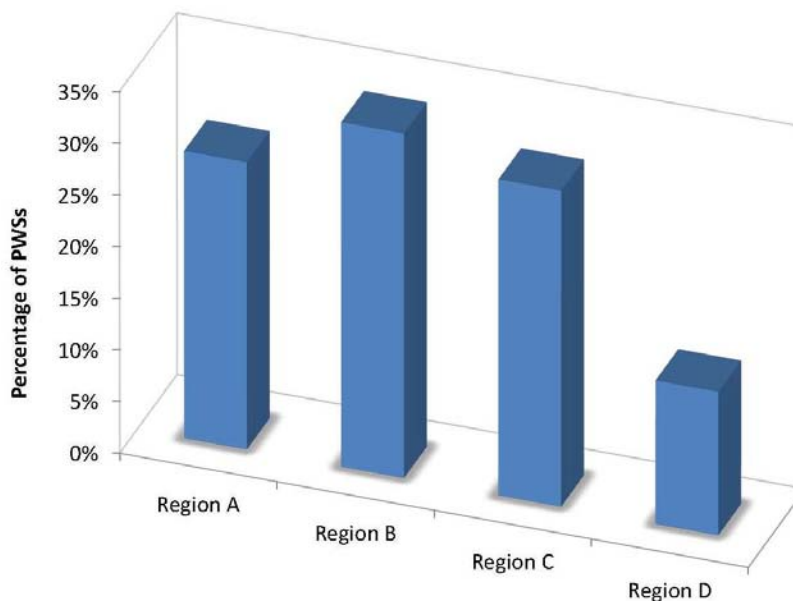
In response to these issues and questions raised by our clients, CEI conducted a survey on manganese in groundwater in May 2013. Select Public Water Suppliers (PWSs) throughout New England were invited to participate. The intent of the survey was to assess the magnitude of the manganese issue within New England groundwaters. Response was voluntary and we received a response rate of approximately 30% from PWSs in Connecticut, Massachusetts, Maine, New Hampshire and Rhode Island.

The responding PWSs have a combined total of 233 wells with the following characteristics:

- Approximately 66% of the wells are tested for manganese each year.
- Approximately 48% of the wells have manganese levels above the 0.05 mg/L Secondary Maximum Contaminant Level (SMCL).
- Approximately 30% of the wells have manganese levels above 0.3 mg/L, which is the EPA Health Advisory level.
- Approximately 22% of the wells have experienced an increase in manganese over time.

We have group the responders into four New England geographic regions for further reduction of the data so that PWSs can see how they compare with nearby water systems. **Figure 1** shows the percentage of responders for each of the four regions.

- **Region A** includes Central Massachusetts and Eastern Connecticut.
- **Region B** includes Northeastern Massachusetts, Southeastern New Hampshire and Coastal Maine.
- **Region C** includes Southeastern Massachusetts and Rhode Island.
- **Region D** includes Western Massachusetts.



**Figure 1. Percentage of Responders from each New England Geographic Region**

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## Summary of Well Data

**Figure 2** shows the percentage of wells tested for manganese each year in the four regions.

The sampling rates range from Region C at 55% to Region D at 80%. All four Regions have a combined total of 233 wells. The combined percentage of testing for manganese among all of the regions is 66%.

**Figure 3** shows the percentage of respondents' wells with manganese levels above the SMCL of 0.05 mg/L and the USEPA Health Advisory Level of 0.3 mg/L.

