CHAPTER 2 – WATER REGULATORY ISSUES

2.1 Introduction

Guam EPA oversees two programs that relate to drinking water protection: the Safe Drinking Water Program and the Water Resources Management Program. The Safe Drinking Water Program's primary goal is to ensure that potable water on Guam meets local and national standards. The Water Resources Management Program's primary goal is to protect and manage Guam's principal source aquifer from pollution and overpumping.

In December 2005, Guam EPA adopted by reference in 22 GAC, Division II, Chapter 6, the Environmental Protection Agency's Primary and Secondary Safe Drinking Water Regulations 40CFR Parts 141 and 143. In January 2006, EPA adopted the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and the Stage 2 Disinfection Byproducts Rule (S2DBPR), which have not been adopted by Guam EPA.

Guam EPA drinking water regulations are discussed in section 2.2. EPA's LT2ESWTR and S2DBPR are discussed in section 2.3.

2.2 Guam EPA Safe Drinking Water Program

Public Water Supply Systems (PWSS) on Guam are regulated by the Safe Drinking Water Program through an Operating Permit issued by the Program. There are currently eleven (11) permitted Public Water Supply Systems on Guam. Three of these systems are operated by the Guam Waterworks Authority (GWA), two by the Department of Defense (Air Force and Navy systems), two by Ultimate Beach, Inc., and one each by Foremost Foods, Cocos Island Resort, Coco Palm Resort, and Earth Tech, Inc.

The three public water systems operated by GWA are the Northern System (GU00000006), Central System (GU00000003), and the Southern System (GU00000001).

The Safe Drinking Water Program's main goals are to undertake planning activities, develop, implement and enforce Guam's Primary and Secondary Safe Drinking Water Regulations, as authorized by the Guam Safe Drinking Water Act (10 Guam Code Annotated, Chapter 53) and the 1986 and 1996 Federal Safe Drinking Water Act, as amended. The Program also oversees regulations for two other laws: The Guam Lead Ban Act and the Water and Waste Water Operator's Mandatory Certification Act.

2.2.1 Primary and Secondary Drinking Water Standards

The primary drinking water standards are listed in Tables 2-1 through 2-6. Table 2-1 provides the standards for microorganisms, Table 2-2 provides the standards for disinfection byproducts, Table 2-3 provides the standards for disinfectants, Table 2-4 provides the standards for inorganic chemicals, Table 2-5 provides the standards for organic chemical, and Table 2-6 provides the standards for radionuclides. Table 2-7 lists secondary treatment standards.

Definitions for the parameters in the tables are outlined as follows:

- **Maximum Contaminant Level (MCL):** 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.

- **Maximum Contaminant Level Goal (MCLG):** 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.
- **Maximum Residual Disinfectant Level (MRDL):** The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants. (Note: This definition was added as part of the 1996 amendments to the Safe Drinking Water Act.)
- **Maximum Residual Disinfectant Level Goal (MRDLG):** 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. (Note: This definition was added as part of the 1996 amendments to the Safe Drinking Water Act.)
- **Treatment Technique (TT):** A required process intended to reduce the level of a contaminant in drinking water.
- **Milligrams per Liter (mg/L):** All units are in milligrams per liter unless otherwise noted. Milligrams per liter are equivalent to parts per million.

2.2.2 Water and Wastewater Operator Certification Regulations

The Water and Waste Water Operator's Mandatory Certification Act (10 GCA Chapter 52) was enacted in its current form by Public Law 14-31. It establishes a policy of mandatory certification for operators of drinking water and waste water treatment facilities.

The purpose of the program is to promote the improvement and certify the ability of personnel engaged in water and wastewater system operation and thereby reduce the hazards to public health and protect water resources and the large investments made in water and wastewater systems in the Territory. The regulations further provide criteria and procedures by which personnel in the water and wastewater fields may be examined, rated, and certified.

The program classifies plants based on size and complexity and requires that a person with a certification level that corresponds to the plant classification be in direct responsible charge of the system. In smaller facilities where shift operation is not required, direct responsible charge means active, daily on-site charge and performance operation, or in larger facilities where shift operation is required, both (1) active, daily on-site technical direction and supervision, and (2) active, daily on-site charge of an operating shift, or a major segment of a system or facility.

The Northern (GU00000006) and Central (GU00000003) Public Water Systems are designated "Large" and Southern (GU00000001) water system is designated "Small" - these are "Distribution" system classifications based on the population served. The certification requirements for the public water systems served by GWA are listed below:

- Northern System (Deep Wells) – Level II
- Northern Distribution – Level IV
- Central Treatment – Level II
- Central Distribution – Level III

- Southern Treatment (Ugum) – Level III
- Southern Distribution – Level II

2.2.3 Guam Lead Ban Act

The Guam Lead Ban Act was first adopted in 1999 by Public Law 25-51. It prohibits the use of any pipe, plumbing fittings or fixtures, any solder, or any flux, which is not lead free in the installation or repair of any public water system or any plumbing in a residential or nonresidential facility providing water for human consumption.

It does not apply to leaded joints necessary for the repair of cast iron pipes. *Lead free* means solders and flux containing not more than 0.2 percent (.2%) lead; pipes and pipe fittings containing not more than 8.0 percent (8%) lead; and plumbing fittings and fixtures intended to dispense water from the domestic water piping system for human ingestion that have been certified by an independent third party to be in compliance with ANSI/NSF Standard 61, §9.

2.2.4 Water Resources Management Program

The Water Resources Conservation Act was adopted in its current form in 1985 by Public Law 17-87. It outlines procedures for the conservation of water resources through the establishment of standards and guidelines for the operation of water wells on Guam. This act is the basis for the Water Resources Management Program.

The Water Resources Management Program plays a key role in managing and protecting Guam's principal source aquifer from pollution and overpumping. The program is responsible for implementing the Water Resources Development and Operating Regulations, Underground Injection Control (UIC) Regulations, Wellhead Protection and Water Quality Standards.

Data on groundwater lens characteristics is continuously collected and used to determine how the groundwater resource has been affected and to what extent future development can or should occur. The data is also used to determine whether changes or modifications to the current management are necessary.

GWA has currently 110 permits for production or source wells on the island of Guam.

