TM-9: Drinking Water Regulations Present and Future

1.0 Introduction

This technical memorandum summarizes the current regulations pertaining to water supply and water quality that are relevant to DWSD. In addition, pending regulations and future regulatory trends are identified. The regulatory information presented is based on current and historical literature published by the United States Environmental Protection Agency (EPA) and the Michigan Department of Environmental Quality (MDEQ). Pending regulations and future speculation are based on discussion with EPA, MDEQ, and the American Water Works Association (AWWA) Government Affairs Office.

2.0 Current Drinking Water Regulations

The Safe Drinking Water Act (SDWA) was passed in 1974 and amended in 1986 and 1996. The SDWA gives the United States Environmental Protection Agency (EPA) the authority to establish and implement national drinking water standards and regulations. Public water suppliers have the responsibility of meeting the standards set forth by the EPA. The 1996 amendments greatly enhanced the existing law by recognizing source water protection, operator training, funding for water system improvements, and public information as important components of safe drinking water.

The MDEQ passed the Michigan Safe Drinking Water Act 399 in 1976. The MDEQ holds primacy in the State of Michigan and adopts EPA regulations largely unchanged.

The EPA has established primary and secondary drinking water standards. The National Primary Drinking Water Regulations (NPDWR) are legally enforceable standards that apply to all public water systems. These standards protect the drinking water quality by limiting the levels of specific contaminants that can adversely affect public health. There are current regulations for over 80 contaminants. A listing of the regulated contaminants, their associated maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs), sources, and health effects are presented in Appendix A.

National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are federally non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards and FEDP has done so. A list of the NSDWRs is in Appendix B.

The regulations concerning water supply and quality are organized here in the following manner:

- Surface Water

- Systems relying on purchased water sources
- Water treatment facilities and distribution systems

2.1 Surface Water Regulations

2.1.1 Surface Water Treatment Rule (SWTR)

The Surface Water Treatment Rule (SWTR) was promulgated in June 1989. It established primary drinking water regulations requiring the treatment of surface water supplies, or groundwater supplies under the direct influence of surface waters, that serve 10,000 or more people. It stipulates that treatment should consist of disinfection and filtration. The SWTR established Maximum Contaminant Level Goals (MCLGs) of zero for the following microbiological parameters: *Giardia lamblia*, Enteric Viruses, and *Legionella*. Since these contaminants are neither routinely monitored nor easily detected, the SWTR established a treatment technique (disinfection and/or filtration) in lieu of maximum contaminant levels (MCLs) for these contaminants. Specific CT (disinfectant concentration multiplied by contact time) requirements for inactivation were established based on temperature, pH and disinfectant used. 3-log *Giardia* and 4-log virus removal must be met at all times. In addition, a detectable disinfectant residual of 0.2 mg/L is required at the entrance point to the distribution system. Disinfectant residuals within the distribution system must be detected in 95 percent of the samples each month for any two consecutive months.

The SWTR established a combined filtered water turbidity standard of less than or equal to 0.5 NTU. This standard was superseded by later rules. This rule also allowed for monitoring of heterotrophic plate count (HPC) in the distribution system in lieu of a disinfectant residual. HPC must be <500 cfu/mL.

2.1.2 Interim Enhanced Surface Water Treatment Rule (IESWTR)

In 1998, the Interim Enhanced SWTR established treatment techniques for removal of *Cryptosporidium* based on filtered water turbidity. The goal of the IESWTR was to optimize treatment reliability and to enhance physical removal efficiencies in order to minimize *Cryptosporidium* levels in finished water. The key provisions of the rule are:

- Maximum contaminant level goal (MCLG) of zero for *Cryptosporidium*
- 2-log *Cryptosporidium* removal requirements for systems that filter
- Strengthened combined filter effluent turbidity performance standards
- Individual filter turbidity monitoring provisions
- Disinfection profiling and benchmarking provisions
- Systems using groundwater under the direct influence of surface water now subject to the new rules dealing with *Cryptosporidium*
- Inclusion of *Cryptosporidium* in the watershed control requirements for unfiltered public water systems

- Requirements for covers on new finished water reservoirs
- Sanitary surveys, conducted by states, for all surface water systems regardless of size

The turbidity performance requirements are complex. The combined filtered water effluent turbidity was lowered to 0.3 NTU, as measured in 95 percent of all samples collected monthly. The maximum turbidity must never exceed 1 NTU. Individual filters must also be continuously monitored for turbidity. Individual filter performance triggers were established which lead to additional reporting, investigation and regulatory compliance. A further description of the requirements is given in **Tables 2-1 and 2-2**.

2.1.3 LT1 (Long Term 1) ESWTR

This regulation extends the provision of the ESWTR to all systems specifically including small systems.

A summary of the turbidity requirements are shown in **Table 2-1** and the follow up/reporting requirements in **Table 2-2**. There are two ways that turbidity is measured: Combined filter Effluent (CFE) and Individual Filter Effluent (IFE).

Table 2-1: Turbidity: Monitoring and Reporting Requirements

Turbidity Reporting Requirements	Monitoring/Recording Frequency	SWTR As of June 29, 1993	IESWTR ≥ 10,000 people As of Jan 1, 2002
CFE 95% Value Report total number of CFE measurements and number and percentage of CFE measurements ≤ 95th % limit	At least every 4 hours	≤ 0.5 NTU	≤ 0.3 NTU
CFE Maximum Value Report date and value of any CFE measurement that exceeded CFE maximum limit	At least every 4 hours	5 NTU Contact State within 24 hours	1 NTU Contact State within 24 hours
IFE Monitoring Report IFE, monitoring conducted and any follow-up actions	Monitor continuously every 15 minutes	None	Monitor – exceedances require follow-up action

Table 2-2: IFE Follow-Up and Reporting Requirements

Condition	IESWTR (≥ 10,000)		
	Action	**Report**	**By**
2 consecutive recordings >0.5 NTU taken 15 minutes apart at the end of the first 4 hours of continuous filter operations after backwash/offline	Produce filter profile within 7 days (if cause not known)	• Filter # • Turbidity value • Date • Cause (if known) <u>or</u> report profile was produced	10th of the following month

Table 2-2: IFE Follow-Up and Reporting Requirements

Condition	IESWTR (≥ 10,000)		
	Action	**Report**	**By**
2 consecutive recordings > 1.0 NTU taken 15 minutes apart	Produce filter profile within 7 days (if cause not known)	• Filter # • Turbidity value • Date • Cause (if known) or report profile was produced	10th of the following month
2 consecutive recordings > 1.0 NTU taken 15 minutes apart at the same filter for 3 months in a row	Conduct filter self-assessment within 14 days	• Filter # • Turbidity value • Date • Report filter self-assessment produced	10th of the following month
2 consecutive recordings > 2.0 NTU taken 15 minutes apart at the same filter for 2 months in a row	Arrange for CPE within 30 days & submit report within 90 days	• Filter # • Turbidity value • Date Submit CPE report	10th of the following month 90 days after exceedance

2.1.4 Long Term 2 Enhanced Surface Water Treatment Rule (LT2)

The LT2 ESWTR (Long Term 2 Enhanced Surface Water Treatment Rule) was published in January 2006. This rule requires two rounds of source water monitoring for *Cryptosporidium, E. coli* and turbidity. The first round of monitoring was completed in April, 2012. The rule requires a second round of monitoring to be completed by 2015. However EPA is re-evaluating this as part of the first six-year review of the rule which is in progress. DWSD has completed the first round of monitoring under the LT2 and the second round is currently planned for 2014.

2.1.5 Source Water Assessment Program (SWAP) and Surface Water Intake Protection Program (SWIPP)

Under the SDWA, the EPA requires States to develop comprehensive Source Water Assessment Programs (SWAPs) that identify the areas that supply public tap water, inventory contaminants and assess water system susceptibility to contamination and inform the public of the results. MDEQ in conjunction with USGS has conducted the basic SWAP requirements for some utilities in Michigan. The SWAP program is not required in Michigan but is encouraged. Completion of a SWAP and SWIPP provide for higher ranking when applying for Drinking Water Revolving Loan Funding. Both SWAP and SWIPP are discussed in further detail in TM No. 9 Watershed Management and Protection.

2.1.6 Filter Backwash Rule

The Filter Backwash Rule was promulgated in 2005 and established an additional treatment technique for *Cryptosporidium* removal. The rule specifically addresses the recycling of certain water streams within a treatment plant, including filter backwash water, thickener supernatant, and liquids from dewatering processes. All of these streams must be recycled to the head of the treatment plant. No specific treatment of these streams is required.

2.2 Systems Relying on Purchased Water

A "consecutive system" refers to a public water system that buys or otherwise receives some or all of its finished water from one or more other public water systems at least 60 days per year. A consecutive system can be categorized as a community or non-community water system.

DWSD serves 85 wholesale supplied plus the City of Detroit with a total of 127 communities. The MDEQ treats the entire DWSD service area as a consecutive for compliance with some regulations. The consecutive wholesale systems as of 2013 are listed in **Table 2-3**.

Table 2-3: DWSD Wholesale Drinking Water Communities

Allen Park	Flint (Genesee)	Melvindale	South Rockwood Village
Ash Township	Fraser	New Haven	Southgate
Auburn Hills	Garden City	Northville	St. Clair Shores
Belleville	Gibraltar	Northville Township	St. Clair County
Berlin Township	Greater Lapeer	Novi	Sterling Heights
Brownstown Township	Grosse Ile Township	Oak Park	Sumpter Township
Bruce Township	Grosse Pointe Park	Oakland County	Sylvan Lake
Burtchville Township	Grosse Pointe Shores	Orion Township	Taylor
Canton Township	Grosse Pointe Woods	Plymouth	Trenton
Center Line	Hamtramck	Plymouth Township	Troy
Chesterfield Township	Harper Woods	Redford Township	Utica
Clinton Township	Harrison Township	River Rouge	Van Buren Township
Commerce Township	Hazel Park	Riverview	W. Bloomfield Township
Dearborn	Huron Township	Rochester Hills	Walled Lake
Dearborn Heights	Inkster	Rockwood	Warren
Eastpointe	Keego Harbor	Romeo	Washington Township
Ecorse	Lenox Township	Romulus	Wayne
Farmington	Lincoln Park	Roseville	Westland
Farmington Hills	Livonia	Royal Oak Township	Wixom
Ferndale	Macomb Township	Shelby Township	Woodhaven
Flat Rock	Madison Heights	SOCWA	YCUA

2.3 Water Treatment Facilities and Distribution Systems

Regulations that affect the treatment of water or monitoring in the distribution system are discussed below.

2.3.1 Lead and Copper Rule (LCR)

On June 7, 1991, the EPA published required MCLGs and national primary drinking water regulations for lead and copper. Minor revisions were published in 2000. The LCR has several important components:

- Action Levels (AL) for lead and copper were set at 0.015 and 1.3 mg/L, respectively.

- Monitoring programs were established to determine lead and copper levels in the distribution system and at consumers' taps. Targeted samples are collected from locations where consumers are most likely to be exposed to increased lead levels.
- Systems were mandated to conduct corrosion control studies and implement treatment programs if ALs are exceeded.
- Treatment technique requirements are triggered if more than 10 percent of measurements exceed the actions levels stated above.
- Water quality monitoring in the distribution system is required to assess continued corrosion control performance.

