Internal Monitoring Report

Policy #: O-2B Water Quality **Date**: October 28, 2014

I certify that the following information is true.

Signed _____, General Manager

Policy Language:

Madison Water Utility consumers will receive high quality water that meets or is better than all primary and secondary drinking water standards, including their public notification requirements, and complies with board-adopted water quality goals, incorporated by attachment.

The Madison Water Utility recognizes that drinking water standards are subject to revision and that new compounds of concern will be determined. This dynamic is a result of health studies being conducted by health organizations and government agencies on the state, national and international level. The technology to quantify compounds at increasingly minute levels is constantly improving.

The Madison Water Utility shall maintain and promulgate a Watch List of compounds of concern by unit well of compounds that are increasing and may approach the primary and secondary drinking water standards. The Watch List shall identify which wells require action.

General Manager's interpretation and its justification:

Few things are more vital to a community than the availability of high quality drinking water. It promotes public health, public safety, and the economic interests of our community. To that end, the water utility will consistently deliver water that meets the primary, health-based drinking water standards, the secondary (aesthetic) standards, and the additional policy goals established by the Board. The Water Utility Procedural Guideline GUIDE 3, which establishes policies regarding iron and manganese, contains the following:

> The Madison Water Utility, under normal operating conditions, shall provide water that contains less than the National Secondary Drinking Water Standard for Fe (currently 0.3 mg/L) and Mn (currently 0.05 mg/L) at the customer's tap.

I interpret this to mean that 95th percentile results from our routine distribution water quality monitoring program shall be less than these values for iron and manganese.

Utility staff will remain vigilant in following developments related to currently unregulated and emerging contaminants like pharmaceuticals, endocrine disruptors, and chromium-6 that may pose problems in the future. Furthermore, the utility will employ multiple methods to adequately inform its consumers of the safety and quality of their drinking water including the federally-required Consumer Confidence Report (CCR), the water utility website, e-mail distribution lists, neighborhood listservs, citizen meetings, and through staff contact in the field and office.

Data directly addressing the General Manager's interpretation:

Primary Drinking Water Contaminants:
Between July and September, 935 water samples were collected from routine monitoring points in the distribution system including the entry point at the well houses (217 samples). None of the samples showed the presence of coliform bacteria.

The annual inorganic samples were collected from each well in early July. Samples were tested for a range of contaminants including nitrate, arsenic, chromium, and mercury. Results are summarized in Table 1. Test results were well below the regulatory limits for each contaminant.

Between July and September, 52 samples were collected from customer taps to comply with the Lead and Copper Rule. Because all lead service lines have been replaced or removed, samples are collected from houses constructed in 1983 or 1984 with copper plumbing and lead-based solder. The rule requires the 90th percentile result to be below the action level – 15 µg/L for lead and 1300 µg/L for copper. The 90th percentile lead level was 3.5 µg/L with a maximum of 10.4 µg/L. Copper also tested well below the action level; the 90th percentile level measured 185 with a maximum of 292 µg/L. These results will keep the utility on reduced monitoring – testing once every three years at 50 homes. The 90th percentile lead and copper levels were similar to the most recent monitoring completed in 2011.

Also during the July to September monitoring period, seven wells showed the presence of at least one volatile organic compound (VOC), with PCE being the most common. Based on previous results, quarterly monitoring is conducted at four wells (6, 9, 15, and 18) and semi-annual testing occurs at two wells (11 and 14). Detections are summarized in Table 2.

Policy Goals for Iron and Manganese:
Routine distribution testing from July through September showed that all 87 samples met the iron and manganese policy goals. Quarterly and year-to-date results are summarized below.

Manganese, µg/L

	Jul - Sep	2014
Policy Goal	50	50
Median	1.7	2.2
Average	3.0	3.8
95th	***9.4***	***16***
Maximum	22	46
Count	87	256
>50	0	0

Iron, mg/L

	Jul - Sep	2014
Policy Goal	0.3	0.3
Median	<0.01	<0.01
Average	0.02	0.03
95th	***0.12***	***0.12***
Maximum	0.23	0.94
Count	87	256
>0.3	0	4

Other Secondary Drinking Water Contaminants

Regular chloride monitoring continues at Well 14. The average chloride level is 116 mg/L [26 results ranging from 109 to 121 mg/L]. Sodium has been tested fourteen times this year with an average result of 40 mg/L. Elevated levels of chloride and sodium in Madison's multi-aquifer wells have been linked to winter de-icing operations. The water utility has been partnering with other City agencies, the Madison Metropolitan Sewerage District, and the county to promote greater awareness of impacts of road salt applications on surface and groundwater resources. Utility staff will also participate in the *Parking Lot, Driveway & Sidewalk Winter Maintenance Workshop* sponsored by MAMSWaP in mid-November.

Fluoride Monitoring:

Daily fluoride measurements are made at each operating well. Through mid-October, 4280 tests had been performed. For calendar year 2014, the average fluoride level was 0.71 mg/L, which is right in line with the target level of 0.7 mg/L. Ninety-two percent of the results fell within the normal operating range of 0.5-0.9 mg/L fluoride. The distribution of year-to-date fluoride results is shown in Figure 1.

Unregulated and Emerging Contaminants:

Semi-annual monitoring for hexavalent chromium was performed at eighteen wells in September and October. Test results are not yet available for all samples that were submitted.

Investigative samples were collected at Well 9 and Well 11 for low level VOCs and 1,4-dioxane, respectively, due to previous detections of these currently unregulated contaminants. Dioxane measured 0.34 µg/L at Well 11 while 1,1-dichloroethane measured 0.074 µg/L at Well 9. These results observed in July were similar to measurements recorded in January.