2.2.5 Primary and Secondary Drinking Water Regulations

Guam EPA's Safe Drinking Water Program has primary enforcement responsibility (primacy) under the Public Health Service Act, as amended by Title XIV, Safety of Public Water Systems (42 U.S.C. §300f *et seq.* and Safe Drinking Water Amendments of 1977). Numerical limits associated with these amendments are incorporated in the Tables 1 through 7.

2.2.5.1 Phase I, II, IIb and V Rules

Most chemical contaminants were promulgated by EPA through the rules known as Phase I, II, IIb, and V. Four rules regulating 69 contaminants were issued over a five-year period. In each rule, EPA set limits on the contaminants, prescribed the schedule under which water systems must test for the presence of the contaminants, and described the treatments which systems may use to remove a detected contaminant. In some cases, EPA revised limits which existed prior to 1986.

For each contaminant, EPA set a health goal, or Maximum Contaminant Level Goal (MCLG). This is the level at which a person could drink two liters of water containing the contaminant every day for 70 years without suffering any ill effects. This goal is not a legal limit with which water systems must comply; it is based solely on human health. For known cancer-causing agents (carcinogens), EPA set the health goal at zero, under the assumption that any exposure to the chemical could present a cancer risk.

The rules also set a legal limit, or Maximum Contaminant Level (MCL), for each contaminant. EPA sets legal limits as close to the health goal as possible, keeping in mind the technical and financial barriers that exist. Except for contaminants regulated as carcinogens, most legal limits and health goals are the same. Even when they are less strict than the health goals, the legal limits provide substantial public health protection.

The contaminants regulated in these rules pose long-term, or chronic, health risks. Some can accumulate in the liver or kidneys and interfere with their functions. Others could affect the nervous system if ingested over a lifetime at levels consistently above the legal limit (MCL). Several of these contaminants have health goals (MCLGs) of zero because EPA believes that they cause cancer and assumes that any amount of exposure, no matter how small, poses some risk of cancer. Other contaminants present health risks only at levels above their legal limits.

The **Phase I Rule** was EPA's first response to the 1986 Amendments. The rule limits exposure to eight chemicals that may be present in tap water. All eight are Volatile Organic Chemicals (VOCs) that industries use in the manufacture of rubber, pesticides, deodorants, solvents, plastics, and other chemicals. The rule requires water systems to monitor and, if levels exceed legal limits, take corrective action to ensure that consumers receive water that does not contain harmful levels of the chemicals.

The **Phase II and IIb Rules** updated or created legal limits on 38 contaminants. Some of these contaminants are frequently-applied agricultural chemicals (nitrate is often present in areas where farmers apply fertilizer) while others are more obscure industrial intermediates (trans-1, 2-Dichloroethylene is a solvent and chemical used in the production of other chemicals).

Health goals and legal limits were set for 36 of the 38 contaminants that the Phase II and IIb rules address. The other two contaminants regulated through the rules, Acrylamide and Epichlorohydrin, are chemicals that some water systems add during the water treatment process. Known as flocculants, these chemicals bond with dirt and other tiny contaminants in water and aid their settling to the bottom of the treatment tank. Water systems then use the cleaner water from the top of the tank. The rules limit the amount of these chemicals that systems may add to water during the treatment process.

The **Phase V Rule** set standards for 23 more contaminants. Several are inorganic chemicals such as cyanide that are present naturally in some water, though only at trace levels. Industrial activity accounts for the potentially harmful levels of these contaminants in drinking water. Other Phase V contaminants are pesticides. These chemicals enter water supplies through run-off from fields where farmers have

applied them or by leaching through the soil into ground water.

There are different monitoring schedules for different contaminants, depending on the routes by which each contaminant enters the water supply. In general, surface water systems must take samples more frequently than ground water systems because their water is subject to more external influences. Systems which prove over several years that they are not susceptible to contamination can usually get state permission to reduce the frequency of monitoring.

2.2.5.2 Surface Water Treatment Rule

The Surface Water Treatment Rule seeks to prevent waterborne diseases caused by viruses, *Legionella*, and *Giardia lamblia*. These disease-causing microbes are present at varying concentrations in most surface waters. The rule requires that water systems filter and disinfect water from surface water sources to reduce the occurrence of unsafe levels of these microbes.

As the title suggests, this rule governs water supplies whose source of drinking water is surface water, which it defines as "all water which is open to the atmosphere and subject to surface runoff." This water, which most of the country's large water systems use, is in rivers, lakes, and reservoirs. Surface water is particularly susceptible to microbial contamination from sewage treatment plant discharges and runoff from storm water. These sources often contain high levels of fecal microbes that originated in livestock wastes or septic systems.

Ingestion of *Giardia* (a protozoan) and viruses can cause problems in the human digestive system, generally in the form of diarrhea, cramps, and nausea. *Legionella* bacteria in water are only a health risk if the bacteria are aerosolized (e.g. in an air conditioning system or a shower) and then inhaled. Inhalation can result in a type of pneumonia known as Legionnaires' Disease.

The rule sets non-enforceable health goals, or Maximum Contaminant Level Goals (MCLGs), for *Legionella*, *Giardia*, and viruses at zero because any amount of exposure to these contaminants represents some health risk. Since measuring disease-causing microbes in drinking water is not considered to be feasible, EPA established a treatment technique in this rule.

All systems must filter and disinfect their water to provide a minimum of 99.9 percent combined removal and inactivation of *Giardia* and 99.99 percent of viruses. The adequacy of the filtration process is established by measuring turbidity (a measure of the amount of particles) in the treated water and determining if it meets EPA's performance standard.

To assure adequate microbial protection in the distribution system, water systems are also required to provide continuous disinfection of the drinking water entering the distribution system and to maintain a detectable disinfectant level within the distribution system.

2.2.5.3 Lead and Copper Rule

The Lead and Copper Rule (LCR) requires that systems conduct monitoring of lead copper from customer taps - generally every six months, annually, or triennially, depending on the levels of lead and copper observed in drinking water (i.e., less

frequent monitoring if levels are low). In some cases, small systems can monitor every nine years. If 10% of the homes that are tested have lead levels greater than the action level (AL) of 15 ppb, or copper levels greater than the AL of 1.3 mg/L, the system must increase monitoring, undertake additional efforts to control corrosion and inform the public. For each monitoring period, a system (or the state) must calculate the lead and copper level at the 90th percentile of homes monitored. For example, if a system monitors 100 homes, it sorts its results from the lowest to the highest concentration and reports the concentration it observed in the 90th sample. It is important to note that exceeding the action level, in and of itself, is not a violation of the regulation. A utility is assessed a violation when it fails to carry out the actions required by the regulations when the action level is exceeded.