If the lead AL is exceeded, then public education is required. The system must also conduct corrosion control studies. DWSD has established a goal for pH of 8.0-8.1 in the distribution system in order to provide corrosion control. The requirement for pH at the entry points to the distribution system and the whole sale communities is 7.0. Many states now require any system that changes its treatment process to reassess its lead and copper compliance and its corrosion control process to ensure that the treatment change does not adversely impact lead occurrence.

In addition to lead and copper monitoring, the rule also requires lead service line replacement if the action level is exceeded.

DWSD is on reduced monitoring for lead and copper. Monitoring is required every three years with a minimum of 50 samples. Water quality parameter must be collected from 10 locations twice per year in the Detroit service area.

The Safe Drinking Water Act was amended in January, 2014, to require that all products that come into contact with drinking water have a maximum lead content of 0.25%. This figure is based on a surface based averaging formula for wetted components. This "Reduction of Lead in Drinking Water Act" applies to pipes, pipe fittings, plumbing fittings and all fixtures. This reduction in lead in faucets and other similar delivery systems should serve to further reduce the potential for lead leaching into drinking water. Already installed leaded components in utility systems are grandfathered. However, any repairs or replacements must follow the new rule.

2.3.2 Total Coliform Rule (TCR)

The Total Coliform Rule was promulgated in 1989. Total coliforms include both fecal coliforms and *E. coli*. The MCLGs for total coliform, fecal coliform and *E. coli* have been set at zero. Compliance with the MCL is based on the presence or absence of total coliforms in a sample, rather than on an estimate of coliform density. The MCL for systems analyzing at least 40 samples per month is no more than 5.0 percent of the monthly samples may have a positive total coliform result. If less than 40 samples are collected per month, then the monthly MCL is triggered by more than one routine positive sample. Samples are collected from representative sites in the distribution system, including high, medium and low water age areas. A sample plan must be approved by the MDEQ. EPA sampling requirements based on system size are given in **Table 2-4**.

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All samples that are positive for total coliform must also be tested for either fecal coliform or *E. coli*. In addition, any sample that tests positive for total coliform requires repeat sampling at the same site and sampling within five service connections both upstream and downstream of the sample site. If either the original sample is positive for fecal coliform/*E. coli* or any of the repeat samples are positive for fecal coliform/*E. coli*, then this constitutes a violation of the MCL for total coliform.

The number of samples that a system must collect varies with the number of customers its serves. For DWSD the distribution system is treated as a consecutive system. Therefore the MDEQ has established a sample size of 54 samples per month for the City of Detroit. Many systems test more frequently in order to assure compliance and to obtain good water quality data.

Table 2-4: Public Water System ROUTINE Monitoring Frequencies

Population	Minimum Samples/ Month	Population	Minimum Samples/ Month	Population	Minimum Samples/Month
25-1,000*	1	21,501-25,000	25	450,001-600,000	210
1,001-2,500	2	25,001-33,000	30	600,001-780,000	240
2,501-3,300	3	33,001-41,000	40	780,001-970,000	270
3,301-4,100	4	41,001-50,000	50	970,001-1,230,000	300
4,101-4,900	5	50,001-59,000	60	1,230,001-1,520,000	330
4,901-5,800	6	59,001-7,0000	70	1,520,001-1,850,000	360
5,801-6,700	7	70,001-83,000	80	1,850,001-2,270,000	390
6,701-7,600	8	83,001-96,000	90	2,270,001-3,020,000	420
7,601-8,500	9	96,001-130,000	100	3,020,001-3,960,000	450
8,501-12,900	10	130,001-220,000	120	≥ 3960001	480
12,307-17,200	15	220,001-320,000	150		
17,201-21,500	20	320,001-450,000	180		

*Includes PWSs which have at least 15 service connections, but serve < 25 people

2.3.4 Stage 1 Disinfectants/Disinfection By-Products Rules (D/DBPR)

The EPA promulgated a revised standard for total trihalomethanes (TTHMs) and a new standard for other disinfection byproducts in 1998 by the Stage 1 Disinfectant/Disinfection Byproducts Rule (D/DBPR). This rule applies to all systems that use a disinfectant. The Stage 1 D/DBPR lowered the MCL for TTHMs of 0.08 mg/L and established the MCL for the five haloacetic acids (HAA5) at 0.06 mg/L. The compliance period for these contaminants is based on a running annual average (RAA) of quarterly samples from the distribution system. The number of required samples is based on system size. The regulated THMs are chloroform, dichlorobromomethane, chlorodibromomethane and bromoform. The five regulated HAAs are monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, bromoacetic acid, and dibromoacetic acid. More species of HAA have been identified but methods for measurement are routinely used.

For plants using ozone, the rule establishes as MCLG of zero and an MCL of 0.010 mg/L for bromate at the entry to the distribution system sampled monthly with compliance calculated as an RAA. No bromate monitoring or compliance are required if ozonation is not practiced.

The rule also sets maximum residual disinfectant levels (MRDLs) for chlorine and chloramine levels in the distribution system at 4.0 mg/L (samples taken at total coliform compliance locations). Disinfectant residual must be monitored daily at distribution system entry points. Compliance is calculated as the monthly average of all distribution system residual values.

Removal of TOC is required by plants that use conventional filtration and enhanced coagulation or softening may be necessary. The percent TOC removal is based on a combination of influent TOC concentration and other water quality parameters including raw water alkalinity. If the TOC in the source water is <2.0 mg/L, then the plant is exempt from the TOC removal requirements and this is the current case for DWSD. If TOC increases in the future, than the TOC removal requirements as shown in **Table 2-5** would be required.

Table 2-5: Stage 1 Disinfection Byproducts Rule TOC Percent Removal Requirements

TOC mg/L	Alkalinity mg/L as CaCO3		
	0-60	>60-120	>120
>2.0 – 4.0	35%	25%	15%
>4.0 – 8.0	45%	35%	25%
>8.0	50%	40%	30%

2.3.5 Stage 2 Disinfectants/Disinfection By-Products Rules (D/DBPR)

The Stage 2 D/DBPR was promulgated in 2005. The MCLs remain the same as in Stage 1 D/DBPR, but the compliance calculation was modified for TTHMs and HAA5s. Compliance is now calculated based on location-specific RAA. RAA. Sample frequency is based on population size (**Table 2-6**). The rule also modified the MCLGs for the individual DBPs. As part of the Stage 2 Rule, utilities were required to conduct programs to determine areas of maximum TTHM and HAA5 formation in their distribution systems (IDSE or Initial Distribution System Evaluation). The IDSE was used to develop a revised DBP monitoring plan to capture locations with the highest DBP concentrations. The DWSD system is considered a consecutive system by the MDEQ. Therefore, 3 samples are required quarterly in the City of Detroit. Schedule 1 system such as DWSD must comply with the requirements of Stage 2 by January 2013 (monitoring requirements began April 1, 2012)

Table 2-6: Compliance with Stage 2 DBPR MCLs (Routine Monitoring)

Source Water Type	Population Size Category	Monitoring Frequency	Total Distribution System Monitoring Locations per Monitoring Period
Subpart H	<500	per year	2
	500-3,300	per quarter	2
	3,301-9,999	per quarter	2
	10,000-49,999		4
	50,000-249,999		8
	250,000-999,999		12
	1,000,000-4,999,999		16
	≥ 5,000,000		20

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2.3.6 Arsenic Rule

The arsenic rule was promulgated in 2001 and became effective January 2006. This rule lowered the MCL to 0.010 mg/L with an MCLG of zero. Surface water systems must sample annually and groundwater systems triennially at the each entry point to the distribution system. Compliance is based on the RAA at each sample point (LRAA). The rule also requires public notification in the Consumer Confidence Report if the water exceeds 5 µg/L arsenic.

2.3.7 Synthetic Organic Chemicals (SOCs) and Inorganic Chemicals

Several phases of regulations have been developed by EPA to address synthetic organic chemicals (SOCs) and volatile organic chemicals (VOCs). DWSD is required to monitor for SOCs twice per 3 years. For inorganics, monitoring is required once every 9 years.

2.3.8 Phase I: Volatile Organic Chemicals (VOCs)

In 1987, the EPA established the first regulation for eight VOCs. MCLs and MCLGs were set for each individual VOC. Monitoring was initially required quarterly for one year. If the regulated VOCs were not detected then the sampling frequency could be reduced. The state is allowed to set the monitoring frequency based on individual system needs. DWSD is required to monitor for VOCs quarterly

2.3.9 Phase II and V: Inorganics, SOCs and VOCs

The Phase II regulation was established in 1991 and the Phase V in 1992. These rules are typically considered in concert with each other. The Phase II rule regulates a wide variety of inorganics, pesticides, herbicides, asbestos, nitrate and nitrite. The Phase V rule expands on the list of regulated metals, pesticides, VOCs and added a new substance, cyanide. Under both the Phase II and Phase V rules, most monitoring is initially quarterly for one year. If substances are not detected, the monitoring frequency may be reduced and is established by the state. Exceptions to this monitoring include nitrate and nitrite (annual), and asbestos (once per nine years). The MDEQ has rescinded the waiver for cyanide monitoring, effective in 2013. Therefore, DWSD will be required to conduct cyanide monitoring in the future. Individual MCLs and MCLGs were established. DWSD is required to monitor for SOCs twice per 3 years. For inorganics, monitoring is required once every 9 years.

2.3.10 Fluoride

The EPA promulgated the fluoride rule in 1986. This regulation set an MCL of 4.0 mg/L, an MCLG of 4.0 mg/L and a secondary standard of 2.0 mg/L. Monitoring is at least annual, with the state allowed to set more frequent requirements. Daily monitoring is typical for treatment plants that feed fluoride. This regulation continues to generate controversy and has attracted continuing public and congressional interest. Recent health studies have recommended lowering the fluoride concentration to 0.7 mg/L. The MDEQ is encouraging this practice and DWSD has adjusted the fluoride feed rates accordingly.

2.3.11 Radionuclides

The radionuclides regulation was promulgated by EPA in 2000. The rule sets MCLs for gross alpha at 15pCi/L, beta particle and photon emitters at 4 mrem/year, radium (226 and 228 combined) at 5 pCi/L and uranium at 0.030 mg/L. MCLGs for all parameters are zero. Initial monitoring is at the entry to the distribution system quarterly for one year. Sampling frequency may subsequentially be reduced and set by the state based on system vulnerability. DWSD is required to sample once per treatment plant every nine years

2.3.12 Consumer Confidence Report

The consumer confidence report requires annual notification by direct mail and web site posting of information on the water utility including mandatory health language, water quality data and drinking water violations. This rule was promulgated in 1998. The Consumer Confidence Report (CCR) was updated in 2013 to allow for alternate methods of delivery to customers, including electronic notification and electronic availability in lieu of direct mail of hard copy.

2.3.13 Public Notification

A regulation regarding requirements for public notification was promulgated in 2000. This rule establishes different levels of regulatory violation, standard language for public notification, and the methods and timeliness of public notices. Subsequent rules may individually set public notification requirements specific to that rule. An update Public Notification Handbook was published by EPA in March, 2010.

2.3.14 Operator Certification

The MDEQ currently certifies plant and distribution system operators. The operator certification rules are set forth in Act 399.