Water Quality Watch List

The Water Quality Watch List was updated to incorporate year-to-date test results for organic and inorganic contaminants. In addition, the Water Quality Technical Advisory Committee assisted staff in the development of a set of recommended treatment policies to help guide the response to increasing concentrations of contaminants identified on the Watch List. The general approach establishes benchmarks that trigger an investigation into the cause of the increase and potential mitigation efforts to reduce the contaminant level or slow further increases. The proposed policy provides guidance for contaminants regulated by a primary or secondary maximum contaminant level (MCL), an enforcement standard established under the Groundwater Quality Law (NR 140), or other guideline or regulation that has been adopted by the US EPA or another state. The objective of the policy is to provide ample planning time for either source replacement or modifications to an existing facility before the regulatory limit is exceeded.

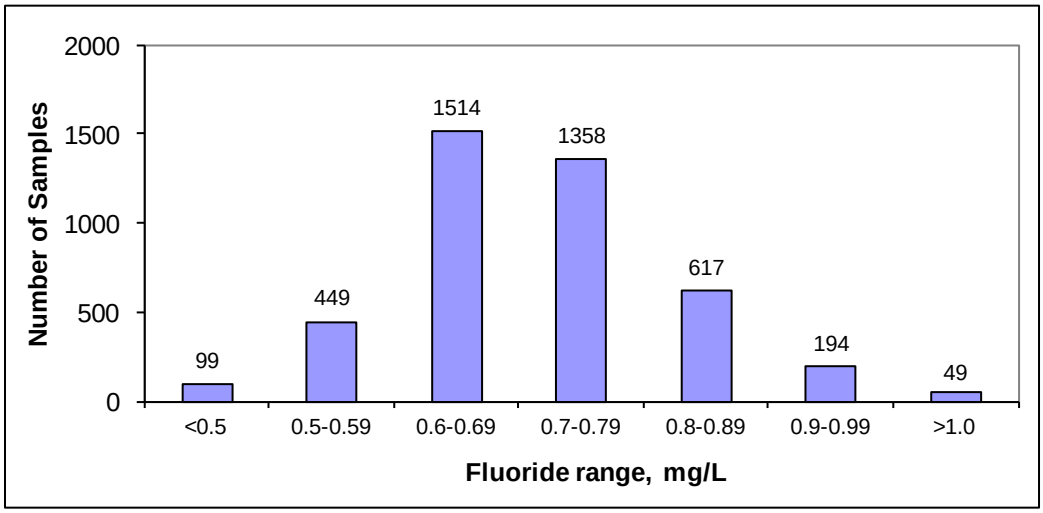
Table 1. Summary of the 2014 annual inorganic monitoring results.

Regulated Inorganic	MCL	Minimum	Median	Maximum	Detections
Antimony	6	<0.2	<0.2	<0.2	0
Arsenic	10	<0.2	0.3	0.7	17
Barium	2000	8.4	19	57	22
Beryllium	4	<0.2	<0.2	<0.2	0
Cadmium	5	<0.1	<0.1	<0.1	0
Chromium	100	<0.4	0.9	2.3	15
Copper	1300	0.5	4.9	61	22
Fluoride	4	0.7	0.8	1.0	22
Lead	15	<0.1	0.2	1.0	15
Mercury	2	<0.02	<0.02	<0.02	0
Nickel	100	0.5	1.1	5.4	22
Nitrate	10	<0.1	0.9	4.4	15
Nitrite	1	<0.04	<0.04	<0.04	0
Selenium	50	<0.4	0.5	1.2	11
Thallium	2	<0.1	<0.1	0.2	8

Table 2. VOC detections for the period July to September.

VOLATILE ORGANIC COMPOUND	MCL, µg/L	Well 6	Well 8	Well 9	Well 11	Well 14	Well 15	Well18
	Sample Date	7/15	8/4	7/14	7/14	7/14	8/4	7/14
1,2-Dichloroethylene (cis)	70	<0.30	**0.17**	<0.30	**0.42**	<0.30	<0.13	<0.30
Tetrachloroethylene [PCE]	5	**1.0**	<0.18	**1.7**	**0.59**	**0.56**	<0.18	**2.0**
Trichloroethylene [TCE]	5	<0.28	<0.19	<0.28	<0.28	<0.28	<0.19	<0.28
Trichlorofluoromethane	n/a	<0.31	<0.13	<0.31	**0.85**	<0.31	<0.13	<0.31
DISINFECTION BY-PRODUCT								
Bromodichloromethane	80	<0.33	**0.46**	**0.61**	<0.33	<0.33	<0.18	<0.33
Bromoform	80	**0.14**	<0.17	**0.41**	**0.24**	**0.23**	<0.17	**0.23**
Chloroform	80	<0.24	**0.57**	**0.26**	<0.24	<0.24	<0.20	<0.24
Dibromochloromethane	80	<0.26	**0.24**	**0.88**	<0.26	<0.26	**0.16**	**0.49**

Figure 1. Distribution of year-to-date fluoride test results.



I report compliance.

