POLICY ANALYSIS OF THE STAGE 2 DRINKING WATER DISINFECTANTS AND DISINFECTION BYPRODUCTS RULE IN THE STATE OF OREGON

by

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A THESIS

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Drinking Water Disinfection Byproducts are a rapidly growing public health concern mitigated by multiple regulations including the Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR). Expected to be finalized in late 2005, this rule will impact water systems serving over 254 million people in the United States (EPA 2003).

This Thesis is a study of the potential impact of the Stage 2 DBPR on Oregon drinking water utilities through examination of historical water quality data and four case studies. Comparison of 2004 data reported to the Oregon Drinking Water Program with national data compiled by the EPA indicates that a similar percentage of Oregon utilities will be impacted by Stage 2 requirements as in the United States overall. This comparison

opens questions about the accuracy of either the EPA's or Oregon's data because DBP precursors are commonly known to be lower in Oregon than in the US overall.

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CHAPTER I: INTRODUCTION

The Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR), expected to be finalized by the Environmental Protection Agency (EPA) in late 2005, is an important step in the protection of public health, and a daunting task for those who are responsible for its implementation. The regulation is intended to reduce public exposure to carcinogenic byproducts found in drinking water. When fully implemented, the regulation is expected to prevent 20.9 to 182.2 bladder cancer cases per year in the United States at a health cost savings of $54.3 to 70.0 million per year in addition to other un-quantified health benefits (US EPA 2003a). Despite the benefits of the regulation, there has been significant controversy over the rule and delay of its final release.

In writing the regulation, the EPA confronts complicated issues of public health, rapidly evolving scientific understanding, and vast scope. In attempt to tackle such a deluge of issues, the regulation itself is a multifaceted document. The organizations that are required to implement the regulation, primarily public drinking water systems and state regulatory agencies, express great frustration over its complexity. Confusion about the regulation, fear of potential costs and unknown outcome, and desire by water systems to ensure that they will be able to meet the new requirements, has caused these organizations to devote extra resources into preparing for the regulation.

For this study, I have examined the expected implementation costs of the Stage 2 DBPR in Oregon and how they compare with the EPA estimates nationwide. In Chapter

II, I discuss the health impacts of drinking water DBP's and the series of policies that regulate them. Also discussed are the various interest groups impacted by the regulation and the compliance activities that will be conducted in Oregon and Nationwide. In chapter III, I present methodology used to study two hypotheses. First, Oregon would be less impacted by the new regulation than the rest of the nation, and second, the actual costs of rule implementation are greater than the EPA accounted for in its cost benefit analysis.

To carry out this study, I performed two analyses, described in chapter III. The first was an examination of 2004 water quality data for Oregon Public Water Systems. I analyzed the data to determine the baseline number of Oregon water systems subject to the Stage 2 DBPR and the estimated number that will perform various rule activities. The methods I used to perform this analysis simulated methods used by the EPA in its economic analysis for the Stage 2 DBPR (2003a). For the second analysis I conducted case studies of four water systems in Oregon to obtain information on rule implementation activities and the associated costs. I compared data obtained in the case studies with cost data presented in the EPA's economic analysis for the regulation.

Based on the results of my analysis of 2004 data, the number of utilities impacted by the regulation could be more than the EPA predicted. There were also several implementation activities performed by water systems in the case studies that were not considered in the EPA's economic analysis. As a result of these findings, the cost of the regulation may be greater than the estimates in the EPA's economic analysis.

CHAPTER II: REVIEW OF DRINKING WATER POLICY AND DISINFECTION BYPRODUCTS

Background

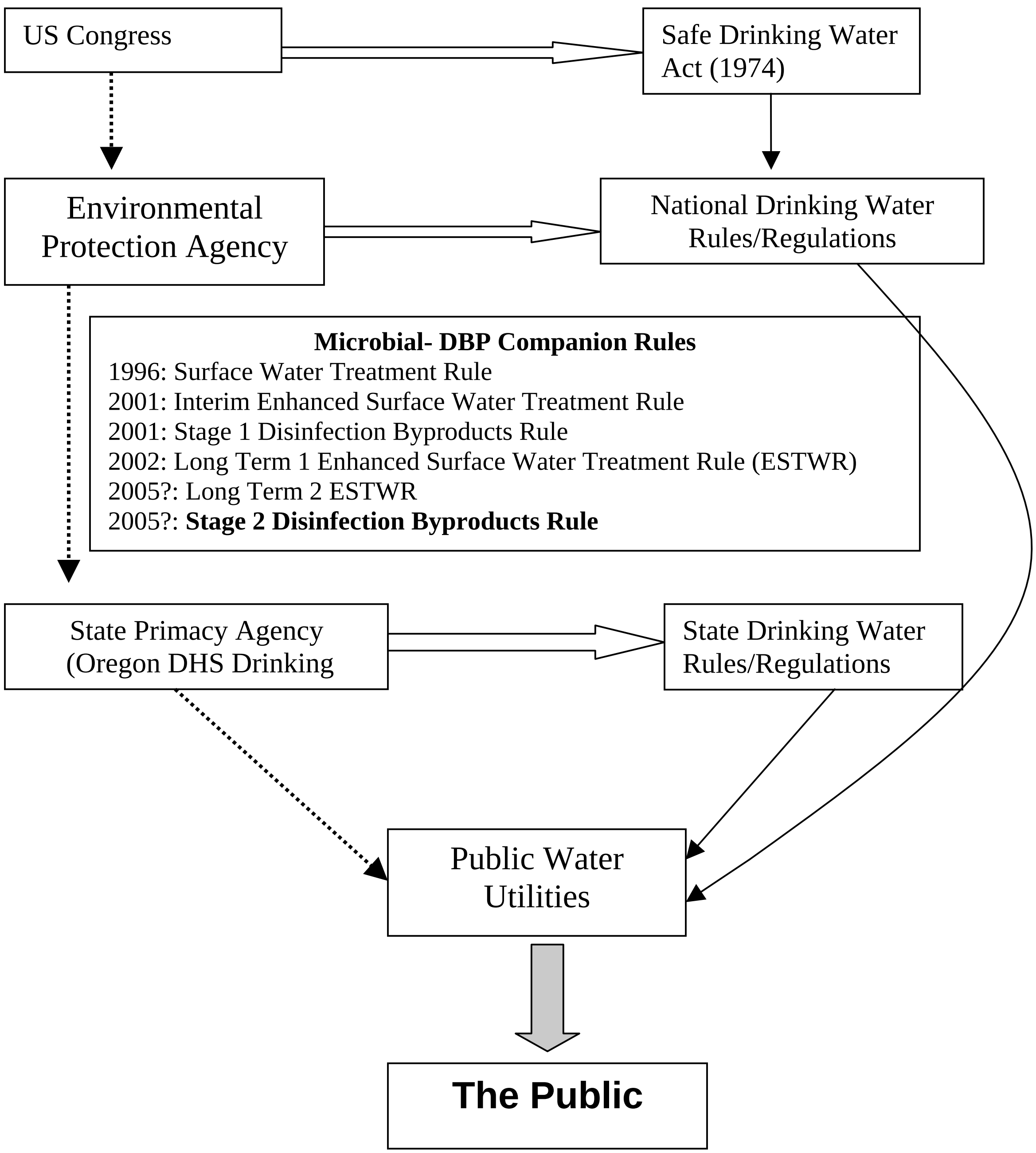
The use of chemical disinfectants such as chlorine to kill or inactivate harmful microorganisms in water used for drinking and sanitation is considered to be one of the greatest public health advances of the 20th century. Prior to the use of disinfectants, outbreaks of cholera, typhoid, amoebic dysentery and other waterborne diseases were a common cause of death, and still are in many Third World countries. The 1904 typhoid outbreak in Eugene, OR (Eugene Water and Electric Board, 2004) and more recently the 2001 E-coli outbreak in Walkerton British Columbia (American Waterworks Association, 2001) could have been prevented by proper disinfection of the water. On the other hand, disinfectants such as chlorine, bromine, chloramines and ozone that are used to destroy harmful pathogens are also known to react with natural organic matter in the water to produce carcinogens and other harmful byproducts. These “Disinfection Byproducts” or DBP’s are carcinogenic to humans when exposed in sufficient quantities over a period of time and may increase the risk of some reproductive problems. This leads to a scientific and public policy dilemma: how can we prevent the formation of the harmful byproducts while also ensuring that public drinking water is free from waterborne pathogens and therefore safe to drink? To confront this problem, the USEPA has introduced a series of companion rules under the Safe Drinking Water Act. The Stage 2 Disinfection

Byproducts Rule is expected to be finalized in late 2005. The goal of this regulation is to reduce the level exposure to harmful disinfection byproducts through drinking water, and therefore lower cancer rates and the occurrence of other related illnesses. "EPA estimates that full implementation of the Stage 2 DBPR will reduce the incidence of bladder cancer cases by up to 182 cases per year, with an associated reduction of up to 47 premature deaths" (EPA 2003a). The regulation is also expected to bring an un-quantified reduction of reproductive and developmental health effects believed to be associated with DBP's.

The Safe Drinking Water Act and the United States Environmental Protection Agency

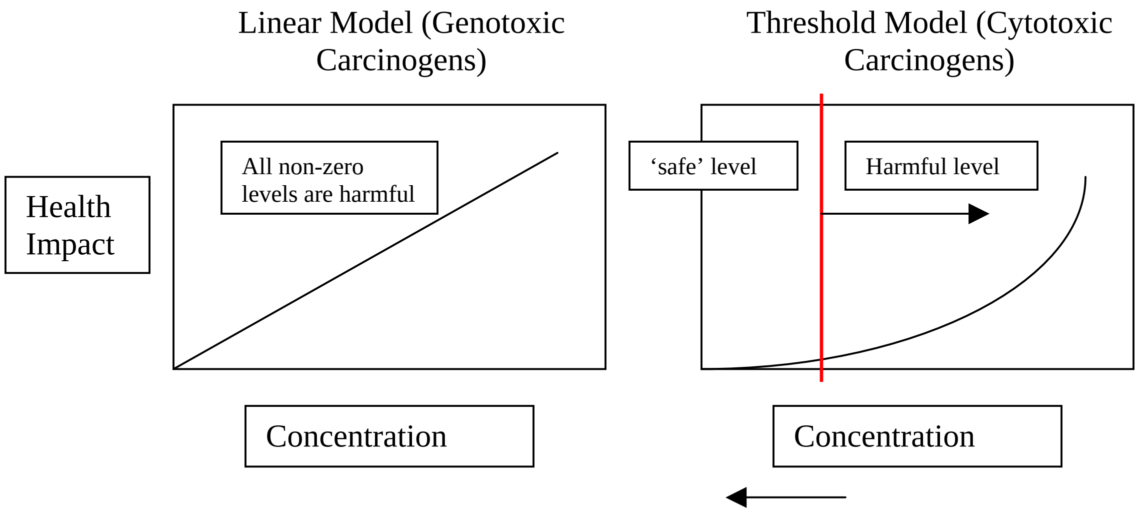
Drinking Water regulation in the United States has gone through a variety of stages and agencies over the past century. The present "era" of drinking water regulation began in 1974 when the United States Congress passed the Safe Drinking Water Act and placed the USEPA in charge of interpreting and enforcing it. Figure 1 depicts the relationships between the agencies responsible for promulgating and enforcing drinking water regulation. The EPA delegates its power and responsibility (called "primacy") to enforce drinking water regulation to state agencies, such as the Oregon Department of Human Services Drinking Water Program. The State agencies must adopt and enforce the regulations set by the EPA and may choose to write their own more stringent requirements. Public water systems are required to implement drinking water regulations of the EPA and the State primacy agency.

Figure 1. Drinking Water Regulation Flow Chart



As part of the regulatory process, the EPA sets un-enforced Maximum Contaminant Level Goals for drinking water contaminants at levels which “no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety” (US EPA 2001, 2003c). Enforced Maximum Contaminant Levels are then set as close to the Maximum Contaminant Level Goal as feasible according to a risk management decision that includes the economic feasibility of the policy. In addition to the Maximum Contaminant Levels, the EPA also designates specific treatment processes for the different types of source water, and monitoring requirements according to a water systems type and population served. EPA approved treatment techniques and preventative measures are used by water utilities to meet the water quality standards set by the EPA. In the 1986 *Cancer Guidelines for Carcinogen Risk Assessment* the USEPA recommended a default Maximum Contaminant Level Goal of zero for known or probable carcinogens (Driedger, 2003). This policy is based on a linear model for toxicity of compounds that assumes that all non-zero concentrations will produce some harm to humans and no truly safe ‘threshold’ can be set (Figure 2). This concept sets a precedent for the regulation of carcinogens and is a topic of the debate in the Disinfection Byproducts Rule.

Figure 2. Linear vs. Threshold Model for Health Effects



Baldwin, J.. University of Oregon Planning Public Policy and Management Program Natural Resource Policy Lecture Notes: February, 2004

Health Effects of Disinfection Byproducts

Approximately 254 million people in the United States are served by water systems that use a disinfectant such as chlorine, which is a precursor of DBP's (EPA, 2003c). Disinfection Byproducts can occur in any water system that uses a disinfectant, however the concentration and types of DBP's depends on the DBP precursors, such as organic matter in the water, and the amount of contact the disinfectant has with the water. DBP's are also found in some food and milk products. Simply removing the disinfectant causing the byproducts will cause much more damage than good by exposing the population to microbial pathogens. The installation of alternative treatment techniques will impact the cost of drinking water and there may be unknown drawbacks to using new and unproven techniques. Affective disinfectants that do not produce DBP's, such as ultra violet light also leave no residual, requiring water systems to use an additional disinfectant that leaves a residual in the water to ensure that no pathogens can re-enter the distribution system. Unlike the well-publicized issues of arsenic and MTBE (*methyl tertiary-butyl ether*), which caused widespread alarm but only affected a small percentage of the population, nearly every regulated public water utility is required to disinfect or provide some disinfectant residual in the drinking water. Water utilities and regulating agencies are working aggressively to confront the problem of DBP's. Major effort and dollars are being put into research, rule promulgation and treatment techniques to protect the public from this group of contaminants. Foremost in the mind of the water professional is to protect the public health and maintain the people's trust in public drinking water.