2.2.5.4 Total Coliform Rule

The Total Coliform Rule (TCR) requires all PWSS to monitor for the presence of coliforms in their distribution systems, as measured by "total coliforms." The TCR requires all public water systems (PWSs) to monitor for the presence of total coliforms in the distribution system. Total coliforms are a group of closely related bacteria that are (with few exceptions) not harmful to humans. Because total coliforms are common inhabitants of ambient water and may be injured by environmental stresses (e.g., lack of nutrients) and water treatment (e.g., chlorine disinfection) in a manner similar to most bacterial pathogens and many viral enteric pathogens, EPA considers them a useful indicator of these pathogens. More important, for drinking water, total coliforms are used to determine the adequacy of water treatment and the integrity of the distribution system. The absence of total coliforms in the distribution system minimizes the likelihood that fecal pathogens are present. Thus, total coliforms are used to determine the vulnerability of a system to fecal contamination.

The TCR requires systems to monitor for total coliforms at a frequency proportional to the number of people served. If any sample tests positive for total coliforms, the system must perform the following additional tests:

Further test that culture for the presence of either fecal coliforms or *Escherichia coli*;

- Take one set of 3-4 repeat samples at sites located within 5 or fewer sampling sites adjacent to the location of the routine positive sample within 24 hours; and
- Take at least 5 routine samples the next month of operation.

2.2.5.5 Interim Enhanced Surface Water Treatment Rule

The Interim Enhanced Surface Water Treatment Rule applies to systems using surface water, or ground water under the direct influence of surface water that serve 10,000 or more persons. The rule also includes provisions for states to conduct sanitary surveys for surface water systems regardless of system size. The rule builds upon the treatment technique requirements of the Surface Water Treatment Rule with the following key additions and modifications:

- Maximum contaminant level goal (MCLG) of zero for *Cryptosporidium*
- 2-log *Cryptosporidium* removal requirements for systems that filter

- Strengthened combined filter effluent turbidity performance standards
- Individual filter turbidity monitoring provisions
- Disinfection profiling and benchmarking provisions
- Systems using ground water under the direct influence of surface water now subject to the new rules dealing with *Cryptosporidium*
- Inclusion of *Cryptosporidium* in the watershed control requirements for unfiltered public water systems
- Requirements for covers on new finished water reservoirs
- Sanitary surveys, conducted by states, for all surface water systems regardless of size

The Interim Enhanced Surface Water Treatment Rule, with tightened turbidity performance criteria and required individual filter monitoring, is designed to optimize treatment reliability and to enhance physical removal efficiencies to minimize the *Cryptosporidium* levels in finished water.

2.2.5.6 Stage 1 Disinfection Byproduct Rule

The Stage 1 Disinfectants and Disinfection Byproducts Rule applies to community water systems and non-transient non-community systems, including those serving fewer than 10,000 people, that add a disinfectant to the drinking water during any part of the treatment process.

The final Stage 1 Disinfectants and Disinfection Byproducts Rule includes the following key provisions:

- Maximum residual disinfectant level goals (MRDLGs) for chlorine, chloramines, and chlorine dioxide;
- Maximum contaminant level goals (MCLGs) for four trihalomethanes, two haloacetic acids, bromate, and chlorite;
- MRDLs for the disinfectants chlorine, chloramines, and chlorine dioxide;
- MCLs for total trihalomethanes, haloacetic acids (HAA5), two inorganic disinfection byproducts (chlorite and bromate; and
- A treatment technique for removal of DBP precursor material.

The terms MRDLG and MRDL, which are not included in the SDWA, were created to distinguish disinfectants (because of their beneficial use) from contaminants. The final rule includes monitoring, reporting, and public notification requirements for these compounds. This final rule also describes the best available technology (BAT) upon which the MRDLs and MCLs are based.

2.2.5.7 Filter Backwash Recycling Rule

The Filter Backwash Recycling Rule (FBRR) requires public water systems (PWSs) to review their backwash water recycling practices to ensure that they do not compromise microbial control. Under the FBRR, recycled filter backwash water, sludge thickener supernatant, and liquids from dewatering processes must be returned to a location such that all processes of a system's conventional or direct filtration including coagulation, flocculation, sedimentation (conventional filtration

only) and filtration, are employed. Systems may apply to the State for approval to recycle at an alternate location. The Filter Backwash Rule applies to all public water systems, regardless of size.

2.2.5.8 Long-term 1 Enhanced Surface Water Treatment Rule

The Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) requires systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium:* 99% removal.
- *Giardia lamblia:* 99.9% removal/inactivation.
- Viruses: 99.99% removal/inactivation.
- *Legionella:* No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, for systems servicing > 10,000, and January 14, 2005, for systems servicing < 10,000, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter.
- Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).

2.3 Additional EPA Regulations

As stated previously, the Long-Term 2 Enhanced Surface Water Treatment Rule and the Stage 2 Disinfection Byproducts Rule were promulgated by EPA after Guam EPA adopted other EPA drinking water regulations. These two rules are discussed in this section.

2.3.1 Stage 2 Disinfection Byproduct Rule

EPA promulgated the Stage 2 Disinfection Byproduct Rule (S2DBPR) to reduce potential cancer and reproductive and developmental health risks from disinfection byproducts (DBPs) in drinking water, which form when disinfectants are used to control microbial pathogens. Under the Stage 2 DBP rule, systems will conduct an evaluation of their distribution systems, known as an Initial Distribution System Evaluation (IDSE), to identify the locations with high disinfection byproduct concentrations. These locations will then be used by the systems as the sampling sites for Stage 2 DBP rule compliance monitoring.

Compliance with the maximum contaminant levels for two groups of disinfection byproducts (TTHM and HAA5) will be calculated for each monitoring location in the

distribution system. This approach, referred to as the locational running annual average (LRAA), differs from previous requirements, which determined compliance by calculating the running annual average of samples from all monitoring locations across the system.

The Stage 2 DBP rule also requires each system to determine if they have exceeded an operational evaluation level, which is identified using their compliance monitoring results. The operational evaluation level provides an early warning of possible future MCL violations, which allows the system to take proactive steps to remain in compliance. A system that exceeds an operational evaluation level is required to review their operational practices and submit a report to their state that identifies actions that may be taken to mitigate future high DBP levels, particularly those that may jeopardize their compliance with the DBP MCLs.