Attachments:

Water Quality Watch List
Proposed Water Quality Treatment Policies
Water Quality Technical Advisory Committee Meeting Notes: 7/8/2014, 9/9/2014, and 10/14/2014

MADISON WATER UTILITY
WATER QUALITY WATCH LIST

Organics - Regulated

Contaminant	Maximum*	Units	MCLG	PAL	MCL	Detects Below PAL%	Watch List	Action Plan	Reference
1,2-Dichloroethane	0.20	µg/L	zero	0.5	5	#17	none		NR 809.24
1,2-Dichloroethylene (cis)	0.42	µg/L	70	7	70	#8, #11	none		NR 809.24
Ethylbenzene	0.14	µg/L	700	140	700	#225	none		NR 809.24
Tetrachloroethylene [PCE]	3.9	µg/L	zero	0.5	5	#11, #14, #27	#6, #9, #18	Budget one GW Inv per Year	NR 809.24
Toluene	0.12	µg/L	1000	160	1000	#25	none		NR 809.24
1,1,1-Trichloroethane	0.26	µg/L	200	40	200	#9, #18	none		NR 809.24
Trichloroethylene [TCE]	0.43	µg/L	zero	0.5	5	#11, #14, #18, #27	none		NR 809.24
Xylene, Total	1.5	µg/L	10000	400	10000	#225	none		NR 809.24

* Maximum detection observed at any Madison well from 2010 through 2014 % Detected in at least one sample collected from 2010 through 2014

Organics - Unregulated

Contaminant	Maximum*	Units	MCLG	PAL	ES	Detects Below PAL%	Watch List	Action Plan	Reference
Dichlorodifluoromethane	0.22	µg/L	n/a	200	1000	#14	none		NR 140.10
1,1-Dichloroethane	0.08	µg/L	n/a	85	850	#9	none		NR 140.10
1,4-Dioxane	0.63	µg/L	n/a	0.3	3	#9, #14, #15	#11	Monitor	NR 140.10
Methyl t-butyl ether [MTBE]	0.14	µg/L	n/a	12	60	#15	none		NR 140.10
Trichlorofluoromethane	1.2	µg/L	n/a	698	3490	#11	none		NR 140.10
1,2,4-Trimethylbenzene	0.64	µg/L	n/a	96	480	#7	none		NR 140.10

* Maximum detection observed at any Madison well from 2010 through 2014 % Detected in at least one sample collected from 2010 through 2014

Radionuclides

Contaminant	Maximum	Units	MCLG	Watch	MCL	Wells with Detects	Watch List	Action Plan	Reference
Gross alpha	9.6	pCi/L	zero	5	15	All Except #14	#19, #27, #30	Monitor	NR 809.50
Gross beta	8.8	pCi/L	zero	10	50	All Except #14	none		NR 809.50
Combined Radium	4.5	pCi/L	zero	2.5	5	All Wells	#7, #8, #19, #24 #27, #28, #30	Monitor	NR 809.50
Uranium	2.0	µg/L	zero	3	30	All Wells	none		NR 809.50

ES - Enforcement Standard (NR 140 - Groundwater Quality) MCL - Maximum Contaminant Level Legal Limit MCLG - MCL Goal (Public Health Goal) PAL - Preventive Action Limit (NR 140 - Groundwater Quality)

MADISON WATER UTILITY
WATER QUALITY WATCH LIST

Inorganics - Regulated

Substance	Maximum*	Units	MCLG	PAL	MCL	Detects Below PAL	Watch List	Action Plan	Reference
Arsenic	0.7	µg/l	zero	1	10	All Except #13, #15, #20, #25, #29	none		NR 809.11
Barium	57	µg/l	2000	400	2000	All Wells	none		NR 809.11
Chromium	2.3	µg/l	100	10	100	All Except #7, #8, #17 #19, #24, #28, #30	none		NR 809.11
Copper	61	µg/l	1300	130	1300	All Wells	none		NR 809.11
Lead	1.0	µg/l	zero	1.5	15	All Except #8, #17, #19, #26, #27, #29, #30	none		NR 809.11
Nickel	5.4	µg/l	100	20	100	All Wells	none		NR 809.11
Nitrogen-Nitrate	4.4	mg/l	10	2	10	#9, #12, #18, #20, #25, #26, #27, #29	#6, #11, #13, #14, #15, #16, #23	Monitor	NR 809.11
Selenium	1.2	µg/l	50	10	50	#6, #9, #11, #13, #14, #15, #16, #23, #25, #27, #29	none		NR 809.11
Thallium	0.2	µg/l	0.5	0.4	2	#11, #13, #15, #17, #19, #23, #27, #28	none		NR 809.11

* Based on 2014 annual test data

Inorganics - Unregulated

Substance	Maximum*	Units	MCLG	Watch	SMCL	Wells with Detects	Watch List	Action Plan	Reference
Aluminum	2.5	µg/l	n/a	50	200	All Wells	none		NR 809.70
Chloride	120	mg/l	n/a	125	250	All Wells	none		NR 809.70
Iron	0.56	mg/l	n/a	0.1	0.3	All Except #6, #9, #12, #14, #15, #16, #20	#8, #17, #19, #24, #27, #28, #30	#8 - Install Filtration (2017), #19 - Install Filtration (2016), #30 - Install Filtration (2020)	NR 809.70
Manganese	50	µg/l	n/a	20	50	All Wells	#8, #17, #19, #23, #24, #27, #28	#8 - Install Filtration (2017), #19 - Install Filtration (2016)	NR 809.70
Sodium	40	mg/l	n/a	20	n/a	All Wells	#14, #15, #16, #23	Monitor	EPA DWEL
Sulfate	40	mg/l	n/a	125	250	All Wells	none		NR 809.70
Zinc	44	µg/l	n/a	2500	5000	All Wells	none		NR 809.70

* Based on 2014 annual test data

MCL - Maximum Contaminant Level (Legal Limit) MCLG - MCL Goal Public Health Goal PAL - Preventive Action Limit (NR 140 - Groundwater Quality) SMCL - Secondary MCL (Aesthetic Guideline)
DWEL - Drinking Water Equivalency Level

