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OREGON DRINKING WATER QUALITY STANDARDS

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This summary provides a broad overview of current and future drinking water quality standards which public water systems in Oregon must meet through the year 2010 and beyond. It is organized in two major sections - Section I: Current Standards, and Section II: Future Standards. The summary of current standards is for reference only, and is not a substitute for the actual statutes and regulations that govern public water supply in Oregon. Future standards described here are still under development at the national level, and are subject to change.

Types of Drinking Water Contaminants

The sources of drinking water, both tap water and bottled water, include surface water (rivers, lakes, ponds, reservoirs), and groundwater (wells and springs). As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and in some cases natural radioactive materials, and can pick up substances from the presence of animals or from human activities.

Drinking water contaminants are any substances present in drinking water that could adversely affect human health if present in high enough concentrations. All drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily mean that the water presents a health risk.

There are now drinking water quality standards for 95 different contaminants. They can be grouped into the following general categories:

- **Microbial Contaminants** - such as viruses, bacteria, and parasites which can come from sewage treatment plants, septic systems, agricultural and livestock operations, and wildlife.
- **Disinfectants and Disinfection By-Products** - chemical disinfectants used in water treatment to kill harmful microbes, and the chemical by-products formed from the reaction of disinfection treatment chemicals with natural substances in the water.
- **Inorganic Chemicals** - such as salts or metals, which can be naturally-occurring or can result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming. Includes lead and copper leached into the water from household plumbing and fixtures.
- **Organic Chemicals** - Pesticides and herbicides which may come from a variety of sources, such as agriculture, urban stormwater runoff, and residential uses. Also includes synthetic and volatile chemicals which are used in industrial processes and petroleum production and can come from gas stations, urban stormwater runoff, and septic systems.
- **Radiologic Contaminants** - Naturally occurring or resulting from oil and gas production or mining operations.

Every drinking water supply is vulnerable to microbial or chemical contaminants of one type or another from a variety of sources. Disease-causing microorganisms from human or animal feces (bacteria, viruses, parasites) can be present in surface water or from groundwater. Microorganisms can also enter the water system through pipe breaks or cross connections. Organic chemicals (industrial solvents, pesticides) are mainly man-made and can enter drinking water supplies from chemical production, storage, use, or disposal in the water source area. Inorganic chemicals can be introduced by human activities (nitrate from fertilizer) but more often result from natural occurrence in rocks, soils, and mineral deposits (radon, arsenic). Drinking water treatment which is essential to remove microbes and chemicals can also add or form contaminants in drinking water, such as disinfectant chemicals themselves, byproducts of disinfectants reacting with other substances in the water, and treatment chemicals used in filtering water. Finally, water storage tanks, pipes, and household plumbing that are in direct contact with water can contribute contaminants from either the material used in the tanks and pipes or from internal coatings used to protect the materials from contact with the water.

Drinking Water Standards and Health Protection

To protect health, national regulations set by the US Environmental Protection Agency limit the amounts of certain contaminants in tap water provided by public water systems. Other regulations set by the federal Food and Drug Administration establish limits for contaminants in bottled water which must provide the same level of protection of public health.

In order to be regulated under the Safe Drinking Water Act, a drinking water contaminant must meet certain criteria. The contaminant must be one which:

- may have an adverse effect on the health of persons,
- is known or likely to occur in public drinking water systems with frequencies and levels of health concern, and
- where regulation presents a meaningful opportunity for health risk reduction for persons served by public water systems, considering feasibility and cost.

Drinking water standards take several forms:

- **Maximum Contaminant Level Goal (MCLG)** - The level of a contaminant in drinking water below which there is no known or expected risk to health, allowing for a margin of safety. All regulated contaminants must have a MCLG, although the MCLG is not enforceable.
- **Maximum Contaminant Level (MCL)** - The highest level of a contaminant allowed in drinking water, set as close the MCLG as feasible using the best available treatment technology. Most MCLs are expressed in concentration units called "milligrams per liter" (mg/L), which for drinking water is the same as parts per million (ppm). MCLs can be expressed in a variety of other measurement units.
- **Treatment Technique (TT)** - A required treatment process intended to reduce the level of a contaminant in drinking water. For any contaminant that can not be effectively measured or detected in drinking water, the standard may be a treatment technique requirement instead of an MCL. This means that all water systems at risk of the contaminant must provide continuous water treatment to remove the contaminant at all times. Performance Standards (PS) are used to determine whether or not a water system is meeting a specific treatment technique requirement. Performance Standards are measurements of water quality parameters related to specific treatment processes, such as turbidity, disinfectant residual, pH, or alkalinity.
- **Action Level (AL)** - The concentration of a contaminant, which when exceeded, triggers treatment or other requirements which a water supplier must follow.

Public water suppliers and bottled water producers must sample for contaminants routinely to ensure that standards are met, and report the results of that sampling to the regulatory agency. Sampling frequencies for public water systems vary by the type of drinking water contaminant. Contaminants that are associated with immediate health impacts, like bacteria and nitrates, must be sampled as often as every month, quarter, or year. Contaminants that are associated with health effects that could develop from very long-term exposures, like arsenic, are sampled less frequently, such as every three or four years or more.

Some people may be more vulnerable to drinking water contaminants than the general population. Immune-compromised persons, such as persons with cancer and undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from microbial infections. These people should seek advice from their health care provider. USEPA and the federal Centers for Disease Prevention and Control (CDC) developed guidelines on appropriate measures to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants. These are available from the USEPA at http://www.epa.gov/safewater/crypto.html.

Public Drinking Water Regulatory Program

The first national public drinking water standards, called the National Interim Primary Drinking Water Regulations (NIPDWR), were adopted on December 24, 1975, by the US Environmental Protection Agency (USEPA) under the 1974 Safe Drinking Water Act. By 1986, drinking water quality standards were in place for 23 different contaminants. The 1986 Safe Drinking Water Act mandated USEPA to set standards for 83 contaminants within 3 years, and 25 more contaminants every three years thereafter. The 1996 Safe Drinking Water Act significantly redirected this standard-setting schedule to focus on the highest remaining risks to health.

In Oregon, public drinking water systems are subject to the Oregon Drinking Water Quality Act (ORS 448 - Water Systems). The primary purpose of the 1981 Oregon Act is to "assure all Oregonians safe drinking water". According to the Oregon Act, safe drinking water means water which is "sufficiently free from biological, chemical, radiological, or physical impurities such that individuals will not be exposed to disease or harmful physiological effects". Under the Oregon Act, the Department of Human Services has broad authority to set water quality standards necessary to protect public health through insuring safe drinking water within a public water system. To accomplish this, the Department is directed under the Act to require regular water sampling by water suppliers. These samples must be analyzed in laboratories approved by the Department, and the results of laboratory tests on those samples must be reported by the water supplier to the Department. The Department must investigate water systems that fail to submit samples, or whose sample results indicate levels of contaminants that are above maximum allowable levels. Water suppliers who fail to sample the water or report the results, or whose water contains contaminants in excess of allowable levels must take corrective action and notify water users.

Since 1986, the Department has exercised primary responsibility for administering the federal Safe Drinking Water Act in Oregon, an arrangement called Primacy. The Department adopts and enforces standards that are no less stringent than the federal standards, and in return, the USEPA gives the Department the regulatory responsibility for public drinking water systems and partial financial support for the Oregon program operation.

In practice, the Oregon drinking water standards match the national standards established under the Safe Drinking Water Act by the USEPA. This is because setting maximum levels for drinking water contaminants to protect human health involves considerable development of health effects information and other scientific research that is best carried out at the national level. The Department of Human Services concentrates its efforts on implementing the national standards at Oregon public water systems.

Oregon Public Water Systems

Today, there are 2,756 public water systems in Oregon subject to regulation under the federal Safe Drinking Water Act. They serve 25 or more people at least 60 days per year. Of these, 898 are community water systems, which means the systems serve at least 15 connections used by year-round residents. These systems perform the most frequent water sampling for the greatest number of contaminants, because the people served have the most ongoing exposure to the drinking water. **Community water systems** in Oregon serve a total of about three million people and range in size from 15-home subdivisions and mobile home parks up to and including the City of Portland. **Nontransient noncommunity water systems** serve nonresidential populations consisting of the same people every day, such as a school or workplace with its own independent water supply system. There are 345 of these in Oregon.

