Chapter 6 Peer Review and EPA Response for posting in Science Inventory Database Record # 81729

Reviewer	Comment Number	Comment	Response
Harrington	1	Thank you for the opportunity to review the above referenced item. As a former member of the economic analysis team for the Disinfectants and Disinfection Byproducts Rule, I can sympathize with the amount of effort required to do this work. In general, I support what your team has done. Please note that the attached review focuses on things that could be improved, at least from my perspective. If you have any questions, please let me know. I look forward to seeing the final product.	EPA thanks the reviewer for the comment.

Harrington	2	The objective of this document was to provide a review of the cost analysis portion of the draft Ground Water Rule Economic Analysis (GWREA). The review contained herein is an analysis of Chapter 6 and Appendix D in the draft GWREA report. My review was aided by also reviewing Chapter 4 and the reference list of the same report. Specifically, the EPA has asked me "to focus on the following questions for reviewing Chapter 6 and provide specific recommendations for improvement." 1. Discuss the reasonableness of using the occurrence data to inform compliance forecast. 2. Discuss the reasonableness of the uncertainty characterization of the compliance forecast. 3. Comment on whether the data and calculations are sufficiently referenced, displayed, and explained and on the ease in following the calculations. 4. Discuss the clarity, reasonableness, and transparency of the descriptions of approaches, tools, rationales and assumptions. I was also asked to provide any additional comments on the document. Therefore, my review will be organized into 5 sections with the first 4 sections focused on each of the above questions. The last section will provide additional comments.	EPA thanks the reviewer for the comment.
Harrington	3	In reviewing the report, I selected the CWS category serving 3,001 to 10,000 people and attempted to duplicate the cost estimate for this category within a reasonable value. As noted by the sections below, I was unable to do this. The suggestions offered below may help the EPA put together a more transparent cost document.	EPA has considered the reviewer's suggestions and improved the transparency of cost estimates (see the preamble for details).
Harrington	4	In my opinion, it is vitally important to use occurrence data to inform the compliance forecast, provided that the data and the assumptions regarding the use of that data are also reasonable. As noted at various locations within the draft document, there are some uncertainties in the reasonableness of the data. Much of the occurrence data are documented in Chapter 4, so my comments in this section of my review are based on both Chapters 4 and 6. In general, I support the use of the data with the following reservations:	EPA thanks the reviewer for the comment.

Harrington	5	The target of the rule is waterborne viruses. However, there are numerous waterborne viruses and the cost impact of the rule will truly be driven by the target virus. For example, the chlorine disinfection costs are based on the inactivation of the hepatitis A virus. Although this may be the best course of action that can be taken in the cost analysis, it is important to note that there are other waterborne viruses with the potential of being more resistant to chlorine than hepatitis A. A substantial amount of data has been obtained on the inactivation of viruses by ultraviolet irradiation and it appears that the adenoviruses are the most resistant to this technology. We do not know if hepatitis A is the most resistant virus to chlorination. This assumption drives the estimate of how many systems already achieve 4-log inactivation and, therefore, influences the estimate of the national benefit and the estimate of the national cost. In addition, the costs of installing technology for those systems that do not already achieve 4-log inactivation are dictated by the hepatitis A assumption. A thorough review of the literature is needed to justify the selection of hepatitis A as the virus to use in the analysis of chlorination costs. This review should include the CT values required to achieve 4-log inactivation of all viruses studied to date.	SWTR requirements are based on Hepatitis A inactivation. This regulation does not propose to change these requirements. EPA believes there is insufficient data to change the current basis for CT's necessary to achieve 4-log viral inactivation under the SWTR and, therefore, uses these same criteria for level of viral inactivation determinations under the GWR. Although UV is not included in compliance forecasts, states have a flexibility to approve this treatment for compliance with the GWR. See Chapter 6 for the detailed discussion.

Harrington	6	The estimated numbers of systems already achieving 4-log virus inactivation are not at all consistent with my experience, even with hepatitis A as the target virus. For example, I have worked with more than 20 community water systems in the past two years that serve populations of 1,000 to 10,000. Of these systems, only 5 feed chlorine on a permanent basis. Several others are listed by the state as having a chlorine feed system, but these only have the system in place for use when an unsafe bacteriological sample is obtained from the distribution system. These systems have 2 to 4 entry points each, for a total of more than 50 entry points. None of these systems have storage tanks located between the point of disinfectant addition and the distribution system entry point. A significant number (roughly 50 to 60 percent) of these well houses have a bathroom within the pump station, and this bathroom could be considered as the first customer. Almost all of the remainder have the first customer on the adjoining property, within 100 feet of the entry point. When the well is running, the residence times to the adjoining property are generally less than 2 minutes. For those that use the chlorine, a typical chlorine concentration at the entry point varies from 0.2 to 0.5 mg/L. Therefore, the CT values are far short of the 5 to 10 mg•min/L required for 4-log inactivation of hepatitis A at the temperatures typical of ground water systems. The document estimates that more than half of systems in this size category already achieve 4-log inactivation of hepatitis A. Based on my experience, my estimate would be that less than 10 percent actually achieve this. Because of this, I believe the national benefit estimate may be significantly underestimated and that the national cost estimate could be underestimated by a factor of 4 or 5. This is the most critical assumption in the analysis, because it drives the number of systems that need to take corrective action. As pointed out in the document, the costs of the corrective action dominate the total cost of the rule.	The percentage of community water system entry points providing disinfection is based on data compiled as part of the 1995 Community Water System Survey. The percentage of those entry points that achieve 4-log is based on the 1998 AWWA survey of ground water systems. EPA believes that this is the best available data for representing national trends. There is great variability in system design and operation. As a result, the nationally representative data used in the EA may not reflect experience at a smaller, less geographically diverse subset of systems. Also, EPA has re-evaluated the AWWA data and revised downward the percent of systems currently achieving 4-log virus disinfection rates.
Harrington	7	At the flow rates common in systems serving 1,000 to 10,000 people, a storage tank of 2,000 to 20,000 gallons would be needed to achieve the required CT values with chlorine. Typical footprints of 150 to 250 square feet will not allow routine installation of these facilities.	EPA recognizes that some systems may not have sufficient land to install disinfection and has modified the EA to 1) estimate more systems not installing treatment, and 2) additional land cost as unquantified cost.

