Technical Memorandum

Regulations

City of Gillette, Wyoming

1.0 Introduction

The following summary of pertinent Safe Drinking Water Act (SDWA) regulations is provided to help identify regulatory situations that may impact the City's water supply. Establishing water quality objectives for water treatment projects depends on current and anticipated Safe Drinking Water Act regulations. The regulations of primary concern for the City of Gillette are contaminants regulated under the National Primary Drinking Water Standards, and unregulated contaminants in both the National Secondary Drinking Water Standards, the Secondary Contaminant Candidate List and the Stage 1 Disinfectants/Disinfection By-Products Rule (D/DBPR). **All these regulations are enforceable for City of Gillette since the City treats raw water sources classified as ground water.** The recently promulgated Ground Water Rule and Stage 2 D/DBPR are also of concern to the City of Gillette and are discussed in this technical memorandum, however, these two regulations are not currently enforceable but will be in the next few years.

This technical memorandum also discusses regulatory requirements that must be met if the City's existing wells were to be classified as "Groundwater Under the Direct Influence of Surface Water" (GWUDI) and/or the City started to treat surface water sources. In both cases, the City would then be required to meet the Surface Water Treatment Rule (SWTR), the Interim Enhanced Surface Water Treatment Rule (IESWTR), Enhanced Surface Water Treatment Rule (ESWTR), Stage 1 Disinfectants/Disinfection By-Products Rule (D/DBPR), and the Filter Backwashing Recycling Rule (FBRR).

In January 2006, Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and the Stage 2 D/DBPR were promulgated. The compliance deadline for these regulations is approximately 2009. Although not currently in effect, these regulations are considered in the overall evaluation of the alternatives since they would need to be addressed by the City, if surface water is used or if any of the existing water sources are categorized as GWUDI. The LT2ESWTR would apply to the City since its population is greater than 10,000, whereas the

Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) would not since it applies only to systems serving a population less than 10,000.

To further determine regulatory and treatment requirements, water systems are also classified by size according to the *average* population size category they serve as shown below:

- < 500 people
- 500-3,300 people
- 3,301-9,999 people
- 10,000-49,999 people
- 50,000-249,000 people
- 250,000 -999,999 people
- 1,000,000-4,999,999 people
- >5,000,000 people

The City of Gillette falls into the 10,000 – 49,999 population size category. Also, it is important to note that the Wyoming Department of Environmental Quality (DEQ) does not have primacy in the State of Wyoming and therefore, it is not the state but the federal government, the US Environmental Protection Agency (EPA), that retains oversight and final jurisdiction of any DEQ programs that implement federal requirements.

2.0 SAFE DRINKING WATER ACT

The Safe Drinking Water Act (SDWA) was originally authorized by the Congress in 1974. The SDWA made all previous water standards legally binding (such as the Interstate Quarantine Act and previous Coliform rules). The act also set Primary Standards for the protection of public health, which are enforceable standards. The SDWA was revised in 1976, 1979 and 1980 and amended in 1986 and 1996. In 1979, the United States Environmental Protection Agency (USEPA) also set secondary standards. Secondary standards set desirable levels for contaminants that may adversely affect the aesthetic value of drinking water. The secondary standards were revised in 1986 and 1989.

In 1986 and 1996, major amendments to the SDWA were approved. The 1986 amendments set maximum contaminant level goals (MCLGs). MCLGs are set at a level at which “no known adverse effects on the health of persons occur and which allows an adequate margin of safety”.

Maximum contaminant levels (MCLs) are enforceable standards that are set as close to the MCLGs as feasible. "Feasible" means the best use of technology, treatment techniques and other means that the USEPA administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available, taking cost into consideration. In the 1986 amendments, several best available technology (BAT) practices were established. The 1986 amendments also required a "Drinking Water Priority List". The priority list (January 1988) was a list of contaminants that occur in drinking water, that pose a health risk, and may warrant regulation under the SDWA. Requirements were also established to set standards and monitoring requirements for a specific number of these priority pollutants.

The 1986 amendments also set filtration and disinfection requirement standards, which are covered in the Surface Water Treatment Rule (SWTR). In 1996, Congress amended the Safe Drinking Water Act to emphasize sound science and risk-based standard setting, small water supply system flexibility and technical assistance, community-empowered source water assessment and protection, public right-to-know, and water system infrastructure assistance through a multi-billion-dollar state revolving loan fund. The 1986 and 1996 amendments include requirements for volatile organic compounds, the surface water treatment rule, lead and copper, radionuclides, the information collection rule, synthetic organic and inorganic chemicals, arsenic, total coliform rule, disinfectants and disinfection by-products rule, the enhanced surface water treatment rule, the groundwater disinfection rule, secondary standards, the drinking water candidate contaminant list, and the filter backwash water recycle rule.

1.1 Primary Drinking Water Contaminants

The National Primary Drinking Water Regulations (Primary Standards) are legally enforceable standards that apply to all public water systems. Primary Standards protect public health by limiting the levels of contaminants in drinking water. In addition to the contaminants' names, the Primary Standards include:

- Contaminant Categories – All of the contaminants are identified as being in one of the following categories; microorganisms, disinfectants, disinfection by-products, inorganic chemicals, organic chemicals, and radionuclides.
- MCL – The Maximum Contaminant Level is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.