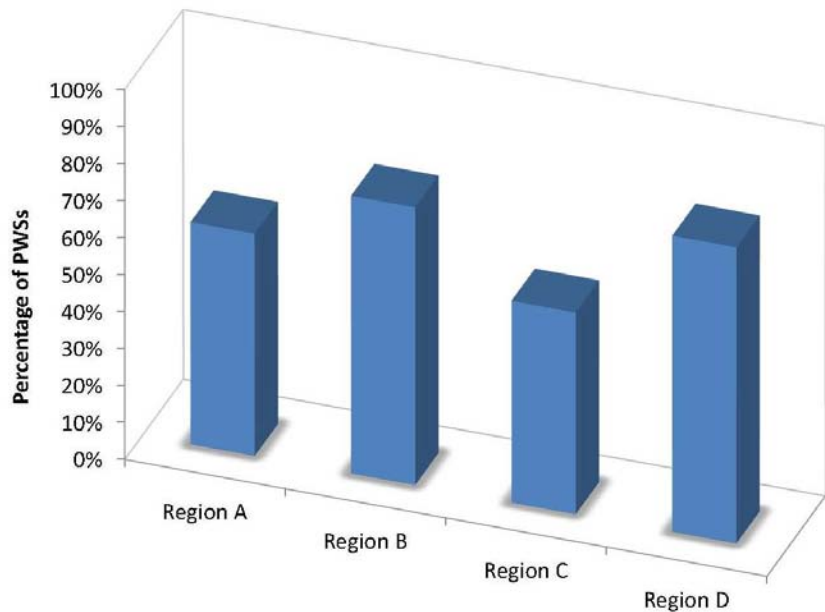
Regions A, C and D have similar percentages of wells, 36% to 46%, with manganese greater than the SMCL of 0.05 mg/L.

Region B has 64% of wells with manganese greater than the SMCL of 0.05 mg/L.

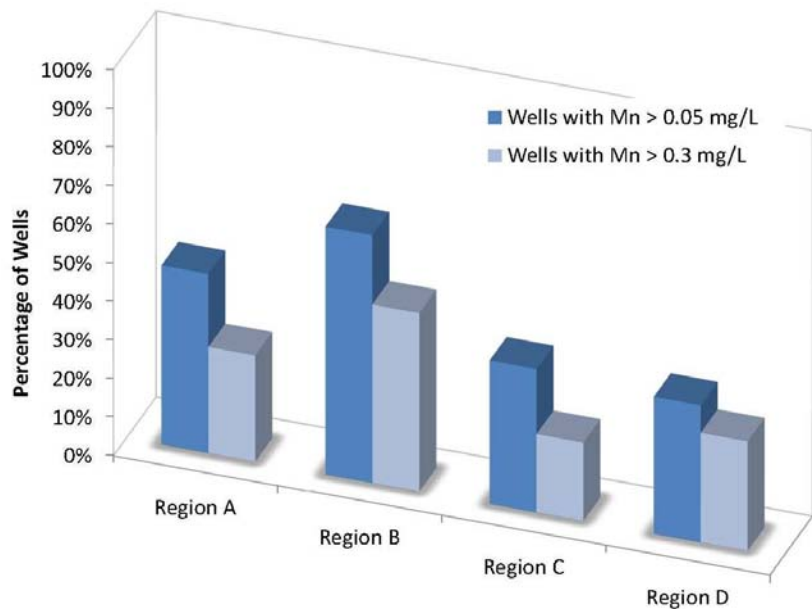
Region B also has the greatest percentage of wells, 46%, with manganese greater than 0.3 mg/L (Health Advisory Level), when compared with rates ranging from 20% to 29% in Regions A, C and D.

## Summary of PWS Data

**Figures 2 and 3** are based upon well data, while **Figures 4 and 5** are based upon the PWSs responding to the survey. The data has been presented in this manner since all of the PWSs responding have more than one well, some wells with manganese and some without.