Transient noncommunity water systems serve transient populations. Examples are campgrounds, parks, or restaurants with their own independent water supply systems, and there are 1,513 of these in Oregon. There are many small water systems in Oregon. About 87% of the public water systems in Oregon serve 500 or fewer people each.

Oregon public water systems get their water either from wells or springs (called groundwater) or from rivers, lakes, or streams (called surface water). Of the 2,756 public water systems in Oregon, 2,459 get their water exclusively from groundwater. 297 water systems get their water in whole or in part from surface water supplies. Generally speaking, surface water requires much more treatment and processing to ensure safety for drinking than does groundwater.

An additional 939 very small systems, serving 10-24 people each, are subject only to the Oregon Act, serving a total of nearly 17,300 people. About 400,000 Oregonians get their drinking water from **individual home wells**, which are not subject to either state or federal public drinking water standards.

For More Information

Visit the Oregon Drinking Water Web Page for drinking water information and publications (http://www.ohd.hr.state.or.us/dwp). Use the "Data Online" feature to look at past and current water sample test results and regulatory compliance status information for any Oregon public water system. In addition, contact names and phone numbers of state and county program staff are listed. You can use "links" at this site to access many other sources of drinking water information. For example, a comprehensive schedule of federal drinking water standards implementation can be found at http://www.epa.gov/safewater/pws/imp_milestones.pdf.

County staffs are responsible for community water systems serving 3,300 people or fewer and using groundwater sources, and all nontransient noncommunity and transient noncommunity systems. Questions about these systems should be directed to the respective county health department.

Department staff are responsible for all community water systems serving more than 3,300 people and all community systems that use surface water sources. In counties without drinking water programs, Department staff are responsible for all public water systems. Department staff also serve as a technical resource for county drinking water programs as needed.

Compliance with drinking water standards is summarized for each calendar year on a statewide basis in the Oregon Annual Compliance Report, which is prepared in June and distributed via the PIPELINE newsletter shortly thereafter. Each community water system must distribute to users an annual Consumer Confidence Report, detailing the levels of contaminants detected in the water system and their significance, listing any violations of standards or sampling requirements that occurred, and providing information on the water sources used by the community.

I. CURRENT STANDARDS

There are now drinking water quality standards for 95 contaminants, including 9 microbials, 8 disinfection by-products and residuals, 18 inorganics (including lead and copper), 53 organics, and 7 radiologic contaminants. These standards either have established MCLs or treatment techniques, and are summarized in this Section.

Microbial Contaminants - Coliform Bacteria

Purpose: Reduce the risk of waterborne illness. Coliforms are bacteria that are naturally present in the environment and normally do not cause illness. Coliforms present in more samples than allowed is, however, a warning of potential problems. Their presence in drinking water is used as an indicator that other organisms that are potentially harmful may be present. Routine samples collected by Oregon public water suppliers are analyzed for total coliform bacteria. Samples that show the presence of total coliforms are further examined for fecal coliforms or *E. coli*, which are more specific indicators of fecal contamination.

Health effects: The presence of total coliforms indicates potential problems with water system operations or maintenance that require attention and correction. Fecal coliforms and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes, and urgent action is required to protect health including advising water users to boil drinking water or use alternate supplies. Microbes in these wastes can cause short-term health effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely compromised immune systems.

Application: All public water systems must regularly test for coliform bacteria from locations in the distribution system, identified in a coliform sampling plan.

Monitoring: All community systems, and non-community systems using surface water sources or serving over 1,000 people, must sample monthly:

Population	Number of Monthly Samples
up to 1,000	1
1,001-2,500	2
2,501-3,300	3
3,301-4,100	4
4,101-4,900	5
>4,900	see rules

All other systems must test for coliform bacteria once per quarter.

Compliance: All coliform sample results are reported as "coliform absent" (negative) or "coliform present" (positive). A set of 3-4 repeat samples is required for each positive coliform sample (so that a total of at least five samples is collected during the month). Repeat sampling continues until the maximum contaminant level is exceeded or a set of repeat samples with negative results is obtained. Small systems (fewer than 40 samples/month) are allowed no more than one positive sample per month. Larger systems are allowed no more than 5% positive samples in any month. Confirmed presence of fecal coliform or *E. coli* is considered an acute health risk and requires immediate notification of the public to take protective actions such as boiling or using bottled water.

Water Treatment/control measures: Use of disinfection processes for source waters, such as chlorination, ozonation, and ultraviolet light. Other control measures include maintaining a disinfectant residual in the distribution system, protecting the source water area, proper well construction, maintaining distribution system pressure, and cross connection control.

Rule history:

Federal rule - 12/24/75 (National Interim Primary Drinking Water Regulation)
Oregon rule - 9/24/82
Federal rule - 6/29/89 (Total Coliform Rule)
Oregon rule - 1/1/91

Microbial Contaminants - Surface Water Treatment

Purpose: Increase protection of people against gastrointestinal illness from *Cryptosporidium* and other disease-producing (pathogenic) organisms by improving filtration treatment in water systems that use surface water supplies. All surface water supplies are considered at some risk of containing microorganisms at any given time. Requirements are designed to control pathogenic microorganisms and indicators in surface water sources, including *Cryptosporidium, Giardia lamblia*, enteric viruses, and *Legionella*. Requirements also control indicators of microbial contamination including heterotrophic plate count bacteria (HPC), and particulate matter from soil runoff (turbidity). At the same time, water suppliers must assure that actions to limit the levels of disinfection by-products do not increase the risk of waterborne disease.

Health effects: Pathogenic organisms in drinking water can cause acute gastrointestinal disease in humans (see Table 1). These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headaches. EPA estimates that 334,000 to 1,173,000 cases of waterborne disease per year are avoided in the U.S. in water systems by meeting the surface water treatment requirements. These figures include epidemic illness (large outbreaks) and endemic illness (periodic low numbers of illness).Turbidity performance standards are specified. Turbidity has no direct health effects, however, turbidity can interfere with disinfection treatment and provide a medium for microbial growth. Primarily, turbidity is used to evaluate the effectiveness of filtration treatment processes.

Application: All public water systems using surface water sources. Also all public water systems using groundwater sources determined by the Department to be under the "direct influence of surface water", as indicated by:

- Significant similarities in water characteristics such as turbidity, temperature, conductivity, or pH between the groundwater source and nearby surface water, and if so,
- A significant occurrence of insects or other macroorganisms, algae, organic debris, or large pathogens like *Giardia* and *Cryptosporidium*, as indicated by microscopic particulate analysis.

Compliance: Water systems must provide a total level of treatment to remove/inactivate 99.9% (3-log) of *Giardia lamblia*, and to remove/inactivate 99.99% (4-log) of viruses. In addition, filtered water systems must achieve 99% (2-log) removal of *Cryptosporidium*, and those water systems with exceptions from the filtration requirements must include *Cryptosporidium* control in their watershed control programs. Filtration performance standards for turbidity, and CxT [concentration x time] calculations for disinfection, are used to determine if a water system is meeting the required removal/inactivation levels. Filtered water systems that recycle spent filter backwash water or other waste flows must return those flows through all treatment processes in the filtration plant.

Compliance can be achieved by:

- Filtration plus disinfection treatment meeting performance standards, or
- Disinfection plus "natural filtration" plus wellhead/source water protection (for groundwater sources under the direct influence of surface water), or
- Disinfection treatment plus meeting exception criteria to remain unfiltered.

Filtration treatment performance standards for combined filter effluent for systems using conventional or direct filtration treatment:

- Turbidity measurements of filtered water every four hours by grab sampling or continuous monitoring (1 measurement per day for slow sand filtration, diatomaceous earth filtration, and alternative technologies).
- 95% of turbidity readings less than or equal to 0.3 ntu (1 ntu for slow sand filtration, diatomaceous earth filtration, and alternative technologies).
- All turbidity readings less than or equal to 1 ntu (5 ntu for slow sand filtration, diatomaceous earth filtration, and alternative technologies).
- Minimum 2-log *Cryptosporidium* removal/inactivation, based on meeting turbidity performance standards.

Alternative filtration technologies include membrane filtration and cartidge filtration.