- MCLG – The Maximum Contaminant Level Goal is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- MRDL – The Maximum Residual Disinfectant Level is the highest concentration of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants. (This is similar to MCL but for disinfectant residuals)
- MRDLG – The Maximum Residual Disinfectant Level Goal is the level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants. (This is similar to MCLG, but for disinfectant residuals)
- Potential Health Effects from Ingestion of Water – This identifies the specific health risks associated with each contaminant.
- Sources of Contaminant in Drinking Water – This identifies the source of the contaminant, often distinguishing between naturally occurring contaminants and those introduced to the water by humans.

A complete list of the Primary Drinking Water Contaminants, their MCLs, and a time line for the MCLs institution is provided immediately after this writeup.

Nearly all of the contaminants in the microorganism category are addressed specifically in the EPA's surface water treatment rules which are applicable to surface water and not ground water. *Cryptosporidium*, *Giardia lamblia*, heterotrophic plate count, *Legionella*, and turbidity are controlled through filtration and disinfection, which are regulated as described in the LT2ESWTR, LT1ESWTR, IESWTR, SWTR, D/DBPR (Stages 1 & 2), and FBRR.

The remaining contaminant in the microorganism category is Total Coliforms (TC). They include, but are not limited to fecal coliforms and E. Coli. TCs are naturally present in the environment as well as in feces. However, fecal coliforms and E. Coli are only present in human and animal feces. Therefore, TCs are not necessarily a threat themselves, but used as an indicator of whether other potentially harmful bacteria are present. The MCL for TC states that if more than 5% of the monthly samples indicate total coliforms are present, the sample is retested to determine if the bacteria detected are fecal coliform or E. Coli. The MCL is exceeded if, in two consecutive months, TC-positive samples are collected and one is also positive for E. Coli or fecal coliforms.

The contaminants in the Disinfection By-products and Disinfectants categories are addressed in the D/DBPR (Stages 1&2) and are summarized below.

There are 16 inorganic chemicals listed in the Primary Standards. Many of these contaminants can come from natural sources, decay of distribution system conduits, improper disposal of industrial wastes, and run-off of fertilized agricultural lands.

There are 53 inorganic chemicals listed in the Primary Standards. The majority of these contaminants come from chemical treatment to agricultural lands. Others come from industrial discharges and petro-chemical production. The City currently does not have any inorganic contaminants of concern since the City's raw water sources are deep ground water wells.

Following is a description of these primary standards in further detail.

1.2 Volatile Organic Chemicals (VOCs)

The VOC amendment was effective on July 8, 1987. The original rule established MCLs for 8 VOCs. The rule established monitoring requirements for 51 additional VOCs. The rule requires that one sample per quarter needs to be analyzed. If no VOCs are detected, samples need to be analyzed once every 3 to 5 years. Compliance is based on an annual average of quarters. Table 1 lists the original 8 regulated VOCs and their MCLs.

Table 1 Regulated Volatile Organic Chemicals

Contaminant	MCL (mg/L)
Benzene	0.005
Carbon Tetrachloride	0.005
Para-dichlorobenezene	0.075
1,2-dichloroethane	0.005
1,1-dichloroethylene	0.007
1,1,1-trichloroethane	0.200
Trichloroethylene	0.005
Vinyl Chloride	0.002

The City's 2006 Water Quality Report, which is included in after this writeup indicated that the water was tested for the VOCs listed in Table 1 and no concentrations were found present. Therefore, these contaminants do not appear to be a concern for the City's existing water supply.

1.3 Lead and Copper Rule

The Lead and Copper amendment became effective on December 7, 1992. The original rule established action levels and monitoring requirements for lead and copper. If the action levels are exceeded on 10% of consumer's taps tested, control or reduction is required. The control or reduction may include source water treatment, public education, corrosion control and lead service line replacement. The rule states that large systems must implement optimal corrosion control. Optimal corrosion control consists of the following: pH control, alkalinity control, calcium adjustment, and corrosion inhibitor addition. Compliance testing is based on a multitude of factors. Table 2 lists the lead and copper action levels.

Table 2 Lead and Copper Action Levels

Contaminant	Action Level (mg/L)
Lead	0.015
Copper	1.3

The Rule was recently revised and became effective on April 11, 2000. The minor revisions to the Rule includes the following key items:

- Demonstration of optimal corrosion control – systems must optimize corrosion control and continue to maintain and operate any corrosion control that is already in place.
- Lead service line replacement – systems must replace lead service lines and notify residents of lines that have not yet been replaced.
- Monitoring and reporting – systems that demonstrate optimal corrosion control may monitor for lead and copper once every three years.
- Public education – systems that have not completed lead service line replacement must provide residents with information on measures they can take to reduce lead levels.

The City's 2006 Water Quality Report which included water quality data from 2004 showed that the lead and copper concentrations in the distribution system were ND-0.006 mg/L and 0.04-0.19 mg/L, respectively. These levels are well below the MCLs.

1.4 Radionuclides

On December 8, 2003, new drinking water standards for radionuclides became effective. The revised rule lowered the MCLs for combined radium -226/-228 to 5 pCi/L, gross alpha to 15 pCi/L, and beta particles to 4 mrems. In addition, a new MCL for radium was established at 30 ug/L. These requirements are summarized in Table 3 below. The revised standard also changed the sampling point for radionuclides from a 'representative point' in the distribution system, to a point (or points) such that all water entering the distribution system is tested. The rule applies to the City of Gillette, and all community water systems, although the City's 2006 Water Quality Report (included after this writeup) showed all the radionuclides below the MCLs and therefore, radionuclides have not been a contaminant of concern for the City.