Proposed Water Quality Treatment Policies

October 2014

Madison experiences water quality challenges related to aquifer geochemistry as well as historic soil and groundwater contamination. Mineral-rich groundwater pumped from the regional sandstone aquifers is very hard; it has high amounts of calcium and magnesium that require water softening. The deeper Mt. Simon aquifer is also a source of naturally occurring iron, manganese, and radium. At elevated levels, iron and manganese can lead to stains on laundry and plumbing fixtures and possible water discoloration while radium may cause cancer. Normal use, spills, and improper handling of chemicals have caused the contamination of soil and shallow groundwater in some areas of Madison, particularly in former commercial and industrial districts. Environmental releases of volatile organic compounds such as tetrachloroethylene [PCE] and trichloroethylene [TCE] are associated with dry cleaning facilities, automotive repair shops, and manufacturing. Winter de-icing repeatedly introduces road salt [sodium and chloride] onto city streets which later seeps into the drinking water source. Groundwater may remain high in nitrate in areas formerly under agricultural production. Finally, contamination threats to shallow groundwater are not always related to human activity; research suggests aquifer geochemistry supports the release of chromium to the upper bedrock aquifer yet significant amounts of chromium are not found in water drawn from the Mt. Simon aquifer. Future threats to Madison's drinking water supply may emerge as new contaminants are identified or human health impacts of well known pollutants become better understood.

Drinking water contaminants fall into one of three regulatory classifications: (1) ones with a primary Maximum Contaminant Level [MCL] such as tetrachloroethylene [PCE], radium, and nitrate; (2) ones with a non-enforceable, Secondary Maximum Contaminant Level [SMCL] including manganese, iron, and chloride; and (3) ones currently without a federal primary or secondary MCL like sodium, hexavalent chromium, and 1,4-dioxane. Contaminants is this third group may be regulated in Wisconsin under the Groundwater Quality Law (NR 140) by an Enforcement Standard [ES], regulated in another state with an MCL, or have a recommended guideline established by US EPA. Federal and state drinking water regulations, the Safe Drinking Water Act and Wisconsin Administrative Code Chapter NR 809, establish acceptable levels of contaminants in the public water supply; however, the Water Utility Board may establish policies that go beyond these minimum standards.

The Board previously adopted treatment policies for iron and manganese, a policy on testing for pharmaceuticals and endocrine disrupting compounds, and a fluoridation policy. The recommendations below attempt to expand these water quality treatment policies to include contaminants identified on the utility's Water Quality Watch List. Overall, the objective of this report is to establish a strategic framework to identify and respond to an increasing contaminant concentration long before a regulatory threshold might be reached. This approach would establish the contaminant level above which a study would be conducted to evaluate the cause of the increase and potential mitigation efforts – operations change, wellhead treatment, or source replacement – to either reduce the contaminant level or slow further increases.

The general approach proposed is to establish two thresholds: one when a contaminant level consistently exceeds 50% of an established MCL, SMCL, ES, or other numerical guideline or recommendation, and two when it surpasses 80% of these marks. The first threshold would trigger an investigation including an analysis that identifies treatment alternatives, operational changes, or source reductions for mitigating contaminant levels. If a contaminant level rises beyond the second threshold, implementation of wellhead treatment, source replacement, or other mitigation would commence.

A. Volatile and Synthetic Organic Compounds with an MCL or ES

Volatile Organic Compounds [VOCs] are man-made contaminants that volatilize or readily move from water to air. They include compounds such as chlorinated solvents (PCE and TCE, for example) and petroleum chemicals such as toluene, benzene, and xylene. Some are known carcinogens while others may damage the kidney, liver, or other internal organs. Health impacts occur following long-term exposure to high concentrations of the chemical. The Maximum Contaminant Level Goal [MCLG], also called the Public Health Goal, for known or probable carcinogens is set at zero while the MCL is established at a level as close as possible to the MCLG as is technically and economically feasible. For a VOC with non-carcinogenic health impacts, the MCLG is set at a level where there is no known or expected risk to human health with a margin of safety; often the MCL and MCLG are the same. Other VOCs are regulated under NR 140 with enforcement standards for groundwater that are analogous to MCLs. Synthetic Organic Compounds [SOCs] are other man-made contaminants regulated under NR 809 or NR 140. They include pesticides and non-volatile industrial solvents.

Recommendation: As required by NR 809, quarterly monitoring shall occur if any regulated VOC is detected at a level that exceeds 0.0005 mg/L. When four consecutive quarterly samples exceed a concentration equivalent to 50% of the MCL or ES, utility staff shall begin an investigation into feasibility of wellhead treatment, best available technologies [BATs] for VOC reduction, and the source and extent of contamination if not known or previously investigated. At the 80% threshold, staff shall begin a planning process to design and construct a treatment plant to reduce the contaminant level or begin the process to identify a new supply point, free of contamination.

Existing Conditions: Six wells show detections of PCE above the 0.0005 mg/L threshold; four are tested quarterly, the remaining two are tested semi-annually. An air stripper installed at Well #15 successfully reduces the PCE concentration to <0.0005 mg/L. In the last two years, two samples from Well #18 tested above 50% of the MCL for PCE (MCL=0.005 mg/L; max = 0.0035 mg/L); PCE ranged from 0.00085 to 0.0020 mg/L in the other samples. After several years of decline, PCE at Well #9 has gradually increased over the last two years. The current level is 0.0017 mg/L. VOC detections at other wells are either stable or well below the 0.0005 mg/L benchmark.

Implications for the Water Utility: Following the recommendation outlined above would require additional monitoring, most of which the utility already conducts. As a contingency, the utility included a treatment facility at Well #18 as part of its Capital Improvement Plan; construction is projected for 2018 at an estimated cost of $3.3 million. Wellhead treatment at Well #9 might be necessary if the upward trend continues.

B. Inorganics with a Primary MCL or ES

Many regulated inorganic contaminants including trace metals such as chromium, lead, and nickel are found at very low levels in Madison-area ground water. The chemicals are leached from the underlying rock that makes up the aquifer. Their concentrations are well below regulatory and public health goals. Nitrate is one exception. It comes from urban and agricultural fertilizer use in addition to septic tanks and leaky sewer pipes. Madison municipal wells that are open to the upper bedrock aquifer show some signs of nitrate contamination likely reflecting prior land use or aging infrastructure.