Individual filter effluent monitoring for systems using conventional or direct filtration treatment:

- Continuous turbidity monitoring of individual filters, recorded every 15 minutes.
- Specific follow up actions required if any individual filter has:
  - Turbidity > 1.0 ntu in two consecutive measurements 15 min. apart, or

- Turbidity > 0.5 ntu in two consecutive measurements 15 min. apart after 4 hours of operation following backwash, or
- Turbidity > 1.0 ntu in two consecutive measurements 15 min. apart in each of three consecutive months, or
- Turbidity >2.0 ntu in two consecutive measurements 15 min. apart in two consecutive months.

Specific follow up actions include additional reporting, filter self-assessment, and comprehensive performance evaluations.

Criteria for surface water systems to remain unfiltered:

- Source water quality criteria:
  - Coliform bacteria:
    - Less than or equal to 100 total coliform bacteria per 100 ml in 90% of samples collected for a running 6 month period, or
    - Less than or equal to 20 fecal coliform bacteria per 100 ml in 90% of samples collected for a running 6 month period
  - Turbidity:
    - Continuous monitoring, or test every four hours
    - No exceedence of 5 ntu
    - Collect source water coliform sample on any day where turbidity exceeds 1 ntu
- Site-specific criteria:
  - Adequate disinfection:
    - 99.9% (3-log) *Giardia* inactivation
    - 99.99% (4-log) enteric virus inactivation
    - Continuous recording of disinfectant residual at distribution system entry point
    - Reliable backup equipment
    - Maintain distribution residuals throughout system
  - Control over the watershed area, and a formal Watershed Control Program addressing control of *Cryptosporidium*.
  - Annual sanitary survey showing no source water quality, disinfection treatment, or watershed control deficiencies
  - On-going compliance with total coliform and disinfection by-products standards
  - No history of waterborne disease outbreaks

Disinfection performance standards (all systems):

- Continuous recording of disinfectant residual at the entry point to the distribution system (small systems can substitute 1-4 grab samples per day).
- Daily calculation of CxT (disinfectant concentration x time) at highest flow.
- Provide adequate CxT to meet needed removal/inactivation levels.
- Maintain a continuous minimum 0.2 mg/L disinfectant residual at entry point to the distribution system.
- Maintain a minimum detectable disinfectant residual in 95% of distribution system samples (collected at coliform bacteria monitoring points).

Disinfection profiling and benchmarking:

- All systems must develop four quarters of total trihalomethane (TTHM) and haloacetic acid (HAA5) data.
- If the annual running average for TTHM ≥ 0.064 mg/L, or HAA5 ≥ 0.048 mg/L, develop disinfection profile reflecting daily inactivation rates for *Giardia* for at least one year.
- Using the profile, calculate a disinfection benchmark (lowest monthly average inactivation) and consult with Department before making significant changes to the disinfection process.

Compliance dates:

12/91 Unfiltered systems meet requirements to remain unfiltered

6/93 Filtration or alternate water source in place.

6/94 Department determines which community groundwater systems are under direct influence of surface water
12/95 Surface-influenced community systems meet treatment performance requirements
2/99 Construction of uncovered finished water reservoirs prohibited
3/99 Large systems (10,000 or more people) begin TTHM, HAA5 quarterly monitoring
6/99 Department determines which non-community groundwater systems are under direct influence of surface water
4/00 Large systems begin to develop disinfection profile, based on TTHM, HAA5 results
12/00 Surface-influenced noncommunity systems meet treatment performance requirements
4/01 Large systems complete disinfection profile
1/02 Large systems start individual filter monitoring and meet turbidity performance standards
12/03 Systems that recycle waste flows within the treatment plant provide notice to the state
7/03 Systems serving 500-9,999 persons report TTHM/HAA5 monitoring data or start disinfection profiling
1/04 Systems serving fewer than 500 persons report TTHM/HAA5 monitoring data or start disinfection profiling
6/04 Systems serving 500-9,999 persons complete disinfection profile
6/04 Systems that recycle waste flows complete collection of technical data on recycling practices and treatment, retain information on-site for state review
6/04 Systems that recycle waste flows comply with filter backwash recycling requirements
12/04 Systems serving fewer than 500 persons complete disinfection profile
1/05 Systems serving fewer than 10,000 people start individual filter monitoring and meet turbidity performance standards
6/06 Compliance date for systems that recycle waste flows, but need capital improvements to meet the rule

<u>Cost:</u> Total US cost estimated to be $870M/yr.

Rule history:

Federal rule - 12/24/75 (turbidity)
Oregon rule - 9/24/82 (turbidity)
Federal rule - 6/29/89 (Surface Water Treatment Rule - SWTR)
Oregon rule - 1/1/91 (SWTR)
Federal rule - 12/16/98 (Interim Enhanced Surface Water Treatment Rule- IESWTR)
Federal rule - 4/14/00, 6/13/00 (revisions)
Oregon rule - 7/15/00 (IESWTR)
Federal rule - 1/16/01, 2/12/01 (revisions)
Federal rule - 6/8/01 (Filter Backwash Recycling Rule-FBRR)
Oregon rule - 10/31/01 (revisions)
Federal rule - 1/14/02 (Long Term 1 Enhanced Surface Water Treatment Rule)
Oregon rule - expected 10/02 (FBRR)
Oregon rule - expected 4/04 (LT1ESWTR)

Table 1 - Microbial Contaminants

Contaminant	MCL, mg/L	Potential Health Effects	Source of Drinking Water Contamination
Giardia lamblia	TT[1]	Gastrointestinal disease	Human and animal fecal wastes
Cryptosporidium	TT	Gastrointestinal disease	Human and animal fecal wastes
Legionella	TT	Legionnaires disease	Natural waters, can grow in water heating systems
Heterotrophic plate count (HPC)	TT	Indicates water quality, effectiveness of disinfection treatment	Naturally occurring bacteria
Turbidity	PS[2]	Interferes with disinfection, indicator of filtration treatment performance	Particulate matter from soil runoff
Viruses	TT	Gastrointestinal disease	Human fecal wastes
Total coliforms	<5% positive[3]	General indicator of the presence of pathogens	Bacteria naturally present in the environment, human and animal fecal wastes
Fecal coliforms	Confirmed presence	More specific indicator of the presence of pathogens	Human and animal fecal wastes, some natural environmental sources
E. coli	Confirmed presence	Most specific indicator of the presence of pathogens	Human and animal fecal wastes

[1] *Treatment Technique, filtration plus disinfection of surface water, or equivalent*
[2] *Performance Standard, see text*
[3] *No more than one positive routine sample per month (or quarter) for systems collecting fewer than 40 samples/month*

Disinfectants and Disinfection By-products

Purpose: Protect public health by limiting the exposure of people to chemical disinfectant residuals and chemical by-products of disinfection treatment that result from disinfection treatment practices. Disinfection treatment used to kill microorganisms in drinking water can react with naturally occurring organic and inorganic matter in water to form disinfection by-products. The challenge is to apply levels of disinfection treatment needed to kill microorganisms while limiting the levels of disinfection by-products produced. The primary disinfection by-products of concern in Oregon are the trihalomethanes and the haloacetic acids.

Health Effects: See Table 2.

Application: All community and nontransient noncommunity water systems that 1) apply a disinfectant to the drinking water for primary or residual water treatment, or 2) that distribute water that has been disinfected. In addition, transient noncommunity systems that use chlorine dioxide are also affected.

Monitoring: Disinfectant residuals must be monitored at the same locations and frequency as coliform bacteria. Disinfection by-products (DBPs) must be monitored throughout the distribution system at frequencies daily, monthly, quarterly or annually, depending on the population served, type of water source, and the specific disinfectant applied, and in accordance with an approved monitoring plan. Systems using surface water sources and conventional filtration treatment must monitor source water for total organic carbon (TOC) and control with enhanced coagulation if TOC exceeds 2.0 mg/L.

Compliance: Compliance is determined based on meeting maximum levels for disinfectant residual and disinfection by-products over a running 12-month average of the sample results, computed quarterly. See Table 2 for MCLs. Maximum Residual Disinfectant Levels (MRDLs) are:

- Chloramines (total chlorine residual) - 4.0 mg/L (as Cl_2)
- Chlorine (free chlorine residual) - 4.0 mg/L (as Cl_2)
- Chlorine dioxide - 0.8 mg/L (as ClO_2)

Compliance dates:

1/02 - Surface water systems serving 10,000 or more people.