Radionuclides emit 'ionizing radiation', which is a known carcinogen, as they radioactively decay. People who drink water containing these contaminants in excess of the MCLs may have an increased risk of developing cancer. Additionally radium can have toxic effects on the kidneys.

BAT's identified for radionuclides are air stripping (radon), ion exchange (all but radon), lime softening (radium 226, radium 228, uranium) and coagulation and filtration (uranium).

Table 3 Radionuclide MCLs

Contaminant	MCL (Dec. 8, 2003)
Gross alpha particles	15 pCi/L
Gross beta and photon emitters *	4 mrems/yr
Radium 226 + 228	5 pCi/L
Uranium	30 μg/L

*** A total of 168 individual beta particles and photon emitters may be used to calculate compliance with the MCL**

The gross beta and photon emitters must not exceed a yearly dose of 4 mrems/yr. To determine this, a sample is first analyzed to determine if the gross beta is greater than 50 pCi/L.

If this occurs, then the sample is reanalyzed to determine the presence of other radionuclides. The combination of all man-made radionuclides found in the water sample must not cause a dose greater than 4 mrem/yr.

1.5 Arsenic

On January 22, 2001 EPA adopted a new standard for arsenic in drinking water. This standard was lowered to 10 ppb, from the previous standard of 50 ppb. The rule became effective on February 22, 2002, and required compliance by January 23, 2006. The rule applies to the City of Gillette, although arsenic has not been a contaminant of concern for the City.

Arsenic can exert toxic effects from both acute and chronic exposure. Studies have linked arsenic to cancers of the skin, bladder, lung, kidney, liver, and prostate. It is also demonstrated to have non cancerous effects on the cardiovascular, pulmonary, immunological, neurological and endocrine systems.

Currently, systems below the MCL are required to collect annual samples from surface water sources and one sample every three years for ground water sources. Systems with a sampling point result above the MCL must collect quarterly samples at that location. Systems exceeding the MCL at anytime during the year are required to include a health effects statement in their Consumer Confidence Reports (CCRs). Systems exceeding one-half of the MCL must include an educational statement in their CCRs. Table 4 shows the MCL for arsenic.

Table 4 Arsenic Maximum Contaminant Level

Contaminant	MCL* (mg/L)
Arsenic	0.010

* The new MCL became effective January 23, 2006.

1.6 Synthetic Organic (SOCs) and Inorganic Chemicals (IOCs)

Regulations for Synthetic Organic Chemicals (SOCs) and the Inorganic Chemicals (IOCs) were enacted in two phases. The first initial 38 contaminants were enacted in June 1992. The second 23 contaminants were enacted in January 1993. Compliance monitoring for the Phase II contaminants began January 1, 1993, with each of the contaminants assigned differing sampling schedules. BAT's vary for each of the 38 contaminants. These BATs include granular

activated carbon, coagulation-filtration, ion exchange, reverse osmosis, packed tower aeration, corrosion control and electrodialysis. The MCLs (or proposed MCLs) for the synthetic organic chemicals and the inorganic chemicals are listed in Table 5.

Table 5 Synthetic Organic Chemicals and Inorganic Chemicals

Contaminant	MCL (mg/L unless noted)
Asbestos	7×10^6 fibers/L
Barium	2
Chromium	0.1
Nitrate	10 (as N)
Selenium	0.05
Cadmium	0.005
Mercury	0.002
Nitrite	1
Ethylbenzene	0.7
Toluene	1
Cis-1,2-dichloroethylene	0.07
1,2-dichloropropane	0.005
Monochlorobenzene	0.1
o-dichlorobenzene	0.6
Tetrachloroethylene	0.005
Trans-1,2-dichloroethylene	0.1
Styrene	0.1
Xylenes	10
Alachlor	0.002
Atrazine	0.003
Chlordane	0.002
Heptachlor	0.0004
Methoxychlor	0.04
Toxaphene	0.005
Aldicarb Sulfone	0.003
Ethylene dibromide	0.00005
Pentachlorophenol	0.001

Aldicarb	0.003
Carbofuran	0.04
2,4-D	0.07
Lindane	0.0002
PCB	0.0005
2,4,5-TP	0.05
Aldicarb Sulfoxide	0.004
Heptachlor epoxide	0.0002
Dibromochloropropane	0.0002
Acrylamide	0.005% dosed at 1 mg/L
Epichlorohydrin	0.01% dosed at 20 mg/L

The City's 2006 Water Quality Report, which is included in immediately after this writeup indicated that the water was tested for the synthetic and organic chemicals listed in Table 5 and no concentrations were found present. Therefore, these contaminants do not appear to be a concern for the City's existing water supply.

1.7 Secondary Drinking Water Contaminants

The National Secondary Drinking Water Regulations (Secondary Standards) are non-enforceable standards regulating contaminants that may cause cosmetic effects (effects which are not harmful to the body but are still undesireable), aesthetic effects (undesireable taste, odor, or color), or technical effects (damage to water equipment or reduced effectiveness of treatment for other contaminants) in drinking water. The secondary standards were originally promulgated in 1979 and revised in 1986 and 1989.

The EPA recommends Secondary Maximum Contaminant Levels (SMCLs) to water systems, but does not require systems to comply. These contaminants are not considered to present a risk to human health at the SMCLs. State governments, however, can choose to adopt SMCLs as enforceable standards. Since the EPA has not adopted these standards as enforceable, for the State of Wyoming, they are not enforceable. The 15 contaminants included in the Secondary Standards are shown in Table 6.