3.0 Current Compliance

DWSD is currently in compliance with all regulations.

4.0 Future Drinking Water Regulations

Upcoming regulatory developments may present challenges to many water utilities across the United States. This section provides an overview of anticipated drinking water regulations both in the short term (1 – 5 year) and long term (5 – 20 year) time horizons, as well as provides insight on the future regulatory framework which may impact water quality decisions made as part of the master planning efforts for the Detroit Water and Sewerage Department (DWSD) water system. As the regulatory forefront continues to advance, it is recommended that DWSD plan to continue to proactively track and plan for potential regulatory changes. Staff time and costs should be budgeted to maintain this activity. A summary of potential future regulations is shown in **Table 4-1** and discussed in the following sections.

Table 4-1: Proposed and Pending USEPA Regulatory Actions (adapted from Roberson, 2013)

Regulatory Action	Topic Addressed	Regulatory Date	Final/Compliance Date
Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) sampling	Cryptosporidium control	Jan 2006 Final	Second round of sampling by 2015
CFATS	Gas chlorine use	2008 Draft	Unknown
Revised Total Coliform Rule (RTCR)	Bacteria occurrence	Jul 2010 Final	February 13, 2013 Compliance
Consumer Confidence Rule (CCR)	Public information	Sep 2012 Final	January 3, 2013 Compliance
Long-Term Lead and Copper Rule (LT-LCR) Revisions	Lead exposure	2013 Draft	2014 or 2015 Final
Perchlorate	Perchlorate minimization	Late 2013 Draft	18 months after draft rule

Table 4-1: Proposed and Pending USEPA Regulatory Actions (adapted from Roberson, 2013)

Regulatory Action	Topic Addressed	Regulatory Date	Final/Compliance Date
Carcinogenic VOCs (cVOCs)	Carcinogens minimization	2014 Draft	2016 Final
Hexavalent Chromium (Cr-6)	Chromium minimization	2017 or 2018 Draft	2019 or 2020 Final
Third Six-Year Review (SY3)	Regulatory process	2015 Draft	2016 final
Unregulated Contaminant Monitoring (UCMR3)	Regulatory process	May 2012 Final	2014 Sampling
Third Regulatory Determination (RD3)	Regulatory process	2013 Draft	2014 or 2015 Final
Anticipated RD3 Regulations	Regulatory process	2016 or 2017 Draft	2018 or 2019 Final

4.1 Long Term 2 Enhanced Surface Water Treatment Rule (LT2 ESWTR)

The LT2 ESWTR (Long Term 2 Enhanced Surface Water Treatment Rule) was published in January 2006. This rule requires two rounds of source water monitoring for *Cryptosporidium, E. coli* and turbidity. The first round of monitoring was completed in April, 2012. The rule requires a second round of monitoring in 2015; however this is being discussed as part of the first six-year review of the rule which is in progress. The first round of monitoring found that most utilities fell into Bin 1 with only 7.1% in Bin 2 and none in Bin 3 or Bin 4 (Obolensky and Hotaling, 2013). However, *Cryptosporidium* was observed more frequently in surface water supplies from flowing rivers/streams (11% of samples) than in in surface water lakes/reservoirs (3% of samples) or groundwater under the direct influence (GWUDI) (4% of samples). The EPA is required to conduct stakeholder meetings prior to the start of the second round of monitoring. Review meetings to discuss the requirements to cover uncovered finished water reservoirs and other issues are also planned.

Past DWSD monitoring for *Cryptosporidium* from October 2006 through September 2007 for LT2 found largely non-detects with only a single detection in April 2008 of 0.1 oocysts per liter in the samples from the intakes at Water Works Park and Fighting Island. No *Cryptosporidium* were detected at the Lake Huron intake. This rule is not predicted to adversely impact DWSD.

4.2 Chemical Facilities Anti-Terrorism Standards (CFATS)

This regulation has been under discussion by the Department of Homeland Security for several years, with a draft regulation issued in 2008. The final rule would require enhanced security and assessment at any facility that used gas chlorine. While the water industry has lobbied for exemption for water and wastewater treatment plants, this remains controversial. CFATS has attracted considerable congressional attention in the past. However, congress no longer appears to be pushing this legislation but that could change at any time or with a shift in representation (personal communication, Roberson, 2013). DWSD should be prepared for either increased costs for continued use of gas chlorine due to security requirements or prepare a plan for conversion to non-gas chlorine alternatives. As of May, 2014, CFATS was extended for three years by the House Homeland Security committee with the continuation of the drinking water exemption. However, the committee unanimously adopted an amendment called for a study of the security implications of the amendment On-site generation will be preferable to liquid hypochlorite due to both space and cost requirements.

4.3 Revised Total Coliform Rule (RTCR)

In order to identify deficiencies in water distribution systems that may allow for the entrance of disease-causing microorganisms and fecal contamination, the USEPA established the Total Coliform Rule (TCR) in 1989. This rule requires utilities to routinely (monthly) monitor total coliform in the finished water and distribution system as an indicator of potential contamination. Utilities must not detect >5% positive sample results on a monthly basis to remain compliant with the total coliform MCL. If more than 5% positives results are detected, the utility is required to release a public notification in 30 days. This is known as a non-acute violation. For every total coliform positive sample, a utility must also analyze for fecal coliform or *E. coli*. Each positive total coliform sample also triggers repeat sampling at the same location plus one sample upstream and one sample downstream (both within 5 service connections). A system is in violation of the MCL if it has an *E. coli*-positive repeat sample following a total coliform positive routine sample; or a routine sample is *E. coli*-positive and one of its associated repeat samples is total coliform-positive. For this violation, a utility must issue a public notification within 24 hours. This is considered an acute violation.

For some utilities the monthly monitoring required is a significant expense. Minimal provisions exist in the original TCR for utilities to obtain reduced monitoring status. In addition, the principal ramifications of violating the rule are public notification but the rule does not outline provisions for recommended fixes. As a result, the USEPA decided to revise the TCR in 2003 as part of the First Six Year National Primary Drinking Water Regulation Review. The final revisions to the TCR were published in February, 2013.

In summary, the most recent Revised Total Coliform Rule (RTCR) requires the following changes to the 1989 Rule:

- Basic monitoring requirements from the 1989 TCR remain the same but the rule outlines a series of criteria for well operated small systems (less than 1,000 customers) to qualify for and remain on reduced monitoring as well as requiring increased monitoring for high-risk small systems with unacceptable compliance histories and requiring some monitoring for seasonal systems.

- Establishes a MCL and MCLG for *E. coli* and removes the MCL and MCLG for total coliform. As a result, the acute total coliform violation under the TCR has been amended to refer to *E. coli*.

- Eliminated the option to perform fecal coliform testing subsequent to a total coliform positive result. All total coliform positive samples must be analyzed for *E. coli*.

- If a violation of the *E. coli* MCL occurs, a utility must conduct an investigation to identify and perform corrective action(s) to reduce contamination. Two levels of assessment may be required. A Level 1 assessment is an evaluation to identify the possible presence of sanitary defects, defects in distribution system coliform monitoring practices and, when possible, the likely reason that the system triggered the assessment. A Level 2 assessment provides a more detailed examination of the system, including the system's monitoring and operational practices, than does a Level 1 assessment. This is done through the use of more comprehensive investigation and review of available information, additional internal and external resources, and other relevant practices. A Level 1 assessment is performed by the utility; a Level 2 assessment will be done by the MDEQ.

- The RTCR removes the requirement for public notification based on total coliform presence only. Instead public notification is required only when an *E. coli* MCL violation occurs or when the utility has failed to conduct required assessments or corrective actions.

In essence the triggers for compliance of the original TCR remain the same but the resulting actions are different. The existing TCR will remain in effect until March 31, 2016 and on April 1, 2016 the RTCR compliance requirements will take effect.

It is predicted that DWSD and its customers will be able to comply with the RTCR. A review of all available online CRRs for 2012 (or earlier if 2012 was not available) was conducted for DWSD and its customers. In addition, 55 utilities had online CCRs with total coliform data reported which indicated that total coliforms were not detected in any of the water systems. In addition, the total coliform raw data for 2011 were provided by DWSD who performs all the total coliform compliance testing for 82of its customers. Ten communities had at least one positive sample during 2011. DWSD and its customers currently meet the TCR. If modifications are made to the overall distribution system that will create increased water age, then maintenance of a chlorine residual will be a greater challenge. This can lead to increases in total coliform occurrence. DWSD and its communities should be prepared to perform a Level 1 and Level 2 assessment if necessary.

In addition, DSWD currently is approved for consecutive monitoring and therefore collects 56 distribution samples per month (54 are currently required) for the City of Detroit. Wholesale customers are also part of the consecutive system designation and sample accordingly. MDEQ has verbally confirmed that this sampling frequency and plan will continue to be acceptable under the RTCR (Brock Howard, personal communication, September 23, 2013)

4.4 Consumer Confidence Rule (CCR)

The Consumer Confidence Rule (CCR) requires water utilities to release annual drinking water quality reports, known as consumer confidence reports, that document among other things information regarding the water source, the levels of any contaminant found in local drinking water, likely sources of contaminants, potential health effects of any violations of EPA standards, and educational information on certain contaminants, especially *Cryptosporidium*, lead, nitrate, and/or arsenic, where these contaminants may be a concern. The Michigan Department of Environmental Quality (MDEQ) provides recommended language for inclusion in CCRs and provides guidance on presentation of water quality data.

The CCR includes accepted methods of delivery of consumer confidence reports. The CCR requires that utilities must "mail or otherwise directly deliver" one copy of the report to each of their customers. According to the CCR, utilities must make a "good faith effort" to deliver CCRs to customers who do not receive a water bill. Responding to utility interest in alternative methods of delivery, the USEPA released a regulatory guidance document on the CCR in January 2013 entitled "Safe Drinking Water Act – Consumer Confidence Report Rule Delivery Options." While not a regulation per se this document provides guidance on interpretation of the rule regarding accepted methods of delivery. This interpretative document defines direct delivery as "sending URL on a postcard or in the customer's bill". As such, utilities now have the option for electronic delivery or notification of customers of the online location of the utilities' annual report. Carpenter and Roberson (2013) conducted a nationwide survey of water utilities and reported that of the utilities surveyed, 93% indicated that they would prefer to post their CCR electronically and provide a web URL as part of the bill mailing. The authors predicted that this method of delivery could save over $19 million dollars nationwide on an annual basis (Carpenter and Roberson, 2013).

DWSD and all of its customer communities provide CCRs annually to their customers and many also post their reports online. As of July 2013, among DWSD and its 91 total customer communities, 65 posted a CCR online. As a result DWSD and many of its communities may be able to easily make the transition to electronic delivery should they desire. This transition will provide a cost savings in terms of staff time and delivery.

4.5 Long-Term Revisions to the Lead and Copper Rule (LT-LCR)

During previous regulatory reviews, the USEPA identified gaps in the Lead and Copper Rule (LCR) that may be addressed through a new long term regulation (LTLCR). The action limits for lead and copper from the current LCR may also change as there are groups pushing for a lower MCL for lead. Potential regulatory changes to the LCR include:

- Elimination of partial lead service line replacement;
- Enhanced guidance on acceptable water quality indicators and targets to minimize corrosion;
- Changes in sampling protocols including stagnation times, and presence or absence of aerators and sampling of the actual lead service line water;
- Possible inclusion of any distribution system lead component including lead gooseneck connections as sample points.