Harrington	8	It is not clear which flow rate was used to estimate compliance with 4-log inactivation. A typical ground water entry point includes a pump with a fixed speed drive. Many states place restrictions on the number of hours that a well pump can run in a day. Because of this, the pump station capacity (i.e., design flow) will be smaller than the capacity of the pump. Therefore, the appropriate flow rate to use in calculating CT is the flow rate of the pump when it is running. It is not appropriate to use an average day flow rate or a maximum day flow rate to estimate the CT value achieved for these systems.	The required contact times are based on the design flows. EPA realizes that systems may operate at flows lower than this, but this provides a conservative estimate and ensures that adequate disinfection is in place.
Harrington	9	Any publication with Batigelli as an author must be used with caution. As I understand it, he is currently under investigation by the EPA for scientific misconduct, including falsification of data.	The baseline, benefits, and costs analyses use the following two studies in which Battigelli is a second author: Three-State Study: (Maryland-Banks and Battigelli, 2002) Three-State Study: (Minnesota-Banks and Battigelli, 2002)
Harrington	10	For Exhibit 6.4, it would be nice to see an explanation for the trend of rate versus system size. For example, why is the rate so much lower for private systems serving 10,000 to 50,000 people?	The rate differences between systems represent many factors (e.g., the different borrowing sources each type of system has available to it, bond ratings, etc.) depending on system size and ownership. A detailed description of the development of interest rates used is outside the scope of the GWR EA, and is provided in "Development of Cost of Capital Estimates for Public Water Sytems, Final Report" (USEPA, 2000f).
Harrington	11	For analysis of state costs, I would think that state costs would depend on the number of systems that need to be monitored for compliance. For example, I am very skeptical that Wisconsin, with approximately 10,000 public ground water supplies, could annually administer this rule with just 2.5 FTEs (see Exhibit 6.8). Utilities are analyzed with Monte Carlo techniques and it seems that similar strategies could be used to better characterize state costs.	Because time requirements for implementation and annual administration activities vary between State agencies, EPA recognizes that the burden and cost estimates are highly variable and may be an over- or under-estimate for some States. However, the GWR EA uses national averages to estimate burden and costs. EPA believes that the estimates used in the EA are representative of a national average and that the total costs represent a reasonable estimate.

Harrington	12	Comparing Exhibits 6.13 and 6.14, it is clear that EPA thinks states will spend more time reviewing reports than systems will spend in report preparation. I am skeptical of this assumption.	EPA estimates that the source water positive report will require, on average, 2.5 hours for systems to complete and submit. EPA has developed and systems will have access to automated forms that will minimize the burden to systems in complying with this reporting requirement. Based on its experience with similar reporting requirements, EPA estimates that States will require 3.5 hours to review the report. This estimate is greater than the burden estimated for systems to prepare and submit the report because it is anticipated that the State will have less familiarity with any particular system and will be required to look up additional historical information to make any assessments/determinations regarding the report.
Harrington	13	As noted in the document, sanitary surveys may identify the need for corrective actions in the distribution system. The uncertainty associated with this has the potential of being significant. The rule has been under development for about 15 years, so one is tempted to ask why these data have not been collected.	EPA lacks adequate data to quantify the number of significant deficiencies that will be detected and corrected in the distribution system as well as in the treatment processes. Therefore, costs associated with these deficiencies are not included in the cost model. Similarly, the associated benefits are not included in the benefits model. Note, data collection efforts were focused on source water deficiences as opposed to distribution system deficiencies and are limited by a number of constraints, such as budget, and time. The number of PWSs identifying a significant deficiency during a sanitary survey is determined based on survey data from the Association of State Drinking Water Administrators (ASDWA) (1997). Based on responses to the ASDWA survey, it was determined that 17% of systems were not constructed according to applicable State regulations. This percentage is used as an estimate of the number of systems that will find significant deficiencies at or near the source over the 25-year cost model analysis period. Within the cost model, the assignment of significant deficiencies is applied equally in years 4 - 25 of the analysis, resulting in approximately 0.77% of systems (17% / 22 years) being assigned a corrective action in each of those years.