2.3.2 Long-term 2 Enhanced Surface Water Treatment Rule

EPA promulgated the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) to reduce disease incidence associated with *Cryptosporidium* and other pathogenic microorganisms in drinking water. The LT2ESWTR will supplement existing regulations by targeting additional *Cryptosporidium* treatment requirements to higher risk systems. This proposed regulation also contains provisions to mitigate risks from uncovered finished water storage facilities and to ensure that systems maintain microbial protection as they take steps to reduce the formation of disinfection byproducts. The LT2ESWTR will apply to all systems that use surface water or ground water under the direct influence of surface water.

Under the LT2ESWTR, systems initially conduct source water monitoring for *Cryptosporidium* to determine their treatment requirements. Filtered systems will be classified in one of four risk bins based on their monitoring results. EPA projects that the majority of systems will be classified in the lowest risk bin, which carries no additional treatment requirements. Systems classified in higher risk bins must provide 90 to 99.7 percent (1.0 to 2.5-log) additional reduction of *Cryptosporidium* levels. The regulation specifies a range of treatment and management strategies, collectively termed the "microbial toolbox," that systems may select to meet their additional treatment requirements. All unfiltered systems must provide at least 99 or 99.9 percent (2 or 3-log) inactivation of *Cryptosporidium*, depending on the results of their monitoring.

Cryptosporidium monitoring by large systems (serving at least 10,000 people) will begin six months after the LT2ESWTR is finalized and will last for a duration of two years. Small systems (serving less than 10,000 people) are on a delayed schedule and will start monitoring when the required large system monitoring is finished. To reduce monitoring costs, small filtered systems will initially conduct one year of monitoring for *E. coli*, which is a bacterium that is less expensive to analyze than *Cryptosporidium*. These systems will be required to monitor for *Cryptosporidium* for one year only if their *E. coli* results exceed specified triggering concentrations. Systems must conduct a second round of monitoring beginning six years after the initial bin classification. Systems may grandfather equivalent previously collected data in lieu of conducting new monitoring, and systems are not required to monitor if they provide the maximum level of treatment required under the rule.

The LT2ESWTR proposal also contains disinfection profiling requirements to ensure that systems maintain protection against microbial pathogens as they take steps to reduce the formation of DBPs. Disinfection profiling involves systems assessing the level of disinfection they currently provide and then determining the impact that a proposed change

in their disinfection practice would have on this level. Additionally, the proposed LT2ESWTR has requirements that address risk in uncovered finished water storage facilities, which are subject to contamination if not properly managed or treated.

Table 2-1 – Primary Drinking Water Standards – Microorganisms

Contaminant	MCL or TT(mg/L)	Public Health Goal (mg/L)
Cryptosporidium	TT[1]	zero
Giardia Lamblia	TT[1]	zero
Heterotrophic plate count (HPC)	TT[1]	n/a
Legionella	TT[1]	zero
Total Coliforms (including fecal coliform and E. coli)[2]	5.0%[3]	zero
Turbidity	TT[1]	n/a
Viruses (enteric)	TT[1]	zero

1. EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:
   - *Cryptosporidium:* (as of 1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99% removal.
   - *Giardia lamblia:* 99.9% removal/inactivation.
   - Viruses: 99.99% removal/inactivation.
   - *Legionella:* No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
   - Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, for systems servicing > 10,000, and January 14, 2005, for systems servicing < 10,000, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
   - HPC: No more than 500 bacterial colonies per milliliter.
   - Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
   - Filter Backwash Recycling; The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.
2. Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems
3. No more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli* if two consecutive TC-positive samples, and one is also positive for *E.coli* fecal coliforms, system has an acute MCL violation.

Table 2-2 – Primary Drinking Water Standards – Disinfection By-Products

Contaminant	MCL or TT (mg/L)	Public Health Goal (mg/L)
Bromate	0.010	zero
Chlorite	1.0	0.8
Haloacetic acids (HAA5)	0.060	n/a[1]
Total Trihalomethanes (TTHMs)	0.10; 0.080 after 12/31/03	n/a[1]

1. Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:
   - Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
   - Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L).

Table 2-3 – Primary Drinking Water Standards – Disinfectants

Contaminant	MCL or TT (mg/L)	Public Health Goal (mg/L)
Chloramines (as Cl_2)	MRDL = 4.0	MRDLG = 4
Chlorine (as Cl_2)	MRDL = 4.0	MRDLG = 4
Chlorine dioxide (as ClO_2)	MRDL = 0.8	MRDLG = 0.8

Table 2-4 – Primary Drinking Water Standards – Inorganic Chemicals

Contaminant	MCL or TT (mg/L)	Public Health Goal (mg/L)
Antimony	0.006	0.006
Arsenic	0.010 as of 1/23/06	0
Asbestos (fiber>10 μm)	7 million fibers per Liter (MFL)	7 MFL
Barium	2	2
Beryllium	0.004	0.004
Cadmium	0.005	0.005
Chromium (total)	0.1	0.1
Copper	TT[1]; Action Level=1.3	1.3
Cyanide (as free cyanide)	0.2	0.2
Fluoride	4.0	4.0
Lead	TT[1]; Action Level=0.015	zero
Mercury (inorganic)	0.002	0.002
Nitrate (measured as Nitrogen)	10	10
Nitrite (measured as Nitrogen)	1	1
Selenium	0.05	0.05
Thallium	0.002	0.0005

1. Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

Table 2-5 – Primary Drinking Water Standards – Organic Chemicals

Contaminant	MCL or TT (mg/L)	Public Health Goal (mg/L)
Acrylamide	TT[1]	zero
Alachlor	0.002	zero
Atrazine	0.003	0.003
Benzene	0.005	zero
Benzo(a)pyrene (PAHs)	0.0002	zero
Carbofuran	0.04	0.04
Carbon tetrachloride	0.005	zero
Chlordane	0.002	zero
Chlorobenzene	0.1	0.1
2,4-D	0.07	0.07
Dalapon	0.2	0.2
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	zero
o-Dichlorobenzene	0.6	0.6
p-Dichlorobenzene	0.075	0.075
1,2-Dichloroethane	0.005	zero
1,1-Dichloroethylene	0.007	0.007
cis-1,2-Dichloroethylene	0.07	0.07
trans-1,2-Dichloroethylene	0.1	0.1
Dichloromethane	0.005	zero
1,2-Dichloropropane	0.005	zero
Di(2-ethylhexyl)adipate	0.4	0.4
Di(2-ethylhexyl)phthalate	0.006	zero
Dinoseb	0.007	0.007
Dioxin (2,3,7,8-TCDD)	0.00000003	zero
Diquat	0.02	0.02
Endothall	0.1	0.1
Endrin	0.002	0.002
Epichlorohydrin	TT[1]	zero
Ethylbenzene	0.7	0.7
Ethylene dibromide	0.00005	zero
Glyphosate	0.7	0.7
Heptachlor	0.0004	zero
Heptachlor epoxide	0.0002	zero
Hexachlorobenzene	0.001	zero
Hexachlorocyclopentadiene	0.05	0.05