The potential change in requirements for sampling from lead service line properties may particularly impact utilities serving older cities with lead service lines (Roberson, 2012). If samples are collected from the lead service line instead of first flush, the sample collection effort and complexity will increase. Lead results are also likely to increase leading to increased non-compliance. A draft of the revised rule is expected this year with a final revised rule anticipated in 2015.

All DWSD and its customer communities who had an online CCR (56 utilities) have reported compliance with the LCR (90^{th} percentile of samples below lead action limit of 15μg/L). In addition, lead and copper data were provided by DWSD for the customers for who it preforms monitoring (**Figure 8-1**). All 91 of these systems comply with the LCR. A few systems are already reporting a 90^{th} percentile lead of approximately 10 μg/L. Therefore, a lower MCL or a modification of sampling procedures could adversely impact regulatory compliance for some systems. Understanding of the lead and copper data and piping infrastructure types in all systems will be important to assess and document. DWSD and its customers should pay special attention to LCR updates given that future sampling requirements may cause increased level of effort and have the potential for compliance concerns. USEPA has also issued a revised "lead-free" definition which goes into effect this year (Roberson, 2013). Under this definition "lead free" is now considered to be materials with less than 0.25% lead by weight. Any new distribution system appurtenances must comply with this definition.

Existing inventory must be installed in 2013 or disposed of if it does not comply with the revised definition.

It is expected that partial lead service line replacement will not be allowed under the LT-LCR. Instead, full replacement from the water main to the customer meter will be required when the lead action level is exceeded. Full replacement would be problematic since portions of the service line are not owned by DWSD or the wholesale communities. Therefore, access is an issue. In addition, the question of how the replacement is paid for creates a potential issue with customers and potentially increases the utility budget to pay for the full replacement.

4.6 Perchlorate

Perchlorate is a contaminant that has been recently identified as a potential health. Perchlorate was included on the first, second, and third Contaminant Candidate Lists and a determination to regulate it under the National Primary Drinking Water Regulations was made in 2011. Pursuant to the requirements of the SDWA (Safe Drinking Water Act), a draft rule should have been presented for public review in February 2013; however lack of agreement over establishment of the MCL and MCLG has led to delays. The draft rule is still anticipated in 2013 with a final rule 18 months after presentation of the draft rule. Currently, California regulates perchlorate at 6 µg/L (2007) and Massachusetts at 2 µg/L (2006). Per personal communication with Alan Roberson, a likely EPA MCL is between 5 and 10 µg/L.

DWSD tested for perchlorate in 2003 as part of UCMR1 (Unregulated Contaminant Monitoring Rule). No perchlorate was detected in any of the source or finished water. However, since these data are 10 years old, it is recommended that perchlorate sampling of the source waters should be repeated. Perchlorate is typically associated with the production of rocket fuel, fireworks, flares and explosives. Perchlorate can also be present in bleach and in some fertilizers and can be naturally occurring. Since there are significant chemical manufacturers present in the source water area, there exists the potential for discharges of multiple chemicals of concern.

4.7 Carcinogenic Volatile Organic Chemicals (cVOC)

Volatile Organic Chemicals (VOCs) were promulgated by USEPA in July, 1987 and are known on the Phase 1 Rule. This rule established MCLs and MCLGs for benzene, carbon tetrachloride, p-dichlorobenzene, trichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,1-dichloroethylene and 1,2-dichloroethane. Additional VOCs of cis-1,2-dichloroethylene, ethylbenzene, monochlorobenzene, styrene, tetrachloroethylene, toluene, trans-1,2-dichloroethlylene, xylenes and 1,2-dichloropropane plus some SOCs (synthetic organic chemicals) and inorganics were regulated under the Phase II and Phase IIB rules in January, 1991 The Phase V in July, 1992 added dichloromethane, 1,1,2-trichloroethane and 1,2-4-trichlorobenzene plus additional SOCs and inorganics.

According to Roberson (2012), a draft rule regarding Carcinogenic Volatile Organic Compounds (cVOCs) is also anticipated this year for draft publication in 2014. Up to 16 compounds including trichloroethylene (TCE) and tetrachloroethylene (PCE) plus additional regulated and CCL3 VOCs are anticipated to be included in this rule. The draft list of candidates for monitoring from the currently regulated compounds are benzene, carbon tetrachloride, 1,2-dichloroethane, 1,2-dichloropropane, chloromethane, tetrachloroethylene, trichloroethylene, vinyl chloride, and the eight unregulated compounds are aniline, benzyl chloride, 1,3-butadiene, 1,1-dichloroethane, nitrobenzene, oxirane methyl, 1,2,3-trichloropropane and urethane. This rule is important as it sets a direction for future regulations. For this rule, EPA is proposing to regulate based on a suite of compounds rather than individually and has been requesting comment regarding the group approach to regulation. This regulation is linked to potential revision of the MCLs for TCE and PCE as part of the Six-Year Review of existing drinking water regulations.

While the potential cVOC compounds are not currently detected in DWSD source waters or finished waters, it is recommended that DWSD track this regulation and prepare for monitoring.

4.8 Hexavalent Chromium

Both hexavalent chromium (chromium 6) and total chromium were included in the UCMR3 and depending on the incidence and risk of exposure the EPA may prepare a draft rule for public comment by 2017 or 2018. Total chromium is already regulated with a MCL of 100 µg/L under the Inorganic Contaminants (IOC) Phase 2 rule of January, 1991. Total chromium consists of a combination of hexavalent chromium and trivalent chromium. Since hexavalent chromium is more toxic than trivalent chromium, a lower MCL is anticipated than for total chromium. The use of oxidants such as chlorine and chloramine shift the oxidation from trivalent chromium to hexavalent chromium. Therefore, formation of hexavalent chromium in the distribution system is likely to be addresses. California has a public health goal of 10 µg/L in the finished water as of May, 2014. Roberson (2012) suspects that that the EPA will hold off making a regulatory determination until a full risk assessment of the contaminant has been finalized. Guidance on enhanced monitoring for hexavalent chromium was released by EPA in 2011.

DSWD has detected hexavalent chromium in its source and finished waters. Hexavalent chromium was measured May 16, 2011 and December 6, 2011. Hexavalent chromium results are shown in **Tables 4-2 and 4-3**. These results are all below the total chromium MCL but hexavalent chromium is consistently detected in most samples. DWSD should sample for hexavalent chromium in the distribution system to assess its potential increase in concentration due to chlorine oxidation. DWSD is scheduled to collect hexavalent chromium in 2014 as part of the UCMR3.

Table 4-2: Hexavalent Chromium at DWSD WTPs

Hexavalent Chromium ug/L (Method 218.6) May 16, 2011					
Sample Location	Water Works Park	Springwells	Southwest	Northeast	Lake Huron
Raw water	0.25	0.25	0.25	0.25	0.27
Plant Tap	0.13	0.24	0.29	0.27	0.23
Distribution system (highest retention)	0.14	0.39	0.34	0.28	0.23

Table 4-3: Hexavalent Chromium ug/L (Method 218.6) December 6, 2011

Sample Location	Water Works Park	Springwells	Southwest	Northeast	Lake Huron
Raw water	0.16	0.16	0.15	0.16	0.18
Plant Tap	0.09	0.10	0.10	0.09	0.11
Distribution system (highest retention)	0.10	0.11	0.15	0.11	0.13

Notes: Method Reporting Limit 0.02 ug/L

4.9 Six Year Review

The SDWA requires a review of existing drinking water regulations once every six years to determine if revisions are needed. The first took place in 2003 (finalized in 2004) followed by 2009 (finalized in 2010) and the third is expected in 2015 to be finalized by 2016.

4.10 Unregulated Contaminant Monitoring (UCMR3)

The Third Unregulated Contaminant Monitoring Rule (UCMR3) commenced this year and will continue through 2015. The UCMR3 presents unique challenges to systems such as DWSD. Under the UCMR3 utilities with more than 10,000 customers are required to sample for 21 "List 1" chemicals and utilities serving less than 10,000 customers are required to sample for 7 "List 2" chemicals. Under previous UCMRs consecutive systems were not required to monitor, however under the UCMR3 consecutive systems, namely all of DWSDs customer communities, are required to conduct sampling in accordance with their population served. In addition, the party conducting sampling (in most cases the utility) must perform a "field blank" which will increase the time and cost required for sampling.

4.11 Third Regulatory Determination (RD3)

The SDWA requires the USEPA to make a regulatory determination on at least five contaminants on the Contaminant Candidate List (CCL) every five years. According to Roberson (2012) the next regulatory determination is expected in 2013 and must be signed by 2015. At the last regulatory determination, the EPA chose to not pursue regulatory action for 10 of the 51 contaminants on the CCL2 and chose to pursue regulatory action for perchlorate (see previous section).

For the Third Regulatory Determination (RD3), the EPA will make a regulatory determination on a subset of the 116 contaminants on the CCL3. According to Roberson (2012) the EPA is anticipated to make a decision to pursue regulation on at least three contaminants: nitrosamines, strontium, and chlorate. Chlorate is also expected to be included in UCMR3.

Nitrosamines have been associated with chloramination in drinking water distribution systems but are also present from other sources in the environment. Utilities using PolyDADMAC or polyamine polymers are also at risk (Roberson, 2012). Roberson (2012) indicates that a key barrier to regulation is consensus on whether or not regulation in drinking water presents a meaningful reduction of health risk due to the potential exposure to nitrosamines from other sources. Nitrosamines are not anticipated to be an issue for DWSD. If future changes to the disinfection or coagulation approaches are ever considered, then this may need to be evaluated.

Chlorate is a disinfection by-product (DBP) that is associated with chlorine dioxide but also with degradation of sodium hypochlorite from either bulk liquid ore on-site generation. As many utilities switch from chlorine gas to sodium hypochlorite or away from free chlorine to alternative disinfectants such as chlorine dioxide, chlorate may become an issue. A regulatory determination on chlorate would affect utilities interested in either of those disinfection alternatives. Chlorate is not a current issue for DWSD. However, should DWSD elect to replace gas chlorine with hypochlorite, than it may be appropriate to assess chlorate.

Strontium is both naturally occurring and present in the environment due to human-caused contamination. The USEPA is reviewing its potential as a regulated contaminant due to the potential for human health risk if present in drinking water. Currently, DWSD has not collected any data on strontium. DWSD is scheduled to collect samples for strontium in 2014 as part of UCMR3.

Should the EPA decide to regulate nitrosamines, chlorate, or strontium under the RD3, a draft rule would be due 24 months from the RD3 and a final rule 18 months after that. Thus anticipated regulations on RD3 contaminants are expected in 2018 or 2019.

5.0 Overview of Anticipated Regulations (Long Term)

Emerging contaminants, improved scientific methods, review of existing regulations, and further research into health effects of known chemicals or drinking water additives will spur further drinking water regulatory actions in the future. Potential regulatory actions may include those listed in **Table 5-1** and discussed below.