1/04 - Surface water systems serving fewer than 10,000 people, and all groundwater systems.

Water treatment/control measures: Optimize treatment processes to reduce disinfectant residuals. DBPs can be reduced by moving the point of chlorine application from prior to filtration to after filtration, where many of the natural organic compounds in the water have been reduced, and by enhanced coagulation treatment to remove total organic carbon prior to disinfection. Alternative disinfectants such as ozone, or using chlorine combined with ammonia (chloramines), can reduce DBP levels.

Cost: Total cost US is estimated at $684M/yr. Benefits include reduced exposure for 140M people in US, 24% reduction in THM levels across US, and reduction in exposure to bromate and chlorite. Benefits difficult to quantify due to uncertainties in health data. Benefits are believed to exceed costs.

Rule history:

Federal rule - 11/29/79 (Total Trihalomethanes (TTHM), 0.10 mg/L, for water systems serving more than 10,000 people)
Oregon rule - 9/24/82 (TTHM)
Federal rule - 12/16/98 (Stage 1 Disinfectants/ Disinfection By-products Rule - D/DBP)
Federal rule - 4/14/00, 5/30/00, 6/13/00 (revisions)
Oregon rule - 7/15/00 (Stage 1 D/DBP)
Federal rule - 1/16/01, 2/12/01 (revisions)
Oregon rule - 10/31/01 (revisions)

Table 2. Disinfectant Residuals, and Disinfection By-products

Contaminant	MCL, mg/L	Potential Health Effects	Source of Drinking Water Contamination
Bromate	0.010	Cancer	Drinking water ozonation by-product
Bromodichloro-methane	(see total trihalometh-anes, TTHMs)	Cancer; liver, kidney, and reproductive effects	Drinking water chlorination by-product
Bromoform	(see TTHMs)	Cancer; nervous system, liver and kidney effects	Drinking water chlorination by-product
Chlorite	1.0	Oxidative effects to red blood cells	By-product of disinfection using chlorine dioxide
Chloroform	(see TTHMs)	Cancer; liver, kidney, reproductive effects	Drinking water chlorination by-product
Dibromo-chloromethane	(see TTHMs)	Nervous system, liver, kidney, reproductive effects	Drinking water chlorination by-product
Dichloroacetic acid	(see HAA5)	Cancer; reproductive, developmental effects	Drinking water chlorination by-product
Haloacetic acids (HAA5) [1]	0.060	Cancer and other effects	Drinking water chlorination by-products
Trichloroacetic acid	(see HAA5)	Liver, kidney, spleen developmental effects	Drinking water chlorination by-product
Total Trihalo-methanes (TTHMs)[2]	0.080	Liver, kidney, central nervous system effects, increased risk of cancer	Drinking water chlorination by-products
Total Organic Carbon (TOC)	TT (if source water TOC exceeds 2.0 mg/L)	None, used as a surrogate for DBP formation potential	Natural organic materials present in surface waters

[1] *Sum of the concentrations of mono-, di-, and trichloroacetic acids and mono- and dibromoacetic acids*

[2] *Sum of the concentrations of chloroform, bromoform, dibromochloromethane, and bromodichloromethane*

Lead and Copper

Purpose: Set treatment technique requirements to control lead and copper in drinking water at the customer tap. Although lead and copper are naturally present in geologic deposits, they are rarely present in Oregon at significant levels in surface water or groundwater sources. They are primarily from corrosion of plumbing and plumbing fixtures in homes and buildings. Lead comes from lead solder and brass fixtures, and copper comes from copper tubing and brass fixtures. Copper is also used as a wood preservative.

Health effects-Lead: Infants and young children are typically more vulnerable to lead in drinking water than the general population. Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure. EPA considers lead a probable human carcinogen.

Health effects-Copper: Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short period of time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years could suffer liver or kidney damage. People with Wilson's Disease should consult their health care provider.

Application: All community and nontransient noncommunity systems

Monitoring: Samples are collected from "high-risk" homes; those with lead-soldered plumbing built prior to the 1985 prohibition of lead solder in Oregon. One-liter samples of standing water (first draw after 6 hours of non-use) are collected at homes identified in the water system sampling plan. The number of samples required for initial and subsequent monitoring is summarized below:

Water System Population	Initial Sample Sites	Reduced Sampling Sites
>100,000	100	50
10,001-100,000	60	30
3,301-10,000	40	20
501-3,300	20	10
101-500	10	5
<101	5	5

Two rounds of initial sampling were required during 1992-94, collected at six-month intervals. Subsequent annual sampling from the reduced number of sites is required after demonstration that lead and copper action levels are met. After three rounds of annual sampling, samples are required every three years. Water systems practicing corrosion control treatment must also monitor for water quality parameters (such as pH, temperature, alkalinity) and comply with target levels as specified by the Department.

Compliance: In each sampling round, 90% of samples from homes must have lead levels less than or equal to the Action Level of 0.015 mg/L, and copper levels less than or equal to the Action Level of 1.3 mg/L. Water systems with lead above the Action Level must conduct periodic public education, and either install treatment, change water sources, or replace plumbing.

Water Treatment/Control Measures: Water systems that can not meet the Action Levels must either install corrosion control treatment or develop alternate sources of water by January, 1998. Water treatment alternatives include adding chemicals to adjust pH, alkalinity, or both (such as soda ash, caustic soda) or adding passivating agents (such as orthophosphates or ortho/polyphosphate blends). If levels are not met even after treatment installation and optimization, then continuing public education efforts are required, along with replacement of any lead service lines. It is possible that lead levels in a particular home may be higher than at other homes in the community as a result of the materials used in that home's plumbing. People who are concerned about elevated lead levels can arrange to test their water and if the results are high, can flush taps for 30 seconds to two minutes before using tap water, especially after periods of extended non-use.

Rule History:
- Federal rule - 12/24/75 (Lead, 0.05 mg/L)
- Oregon rule - 9/24/82
- Oregon rule - 7/1/85 (Lead solder ban)
- Federal rule - 6/7/91 (Lead and Copper)
- Oregon rule - 12/7/92
- Federal rule - 7/15/91, 6/29/92, 6/30/94 (technical corrections)
- Federal rule - 1/12/00 (minor revisions)
- Oregon rule - 10/31/01 (technical corrections, revisions)

Inorganic Contaminants

Purpose: Control levels of metals and minerals in drinking water, both naturally-occurring and resulting from agricultural or industrial use. Inorganic contaminants most often come from the source of water supply, but can also enter water from contact with materials used for pipes and storage tanks. A new and more stringent drinking water standard was recently established for arsenic. See Table 3.

Health effects: For most inorganic contaminants, health concerns are related to long-term or even lifetime exposures (see Table 3). Arsenic is a naturally-occurring mineral known to cause cancer in humans at high concentrations over years of exposure. Nitrate and nitrite, however, can seriously affect infants in short-term exposures by interfering with the transfer of oxygen from the lungs to the bloodstream. Infants below the age of six months who drink water containing nitrate or nitrite in excess of the MCLs could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.

Application: All public water systems. The exceptions are the arsenic and asbestos standards which apply only to community and nontransient noncommunity systems.

Monitoring: Nitrate - community and nontransient noncommunity systems must sample quarterly for surface water sources and annually for groundwater sources. All noncommunity and state-regulated water systems must sample annually. Asbestos - community and nontransient noncommunity systems with asbestos-cement water pipes or with water sources in geologic asbestos deposit areas must sample every nine years. Arsenic - community and nontransient noncommunity systems begin monitoring and comply with the new standard by January, 2006. All other inorganics - community and nontransient noncommunity systems must sample surface water sources annually and groundwater sources every three years. All noncommunity and state-regulated water systems must sample once.

Compliance: Water systems must meet the established maximum contaminant levels (Table 3). Systems that can not meet one or more MCLs must either install water treatment systems or develop alternate sources of water.

Compliance dates for arsenic:
- 1/06 0.010 mg/L MCL becomes effective, water systems begin monitoring
- 12/06 Surface water systems complete initial monitoring
- 12/07 Groundwater systems complete initial monitoring

Water Treatment: A variety of water treatment processes are available for reducing levels of specific inorganic contaminants in drinking water, including ion exchange and reverse osmosis.

