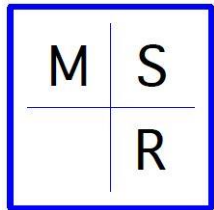




Southern Gulf Islands Ground Water Metals Issues and Solutions



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Michael Day, P. Eng.

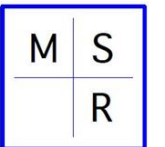
Arash Kanani, Ph.D., P. Eng.

October 25th 2018

Parkville Community
and Conference Centre

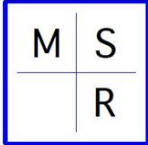


Photo Source: <https://www.fluksaqua.com>



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Southern Gulf Islands

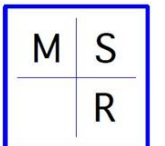


Gulf Islands Groundwater

- Groundwater primary source of drinking water for most small water systems in the Gulf Islands
- Primarily derived from drilled wells in bedrock
- Fe and Mn common groundwater quality issue on Gulf Islands



A resort on Pender Island



A Recent Example



Making a difference...together

Public Service Announcement

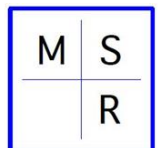
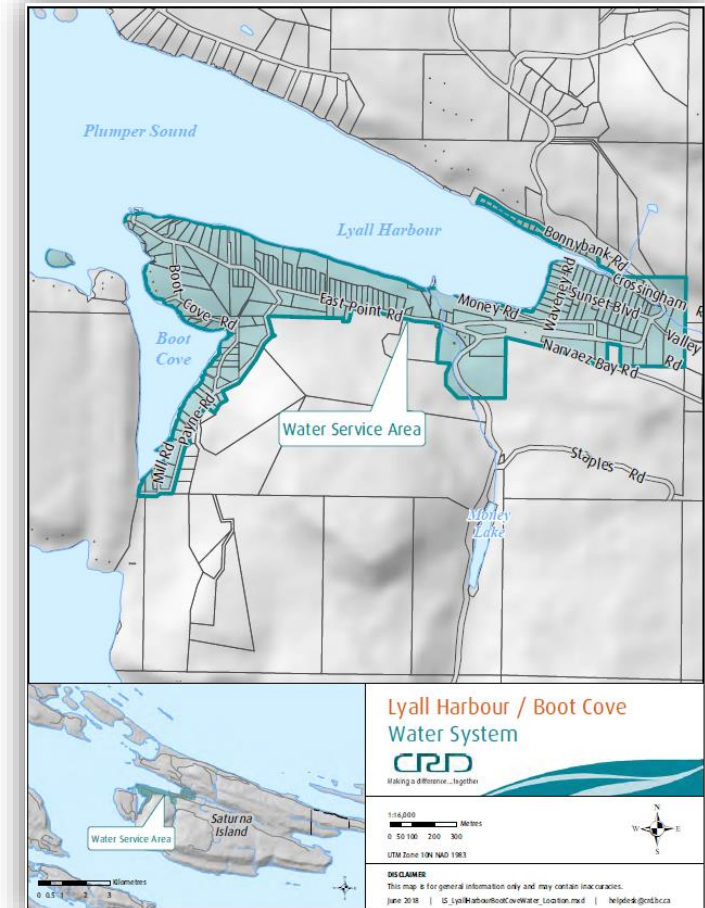
For Immediate Release

September 25, 2018

Discolouration in Lyall Harbour/Boot Cove Water Service (Saturna Island)

Victoria, BC- Capital Regional District (CRD) Integrated Water Services advises customers of the Lyall Harbour/Boot Cove Water Service on Saturna Island (see attached map) that elevated iron and manganese concentrations in the water are currently causing a slight discolouration in the treated drinking water. Iron and manganese are naturally occurring in the sediments of Money Lake, one of the water sources for this water system. These two metals can be released from the lake sediments especially during the spring and fall season, enter the raw water stream and cause water discolouration after disinfection with chlorine. The duration of this event is difficult to estimate at this time.

Please be advised that while the aesthetics of the water may be disagreeable, the water remains safe to drink and it is not a health concern. During this period, residents are not being advised to boil their water as a result of this occurrence.



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Outline

Fe and Mn

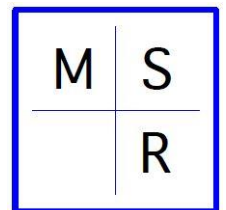
- What are Fe and Mn?
- Fe and Mn and Water Quality
- Existing Guidelines
- Recent Findings

Treatment Methods

- Methods
- Oxidation -> Filtration
- Challenges: Chlorine -> Filtration
- Case Study: Oxidation -> Filtration

New Guideline (Proposed)

- Proposed Guideline



- **What are Iron and Manganese?**

- Fe and Mn and Water Quality
- Existing Guidelines
- Recent Findings

What are Iron and Manganese?

- Iron is a metal that makes up about 5 percent of the earth's crust
- Manganese is a metal that can resemble iron in appearance. Manganese comprises about 0.1 percent of the earth's surface.



- What are Iron and Manganese?