Table 5-1: Potential Future Regulations

Regulatory Action	Potential Impact
Fluoride	Lower MCL and recommended dose, cost savings
MTBE	New monitoring and treatment requirements
CCL4/UCMR4	Development of next UCMR and CCL cycle
D/DBP3	Lower MCLs, Individual DBP regulations
Non-Regulated DBPs	New regulated compounds
LT3ESWTR	New pathogens monitoring and new microbial movement requirements, lower combined filter effluent turbidity
EDCs and PPCPs	New regulated compounds
Regulatory approach	Consideration of sensitive subpopulations in any regulation

5.1 Fluoride

The United States Department of Health and Human Services has recommended lowering the upper limit to 0.7 mg/L fluoride. The USEPA has considered this proposal but has not yet issued a regulatory determination on this subject. Some state regulatory authorities have lowered or are considering lowering their limit to 0.7 mg/L to correspond to the US Health and Human Services recommendations. DWSD should continue to monitor fluoridation regulations and recommendations. DWSD has already lowered the fluoride concentration consistent with MDEQ recommendations.

5.2 Methyl-tertiary-butyl ether (MTBE)

DWSD monitors quarterly for MTBE as part of VOC screen. MTBE has been an ongoing consideration for regulation. MTBE occurrence was assessed in UCMR1 and it has been a potential candidate for regulatory consideration in CCL1, CCL2 and CCL3 but no determination has yet been made. EPA determined that additional occurrence data and health effects data are needed prior to determining if regulatory actions should be pursued. EPA published a drinking water advisory on MTBE in 1997. California established and MCL of 13 µg/L in 2000. MTBE is a fuel oxygenate that have been added to fuel such as gasoline to reduce carbon monoxide and ozone levels from auto emissions. Its use for this purpose began in 1979. MTBE has contaminated both groundwater and surface water primarily via leaking underground storage tanks and small boat engines used on lakes. Water treatment processes

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that remove MTBE are air stripping, GAC and advance oxidation processes. DWSD should monitor for MTBE to be prepared for potential regulation.

5.3 CCL4 & UCMR4 Development

It is anticipated that the CCL process will continue in the future. Development and proposal of the CCL4 may take place within the next 10 to 15 years which may affect future regulatory determinations. DWSD and its communities should budget and plan on participation in the associated UCRM4.

5.4 Disinfectant/Disinfection Byproducts Stage 3 (D/DBP)

DBPs that are currently regulated under the Stage 1 and Stage 2 D/DBP Rules may be the subject of future regulatory revisions. While the Stage 2 Rule developed the Locational Running Annual Average (LRAA) for monitoring, the MCLs remained the same for four total trihalomethanes (TTHMs) and five haloacetic acids (HAAs) as in Stage 1. Potential changes to the D/DBP regulations include the following:

- Originally during the development of Stage 2, the USEPA had considered decreasing the MCL to 40 ug/L and 30 ug/L for TTHMs and HAAs, respectively. While this change was not made in the Stage 2 Rule it may be considered again in future rules. Likewise, there has been discussion over possibly lowering the bromate MCL.

- Regulation of nine HAAs as opposed to five was also originally proposed in Stage 2, however four were left the final off due to unavailability of reliable analytical procedures. According to Singer (2006), by the time of the final D/DBP Rule, appropriate methods existed for detection of these four additional HAAs so analytical procedures are no longer a restriction. Further, utility monitoring data indicated that they constituted approximately 20 – 50% of the total HAAs. Inclusion of these four compounds may be included in future D/DBP rules. It is recommended that DWSD investigate the occurrence of HAA9s.

- According to Singer (2006) a re-definition of the MCLs is a possibility. Assessing TTHMs and HAAs on a mass basis as opposed to a molar basis creates a weight bias for compounds such as chloroform which is less toxic than the brominated THMs. Further, Singer (2006) suggests that the USEPA should consider abandoning regulating THMs and HAAs as a group and should instead regulate them individually. This would allow the limits to be expressed on a weight basis with a risk-associated MCL assigned to each, similar to the World Health Organization (WHO) limits. Future regulation of THMs and HAAs may include such provisions. However, with EPA recent proposed move to regulations by contaminant grouping, a shift to individual DPB species becomes less likely.

- Additionally future D/DBP regulations may include additional guidance on treatment techniques and disinfection practices to minimize the risk of formation.

Data from the 2012 CCRs were examined to assess the individual maximum TTHM observed (**Figure 8-2**). Of the 50 utilities with online CCR data and with a TTHM range and HAA range reported, it is predicted that Stage 2 compliance will be achieved. However, there is the possibility of future concerns if the MCLs are lowered in a future regulation. There are individual values greater than the

40/30 TTHM/HAA5. However, lower concentrations are typical in cold temperatures which should decrease a running average to an acceptable level. DWSD should track the development of DBP Stage 3 and track distribution system hydraulic changes that could increase water age.

5.5 Non-Regulated DBPs

Non-Regulated DBPs include nitrogenous, iodinated, and brominated DBPs. A large fraction of DBPs, estimated at over 50%, are not accounted for by TTHM and HAA5. Therefore, it is recognized that there are many additional compounds formed from different disinfection practices. While nitrosamines may be slated for regulation as a result of the RD3 and the non-regulated brominated and chlorinated HAAs may be included in future D/DBP rules, additional DBPs may also be considered for regulation in the next 20 years. Muellner et al., 2006 identified nitrogenous (i.e. nitrogen-based compounds), brominated (containing bromine), and iodinated (containing iodine) to be several times more genotoxic and cytotoxic than the current set of regulated chlorinated carbonaceous DBPs (i.e. carbon-based molecules with chlorine such as chlorinated THMs and HAAs). These findings demonstrate the need for future research in this area to determine what type of risk is present. This could lead to future regulatory action. Utilities with high bromide or iodide in their source water may be especially at risk. A current Water RF study (4242) entitled "Fate of Non-Regulated DBPs in Distribution Systems" will provide insight into the complexity of a wide variety of DBPs, their formation and degradation (both biotic and abiotic). DWSD performed nitrosamine monitoring as part of UCMR2 and all samples had non-detectable concentrations.

5.6 Long Term 3 ESWTR

Similar to D/DBP Stage 3, an LT3ESWTR (Long Term 3) rule is a possibility. It is likely that EPA will require additional *Cryptosporidium* monitoring as methods are improved. In addition, other protozoa could be added to the list. Such monitoring would be used to revise the LT2ESWTR. It is also speculated that the USEPA might lower the combined filtered water turbidity to 0.15 or 0.10 NTU. DWSD should plan on future monitoring and enhancements to filtration performance.

A separate component of the SWTR's is the requirement to maintain a detectable chlorine residual in 95% of distribution system monthly samples. Chlorine residuals from the CCR were based on the chlorine residuals taken at the time of TCR bacteria sampling and RAA averages are calculated quarterly and yearly by plant. Each community is assigned a water plant based on the DWSD color coded service area map available on its website. The CCR tables' chlorine residuals are based on the high and low month average values for the specific plant and the highest RAA quarter per MDEQ request. Only distribution system information is used. MDEQ requirements considers no chlorine is present when the chlorine residual is less than or equal to 0.1 mg/L. DWSD has never had a chlorine residual in the distribution system below the 95% value required for more than two consecutive months. Instead, the raw data from DWSD TCR 2011 files were reviewed and the lowest total chlorine residual in each community examined (**Figure 8-3**). Of the 79 utilities with data, minimum residuals ranged from 0.03 to 0.87 mg/L. Of these communities, only 7 had a minimum residual greater than 0.5 mg/L and 34 were below conventional method detection limits of 0.2 mg/L. Compliance calculations were not performed on this data set. However, it is observed that low chlorine residuals are already present in many communities. Any increase in water age would further degrade the chlorine residual. Assessment of water age and chlorine residual should be performed as part of any distribution system modifications.

5.7 Endocrine Disrupting Compounds (EDCs) and Pharmaceutical and Personal Care Products (PPCPs)

EDCs and PPCPs have attracted increasing attention. DWSD participated in a tailored Water Research Foundation project that assessed the occurrence of 20 compounds in the Detroit River and the ability of ozone to remove those compounds. Sixteen compounds were detected in the source water and nine in the finished water from Water Works Park WTP (**Table 5-2**). A limited study (one sample of source water and one of finished water) performed at the Southwest WTP detected one compound in the source water and two in the finished water. It is likely that some of the EDCs and PPCPs assessed in UCMR2 may be considered in CCL3. With increasing pressures on the Great Lakes watershed, such as increasing population, industrial discharges and wastewater discharges, coupled with improvements in analytical techniques, the occurrence of EDCs and PPCPs is predicted to continue and potentially increase. Therefore, it is recommended that DWSD continue to monitor the source waters and consider future addition of processes, such as ozone where it is not currently employed, to help mitigate EDC and PPCP occurrence in the finished water.

5.8 Radon

A Radon rule was proposed in which would have set an MCLG of zero, an MCL of 300 pCi/L and an alternative MCL of 4,000 pCi/L. If the state developed a multimedia mitigation program, then the alternative MCL would apply. The multimedia mitigation program is based on the National Indoor Radon Program and recognizes the multiple potential sources of radon and their relative contribution to exposure. Initial sampling would be quarterly for one year at each entry point to the distribution system. Reduced monitoring would be allowed in future years based on the results of the initial monitoring. This rule was rescinded by EPA in August 1997 due to controversy. It has not appeared on the regulatory front since then and is not likely to be revived.

5.9 Regulatory Approach

EPA and other groups are expressing increasing recognition of the sensitive subpopulations, specifically the immune compromised, the very young and the elderly. These groups tend to have increased risks from contaminants. Therefore, it is possible that any of the regulations could become more restrictive to improve protection of these groups.

Table 5-2: Removal Efficiency of Detroit Water Works Park WTP for the Most Occurring Substances

Total number of samples: 8 paired raw and treated water							
	Detected in raw samples	Detected in treated samples	Detected in treated but not in raw samples	No. of positive removal (removal rate)	No. of negative removal (removal rate)	Range of concentration in raw (ppt)	Range of concentration in treated (ppt)
Benzafibrate	0	0	0			< 0.5	< 0.5
Bisphenol A	5	5	0	4 (21-100%)	1 (88%)	7.6-1967	2-18
Carbamazepine	6	0	0	6 (100%)	0	0.1-1.5	< 0.004
Ciprofloxacin	1	1	1	1 (100%)	1 (∞)	8.1	7.0
Clofibricacid	1	0	0	1 (100%)	0	3.0	0.6
Diclofenac	0	0	0			< 0.03	< 0.03
Erythromycin	2	3	1	0	3 (374-823%,	3.8-3.9	16.36

Table 5-2: Removal Efficiency of Detroit Water Works Park WTP for the Most Occurring Substances

Total number of samples: 8 paired raw and treated water							
	Detected in raw samples	Detected in treated samples	Detected in treated but not in raw samples	No. of positive removal (removal rate)	No. of negative removal (removal rate)	Range of concentration in raw (ppt)	Range of concentration in treated (ppt)
					∞)		
Gemfibrozil	6	2	0	5 (29-100%)	1 (233%)	0.2-1.8	1-2
Ibupropfen	5	6	3	3 (33-100%)	5 (225-308%, ∞)	2-42	1-24
Indomethacin	0	0	0			< 1.2	< 1.2
Ketoprofen	1	2	2	1 (100%)	2 (∞)	0.4	1.0
Lasaloid A	1	0	0	1 (100%)	0	21	< 0.04
Lincomycin	1	0	0	1 (100%)	0	0.2	< 0.01
Naproxen	1	0	0	1 (100%)	0	14.3	0.15
PFOA	8	8	0	5 (66-83%)	3 (33-967%)	3-20	3-32
PFOS	8	8	0	5 (0-66%)	3 (25-100%)	1-12	1-5
Sulfamethoxazole	1	0	0	1 (100%)	0	0.3	< 0.03
Tetracyclin	0	0	0			< 0.2	< 0.2
Trimethoprim	1	0	0	1 (100%)	0	1.4	< 0.01
Tylosin	2	1	1	2 (100%)	1 (∞)	3.3	19.4

6.0 Recommendations

This report borrows heavily from regulatory updates, published guidance documents on existing practices, and current drinking water regulations. While this memorandum is intended to be as comprehensive as possible there may be regulatory actions which may result from future monitoring, regulatory developments, and industry practices that are not yet known. While the short term regulations discussed in Section 2.0 are highly likely to be developed in the next 5 years, the potential regulations outlined in Section 3.0 are more uncertain but could take place within the twenty year horizon.