**Figure 2. Percentage of Wells Tested for Manganese each Year**



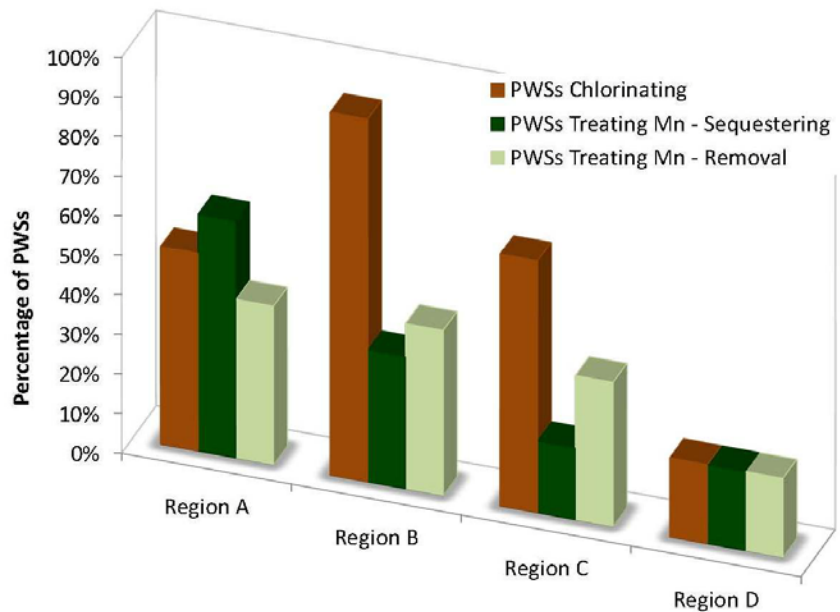
**Figure 3. Percentage of Wells with Manganese greater than 0.05 and 0.3 mg/L**

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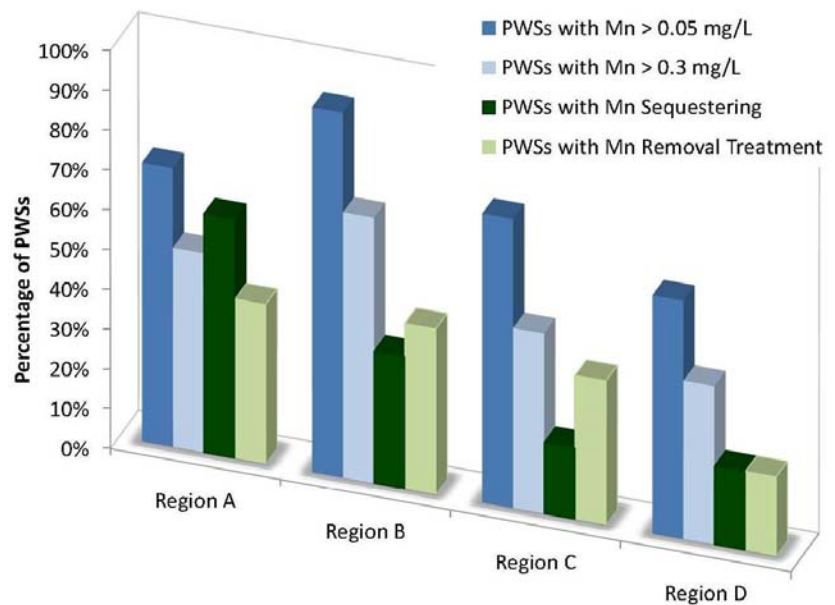
**Figure 4** shows the percentage of systems that chlorinate and/or treat for manganese using sequestering and/or a treatment removal process. Chlorination may create objectionable discoloration of water in the presence of manganese, if the manganese is not being removed through treatment.

These data suggest that many PWSs chlorinate to provide disinfection even though they do not have manganese treatment. For example, 92% of PWSs chlorinate in Region B, while only 42% of PWSs in Region B have any type of treatment process for manganese removal. As more systems are required to implement chlorine for disinfection, the resulting adverse effects from manganese precipitation may result in PWSs implementing manganese removal.