Table 6 Secondary Maximum Contaminant Levels

Contaminant	Secondary Standard	Noticeable Effects above the SMCL
Aluminum	0.05 to 0.2 mg/L	Colored Water
Chloride	250 mg/L	Salty Taste
Color	15 (color units)	Visible Tint
Copper	1.0 mg/L	Metallic Taste; Blue-Green Staining
Corrosivity	Noncorrosive	Metallic Taste; Corroded Pipes and Fixtures
Fluoride	2.0 mg/L	Tooth Discoloration
Foaming Agents	0.5 mg/L	Frothy, Cloudy; Bitter Taste; Odor
Iron	0.3 mg/L	Rusty Color; Sediment; Metallic Taste; Red to Orange Staining
Manganese	0.05 mg/L	Black to Brown Color; Black Staining; Bitter Taste
Odor	3 threshold odor number	Rotten Egg, Musty, or Chemical Smell
pH	6.5 – 8.5	Low pH: Bitter Metallic Taste; Corrosion High pH: Slippery feel; Soda Taste; Deposits
Silver	0.10 mg/L	Skin Discoloration; Graying of the White Part of the Eyes
Sulfate	250 mg/L	Salty Taste
Total Dissolved Solids	500 mg/L	Hardness; Deposits; Colored Water; Staining; Salty Taste
Zinc	5 mg/L	Metallic Taste

Of particular interest to the City are Total Dissolved Solids, fluoride and sulfate. The City has wells that are naturally high in TDS. The ground water supplied from the Fox Hills and Madison formation wells have TDS concentrations at 800 and 650 mg/L respectively. These concentrations are significantly higher than the SMCL, whereas the Fort Union formation has concentrations around 473 mg/L, slightly less than the SMCL. The ground water supplied from the City's Fox Hills wells contains the highest concentrations which are significantly higher than the SMCL. The Fort Union formation also has relatively high levels of fluoride, just around the MCL, whereas the Madison wells have a lower fluoride concentration (approximately averaging 1.1 mg/L). The City is currently able to blend the water from all three sources to maintain fluoride concentrations below the SMCL of 2 mg/L. Sulfate concentrations in the Fort Union and Fox Hills formation wells are less than 50 mg/L, significantly lower than the SMCL of 250

mg/L. The Madison formation wells vary from approximately 250 mg/L to 330 mg/L exceeding the 250 mg/L SMCL.

1.8 Drinking Water Candidate Contaminant List (DWCCL)

The DWCCL was published February 1998 following the draft list, which was originally published October 1997. The draft list consisted of 58 chemicals and 13 microbials. The DWCCL requires that 30 contaminants be on the Unregulated Contaminant Monitoring List by August 1999 and five added at scheduled intervals. The DWCCL must determine if five contaminants should be regulated by October 2001. Thereafter, the DWCCL must evaluate five contaminants every five years. Three of the first contaminants to be regulated include aldicarbs, nickel, and sulfate. It was proposed that blue-green algae, rotavirus and perchlorate be added to the DWCCL and that sodium be removed from the list.

Aldicarb

The first regulation of aldicarb was to be promulgated in July 1991, but was postponed by administrative order. The current regulation for aldicarbs include the following MCLs:

- Aldicarb 0.003 mg/L
- Aldicarb Sulfoxide 0.004 mg/L
- Aldicarb Sulfone 0.003 mg/L

Nickel

Similarly to aldicarb, the original rule for nickel was postponed by the Nickel Development Institute. The original MCL for nickel was 0.1 mg/L. The MCL and MCLG for nickel were remanded on February 9, 1995. This means that while many water suppliers continue to monitor nickel levels in their water, there is currently no EPA legal limit on the amount of nickel in drinking water. EPA is reconsidering the limit on nickel but it currently is still under evaluation.

Sulfate

Sulfate standards were originally proposed in December 1994 at a MCLG of 500 mg/L. Before this rule is promulgated, the EPA and the CDC are required to complete health effects studies to determine the appropriate levels of sulfate. This contaminant is also on the first round of

evaluation of the DWCCL. A MCL for sulfate will likely not be established, but a health advisory will probably be issued for systems with sulfate concentrations exceeding 500 mg/L.

1.9 Total Coliform Rule (TCR)

The Total Coliform Rule (TCR) was adopted on June 29, 1989, and was effective January 1, 1992. The TCR sets an MCL based on the presence-absence (P-A) of total coliforms. The basis represents a major change in the approach from the original rule, which estimated coliform density. The actual MCL depends upon the total number of samples taken per month, as follows:

- Systems analyzing at least 40 samples per month require that no more than 5.0 percent of the month's samples be positive for total coliform.
- Systems analyzing less than 40 samples per month require that no more than 1 sample per month be positive for total coliform.

This MCL can cause a utility to be in violation with just one positive sample, if that positive sample is followed by a positive repeat sample, or if that sample brings the total percent of positive samples to greater than 5.0 percent.