Key recommendations for DWSD are:

- Familiarize staff and prepare a plan for Level 1 assessment requirements under RTCR
- (Re)assess perchlorate concentrations in source water
- (Re) assess MTBE concentrations in source water
- Develop an inventory of lead pipe and lead connections in distribution system (in progress);
- Assess strontium in source water and finished water (2014 UCMR3)
- Assess hexavalent chromium in distribution system (2014 UMCR3)

- Continue monitoring of EDCs and PPCPs in source water
- Assess HAA9 concentrations
- Deliver CCR via provision of URL on postcard and/or water bill
- Evaluate conversion from gas chlorine to hypochlorite
- Continue to proactively track and plan for potential regulatory changes
- Budget for regulatory changes (staff time and costs for increased monitoring)

7.0 Recommended Projects

Specific projects for budget purposes are shown in **Table 7-1**. This table provides planning level cost estimates for studies and capital projects. Potential FTEs required if the projects are performed by DWSD are also included. Projects are divided into short term (5-year) or long term (20 year) programs.

Table 7-1: Recommended Studies and Capital Projects to Support Future Water Quality Regulatory Compliance

Project	Study Cost	Capital Cost	FTE	Schedule (short or long term)
Increased monitoring & regulatory tracking	$40,000	$0	0.5 FTE	Short
Evaluate conversion from gas chlorine to onsite hypochlorite generation	$500,000	$30,000,000		Long

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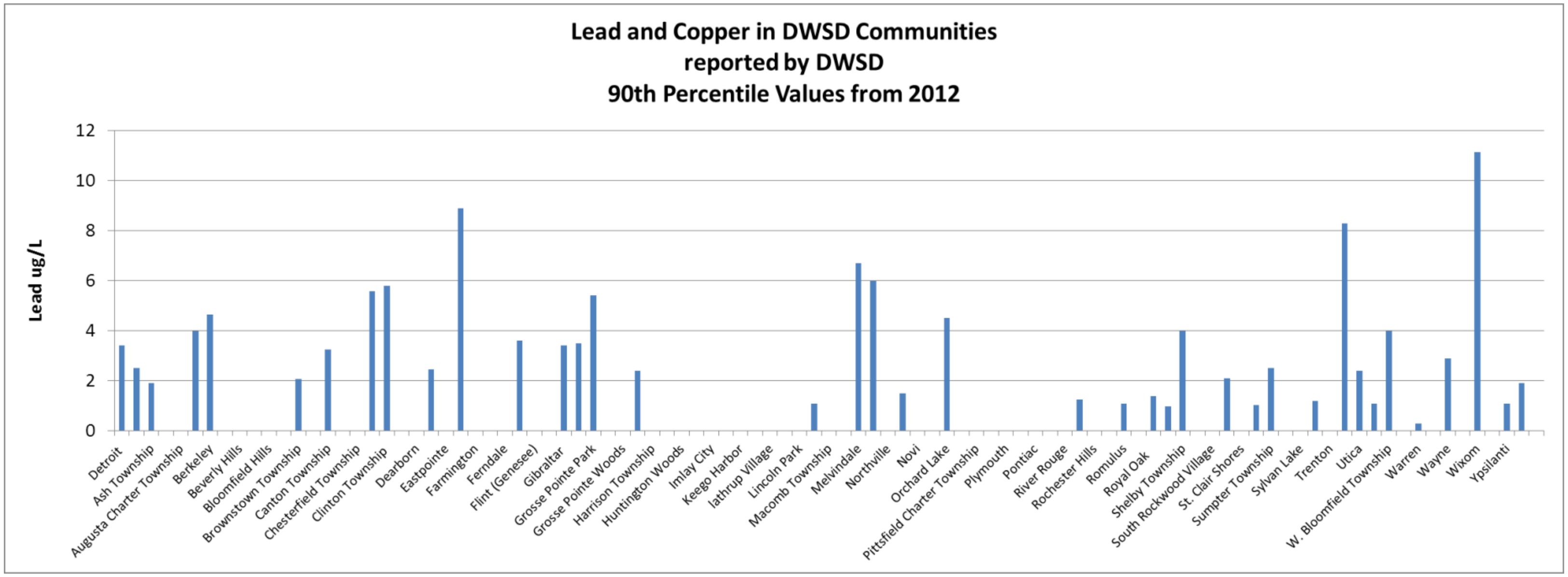

Figure 8-1: 90th Percentile Lead Values for DWSD and Customers in 2012
(note: data only shown for communities reported, blank results indicate a 90th percentile of zero)

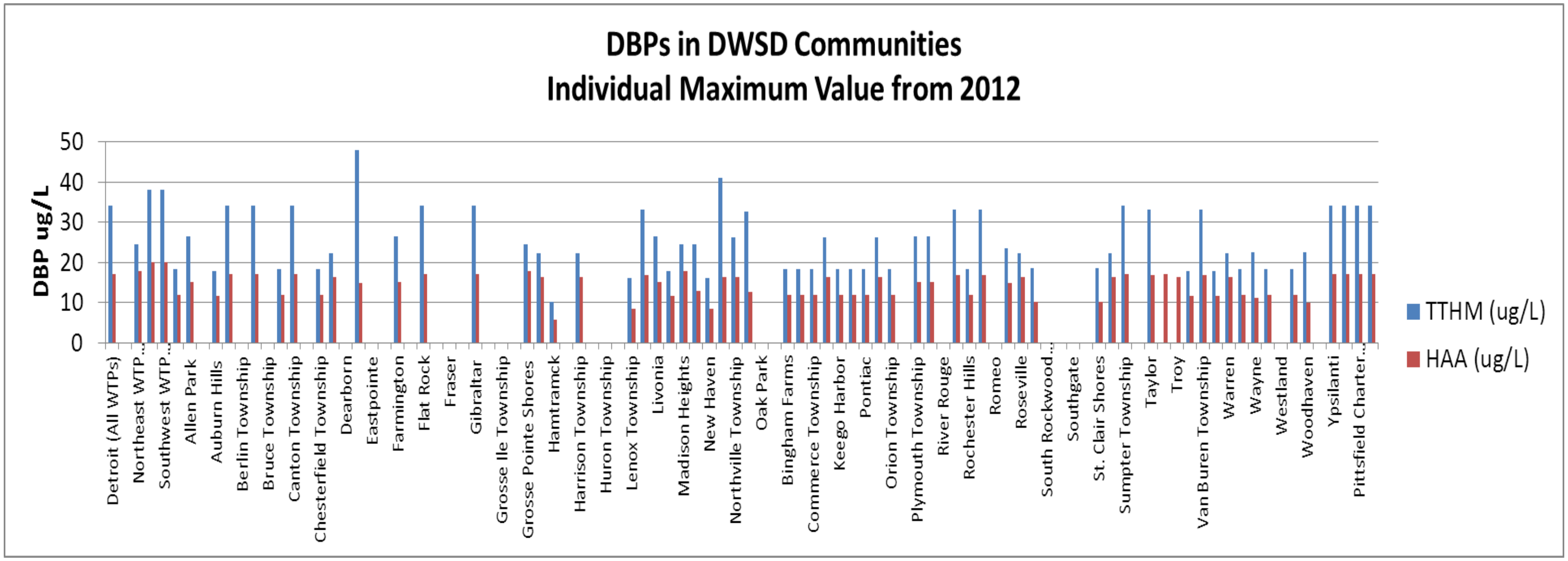

Figure 8-2: TTHM and HAA5 Maximum Values for DWSD and Customers in 2012

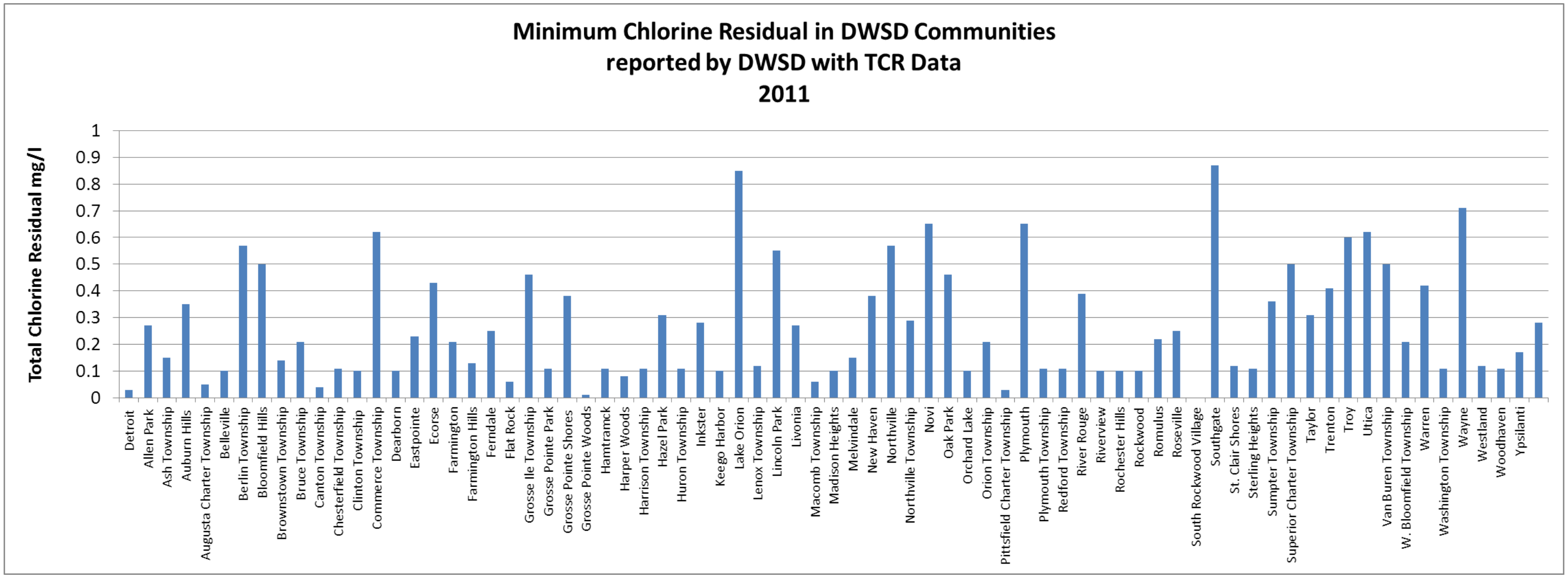

Figure 8-3: Minimum Total Chlorine Residual in DWSD and Customers' Distribution Systems in 2011