Disinfection Byproducts are formed when disinfectants such as Chlorine react with natural organic compounds in the water. Total Organic Carbon in water can react with common disinfectants to form Trihalomethanes, "a sum of chloroform, bromodichloromethane, dibromochloromethane, and bromoform" and Haloacetic Acids, "a sum of mono-, di-, and trichloroacetic acids and mono- and dibromoacetic acids" (EPA, 2003c) among many other groups of byproducts. Some of these compounds have been found to increase the risk of bladder and rectal cancer and may increase the incidence of reproductive and developmental problems such as stillbirth, spontaneous abortion and low birth weight. The risk of DBP formation increases as Total Organic Carbon levels increase and as certain disinfectant levels increases. Increasing the amount of time Total Organic Carbon in the water is in contact with a disinfectant will also increase the amount of DBP formation. For this reason, chlorinated water that has been stored in reservoirs for a long period of time, or homes located on the fringes of a large water system may have higher levels of DBP's than other areas.

How hazardous are DBP's to humans? A wide variety of research has been conducted using laboratory animals. Although such research gives us an idea of what compounds could be hazardous to people and what levels are probably safe, exact numbers are difficult to predict. The most conclusive results of studies on DBP's involve their association with bladder cancer. The Stage 1 DBPR states that a range between 2-17% of new bladder cancer cases could be attributable to DBP's. This would mean that 1,100 to 9,300 cases out of the estimated 54,500 new cases per year could be associated with DBP's. This was the estimated health effect of DBP's before the Stage 1 DBPR was instituted; theoretically these numbers have decreased as a result of the Stage 1 DBPR. A 2003 report that reviewed 14 DBP reproductive risk studies produces the following conclusions: "The studies of THMs [Trihalomathanes] and adverse birth outcomes provide moderate evidence for associations with SGA [Small For Gestational Age], NTDs [Neural Tube Defects], and spontaneous abortions (Bove et.al. 2002 p.72)[1]." Consistent with the EPA rules and other studies examined, conclusive numbers indicating the risk of certain levels of DBP's on birth defects were not readily available from this and other studies. However, enough information about the relationship between DBPs

[1] This study examined birth records for areas with known levels of Total trihalomethanes. Prevalence ratios for SGA; 1.08 to 5.9, neural tube defects; 0.9 to 3.0, spontaneous abortion; 0.6 to 3.0 (p.64 Table 3).

and cancer has been obtained for the EPA to set Maximum Contaminant Level Goals and Maximum Contaminant Levels for the different categories of DBP's and to require more thorough testing and reporting of DBP's within the drinking water distribution system.

Regulation of Disinfection Byproducts

Disinfection Byproducts were first regulated in 1979 when the EPA promulgated the Total Trihalomethanes Rule (44FR 68624). This required some water systems to limit the amount of disinfectant used, or the time that the disinfectant remained in the water, to prevent the formation of Trihalomethanes. With the 1979 Total Trihalomethanes Rule, the EPA set the Maximum Contaminant Level for Total Trihalomethanes at 100 parts per billion. Unfortunately the Surface Water Treatment Rule and Total Coliform Rule finalized by the EPA in 1989 made it necessary for many water utilities to increase their use of disinfectants. "While reducing exposure to pathogenic organisms, the Surface Water Treatment Rule also increased the use of disinfectants in some public water systems and, as a result, exposure to DBP's in those systems (EPA, 2003c, p. 49554)." The EPA has approached this problem by promulgating a series of companion rules known as the Microbial-Disinfection Byproduct Rules. One group of the companion rules known as the Enhanced Surface Water Treatment Rules[2] target the treatment of microbial contaminants by requiring a variety of treatment techniques and process control. An important part of the Microbial

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[2] Includes the Interim Enhanced Surface Water Treatment Rule (2001), and the Long Term 1 Enhanced Surface Water Treatment Rule and the Long Term 2 (2002), Enhanced Surface Water Treatment Rule (2005?).

side of the companion rules is to ensure that water systems do not fall below a stated *minimum* level of disinfection. On the other side of the companion rules are the Stage 1 and Stage 2 Disinfection Byproducts Rule's. Through the DBP rules, the EPA has set new lower Maximum Contaminant Levels for DBP's and also places requirements on the way in which water systems measure and calculate DBP levels. The two sets of rules were proposed together because the DBP rules would limit the use of certain disinfectants in many water utilities and the Enhanced Surface Water Treatment Rules would compensate for the disinfectant reduction by requiring alternative treatment techniques or alternative disinfectants such as ultra violet light. The Interim Enhanced Surface Water Treatment Rule and Stage 1 DBP rules were proposed in 1994 using preliminary data and finalized "after additional information was obtained on health risk, occurrence, treatment technologies, and analytical methods to better understand the risk-risk tradeoffs between microbial pathogens and those from DBP's" (Boorman et. al, 1999) in 2001. The Long Term 2 IESTWR and the Stage 2 DBPR are expected to be finalized in 2005.

The microbial-disinfection byproducts companion rules are a comprehensive plan by EPA to minimize the health risk of disinfection byproducts while ensuring the continued protection from microbial pathogens. As with all public policy implementation, each of the above regulations is accompanied by significant barriers to success. There are two major challenges to the successful implementation of the Stage 2 DBPR: the vast scope of the regulation, and the complexity of DBP's and their health effects.

The Stage 2 DBPR will be carried out by over 51,600 public water systems serving nearly 260 million people (EPA 2003a). Included in the group of public water systems that must carry out the rule are very small systems that serve fewer than 500 people. Small systems such as these are waived from many regulations due to the small population served and the lack of resources to carry out the regulations. Small water systems are frequently run by a volunteer or employee with other duties, such as a school janitor or apartment complex manager. These systems do not always have the resources or expertise to carry out a regulation as complex as the Stage 2 DBPR. Due to this lack of resources, much of the responsibility for educating water system representatives and assisting them with the rule compliance will fall on the State regulatory agencies. Representatives of many State regulatory agencies state that they do not have the resources necessary to enforce the regulation (Utah Department of Environmental Quality, 2005 and Oregon Department of Human Services, 2005).

The second barrier to implementation of the Stage 2 DBPR is the complexity of the scientific and health related data available for DBP's. Disinfection Byproducts represent a large assortment of compounds, and several hundred types of DBPs have been identified, and many more are yet to be identified (Simmons 2004). Of the known DBP's, the understanding of their health affects is a complex phenomena, and is summarized by Boorman et. al. in the following paragraph.

> Animal toxicity studies have been one of the key sources of data for policy makers in setting DBP standards…. These studies have been useful in identifying potential human reproductive and carcinogenic risks for several byproducts; however, human exposures are to mixtures of DBP's….There is a need to better understand the relative risks from DBP's that occur from other disinfection processes as well as a need for information on DBP mixtures (1999, p. 208).

In response to the amount of unknown information, the Stage 2 DBPR is designed in the manner of the Precautionary Principle to prevent the formation of both known and *unknown* DBP's and therefore reduce the risk of known and *unknown* health effects that could result from them. The water utility industry is also concerned about instituting drastic changes to the water treatment processes that utilities have perfected which may cause some system vulnerability. This is driven by the desire to avoid alarming the public with health 'statistics' that are not supported by scientific evidence.

The control of disinfection byproducts in drinking water is a complex, chemical process. Water, especially surface water, must be disinfected to control microbial pathogens. When dealing with water with high concentrations of naturally occurring Total Organic Compounds, it can become quite the science experiment to prevent the formation of DBP's while still ensuring that potential pathogens are controlled. The types of reactions dealt with are outlined in the following quote.

> DBPs are formed when disinfectants react with precursors such as natural organic matter (NOM) and bromide in water. NOM comes from decaying vegetation, etc. and bromide comes from salt-water intrusion into source waters, etc. All disinfectants form DBPs. DBPs are formed in one of two reactions: 1) Halogen substitution reactions resulting in halogenated by-products and 2) oxidation reactions. Secondary by-products are also formed when multiple disinfectants are used.
>
> Temperature, time and pH, along with the disinfection process and other source water characteristics, determine what DBPs will be formed. Most reactions that form DBPs occur in the first 24 hours. The pH determines, in part, which DBP will be formed, resulting in risk/risk tradeoffs. For example, lowering pH to control for trihalomethane (THM) formation can result in the increased formation of trihaloacetic acids. Reaction time is also an important variable - for example, chloral hydrate is unstable at high pH levels, and over time, it degrades to chloroform, which results in an increase of THMs over time.
>
> Bromide also presents risk/risk tradeoff questions: an increase in bromide in source water results in less formation of chloroform and a greater formation of

> bromodichloromethane. Moderate-to-high bromide levels increase the formation of bromoform. Increased bromide levels result in higher levels of brominated DBP species. Regulations are currently based on total THM instead of individual THMs (US EPA, 1999, Background section, ¶ 8).

The complex water chemistry associated with DBP's places the EPA in a difficult position. It must guard the public from pathogenic microbial outbreaks while also minimizing DBP's. To make the issue more complex, a 'breaking news' study reviewed on the American Water Works Association website indicates that alternative disinfectants other than chlorine such as chloramines, ozone, bromine compounds and chlorine dioxide produced comparable levels of DBP's as chlorine that could also pose health risks (American Water Works Association, 2004). Although the EPA's regulations for DBP's did acknowledge the role of these alternative disinfectants in DBP production, much of the concern has been centered on chlorine. Continued research on the topic makes the topic more complicated and further emphasizes the importance of carefully considering alternative treatment techniques when dealing with DBP's.

Interested Parties

The Public

Many groups embrace the precautionary principle over the topic of DBP's in drinking water including the Natural Resource Defense Council and the Children's Environmental Health Network. The Network submitted a docket comment on the Stage 2 DBPR in January 2004 emphasizing the need for the rule to require the reporting of more specific health information to the customers of water utilities who are in violation of the rule, as stated below.

> "Public Notifications" (PNs) and "Consumer Confidence Reports"(CCRs) should include information on the potential reproductive and developmental risks from elevated DBP levels. We agree with the Working Group on Community Right-to-Know and others that a clear mandate for water systems to publicly note potential health effects exists. The general public and health professionals should be clearly informed in specific and easy to understand language about the reproductive risks through the two aforementioned mediums. In particular, pregnant women and those that medically advise them have a right to know that some scientific studies indicate a link between DBPs and miscarriages, stillbirths, specific birth defects, low birth weight, and premature delivery. Once advised, the public, particularly those at high-risk, can make an informed choice when they select their drinking water.
> EPA should revise the notification requirements of the proposed rule to include the specific language regarding the potential health effects – including those to vulnerable subpopulations – of DBPs to be included in CCRs and PNs and to require water systems that exceed the maximum contaminant level of DPBs to include that language (Children's Environmental Health Network, 2004, Recommendation #2).

All water systems under regulation are required to send out annual consumer confidence reports to all their users that provide a list of water quality data and any violations of water quality standards. Also required is a summary of the health risks associated with the contaminant for which the plant was in violation. Because the scientific evidence linking DBP's and reproductive problems has not been well explored, the EPA may have only required utilities to report the cancer and other risks that have more conclusive evidence. Regardless of the issue, the stance of the Children's Network emphasizes the importance of community right to know and the precautionary principle in drinking water regulation.

Public Drinking Water Systems

The primary purpose of the public water utility is to protect public health in the form of ensuring that the public has a reliable supply of clean drinking water. It is not their interest to undermine the EPA rule promulgation process in favor of saving cost and effort for the water industry. The articles, reports, and meeting minutes available from water professional organizations such as the American Water Works Association, the Oregon Water Utilities Council, and the (National) Water Utility Council do not outwardly object to strengthening regulations on DBP's but would like all wording in the Rules supported by solid scientific evidence and studies to be cited accurately. Central to the concern of the drinking water industry is to maintain the safety and the communities' trust in public drinking water.

It is an important goal of most water providers to go beyond the minimum level of 'compliance' with water quality regulations. It is also an important value among drinking water professionals that the public has trust in the quality of their drinking water. Many people use at home treatment devices or drink bottled water in the belief that it is healthier for them. Few do the research to actually see if the quality of water from the bottle is better than the water that flows out of the tap. Bottled water is regulated by the FDA as a food product and quality parameters are less stringent than for public drinking water. Certain types of home treatment devices can remove chlorine, objectionable taste and odor, bacteria, and some toxins (depending on the device). Unfortunately, if used incorrectly, they may also introduce bacteria into the water. It is important for water users to understand what they are using before switching to an alternative water source; something that tastes better may still contain harmful compounds.

People do not like chemicals in their drinking water. Chlorine taste and odor is a very common complaint received at the Eugene Water and Electric Board water quality lab, despite the fact that the chlorine level is usually between 0.2 mg/L(or parts per million) and 0.5 mg/L. The lowest allowable level of chlorine leaving a treatment plant is 0.2 mg/L; any less and the system is out of regulatory compliance and may be at risk for bacterial re-growth. Due to the aversion that many people have to chlorine, despite its central role in protecting public health, many in the water industry are concerned that reports about DBP’s will cause undue alarm among water users. They have therefore been very sensitive about the wording used in the Stage 1 and 2 DBPR’s.

Implementation of the Stage 2 DBPR

First Phase of the Regulation: Stage 2A DBPR

The proposed Stage 2 DBPR introduces two significant changes from the requirements of the previous rules. The first is the Initial Distribution System Evaluation. Most public water systems that use a disinfectant other than ultra violet light will be required to conduct an Initial Distribution System Evaluation to determine new sampling sites for DBP compliance monitoring. Waivers may be available for very small systems and those whose historical DBP levels are 50% or less than the new Maximum Contaminant Level for each individual sample. The Initial Distribution System Evaluation will involve a rigorous sampling program throughout the geographical boundary of the water system or a system specific study that may involve hydraulic modeling and historical data if previous monitoring is determined to be sufficient by the state or federal regulatory agency.

The cost of the Initial Distribution System Evaluation will fall on nearly all water systems, even those that do not exceed the Maximum Contaminant Level for the new regulation. The reason for the Initial Distribution System Evaluation is to locate the worst case scenario sites in a water system. The case study section in Chapter 4 of this paper contains an assessment of the possible costs for conducting the evaluation; however it is important to note that there are a variety of methods that can be used and the EPA has not yet finalized some of the details that will determine how many samples each water system must collect.

The EPA has designated several categories of plants with multiple size groups that determine how many samples a water system must collect for the Initial Distribution System Evaluation. For example, a water system the size of the Eugene Water and Electric Board, with between 100,000 and 499,000 people, served by one treatment plant and a surface water source, would be required to collect a total of 48 samples[3], or 8 samples every two months for one year (Table 1). It is important to note that a system with multiple treatment plants would be required to collect a full set of samples for each plant, for example a water system with 4 surface water plants that served 100,000 people would be required to collect 192 samples (4 * 48). In the case study section of the paper, the significance of this issue will become apparent when the costs are compared for a system like Eugene's, with a single water source, and the City of Tigard, that has several sources. Table 2 is used to determine the number of samples required for a system that purchases all of its water from wholesale water systems. One of the topics that the EPA

[3] Each sample consists of one Total Trihalomethane sample and one Haloacetic Acid 5 sample (The Haloacetic Acid sample is a test for five separate compounds).

requested comments on after the release of the proposed rule was the idea of changing all of the water systems to a population based sampling for the Initial Distribution System Evaluation. In the case study section of Chapter IV, I have produced cost comparisons of the plant based sampling system and the population based sampling.