Harrington	14	In the meantime, it would be good for the EPA to list the corrective actions that might be taken in the distribution system (e.g., implementation of cross-connection control programs, repair of storage facilities, etc.) and at least get a unit cost associated with these actions. The EPA could then present a sensitivity analysis showing the possible magnitude of these costs. For example, how much would these corrections cost if 5% of the systems needed them? How much would these corrections cost if 25% of the systems needed them? This would be a much better presentation of the uncertainty than is currently presented in the document.	EPA lacks adequate data to quantify the number of significant deficiencies that will be detected and corrected in the distribution system as well as in the treatment processes. Therefore, costs associated with these deficiencies are not included in the cost model. Similarly, the associated benefits are not included in the benefits model. Note, data collection efforts were focused on source water deficiences as opposed to distribution system deficiencies and are limited by a number of constraints, such as budget, and time.
Harrington	15	Also, is it reasonable to believe that the sanitary surveys required in the Ground Water Rule will uncover deficiencies that Total Coliform Rule sampling will not uncover?	A sanitary survey is "an onsite review of the water source (identifying sources of contamination by using results of source water assessments or other relevant information where available), facilities, equipment, operation, maintenance, and monitoring compliance of a PWS to evaluate the adequacy of the systems, its sources and operations and the distribution of safe drinking water." (40 CFR 65, p. 30220). Sanitary surveys are not required under TCR. Therefore, it is reasonable to assume that the sanitary surveys required under the GWR will uncover deficiencies that TCR sampling will not uncover. However, under the GWR, the State may reduce the frequency of sanitary surveys for CWSs from once every three years to at least once every five years if the water system either treats to 4-log treatment of viruses (using inactivation, removal, or State-approved combination of these technologies) before or at the first customer or if the system has an outstanding performance record (i.e., no significant deficiencies) documented in previous inspections and has no history of total coliform maximum contaminant level (MCL) or monitoring violations under the TCR (as determined by the State).

Harrington	16	As noted in Section 6.3.6.1, there is also uncertainty in the estimates of corrective actions taken at the source to address deficiencies uncovered in the sanitary surveys. As with the above, it would be helpful to see a comparison of the unit costs of the options that were considered with the unit costs of the options that were not considered. For example, the document shows the unit cost of replacing sanitary well seals and the unit cost of rehabilitating an existing well. However, what is the unit cost of drilling a new well? What is the unit cost of installing pump block seals? Listings of these unit costs will build more confidence in the uncertainty characterization, even if they were not used in the cost estimate.	An evaluation of unit costs for various corrective actions (e.g., costs for drilling a new well and for replacing well seals) is provided in Chapter 5 of the GWR Technologies and Costs Document.
Harrington	17	Exhibit 6.30 is very revealing in terms of an uncertainty characterization. The cost of Alternative 3, which is apparently the preferred alternative, is less than 10% of the cost of Alternative 4. Because the majority of costs are those associated with corrective action, this comparison suggests that fewer than 10% of the systems will need to implement strategies that would be required under Alternative 4. As I noted earlier, it is my opinion that EPA has underestimated the number of corrective actions required by a factor of about 5. If my opinion is correct, the national cost could reach 50% of the cost shown for Alternative 4. In other words, an annual cost of $250 million rather than $50 million. This is significantly greater than we are led to believe in Sections 6.6 and 6.7 of the document. I believe the EPA needs to make a better attempt to quantitatively characterize the uncertainties in the national cost estimate.	The sections detailing the non-quantified costs and and the uncertainty analysis have been expanded since the Peer Review draft of the GWR EA. Rule requirements have also been modified since the Peer Review Draft and the main analysis has been re-run, significantly decreasing the costs of Alternatives 1-3. Approximately 49% of the costs associated with Alternative 3 are due to corrective actions from significant deficiencies, and assessment and triggered monitoring. In the present analysis, Alternative 3 costs represent roughly 4% of the costs of Alternative 4. EPA feels that the number of systems performing corrective actions is not under-estimated by a factor of 5, and therefore does not agree with the commentor that the annualized costs of Alternative 3 are understimated by 5-fold.
Harrington	18	In many locations, unit costs are calculated. However, it is often unclear whether the unit cost is based on the entry point as the unit, or on the system as the unit. I suggest that each unit cost be displayed with a clarifying heading in the table.	EPA has added information, as appropriate, that clarifies the level (i.e., entry point or system) at which unit costs are applied.