All public water systems must sample according to a written sample-siting plan. This plan is subject to review and revision by the state. The total number of routine monthly samples for CWS's is determined by the size of the system as shown below, and is based on *minimum* service population:

- 25 to 1,000—1 sample/month
- 1,001 to 2,500—2 samples/month
- 2,501 to 3,300—3 samples/month
- 3,301 to 4,100—4 samples/month
- 4,101 to 4,900—5 samples/month
- 4,901 to 5,800—6 samples/month
- 5,801 to 6,700—7 samples/month
- 6,701 to 7,600—8 samples/month
- 7,601 to 8,500—9 samples/month
- 8,501 to 12,900—10 samples/month

The City's 2006 Water Quality Report, which is included in Appendix 5B indicated that the water was tested for the total coliform and samples came back positive. Therefore, total coliform does not appear to be a concern for the City's existing water supply.

1.10 Ground Water Rule

The Ground Water Rule (GWR) was signed into effect on October 11, 2006 and published in the Federal Register on November 8, 2006. The purpose of the rule is to provide for increased protection against microbial pathogens in public water systems that use ground water sources. The primary pathogens of concern in ground water systems are fecal coliforms. Fecal contamination can reach ground water sources from failed septic systems, leaking sewer lines, and by passing through the soil. Disease causing microbes such as *Cryptosporidium* and *Giardia lamblia* are not found in ground water. They only occur in surface water and ground water under the direct influence of surface water.

The proposed requirements minimize the risks of ground water contamination by using a multiple barrier approach that relies on five major components:

Periodic Sanitary Surveys – These surveys will require the evaluation of the following eight elements:

- Water supply source
- Water treatment
- Distribution system
- Finished water storage
- Pumps/pump facilities and controls
- Monitoring/reporting data
- Water system management/operations
- Operator compliance with State Health Department requirements

And the identification of significant deficiencies, which may include, but are not limited to the following:

- Unsafe source
- Improper well construction
- Presence of fecal indicators
- Lack of cross connection control for treatment chemicals
- Lack of redundant components for chlorination

- Improper venting of storage tank
- Lack of screening of overflow pipe and drain (storage tanks)
- Inadequate roofing (storage tanks)
- Inadequate cleaning (storage tanks)
- Unprotected cross connections
- System leakage that could introduce contaminants
- Inadequate monitoring of disinfectant residual

Hydrogeologic Sensitivity Assessments – These assessments will identify wells sensitive to microbial fecal contamination.

Source Water Monitoring – This monitoring will test for the presence of *E. Coli*, enterococci, or coliphage.

- *Routine Monitoring* will be required for systems that do not provide 4-log treatment/inactivation or removal of viruses and draw water from sensitive wells.
- *Triggered Monitoring* will be required for systems that do not provide 4-log treatment and have a total coliform positive sample under the Total Coliform Rule.

Corrective Action – Action will be required for any system with a significant deficiency or source water fecal contamination. The system must implement one or more of the following corrective action options.

- correct the significant deficiency
- eliminate the source of contamination
- provide an alternate source of water
- provide treatment which achieves a 4-log inactivation or removal of viruses.

Compliance Monitoring – Continued monitoring will be required to ensure that the treatment technology reliably achieves 4-log inactivation or removal of viruses.

1.11 Ground Water Under The Direct Influence of Surface Water

In many hydrogeologic situations, ground water and surface water are very closely linked. Where ground water is pumped for water supply sources, infiltration is often induced from nearby surface water. In situations like this, surface water can have a direct impact on the

quality of the groundwater produced. The degree of influence exerted by the surface water on the ground water can dictate the level of treatment required of the ground water. The US EPA first addressed this in a guidance document issued in October, 1992 titled 'Consensus Method for Determining Ground Waters under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)'.

The IESWTR contains the following definition of 'ground water under the direct influence of surface water' (GWUDI) – *any water beneath the surface of the ground with significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as Giardia lamblia or Cryptosporidium, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. Direct influence must be determined for individual sources in accordance with criteria established by the State. The State determination of direct influence may be based on site-specific measurements of water quality and/or documentation of well construction characteristics and geology with field evaluation.*

The Wyoming DEQ currently does not expound on this definition in its Primary Drinking Water Regulations. Its definition of GWUDI only states the underlined portions of the definition above.

In current practice the degree of influence surface water has over ground water is quantified via the EPA's Consensus Method. This method is used to score the results of a Microscopic Particulate Analysis (MPA) test. The numerical score correlates the MPA findings to a degree of risk of surface water influence. Ground water sources exhibiting high scores, or a high degree of risk, are then classified GWUDI. Scores are classified as high, medium, and low risk. Sources classified as GWUDI then become subject to all of the treatment requirements of surface water sources.

The City indicated that MPA analyses is not currently performed on its groundwater sources. It is not known at this time whether or not the City's wells pose a risk for surface water contamination. Classification as GWUDI would likely dictate significant changes to the City's current treatment strategy.

1.12 Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR) became effective on June 29, 1993. It defined turbidity and disinfection requirements for both surface waters and groundwaters under the influence of surface water. Since none of the City's existing raw water is provided by surface water sources, it does not have to currently comply with the SWTR.

The turbidity standard requires that finished water turbidity be less than or equal to 0.5 Nephelometric Turbidity Unit (NTU) in 95% of the readings on a monthly basis. The finished water turbidity shall never exceed 5 NTU and turbidity must be sampled at least every 4 hours or continuously.