Table 1. Initial Distribution System Evaluation Standard Monitoring Plan Requirements for Producing Systems [a]

System Size (Population Served[b])	Total Number of Sites per Plant	Monitoring Frequency[c]	Total Number of Samples per Plant
Surface Water Systems[d]			
< 500	2	Every 180 days	4
500 - 9,999	2	Every 90 days	8
≥ 10,000	8	Every 60 days	48
Ground Water Systems			
< 10,000	2	Every 180 days	4
≥ 10,000	2	Every 90 days	8

Note. Adapted from USEPA 2003a. The Stage 2 Disinfectants and Disinfection Byproducts Rule Implementation Guidance*:* Draft for Comment. EPA 816-D-03-002 Table 1-1 IDSE Monitoring Requirements for Producing Systems p.24.

[a] P*roducing systems* are those that do not buy 100 percent of their water year round i.e., they produce some of all of their own finished water)

[b] Population served is usually a system's residential population. It does not include populations served by consecutive systems that purchase water from that system.

[c] Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location

[d] Surface water systems include systems that use surface water or ground water under the direct influence of surface water, including all mixed systems that use some surface water or GWUDI and some ground water.

Table 2 Initial Distribution System Evaluation Standard Monitoring Plan Requirements for 100 % Purchasing Systems [a]

System Size (Population Served)[b]	Total Number of Sites per System	Monitoring Frequency [c]	Total Number of Samples per System
Surface Water Systems			
< 500	2	Every 180 days	4
500 - 4,999	2	Every 90 days	8
5,000 - 9,999	4	Every 90 days	16
10,000 - 24,999	12	Every 60 days	72
25,000- 49,999	16	Every 60 days	96
50,000 - 99,999	24	Every 60 days	144
100,000 - 499,999	32	Every 60 days	192
500,000 - < 1.5 million	40	Every 60 days	240
≥ 5 million	48	Every 60 days	288
Ground Water Systems			
< 500	2	Every 180 days	4
500 - 9,999	2	Every 90 days	8
10,000 - 99,999	6	Every 90 days	24
100,000 - 499,999	8	Every 90 days	32
≥ 500,000	12	Every 90 days	48

Note. Adapted from "The Stage 2 Disinfectants and Disinfection Byproducts Rule Implementation Guidance: Draft for Comment." EPA 816-D-03-002 Table 1-2 IDSE Monitoring Requirements for 100 Percent Purchasing Systems Table 1-2 p.24.

[a] Systems that purchase or receive all of their water from one or more wholesale systems year round.

[b] Population served is usually a system’s residential population. It does not include populations served by consecutive systems that purchase water from that system.

[c] Monitoring frequency is the approximate number of days between monitoring events. A dual sample set must be collected at each location. A dual sample set is one TTHM and one HAA5 sample that is taken at the same time and location

[4] “surface water systems” include systems that use surface water or ground water under the direct influence of surface water, including all mixed systems that use some surface water or GWUDI and some ground water.

Table 1 and Table 2 depict the sampling required as part of the Initial Distribution System Evaluation using the *Standard Monitoring Plan*. This is a one time sampling program to be conducted over a period of 12 months. Water systems will then choose permanent sample sites based on the results from the Initial Distribution System Evaluation. The EPA also gives water systems the option to perform a *System Specific Study* which is a study customized for the individual water system and may be based on historical DBP data, a detailed computer hydraulic model or some combination of modeling and historical data. The System Specific Study must be approved by the state primacy agency. Typically, it is only recommended that a water system use the System Specific Study if it already has a hydraulic model or excellent historical DBP data. The use of the System Specific study will also be discussed in the case study sections of Chapters 3 and 4.

The final option for the Initial Distribution System Evaluation is the waiver. Water systems with extremely low historical DBP data, or systems that are very small, may qualify for a waiver from the Initial Distribution System Evaluation. Systems categorized as Non Transient Non Community Water Systems[4] serving fewer than 10,000 people and systems serving fewer than 500 people may apply for a small system waiver. These systems will not be required to conduct the intense Initial Distribution System Evaluation monitoring but will be required to submit a report and choose new sampling sites for testing. Water systems that have historically low levels of DBP's may be eligible for a '40/30' certification. The 40/30 certification will be available to systems

[4] *Non-Transient Non-Community Water System* (NTNCWS): A public water system that regularly supplies water to at least 25 of the same people at least six months per year, but not year-round. Some examples are schools, factories, office buildings, and hospitals which have their own water systems (EPA 2005 ¶ 3).

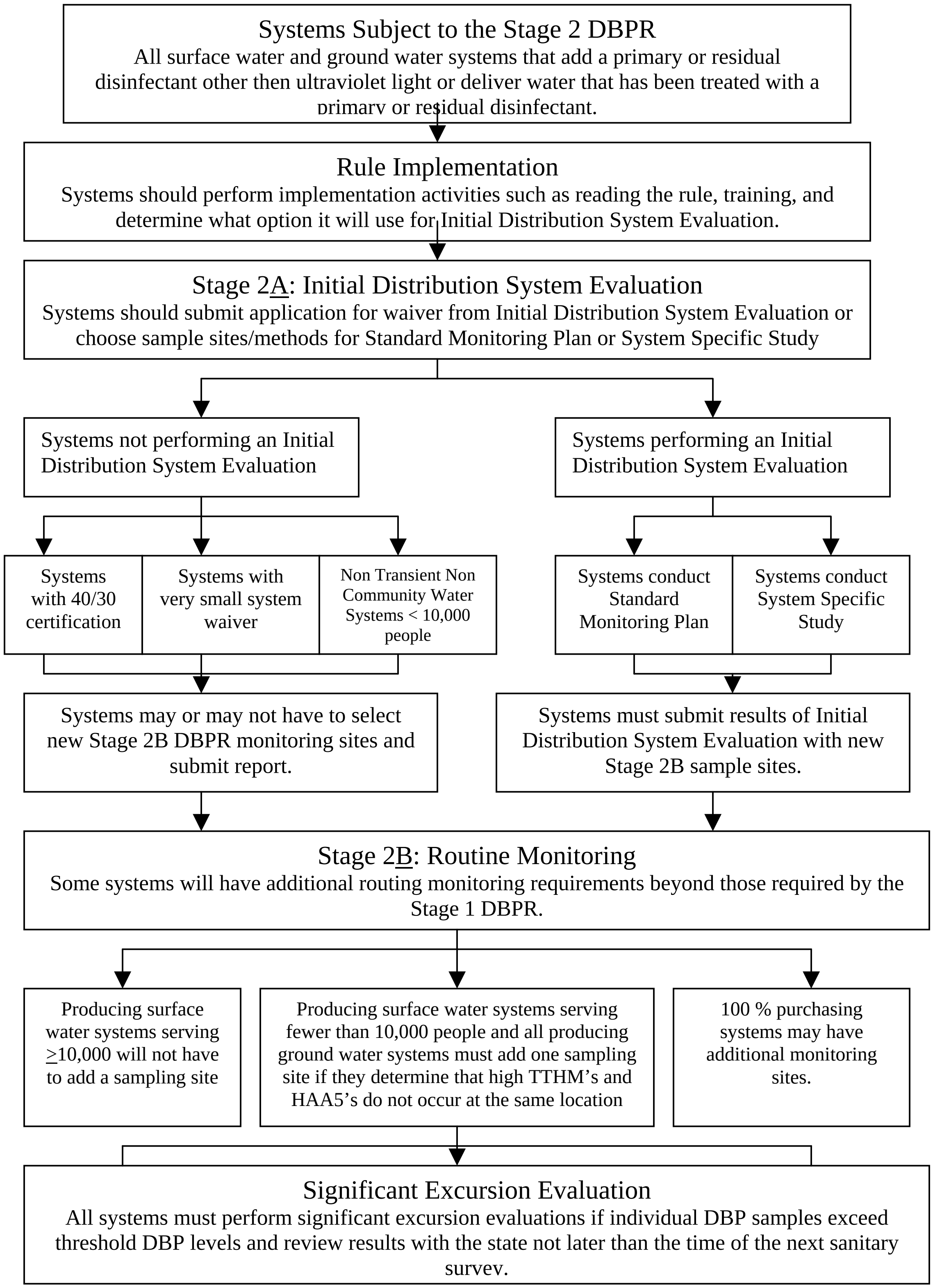
with all individual Total Trihalomethane compliance data less than or equal to 40 parts per billion and all individual Five Haloacetic Acid compliance data less than or equal to 30 parts per billion. This level is half of the new DBP Maximum Contaminant Level of 80/60. Systems that qualify for the 40/30 certification will still be required to submit an Initial Distribution System Evaluation report and pick new DBP monitoring sites that represent high Total Trihalomethane and Five Haloacetic Acid levels in the distribution system.

Second Phase of the Regulation: Stage 2B DBPR

The second part of Stage 2, called the “Stage 2B DBPR,” involves the use of Locational Running Annual Averages as opposed to the “Running Annual Averages” required in previous rules. Presently the Total Trihalomathanes and Five Haloacetic Acids for a water system are reported as running annual averages. For water systems with 10,000 or more customers, Running Annual Average means that quarterly samples collected from four representative locations of the distribution system are averaged (into one value) and this average must be less than the Maximum Contaminant Level (EPA 2001). Locational Running Annual Average means that the system will average the values for each individual sample location and each location must meet the requirements of the Maximum Contaminant Level (EPA 2003c). The Initial Distribution System Evaluation poses an initial large expenditure of resources for all public drinking water systems in the United States while the Locational Running Annual Average means that facilities that previously were in compliance because the average Total Trihalomethanes and Five Haloacetic Acid values among the locations were below the Maximum Contaminant level may be in violation because an individual sample point has high DBP levels.

Figure 3 is a flow chart of the step-by-step path that a water utility would be expected to follow to implement the proposed rule. There are a variety of ‘routes’ along the path depending upon the type and size of the utility.

Figure 3. Flow Chart for Water System Compliance with the Stage 2 DBPR



Economic Analysis for the Stage 2 DBPR

Measuring the costs and benefits of a regulation is an important analytical tool to determine the rationality of a policy. In general, when considering a project, such as the Stage 2 DBPR, when its benefits exceed the costs, the project should be accepted (Gupta, 2001). Although cost benefit analysis has been an important tool for justifying public policies, it has only recently been required for setting drinking water policy. Prior to 1996, "standard setting under the Safe Drinking Water Act could not take into consideration what the quantified health benefits of a regulation might be, or how those benefits compared to the costs (Raucher, 2003, p 226)." Benefit-cost studies have shown that the pre-1996 requirements were diverting scarce resources away from addressing more critical drinking water health risks (Raucher, 2003, p.228).

A cost assessment is not only important for justifying a given regulation, it also provides information from which the implementing agencies can budget and acquire resources to cover the cost of the rule. The EPA has placed estimates concerning the cost of the Stage 2 DBPR in its Economic Analysis.

> The Stage 2 DBPR will result in increased costs to public water systems and States. The annual cost of the rule is expected to be $54.3 to 63.9 million. Public water systems will bear approximately 98 percent (equivalent to $53.1 to 62.8 million) of this total cost, with States incurring the remaining 2 percent ($1.1 to 1.2 million). The average annual household cost is estimated to be $0.51 per year, and over 99 % of households will experience annual costs of less than $12 per year. (EPA, 2003a)

The health benefits of the regulation are estimated at over $47.6 to 976.2 million per year nationwide, which accounts for the cost of 20.9-182.2 bladder cancer cases avoided (EPA 2003a). The range in estimated benefits is due to the use of two different discount rates (3% and 6%), and different estimates of Population Attributable Risk[5]. Beyond the benefit of cancer cases avoided, the EPA has identified additional non-quantified benefits of the regulation that are associated with reproductive risks.

> In particular, the science is not strong enough to quantify risk of reproductive and developmental health effects resulting from DBP exposure. To help inform the assessment of the Stage 2 DBPR benefits, EPA has prepared an illustrative calculation for one specific reproductive effect's endpoint (fetal loss). Results from this analysis show that 1,100 to 4,700 fetal losses could potentially be avoided annually as a result of the Stage 2 DBPR (EPA 2003a, p. ES-8)

Regardless of the cost of non-quantified benefits such as the reproductive effects listed above, the quantified benefit of cancer cases avoided is sufficient to justify the cost of the regulation.

The cost of compliance with the Stage 2 DBPR is expected to be lower in Oregon and the Pacific Northwest than in other areas of the country due to high quality source water that contains fewer DBP precursors such as Total Organic Carbon (Figure 4). Despite this, Oregon drinking water utility representatives are concerned about the high cost of the regulation and the Initial Distribution System Evaluation sampling requirements for Phase I of the regulation.   To establish a basis for comparison with the EPA's economic assessment of the Stage 2 DBPR, I have conducted a data-set analysis and case studies examining the impact and cost of the regulation in the State of Oregon.

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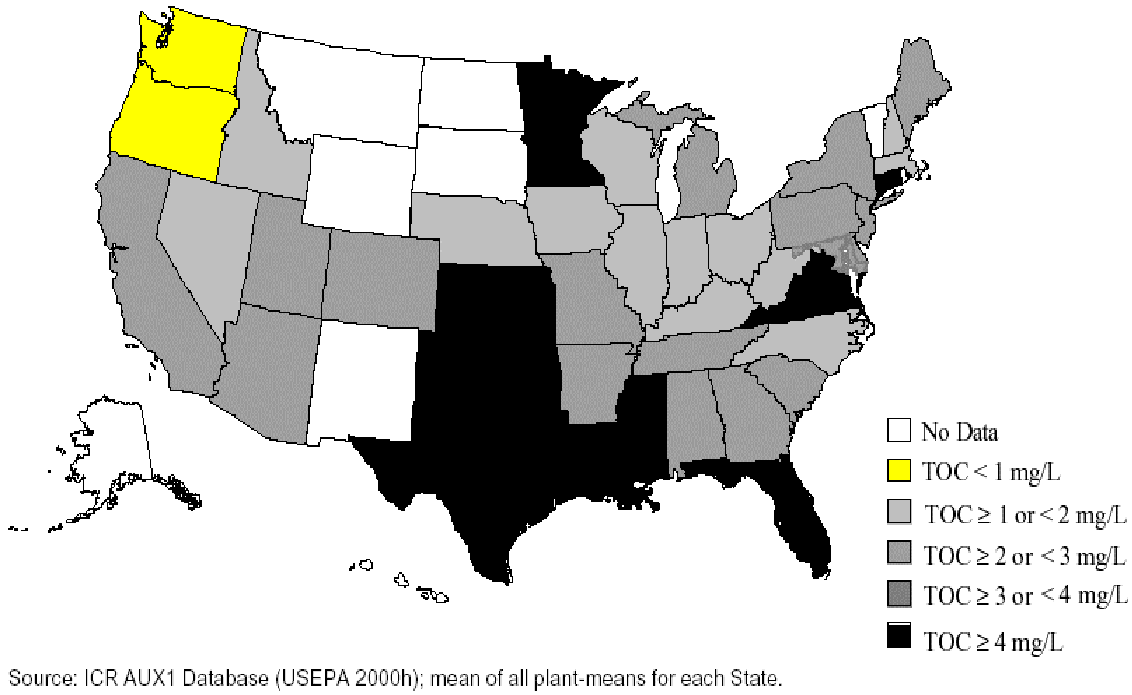
5 "PAR = Population Attributable Risk. A range of "best estimates" of 2 to 17 percent derived from five epidemiological studies. EPA recognizes that the lower bound estimate may be as low as zero since causality has not yet been established between exposure to chlorinated water and bladder cancer (EPA 2003a, p. ES-9)."