Appendix A

List of Drinking Water Contaminants & MCLs

National Primary Drinking Water Regulations

Microorganisms				
Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Cryptosporidium	zero	TT[3]	Gastrointestinal illness (such as diarrhea, vomiting, and cramps)	Human and animal fecal waste
Giardia lamblia	zero	TT[3]	Gastrointestinal illness (such as diarrhea, vomiting, and cramps)	Human and animal fecal waste
Heterotrophic plate count (HPC)	n/a	TT[3]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment
Legionella	zero	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems
Total Coliforms (including fecal coliform and *E. coli*)	zero	5.0%[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment; as well as feces; fecal coliforms and *E. coli* only come from human and animal fecal waste.
Turbidity	n/a	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (such as whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff

Microorganisms				
Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Viruses (enteric)	zero	TT[3]	Gastrointestinal illness (such as diarrhea, vomiting, and cramps)	Human and animal fecal waste

Disinfection Byproducts				
Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Bromate	zero	0.010	Increased risk of cancer	Byproduct of drinking water disinfection
Chlorite	0.8	1.0	Anemia; infants and young children: nervous system effects	Byproduct of drinking water disinfection
Haloacetic acids (HAA5)	n/a[6]	0.060[7]	Increased risk of cancer	Byproduct of drinking water disinfection
Total Trihalomethanes (TTHMs)	--> n/a[6]	--> 0.080[7]	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection

Disinfectants				
Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Chloramines (as Cl_2)	MRDLG=4[1]	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes
Chlorine (as Cl_2)	MRDLG=4[1]	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes
Chlorine dioxide (as ClO_2)	MRDLG=0.8[1]	MRDL=0.8[1]	Anemia; infants and young children: nervous system effects	Water additive used to control microbes

Inorganic Chemicals				
Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Antimony	0.006	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
Arsenic	0	0.010 as of 01/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass and electronics production wastes
Asbestos (fiber > 10 micrometers)	7 million fibers per liter (MFL)	7 MFL	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits
Barium	2	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Beryllium	0.004	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries
Cadmium	0.005	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints
Chromium (total)	0.1	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits

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Inorganic Chemicals				
Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Copper	1.3	TT[7]; Action Level=1.3	Short term exposure: Gastrointestinal distress Long term exposure: Liver or kidney damage People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits
Cyanide (as free cyanide)	0.2	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories
Fluoride	4.0	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories
Lead	zero	TT[7]; Action Level=0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits
Mercury (inorganic)	0.002	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands
Nitrate (measured as Nitrogen)	10	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits
Nitrite (measured as Nitrogen)	1	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include	Runoff from fertilizer use; leaking from septic tanks, sewage;

Inorganic Chemicals				
Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
			shortness of breath and blue-baby syndrome.	erosion of natural deposits
Selenium	0.05	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines
Thallium	0.0005	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories

Organic Chemicals				
Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Acrylamide	zero	TT[8]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/wastewater treatment
Alachlor	zero	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops
Atrazine	0.003	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops
Benzene	zero	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills
Benzo(a)pyrene (PAHs)	zero	0.0002	Reproductive difficulties; increased	Leaching from linings of water storage tanks and

Organic Chemicals				
Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
			risk of cancer	distribution lines
Carbofuran	0.04	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa
Carbon tetrachloride	zero	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities
Chlordane	zero	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide
Chlorobenzene	0.1	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories
2,4-D	0.07	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops
Dalapon	0.2	0.2	Minor kidney changes	Runoff from herbicide used on rights of way
1,2-Dibromo-3-chloropropane (DBCP)	zero	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards
o-Dichlorobenzene	0.6	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories
p-Dichlorobenzene	0.075	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories
1,2-Dichloroethane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories

Organic Chemicals				
Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
1,1-Dichloroethylene	0.007	0.007	Liver problems	Discharge from industrial chemical factories
cis-1,2-Dichloroethylene	0.07	0.07	Liver problems	Discharge from industrial chemical factories
trans-1,2-Dichloroethylene	0.1	0.1	Liver problems	Discharge from industrial chemical factories
Dichloromethane	zero	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories
1,2-Dichloropropane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
Di(2-ethylhexyl) adipate	0.4	0.4	Weight loss, liver problems, or possible reproductive difficulties.	Discharge from chemical factories
Di(2-ethylhexyl) phthalate	zero	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories
Dinoseb	0.007	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables
Dioxin (2,3,7,8-TCDD)	zero	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories
Diquat	0.02	0.02	Cataracts	Runoff from herbicide use
Endothall	0.1	0.1	Stomach and intestinal problems	Runoff from herbicide use

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Organic Chemicals				
Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Endrin	0.002	0.002	Liver problems	Residue of banned insecticide
Epichlorohydrin	zero	TT[8]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals
Ethylbenzene	0.7	0.7	Liver or kidneys problems	Discharge from petroleum refineries
Ethylene dibromide	zero	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries
Glyphosate	0.7	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use
Heptachlor	zero	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide
Heptachlor epoxide	zero	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor
Hexachlorobenzene	zero	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories
Hexachlorocyclopentadiene	0.05	0.05	Kidney or stomach problems	Discharge from chemical factories
Lindane	0.0002	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens
Methoxychlor	0.04	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on

Organic Chemicals				
Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
				fruits, vegetables, alfalfa, livestock
Oxamyl (Vydate)	0.2	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes
Polychlorinated biphenyls (PCBs)	zero	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals
Pentachlorophenol	zero	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories
Picloram	0.5	0.5	Liver problems	Herbicide runoff
Simazine	0.004	0.004	Problems with blood	Herbicide runoff
Styrene	0.1	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills
Tetrachloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners
Toluene	1	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories
Toxaphene	zero	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle
2,4,5-TP (Silvex)	0.05	0.05	Liver problems	Residue of banned herbicide

Organic Chemicals				
Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
1,2,4-Trichlorobenzene	0.07	0.07	Changes in adrenal glands	Discharge from textile finishing factories
1,1,1-Trichloroethane	0.20	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories
1,1,2-Trichloroethane	0.003	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories
Trichloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories
Vinyl chloride	zero	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories
Xylenes (total)	10	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories

Radionuclides				
Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Alpha particles	none[7] ---- ------ zero	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation
Beta particles and photon emitters	none[7] ---- ------ zero	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation
Radium 226 and Radium 228 (combined)	none[7] ---- ------ zero	5 pCi/L	Increased risk of cancer	Erosion of natural deposits

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Radionuclides				
Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	Potential Health Effects from Long-Term Exposure Above the MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Uranium	zero	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits

Appendix B

National Secondary Drinking Water Regulations

List of National Secondary Drinking Water Regulations	
Contaminant	**Secondary Standard**
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

Appendix C

1.0 Current Drinking Water Regulations

Chemical Contaminants		
Substance Name	**CASRN**	**Use**
1,1,1,2-Tetrachloroethane	630-20-6	It is an industrial chemical used in the production of other substances.
1,1-Dichloroethane	75-34-3	It is an industrial chemical used as a solvent.
1,2,3-Trichloropropane	96-18-4	It is an industrial chemical used in paint manufacture.
1,3-Butadiene	106-99-0	It is an industrial chemical used in rubber production.
1,3-Dinitrobenzene	99-65-0	It is an industrial chemical and is used in the production of other substances.
1,4-Dioxane	123-91-1	It is used as a solvent or solvent stabilizer in the manufacture and processing of paper, cotton, textile products, automotive coolant, cosmetics and shampoos.
17alpha-estradiol	57-91-0	It is an estrogenic hormone and is used in pharmaceuticals.
1-Butanol	71-36-3	It is used in the production of other substances, and as a paint solvent and food additive.
2-Methoxyethanol	109-86-4	It is used in consumer products, such as synthetic cosmetics, perfumes, fragrances, hair preparations, and skin lotions.
2-Propen-1-ol	107-18-6	It is used in the production of other substances, and in the manufacture of flavorings and perfumes.
3-Hydroxycarbofuran	16655-82-6	It is a carbamate, and is a pesticide degradate. The parent, carbofuran, is used as an insecticide.
4,4'-Methylenedianiline	101-77-9	It is used in the production of other substances, and as a corrosion inhibitor and curing agent for polyurethanes.
Acephate	30560-19-1	It is used as an insecticide.
Acetaldehyde	75-07-0	It is used in the production of other substances, and as a pesticide and food additive.
Acetamide	60-35-5	It is used as a solvent, solubilizer, plasticizer, and stabilizer.
Acetochlor	34256-82-1	It is used as an herbicide for weed control on agricultural crops.
Acetochlor ethanesulfonic acid (ESA)	187022-11-3	Acetochlor ESA is an acetanilide pesticide degradate. The parent, acetochlor, is used as an herbicide for weed control on agricultural crops.
Acetochlor oxanilic acid (OA)	184992-44-4	Acetochlor OA is an acetanilide pesticide degradate. The parent, acetochlor, is used as an herbicide for weed control on agricultural crops.
Acrolein	107-02-8	It is used as an aquatic herbicide, rodenticide, and industrial chemical.
Alachlor ethanesulfonic acid (ESA)	142363-53-9	Alachlor ESA is an acetanilide pesticide degradate. The parent, alachlor, is used as an herbicide for weed control on agricultural crops.
Alachlor oxanilic acid (OA)	171262-17-2	Alachlor OA is an acetanilide pesticide degradate. The parent, alachlor, is used as an herbicide for weed control on agricultural crops.
alpha-Hexachlorocyclohexane	319-84-6	It is a component of benzene hexachloride (BHC) and was formerly used as an insecticide.
Aniline	62-53-3	It is used as an industrial chemical, as a solvent, in the synthesis of explosives, rubber products, and in isocyanates.