Recommendation: Quarterly monitoring shall occur following detections above one half the MCL or ES. When four consecutive quarterly samples exceed this benchmark, an investigation into the contaminant source, causes of the elevated concentration, and alternative strategies for contaminant reductions shall begin. Triggers for an investigation will be based on concentrations at the well rather than in the distribution system. Action shall be taken to reduce the contaminant level if it consistently exceeds 80% of the MCL or ES.

Existing Conditions: Over a dozen inorganic contaminants are detected at some or all Madison municipal wells. Except for nitrate, none of the concentrations are high enough to elicit any additional action. Nitrate is present at fifteen of twenty-two wells with the highest concentrations observed in multi-aquifer wells drawing water from both the upper and lower aquifers. Seven wells exceed 2 mg/L nitrate; the MCL is 10 mg/L. The highest nitrate level (4.4 mg/L) is found at Well #13.

Implications for the Water Utility: None expected.

C. Radionuclides with an MCL

Naturally occurring radioactive elements are found in rock, soil, water, and air. They derive from the creation of our planet and enter our bodies when we drink water, breathe air, and eat foods that contain them. Naturally occurring uranium is found in rock and soil. Over time, it decays to other elements including radium which later decays to radon gas. Data suggest that radium levels are highest at the base of the Mt. Simon aquifer.

Recommendation: Monitor gross alpha, radium, and uranium according to the requirements established by Wisconsin DNR. Detections of any radionuclide above 50 % of the MCL shall trigger quarterly monitoring. If four consecutive quarterly samples exceed this benchmark, staff shall investigate alternatives for contaminant reductions including wellhead treatment, well modifications, and changes to well operations. Source reduction shall be provided if contaminant levels consistently exceed 80% of the MCL.

Existing Conditions: Radium levels are highest at Madison wells that exclusively draw water from the Mt. Simon aquifer. Seven confined aquifer wells exceed 50% of the combined radium MCL and four exceed the 80% benchmark. One sample collected from Well 19 in July 2011 exceeded the radium MCL; however, none of eleven subsequent samples exceeded the legal limit. Best Available Technologies for radium removal include ion exchange, reverse osmosis, and lime softening.

Implications for the Water Utility: The DNR requires radionuclide testing at most Madison wells once every six years. Some wells drawing water exclusively from the Mt. Simon aquifer are monitored more frequently. This policy would mandate quarterly monitoring at seven wells and may ultimately require source reduction at four wells – Well 8, Well 19, Well 27, and Well 28. In addition to the BATs identified above, sealing off a portion of the Mt. Simon aquifer, the source of radium, could be an alternative for reducing radium levels. Estimated costs for increased monitoring are $6000 annually.

D. Inorganics with a Secondary MCL

The US EPA and Wisconsin DNR set non-enforceable secondary MCLs which serve as guidelines for the aesthetic quality of water: taste, odor, and appearance (color). Naturally occurring iron and manganese are present at higher levels in the Mt. Simon aquifer. At elevated levels, these metals can discolor water and stain laundry and plumbing fixtures. Wells open to the upper bedrock aquifer are more susceptible to contamination from road salt (sodium chloride). Increasingly, chloride is becoming problematic at some wells due to long-term application of road salt. Elevated chloride may impart a taste that customers find objectionable.

Policy goals for iron and manganese in new and existing sources were previously established by the Water Utility Board. Existing sources shall meet the secondary MCL while new wells shall supply water with less than 0.1 mg/L of iron and 0.02 mg/L of manganese. The Well #7 facility is currently being re-constructed with the addition of an iron and manganese filter. The 2015 Capital Improvement Plan includes wellhead treatment for iron and manganese removal at Well #8 (2017), Well #19 (2016), and Well #30 (2020). The policy described below would build on policy goals previously developed for iron and manganese and provide further justification for staff recommendations regarding wellhead treatment at Well #19 and Well #30.

Recommendation: Confirmed detections of an inorganic contaminant above one half the SMCL shall trigger an investigation into the contamination source, causes of the elevated concentration, and alternative strategies for reductions. Triggers for an investigation shall be based on concentrations at the well rather than in the distribution system. If the contaminant consistently exceeds 80% of the SMCL, action shall be taken to reduce the contaminant level through wellhead treatment, operations, or source abandonment/new supply.

Existing Conditions: All confined aquifer wells currently produce water that exceeds 50% of the SMCL for iron, manganese, or both nuisance contaminants (see Appendix). Water at Well #19 also exceeds the 80% threshold for iron.

No other contaminant for which an SMCL has been developed measures above 50% of the SMCL. However, the chloride concentration at Well #14 is expected to exceed this level within two years and, if the current trend continues, chloride will surpass the SMCL in 15-20 years. No other well appears at risk of exceeding the SMCL for chloride over the next 30 years; however, four wells could exceed the 50% SMCL benchmark within the next 10-20 year window if current trends continue. Chloride is increasing at a rate of 3-5 mg/L per year at these wells.

Implications for the Water Utility: An investigation into the rising chloride levels and an alternatives analysis would be required for Well #14. Absent a dramatic reduction in chloride, the addition of wellhead treatment, an operational change, source abandonment, or some other alternative likely would be implemented to reduce chloride. An alternatives analysis will be necessary at four other wells if chloride increases continue over the long term.

Expansion of the iron and manganese treatment policy would require wellhead treatment at Well #19, which is already included in the Capital Improvement Plan. An investigation would not be conducted at wells where either iron or manganese exceeds one half the SMCL because the source – the Mt. Simon aquifer – is well known.