Cost (arsenic): EPA estimates the cost of meeting the new arsenic standard is $165M per year in the US. A drinking water research organization estimates the US cost at $605M per year. Benefits include avoiding 16-26 non-fatal bladder and lung cancer cases per year in the US, avoiding 21 to 39 fatal bladder and lung cancer cases per year, and reducing non-cancer diseases.

Rule history:
- Federal rule - 12/24/75 (inorganic chemicals)
- Oregon rule - 9/24/82 (inorganic chemicals)
- Federal rule - 4/2/86 (fluoride)
- Oregon rule - 11/13/89 (fluoride)
- Federal rule - 7/1/91 (Phase II)
- Federal rule - 6/29/92, 7/1/94 (corrections to Phase II)
- Federal rule - 7/19/92 (Phase V)
- Federal rule - 7/1/94 (corrections to Phase V)
- Oregon rule - 6/9/92 (Phase II), and 1/14/94 (Phase V)
- Federal rule - 1/22/01 (arsenic)
- Oregon rule - expected 1/22/05

Table 3. Inorganic Contaminants

Contaminant	MCL, mg/L (or as noted)	Potential Health Effects	Sources of Drinking Water Contamination
Antimony	0.006	Blood cholesterol increases, blood sugar decreases	Discharge from petroleum refineries, fire retardants, ceramics, electronics, solder
Arsenic	0.010	Skin damage, circulatory system effects, increased cancer risk	Erosion of natural deposits of volcanic rocks, runoff from orchards, runoff from glass and electronics production wastes
Asbestos	7 million fibers per liter (>10 um fiber size)	Increased risk of developing benign intestinal polyps	Erosion of natural geologic deposits, decay of asbestos-cement water pipes
Barium	2	Increase in blood pressure	Discharge of drilling wastes, discharge from metal refineries, erosion of natural deposits
Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories, discharge from electrical, aerospace, and defense industries
Cadmium	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	Allergic dermatitis	Discharge from steel and pulp mills, erosion of natural deposits
Cyanide	0.2	Thyroid, nervous system damage	Discharge from steel/metal factories, discharge from plastic and fertilizer factories

Table 3. Inorganic Contaminants (continued)

Fluoride	4[1]	Bone disease, mottled teeth	Erosion of natural deposits, discharge from fertilizer and aluminum industries, drinking water additive promoting strong teeth
Mercury (total inorganic)	0.002	Kidney damage	Erosion of natural deposits, discharges from refineries and factories, runoff from landfills, runoff from cropland
Nickel	0.1[2]	Heart and liver damage	Metal alloys, electroplating, batteries, chemical production
Nitrate (as N)	10	Methemoglobinemia ("blue baby syndrome") in infants below the age of six months	Runoff from fertilizer use, leaching from septic tank/drain fields, erosion of natural deposits
Nitrite	1	Methemoglobinemia ("blue baby syndrome") in infants below the age of six months	Runoff from fertilizer use, leaching from septic tank/drain fields, erosion of natural deposits (rapidly converted to nitrate)
Nitrate + nitrite	10	Methemoglobinemia ("blue baby syndrome") in infants below the age of six months	Runoff from fertilizer use, leaching from septic tank/drain fields, erosion of natural deposits (rapidly converted to nitrate)
Selenium	0.05	Hair and nail loss, numbness in fingers and toes, circulatory problems	Discharge from petroleum and metal refineries, erosion of natural deposits, discharge from mines
Thallium	0.002	Hair loss, blood changes, and kidney, liver, intestinal effects	Leaching from ore processing sites, discharge from electronics, drugs, and glass factories

[1]*Note: a secondary standard for fluoride is set at 2.0 mg/L to control tooth discoloration*

[2]*Oregon regulatory standard only, federal standard withdrawn 2/23/95*

Organic Chemicals

Purpose: Control levels of organic contaminants (see Table 4). Organic contaminants are most often associated with industrial or agricultural activities that affect sources of drinking water supply. Major types of organic contaminants are Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs). These include industrial and commercial solvents and chemicals, and pesticides used in agriculture and landscaping. Organic contaminants can also enter drinking water from materials in contact with the water such as pipes, valves, and paints and coatings used inside water storage tanks.

Health effects: For organic contaminants, health concerns are related to long-term or even lifetime exposures to low levels of contaminant (see Table 4).

Application: Community and nontransient non-community water systems.

Monitoring: At least one test for each contaminant from each water source is required during every 3-year compliance period. Public water systems serving more than 3,300 people must test twice during each 3-year compliance period for SOCs. Public water systems using surface water sources must test for VOCs annually. Quarterly followup testing is required for any contaminants that are detected. The exceptions are dioxin and acrylamide/epichlorohydrin. Only those systems determined by the Department to be at risk of contamination must monitor for dioxin. Water systems using polymers containing acrylamide or epichlorohydrin in their water treatment processes must keep their dosages below specified levels.

Compliance: Water systems must meet the established maximum contaminant levels (Table 4). Systems that can not meet one or more MCLs must either install or modify water treatment systems or develop alternate sources of water.

Water Treatment: A variety of water treatment processes are available for reducing levels of specific organic contaminants in drinking water, including activated carbon and aeration.

Rule history:
- Federal rule - 12/24/75 (National Interim Primary Drinking Water Regulation)
- Oregon rule - 9/2/82
- Federal rule - 7/8/87 (Phase I Volatile Organic Chemicals)
- Oregon rule - 11/13/89 (Phase I)
- Federal rule - 1/30/91 and 7/1/91(Phase II Synthetic Organic Chemicals)
- Federal rule - 6/29/92, 7/1/94 (corrections to Phase II)
- Federal rule - 7/19/92 (Phase V Synthetic Organic Chemicals)
- Federal rule - 7/1/94 (corrections to Phase V)
- Oregon rule - 6/9/92 (Phase II); and 1/14/94 (Phase V)

Table 4. Organic Contaminants

Contaminant	MCL, mg/L	Potential Health Effects	Sources of Drinking Water Contamination
Acrylamide	TT[1]	Central nervous system and blood effects, increased risk of cancer	Added to water during water and sewage treatment
Alachlor	0.002	Eye, liver, kidney, spleen effects, anemia, increased risk of cancer	Runoff from herbicides used on row crops
Atrazine	0.003	Cardiovascular and reproductive effects	Runoff from herbicides used on row crops
Benzene	0.005	Decreased blood platelets, anemia, increased risk of cancer	Discharge from factories, leaching from landfills and gas storage tanks
Benzo(a)pyrene (Polyaromatic hydrocarbons)	0.0002	Reproductive difficulties and increased risk of cancer	Leaching from linings of water storage tanks and water pipes
Carbofuran	0.04	Blood, nervous system, and reproductive system effects	Leaching of soil fumigant used on rice and alfalfa
Carbon tetrachloride	0.005	Liver effects and increased risk of cancer	Discharge from chemical plants and other industrial activities
Chlordane	0.002	Liver and nervous system effects, increased risk of cancer	Residue of banned termiticide
Chlorobenzene	0.1	Kidney and liver effects	Discharge from chemical and agricultural chemical factories
2,4-D	0.07	Liver, adrenal gland, and kidney damage	Runoff from herbicides used on row crops
Dalapon	0.2	Minor kidney effects	Runoff from herbicides used on rights of way
Dibromo-chloropropane (DBCP)	0.0002	Reproductive difficulties and increased risk of cancer	Runoff from soil fumigant used on soybeans, cotton, pineapples, orchards

Table 4. Organic Contaminants (continued)

o-Dichloro-benzene	0.6	Liver, kidney, circulatory system damage	Discharge from industrial chemical factories
p-Dichlorobenzene	0.075	Liver, kidney, spleen damage, anemia, blood effects	Discharge from industrial chemical factories
1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories
1,1-Dichloroethylene	0.007	Liver damage	Discharge from industrial chemical factories
cis 1,2-Dichloro-ethylene	0.07	Liver damage	Discharge from industrial chemical factories
trans 1,2-Dichloro-ethylene	0.1	Liver damage	Discharge from industrial chemical factories
Dichloromethane (methylene chloride)	0.005	Liver damage and increased risk of cancer	Discharge from pharmaceutical and chemical factories
1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories
Di(2-ethylhexyl) adipate	0.4	General toxic and reproductive effects	Discharge from chemical factories
Di(2-ethylhexyl) phathalate	0.006	Liver effects, reproductive difficulties, increased risk of cancer	Discharge from chemical and rubber factories
Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables
Dioxin (2,3,7, 8-TCDD)	3×10^{-8}	Reproductive difficulties and increased risk of cancer	Emissions from waste incineration and other combustion, discharge from chemical factories
Diquat	0.02	Cataracts	Runoff from herbicide use
Endothall	0.1	Stomach, intestine effects	Runoff from herbicide use
Endrin	0.002	Liver damage	Residue of banned insecticide