Figure 4. Total Organic Carbon Distribution for Surface Water Systems



Reproduced from USEPA 2003a. *Economic Analysis for the Proposed Stage 2 DBPR.* Washington, DC. EPA 815–D–03–001. p. 3-34.

According to the EPA's cost analysis for the regulation, the cost to perform an Initial Distribution System Evaluation for the Eugene Water and Electric Board will be $12,452.8 (2003a Exhibit H.5A). This number includes the cost of labor to determine the sample location, collect the samples, and write up the report in addition to the laboratory costs for sample analysis. Comparison of the EPA's cost estimates for several rule activities and the costs that are actually accrued by the water systems will be analyzed and discussed in the following chapters.

CHAPTER III: STUDY #1: RULE ACTIVITIES IN OREGON

Methodology

To assess the potential economic impact of the Rule in the State of Oregon I conducted a two part study. The first part was an analysis of water quality data for all Oregon public drinking water systems available through the State of Oregon Department of Human Services Drinking Water Program. Using historical water quality data, I assessed several implementation and compliance activities that water systems in Oregon would conduct to meet the requirements of the Stage 2 DBPR. This data analysis replicated the methods used by the EPA to determine impact and cost of the regulation nationwide. This allows for a comparison of the type and cost of regulatory activities in Oregon with the EPA's prediction of nationwide activities.

To develop a comparison of the impact of the Rule in the State of Oregon with its nationwide impact, I focused on information from two tables in the US EPA Economic Analysis. The tables in Appendix A display the number of systems subject to non-treatment related rule activities (Table ES-3), and the number of plants in the nation that would be required to add treatment to meet the rule requirements (Table ES-6). These tables are important because they provide a baseline of all water systems that are subject to rule implementation activities, and therefore the associated costs. The EPA used 4th quarter 2000 data from the Safe Drinking Water Information System, a database containing water quality data reported from each state regulatory agency.

I compiled Table 3 using data from the EPA tables ES-3 and ES-4 (Appendix A). Table 3 displays the estimated number of water systems that would be required to perform rule implementation, Initial Distribution System Evaluations, and the number of plants that would be required to add treatment. I then analyzed 2004 water quality data for Oregon water systems to create Table 4, which displays the number and percentage of Oregon water systems that will be required to perform rule implementation, Initial Distribution Evaluations and add treatment.

To obtain the numbers for Table 4, I used a data query of the Safe Drinking Water Information System for water systems in each category that also used a chemical disinfectant. To obtain data for the Initial Distribution System Evaluation Monitoring column, I queried the data set for water systems that would meet the requirements for waivers from the Initial Distribution System Evaluation. This included water systems that met very small system waivers and/or the 40/30 certification waiver. I subtracted the water systems that met these waivers from the "system baseline" column to get the numbers in the "monitoring" column. Finally, I obtained data for the "Plants Adding Treatment" column by conducting a data query for the systems with 2004 DBP data that would violate the Stage 2 requirements. I did not include plants that violated both Stage 1 and Stage 2 requirements in this column. In its Economic Analysis, the EPA assumed that all plants that violated the Stage 1 DBPR would add treatment sufficient to meet the requirements of both the Stage 1 and Stage 2 Rules. I made this same assumption, and displayed only the plants that violated the Stage 2 DBPR regulations but not the Stage 1 requirements. Finally, I displayed a summary of the National and Oregon data side by side in Table 5, using only the "grand total" percentages for the monitoring and treatment columns.

Table 3: Stage 2 DBPR Activities (National)

System Size (Population Served)	Stage 2 DBPR System Baseline	Number and Percent of Systems Performing Rule Activities					
		Implementation		IDSE Monitoring		Plants Adding Treatment	
Surface Water and Mixed Community Water Systems							
≤ 10000	9,111	9,111	100%	5,954	65.3%	149	3.7%
> 10,000	2,292	2,292	100%	1,932	84.3%	143	5.8%
National Totals	11,403	11,403	100%	7,886	69.2%	293	4.5%
Disinfecting Ground Water Only Community Water Systems							
≤ 10,000	30,683	30,683	100%	1,955	6.4%	1,151	2.7%
> 10,000	1,423	1,423	100%	258	18.1%	145	2.1%
National Totals	32,105	32,105	100%	2,213	6.9%	1,296	2.6%
Surface Water and Mixed Non-Transient Non-Community Water Systems							
≤ 10,000	810	810	100%	0	0.0%	30	3.8%
> 10,000	11	11	100%	10	90.9%	1	5.8%
National Totals	821	821	100%	10	1.2%	31	3.8%
Disinfecting Ground Water Only Non-Transient Non Community Water Systems							
≤ 10,000	7,298	7,298	100%	0	0.0%	204	2.8%
> 10,000	6	6	100%	1	16.7%	0.1	2.1%
National Totals	7,303	7,303	100%	1	0.0%	204	2.8%
All Systems							
≤ 10,000	47,901	47,901	100%	7,909	16.5%	1,535	2.8%
> 10,000	3,731	3,731	100%	2,201	59.0%	289	3.1%
Grand Total All Systems	51,632	51,632	100%	10,110	19.6%	1,824	2.8%

Note: Compiled from Exhibits ES-3 and ES-4 (Appendix A) of the US EPA Economic Analysis of the Proposed Stage 2 DBPR.

Table 4: Stage 2 DBPR Activities for Oregon Water Systems

System Size (Population Served)	Stage 2 DBPR System Baseline	Number and Percent of Systems Performing Rule Activities					
		Implementation		Initial Distribution System Evaluation Monitoring		Plants Adding Treatment	
Surface Water and Mixed Community Water Systems							
≤ 10000	98	98	100%	41	41.8%	7	16.7%
> 10,000	42	42	100%	29	69.0%	1	1.0%
State Totals	140	140	100%	70	50.0%	8	5.7%
Disinfecting Ground Water Only Community Water Systems							
≤ 10,000	108	108	100%	4	3.7%	1	0.9%
> 10,000	5	5	100%	1	20.0%	0	0.0%
State Totals	113	113	100%	5	4.4%	1	0.9%
Surface Water and Mixed Non-Transient Non-Community Water Systems							
≤ 10,000	46	46	100%	0	0.0%	0	0.0%
> 10,000	0	0	100%	0	0.0%	0	0.0%
State Totals	46	46	100%	0	0.0%	0	0.0%
Disinfecting Ground Water Only Non-Transient Non-Community Water Systems							
≤ 10,000	42	42	100%	0	0.0%	1	2.4%
> 10,000	0	0	100%	0	0.0%	0	0.0%
State Totals	42	42	100%	0	0.0%	0	0.0%
All Systems							
≤ 10,000	294	294	100%	45	15.3%	8	2.7%
> 10,000	47	47	100%	30	63.8%	1	2.1%
Grand Total All Systems	341	341	100%	75	22.0%	9	2.6%

Note: Compiled from water system data in the US EPA Safe Drinking Water Information System and Stage 1 DBPR reporting data for Oregon.

Table 5: Comparison of Rule Activities: Oregon and National

System Size (Population Served)	Initial Distribution System Evaluation Monitoring		Plants Adding Treatment	
	National	Oregon	National	Oregon
≤ 10,000	16.5%	15.3%	2.8%	2.7%
> 10,000	59.0%	63.8%	3.1%	2.1%
GRAND TOTAL ALL SYSTEMS	19.6%	22.0%	2.8%	2.6%

Compiled from Tables 3 and 4

Presentation and Analysis of Data

Table 3 displays the distribution and percentages of water systems in the United States that will be required to implement and carry out certain activities for the Stage 2 DBPR. The category with the greatest number of systems implementing the Stage 2 DBPR is the "disinfecting groundwater systems" category. However, note that a greater percentage of surface water systems implementing the rule, 69.2% versus 6.9% of ground water systems, will be required to perform Initial Distribution System Monitoring. This supports the discussion in earlier chapters that surface water systems usually have higher levels of DBP's because there is more organic matter in rivers and lakes than in ground water.

In comparison with the national data, Oregon also shows a high percentage (Table 4 : 50%) of surface water systems that will be required to perform Initial Distribution

System Evaluations. However, as a ratio, fewer surface water systems will perform the evaluation in Oregon than nationally (50% vs. 69%). Overall, the percentage of systems that will conduct Initial Distribution System Evaluations and add treatment as a result of the Stage 2 DBPR are similar (Table 5). Twenty Two percent of Oregon water systems will be required to perform the evaluations, as opposed to 19.8% of water systems nationwide.

Discussion

The similarity between the Oregon and Nationwide data is in contrast to my hypothesis that Oregon water systems would be less impacted by the Stage 2 DBPR than the United States. Reasons for this could be the difference in source data between my own and EPA's analysis. The EPA used data reported by water systems in 2000 as well as data from the 1996 Information Collection Rule. At this time, many water systems throughout the United States had not started to monitor for Haloacetic acids, which was required by the Stage 1 DBPR in 2001 for systems that served greater than 10,000 and 2004 for small systems serving less than 10,000. The Information Collection Rule did include non regulatory Total Trihalomethane and Five Haloacetic Acid levels; however it only included data for large and medium surface water systems and large ground water systems.

I was able to use more recent 2004 data reported by water systems under the Stage 1 DBPR. Using this data, I was able to establish baseline implementation and compliance activities using more comprehensive information, and less projection than the EPA used. This may be the reason that the impact of the rule in Oregon appears unusually high in comparison with the National data. It is possible that if the EPA conducted its baseline analysis using current 2004 data reported under the Stage 1 DBPR, that a higher percentage of water systems would be required to conduct Initial Distribution System Evaluation monitoring and add treatment.

CHAPTER IV: STUDY #2 CASE STUDY OF FOUR OREGON WATER SYSTEMS

Methodology

For the second part of the analysis I conducted case studies of four public water systems in Oregon. Criteria used to choose each case study were water system size, source water type, treatment processes, and historical level of Disinfection Byproducts. All of the water systems in the case study are considered large systems serving greater than 10,000 people. Large systems will absorb the bulk of the cost of the Stage 2 DBPR, and will be required to comply with the regulation two years before the smaller systems. Due to this, I decided to use only large systems as case studies.

I did not include small systems in my study because they will not be required to begin implementation of the rule until three years after it is finalized. Small systems therefore are not as far along in planning for the regulation as larger systems. I discovered that in order to estimate the cost of rule compliance, I would have to develop their compliance plan for the regulation, which was beyond the scope of my thesis. By working with large water systems, I was able to conduct interviews with water quality or regulatory specialists in the organizations to obtain information about their existing plan for compliance.

I chose water systems with a variety of source water types in order to obtain information on the various activities and costs that will be required of systems with different source water. Although each water system is classified as a surface water producing system, they are all unique in their water sources and treatment systems. In addition to the type of source water, the systems have varying numbers of plants.[6] Table 1 and 2 demonstrate how the different source type and number of plants can influence the type of activities and cost of regulatory compliance.

The water systems studied are the Eugene Water and Electric Board, Springfield Utility Board, Portland Water Bureau, and City of Tigard. The study consisted of an analysis of implementation activities based on historical water quality data for the systems, interviews with employees in charge of regulatory compliance at each of the facilities, and cost projections based on the information obtained from the analysis and interviews. Rather than obtaining exact expenditures from each case study, I examined the types of activities that were being conducted and the approximate amount of time invested in these activities. These numbers were then compared with activities and expenditures predicted in the EPA's economic analysis (Tables 6 and 7).

Chapter II p. 18 presents a brief description of population and plant based monitoring for the Initial Distribution System Evaluation. If the EPA decides to use the population based sampling program for all water systems, it will increase the cost for water systems with large populations and few plants (such as EWEB and Portland) but will decrease the cost for waters systems with many sources (or plants) and smaller

[6] A plant is considered a treatment plant -- one or more wells drawing from the same aquifer with a single point of disinfection -- or an entry point where a system receives water from an adjoining system.

populations (such as the City of Tigard). For this reason I have included costs for both population based sampling and plant based sampling in each case study.

Presentation and Analysis of Data

Case Study #1: Eugene Water and Electric Board

The Eugene Water and Electric Board provides water to the city of Eugene Oregon and a few outlying areas. It draws water from a surface source, the McKenzie River, which is cold with low levels of Total Organic Carbon and turbidity most of the year; in other words, with few Disinfection Byproducts precursors. In the summer, however, the water increases in temperature and algae blooms can occur. Leaf matter in the fall and storm runoff in the winter can also increase the TOC for short periods of time. On average, the TOC for the river is around 1000 parts per billion (ppb). Under the Stage 1 DBPR, water systems are required to remove a percentage of their TOC using treatment technologies such as enhanced coagulation only if the average TOC of the source water exceeds 2000 parts per billion.

The treatment process used by EWEB is considered “direct filtration.” This process involves disinfection with chlorine, coagulation and settling of suspended solids, and filtration through beds of anthracite coal and silica sand. The average level of Disinfection Byproducts in EWEB’s water are extremely low, the 2004 running annual averages were 18 parts per billion (ppb) for Total Trihalomethanes and 16 ppb for five Haloacetic Acids; well below the 80/60 part per billion maximum contaminant level. Even the highest individual sample result was less than half of the maximum contaminant level. The utility is able to maintain such low levels of DBP's due to the high source water quality in the McKenzie River, the optimal use of chlorine, and the cycling of the water in the distribution system reservoirs to keep water fresh. The drinking water produced by the Eugene Water and Electric Board should easily meet all the requirements of the Stage 2 DBPR. Despite this, the utility has spent over $50,000 for supplemental monitoring and will invest more to prove that it can meet the requirements of the new Disinfection Byproducts regulations.