Harrington	19	Calculations of costs were not easy for me to follow and, as a result, I was unable to duplicate the cost estimates. In my case, I would have been able to follow the calculations much more easily if the assessment included flow charts like those shown in Exhibit A (see next page). I put together Exhibit A in an attempt to make sure that all costs were accounted for in CWSs serving 3,001 to 10,000 people. I do not believe that my flow chart is an accurate representation of the cost analysis, so I would suggest that the EPA revise the chart for accuracy and then create similar charts for each of the system categories. Please note that there are a total of 27 system categories (3 system types - CWS, TNCWS, NTNCWS - and 9 population ranges). Because I could not follow the cost calculations well, I do not feel confident in the cost estimate. I think it would be appropriate to select one of the 27 categories as an example to follow in Chapter 6. The flow charts for the remaining 26 categories could appear in an appendix.	To provide further clarification EPA has included schematics in Chapter 6 of the EA. The schematics provide the percentages and numbers of entry points or systems required to comply with each step of each major GWR rule component for an example size category of CWSs serving 3,300 - 10,000 people.
Harrington	20	Descriptive text should be used to accompany a flow chart like the one shown in Exhibit A. For each question on the flow chart, the percentage of "yes" answers was estimated from a Monte Carlo simulation in some cases and from other procedures in the remaining cases. The text should clearly state what method was used to answer the question and cite references (e.g., databases) as needed.	EPA thanks the reviewer for the suggestion. To provide further clarification, EPA has included schematics in Chapter 6 of the EA and has expanded the corresponding text to provide a more comprehensive description. The schematics provide the percentages and numbers of entry points or systems required to comply with each step of each major GWR rule component for an example size category of CWSs serving 3,300 - 10,000 people.
Harrington	21	A flow chart similar to Exhibit A would also be nice for state costs.	Flowcharts specifically detailing State costs have not been added to the GWR EA; however, to provide further clarification EPA has included a number of schematics in Chapter 6 of the EA. These schematics provide the percentages and numbers of entry points or systems required to comply with each step of each major GWR rule component for an example size category of CWSs serving 3,300 - 10,000 people.

Harrington	22	In Exhibit 6.25, the start-up costs for CWSs serving more than 10,000 need to be explained. I cannot understand why these costs are orders of magnitude different from the other system types.	Start-up costs for CWSs serving > 10,000 people have been re-generated since the Peer Review draft. Start-up costs for large CWSs are now approximately 5 times smaller than start-up costs for small CWSs, and are on the same order of magnitude as start up costs for NCWSs.
Harrington	23	Exhibit A. Flow Chart for Cost Analysis of Community Water Systems Serving a Population of 3,300 to 10,000. [SEE APPENDIX OF THIS COMMENT RESPONSE DOCUMENT FOR THIS EXHIBIT]	To provide further clarification EPA has included schematics in Chapter 6 of the EA. The schematics provide the percentages and numbers of entry points or systems required to comply with each step of each major GWR rule component for an example size category of CWSs serving 3,300 - 10,000 people.
Harrington	24	Clarity, reasonableness, and transparency would all be significantly improved by the incorporation of flow charts like those shown in Exhibit A.	To provide further clarification EPA has included schematics in Chapter 6 of the EA. The schematics provide the percentages and numbers of entry points or systems required to comply with each step of each major GWR rule component for an example size category of CWSs serving 3,300 - 10,000 people.
Harrington	25	Page 6-1, Lines 26 and 27. This information is not really ideal in my opinion. The ideal information would be a complete characterization of the drinking water industry so that we would not need to run these simulations. This information is a reasonable substitute for the real information.	Data is not available that would allow a complete characterization of the drinking water industry. In all cases, the most robust data set(s) available has been used to inform the cost model. To more accurately reflect reality, the sentence "This information is ideal for examining impacts to PWS and technology affordability." has been changed to read - "This information forms the basis for examining impacts to PWSs and technology affordability."
Harrington	26	Page 6-5, Lines 5 and 6. Nanofiltration is not an alternative disinfectant. It is an alternative treatment technology.	The text has been re-worded to correct this oversight.

Harrington	27	Exhibit 6.11a. The cost of HSAs per entry point increases with increasing population served. This is counterintuitive and should be better explained. I can understand the cost of HSAs per system increasing with increasing population served.	HSAs are no longer required under the final GWR, thus costs are not included in the main analysis. For costing of the rule alternative that does include HSAs (Alternative 3), the entry point unit costs are derived based on system-level CWS estimates. Larger systems are expected to cover a larger geographic area and possibly draw from multiple aquifers, requiring more time to perform an HSA. The entry point unit costs are simply a calculation based on the number of entry points per CWS, which varies from 1.3 - 12.4, generally increasing with system size. Labor hours for CWS entry points are used for NCWSs in the absence of NCWS-specific estimates.
Harrington	28	Exhibit 6.13. This exhibit was not mentioned in the text. Is the unit cost based on entry points or only on entry points that test positive? As noted earlier, the definition of unit cost seems to change frequently in the report and it would help to clarify these.	Exhibit 6.13 - PWS Unit Costs for Trigerred Monitoring has been redone since the Peer Review Draft to clarify the units of the unit costs. It is now Exhibit 6.19 and is referred to in the text.
Harrington	29	Page 6-26, Lines 30 through 34. This was not a confidence builder for me.	Comment is based on an internal EPA note, not on text of the EA. No further explanation needed.
Harrington	30	Page 6-35, Lines 35 and 36. In my experience, systems serving fewer than 10,000 people rarely participate in AWWA functions. I am skeptical that AWWA survey data would accurately characterize these systems.	The 1998 AWWA survey is a joint effort from AWWA and EPA. The survey was designed with two different sets of questionnaires for large and small systems, respectively, and provides the best available data to EPA.
Harrington	31	Exhibit 6.19a. More figures like this are needed. However, this figure should be augmented with percentages falling into each box (see my Exhibit A as an example).	Exhibit 6.19a of the Peer Review Draft (which is now Exhibit 6.27a) has been augmented with percentages. Additionally, to provide further clarification EPA has included a number of schematics in Chapter 6 of the EA. The schematics provide the percentages and numbers of entry points or systems required to comply with each step of each major GWR rule component for an example size category of CWSs serving 3,300 - 10,000 people.
Harrington	32	Page 6-49, Lines 1 through 4. These references to Appendix D are not correct.	The references to Appendix D have been corrected as follows: Appendix D contains results from each step above for the final GWR. Exhibits D.1 through D.5 show the nominal costs projected over the rule schedule and the present value of each cost calculated to the expected year of rule implementation for the preferred regulatory alternative. Exhibits D.6 through D.8 show the results for Alternatives 1, 3, and 4.