The disinfection portion of the SWTR requires 99.9% (3-log) removal/inactivation of *Giardia lamblia* cysts and 99.99% (4-log) removal/inactivation of viruses. This reduction can be achieved through a combination of the type of filtration process utilized and the Contact Time (Ct) concept. With disinfection, the disinfectant residual combined with the contact time produces a certain Ct value. C is the residual concentration of disinfectant (mg/L) and t is the effective contact time t_{10} (min). The Ct value, in conjunction with the pH and temperature of the water, produces a certain log reduction of the waterborne pathogens of *Giardia* and viruses. The effective contact time is determined by using the tracer test or by using baffling factors presented in the SWTR Guidance Manual. Conventional filtration, which includes coagulation and sedimentation, provides 2.5-log removal of *Giardia* and 2-log removal of viruses. Disinfection typically meets the additional 0.5-log *Giardia* and 2-log virus removal needed. Also, the system is required to maintain 0.2 mg/L disinfectant residual entering the distribution system and must never fall below 0.2 mg/L for more than 4 hours. Residual disinfectant must be free chlorine, chloramines, or chlorine dioxide.

1.13 Information Collection Rule (ICR)

The main purpose of the Information Collection Rule (ICR) was to gather information to assist the EPA with the evaluation of the Surface Water Treatment Rule. Water systems that get their water from surface water sources such as lakes and rivers and serve at least 100,000 people were required to participate. Additionally, water systems that rely on ground water as the source of their drinking water and serve at least 50,000 people had to participate. Since the City has a population less than 50,000 people, the City was not required to participate in the ICR.

The ICR required monitoring disinfection by-products and pathogens at various locations throughout the treatment plant. If applicable, a treatment study was required using either granular activated carbon (GAC) or membrane filtration. Treatment studies are not required for surface water utilities that serve large populations (>100,000) if the raw water has total organic carbon of less than 4 mg/L; and finished water trihalomethanes (THM) are less than 40 g/L and halo-acetic acids (HAA5) are less than 30 g/L. Tests on both the GAC and membranes are to follow coagulation/filtration prior to an oxidant addition.

The ICR testing required multiple sampling points throughout the treatment train for disinfection by-products and other parameters. The list of parameters tested was dependent upon the disinfection scheme utilized at the plant. The disinfection by-products and other water quality parameters to be tested were as follows:

- Trihalomethanes (THM)
- Haloacetic acids (HAA5)
- Total Organic Halides (TOX)
- Total Organic Carbon (TOC)
- pH
- Alkalinity
- Turbidity
- Calcium
- Total hardness
- Haloacetial Nitriles (HAN)
- Choropicrin (CP)
- Ultraviolet Light (UV 254)
- Bromide
- Ammonia
- Disinfectant Residual
- Choral Hydrate (CH)
- Haloketones (HK)

In order to utilize the ICR data correctly, additional plant data was to be collected. The plant data included a detailed explanation of utility, plant and source water information. The plant's flows, sludge treatment, process parameters, chemical feed data and disinfection data was collected and entered into a data base provided by the EPA.

The ICR data is available on the EPA website. The ICR data after analysis shows that approximately 75% of the existing systems will comply with the Stage 1 D/DBPR. This rule is explained thoroughly in the disinfectants/disinfection byproduct rule section. The ICR data also reveal that approximately 62% of utilities will not comply with the recently promulgated Stage 2 D/DBPR.

1.14 Disinfectants / Disinfection By-Products Rule (Stages 1 &2)

The Disinfectants/Disinfection By-Products Rule (D/DBPR) became effective in two stages. The purpose of the D/DBPR is to minimize customer exposure to disinfection by-products (DBPs) and disinfectants in drinking water. The rule sets limits for disinfectant residual levels and mandates a Total Organic Carbon (TOC) reduction percentage, unless variance criteria are met. The rule also sets MCLs for total trihalomethanes (TTHM) and haloacetic acids (HAA5), which are both disinfection byproducts.

Two elements of the D/DBP rule are the regulation of both disinfection byproducts and maximum residual disinfectant levels. The promulgation of Stage 1 occurred before the end of the ICR. Large surface water systems, such as the City's (greater than or equal to 10,000 population) must comply 3 years following publication of the rule (compliance date - December 16, 2001). Small systems must comply with the Stage I rule by January of 2004. Stage 2 was promulgated in January of this year. Large systems must comply with the Stage 2 rule by September 5, 2009. Stage 2 D/DBPR builds on the Stage 1 D/DBPR by focusing on monitoring and reducing concentrations of TTHM and HAA5. Stage 2 D/DBPR requires some systems to complete an Initial Distribution System Evaluation (IDSE) to characterize DBP levels in their distribution systems and identify locations to monitor DBP's for Stage 2 D/DBPR compliance. The Stage 2 D/DBPR bases TTHM and HAA5 compliance on locational running annual average (LRAA) calculate at each monitoring location. The levels of disinfection by-products and maximum disinfectant residual levels are shown in Table 7 and 8.

Table 7

Maximum Disinfectant Residual Levels

Disinfectant Residual	Stage 1 MDRL	Stage 2 MDRL	Compliance Based On
Chlorine	4.0 mg/L (as Cl_2)	4.0 mg/L (as Cl_2)	Annual Average
Chloramine	4.0 mg/L (as Cl_2)	4.0 mg/L (as Cl_2)	Annual Average
Chlorine Dioxide	0.8 mg/L (as ClO_2)	0.8 mg/L (as ClO_2)	Daily Samples

Table 8

Disinfection Byproduct MCLs

Disinfection Byproduct	Stage 1 MCL	Stage 2 MCL	Compliance Based On
TTHM[(1)]	0.080 mg/L	Same	Annual Average
HAA5[(2)]	0.060 mg/L	Same	Annual Average
Chlorite ion	0.010 mg/L	Same	Monthly Average
Bromate ion	1.0 mg/L	Same	Annual Average

Notes:

1. Total trihalomethanes includes chloroform, bromoform, bromodichlormethane, and dibromochlormethane.
2. HAA5 includes trichloroacetic acid, dichloroacetic acid, monochloroacetic acid, dibromoacetic acid and monobromoacetic acid.