As part of the study, I conducted interviews with Mitch Postle, Water Quality Supervisor, and Brad Taylor, Water Planner at the Eugene Water and Electric Board (Appendices A and B). Through the surveys with these employees, I identified the water systems' present and historical DBPs levels, what activities and expenditures they had conducted in preparation for the regulation, how the regulation would impact them, and what they planned to do to meet the requirements of the DBPR2.

Table 6: Possible costs of the Stage 2 DBPR for EWEB.

Implementation and Pre-Implementation Expenditures

Total Organic Carbon Analyzer	$10,000
Training: 60 + hours @ 45.98/hr	= $2,758.8
Meetings: 6 hours @ $45.98/hr	= $275.88 [7]
Additional Reservoir Monitoring (For both Stage 1 and Stage 2 DBPR):	
Monthly sampling at 3 reservoirs: 36 samples x 5 years = 180 samples	
Lab Fees: 180 paired samples @ $275 each	= $ 49,500
Labor[8]: 180 hours @ 45.98/hr	= $ 8,276
	= $ 57,776
Total Reservoir Monitoring Cost:	$ 28,888[9]
TOC Analyzer Cost:	$ 10,000
Training Cost:	$ 2,759
Total Implementation Cost:	**$ 41,647**

[7] I Did not have detailed description of number and length of meetings. This figure represents the minimum meeting cost.

[8] Labor cost is based on one hour per paired sample collection including labeling and packaging bottles, transportation to sample locations, and collection of associated data such as temperature, Cl2, pH and bac-t. $45.98 was based on the billing rate for the employee who would collect the samples at EWEB.

[9] Half of the $57,776 reservoir monitoring cost is attributed to the Stage 2 DBPR costs.

Table 7: Options and Costs of the Initial Distribution System Evaluation for EWEB[10]:

Standard Monitoring Program:

Plant based sampling (see Table 1):		
Lab Fees:	48 paired samples @ $275 each	= $13,200
Labor:	48 hours @ $45.98/hr	= $2,207
Total		= **$15,407**
(or) Population Based Sampling (see Table 2):		
Lab Fees:	144 paired samples @ $275 each	= $39,600
Labor:	144 hours @ $45.98 /hr	= $6,621
Total:		= **$46,221**
(or) System Specific Study:		
Extended Period Simulation Hydraulic Model:		= $0 [11]
One round of Plant Based Sampling (required for System Specific Study)		
Lab Fees: 8 paired samples @ $275 each		= $2,200
Labor: 8 hours @ $45.98/hr		= $368
Total		**= $2,568**

[10] Systems will be subject to either plant based sampling or population based sampling, not both.

[11] Cost of the Hydraulic model is zero because EWEB upgraded the model for reasons not related to Stage 2 DBPR.

Cost of 40/30 Waiver: (EWEB should receive a waiver from Initial Distribution System Evaluation monitoring because of very low levels of DBP's that may meet the requirements for a 40/30 certification.)

Costs of preparing report justifying that the system meets the requirements for the waiver.

40 hours labor @ $57.06/hour (Assistant Supervisor) = **$2,282**

After assessing the costs and various options for Stage 2 compliance the Eugene Water and Electric Board plans on applying for a waiver from the Initial Distribution System Evaluation using the 40/30 certification option. Table 6 represents the most likely costs for implementation and Initial Distribution System Evaluation.

Table 8: Eugene Water and Electric Board Probable Stage 2 DBPR Costs

	Activity	Cost
Accrued Costs	Training	$2,759
	Meetings	$276
	Extra Monitoring/Equipment	$38,888
Future Costs	Application for 40/30 waiver	$2,282
	Total	$44,205

Case Study #2: Portland Water Bureau

As the largest water provider in the State of Oregon, the Portland Water Bureau was an obvious choice for a case study. The Portland Water Bureau serves a population of over 500,000 which includes the City of Portland and 18 wholesale water systems in surrounding areas. Their primary source is the Bull Run, a protected watershed owned by the city. The City also owns wells that are used as supplemental water during periods of high demand and as an emergency backup source. The treatment for the Portland Bull Run water is disinfection with chlorine and chloramines and pH adjustment with caustic soda. The upcoming companion rule to the Stage 2 DBPR, the Long Term 2 ESWTR, will most likely require Portland to add additional treatment to its water such as filtration or UV disinfection and to mitigate the risk of several uncovered finished water reservoirs (USEPA 2003b).

Like EWEB, the Portland Water Bureau has very low levels of Total Trihalomethanes and Haloacetic Acids. However, it will be required to conduct Initial Distribution System Evaluation monitoring due to a couple of Haloacetic Acid samples above 30 parts per billion. Their use of chloramines as a disinfectant is advantageous because it ensures a sustained disinfectant residual in the water throughout the distribution system, but does not form as many byproducts as chlorine. As a result, the Total Trihalomethane and Haloacetic Acid levels in the Portland water are around 20 parts per billion and remain very consistent throughout the entire system (Kassen, 2005).

The case study of the Portland Water Bureau consisted of an interview with Kathy Kassen, Environmental Specialist in the Water Regulatory Compliance department, examination of historical data reported to the Oregon Drinking Water Program, planning documents and supplemental test results provided by Kassen at the Portland Water Bureau.

Pre-Implementation Costs:

The Water Bureau, like many other water systems, has invested a moderate amount of capital into preparation for the Stage 2 DBPR. Pre-Implementation activities conducted by the Portland Water Bureau include employee education, analysis of the regulation and the impact that it will have on the Bureau, and a two year monitoring study to determine what the Portland system samples would look like under the Locational Running Annual Average requirement of the Stage 2 DBPR. The Bureau, with the help of its wholesale customers, conducted extra monitoring at approximately $5100, and held three two-hour planning meetings with five staff this year, as well as three meetings to review the proposed rule when it came out a few years ago. Several employees attended a variety of local trainings related to the regulation. Additional unquantified costs would have been accrued for data analysis, discussions, and repeated planning for the regulation as it has been delayed multiple times.

Expected Initial Distribution System Evaluation Costs:

According to Kassen, the Bureau estimates a cost of $52,800 for laboratory analysis costs for the Standard Monitoring Program option of the IDSE. With the cost of labor for sampling added to this at $45.98/hour for approximately 192 hours of labor the total cost of this option is $ 61,628. Due to the high cost of the Standard Monitoring Plan, the Bureau has decided to use the other Initial Distribution System Evaluation option, the System Specific Study, because they do not feel that the Standard Monitoring Plan will add any new information to what they already know about the DBP's in their system. The options presented by a System Specific Study, such as the use of a detailed, "extended period simulation" hydraulic model, will be useful to Portland for purposes beyond the Stage 2 DBPR. Kassen states that "learning more about the distribution system will be more productive for the utility (2005)." The System Specific Study option could be more expensive than the Standard Monitoring Plan, as exemplified by the hydraulic model upgrade for EWEB. However the benefits external to the Stage 2 DBPR can easily exceed the extra cost (Appendix B, Interview with Brad Taylor, 2005).

After assessing the costs and various options for Stage 2 compliance the Portland Water Bureau plans on conducting a System Specific Study for the Initial Distribution System Evaluation. The Table 7 represents the most likely costs for Portland's implementation and Initial Distribution System Evaluation.

Table 9: Portland Water Bureau Probable Stage 2 DBPR Costs

	Activity	Cost
Accrued Costs	Training	$451
	Meetings	$2,759
	Extra Monitoring	$5,100
Future Costs	IDSE	
	Upgraded Hydraulic Model	$80,000
	1 round of sampling	$2,690
	Total	$91,000

Case Study #3: Springfield Utility Board

The case study for the Springfield Utility Board consisted of an interview with Chuck Davis, Water Quality and Regulatory Specialist for the Springfield Utility Board as well as water quality and cost analysis data from the Springfield Utility Board and the Oregon Drinking Water Program.

The Springfield Utility Board is served by six chlorinated well fields and one “ground water under the influence of surface water” source, and serves a population of about 56,000. Like most ground water systems in the United States, the SUB source water is very low in Total Organic Carbon, and has only small traces of Total Trihalomethanes and Haloacetic Acids in the distribution system averaging below ten ppb for both Trihalomethanes and Haloacetic Acids (Appendix C).

The pre-implementation activities conducted by SUB have included employee training, increased water quality monitoring, and some cost analysis for the regulation. The DBP levels of the water system are so low that they will easily meet the requirements for a 40/30 waiver and are well below the 60/80 Locational Running Annual Average requirement of the regulation. Despite this, the Springfield Utility Board has incurred expenses for education, monitoring and planning to meet the requirements of the regulation. The State Drinking Water Program offered the utility a monitoring reduction for the Stage 1 DBPR which the Springfield Utility Board decided not to use in order to ensure that it would meet the requirements of the waiver for the Stage 2 DBPR Initial Distribution System Evaluation. As a result, the utility monitored at times when it could have had a waiver, so the costs of the monitoring should be added to the cost of the Stage 2 regulation. The options that the Springfield Utility Board had for compliance with the Stage 2 DBPR are listed in table 10.

Table 10: Possible Costs of the Stage 2 DBPR for the Springfield Utility Board

<u>Implementation Costs</u>	
Training: 16hrs @ $45.98/hr	= $736
Extra Sampling Costs:	= $1,000
Extra Sampling (Labor) 52 hours @45.98/hr	= $2,391
Equipment (pH and Conductivity meters)	= $1,000
Total Implementation Costs:	**= $5,127**
<u>Options for the Initial Distribution System Evaluation:</u>	
Plant Based Sampling Costs	
Lab Fees: 96 paired samples @ $275 each	= $26,400
Labor: 96 hours @ $45.98/hr	= $4,414
Total Sampling Cost with Plant Based SMP	= **$30,814**
Population Based Sampling Costs	
Lab Fees: 96 paired samples @ $275 each	= $26,400
Labor: 96 hours @ $45.98/hr	= $4,414
Total Sampling Cost with Plant Based SMP	= **$30,814**

After assessing the costs and various options for Stage 2 compliance the Springfield Utility Board plans on applying for a waiver from the Initial Distribution System Evaluation using the 40/30 certification option. Table 8 represents the most likely costs for implementation and Initial Distribution System Evaluation.

Table 11: Springfield Utility Board Probable Stage 2 DBPR Costs

	Activity	Cost
Accrued Costs	Training	$735.68
	Meetings	$0
	Extra Monitoring/Equipment	$1,000
Future Costs	Application for 40/30 waiver	$2,282
	Total	$4,018

Case Study #4: City of Tigard

The City of Tigard serves nearly 47,000 customers and is an example of a purchasing system. Although it is considered a producing system because it owns one well, the majority of the city's water is purchased from five surrounding water wholesalers. Tigard's DBPs are below the Maximum Contaminant Levels under the Stage 1 DBPR, however are not low enough to qualify for a waiver from the Initial Distribution System Evaluation.

Tigard's implementation activities include employee training, and a cost analysis of the Initial Distribution System Evaluation. Each of the multiple sources from which Tigard purchases water is considered a "plant" and requires its own set of Initial Distribution System Evaluation samples. Due to this, the cost of the initial monitoring for Tigard is very expensive, and expected to be over $60,000. Like Portland, Tigard plans on conducting a System Specific Study, because the resulting Hydraulic Model will be useful for purposes beyond the Stage 2DBPR.

Table 12: Possible Costs of the Stage 2 DBPR for the City of Tigard

Plant Based Sampling Costs	
Lab Fees: 216 samples @ $275 each	=$59,400
Labor: 216 hours @ $45.98/hr	= $9,932
Total Sampling Cost with Plant Based SMP	= **$69,332**
Population Based Sampling Costs	
Lab Fees: 144 paired samples @ $275 each	= $39,600
Labor: 144 hours @ $45.98/hr	= $6,621
Total Sampling Cost with Plant Based SMP	= **$46,221**

After assessing the costs and options for Stage 2 compliance the City of Tigard plans on conducting a System Specific Study for the Initial Distribution System Evaluation Monitoring. Table 13 represents the most likely costs for implementation and Initial Distribution System Evaluation.

Table 13: City of Tigard Probable Stage 2 DBPR Costs

	Activity	Cost
Accrued Costs	Training	$369
	Meetings	$276
	Extra Monitoring	$0
Future Costs	IDSE	
	Upgraded Hydraulic Model	$20,000
	1 round of sampling	$9,900
	Total	$30,544

Summary of Case Studies

From the case studies that I conducted I was able to discern several cost comparisons between the EPA's estimates and the actual water system expenditures. First of all, the EPA's calculations for the costs of laboratory analysis for the DBP samples in the Initial Distribution System Evaluations and the costs that have been calculated by the water systems were similar. The EPA used a number of $220 for each sample pair which was similar to the $275 per pair that was quoted by the water utilities. The actual number may be closer to the EPA estimate because water systems are likely to get discounts for bulk samples that I did not include in my analysis.

Labor costs used by the EPA were less than the labor costs used for the case study utilities. The $45.98 figure that I used in all of my labor calculations was for the wage and benefits of an operator level worker paid 51% of market rate for a large water utility in the region. This was much more than the $28.95/hour used by the EPA.

The hours estimated by the EPA for training on the regulation were less than the time spent in all of the case studies. Table 10 is a representation of the training and reading hours that should be spent on the regulation according to the EPA estimates in Appendix H of the Economic Analysis for the Stage 2 DBPR (2003a). Table 11 is the actual time spent in implementation activities such as training and meetings from the case studies I conducted. According to the EPA "hour estimates for reading the rule and training appropriate personnel [were] estimated based on EPA experience implementing previous regulations. (2003a, Appendix H)." It is possible that the difference in the training activities can be attributed to the complexity of the rule.