Jacangelo	1	Per the instructions of the intent for this effort, the comments herein represent a review of Chapter 6. Cost Analysis. Chapter 4 was employed for background use. The reviewer acknowledges the high quality work product provided by the authors in this document. Chapter 6 is well written and reflects the authors' knowledge in the subject area. For the most part, each section is adequately referenced. I have noted where more referencing would enhance the document under Specific Comments. The exhibits are clear and well laid out. In particular Exhibits 4-16 and 6-19 are particularly useful in understanding the concepts being developed in their particular discussions. The data and calculations used in the document are also sufficiently referenced; I have noted a few exception under Specific Comments. The calculations can be followed without a lot of undue burden to the reader.	EPA thanks the reviewer for the comment.
Jacangelo	2	Some of the calculations and derivations under parameter estimation methods in Chapter 4 require some focused attention to readily understand them; as such, they may not be widely read by other than those with statistical backgrounds.	EPA thanks the reviewer for the comment and the transparency of calculations has been improved.

Jacangelo	3	To develop a compliance forecast, virus occurrence data were employed from various studies. Data from 23 studies of pathogen and fecal organisms in groundwater were reviewed. As with any program such as this one, only a subset of these (14) were employed. The use of the occurrence data as such is reasonable given the complexities of conducting viral prevalence studies. Each on its own has certain aspects or deficiencies that may not make it entirely useful to the GDR. These deficiencies are well documented in Chapter 4. However, as a group of studies, a reasonable amount of data is presented and employed. The uncertainties of the compliance forecast are well described and documented. The authors have done a very good job in stipulating precisely where the uncertainties lie.	EPA thanks the reviewer for the comment.
Jacangelo	4	However, in selected instances, some of the uncertainties could benefit from potential revision. I have listed specific examples under Specific Comments.	EPA thanks the reviewer for the comment and has considered these examples for the final EA.
Jacangelo	5	I have three salient issues with Chapter 6. The first is associated with the amount of labor allocated for particular tasks such as reporting or conduct of other rule-associated efforts. In almost all cases, the allocation of time appears low. This will ultimately bias household costs and national costs towards the low side. It is important to note that many tasks, especially for large systems, involve not just one person, but several since multiple reviews can be required before an official document is sent out. This is particularly true of the larger systems. Each instance of the low number of allocated hours is pointed out under Specific Comments.	Labor estimates used in the EA are based on consultations with water systems and EPA's best professional judgment. Since the Peer Review draft, some labor estimates have been updated based on more input from various sources, including peer reviewer's comments.

Jacangelo	6	The second issue deals with the use of the nanofiltration as a disinfection technology. As I point out below, this technology can be employed for disinfection on systems that already have the technology installed. However, for new systems investigating physical disinfection options, ultrafiltration would be the technology of choice. The latter is more effective in many ways than nanofiltration for virus removal and is certainly less costly in terms of capital and operation and maintenance. Using nanofiltration will bias the costs high. More discussion on this issue is provide under Specific Comments.	Ultrafiltration is not one of the technologies considered for correcting treatment corrective actions. As discussed in the GWR Technologies and Costs document, NF membranes have pore sizes that are much smaller than those of MF or UF, and typically remove particles between 5-10nm (USEPA 1993a). As shown in Step 4 of Exhibit 6.27b (Exhibit 6.19b from the Peer Review draft) less than one percent of systems from any single size category is predicted to choose nanofiltration as their treatment corrective action.
Jacangelo	7	The third general issue deals with potential confusion of systems under this rule and those that may be declared under the direct influence of surface water. While the monitoring rationale is well described in this document, many health departments would look at total or fecal positive coliforms in wells to trigger a GWUDI investigation. This issue is described in more detail under Specific Comments. Some discussion for clarification is warranted in this document.	EPA agrees that GWUDI determinations may be made for some aquifers as a result of analyses performed under the GWR. However, the number and impact of these determinations are highly uncertain. Further discussion of this issue has been include in the uncertainty section of Chapter 6 in the final EA.
Jacangelo	8	A total of 1.0 hour is allocated for an in-house laboratory to collect a sample and conduct an E. coli analysis. The time stated appears low. To collect a sample may take as much as 2 to 2.5 hours plus analysis time, considering travel, proper sample collection and a return to the laboratory (even if multiple samples are taken).	The estimated burden required to collect samples includes travel time and reflects a national average. Individual systems may realize collection burden that is either less than or greater than this average depending on the locations of wells at a particular system.
Jacangelo	9	The commercial analysis fee appears to be high, so verification from a couple of laboratories is warranted. As above, to collect a sample and prepare it properly for shipping may take as much as 1.0 to 1.5 hours to prepare including shipping (even if multiple samples are taken).	For commercial laboratory analysis, EPA's estimate of the cost per sample includes a shipping and commercial analysis fee ($74.80) and 0.5 hours of the system operator's time to collect the sample and arrange for delivery to the laboratory. The estimated burden required to collect samples includes travel time and reflects a national average.