Table 4. Organic Contaminants (continued)

Epichlorohydrin	TT[1]	Stomach effects and increased risk of cancer	Discharge from industrial chemical factories, impurity in some water treatment chemicals
Ethylbenzene	0.7	Liver, kidney damage	Discharge from petroleum refineries
Ethylene dibromide	0.00005	Liver, stomach, kidney, reproductive system effects, and increased risk of cancer	Discharge from petroleum refineries
Glyphosate	0.7	Kidney, reproductive system effects	Runoff from herbicide use
Heptachlor	0.0004	Liver damage, increased risk of cancer	Residue of banned termiticide
Heptachlor epoxide	0.0002	Liver damage, increased risk of cancer	Breakdown of heptachlor
Hexachlorobenzene	0.001	Liver, kidney, reproductive system effects, and increased risk of cancer	Discharge from metal refineries and agricultural chemical factories
Hexachloro-cyclopentadiene	0.05	Kidney, stomach damage	Discharge from chemical factories
Lindane	0.0002	Liver, kidney effects	Runoff/leaching from insecticide used on lumber, gardens, cattle
Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetable, alfalfa, livestock
Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, tomatoes
Pentachlorophenol	0.001	Liver and kidney effects, increased risk of cancer	Discharge from wood preserving operations
Picloram	0.5	Liver damage	Herbicide runoff
Polychlorinated biphenyls (PCBs)	0.0005	Skin, thymus gland, reproductive system, and nervous system effects, immune deficiencies, increased risk of cancer	Runoff from landfills, discharge of waste chemicals

Table 4. Organic Contaminants (continued)

Simazene	0.004	Blood effects	Herbicide runoff
Styrene	0.1	Liver, kidney, circulatory system damage	Discharge from rubber and plastic factories, leaching from landfills
Tetrachloroethylene	0.005	Liver damage and increased risk of cancer	Discharge from factories and dry cleaning
Toluene	1	Liver, kidney, nervous system effects	Discharge from petroleum refineries
Toxaphene	0.003	Kidney, liver, thyroid effects, increased risk of cancer	Runoff/leaching from insecticide used on cattle, cotton
2,4,5-TP (Silvex)	0.05	Liver damage	Residue of banned herbicide
1,2,4-Trichloro-benzene	0.07	Adrenal gland changes	Discharge from textile finishing factories
1,1,1-Trichloroethane	0.2	Liver, nervous system, circulatory system effects	Discharge from metal degreasing sites and other factories
1,1,2-Trichloroethane	0.005	Kidney, liver, immune system damage	Discharge from industrial chemical factories
Trichloroethylene	0.005	Liver damage and increased risk of cancer	Discharge from metal degreasing sites and other factories
Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipe, discharge from plastics factories
Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories, discharge from chemical factories

[1]*Treatment technique requirement (limit dosage of polymer treatment chemicals)*

Radiologic Contaminants

Purpose: Limit exposure to radioactive contaminants in drinking water (see Table 5). These contaminants are both natural and man-made. Rules were recently revised to include a new MCL for uranium, and to clarify and modify monitoring requirements.

Health effects: Primarily increased cancer risk from long-term exposure. Reduced uranium exposure for 620,000 persons in the US and protection from toxic kidney effects of uranium.

Application: All community water systems.

Monitoring: Initial tests, quarterly for one year from each source, must be completed prior to December 31, 2007 for gross alpha, radium-226, radium-228 and uranium. Gross alpha may substitute for radium 226 monitoring if the gross alpha result does not exceed 5 pCi/L. Gross alpha may substitute for uranium monitoring if the gross alpha result does not exceed 15 pCi/L. Subsequent monitoring every 3, 6, or 9 years depending on initial results. Only those communities with water supplies potentially impacted by man-made radiation sources, as designated by the Department, must sample for beta/photon radiation, iodine-131, strontium-90, or tritium.

Compliance: Community water systems that can not meet MCLs must install treatment or develop alternate water sources.

Compliance dates:

6/00-12/03	Monitoring data collected is eligible for use as initial data
12/03	Systems begin initial monitoring
12/07	All systems complete initial monitoring

Water treatment: Variety of treatment processes will reduce radiologic contaminants, including ion exchange and reverse osmosis.

Cost: $81M per year in the US. About 800 public water systems in the US will have to install treatment.

Rule history:
- Federal rule - 7/9/76
- Oregon rule - 9/24/82
- Federal rule -12/7/00 (uranium, Ra 226&228)
- Oregon rule - expected 10/02

Table 5. Radiologic Contaminants

Contaminant	MCL, pCi/L (picocuries per liter), unless otherwise noted	Potential health effects	Sources of Drinking Water Contamination
Gross alpha	15	Increased risk of cancer	Erosion of natural deposits
Beta and photon emitters[1]	4 mrem/yr	Increased risk of cancer	Decay of natural and man-made deposits
Iodine-131[2]	3	Increased risk of cancer	Power production
Combined Radium 226 & 228[3]	5	Increased risk of cancer	Erosion of natural deposits
Uranium	30 ug/L	Increased risk of cancer, kidney toxicity	Erosion of natural deposits
Strontium 90[2]	8	Increased risk of cancer	Power and weapons production
Tritium[2]	20,000	Increased risk of cancer	Power and weapons production

[1]Sampling required only if designated by the Department - Gross beta + photon emitters not to exceed 4 millirems per year (mrem/yr)
[2]State standards only, sampling required only if designated by the Department. (Based on 4 mrem/yr dose)
[3]Measured separately.

Review and Update of Current Standards

The 1996 Safe Drinking Water Act requires EPA to review and revise as appropriate each current standard at least every six years. On April 17, 2002, EPA announced a preliminary determination that 68 chemical current regulations remain appropriate, and that the Coliform Rule should be revised. A final rule presenting a timetable for proposal and finalizing revisions is scheduled for August, 2002.

Unregulated Contaminant Monitoring

Purpose: Develop occurrence data on contaminants not currently regulated in order to support development of future drinking water standards in 2005 (see Table 6).

Health effects: Not fully characterized at present. Research on health effects is in progress.

Application: All community water systems serving over 10,000 people, plus a statistically representative selection of community water systems serving 10,000 or fewer people.

Monitoring: Surface water systems sample quarterly for one year during 2001-2003. Groundwater systems sample twice in one year during 2001-2003.

Compliance: Large water systems must collect samples, have them analyzed at approved labs, and report results to EPA, all at their own expense. Small systems must collect samples and ship them to EPA approved labs for analysis at EPAs expense. All water systems with unregulated contaminant results must present any contaminant detections in their annual Consumer Confidence Reports.

Compliance dates:

2001-03	Assessment monitoring (List 1-1999), all systems
2001-05	Index monitoring, 30 small systems
2001	Screening surveys - chemicals (List 2-1999), 180 small systems
2002	Screening surveys - chemicals (List 2-1999), 120 large systems
2003	Screening surveys - microbes (List 2-1999), 300 large and small systems

Rule History:

Federal rule - 7/8/87
Federal rule - 7/1/88, 7/1/94, 1/8/99, 4/30/99, 6/8/99 (corrections)
Federal rule - 9/17/99
Federal rule - 3/2/00, 1/11/01 (revisions)
Oregon rule - Not applicable, rule to be enforced by EPA