Table 2-5 – Primary Drinking Water Standards – Organic Chemicals (continued)

Contaminant	MCL or TT[1] (mg/L)[2]	Public Health Goal (mg/L)[2]
Lindane	0.0002	0.0002
Methoxychlor	0.04	0.04
Oxamyl (Vydate)	0.2	0.2
Pentachlorophenol	0.001	zero
Picloram	0.5	0.5
Polychlorinated biphenyls (PCBs)	0.0005	zero
Simazine	0.004	0.004
Styrene	0.1	0.1
Tetrachloroethylene	0.005	zero
Toluene	1	1
Toxaphene	0.003	zero
2,4,5-TP (Silvex)	0.05	0.05
1,2,4-Trichlorobenzene	0.07	0.07
1,1,1-Trichloroethane	0.2	0.2
1,1,2-Trichloroethane	0.005	0.003
Trichloroethylene	0.005	zero
Vinyl Chloride	0.002	zero
Xylenes (total)	10	10

1. Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows:
    - Acrylamide = 0.05% dosed at 1 mg/L (or equivalent)
    - Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent)

Table 2-6 – Primary Drinking Water Standards – Radionuclides

Contaminant	MCL or TT (mg/L)	Public Health Goal (mg/L)
Alpha particles	15 picocuries per Liter (pCi/L)	zero
Beta particles and photon emitters	4 millirems per year	zero
Radium 226 and Radium 228 (combined)	5 pCi/L	zero
Uranium	30 µg/L as of 12/08/03	zero

Table 2-7 – Secondary Drinking Water Standards

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

2.4 Ground Water Under the Direct Influence of Surface Water

The water source for Guam Waterworks Authority's Northern System is groundwater. Water producing geologic formations are primarily coral. Evidence exists that karst and other highly porous formations allow rapid response to the lens water level after significant rainfall events.

Wastewater pump station overflows that mimic significant rainfall in the area of some A-series wells have affected water quality rapidly as well. This information as well as other data being gathered by Guam EPA and GWA will be used to determine if the Northern System might be considered groundwater under the direct influence of surface water (GWUDI). Land development standards are not currently protecting the EPA "Sole Source Aquifer" designation of the area Though GWUDI designation has not been made by Guam EPA at the time of this report, it is under serious review. The lack of significant turbidity readings paralleling significant rainfall shows other issues need resolution.

A GWUDI designation for the Northern System would require that groundwater used for drinking water comply with the surface water treatment rules. The greatest impact associated with this designation would be the cost to filter the groundwater and monitor water quality in the distribution system.

The surface water treatment rules provide filtration avoidance criteria, but Guam EPA has stated that some wells might not qualify for filter avoidance. If the wells do not quality, filtration will be required. The filtration avoidance criteria include:

- Source water fecal coliform less than 20/100 mL or total coliform less than 100/100 mL 90 percent of the time;
- Turbidity, sample every four hours or continuously, less than 5 NTU;

- 99.9% (3 log) Giardia inactivation;
- 99.99% (4 log) virus disinfection;
- Watershed control program to limit sources of pathogens;
- Annual watershed and treatment inspections; and
- Compliance with the Total Coliform Rule.

Cost data from GWA indicates current surface water treatment operating costs are over one dollar per thousand gallons. This cost needs to be compared with ground water production costs of $0.60 per thousand gallons. A GWUDI designation could well raise the cost of all water production on island to the higher production price.

If filtration is required for some or all wells, the current co-mingled transmission/ distribution system is a further barrier to cost effective treatment. A system developed to convey water to a common point(s) of treatment is necessary. Even if filtration is not required, the impact of complying with the filtration avoidance criteria for a large number of individual wells will be expensive and operationally difficult.

Since the degree of the surface water influence is not known at this time, there are multiple scenarios which could occur for GWA. These scenarios are summarized in Table 2-8.

2.5 GWA Regulatory Compliance History

GWA's history of compliance with Guam EPA and USEPA regulations is discussed below.

2.5.1 Total Coliform Rule

Coliform bacteria, which are found in decaying organic material and in the intestinal tract of humans and animals, are usually not harmful to human health. Their presence may indicate the presence of other, more dangerous microbial contamination. A review of GWA's Water Quality Reports from 2000 through 2004, identified several violations of the Total Coliform Rule. These violations are summarized below.

2.5.1.1 Northern Water System

The acute MCL for total coliform was violated in June 2000. Positive results for *E. coli* were determined. Guam EPA issued a Notice of Violation and an Order of Compliance in August 2000. Chlorine sampling and monitoring procedures were modified.

On March 9, 10, and 12, 2001, samples from homes in Hagatna, Afame, Sinjana, and Ordot indicated the presence of total in fecal coliform in the source and distribution system water. These areas are served by Wells A-5, A-6, A-23, A-29, and A-30. There was an absence of chlorine residual in the system. A boil water notice was issued on March 13th and was lifted on May 25th. The cause of the contamination is through to be from a sewage overflow from Chaot Wastewater Pumping Station.

Source water is monitored quarterly for the presence or absence of fecal and total coliform. Data from 1998 through 2005 were reviewed to determine the highest source of coliform in source water. Figures 2-1 and 2-2 summarize the number of coliform hits (or detections) according to the wells in which they occurred. The

graphs are based on the number of fecal coliform hits, but the corresponding total coliforms hits are shown for the well also. Wells not shown in the graphs did not experience a fecal coliform hit, but may have experienced total coliform hits.

The benefit of this information is for prioritizing well fields or areas for compliance if the Northern System is designated Groundwater Under the Direct Influence of Surface Water (GWUDI). It is interesting to note that the number of wells showing fecal coliform contamination has decreased from 1998-2002 to 2003-2005.