The TTHM/HAA constituents must be analyzed on a quarterly basis and compliance is based on a running annual average. Bromate, for systems using ozone, will be analyzed on a monthly basis and compliance is based on a running annual average. Chlorite, for utilities using chlorine dioxide, will be analyzed three times a month and compliance is based on a monthly average. Chlorine and chloramines are measured at the same frequency as the total coliform rule and compliance is based on the quarterly running annual average. Chlorine dioxide is measured daily and compliance is based on the daily measurement of the chlorine dioxide. The utility must meet the monitoring and compliance schedule proposed by this rule and submit a monitoring plan to the State. The monitoring plan must contain the sampling locations and compliance calculations for both MCLs and MRDLs. States can modify the content of the monitoring plans. Results must be submitted to the State on a quarterly basis.

Precursor control treatment techniques will be implemented if the raw or finished water quality levels are exceeded. This element of the rule requires enhanced coagulation or enhanced softening to reduce the organics in the water source (TTHM and HAA5 byproduct precursors). The level of removal required will be dependent upon the raw water total organic carbon and the raw water alkalinity. In certain cases where the water is not amenable for treatment with enhanced coagulation or softening, pilot testing may be conducted to prove that removal requirements cannot be met by cost-effective means. Table 9 shows the matrix that determines what percent removal the utility must achieve to conform to the requirements of the rule.

Table 9 TOC Removal Requirements (Percent)

Source Water TOC (mg/L)	Source water alkalinity of 0 to 60 mg/L	Source water alkalinity of greater than 60 to 120 mg/L	Source water alkalinity of greater than 120 mg/L
≥ 2-4	35	25	15
>4-8	45	35	25
>8	50	40	30

The treatment plant must perform enhanced coagulation or enhanced softening unless one of the following criteria is met:

- Source or treated water quarterly TOC running annual average < 2.0 mg/L.
- Source water TOC < 4.0 mg/L, alkalinity > 60 mg/L (annual average) and annual average TTHM ≤ 0.040 mg/L and HAA5 ≤ 0.030 mg/L.
- System has made clear and irrevocable financial commitment to use technologies that limit TTHM and HAA5 to ≤ 0.040 mg/L and ≤ 0.030 mg/L, respectively.
- TTHM ≤ 0.040 mg/L and HAA5 ≤ 0.030 mg/L (annual averages) and system uses only chlorine for primary and residual disinfection.
- Source water SUVA (specific UV absorbance) ≤ 2.0 L/mg/m.
- Treated water SUVA (specific UV absorbance) ≤ 2.0 L/mg/m.

Unless the above criteria are met, the TOC removal in Table 9 must be met. If the TOC removals cannot be met, alternative bench testing must be completed to prove the viability of TOC removal by coagulant addition.

Originally, the proposed D/DBPR only allowed disinfection credit after enhanced coagulation/softening occurred. Because of the large number of utilities which use pre-coagulation disinfection credit to achieve treatment goals, and due to recent research that indicate that once organics are bound during coagulation, they are no longer available to form disinfection by-products (Summer 1997), disinfection credit before enhanced coagulation/softening will be allowed.

1.15 Enhanced Surface Water Treatment Rule (ESWTR)

The proposed Enhanced Surface Water Treatment Rule (ESWTR) consists of three separate elements; the Interim Enhanced Surface Water Treatment Rule (IESWTR), Phase 1 of the Long Term Enhanced Surface Water Treatment Rule, and Phase 2 of the Long Term Enhanced Surface Water Treatment Rule. Large systems, including the City's WTP, must be in compliance with the IESWTR by December of 2001. Small systems must comply with these requirements under the Long Term Enhanced Surface Water Treatment Rule (LTESWTR). All three elements of the ESWTR were established due to the need to maintain a balance between disinfection and disinfection byproducts. The problem with the D/DBP rule is that it encourages water treatment systems to decrease the amount of disinfectant utilized, thus increasing the risk of microbiological growth that could have adverse health effects. The ESWTR will balance the risk from disinfection by-products by providing a microbiological backstop. The ESWTR will utilize data from the ICR and assist utilities by providing practical methods for pathogen evaluation.

1.16 Interim Enhanced Surface Water Treatment Rule(IESWTR)

The IESWTR sets the maximum contaminant level goal (MCLG) for Cryptosporidium at zero. This MCLG cannot currently be measured, but is a goal for the treatment process. The IESWTR requires the Cryptosporidium removal or inactivation necessary for proper treatment. There are currently no changes proposed for *Giardia* or virus removal/inactivation in the IESWTR.

The IESWTR requires utilities to complete a sanitary survey every 3 years. This survey can be performed by the State or by a State-designated agent. If the State cannot meet the time guidelines, the public water supplier can conduct the survey.

The IESWTR contains proposed regulations that provide a microbiological backstop. These include finished water turbidity and Giardia removal/inactivation.