Table 6. Unregulated Contaminants and Their Use/Environmental Source

List 1 - Assessment Monitoring (monitoring methods available)	
2,4-dinitrotoluene	Used to produce isocyanate and explosives
2,6-dinitrotoluene	Used as a mixture with 2,4-dinitrotoluene
DCPA mono- and di- acid	Degradation product of DCPA, an herbicide
4,4' -DDE	Degradation product of DDT, an insecticide
EPTC	Herbicide
Molinate	Herbicide
Methyl tertiary butyl ether (MTBE)	Octane enhancer in unleaded gasoline
Nitrobenzene	Used to produce analine
Terbacil	Herbicide
Acetochlor	Herbicide
Perchlorate	Oxygen additive in solid fuel propellant
List 2 - Screening Survey (Methods available soon)	
Diuron	Herbicide
Linuron	Herbicide
2,4,6-trichlorophenol	By-product of fuel burning, and used as a bacteriacide and wood and glue preservative
2,4-dichlorophenol	By-product of herbicide production
2,4-dinitrophenol	Released in mining, and in metal, petroleum, and dye processing
2-methylphenol	Released in fuel burning, coal tar and petroleum refining, and wood pulp processing
Alachlor ESA	Degradation product of alachlor, an herbicide
1,2-diphenylhydrazine	Used to make benzidine and anti-inflammatory drugs
Diazinon	Insecticide
Disulfoton	Insecticide
Fonofos	Insecticide
Terbofos	Insecticide
Aeromonas	Microorganism present in all fresh and brackish water
Nitrobenzene	Used to make analine
Prometon	Herbicide
RDX	Used in explosives and ammunition

Table 6. Unregulated Contaminants and Their Use/Environmental Source (continued)

List 3 - Prescreening (monitoring methods to be developed)

Cyanobacter	Blue-green algal bloom in lakes and rivers
Echoviruses	Microoganism from fecal sources
Coxsackieviruses	Microoganism from fecal sources
Heliobacter pylori	Microoganism from fecal sources
Microsporidia	Microorganism found in lakes and rivers
Caliciviruses	Microorganism in contaminated food and water, raw shellfish
Adenoviruses	Microoganism from fecal sources
Lead-210	Uranium-decay isotope
Polonium-210	Uranium-decay isotope

Drinking Water Contaminant Candidate List (DWCCL)

Purpose: Identify chemical and microbiological contaminants known or anticipated to occur in public water systems, for possible future regulation. The first DWCCL was published in March, 1998. In Tables 7 and 8, the list is broken into two groups. The first group includes twenty contaminants that are priorities for regulation. The second group includes forty additional contaminants which require further research on health, treatment, and/or analytical methods, or need further occurrence data collection. For each contaminant, its classification is shown along with the Chemical Abstract System Number (CASN), if applicable, for use in locating additional information on the contaminant. The list must be updated every five years.

In addition, the tables indicate the contaminants on the DWCCL for which EPA Health Advisories have been published. These advisories contain known information on health risks, and specify ranges of concentrations that are acceptable for drinking over different lengths of time. Advisories are generally used to evaluate specific contaminant exposures at specific sites, such as chemical spills.

EPA must publish a decision on whether or not to regulate at least five contaminants (including sulfate) from the DWCCL every five years. On June 3, 2002, EPA announced preliminary decision not to regulate any of nine contaminants from the current DWCCL: *Acanthamoeba*, aldrin, dieldrin, hexachlororbutadiene, manganese, metribuzin, napthalene, sodium, and sulfate. In addition, EPA must publish a new DWCCL every five years.

Federal regulation dates:
- Final DWCCL: 3/2/98
- Preliminary regulatory determinations from CCL list: 6/3/02
- Expected final regulatory determinations: 8/02
- Next DWCCL: 2003

Table 7. 1998 Contaminant Candidate List - Regulatory Determination Priorities (20)

Contaminant	Classification	Chemical Abstract Number	Health Advisory Published
Acanthamoeba	microbiological	————————	
1,1,2,2-tetrachloroethane	organic	630-20-6	
1,1-dichloroethane	organic	75-34-3	
1,2,4-trimethylbenzene	organic	95-63-6	
1,3-dichloropropene	pesticide	542-75-6	
2,2-dichloropropane	organic	594-20-7	
Aldrin	pesticide	309-00-2	X
Boron	inorganic	7440-42-8	
Bromobenzene	organic	108-86-1	
Dieldrin	pesticide	60-57-1	X
Hexachlorobutadiene	organic	87-68-3	
p-Isopropyltoluene	organic	99-87-6	
Manganese	inorganic	7439-96-5	
Metolachlor	pesticide	51218-45-2	
Metribuzin	pesticide	21087-64-9	
Naphthalene	organic	91-20-3	
Organotins	organic	———————-	
Triazines & degradation products (including Cyanazine, Atrazin-desethyl)	pesticide	————————	
Sulfate	inorganic	————————	
Vanadium	inorganic	7440-62-2	

Table 8. 1998 Contaminant Candidate List - Research and Occurrence Priorities (40)

Contaminant	Classification	Chemical Abstract Number	Health Advisory Published
Adenoviruses	microbiological	————	
Aeromonas hydrophilia	microbiological	————	
Cyanobacteria (Blue-green algae) and their toxins	microbiological	————	
Caliciviruses	microbiological	————	
Coxsackieviruses	microbiological	————	
Echoviruses	microbiological	————	
Helicobacter pylon	microbiological	————	
Microsporidia	microbiological	————	
1,1-dichloropropene	organic	563-58-6	
1,2-diphenylhydrazine	organic	122-66-7	
1,3-dichloropropane	organic	142-28-9	
2,4,6-trichlorophenol	organic	88-06-2	
2,4-dichlorophenol	organic	120-83-2	
2,4-dinitrophenol	organic	51-28-5	
2,4-dinitrotoluene	organic	121-14-2	
2,6-dinitrotoluene	organic	606-20-2	
2-methyl-phenol	organic	95-48-7	
Alachlor ESA	pesticide	————	
Aluminum	inorganic	7429-90-5	
Acetochlor	pesticide	34256-82-1	
DCPA (Dacthal) mono-acid & degradates	pesticide	887-54-7	

Table 8. 1998 Contaminant Candidate List - Research and Occurrence Priorities (40) (continued)

Contaminant	Classification	Chemical Abstract Number	Health Advisory Published
DCPA (Dacthal) di-acid degradates	pesticide	2136-79-0	
DDE	pesticide	72-55-9	
Diazinon	pesticide	333-41-5	X
Disulfoton	pesticide	298-04-4	X
Diuron	pesticide	330-54-1	X
EPTC (s-Ethyl-dipropyl-thiocarbonate)	pesticide	759-94-4	
Fonofos	pesticide	944-22-9	X
Linuron	pesticide	330-55-2	
Methyl bromide	organic	74-83-9	
Molinate	pesticide	2212-67-1	
Mycobacterium avium intercellulare (MAC)	microbiological	———————	
MTBE	organic	1634-04-4	X
Nitrobenzene	organic	98-95-3	
Perchlorate	inorganic	———————-	
Prometon	pesticide	1610-18-0	
RDX	organic	121-82-4	X
Sodium	inorganic	7440-23-5	
Terbacil	pesticide	5902-51-2	X
Terbufos	pesticide	13071-79-9	X

II. FUTURE STANDARDS

New and revised drinking water quality standards are mandated under the 1996 federal Safe Drinking Water Act. This Section is intended to summarize and preview these standards, currently under development by USEPA and not yet final.
The future standards include:

- Microbial standards - Enhanced surface water treatment, groundwater requirements, and revised coliform requirements
- Disinfectants and disinfection by-products
- Radon
- Contaminant candidate list - next five contaminants

USEPA is expected to complete an ambitious adoption schedule for these standards during 2000-2005. Water suppliers should be aware of and familiar with these mandates and deadlines, and plan strategically to meet them. The Department of Human Services, under the Primacy Agreement with USEPA, has up to two years to adopt each federal rule after it is finalized. Water suppliers have at least three years to comply with each federal rule after it is finalized.

A comprehensive schedule of federal drinking water standards implementation can be found at http://www.epa.gov/safewater/pws/imp_milestones.pdf.

Microbial Standards - Enhanced Surface Water Treatment, Groundwater, and Coliform requirements

Purpose: Increase protection of people from disease-producing (pathogenic) organisms in both groundwater and surface water supplies. All surface water supplies are considered at some risk of containing microorganisms at any given time. Future rules will identify those surface water supplies that are at high risk of *Cryptosporidium,* and prescribe additional levels of treatment selected from a matrix of options. Human enteric viruses from human fecal matter is of concern in groundwater supplies. Available data suggests that 8-10% of public wells may be at risk of virus contamination, so requirements will focus on identification of at-risk wells and either reducing the risk or providing adequate levels of disinfection treatment to kill viruses. Current requirements for coliform bacteria will be revised, emphasizing fecal coliforms and *E. coli*, and focusing on protection of water within the distribution system.