Chemical Contaminants		
Substance Name	**CASRN**	**Use**
Bensulide	741-58-2	It is used as an herbicide.
Benzyl chloride	100-44-7	It is used in the production of other substances, such as plastics, dyes, lubricants, gasoline and pharmaceuticals.
Butylated hydroxyanisole	25013-16-5	It is used as a food additive (antioxidant).
Captan	133-06-2	It is used as a fungicide.
Chlorate	14866-68-3	Chlorate compounds are used in agriculture as defoliants or desiccants and may occur in drinking water related to use of disinfectants such as chlorine dioxide.
Chloromethane (Methyl chloride)	74-87-3	It is used as a foaming agent and in the production of other substances.
Clethodim	110429-62-4	It is used as an herbicide.
Cobalt	7440-48-4	It is a naturally-occurring element and was formerly used as cobaltus chloride in medicines and as a germicide.
Cumene hydroperoxide	80-15-9	It is used as an industrial chemical and is used in the production of other substances.
Cyanotoxins (3)*		Toxins naturally produced and released by cyanobacteria ("blue-green algae"). Various studies suggest three cyanotoxins for consideration: Anatoxin-a, Microcystin-LR, and Cylindrospermopsin.
Dicrotophos	141-66-2	It is used as an insecticide.
Dimethipin	55290-64-7	It is used as an herbicide and plant growth regulator.
Dimethoate	60-51-5	It is used as an insecticide on field crops, (such as cotton), orchard crops, vegetable crops, in forestry and for residential purposes.
Disulfoton	298-04-4	It is used as an insecticide.
Diuron	330-54-1	It is used as an herbicide.
equilenin	517-09-9	It is an estrogenic hormone and is used in pharmaceuticals.
equilin	474-86-2	It is an estrogenic hormone and is used in pharmaceuticals.
Erythromycin	114-07-8	It is used in pharmaceutical formulations as an antibiotic.
Estradiol (17-beta estradiol)	50-28-2	It is an estrogenic hormone and is used in pharmaceuticals.
estriol	50-27-1	It is an estrogenic hormone and is used in veterinary pharmaceuticals.
estrone	53-16-7	It is an estrogenic hormone and is used in veterinary and human pharmaceuticals.
Ethinyl Estradiol (17-alpha ethynyl estradiol)	57-63-6	It is an estrogenic hormone and is used in veterinary and human pharmaceuticals.
Ethoprop	13194-48-4	It is used as an insecticide.
Ethylene glycol	107-21-1	It is used as an antifreeze, in textile manufacture and is a cancelled pesticide.
Ethylene oxide	75-21-8	It is used as a fungicidal and insecticidal fumigant.
Ethylene thiourea	96-45-7	It is used in the production of other substances, such as for vulcanizing

Chemical Contaminants		
Substance Name	**CASRN**	**Use**
		polychloroprene (neoprene) and polyacrylate rubbers, and as a pesticide.
Fenamiphos	22224-92-6	It is used as an insecticide.
Formaldehyde	50-00-0	It has been used as a fungicide, may be a disinfection byproduct, and can occur naturally.
Germanium	7440-56-4	It is a naturally-occurring element and is commonly used as germanium dioxide in phosphors, transistors and diodes, and in electroplating.
Halon 1011 (bromochloromethane)	74-97-5	It is used as a fire-extinguishing fluid and to suppress explosions, as well as a solvent in the manufacturing of pesticides. May also occur as a disinfection by-product in drinking water.
HCFC-22	75-45-6	It is used as a refrigerant, as a low-temperature solvent, and in fluorocarbon resins, especially in tetrafluoroethylene polymers.
Hexane	110-54-3	It is used as a solvent and is a naturally-occurring alkane.
Hydrazine	302-01-2	It is used in the production of other substances, such as rocket propellants, and as an oxygen and chlorine scavenging compound.
Mestranol	72-33-3	It is an estrogenic hormone and is used in veterinary and human pharmaceuticals.
Methamidophos	10265-92-6	It is used as an insecticide.
Methanol	67-56-1	It is used as an industrial solvent, a gasoline additive and also as anti-freeze.
Methyl bromide (Bromomethane)	74-83-9	It has been used as a fumigant as a fungicide.
Methyl tert-butyl ether	1634-04-4	It is used as an octane booster in gasoline, in the manufacture of isobutene and as an extraction solvent.
Metolachlor	51218-45-2	It is used as an herbicide for weed control on agricultural crops.
Metolachlor ethanesulfonic acid (ESA)	171118-09-5	Metolachlor ESA is an acetanilide pesticide degradate. The parent, metolachlor, is used as an herbicide for weed control on agricultural crops.
Metolachlor oxanilic acid (OA)	152019-73-3	Metolachlor OA is an acetanilide pesticide degradate. The parent, metolachlor, is used as an herbicide for weed control on agricultural crops.
Molinate	2212-67-1	It is used as an herbicide.
Molybdenum	7439-98-7	It is a naturally-occurring element and is commonly used as molybdenum trioxide as a chemical reagent.
Nitrobenzene	98-95-3	It is used in the production of aniline, and also as a solvent in the manufacture of paints, shoe polishes, floor polishes, metal polishes, explosives, dyes, pesticides and drugs (such as acetaminophen), and in its re-distilled from (oil of mirbane) as an
Nitroglycerin	55-63-0	It is used in pharmaceuticals, in the production of explosives, and in rocket propellants.
N-Methyl-2-pyrrolidone	872-50-4	It is a solvent in the chemical industry, and is used for pesticide application and in food packaging materials.
N-nitrosodiethylamine (NDEA)	55-18-5	It is a nitrosamine used as an additive in gasoline and in lubricants, as an antioxidant, as a stabilizer in plastics, and also may be a disinfection byproduct.
N-nitrosodimethylamine (NDMA)	62-75-9	It is a nitrosamine and has been formerly used in the production of rocket fuels, is used as an industrial solvent and an anti-oxidant, and also may be a disinfection byproduct.

Chemical Contaminants		
Substance Name	**CASRN**	**Use**
N-nitroso-di-n-propylamine (NDPA)	621-64-7	It is a nitrosamine and may be a disinfection byproduct.
N-Nitrosodiphenylamine	86-30-6	It is a nitrosamine chemical reagent that is used as a rubber and polymer additive and may be a disinfection byproduct.
N-nitrosopyrrolidine (NPYR)	930-55-2	It is a nitrosamine used as a research chemical and may be a disinfection byproduct.
Norethindrone (19-Norethisterone)	68-22-4	It is a progresteronic hormone used in pharmaceuticals.
n-Propylbenzene	103-65-1	It is used in the manufacture of methylstyrene, in textile dyeing, and as a printing solvent, and is a constituent of asphalt and naptha.
o-Toluidine	95-53-4	It is used in the production of other substances, such as dyes, rubber, pharmaceuticals and pesticides.
Oxirane, methyl-	75-56-9	It is an industrial chemical used in the production of other substances.
Oxydemeton-methyl	301-12-2	It is used as an insecticide.
Oxyfluorfen	42874-03-3	It is used as an herbicide.
Perchlorate	14797-73-0	It is both a naturally occurring and human-made chemical. Perchlorate is used to manufacture fireworks, explosives, flares and rocket propellant.
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	PFOS was used in fire fighting foams and various surfactant uses; few of which are still ongoing because no alternatives are available.
Perfluorooctanoic acid (PFOA)	335-67-1	PFOA is used in the manufacture of fluoropolymers, substances which provide non-stick surfaces on cookware and waterproof, breathable membranes for clothing
Permethrin	52645-53-1	It is used as an insecticide.
Profenofos	41198-08-7	It is used as an insecticide and an acaricide.
Quinoline	91-22-5	It is used in the production of other substances, and as a pharmaceutical (anti-malarial) and as a flavoring agent.
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	It is used as an explosive.
sec-Butylbenzene	135-98-8	It is used as a solvent for coating compositions, in organic synthesis, as a plasticizer and in surfactants.
Strontium	7440-24-6	It is naturally-occurring element and is used as strontium carbonate in pyrotechnics, in steel production, as a catalyst and as a lead scavenger.
Tebuconazole	107534-96-3	It is used as a fungicide.
Tebufenozide	112410-23-8	It is used as an insecticide.
Tellurium	13494-80-9	It is a naturally-occurring element and is commonly used as sodium tellurite in bacteriology and medicine.
Terbufos	13071-79-9	It is used as an insecticide.
Terbufos sulfone	56070-16-7	Terbufos sulfone is a phosphorodithioate pesticide degradate. The parent, terbufos, is used as an insecticide.
Thiodicarb	59669-26-0	It is used as an insecticide.
Thiophanate-methyl	23564-05-8	It is used as a fungicide.
Toluene diisocyanate	26471-	It is used in the manufacture of plastics.

Chemical Contaminants		
Substance Name	**CASRN**	**Use**
	62-5	
Tribufos	78-48-8	It is used as an insecticide and as a cotton defoliant.
Triethylamine	121-44-8	It is used in the production of other substances, and as a stabilizer in herbicides and pesticides, in consumer products, in food additives, in photographic chemicals and in carpet cleaners.
Triphenyltin hydroxide (TPTH)	76-87-9	It is used as a pesticide.
Urethane	51-79-6	It is used as a paint ingredient.
Vanadium	7440-62-2	It is a naturally-occurring element and is commonly used as vanadium pentoxide in the production of other substances and as a catalyst.
Vinclozolin	50471-44-8	It is used as a fungicide.
Ziram	137-30-4	It is used as a fungicide.

Appendix D

UCMR3 List

Assessment Monitoring (List 1 Contaminants)			
Contaminant	**CAS Registry Number[1]**	**Minimum Reporting Level**	**Sampling Points[2]**
Seven Volatile Organic Compounds			EPTDS
1,2,3-trichloropropane	96-18-4	0.03 µg/L	
1,3-butadiene	106-99-0	0.1 µg/L	
chloromethane (methyl chloride)	74-87-3	0.2 µg/L	
1,1-dichloroethane	75-34-3	0.03 µg/L	
bromomethane (methyl bromide)	74-83-9	0.2 µg/L	
chlorodifluoromethane (HCFC-22)	75-45-6	0.08 µg/L	
bromochloromethane (halon 1011)	74-97-5	0.06 µg/L	
One Synthetic Organic Compounds			EPTDS
1,4-dioxane	123-91-1	0.07 µg/L	
Six Metals			EPTDS & DSMRT
vanadium	7440-62-2	0.2 µg/L	
molybdenum	7439-98-7	1 µg/L	
cobalt	7440-48-4	1µg/L	
strontium	7440-24-6	0.3 µg/L	

Assessment Monitoring (List 1 Contaminants)			
Contaminant	**CAS Registry Number[1]**	**Minimum Reporting Level**	**Sampling Points[2]**
chromium[3]	N/A[4]	0.2 µg/L	
chromium-6	18540-29-9	0.03 µg/L	
One Oxyhalide Anion			EPTDS & DSMRT
chlorate	14866-68-3	20µg/L	
Six Perfluorinated Compounds			EPTDS
perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.04 µg/L	
perfluorooctanoic acid (PFOA)	335-67-1	0.02 µg/L	
perfluorononanoic acid (PFNA)	375-95-1	0.02 µg/L	
perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.03 µg/L	
perfluoroheptanoic acid (PFHpA)	375-85-9	0.01 µg/L	
perfluorobutanesulfonic acid (PFBS)	375-73-5	0.09 µg/L	

Screening Survey (List 2 Contaminants)				
Contaminant	**CAS Registry Number[1]**	**Minimum Reporting Level**	**Sampling Points[2]**	**Analytical Methods**
Seven Hormones			EPTDS	EPA 539
17-β-estradiol	50-28-2	0.0004 µg/L		
17-α-ethynylestradiol (ethinyl estradiol)	57-63-6	0.0009 µg/L		
16-α-hydroxyestradiol (estriol)	50-27-1	0.0008 µg/L		

Screening Survey (List 2 Contaminants)				
Contaminant	**CAS Registry Number[1]**	**Minimum Reporting Level**	**Sampling Points[2]**	**Analytical Methods**
equilin	474-86-2	0.004 µg/L		
estrone	53-16-7	0.002 µg/L		
testosterone	58-22-0	0.0001 µg/L		
4-androstene-3,17-dione	63-05-8	0.0003 µg/L		

Pre-Screen Testing (List 3 Contaminants)				
Contaminant	**CAS Registry Number[1]**	**Minimum Reporting Level**	**Sampling Points[2]**	**Analytical Methods**
Two Viruses			EPTDS	EPA 1615
enteroviruses	N/A[4]	N/A		
noroviruses	N/A	N/A		