E. Unregulated Contaminants

1. Sodium

EPA's *Consumer Acceptability Advice and Health Effects Analysis on Sodium* (2003) recommends reducing sodium levels to between 30 – 60 mg/L based on aesthetic effects including taste. Drinking water within this range is unlikely to be perceived as salty by most individuals. The report identifies a guidance level of 20 mg/L sodium for individuals on a sodium restricted diet; however, it cautions that this level should not be extrapolated to the general population.

Recommendation: Detection of sodium above 30 mg/L at any source shall result in additional monitoring – monthly testing for a period of one year. If the average monthly sodium level is above 30 mg/L, it shall trigger an investigation into the sources and alternative strategies that can reduce the sodium level. If the level exceeds 48 mg/L, staff shall begin the planning process to design and construct a treatment plant, modify the well to seal off the upper aquifer, or identify a new supply point.

Existing Conditions: Sodium currently measures 40 mg/L at Well #14. Five other wells are at or above 19 mg/L; four have seen sodium increase by 40% or more over the last decade. Road salt used for winter de-icing operations is believed to be causing the sodium increase.

Implications for the Water Utility: If the trends continue, sodium levels at Well #14 could exceed the 48 mg/L benchmark in as little as six years and trigger wellhead treatment, well modifications, or source abandonment. An alternatives analysis could be triggered at several sources within ten years if sodium exceeded 30 mg/L. Four wells appear at risk of exceeding the 48 mg/L threshold over the next 20-30 years.

2. Hexavalent Chromium

Drinking water regulations require monitoring for total chromium but they do not require testing for individual forms such as hexavalent chromium. Research now suggests that hexavalent chromium is a probable human carcinogen when ingested. The determination has led to calls for specific regulation of this form of chromium. Further, California recently adopted an enforceable MCL for hexavalent chromium (10 μg/L) which took effect on July 1, 2014.

A collaborative study with the Wisconsin Geological Survey determined that hexavalent chromium naturally occurs in Madison-area groundwater and that aquifer geochemistry is thought to support release of chromium from the upper bedrock aquifer but not the lower Mt. Simon aquifer.

Recommendation: Continue monitoring hexavalent chromium at all wells twice per year through 2015. Then, reduce to annual monitoring at wells where hexavalent chromium exceeds 1 μg/L – a level that corresponds to one tenth the recently adopted California MCL. All wells shall be tested at least once every three years for hexavalent chromium.

Any detection above 5 μg/L shall trigger an investigation into the causes of the elevated concentration and alternative strategies for reductions including operational changes and wellhead treatment. Action shall be taken to reduce the contaminant level if it exceeds 8 μg/L.

Existing Conditions: Six wells consistently show hexavalent chromium above 1 µg/L. The highest level, just under 2 µg/L, is found at Well #14.

Implications for the Water Utility: After 2015, annual monitoring for hexavalent chromium will continue at seven wells with triennial testing taking place for the remaining fifteen wells. The estimated annual cost of chromium testing will range from $700 - $2500.

3. Other unregulated or emerging contaminants

New contaminants of concern are likely to be recognized in the future as a result of health studies conducted by health organizations and government agencies at the state, national, and international level. Improvements in technology to quantify compounds at increasingly minute levels are also expected.

Recommendation: The utility shall maintain a budget to accommodate the unexpected need to test for new or emerging contaminants. The Technical Advisory Committee shall provide guidance as to the contaminants that should be tested and the frequency of testing.

Draft Water Quality Treatment Policies, October 2014

Primary MCL	Contaminant Group	Contaminant	0.5 MCL	0.8 MCL
	Inorganics	Nitrate	Investigation with Alternatives Analysis	Take Action to Reduce Contaminant Level
	Radionuclides	Radium		
	Volatile Organics	Tetrachloroethylene (PCE)		

NR 140 ES	Contaminant Group	Contaminant	0.5 ES	0.8 ES
	Synthetic Organics	1,4 Dioxane	Investigation with Alternatives Analysis	Take Action to Reduce Contaminant Level

Secondary MCL	Contaminant Group	Contaminant	0.5 SMCL	0.8 SMCL
	Inorganics	Chloride	Investigation with Alternatives Analysis	Take Action to Reduce Contaminant Level
		Iron		
		Manganese		

Guideline*	Contaminant Group	Contaminant	0.5 Guideline	0.8 Guideline
	Inorganics	Chromium (VI)	Investigation with Alternatives Analysis	Take Action to Reduce Contaminant Level
		Sodium		

*Source: 0.01 mg/L Hexavalent Chromium (California MCL, 2014); 60 mg/L Sodium from *Consumer Acceptability Advice and Health Effects Analysis on Sodium* (US EPA, 2003)

Appendix

Table 1. Data for wells with highest iron and manganese levels – 2013 results.

	Iron, mg/L	Manganese, µg/L	Notes
50% SMCL	0.15	25	SMCL (Fe) = 0.3 mg/L
80% SMCL	0.24	40	SMCL (Mn) = 50 µg/L
Well #8	***0.62***	***53***	Construction – 2017
Well #19	*0.19*	***45***	Construction – 2016
Well #24	*0.22*	*28*	
Well #28	*0.17*	21	
Well #30	*0.20*	14	Construction – 2020
Well #17	0.11	*30*	Filtration not recommended
Well #23	0.06	*26*	
Well #27	0.14	*31*	

Table 2. Madison wells with above average chloride and sodium levels.