To increase microbial occurrence data in US public water systems, larger utilities collected microbiological data under the Information Collection Rule (ICR) during 1998-99. ICR data is being used to design future microbial drinking water standards. A negotiated rulemaking process to outline a Long-term 2 Enhanced Surface Water Treatment Rule was concluded in 2000 in a Federal Advisory Committee Act (FACA) committee agreement. Current microbial standards focus on improvements in health protection that can be achieved by optimizing existing large water system facilities without major capital costs (see Microbial Requirements-Surface Water Treatment, described under Section I- Current Standards). Future standards are likely to require major capital investments for some water systems, based on the public health needs demonstrated by analysis of the ICR data and following the FACA rule outline.

The remaining regulatory "stages" are summarized below:

- Groundwater Rule (GWR) - New disinfection treatment performance standards or alternative practices for groundwater systems at high risk of virus contamination
- Long-term Stage 2 Enhanced Surface Water Treatment (LT2ESWTR) - Further increased filtration and disinfection performance standards for surface water systems at high risk from *Cryptosporidium*
- Revisions to current coliform bacteria standards.

Health effects: Gastrointestinal illness. Actual numbers of illness cases are very difficult to quantify - typically, only large and sudden outbreaks are likely to be recognized. Smaller outbreaks and low constant levels of illness are unlikely to be recognized. EPA estimates that as many as 168,000 cases of gastrointestinal illness per year could be avoided in public water systems using groundwater sources.

Application: All public water systems using groundwater or surface water sources of supply.

Monitoring: Monitoring will be required for specific pathogenic organisms and/or indicator organisms, such as *Cryptosporidium*, enteric viruses, or surrogate organisms. Additional monitoring of and stricter performance standards for surface water treatment processes will be required. Identification and correction of sanitary defects and hazards in water systems and use of best management practices to control coliform bacteria in distribution systems will be required.

Compliance: Compliance is demonstrated by meeting MCLs or treatment technique requirements, correcting sanitary defects, and using best management practices.

Costs: Significant costs to some water systems are expected, depending on the scope and content of the final rules. Some surface water systems will have to install additional treatment processes based on pathogen monitoring results. Some groundwater systems will have to correct sanitary defects or install disinfection treatment. Some water systems will need to improve distribution system protection and practices.

Projected compliance dates:

Groundwater Rule source monitoring, hydrogeologic sensitivity assessments, sanitary surveys: Complete by 2008 (community systems) and 2010 (noncommunity systems)
Groundwater Rule, Compliance: 2008-10
LT2ESWTR: 2004-2011

Federal regulation dates:

Proposed Groundwater Rule: 5/10/00
LT2ESWTR/Stage 2 D/DBP rulemaking agreement: 9/29/00
White papers on coliform bacteria/distribution rule issues: 2002
Final Groundwater Rule: 2003
Final LT2ESWTR: 2003
Final coliform bacteria/distribution rule: 2004-05

Disinfectants and Disinfection By-products

Purpose: Further reduce exposure of people to disinfectant residuals and disinfection by-products (D-DBPs). Disinfection treatment used to kill or inactivate microorganisms in drinking water can react with naturally occurring organic and inorganic matter in water to form disinfection by-products. The challenge is to apply levels of disinfection treatment needed to kill microorganisms while limiting the levels of disinfection by-products produced, so these requirements are linked with development of microbial standards described above. The main goal of the Stage 2 rule is to control peak DBP levels within water distribution systems.

To increase D-DBP occurrence data in US public water systems, larger utilities collected data under the Information Collection Rule (ICR) during 1998-99. ICR data is being used to design future D-DBP drinking water standards. A negotiated rulemaking process to outline a Stage 2 Disinfectants and Disinfection By-products Rule was concluded in 2000 in a Federal Advisory Committee Act (FACA) committee agreement. Current standards focus on improvements in health protection that can be achieved by optimizing existing large water system facilities without major capital costs (see Stage 1 D-DBP Rule, Section I- Current Standards). Future standards will address control of peak levels of DBPs and require major capital investments by some water systems.

Health Effects: Possible chronic and reproductive effects.

Application: All water systems that apply disinfectants or distribute water that has been disinfected.

Monitoring: Monitoring for disinfection by-products at sample locations where peak levels are expected, as identified in an Initial Distribution System Evaluation (IDSE).

Compliance: Meet Locational Running Annual Average (LRAA) for DBPs at each sampling location in the distribution system in two phases. Phase 1: meet running locational annual average at each sampling point for TTHM (120 ug/L) and HAA5 (100 ug/L) within 3 years of the final rule. Phase 2: meet running locational annual average at each sampling point for TTHM (80 ug/L) and HAA5 (60 ug/L) within 6-8.5 years of the final rule, depending on system size.

Costs: Significant capital costs to some water systems are expected.

Projected Compliance Dates:

- IDSE and monitoring (>10,000 pop.): 2003-04
- IDSE and monitoring (≤10,000 pop.): 2005-06
- Compliance with Phase 1 LRAA (all systems): May, 2005
- Compliance with Phase 2 LRAA (>10,000 pop.): May, 2008
- Compliance with Phase 2 LRAA (≤10,000 pop.): 2009-10

Federal Regulation Dates:

- LT2ESWTR/Stage 2 D/DBP rulemaking agreement: 9/29/00
- Final Stage 2 Disinfectants/Disinfection By-products (Stage 2 D/DBP): 2003

Radon

Purpose: Reduce exposure of people to both indoor air radon and radon in drinking water. Radon is a naturally occurring gas formed from the decay of uranium-238. Radon enters indoor air primarily from soil under homes. Tap water from groundwater sources is a relatively small source of radon in air. Surface water supplies of drinking water are unlikely to contain radon.

Health effects: Inhalation of radon and its decay products causes lung cancer, with smokers at particular risk. EPA estimates that 15,000 to 22,000 deaths per year in the US result from indoor air radon, primarily from soil gases. Radon in drinking water can contribute to indoor air radon levels from washing and showering. Ingestion of radon in drinking water presents a small risk of stomach cancer. 168 deaths are likely due to radon in drinking water (149 from inhalation, 19 from ingestion).

Application: All community water systems using groundwater sources.

Monitoring: Quarterly initial sampling at distribution system entry points, for one year. Subsequent sampling once every 3 years.

Compliance: Meet MCL of 300 pCi/L. An alternative MCL (AMCL) of 4,000 pCi/L is proposed, if the Department develops and adopts an EPA-approved statewide Multi-Media Mitigation program (MMM). Elements of the MMM program include public participation in MMM development, quantitative goals for remediation of existing homes and radon-resistant new construction, strategies for achieving goals, and tracking and reporting of results. Finally, local communities have the option of developing an EPA approved local MMM program, in the absence of a statewide MMM program, and meeting the drinking water AMCL.

Occurrence in Oregon: Oregon radon data from 65 deep community wells collected in 1981 showed 23 with radon greater than 300 pCi/L, and none greater than 4,000 pCi/L. Oregon geologic mapping and results of voluntary indoor air testing in homes suggest that a maximum of 4% of Oregon homes may exceed the EPA indoor air action level due to soil radon.

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PERIODICALS
POSTAGE
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Water treatment: Aeration, granular activated carbon.

Cost: Estimated national annual costs of radon MCLs: 300 pCi/L, $408M/yr; 4,000 pCi/L, $43M/yr.

Projected Compliance Dates:
- Initial monitoring (without MMM):2004-05
- Compliance with MCL (without MMM): Spring, 2005
- Initial monitoring (with MMM):2006
- Compliance with MCL (with MMM): Winter, 2007

Federal regulation dates:
- Proposed rule: 11/2/99
- Final rule: 2003

Drinking Water Contaminant Candidate List (DWCCL) and Unregulated Contaminant Monitoring Rule (UCMR)

Identify chemical and microbiological contaminants known or anticipated to occur in public water systems, develop monitoring and analytical methods, and generate occurrence data for use in developing future drinking water standards. The first DWCCL was published in March, 1998, and the first UCMR was published in 1999 (see current standards). The second DWCCL is due in 2003, and subsequent lists are due every five years. The UCMR is revised periodically to include DWCCL contaminants in UCMR monitoring requirements. EPA must make regulatory decisions on at least five contaminants from the CCL every five years.

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