Table 14. Cost of Rule Implementation Using the US EPA Projections

System	Size Category (Population)	Read Hours	Train Hours	Cost per Labor Hour	Total Cost
City of Tigard	25,000- 49,999	4	2	28.95	$173.70
Springfield Utility Board	50,000-99,000	4	4	28.95	$231.60
Eugene Water and Electric Board	100,000-499,999	4	4	28.95	$231.60
Portland Water Bureau	500,000-1,499,999	4	4	28.95	$231.60

Table 15. Cost of Rule Activities Using Case Study Data

System	Size Category (Population)	Train Hours	Meeting Hours	Cost per Labor Hour	Total Cost
City of Tigard	25,000- 49,999	6	8	45.98	$643.72
Springfield Utility Board	50,000-99,000	16	0	45.98	$735.68
Eugene Water and Electric Board	100,000-499,999	60	6	45.98	$3,034.68
Portland Water Bureau	500,000-1,499,999	10	60	45.98	$3,218.60

Additional implementation costs such as extra monitoring, equipment purchases and meetings were not included in the EPA's cost benefit analysis. It is possible that they can be categorized as unnecessary expenditures. However the information that the

Eugene Water and Electric Board and the Springfield Utility Board learned through additional monitoring is necessary to aid their justification for waivers from Initial Distribution System Evaluations. The extra monitoring that Portland Water Bureau conducted was part of its decision making process of which option to use for Initial Distribution System Evaluation monitoring.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Because Oregon water systems have lower DBP levels than other states, my expectation was that Oregon systems would be required to perform fewer rule activities to comply with the Stage 2 DBPR. Contrary to my hypothesis, it appears that Oregon water systems will perform the same amount of activities as the rest of the nation (Table 5). Rather than assume that this correlation reflects the actual situation, I believe it points towards inaccurate or incomplete data. I was able to use a more recent, more comprehensive data set from 2004 that Oregon water systems reported in compliance with the Stage 1 DBPR. When the EPA conducted its economic analysis for the rule, it did not have Stage 1 data, and instead relied on a combination of 1998 data from the Information Collection Rule, and made projections for small and medium water systems that did not participate in the Information Collection Rule[12]. Based on the more recent data used in the analysis for the state of Oregon, it is likely that the numbers from the EPA's Cost Benefit Analysis for the Rule are underestimated. A study of the rule

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[12] The Information Collection Rule required surface water systems serving greater than 100,000 customers and ground water systems serving greater than 50,000 customers to monitor for a variety of contaminants including DBP's.

activities using current data reported from the Stage 1 DBPR should be conducted by the EPA to gain a more accurate estimate of the impact of the regulation.

Costs of the regulation such as training, planning meetings and extra water quality monitoring were greater for the water systems in my case studies than the estimates based on the EPA's economic analysis. Some of the extra costs incurred by the water systems are due to extra time for training and meetings as a result of the delayed period for release of the final regulation. In normal situations of rule promulgation, a rule proposal will be released with a 90-day comment period and is soon followed with a final rule. The late release for the proposed Stage 2 DBPR has been followed by multiple comment periods before the final release of the rule. Water systems have continued to train employees and hold meetings about the regulation, resulting in an increased cost of the rule due to the delay.

Recommendations

Implementation of the Stage 2 DBPR has not been a smooth process. There are many factors associated with the rule's complexity that decrease the economic feasibility of the regulation. This includes lack of support from many of the organizations that have the responsibility for ground level implementation. In a poll of state regulatory agencies conducted by the Association of State Drinking Water Administrators 22% of respondents stated that they will not conduct pre-primacy implementation activities. Unfortunately, the first phase of the regulation, which includes the Initial Distribution System Evaluation, will be in effect before the states take primacy, leaving the EPA to directly implement this part of the regulation. Because the drinking water utilities have not worked directly with the EPA staff as they have with the State agencies, the bond of trust is not as strong. There is also speculation that the EPA does not have the staff to perform the extensive ground level work required to implement the rule.

Unfortunately, dealing with Disinfection Byproducts is not as simple a matter as a contaminant such as Arsenic. Arsenic, like DBP's is a carcinogen that was the subject of a recent regulation that lowered the Maximum Contaminant Level. Unlike some groups of DBP's however, Arsenic does not increase in concentration through the distribution system, and there is only one compound to study, as opposed to hundreds of DBP's. Although the Arsenic rule did impose high costs on certain water utilities, the costs and benefits of the rule were more easily quantified. However, the answer to a complicated health issue such as that posed by DBP's is not necessarily a complicated regulation. The EPA might provide a greater net benefit to society if it made more of an effort to simplify the Stage 2 DBPR. Even a comparison of the preliminary pages of each rule produces distinctly different patterns. The Arsenic Rule begins with a brief description of the cost and benefit of the rule and how these numbers were produced, then goes into a description of the steps that water utilities must take in order to comply with the rule. In contrast, the Stage 2 DBPR starts out by explaining briefly what the rule will entail, then goes into a long description of the health effects of DBP's, describes scientific studies in great detail, and provides information on a variety of health effect "data…not suitable for a quantitative risk assessment…due in part to inconsistencies in the findings (EPA, August 18th 2003 p.49557)." This information is not necessary to justify the regulation.

Recommendations that will improve the simplicity of the Stage 2 DBPR have been submitted by influential organizations. The Association of State Drinking Water Agencies advised using population based sampling for all water systems (as opposed to plant based and population based), and removing the requirement to conduct the Initial Distribution System Evaluation while simultaneously complying with Stage 1 DBPR Running Annual Averages and the Stage 2A Locational Running Annual Averages. The Association states that this is too complex and will produce too much data for the EPA to track. Initial Distribution System Evaluation and Stage 1 requirements. The Association of State Drinking Water Agencies also advises delaying the implementation of the regulation until the States have primacy for enforcing it.

The research conducted for this thesis supports my recommendation that the EPA consider the cost savings of simplifying their drinking water regulations. This study was not an effort to minimize the importance of protecting the public from harmful contaminants but to point out weaknesses in a rule that may decrease its benefit to society. The EPA proposed the Stage 2 DBPR before sufficient health research and studies of water system DBP's had been conducted to portray the effect of the rule. There was therefore significant controversy over the regulation, contributing to the delay of its final release. Future water regulations will be improved with a more accurate assessment of the cost of labor, the amount of time required to train employees on complex rule requirements, and the costs that result from an unusually long process of rule promulgation.

APPENDIX A: TABLES ES-3 AND ES-4 FROM THE US EPA'S ECONOMIC ANALYSIS OF THE STAGE 2 DBPR.

Exhibit ES-3 Number of Systems Subject to Non-Treatment Rule Activites

System Size (Population Served)	Stage 2 DBPR System Baseline	Number and Percent of Systems Performing Rule Activities							
		Implementation		IDSE Monitoring		Additional Routine Monitoring		Significant Excursion Evaluations	
Surface Water and Mixed CWSs									
≤ 10000	9,111	9,111	100%	5,954	65%	2,700	30%	120	1%
> 10,000	2,292	2,292	100%	1,932	84%	0	0%	218	10%
State Totals	11,403	11,403	100%	7,886	69%	2,700	24%	338	3%
Disinfecting Ground Water Only CWS's									
≤ 10,000	30,683	30,683	100%	1,955	6%	4,772	16%	0	0%
> 10,000	1,423	1,423	100%	258	18%	569	10%	0	0%
State Totals	32,105	32,105	100%	2,213	7%	5,341	17%	0	0%
Surface Water and Mixed NTNCWS's									
≤ 10,000	810	810	100%	0	0%	6	1%	0	0%
> 10,000	11	11	100%	10	91%	6	55%	0	0%
State Totals	821	821	100%	10	1%	12	1%	0	0%
Disinfecting Ground Water Only NTNCWS's									
≤ 10,000	7,298	7,298	100%	0	0%	8	0%	0	0%
> 10,000	6	6	100%	1	17%	1	17%	0	0%
State Totals	7,303	7,303	100%	1	0%	9	0%	0	0%
ALL SYSTEMS									
≤ 10,000	47,901	47,901	100%	7,909	17%	7,486	16%	120	0%
> 10,000	3,731	3,731	100%	2,201	59%	576	15%	218	6%
GRAND TOTAL ALL SYSTEMS	51,632	51,632	100%	10,110	20%	8,062	16%	338	1%

Note: Detail may not add to totals due to independent rounding. Column D does not include the number of systems performing SSS's. Refer to Appendix H, Exhibits H.4a and H.4b for this estimate.

Sources:

(A) Exhibit 3.3, column K.

(B), (D), (F), (H) Exhibit 6.3.

(p. ES-7)

Exhibit ES.6 Plants Making Treatment Changes

System Size (Population Served)	Stage 2 DBPR Plant Baseline	Number and Percentage of Plants Adding Treatment	
	A	B	C=B/A*100
Primarily Surface Water CWS's			
≤ 10,000	4,089	149	3.70%
> 10,000	2,471	143	5.80%
National Totals	6,560	293	4.50%
Primarily Ground Water CWS's			
≤ 10,000	42,496	1151	2.70%
> 10,000	6,999	145	2.10%
National Totals	49,495	1,296	2.60%
Primarily Surface Water NTNCWSs			
≤ 10,000	802	30	3.80%
< 10,000	11	1	5.80%
National Totals	813	31	3.80%
Primarily Ground Water NTNCWS's			
≤ 10,000	7,298	204	2.80%
< 10,000	6	0.1	2.10%
National Totals	7,303	204	2.80%
All Plants			
≤ 10,000	54,685	1535	2.81%
< 10,000	9,486	289	3.05%
Grand Total All Plants	64,171	1,824	2.84%

Note: Detail may not add to totals due to independent rounding.
Sources:
(A) Exhibit 3.4, column Q.
Number and Percent of Plants Adding
Treatment
(B) Number of plants adding treatment based on technology selection delta forecast for surface
water and ground water systems in section 6.4.

(p. ES-11)

APPENDIX B: INTERVIEW WITH MITCH POSTLE, EUGENE WATER AND ELECTRIC BOARD

April 28th[th], 2005

1. Describe the EWEB water system including:
    a. Source water types

Mckenzie River, low TOC, flashy turbidity events in winter, leaf fall in fall. Very soft water, low buffering capacity, Silica will re-precipitate out in the water, from time to time…clear crystals, water temperature 1 to 70 degrees F.(18C) Summer algae blooms affecting taste and odor(anabeana, blue green algae) Impoundment reservoirs…7 impoundments before the plant.

    b. Treatment

Direct filtration,under 35 MGD is conventional, pre-chlorination with approx 1 – 1.5 mg/L Chlorine. Send to town with .5 mg/L. Alum, Poly Aluminum Chloride, non-ionic polymer for filter aid, Activated Carbon during TO events, Caustic for pH LCR compliance. Mixed media bed filtration, anthracite coal, quartz silica sand, 1MG clearwell, MG clearwell. Contact Basins where we achieve CT and also CT in the Clearwells, and 7 miles of transmission pipe.

    c. Distribution System

800 miles of pipe, 26 reservoirs. Pressure levels(Mike Cook)? Sample stations- 96 throughout …representative of the distribution system. DBP sample stations were chosen based on ICR- average residence tikme and MAX residence time….Reserviors historic data on low level reservoirs…approx 10 years. Sample stations are used for CL2, coliform, lead and copper(pH). Have Cl2 data since 1958…

    d. Consecutive Systems

Willamette Water, River Road Water, Santa Clara Water…for a regulatory point of view…they are EWEB, check for PWS #. They will continue to be their own system until they are annexed…The population for EWEB's compliance data # of service connections include these two systems…

2. What steps have you taken to prepare for the requirements of the Stage 2 DBPR such as:
    a. Planning meetings
    b. Employee training

AWWA webcast on the IDSE: 23 employees, 2 hours. Water Quality Technology Conference: Doug – San Antonio…other trainings for 4-5 years. Training in Short School from Dave Leland. Subsection from John Potts,

    c. Increased monitoring…*3 Reservoirs monitoring.. this is for reasons aside from Stage 2 just to target WQ in the reservoirs,,,justify that we don't have old water that sits around…targeting WQ concerns from consultants. 76*

MG storage..of which 69million is in the three base reservoirs…+skinners 1MG.

d. Other activities

3. Please describe the type of costs that have been incurred from the above activities (employee hours, travel, consulting fees, laboratory costs…)

4. What DBP levels do you see in your system from historical monitoring?

Very low, all samples are below 40/30 level. Most TTHM's are 15-25… HAA5's in the low teens(started monitoring in Stage 1)

5. Is there a concern that, after the IDSE, any LRAA for a site will exceed the MCL?

NO…I don't think it is clear that if we got a "60" one time…if that would be an exceedence…if we had a significant excursion he would collect an additional sample and send it as a split sample. Such as what we did with lead and copper…

6. Do you plan on conducting a Standard Monitoring Program (SMP) or System Specific Study (SSS) for the IDSE? *SMP we would work with Brad to find the 8 monitoring sites in addition to the stage 1…60 days apart…not sure how much time effort it would take to find those sites…Brad may know this…not sure what Ron did with the ICR…used rationalization…Doug says we chose not to do a SSS because of high cost…*

7. (If you are considering an SSS) Will the study use historic data, hydraulic model, water quality model or a combination?

8. Does EWEB currently have a hydraulic model of the system and what type of model is it?

See notes from interview with Brad Taylor

9. Do you plan to hire a consultant to help your system prepare to meet the requirements of Stage 2? *No*

10. Please describe any other Stage 2 related activities that the utility has conducted or other concerns about the regulation that you may have. *Have a concern that there may not even be a regulation…not sure that there will even be an IDSE…rumor has it that 45 other states are saying they will not enforce it…Association of Drinking Water Administrator are saying they are not going to enforce it…With the ICR the EPA was no help with this rule…they hired a consultant to do the work and it did not help much either…would send data in and it would come back with a hard copy and there was sometimes the wrong data. What made the ICR complicated was the complexity of various sources…with ICR EWEB was simple…even handling that data was lots of hours for Kathy and Mitch…EWEB will have the simplest plan for IDSE as well…this was so much*

data, not always entered correctly. What happens when you are purchasing from multiple systems…?(McGuire and Associates to manage the ICR data) ICR…$160,000 lab costs

11. I have added a sheet with the sampling costs that you covered in the IDSE summary with the addition of labor costs for collecting the samples. Can you review and determine if this estimate appears to be in the ballpark?

Potential Costs of IDSE for EWEB

Possible Costs of the SMP study for EWEB:

Costs to determine IDSE sample sites: = $???

Plant based sampling:

Lab Fees:	48 paired samples @ $275 each	= $13,200
Labor:	48 hours @ $45.98/hr[13]	= $2,207
Total		= **$15,407**

(or) Population Based Sampling:

Lab Fees:	144 paired samples @ $275 each	= $39,600
Labor:	144 hours @ $45.98 /hr	= $6,621
Total:		= **$46,221**

Costs of the SSS Study:

Costs of upgraded hydraulic model can be considered to be nothing because EWEB upgraded the model for reasons not related to Stage 2. There will be a cost to upgrade the model with water quality characteristics from historical monitoring. (one round of SMP)

Plant Based Sampling:
$15,407 / 6 = **$2,568**

(or) Population Based Sampling:
$46,221 / 6 = **$7,704**

Cost of 40/30 Waiver[14]:

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[13] Labor cost is based on 1 hour per paired sample collection including labeling and packaging bottles, transportation to sample locations, and collection of associated data such as temperature, Cl2, pH and coliforn. $45.98 was based on billing rate for the employee who would collect the samples at EWEB

[14] EWEB may be waived from the SSS or SMP study because they are eligible for a 40/30 certification.