Chloride (mg/L)

Well #	2000	2005	2010	2014
6	26	29	38	59
9	31	31	36	46
11	38	40	52	57
13	6	8	9	40
14	58	70	94	120
15	30	41	49	54
16	18	29	44	57
17	54	56	56	35
23	39	56	60	72
27	19	32	35	38

Sodium (mg/L)

Well #	2000	2005	2010	2014
6	9	10	13	19
9	12	13	15	16
11	12	13	18	19
13	5	5	5	14
14	19	25	34	40
15	11	15	19	20
16	7	11	16	21
17	23	21	23	14
23	13	18	22	25
27	10	18	16	16

Water Quality Technical Advisory Committee – Notes for the WUB Report

Meeting Date – July 8, 2014

A. Well 15 Pilot Study Update

Received DNR approval for sulfuric acid feed system to adjust pH following air stripping. Water utility staff is completing the secondary containment and chemical feed set-up. Acid delivery is expected next week (July 15) and the system could be operational shortly thereafter. Distribution system monitoring is to continue through at least November and a residential meter will be installed to evaluate impact on scale formation.

Further evaluation of factors to mitigate pH changes have not been conducted as the well has been running on a reduced, as-needed basis until the acid system is operational.

B. Road Salt Reduction Initiative – WHPA 14

The white paper making a case for reduced road salt application on University Avenue was finalized and given to County staff for review. A meeting between City and County staff is being planned. The City will not take over winter maintenance on University Avenue, rather the County will be asked to deviate from standard practices and lower the rate and frequency of road salt applications.

C. Water Quality Monitoring Results

The latest water quality test results – volatile organic compounds, radionuclides (gross alpha & radium), and hexavalant chromium – were presented and discussed within the context of the water quality watch list. Interest remains in the PCE level of untreated water at UW 15. Quarterly testing of treated and raw water continues at Well 15 to evaluate groundwater trends and operational performance of the air stripper. Temporal variation of radium is poorly understood. Unless water level drops significantly, radium levels not expected to change much. Newer wells in Jefferson, WI and points east have radium levels of concern. Geochemistry contributing to radium is poorly understood; further study of geology [possibly by WRF] could provide better understanding and guidance for remediation strategy when radium exceeds MCL.

Considerable discussion about value of groundwater investigations for wells impacted by PCE; investigations are suggested in the Action Plan of the *Water Quality Watch List.* Committee members felt that a study, which does not reduce contamination, could be perceived as a waste of money that could be better spent providing wellhead treatment or other system improvements; cautioned that it should be evaluated on a case by case basis. The study at Well 15 was justifiable as a potential source was likely to be found, whereas at Well 18 the landfill has been remediated and a pump test overseen by JD & JB showed generalized background levels that were not related to a particular source. At Well 18, not much more can be done to quench source. Further investigation would be throwing away money that could be used for treatment. The committee recommended not pursuing a groundwater study at Well 18.

D. Water Quality Treatment Policies

Committee was asked to review and provide feedback on draft treatment policies for contaminants identified on the *Water Quality Watch List*. GH could not attend but provided written comments; preferred an MCL-based rather than PAL-based approach. Other general comments included identifying the audience [WUB or general public]; clarifying the meaning of impact [i.e. what is the implication for the utility of adopting a policy]; is a good practice to formalize and make more obvious proactive considerations given by the utility to known or potential contamination. Additional comments included operational strategies for addressing iron and manganese, and

Water Quality Technical Advisory Committee – Notes for the WUB Report

Meeting Date – September 9, 2014

A. Water Quality Treatment Policies – Draft Review

Discussion of the revised Water Quality Treatment Policies document continued. The group noted significant improvement over the earlier draft. The document goes above state and federal law to improve water quality and prevent the utility from exceeding established standards while remaining within a framework that does not set triggers that will tie the utility's hands for substances that aren't really a concern (i.e. secondary contaminant that may be temporarily elevated due to operations).

The following recommendations were made:

- Keep the policy simple; adopt a consistent approach for contaminants regulated with an MCL, similar triggers across contaminant classes (VOC, IOC, and radionuclide)
- Increased monitoring after reaching one half the MCL; it would help the utility respond if EPA suddenly changes a standard (i.e. MCL for PCE/TCE significantly reduced)
- Policy should address contaminants not regulated under NR 809 but are regulated by Groundwater Quality Law (NR 140) or have an established number somewhere else; for unregulated VOCs, adopt one half the ES as a trigger for increased monitoring
- 85% (as opposed to the 80% currently in the policy) could be an appropriate threshold for taking action; need to be fairly certain that, once the threshold is crossed, there is sufficient time to mobilize and add treatment or identify new supply and construct a facility before the MCL is surpassed.
- Also, consider establishing a threshold (95% of an MCL) above which the utility might declare a public health emergency that protects against the sudden lowering of an established standard and allows the utility to quickly respond
- Clarify what "Take Action" means; actions for the different constituents may be different
- Want to establish a balance between secondary MCLs that may not warrant further action by the utility and responding to customer complaints about these contaminants. There is a difference in legality between primary and secondary contaminants; primary is an obligation while secondary is not but should have policies that address them both.
- The utility should exercise caution when considering treatment for unregulated contaminants as the observed levels may be lower than a future regulation; costly treatment may not be needed
- Provide a flexible framework under this policy for responding to contaminants of concern – options may include source abandonment or a variety of treatment technologies or other alternatives
- Citizen Advisory Panels (CAP) may also identify alternatives not previously considered by the utility
- Unregulated contaminants monitoring (i.e. 1,4-Dioxane) can be a good indicator of the leading edge of a plume, indicator of other potential contamination
- Policy approaches recommended for contaminants (1) with a primary MCL, (2) with a secondary MCL, (3) regulated under NR 140 but not under NR 809, and (4) with a guideline or recommendation elsewhere (i.e. sodium and hexavalent chromium)

B. Water Quality Monitoring

Annual Inorganic Results – Results are pretty consistent with the exception of sodium and chloride at Wells 14 and 23. The highest level has been 40 mg/L and 120 mg/L respectively (Well 14) with Well 23 showing a variable but upward trend. All data is available on the utility's website.