Table 2-8 - GWUDI Scenarios

GWUDI Determination		Option		*Cryptosporidium* Monitoring	Option
Not GWUDI	A	Meet regulations using existing wells with individual chlorination systems.	A1	*Cryptosporidium* monitoring does not exceed action values	Meet regulations using existing wells with individual chlorination systems.
GWUDI	B	Meet filter avoidance criteria and continue using existing well system with individual chlorination systems. Filter avoidance requires: ▪ Source water fecal coliform <20 /100 mL or total coliform <100/100 mL 90% of time ▪ Turbidity <5 NTU *(Each well would need to be fitted with a continuous turbidity monitor.)* ▪ 99.9% (3 log) Giardia inactivation ▪ 99.99% (4 log) virus disinfection ▪ Watershed control program to limit sources of fecal pathogens ▪ Annual watershed and treatment inspections ▪ Compliance with Total Coliform Rule	B1	*Cryptosporidium* monitoring does not exceed action values	Meet regulations using existing wells with individual chlorination systems.
			B2	*Cryptosporidium* monitoring exceeds action values	Achieve required log reduction using secondary disinfection with UV light for each well.
	C	Construct transmission lines to convey ground water to a common point(s) of treatment if filter avoidance cannot be achieved. Membrane filters would be used to meet SWTR and LT1ESWTR.	C1	*Cryptosporidium* monitoring does not exceed action values	No additional improvements needed.
			C2	*Cryptosporidium* monitoring exceeds action values	Membrane filters can receive 0.5 to 6.5 log credit based on removal efficiency demonstrated in a challenge test of efficiency verified in direct integrity test. Maximum log reduction that would be required for *Cryptosporidium* removal is 2.5 log. If membrane filter is not granted a 2.5 log credit, secondary disinfection with UV treatment would be required.
	D	Construct collector wells to convey groundwater to common points of treatment if filter avoidance criteria cannot be achieved. Membrane filters would be used to meet SWTR and LT1ESWTR.	D1	*Cryptosporidium* monitoring does not exceed action values	No additional improvements needed.
			D2	*Cryptosporidium* monitoring exceeds action values	Membrane filters can receive 0.5 to 6.5 log credit based on removal efficiency demonstrated in a challenge test of efficiency verified in direct integrity test. Maximum log reduction that would be required for *Cryptosporidium* removal is 2.5 log. If membrane filter is not granted a 2.5 log credit, secondary disinfection with UV treatment would be required.
	E	Develop additional surface water supplies in the Southern System to reduce the reliance and need on groundwater in the Northern System.	E1	*Cryptosporidium* monitoring does not exceed action values	Provide treatment facilities to meet surface water treatment rules.
			E2	*Cryptosporidium* monitoring exceeds action values	Membrane filters can receive 0.5 to 6.5 log credit based on removal efficiency demonstrated in a challenge test of efficiency verified in direct integrity test. Maximum log reduction that would be required for *Cryptosporidium* removal is 2.5 log. If membrane filter is not granted a 2.5 log credit, secondary disinfection with UV treatment would be required.

Figure 2-1 – Wells with Coliform Hits from 1998-2002

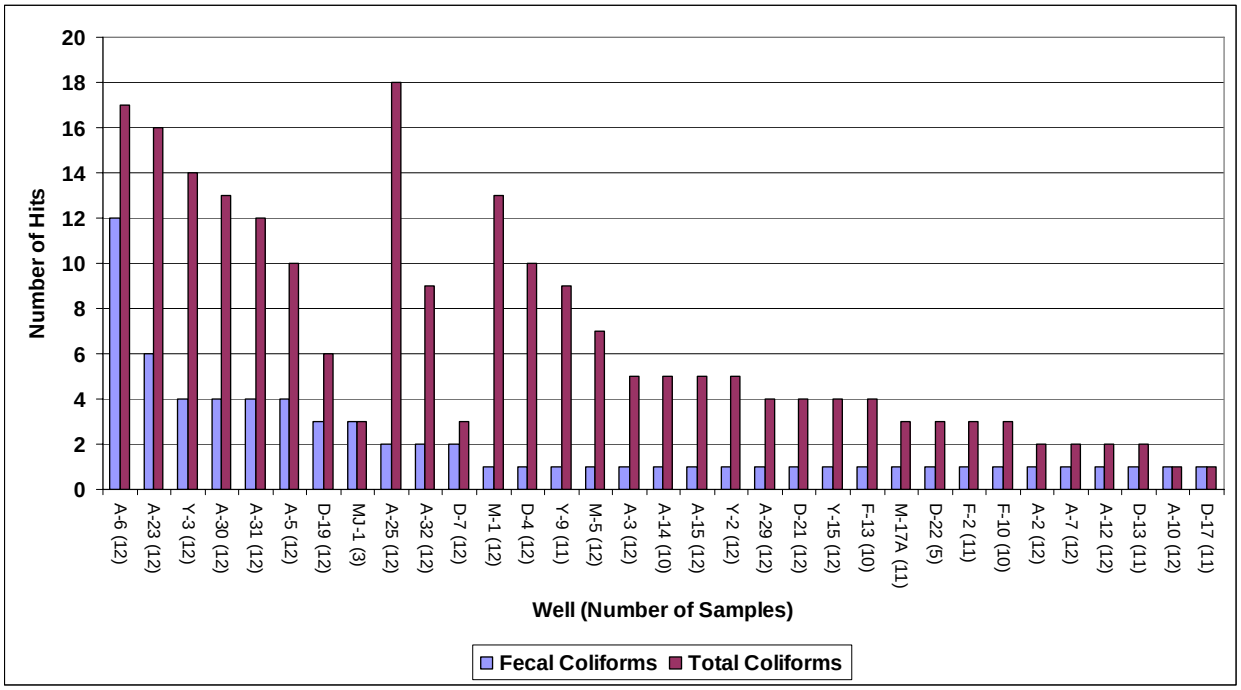
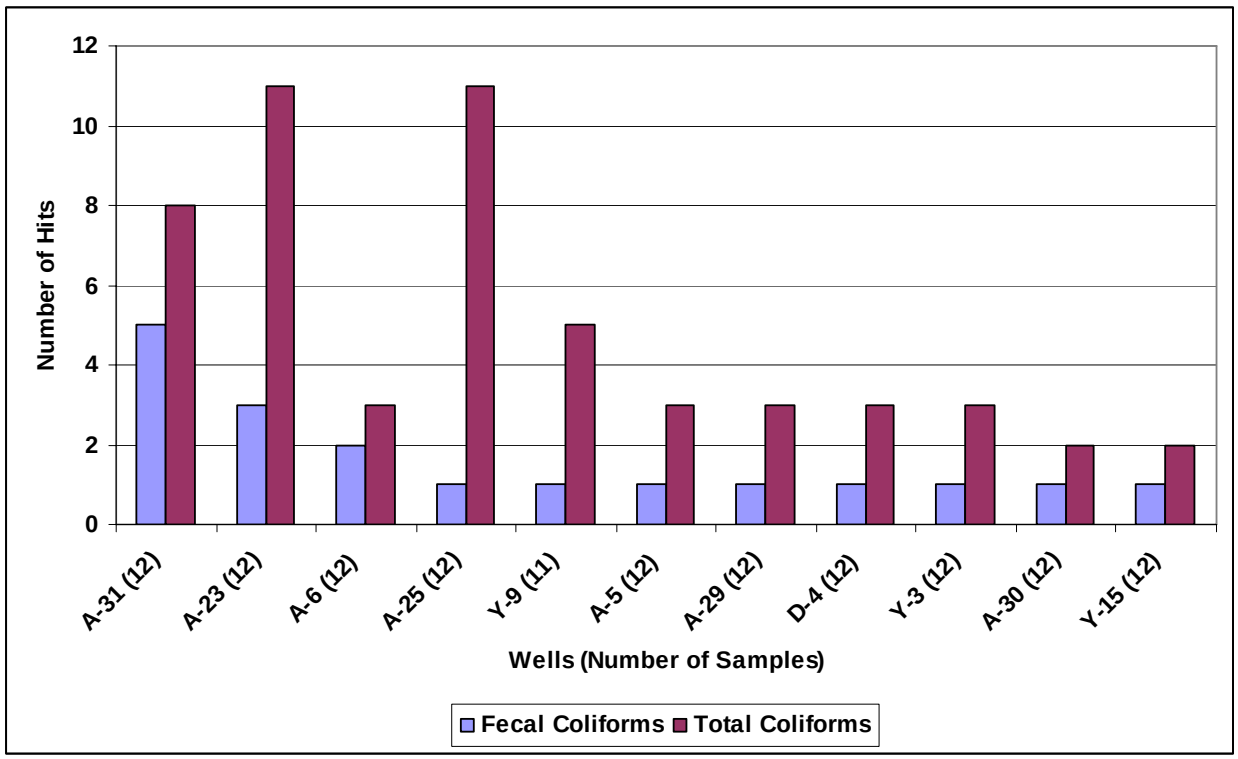