- **Fe and Mn and Water Quality**

- Existing Guidelines

- Recent Findings

Fe and Mn and Water Quality

- Common in deep wells
- Strong metallic taste
- Cause staining
- Initially colourless



- What are Iron and Manganese?

- Fe and Mn and Water Quality

- **Existing Guidelines**

- Recent Findings

Guidelines for Canadian Drinking Water Quality (Feb 2017)

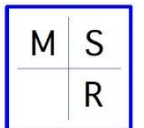
Guidelines for Canadian Drinking Water Quality

Summary Table (February 2017)

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Iron (1978, 2005)		AO: ≤ 0.3	Naturally occurring (erosion and weathering of rocks and minerals); acidic mine water drainage, landfill leachates, sewage effluents and iron-related industries		Based on taste and staining of laundry and plumbing fixtures; no evidence exists of dietary iron toxicity in the general population.
I	Manganese (1987)		AO: ≤ 0.05	Naturally occurring (erosion and weathering of rocks and minerals)		Based on taste and staining of laundry and plumbing fixtures.

MAC: Maximum Acceptable Concentration

AO: Aesthetic Objective



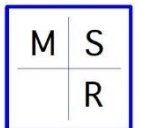
Treatment Methods

- **Methods**

- Oxidation -> Filtration
- Challenges: Chlorine -> Filtration
- Case Study: Oxidation -> Filtration

Fe and Mn Removal Methods

- Water Softening (Ion Exchange)
- Polyphosphate Addition
- Oxidation and Filtration



Treatment Methods

- Methods

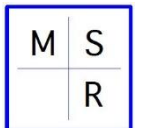
- **Oxidation -> Filtration**

- Challenges: Chlorine -> Filtration

- Case Study: Oxidation -> Filtration

Oxidation -> Filtration

- Most effective > 10 mg/L
- Chemical converts dissolved Fe and Mn into solid, oxidized forms
- Easily filtered from the water
- Chlorine most common: potassium permanganate, hydrogen peroxide can also be used

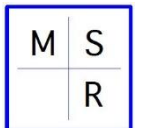


Treatment Methods

- Methods
- Oxidation -> Filtration
- **Challenges: Chlorine -> Filtration**
- Case Study: Oxidation -> Filtration

Challenges: Chlorine -> Filtration

- Social Beliefs
- Technical Reasons
 - High TOC: Trihalomethanes (THMs)
 - Some THMs probable carcinogens in humans or have been shown to be mutagenic (Health Canada 1996)

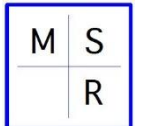


Treatment Methods

- Methods
- Oxidation -> Filtration
- Challenges: Chlorine -> Filtration
- **Case Study: Oxidation -> Filtration**

Case Study: Oxidation -> Filtration

- Small water system on North Pender island
- Surface water (lake) + groundwater (well)
- Combined treatment system
- The upgraded treatment process: potassium permanganate



- What are Iron and Manganese?
- Fe and Mn and Water Quality
- Existing Guidelines
- **Recent Findings**

Recent Findings



Manganese in water tied to kids' low IQ

Manganese in water tied to kids' low IQ



Communities studied between Montreal and Quebec City

CBC News · Posted: Sep 20, 2010 12:02 AM ET | Last Updated: September 20, 2010

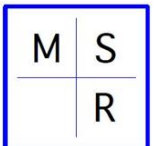
An IQ comparison shows that Canadian regulations on manganese in drinking water should be updated to protect children, Quebec researchers say.

The average IQ of children whose tap water was in the upper 20 per cent of manganese concentration was six points below children whose water contained little or no manganese, the researchers found.



National and international guidelines for safe manganese levels in water should be revised, Quebec researchers say. ((CBC))

<https://www.cbc.ca/news/technology/manganese-in-water-tied-to-kids-low-iq-1.973402>



New Guideline
(Proposed)

- **The proposed Guideline**

- Proposed MAC and AO values

Summary



Health
Canada

Santé
Canada

Your health and
safety... our priority.

Votre santé et votre
sécurité... notre priorité.

Manganese in Drinking Water

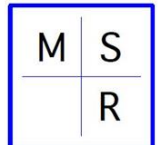
Document for Public Consultation

Prepared by the Federal-Provincial-Territorial
Committee on Drinking Water

Consultation period ends
August 5, 2016



Canada



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New Guidelines
(Proposed)

- The proposed Guidelines
- **Proposed MAC and AO values**

Proposed MAC and AO values

MAC:

The proposed MAC of 0.1 mg/L (100 µg/L) is based on neurological effects observed in rodents. Similar effects have been observed in epidemiological studies conducted in children.

AO:

The proposed AO of 0.02 mg/L (20 µg/L) would minimize the occurrence of discoloured water complaints and improve consumer confidence in drinking water quality.

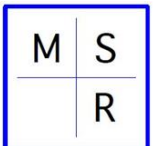
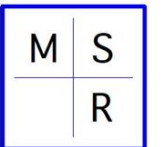




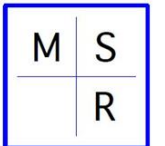
Photo Source: <https://www.fluksaqua.com>



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Conclusions:

- Existing Treatment Method
- Existing Regulations
- The new proposed MAC value for Mn



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