Costs of preparing report justifying that the system meets the requirements for the waiver.

(??)40 hours labor @ $57.06/hour (Assistant Supervisor) = $2,282

<u>Additional reservoir monitoring:</u>

Monthly sampling at 3 reservoirs: 36 samples x 5 years : 180 samples
180 x $275 = $49,500
Labor: 180 hours @ 45.98/hr = $8276
Total Cost: **$57,776**

APPENDIX C: INTERVIEW WITH BRAD TAYLOR, EWEB WATER ENGINEERING DEPARTMENT:

Concerning the Distribution System Hydraulic Model:

1. What were the primary purposes of upgrading the distribution system model?
    a. *Balancing College and Hawkins Reservoirs,*
    b. *predicting water age*
    c. *Fire flow analysis*
    d. *Future hydraulic surge analysis*
    e. *System optimization*
    f. *Hydraulic evaluations…eg CH and HH*
    g. *Pipe capacities…relative to specific hydrant and fire flow issues…adequate hydraulic capacity….and will it protect yus from a fire event….eg. if you pull the flow what results (cl2 resid… will it have) protect public health and safeey.*
    h. *In addition to water age and wQ issues…*
    i. *Security…where would a terrorist go, where are you vulnerable and what would it look like if a something were introduced in a particular spot….applied for a grant for this work…grant lets us use the model to do things more*
2. What were the costs of the project?
    a. *($50-$80,000 for field work)…includes actual physical calibration of the model. Getting data, etc…*
    b. *Not an investment that was made with the intention of WQ…simply an extra benefit.*
    c. *Software purchase and maintenance… developing and maintenance of hydraulic.*

3. What are the results so far? Is the model accurate (calibrated)?
    a. *Not actually GIS.. we are moving towards this …map system…CAD interface then to hydraulic model…. Later this will be moved into a GIS system. Some of the costs result from not using a GIS system.*
    b. *Non quantified results…able to look 20 years into the future and target major improvement that will need to occur…30" transmission main paralleling the main in Beltline road will need to be installed…but can be deferred until later. You can put a system in way ahead of time and waste the $$… this is hard to quantify in terms of value.*
    c. *Well field…installed and we can model how it will serve the system*
    d. *42" transmission main that was put in ..what size, where it should go…*
    e. *Fire flow evaluation…we can quantify the benefits … we did 100 hydrant tests using hydraulic model and it was $50/test with model where it would have been $2-300 per hydrant for the crews to test it.*

4. Has the 16" Inter-Connector between Chambers and Broadway been installed? If so with what results?
    a. *Installed in late 2004 to balance reservoirs during peak pumping period. It was not intended to balance during winter demands. The hydraulic grade lines of reservoirs have gotten closer, but Santa Clara is also offline so there are other elements here to consider. We are not done balancing base level reservoirs. Because Hawkins is 15 ft higher than CH it is a difficult task to balance them.*
    b. *To improve transmission between CH and the intertie we had planned a 3-5 million dollar project, instead of this we spent $50,000 making the interconnect (btw Chambers and Broadway)…which may have prevented the more expensive option. This decision was made because we were able to model the situation.*

5. What are the immediate benefits of the model? (*see fire hydrant testing question 3e)*

6. Long-term benefits?

    a. *Fire flow…we can model fire flow conditions without the actual stress to the system.*
    b. *As the system changes, you already have a baseline…to model changes and see what it will do to the system from this point forward*
    c. *It is beneficial to address a changing system*
    d. *Evaluate future supply systems…*
    e. *Regulatory compliance issue…with future regulations…how do you get your arms around 800 miles of pipe…you cannot visualize how that acts, you need a computational view of hydraulics to understand this.*
    f. *You can run the system using the hydraulic model…you can blow the system up… and see what happens…eg surge analysis, what will happen with the surges? There are many opportunities for surge in our system…main breaks and other problems that may occur that impacts the longevity of pipe materials. We can see where the surges should occur and make decisions of what pipes to replace first depending on what is getting the most wear.*

7. (EWEB) Did you compare the cost of the SSS and the SMP before moving ahead with your calibrated computerized water distribution model study discussed in the paper? *No…the decision to upgrade the model was not related to water quality…this was an external benefit.*

8. EWEB is likely to meet the requirements for a waiver for the IDSE, would we have expended the resources for this model if we were certain that it was not necessary for compliance with the Stage 2 DBPR IDSE requirements? *Yes…*

9. Would you recommend that other water systems implement this model…and what type of system would benefit the most from it?

    a. *Other systems…for any system greater than 10,000 people models make sense and you can justify it for systems smaller than this. Small systems are very easy to model and there are great benefits…eg Florence and Reedsport experienced benefits due to this from steady state modeling.*
    b. *Taking it to Extended Period Simulation…EPS is not needed for small systems, unless they are evaluating a system improvement that is a huge capital investment…eg 10 mill$ reservoir vs. a smaller reservoir.*

Concerning EWEB's preparation for the Stage2 DBPR- (to the extent that Engineering has contributed)
EWEB's prep for this rule does not come from engineering…Water Quality compliance issues reside in HB… engineering… Brads opinion is that it should be an integrated approach between treatment and distribution … new tools that reside w/engineering could benefit water quality compliance… Health division rules and who is DRC…

Need for more integration and a change in the way we confront…these issues

12. What preparation have you already done (if any) for the Stage 2 DBPR? Eg. Training, planning, budgeting etc. *No…ask Mitch*

13. Do you plan to hire a consultant to help your system prepare and meet the requirements of Stage 2?

14. If you plan to hire a consultant, do you have an idea of the cost of this bid?

    a. *In order to get the model to the next step we will need to invest in it but this does not necessarily relate to compliance for Stage 2…10-20K on future modeling costs…*

15. Do you plan on conducting a System Monitoring Plan (SMP) or a System Specific Study (SSS) for the Initial distribution system evaluation?
    a. *Mitch will understand the issue the most…Engineering has not seen the water quality data…and how the data relates to SSS vs. SMP…regardless of which path we choose, using the technology has a value even without the response to regulation…it has a place to serve the customer to allow us to understand this better than without the Model..*

16. If you plan on conducting an SSS, what assurance do you have that it meets the requirements of the regulation and will be approved by the state?

a. *We are calibrated enough in the base level reservoirs to meet the EPA requirements…we need more work for the upper level system…but are planning on investing in this for other reasons anyway…*

Calibration lends itself to the model as it relates to security, and other aspects of the system with its advantages…the model is a long term investment that applies to WQ, engineering, security and ops.

The model generally shows us where to look for certain characteristics

APPENDIX D: INTERVIEW WITH CHUCK DAVIS, WATER QUALITY SUPERVISOR, SPRINGFIELD UTILITY BOARD

Kari J. Duncan
University of Oregon PPPM Program
85591 Ridgeway Road
Pleasant Hill, OR 97455
(541) 746-4870

April 27th, 2005

Attn. Chuck Davis

Water Quality/Regulation
Springfield Utility Board

Re: Interview conducted on Thursday April 21st, 2005.

Dear Chuck,

Thank you for taking the time to speak with me last Thursday. I enjoyed hearing your insight about drinking water regulation and your implementation of this upcoming regulation. Your input will be very helpful for the completion of my Thesis and will provide a better picture of the type of impact this regulation will have on the public water utilities in Oregon. The following pages contain my notes from the interview. Please contact me if I have misinterpreted any of your statements.

I will provide for your review any further comments and references to this interview or the activities of the Springfield Utility Board before using them in presentations (Section Conference 5/6/05 and Thesis Defense 8/05) or in the final paper to ensure that I do not misrepresent the Springfield Utility Board or your comments in any way.

Please accept my utmost gratitude for taking the time to discuss with me the SUB's implementation activities regarding this rule.

Sincerely,

Kari J. Duncan

Kari Duncan
Enc.

Interview with Chuck Davis, Springfield Utility Board April 21st, 2005

17. Describe your water system and the source water types.

a. *SUB has 7 sources (or 'plants')…which includes the shared Rainbow source and their well field…the combined distribution system triggers Rainbow into the compliance process sooner because they will be grouped into the compliance schedule with the 'large' systems in terms of monitoring….with less time to prepare than if they were an isolated system. (Chuck) has given these comments to Tim Hanley (Director of Rainbow Water District)- and will evaluate and keep him abreast of the issues.*

b. *We have 3 major separate water service zones west, north and east. The 1st zone, the west was acquired in 1965 from Pacific Power and Light and leaked about 65% of the water. It has steel pipe dipped and wrapped in asphalt, which impacts TTHM formation in the system. The 2nd is the north system, which was served by Rainbow in general, and as portions of the area have been annexed into city limits they became SUB customers. This is the area where we (SUB) purchase water from rainbow as well as our own sources, this can be complicated because we jointly manage reservoirs and jointly own the source. The 3rd is the east system, originally constructed by McKenzie Highway water district with the intent that it would become part of the SUB system. This system was built in 50s and was then combined w/Rainbow Water, it has expanded since then and has been a part of SUB since the 1960's.*

c. *All of the 1st level (base level) reservoirs are set up at the same elevation, so the first level pressure zones are the same. There are interties between each of the systems via pressure zones. And there are multiple upper level pressure zones.*

d. *SUB has 33 wells. This includes the wells in the Willamette system that go through the slow sand filtration plant as well as some surface water from the Willamette. All the wells are chlorinated and there are 7 different chlorine application facilities: one for each well field.*

e. *SUB has about 160 miles of water distribution pipeline and a population about 56,000 not including Rainbow Water.*

18. Describe the open system with Rainbow Water…how many days a year do you share water?

a. *The water is shared year-round, although some of the sources are off in the winter and it is conceivable that some sampling would not be happening for the sources that are off.*

b. *If necessary, we (SUB and Rainbow) would do the IDSE as a combined system…whether or not it would save any money is hard to tell, but it would better present the picture of the system to the EPA.*

19. What steps have you taken to prepare for the requirements of Stage 2 DBPR, for example, training, sampling, etc.?

a. *Chuck has been to an initial IDSE training that EPA funded. The instructors were Murray Smith and EES. The training was in San Francisco.*
b. *Chuck has also attended some early Stage 2 DBPR sessions at the water quality technology conference. (2004 or 2005?)*
c. *SUB has increased their system monitoring by taking chlorine, temperature, conductivity and pH readings where they collect their regular bacteria and TTHM / HAA5 samples. This was started to demonstrate where water from the different sources in the system is going. For example, in the winter SUB will cut back on production from wells w/higher turbidities or softer water to provide better corrosion control and better water quality.*
d. *Essentially SUB has 2 major aquifers. A deep aquifer with pH ranging from 7.5 to 7.8, and a shallow aquifer with a pH of around 6.8 and lower conductivity. They try to mix the water to manage corrosion issues. The water tends to form a hard corrosion lining on inside of pipes and SUB has observed no significant corrosion even in lines that have been in use for 50 years. If they were required to introduce corrosion control addition to all their wells due to future regulation it will be expensive with no apparent benefit.*
e. *An estimated budget in 2004 for IDSE sampling was $24,000 (laboratory costs) This was the estimate if the regulation had been implemented at that time.*
f. *Both Rainbow water and SUB have been given permission by the State DWP to reduce their DBP sampling. SUB has decided to refuse the sample reduction due to the pending Stage 2 DBPR. If an investment of $1000 for a couple of years can ensure that the utility will meet the 30/40 certification and be waived from conducting an IDSE, then the cost will be more than made up for in the long run.*
g. *SUB has purchased new meters for the collection of pH and conductivity in the field. Nancy (the employee that collects water quality samples) spends an extra hour in the field each week to collect this information. So the added cost of an extra hour every week for field-tests in addition to the time to enter the data into spreadsheets and to review them.*

20. You mentioned that you may meet the 40-30 certification requirements and be waived from an IDSE, can you elaborate on your sampling program and the results that will allow you to do so?

a. *Have added sample locations, refused the sampling reductions (waivers) offered by the Oregon Drinking Water Program.*

b. *Write the report in advance and review when the rule comes out….request for waiver will be sent in as early as they will accept it so if its denied or more info requested Chuck will have time to do more work… do not want to get caught at the last minute…do not want to make a mistake and get to the end with no waiver…*

c. *If denied the waiver he wants to have time to develop a plan in a logical way so that all the issues can be resolved.*

21. What are the potential reasons that you may not meet the 40-30 waiver?

a. *If not enough samples were taken by either Rainbow or SUB*

b. *If the Health Division (Oregon Drinking Water Program) in giving a monitoring reduction is found to be in error…*

c. *If a sampling protocol or the sample site selection is incorrect or does not meet a requirement of the regulation.*

22. If you do not get a waiver, do you plan on conducting a Standard Monitoring Program (SMP) or System Specific Study (SSS)?

a. *We will conduct an SMP. In evaluation of the rule we looked at the cost of upgrading our hydraulic model to a dynamic water quality model and this was too expensive. We could not project an additional benefit for upgrading the model and to justify such an upgrade you need to show additional benefits to the water system outside of this one regulation.*

23. Do you currently have a standard or dynamic hydraulic (or water quality) model of the distribution system?

a. *Our current model is more than a static model but does not meet the requirements of a water quality model. It has been developed to project the need for transmission mains, pipeline sizing, reservoir locations, and hydraulic characteristics of the system rather than water quality.*

24. **If you did not qualify for a waiver, do you plan to hire a consultant to help your system prepare and meet the requirements of Stage 2?**

a. *No we would do this study ourselves…at this point I (Chuck) know enough to put an SMP together for the system.*

Estimated sampling costs of the SMP for Springfield Utility Board

6 Ground Water Plants (wells on separate aquifers)
1 Surface Water Plant (GWUDI)

(Rainbow Water connected > 60 days per year? = 1 additional GW plant)

Total Plants = 7

Plant Based Sampling Costs *

Surface Water Plant:

8 paired TTHM and HAA5 sample sites x 6 samples = 48 samples

Ground Water Plants:

2 paired TTHM and HAA5 sample sites x 4 samples = 8 samples/plant

8 samples/plant x 6 plants = 48 samples

Total IDSE samples collected: = **96 samples**

Lab Fees:	96 paired samples @ $275 each	= $26,400
Labor:	96 hours @ $45.98/hr	= $4,414

Total Sampling Cost with Plant Based SMP = **$30,814**

*The cost will be the same for SUB if EPA requires population based sampling rather than plant based sampling in its final rule.

APPENDIX E: INTERVIEW WITH KATHY CASSEN, ENVIRONMENTAL SPECIALIST, PORTLAND WATER BUREAU

Kari J. Duncan
University of Oregon PPPM Program
85591 Ridgeway Road
Pleasant Hill, OR 97455
(541) 746-4870

April 27th, 2005

Attn. Kathy Casson

Water Regulatory Compliance
Portland Water Bureau

Re: Interview conducted on Tuesday April 26th, 2005.