Figure 2-2 – Wells with Coliform Hits from 2003-2005



2.5.1.2 Central Water System

In January 2004, the presence of total and fecal coliform was detected in the source water and distribution system from Asan Spring. Chlorine residual was absent from the system. A boil water notice was issue for Asan and parts of Piti on January 23rd, and was lifted on February 2nd. Asan Spring was taken off-line until the chlorination system can be improved.

2.5.1.3 Southern Water System

In October 2000, the MCL for total coliform was exceeded. The violation was attributed to the intermittent operation of the chlorination system from Well MJ-1. The well was shut down and water provided from the Ugum Water Treatment Plant.

In June and December, 2002, total and fecal coliform counts exceeded the MCL in the distribution system. The high counts during these months were attributed to Typhoon Chata'an and Super Typhoon Pongsona. Boil water notices were issued.

On June 29, 2004, more than 5 percent of the samples taken exceeded the MCL for total coliform in Santa Rita and Agat. A boil water notice was issued on June 30th, and lifted on July 9th. The contamination was traced to a cross-connection without proper backflow prevention between a spring in Agat and the GWA water system.

2.5.1.4 Island-wide

In January 2003, an island-wide boil water notice was issued as a result of Super Typhoon Pongsona.

2.5.2 Nitrate

Nitrate is a form of inorganic nitrogen. It can be contributed by fertilizer as well as the breakdown of organic nitrogen, such as that contributed by plants and animals. The basic processes of the nitrogen cycle – nitrogen fixation, nitrification, and denitrification – convert nitrogen gas in the atmosphere to nitrate in the soil. Environmental concerns about nitrate include the human health effect of methemoglobinemia in children, and a nutrient source that causes excessive biogrowth (e.g., algae) in aquatic environments.

Analytical results for nitrate (NO_3^-) are usually expressed as nitrate-nitrogen (NO_3-N). The maximum contaminant level (MCL) for nitrate-nitrogen is 10 milligrams per liter (mg/L). The equivalent MCL for nitrate is 45 mg/L.

2.5.2.1 WERI Report

In 2002, Water and Environmental Research Institute (WERI) prepare a report (Technical Report No. 95) titled "Nitrate-nitrogen Concentrations in the Northern Guam Lens and Potential Nitrogen Sources". This study collected data from 147 wells (140 production and 7 monitoring) owned by GWA, GEPA, the Air Force, the Navy, and private companies for the period January 1978 through December 2000. A statistical analysis of the data was performed to determine significant increasing and decreasing trends of nitrate-nitrogen in the wells. Table 2.9 summarizes these results.

Table 2-9 – Nitrate-Nitrogen Trends in Wells of the Northern Guam Lens

Increasing Trend			Decreasing
A-1	F-5	M-3	A-5
A-4	F-6	M-4	A-6
A-28	F-7	M-8	A-23
D-6	F-8	M-9	A-25
D-7	F-9	M-14	A-31
D-17	F-10	M-15	F-4
D-19	F-11	M-16B	HGC-2
D-20	F-12	M-17B	M-GD
D-21	F-13	MGC-4	Y-4
EX-11	FM-1	NCS-2	
F-1	GH-501	NCS-A	
F-2	M-1	Y-4A	
F-3	M-2	Y-5	

In addition to the trends, maximum concentrations were also reported:

- 28 wells had maximum levels greater than 4.0 mg/L
- 22 wells had maximum levels between 4.0 and 4.99 mg/L
- 6 wells had maximum levels > 5.0 mg/L
- The highest concentration was in well NCS-4 (20.9 mg/L), but only one value was available

2.5.2.2 Annual Water Quality Reports

A review of GWA's Annual Water Quality Reports from 2000 through 2004 showed that nitrate-nitrogen was found in all GWA wells in 2000. The concentrations ranged from 0.07 to 5.65 mg/L. Well A-26 in Toto and Well M-4 in Mangilao exceeded ½ the MCL of 10 mg/L for nitrate-nitrogen.