Jacangelo	10	Even though the authors state that the number of systems that may be able take advantage of the savings is not available, a crude estimate may still be warranted given the impact that these savings will have on costing.	Rates may vary due to regional variations in laboratory fees, the number of samples processed (quantity discounts), and laboratory capacity. Although laboratory costs are often lower for multiple samples, there are no estimates of the number of systems that may be able to take advantage of this savings. Therefore, the rates used in this analysis are conservative and may overestimate the actual costs incurred by systems.
Jacangelo	11	Given the comments above, the source water monitoring costs per sample for in-house laboratories appear too low.	Refer to responses to comments above.
Jacangelo	12	The discussion here states that nanofiltration is considered as a potential technology to be employed. It is understood that nanofiltration is mentioned because many plants would be using this technology for softening or DBP precursor removal. However, low pressures membrane technologies, such as microfiltration or ultrafiltration should also be mentioned. Further, nanofiltration is not an "alternative disinfectant" as stated in line 6. Rather it should be termed "a physical disinfection process."	Text has been re-worded to correct this oversight and NF is no longer referred to as an alternative disinfectant. As discussed in the GWR Technologies and Costs document, NF membranes have pore sizes that are much smaller than those of MF or UF, and typically remove particles between 5-10nm (USEPA 1993a). The NF membrane pore size makes it an candidate for virus removal, as viruses range in size from 20nm to 900nm. As discussed in the LT2/Stage 2 T/C document - MF and UF are primarily used for particle and microbial removal, either following granular media filtration or as a replacement for media filters. MF pore sizes are generally too large for virus removal and many States require a minimum 0.5 log chemical inactivation as part of a multiple barrier approach to disinfection. MF pore sizes are generally too large for virus removal and many States require a minimum 0.5 log chemical inactivation as part of a multiple barrier approach to disinfection. Many States have adopted disinfection log removal credits for MF and UF processes. Virus removal credits are typically 0.5 log or less due to the smaller size of viruses relative to MF/UF pores. Based on studies reviewed (including those by the commenter) by EPA in developing the Stage 2/LT2 T/C document, the maximum virus removal reported for MF membranes was approximately 3 log, but the average reported removal was nearer to 1 log. UF membranes typically removed viruses to detection limits.

Jacangelo	13	It is unclear to the reviewer why a 5 year lag time is necessary. The authors may want to clarify the rationale to a greater degree.	For the purposes of this analysis, PWS and State implementation costs are tracked over a 25-year period. A time lag of 5 years for rule implementation and initial compliance with rule requirements (i.e., treatment technology installation after rule promulgation) is consistent with the assumptions used in the Stage 2 DBPR. The remaining 20 year period is to account for the 20-year useful life of most of the capital equipment included in the analysis. Additionally, PWSs also often finance their capital improvements over a 20-year period.
Jacangelo	14	The text states that 90 percent confidence bounds were placed around the mean of the national cost estimates. The rationale for using 90 percent should be stated or referenced. If there is no particular rationale, then it should be stated as such.	Confidence bounds are related to sample size. In the case of GWR benefits and costs, the sample size had been 250, as there were 250 "uncertainty loops." When the sample is this size, 95 percent limits would only exclude 6 in each tail. If the sampling (of 250) were repeated, the 95 percent limits could be quite different. With 90 percent intervals, the limits are a bit more stable.
Jacangelo	15	It is stated that 3 hours will be necessary for implementation activities of sanitary surveys and HSAs and another 2 for implementation of monitoring requirements. These values appear to be very low. Given travel, site inspection and all the other activities associated with sanitary surveys, substantially more time would be required. If a very abbreviated survey is to be conducted, then the particular elements of such a survey should be articulated or a least referenced.	Based on consultations with PWSs, planning and mobilization hours/system have been increased for CWSs since the Peer Review draft. The basis for the HSA time estimate is described in Appendix K of the final EA.
Jacangelo	16	The authors may want to add some wording saying that staff attrition may impact the numbers of hours required for continued activities.	EPA thanks the commentor for the response. The text has been revised in the final EA.
Jacangelo	17	In addition to costs associated with time to review plans and specifications, etc., time should also be added for site visits which may be necessary to assure proper reporting and implementation.	EPA does not believe that there will any travel costs specifically associated with annual administration. The sanitary survey State cost estimate has revised to include costs associated with 1.8 hours of burden for travel (see Exhibits 6.12 a&b for more information).
Jacangelo	18	Also there is no consideration of "other direct costs," , i.e., those costs in addition to just time.	EPA needs additional information from the commentor on "other direct costs" mentioned in order to provide a response.
Jacangelo	19	The hours associated with reading and understanding the rules and for planning and mobilization appear extremely low. They may be 5 to 10 times the number of hours shown in the exhibit.	Planning and mobilization costs for CWSs have been increased from one hour to two hours for systems serving less than 10K, and from one hour to three hours for systems serving more than 10K.