**Figure 5** shows the percentage of PWSs with manganese greater than 0.05 mg/L and 0.3 mg/L and the percentages of PWSs treating manganese with sequestering or removal. Note that the percentages of PWSs with manganese are greater than those with manganese removal treatment, indicating that a number of PWSs do not presently treat for manganese, even though the manganese levels exceed the SMCL. Additionally, systems that presently treat manganese through sequestering (ranging from 18% to 60%) may be impacted by future regulations that address adverse health impacts, since sequestering does not actually remove manganese from the water.



**Figure 4. Percentage of PWSs Chlorinating and/or Treating Manganese**



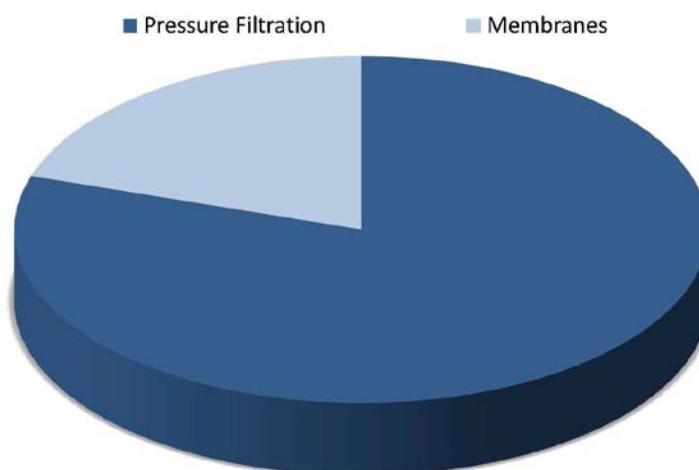
**Figure 5. Percentage of PWSs with Manganese and Manganese Treatment**

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**Figure 6** shows a comparison of the use of pressure filtration and membranes for the PWSs with manganese removal treatment for the responding systems. Pressure filtration has been in use longer than membranes for manganese treatment, however, membranes represent almost a quarter of the manganese removal systems used by the responding PWSs. There is no “one-size-fits-all” treatment process. Each PWS and water source is unique. The selection of which process to use depends on many factors including: raw water quality, treatment goals, site size, operator availability, capital costs, and operations and maintenance costs. These factors require careful evaluation prior to selection of a process.



**Figure 6. Comparison of Use of Pressure Filtration and Membranes for Manganese Removal from Groundwater**

### Summary of Survey

The results of this survey indicate that manganese is prevalent in New England groundwater wells at least in the responding systems, with approximately 48% containing manganese greater than the SMCL of 0.05 mg/L and approximately 30% containing manganese greater than the Health Advisory Level of 0.3 mg/L. Approximately 76% of PWSs have at least one well with manganese greater than 0.05 mg/L and approximately 53% have manganese greater than 0.3 mg/L. While many of these PWSs use removal processes (approximately 37%), some PWSs treat with sequestering alone (approximately 34%) and some PWSs use both removal and sequestering (approximately 13%) with their different sources.

In order to reduce manganese levels in drinking water, treatment removal is required (sequestering is not removal) using processes such as oxidation/filtration, pressure filtration with adsorptive media, membrane filtration, biological filtration, ion exchange and conventional treatment (coagulation/clarification/filtration processes). For more information refer to the Informational Fact Sheets *Manganese Treatment Methods* and *Ability of Processes to Remove Manganese* provided on CEI’s webpage dedicated to manganese found under Water Supply using the following link: <http://www.ceiengineers.com/innovation.php>

CEI is available to assist you in comparing the advantages and disadvantages of treatment methods and completing pilot testing. Our engineers have experience in working with water system suppliers on manganese issues. CEI can work with you to determine which technology is the right fit for your system. For more information, please contact Kristen Berger, P.E., Project Manager at 508-281-5160 x399 or [kberger@ceiengineers.com](mailto:kberger@ceiengineers.com) or Michael Ohl, P.E., Principal at 508-281-5160 x359 or [mohl@ceiengineers.com](mailto:mohl@ceiengineers.com).