PCE Trends - Seven wells have PCE present. A handout showing the trends for the four wells with PCE $\geq$1 was distributed. Well 6 has historically operated as a seasonal well but has remained on line the past 2 years. The year round pumping of Well 6 may be a factor causing the increasing PCE level at this location. Monitoring the raw water at Well 15 will continue. Operation of the well, including being off line for maintenance, seems to impact the PCE level in the raw water. If PCE removal is not needed, the well can be run without the blowers.

C. Policy Review – Pharmaceuticals Testing

All Madison wells have been tested for hormones. Several monitoring wells were also tested for hormones by WGNHS. No hormones were detected in either sampling which can be a good proxy for leaking sanitary sewers. Given the monitoring is very expensive, no detections were noted and most utilities in the country do not monitor for hormones, the group recommends no additional hormone monitoring unless the monitoring becomes required.

Water Quality Technical Advisory Committee – Notes for the WUB Report

Meeting Date – October 14, 2014

A. Water Quality Treatment Policies – Draft Review

The group was pleased with the latest draft. Consensus formed around acceptance of 0.5 / 0.8 triggers for an "Investigation with Alternatives Analysis" and to "Take Action to Reduce Contaminant Level". The levels provide sufficient lead time to mitigate contaminant level before a standard is exceeded. Committee supported inclusion of iron and manganese in the treatment policy for secondary contaminants. Projects for future wellhead treatment are already included in the utility's Capital Improvement Plan.

Committee recommended consistency in approach to contaminants – exceed a threshold, increase monitoring frequency, investigate alternatives, if consistently exceed second threshold begin planning for treatment, source abandonment, or other alternative. Specifically, add quarterly monitoring for radium and inorganic contaminants with an MCL or ES.

Well 14 is the only well expected to exceed the chloride SMCL in the next 30 years. Options for reducing chloride include ion exchange, reverse osmosis, extending the well casing, or blending Well 14 water with another source. Ion exchange and reverse osmosis are not practical due to cost. Extending the casing and blending are potential options that could be investigated at Well 14 or other wells with increasing chloride levels.

Increasing sodium levels are problematic at some wells. Sodium is handled differently by EPA – the customer is responsible for monitoring their sodium intake. The committee recommended adding information to our website that is geared towards individuals on a sodium restricted diet. Creating a link to the Public Health statement on Sodium in Drinking Water was also suggested. MWU and other agencies are working collaboratively with MMSD to increase awareness of surface and groundwater impacts from road salt and to reduce the amount of salt used in the county.

B. Madison Kipp Update – Referred to a future meeting

C. Water Quality Monitoring

Lead and Copper – Required monitoring successfully completed with very good results; confirms low levels of lead & copper at the customer tap and that Madison is effectively controlling corrosion of pipe materials. Based on the results, Madison will remain on reduced monitoring with the next round of tests scheduled for 2017. Fifty-two homes were sampled. The 90^{th} percentile lead and copper levels were 3.5 µg/L and 185 µg/L, respectively, compared to the action levels of 15 µg/L and 1300 µg/L. Fewer than a dozen privately-owned lead service lines remain. Owners have refused to comply and have judgments for non-compliance that, in some cases, exceed the value of the property. When additional lead service lines are discovered, the owners must replace the service line and they are still eligible to receive reimbursement for their costs. Changes to the Lead & Copper Rule are being considered at the national level. Potential changes may affect sample sites, sampling protocols, and optimized corrosion control alternatives. The utility is actively participating in these discussions.

UCMR3 – US EPA is gathering nationwide occurrence data for several unregulated contaminants. Preliminary results have been released and Wisconsin data for hexavalent chromium, 1,4-dioxane and hormones were briefly discussed. Chromium ranged from below detection to 3.1 µg/L. Fitchburg, Stoughton, and Whitewater were non-detect while Baraboo, Beloit, Janesville, and Sun Prairie had measurable levels. The California MCL is currently set at 10 µg/L. Eight of 230 samples (3.5%) indicated the presence of 1,4-dioxane. Communities with detects included Beloit, Cedarburg, Green Bay, and West Bend. At least two of these communities operate air strippers for volatile organics removal. None of the five communities that monitored for hormones had any detection. The communities included Green Bay, Janesville, Milwaukee, Oshkosh, and Plymouth.

clarifying what an investigation is or might be. The committee agreed to review the policies and provide written comments by August 4th for compilation and further discussion at next TAC meeting.

E. Pesticides & Wellhead Protection

The utility periodically receives inquiries about the use of pesticides, particularly in wellhead protection districts. The City has adopted a *Policy Regarding Pest Management on City Property* (2004) which attempts to eliminate or reduce pesticide use to the greatest possible extent; however, the water utility does not regulate pesticide use. Wellhead protection tends to be advisory in the absence of a specific law.

DATCP is given the authority to regulate pesticides and their use. Herbicides/pesticides vary in terms of mobility, degradation, and environmental impact. Currently, no evidence of migration to groundwater. Atrazine prohibition areas have been declared in areas where wells were contaminated. A similar approach could be taken to restrict pesticide use in a wellhead protection area if a particular pesticide were detected. Semi-volatile pesticides most commonly used in urban settings include 2,4D and glyphosate. Committee recommended adding herbicides and pesticides to the Treatment Policy: monitor more frequently than required, if any detected, and provide letter to neighborhood recommending not using specific pesticides if level exceeds 50% MCL. Also suggested inviting a pesticide expert to discuss risk of groundwater contamination; DATCP staff has monitored pesticide levels in groundwater for years and is a good resource. Jeff Postle in particular was recommended.