Jacangelo	20	Staff training appears to be low. An FTE greater than 0.25 will probably be required. Also, it would be useful to the reader to have the FTE column totaled.	Because time requirements for implementation and annual administration activities vary between State agencies, EPA recognizes that the burden and cost estimates presented in Exhibits 6.7a and 6.7b may be an over- or under-estimate for some States.
Jacangelo	21	Same comments as above. Further, there are no "other direct costs" listed, such as for travel or other.	EPA needs additional information from the commentor on "other direct costs" mentioned in order to provide a response.
Jacangelo	22	The authors should explain from where the 50 percent discount is derived. This should be referenced or the rationale should be clearly provided to the reader.	The sanitary survey methodology and discussion has changed significantly since the Peer Review draft. The 50% discount rate is no longer used; substantial detail and exhibits have been added to this section to proide clarity.
Jacangelo	23	Under the column for systems 100,000 or greater, the values provided are 293 for community water systems. For nontransient, noncommunity water systems and for transient, noncommunity water systems, the value is 290. Given all the uncertainties, is this difference real? The same value should be used. Otherwise, the reader is led to believe that there is more certainty than there really is.	The sanitary survey methodology and discussion has changed significantly since the Peer Review draft. Based on conulations with PWSs, the labor hours for sanitary surveys have been updated. Substantial detail and exhibits have been added to this section to proide clarity. Please refer to Exhibits 6.11a&b for labor hour estimates used.
Jacangelo	24	There are no hours that appear to be associated with travel, which may be substantial in many cases.	The travel time has been included in the final EA.
Jacangelo	25	Further, it should be stated in some part of the text that more hours may be required, depending on the familiarity or lack thereof with particular systems.	The sanitary survey methodology and discussion has changed significantly since the Peer Review draft. Based on conulations with PWSs, the labor hours for sanitary surveys have been updated. Substantial detail and exhibits have been added to this section to proide clarity. Please refer to Exhibits 6.11a&b for labor hour estimates used. EPA presents the estimates based on national means, which may under- or over-estimate efforts from some states.
Jacangelo	26	The assumption that states will not have significant requests for information to complete an HAS may not be valid. Rather, the reviewer thinks that requests may be more the rule and less the exception, and thus there may be impacts on costs.	HSAs are no longer required under the final GWR, thus costs are not included in the main analysis. For costing of the rule alternative that does include HSAs (Alternative 3), EPA expects that HSAs will be performed by hydrogeologists with an existing familiarity with the regional hydrogeology and relatively easy access to records that will aid in making assessments, minimizing the time required to make sensitivity determinations.

Jacangelo	27	The estimate of 2 hours per well for the CWS burden per HAS is probably low.	HSAs are no longer required under the final GWR, thus costs are not included in the main analysis. For costing of the rule alternative that does include HSAs (Alternative 3), EPA estimated the time for States to locate existing hydrogeologic data, such as well construction records, and for a State assessor to inspect and review these data. The CWS burden per HSA is developed using an estimate of 2 hours per well. The 2 hour per well estimate is a national average. Some systems may require additional resources to perform HSA (e.g., systems with wells distributed across a large distance and different aquifer types) while others may require less resources (e.g., systems with relatively compact well fields and drawing water from uniform aquifers). Further, it is expected that HSAs will be performed by hydrogeologists with an existing familiarity with the regional hydrogeology and relatively easy access to records that will aid in making assessments, minimizing the time required to make sensitivity determinations.
Jacangelo	28	The cost of $70 per assessment for systems serving less than 1000 people appears to be very low. The authors may want to reconsider this estimate.	Please refer to responses to previous comment on this topic.
Jacangelo	29	This discussion here centers on triggering source water monitoring. Triggered monitoring follows detection of total coliform bacteria in one or more samples collected for compliance with the Total Coliform Rule. There appears to be a larger issue. If total coliforms, much less fecal indicators are detected, many states will question whether the source is a groundwater at all; rather it may be a groundwater under the influence of surface water. In many cases, macroscopic particulate analyses are required. Thus, this discussion should be modified to include that this is indeed a possibility and some systems may be subject to the original Surface Water Treatment Rule if they are under the direct influence of surface water.	EPA agrees that GWUDI determinations may be made for some aquifers as a result of analyses performed under the GWR. However, the number and impact of these determinations are highly uncertain. Further discussion of this issue has been include in the uncertainty section of Chapter 6 in the final EA.
Jacangelo	30	The assumptions regarding source water monitoring, including timing, percent positive and number of samples appear reasonable.	EPA thanks the reviewer for the comment.