2.5.3 Lead-Copper Rule Compliance

Aggressive (or corrosive) water and cause leaching of lead and copper from plumbing fixtures that contain them. Groundwater sources are typically less aggressive than surface water sources. In January 1992, household taps were sampled island-wide for lead and copper. Samples from the Central and Southern Systems exceeded action levels for lead and copper. The Central System is primarily served by the Navy's surface water treatment plant at Fena Reservoir and the Southern System is primarily served by the Ugum Water Treatment Plant, also a surface water source.

A corrosion control study was completed in 2000, and it provided recommendations for optimal corrosion control.

The recommendations have not been implemented.

2.5.4 Organics Chemical Contaminants

Organic chemical contaminants are carbon-based compounds, such as solvents and pesticides that can enter drinking water through a variety of means, including industrial discharges or runoff from crop lands. EPA has established MCLs for 56 organic contaminants. These contaminants can further be categorized as synthetic organic chemicals (SOCs) and VOCs. Volatile organic compounds include disinfection by-products such as trihalomethanes.

2.5.4.1 SOCs

Data from GWA's Water Quality Reports from 2000 through 2004, show that 12 SOCs have been detected in GWA's water. Table 2.10 summarizes the SOCs by water source.

In 2000 and 2001, chlordane was measured in Well M-14 at a concentration above ½ the MCL. In 2004, chlordane exceeded the MCL in Well M-14. The well was physically disconnected from the system.

Table 2-10 – Regulated Synthetic Organic Compounds Summary by Water Source

Groundwater	Ugum Water	Fena Water
Atrazine	None	2,4-D
Picloram		Chlordane
Chlordane		Dalapon
Di(2-ethylhexyl)-phthalate		Di(2-ethylhexyl)-phthalate
Ethylenedibromide		Endrin
Endrin		Heptachlor Epoxide
Heptachlor		Methoxychlor
Heptachlor Epoxide		Simazine

2.5.4.2 VOCs

Data from GWA's Water Quality Reports from 2000 through 2004, show that six regulated volatile organics have been detected in GWA's water. Table 2.11 summarizes the VOCs by water source.

In 2000 and 2001, the concentration of tetrachloroethylene (PCE) in Well A-5 exceeded the MCL.

In 2000, the concentration of trichloroethylene (TCE) in Well NAS exceeded the MCL.

In 2004, the concentration of trihalomethanes in the Northern Water System exceeded the MCL. Well NAS had a concentration of 266 parts per billion. The well was taken out-of-service and will not be placed back into service until the granular activated carbon (GAC) system is placed on-line.

Table 2-11 – Regulated Volatile Organic Compounds Summary by Water Source

Groundwater	Ugum Water	Fena Water
Dichloromethane	Total Trihalomethanes	1,2,4-Trichlorobenzene
Tetrachloroethylene (PCE)	HAA5 (Five Haloacetic acids)	Dichloromethane
Trichloroethylene (TCE)		Trichloroethylene (TCE)
Total Trihalomethanes		Total Trihalomethanes
HAA5 (Five Haloacetic acids)		HAA5 (Five Haloacetic acids)

2.5.5 Radionuclides

Radionuclides include radioactive particles, such as radium-226, radium-228, gross alpha, and beta particle/photon radioactivity. They can occur naturally in water or may result from human activity. EPA has established MCLs for beta/photon emitters, alpha emitters, and combined radium 226/228.

Data from GWA's Water Quality Reports from 2000 through 2004, show that four radionuclides have been detected in GWA's water. Table 2.12 summarizes the radionuclides by water source.

In 2000, Gross Alpha Activity exceeded 1/2 MCL in the Northern and Central Systems.

In 2001, Gross Alpha Activity exceeded 1/2 MCL in the Central System.

In 2002, Radium 226 exceeded the MCL in the Central System and Radium 228 exceeded ½ the MCL in the Northern System.

Table 2-12 – Regulated Radionuclides Summary by Water Source

Groundwater	Ugum Water	Fena Water
Gross Alpha Activity	Gross Beta Activity	Gross Alpha Activity
Radium 226		Radium 226
Radium 228		Gross Beta Activity
Gross Beta Activity		

2.5.6 Surface Water Treatment Rules

The Ugum Water Treatment Plant (WTP) treats surface water from the Ugum River. The water is distributed throughout the Southern System. A review of Water Quality Reports from 2000 through 2004, shows several violations of surface water treatment rules. These are summarized below.

- **2000** – The performance standard for turbidity was exceeded in August and September. This exceedence was attributed to operational problems, inadequate training and equipment, improper plant maintenance, constraint of funding, and high source water turbidity. A Comprehensive Performance Evaluation (CPE) was conducted. The report is summarized in Volume 1, Chapter 3 – Organization Assessment.

- **2001** – Water samples collected on July 5th and 6th showed turbidity levels of 11 NTU, exceeding the maximum of 5 NTU. Ninety-one percent of the monthly average turbidity readings exceeded 0.5 NTU; below the 95% standard. GWA failed to notify Guam EPA. The exceedences were attributed to a lack of process control equipment.

  In August, the Ugum WTP failed to meet turbidity requirements. Ninety-two percent of the monthly turbidity readings exceeded 0.5 NTU; below the 95% standard. The exceedences were attributed to monsoon conditions and a failure of the chemical treatment system.

  GWA was issued a Notice of Non-Compliance and a Stipulated Penalty Order on October 19th. GWA secured funding for improvements to the Ugum WTP through a Drinking Water Improvement Grant.

- **2002** – In 2002, the Ugum WTP met the treatment technique requirements relating to turbidity. The WTP failed to meet standard operating procedure and reporting requirements. This failure was attributed to inadequate staffing and poor operation and maintenance. Comprehensive Technical Assistance (CTA) was provided.

2.5.7 Operator Certification Requirements

In 2002, several GWA operators in responsible charge of the operation and supervision of the water system were not certified as required by law. GWA instituted an in-house training program to support operators' ability to take and pass the certification exam. The program resulted in an improvement of exam scores over previous years.

GWA made a concerted effort to meet the certification requirements through an in-house training program and recruitment. GWA is in compliance currently with the certification requirements.