1.17 Turbidity

The existing finished water turbidity standard is currently set at 0.3 NTU. The Enhanced Surface Water Treatment Rule (ESWTR) was proposed by the USEPA on July 29, 1994 to provide additional protection against disease-causing organisms (pathogens) in drinking water. The primary focus was on the treatment of the waterborne pathogens Giardia, Cryptosporidum, and viruses.

Congress passed the Safe Drinking Water Act (SDWA) Amendments of 1996 which required the USEPA to promulgate the IESWTR by November 1998. In order to meet the expedited schedule, the USEPA established the Microbial and Disinfectants/ Disinfection Byproducts (M/DBP) Advisory Committee on February 12, 1997.

In response to public comments and new data regarding the control of Cryptosporidum through improved filtration performance, the M/DBP Advisory Committee proposed to lower the current turbidity standards. An IESWTR Notice of Data Availability (NOA) was published in November 1997. The NOA included the following information related to the new turbidity standards:

- Turbidity level of a system's combined filtered water must be less than or equal to 0.3 NTU (previously 0.5 NTU) in at least 95% of the measurements taken each month, measured every four hours.
- Turbidity level of a system's combined filtered water must at no time exceed 1 NTU (previously 5 NTU) based on measurements taken every four hours.
- Continuous turbidimeters are required on individual filters.
- Report to state authorities whenever effluent from any filter exceeds 1 NTU at any time and/or exceeds 0.5 NTU after four hours of ripening.
- Profile and evaluate any individual filter that exceeds 1 NTU three months in a row.
- Third-party evaluation is required if any filter exceeds 2 NTU for two consecutive months.

1.18 Long Term 1 & 2 Enhanced Surface Water Treatment Rule(LT1 & 2ESWTR)

Phase 1 of the Long Term Enhanced Surface Water Treatment Rule was promulgated in January 2002, and the EPA just recently promulgated Phase 2 in January, 2006. The Long Term 1 Enhanced Surface Water Treatment. (LT1ESWTR) has a compliance date of January 14, 2005 and does not apply to the City's system since the rule is only for smaller water systems (i.e., systems serving a population greater than 10,000). Under the IESWTR, two-log removal of Cryptosporidium is credited by maintaining the proposed turbidity standards (0.30 NTU 95% of the time).

There is potential in the LT2 ESWTR that one or more source water detections of Cryptosporidium could move utilities into the higher risk category; requiring three log reduction, and potentially as much as five log reduction of Cryptospordium credit.

The LT2ESWTR uses a bin classification system to determine the amount of water treatment needed. The bin classification is determined by two-years of monthly source water monitoring of *Cryptosporidium*, *E. Coli*, and turbidity. The classification is based on the higher annual average value. Requirements presume that conventional treatment obtains 3.0-log removal/inactivation and direct filtration obtains 2.0-log removal/inactivation of *Cryptosporidium*. Table 10 shows the bin classifications for filter systems.

Table 10

Bin Classifications for Filtered Systems

Bin Classification	Crypto Concentration (oocysts/L)	Additional Treatment Requirements for Systems with Conventional Treatment
1	< 0.075	No Additional Treatment
2	0.075 - < 1.0	1 log of Additional Treatment
3	1.0 - < 3.0	2 log of Additional Treatment
4	> 3.0	2.5 log of Additional Treatment

Notes:

1. Systems serving < 10,000 and not required to monitor for Crypto automatically classified in Bin 1.
2. Recalculate after second round of source water monitoring.

1.19 Disinfection Profiling

As a requirement of the IESWTR, systems with a running annual average TTHM $\geq$ 0.064 mg/L or a HAA5 $\geq$ 0.048 mg/L, must develop a disinfection profile. The disinfection profile will examine the disinfection credit that is achieved with time.

1.20 Filter Backwash Recycle Rule

The Filter Backwash Recycle Rule (FBRR) was issued by USEPA June 8, 2001. This rule is valid for all Public Water Supplies/Systems (PWS/S) that backwash filters. This rule is not applicable to the existing City's system but would be applicable if the City constructed a surface water treatment system with conventional treatment. The rule requires surface water systems using conventional treatment to recycle spent filter backwash water, thickener supernatant, or liquids from dewatering processes. These flows must go through the processes of the system's existing conventional filtration system, or to an alternate recycle location approved by the State. The rule is summarized below:

- Requires all plants to return recycle flows prior to the rapid mix to remove pathogens (e.g. *Cryptosporidium, Giardia*, viruses), and includes provisions for state-allowed variances to return recycle elsewhere.
- Direct filtration plants are to report recycle practices to the State. Plants must assess whether practice exceeds design criteria and must submit to the State for review.
- Requires equalization of filter backwash.
- Requires treatment of backwash with a specific technology or to a specific quality before recycle.
- Limits the quantity of backwash to a specific percentage of plant flow.

2.0 FUTURE REGULATIONS

The future of regulations affecting water suppliers is somewhat uncertain. In February, 2005 the USEPA issued its second Contaminant Candidate List (CCL2). The list is made up of 51 contaminants that are known or anticipated to occur in public water systems. These contaminants are not regulated by the Primary Standards. However, the list is used to prioritize research and data collection efforts to help determine which contaminants should be regulated. Between March of 1998 (when CCL1 was finalized) and July 2003 (when the first set of Regulatory Determinations were finalized) enough data was collected to remove 9 of the 60

contaminants from CCL1. Similarly, regulatory determinations for five or more of the contaminants on CCL2 are expected in August, 2006. It is possible that some of these contaminants may become regulated under the Primary Standards. The contaminants on CCL2 are provided in after this writeup.