Dear Kathy,

Thank you for taking the time to speak with me this Tuesday. Your input will be very helpful for the completion of my Thesis and will provide a better picture of the type of impact this regulation will have on the public water utilities in Oregon. The interview was for the purpose of developing a picture of the implementation activities that public water utilities in Oregon are taking to prepare for the Stage 2 DBPR and the associated costs of these activities. The following pages contain my notes from the interview. Please contact me if I have misinterpreted any of your statements.

I will provide for your review any further comments and references to this interview or the activities of the Portland Water Bureau before using them in presentations (Section Conference 5/6/05 and Thesis Defense 8/05) or in the final paper to ensure that I do not misrepresent the Portland Water Bureau or your comments in any way.

Please accept my utmost gratitude for taking the time to discuss with me the Bureau's implementation activities regarding this rule.

Sincerely,

Kari J. Duncan

Kari Duncan
Enc.

Interview Questions for Kathy Casson, Portland Water Bureau
4 PM April 26th, 2005

Key: ***Italic font is Kathy's written and interview response to the questions.***

25. Describe the Portland water system including:
    a. Source water types: *Groundwater (27 wells on Columbia South Shore and Bull Run (2 surface water reservoirs)*
    b. Treatment: *Primary Disinfection with chlorine, Secondary with chloramines:*

When did you start adding Chloramines and was the decision associated with DBP formation?

We started adding Chloramines in 1953. No one that made this decision is around now to tell us the exact reasons for this…it was probably not related to DBP formation but for the purpose of keeping a disinfectant residual in the distribution system.

    c. Distribution System: *Approx 2000 miles of pipe*
    d. Consecutive Systems: *About 18.*

26. What steps have you taken to prepare for the requirements of the Stage 2 DBPR such as:
    a. Planning meetings: *We've had 3 this year:*

How long were the meetings, how many staff attended, and were they specifically for Stage 2?
A couple hours each and 5 staff attended the meetings: 1 tech, 4 engineer level employees. The purpose of the meetings was to discuss the option of the system specific study (SSS).

    b. Employee training: *(WQTC, other earlier meetings)*
    c. Increased monitoring: *In anticipation of LRAA we did 2 years of monitoring. Wholesale customers with >10,000 coordinated with Portland. We had approximately quarterly meetings with wholesalers where these results were reviewed. The results were graphed and LRAAs calculated. We also found differences in the results from different labs and did some side by side sampling. Large differences were confirmed when same sample analyzed by different labs.*

Describe the results of the 2 year study:
The samples from the two-year study look a lot alike… not a whole lot of variability between the LRAA and the RAA results from Stage 1 monitoring. Based on these results the Bureau believes that if they do the SMP option of the IDSE they will be spending a lot of additional $ on monitoring that will not help to uncover any new information.

Were these samples taken in addition to the Stage 1 samples?
Every two months samples were collected at the Stage 1 sites…and we added HAA5's samples to the tests which were not previously collected. Normally this sampling would have been collected quarterly rather than every two months (ie. Monitoring frequency was doubled). We wanted to look at the LRAA for HAA5's which are larger than TTHM's in the Portland system, and we did not know what results we would be getting. Some of the samples were analyzed by a different lab…(Babkock labs) that was getting 50% higher results than MWH labs, who analyzed the majority of the samples. To compare the results we did a round of side by side samples and same water came back with different results from each lab. The method for DBP's (HAA5's?) allows for 40% difference…ie a laboratory will pass the QA test if they are within +/- 40% of the actual value.

d. Other activities: *We had 3 or 4 meetings reviewing the propose rule.* Number of staff in attendance? *4 staff…Engineers 1.5 hours each meeting.*

27. Please describe the type of costs that have been incurred from the above activities (employee hours, travel, consulting fees, laboratory costs…)

Not a whole lot of travel…down town, between offices…. Not significant. One of the reasons that Kathy went to WQTC was to learn about the upcoming regulations…so maybe 10% of the cost of this trip could be attributed to training for Stage 2.

28. What DBP levels do you see in your system from historical monitoring? *Attach chapter 3 from DBP plan. This reviews historical DBPs as well as factors that show a relationship with DBP concentrations.*

29. Is there a concern that, after the IDSE, any LRAA for a site will exceed the MCL? *No*

30. Do you plan on conducting a Standard Monitoring Program (SMP) or System Specific Study (SSS) for the IDSE? *SSS*

31. (If you are considering an SSS) Will the study use historic data, hydraulic model, water quality model or a combination? *We anticipate a combination Our hydraulic model does not yet do an extended period simulation (EPS), because of problems in areas of very low flow. Improvements are in the works, but we may do a simulation of an eps. We don't have enough historic data to substitute for monitoring, but we will incorporate what we have, which exceeds historic requirements.*

32. Does the Bureau currently have a hydraulic model of the system and what type of model is it? *Yes, Synergee*

33. Do you plan to hire a consultant to help your system prepare to meet the requirements of Stage 2? *Probably not.*

34. Please describe any other Stage 2 related activities that the utility has conducted or other concerns about the regulation that you may have.

There was some activity going on around the same time that we were conducting the 2 years of monitoring for Stage 2: this was around 1999 and 2000…we were talking a lot about the Stage 2 concepts… with LRAA etc… going to trainings… Kathy gave training to wholesale systems about the impact of the rule. It is difficult to quantify or give a detailed account of what we were working on back then, but there was early planning and preparation for the upcoming regulation.

35. I have added a sheet with the sampling costs that you covered in the IDSE summary with the addition of labor costs for collecting the samples (based on estimates from EWEB's cost analysis). Can you review and determine if this estimate is similar to the labor costs for the Bureau? It looks generally OK. It looks like you assign 6 hours staff time per event, which covers sample collection, but it should probably be another hour for report writing, proofing data, graphing interpreting data etc.

There could be other incidental costs to the sample collection such as coordinating sampling, data entry, examining the results to determine how we are stacking up with regard to the rule…

36. Will the costs of compliance with Stage 2 effect water rates at all?
No

37. How accurate do you feel that the following statement by the EPA is?

"With the exception of the IDSE, the Stage 2 DBPR is similar to the Stage 1 DBPR, which States have already implemented; therefore, additional implementation costs for the Stage 2 DBPR will be minimal." (EPA 2003a, Economic Analysis for the Stage 2 DBPR Proposal)

In our case we were submitting 4 samples per quarter…if we were to go to the population based sampling we would be doing a lot more sampling and more data entry…it is similar in time (sampling schedule) to what they are already doing…there could be a lot of requests for technical assistance which would be additional costs…any new Rule will require more technical assistance from the EPA or State however LT2 will have bigger impacts for the Bureau than the Stage 2 DBPR and may affect the water rates.

Other comments…
Chapter 3 of DBP plan that was provided was written several years ago and listed potential options for treatment of the source: filtration, UV, etc. We are not considering any of those things actively until the LT2 is produced.

Estimated sampling costs of the SMP for Portland Water Bureau

What will it cost?

If EPA chooses plant based monitoring:
Per plant 8 samples for THM/HAA5 cost=$275, $2200 per event
Cost per plant, 8 sites, every 2 months =$13,200
LABOR*: 48 HOURS @ $45.98/HR = $2,207

Groundwater Plants only require sampling 8 sites once every 6 months. or $4400 each.
Labor: 16 hours @ $45.98/hr = $736

Total Cost: **= $16,143**

If EPA chooses population based monitoring
For Water Systems with population between 100,000 and 499,999, 24 samples/ 2 months.
For Water Systems with population between 500,000 and 1,499,999 32 samples/2months
With PVRWD, we expect to have a retail population above 500,000.
Cost, 32 sites, every 2 months =$52,800

Labor: 192 hours @ $45.98/hr = $ 8828
Total Cost: **= $ 61,628**

Pre-Implementation Costs for Portland Water Bureau:

4 extra quarterly samples (in addition to Stage 1 samples)
16 samples @ $275 each = $4400
16 hours @ $45.98/hr = $736
Total = $5136

* Labor cost is based on 1 hour per paired sample collection including labeling and packaging bottles, transportation to sample locations, and collection of associated data such as temperature, Cl2, pH and bac-t. $45.98 was based on billing rate for the employee who would collect the samples at EWEB.

APPENDIX F: INTERVIEW WITH SALLY MILLS, CITY OF TIGARD

Kari J. Duncan
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April 27th, 2005

Attn. Sally Mills

Water Quality Specialist
City of Tigard

Dear Sally,

Thank you for agreeing to speak with me this Thursday. The attached interview is for the purpose of developing a picture of the implementation activities that public water utilities in Oregon are taking to prepare for the Stage 2 DBPR and the associated costs of these activities. I will also ask for projected future activities related to rule compliance with the understanding that these may change depending on the requirements of the final rule. The study is for my exit thesis written to fulfill the final requirements for a Masters in Public Administration with the University of Oregon Public Policy and Management Program. The thesis is a Policy Analysis of the Stage 2 DBPR and the impact that the rule is expected to have on Oregon water utilities.

As we have agreed, I will call you at 8AM on Thursday, April 28th to discuss these questions with you. The interviews I have already conducted have taken between 35 and 50 minutes. I will provide for your review all notes, comments and references to this interview before using them in presentations (Section Conference 5/6/05 and Thesis Defense) or in the final paper to ensure that I do not misrepresent the city of Tigard or your comments in any way.

Please accept my utmost gratitude for taking the time to discuss with me the City's implementation activities regarding this rule.

Sincerely,

Kari J. Duncan

Kari Duncan

Interview Questions for Sally Mills, City of Tigard
4 PM April 26th, 2005

38. Describe the City of Tigard water system including:
Med sized system…bedroom community serve 50,000 Durham Tigard, King City, unincorporated area Bull Mountain…don't serve the entire city of Tigard, WA square area is served by TBWD
    a. Source water types

Purchase majority of water…from Portland, Tualitin Valley Water District, joint water commission, Beaverton…all surface water q/ GW to supplement. Also have and ASR well, 1 ground water well use in the summer.

    b. Treatment…

No additional treatment, add Cl2 at their own well.

    c. Distribution System

200 mi pipe, 11 tanks, 6 pressure

    d. Consecutive Systems

Emergency interties…eg tualitin, LO, River grove water district.

39. What steps have you taken to prepare for the requirements of the Stage 2 DBPR such as:

Employee training… offered by EPA, some through AWWA, NW OR subsection.

    a. Planning meetings
    b. Employee training
    c. Increased monitoring

No increased monitoring…already monitor lots…

    d. Other activities

Would like to talk to state about what trends there are…what type of requirements for modeling system…beef it up before stage 2 starts. If we go with SMP it will be very expensive….”Water Whore”…changes who we buy water from every couple of years. SMP…would we have to do it all over again if we gat another source, with SSS we may not have to update the program before we change the source. Meet with the state next month… and with a consultant that has a hydraulic model. We do not know how to approach the model due to the multiple sources… lots of sampling requirements,

40. Please describe the type of costs that have been incurred from the above activities such as employee hours, travel, consulting fees, laboratory costs, etc…

Not a lot of costs…just for Stage 1 requirements…most of trainings are free eg. CH2 free training…4 trainings…not too time consuming…just Sally or Sally and Richard. 4 Trainings over the year, no managers or workers…web-casts, subsection meeting, couple of hours, given by the state.

41. What DBP levels do you see in your system from historical and Stage 1 monitoring?

We are not exceeding any MCL's…TTHM's less than half of the MCL but not consistently under half with the HAA5…no waiver on monitoring.
Maybe in the fall…only using 2 sources or in summer with 5.

42. Is there a concern that, after the IDSE, the LRAA for any site will exceed the MCL?

No- just because the individual numbers are not even close to the MCL…just a couple of spots are a little high but do not approach any MCLs.

   a. *If so, does the city have a plan to deal with this?*

43. Do you plan on conducting a Standard Monitoring Program (SMP) or System Specific Study (SSS) for the IDSE? *Fluctuation with sources…but need to speak with the state…I know each way will be expensive…but if we pay $ we may as well walk out with a tool for the study….*

44. (If you are considering an SSS) Will the study use historic data, hydraulic model, water quality model or a combination? *Combination…*

45. Does the City currently have a hydraulic model of the system and what type of model is it? *Yes…could not find out the name of the type of model…not sure about it…MSA has the model and they do all the water stuff and the engineering.*

46. Do you plan to hire a consultant to help your system prepare to meet the requirements of Stage 2? *YES…not sure what the cost of this bid would be…thinks the model will be the majority of the cost…*

47. Will the costs of complying with this regulation have an impact on your water rates? *Yes and no…water rates are based on budget and the budget will grow…may be a slight impact but we already increase them 3-5% each year…but not significant…this is we don't foresee as making a big impact in the whole scheme of the budget…*

48. Please describe any other Stage 2 related activities that the utility has conducted or other concerns about the regulation that you may have.

Only thing that we have been doing…gone to meetings and running different number according to current info…id all sampling sites from all of sources….sampling bimonthly…$60,000 in TTHM;s and HAA5 sampling for IDSE…already spends $75,000 total on sampling…is there any room for a system like us when we are not using certain sources during certain time of year…will this data be useful…we do this study and then change the water source…eg change to Wilsonville and LO will we have to go through the process again…State does not have a strong stance…will they have it together by the time it comes in…sounds like a quick compliance thing and we want to be prepared…it takes us a long time to get $ approved for anything…we would like the state to come in and say hey these are your two options as we define them…eg…we want to address everything before doing a model…we are hoping that these concerns will be taken care of *with the meeting with the state…source decisions before it is implemented…and would like a product to use before this comes through.*

(e-mail from Sally immediately after the interview)

Hi Kari -

This is what our consultant provided me with:

"

The existing hydraulic model of the City's water system is a Haested Methods - Cybernet/WaterCAD hydraulic model. The model was developed in 1999 and 2000 for the 2000 Water Distribution System Hydraulic Study and includes most of the system except for smaller diameter piping (4-inch diameter and less, and some 6-inch diameter). The model has been periodically updated since this time to reflect current developments, including the construction of the Gaarde PRV and the inclusion of a few subdivisions.

In terms of the "Type" of model, Tigard's hydraulic model was developed for master planning purposes, so it is a static model, meaning that a model run represents a "snapshot", or a single moment in time for the water system. This type of model would serve as the basis for an "extended period simulation" (EPS) model or a water quality model, as a reliable calibrated static model is needed to ensure that the move to these more advanced models results in a tool that is reliable."

Hope this helps...if there is anything else you need, just let me know!

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