Jacangelo	31	The estimate of 2.5 hours to prepare and submit the report to the state appears low. The authors may want to rereview this estimate.	EPA has developed and systems will have access to automated forms that will minimize the burden to systems in complying with this reporting requirement.
Jacangelo	32	Same comment as above. The estimate of 2.5 hours to prepare and submit the report to the state appears low. Remember, such a report would need to have review by several system staff, not just the person who prepares the report.	EPA has developed and systems will have access to automated forms that will minimize the burden to systems in complying with this reporting requirement.
Jacangelo	33	Per comments above, column A, report prep time for reporting and time for waiver applications appear low. The authors should review the assumptions or past experience here.	EPA has developed and systems will have access to automated forms that will minimize the burden to systems in complying with this reporting requirement.
Jacangelo	34	The corrective actions used in the cost model are limited, but given the following discussion in the text, they are appropriate.	EPA thanks the reviewer for the comment.
Jacangelo	35	Corrective actions should include fencing off or providing other limited access to infrastructure in order to protect wells from intrusion of people or animals.	The text in this section has been modified to include the following sentence "However, based on discussions with experts, EPA believes that a majority of corrective actions (e.g., fencing off or providing other limited access to infrastructure to protect wells) may actually be less expensive than the two used in the cost model."
Jacangelo	36	The distributions provided in this exhibit are considered by the author to be appropriate given the lack of other supporting information.	EPA thanks the reviewer for the comment.
Jacangelo	37	The distribution of corrective actions are based on best professional judgement. While using professional judgement when no data or other information is available or adequate is industry practice, the source of this professional judgement should be articulated here or in another part of the text.	As noted in Step 4 of Exhibit 6.27b (Exhibit 6.19b from Peer Review draft), EPA assumes that entry points will choose treatment in proportion to current treatment practices. Estimates for hypochlorination and chlorine gas based on the remainder of entry points not performing other treatment practices. Thus, EPA's best professional judgment is based on existing data pertaining to national treatment trends.

Jacangelo	38	The discussion of corrective action again raises the question in the reviewers mind of whether the first step in the whole process is to determine if the source is indeed a groundwater. As noted above, the authors should add a paragraph in Section 6 on this important issue.	Chapter 1 of the GWR EA clearly describes which systems must comply with the GWR - "The GWR applies to all community and noncommunity public water systems that serve ground water as a water source. The GWR does not apply to ground water determined by the State to be under the influence of surface water, nor does the rule apply to public water systems that combine all of their ground water with surface water prior to treatment. These systems are already regulated under surface water treatment rules." Based on this understanding, EPA feels that the discussion in Section 6.3.6.2 of the Peer Review document (now Section 6.4.62) provides a clear discussion.
Jacangelo	39	The stated durations for interim disinfection appear appropriate in the reviewer's opinion.	EPA thanks the reviewer for the comment.
Jacangelo	40	Nanofiltration is the not the proper removal technology to employ for corrective action. As noted earlier in the comments, it would be appropriate if the well already had this treatment installed. However, as a corrective action it is inappropriate since: It is a higher cost, both in capital and operation and maintenance than ultrafiltration.	As discussed in the GWR T/C document, NF membranes have pore sizes that are much smaller than those of MF or UF, and typically remove particles between 5-10nm (USEPA 1993a). The NF membrane pore size makes it an candidate for virus removal, as viruses range in size from 20nm to 900nm. As noted in Step 4 of Exhibit 6.27b (Exhibit 6.19b from Peer Review draft), EPA assumes that entry points will choose treatment in proportion to current treatment practices.
Jacangelo	41	Nanofiltration will alter the balance of the salt content (ionic strength of the target water), removing about 90+ percent of the divalent cations and as much as 50 percent of the total dissolved solids. Thus, post-treatment would need to be installed in order to stabilize the water and make it non-corrosive as well as to make it compatible for blending with any other waters in the distribution system. Post-treatment will add more costs to the overall cost burden.	As noted in Step 4 of Exhibit 6.27b (Exhibit 6.19b from Peer Review draft), EPA assumes that entry points will choose treatment in proportion to current treatment practices. Based on this data, the percentage of systems expected to choose NF as their treatment technology is very low and any additional costs will have a negligible impact on the national cost estimates presented in the EA. It is assumed that systems will not choosing NF as a treatment technology unless it has existing conditions that make NF a cost-effective treatment alternative.

Jacangelo	42	The authors suggests that ultrafiltration replace nanofiltration as the technology of choice for physical removal (sieving) of viruses. Ultrafiltration will not remove any of the dissolved solids and will be less costly in terms of capital and operation and maintenance. Further, there is evidence that ultrafiltration can be more effective as a virus removal barrier, given that nanofiltration is more subject to leaks in seals and glue lines, and can be subject to more membrane imperfections.	As discussed in the GWR T/C document, NF membranes have pore sizes that are much smaller than those of MF or UF, and typically remove particles between 5-10nm (USEPA 1993a). The NF membrane pore size makes it an candidate for virus removal, as viruses range in size from 20nm to 900nm. As discussed in the LT2/Stage 2 T/C document - MF and UF are primarily used for particle and microbial removal, either following granular media filtration or as a replacement for media filters. MF pore sizes are generally too large for virus removal and many States require a minimum 0.5 log chemical inactivation as part of a multiple barrier approach to disinfection. Many States have adopted disinfection log removal credits for MF and UF processes. Virus removal credits are typically 0.5 log or less due to the smaller size of viruses relative to MF/UF pores. Based on studies reviewed (including those by the commenter) by EPA in developing the Stage 2/LT2 T/C document, the maximum virus removal reported for MF membranes was approximately 3 log, but the average reported removal was nearer to 1 log. UF membranes typically removed viruses to detection limits.
Jacangelo	43	The five step compliance forecast appears appropriate in the author's view.	EPA thanks the reviewer for the comment.
Jacangelo	44	The exhibit here is very clear and well laid out.	EPA thanks the reviewer for the comment.
Jacangelo	45	It is unclear to the reviewer why rehabilitating an existing well or drilling a new well would result in the same cost regardless of system size. Presumably larger systems would have larger average size wells which would require greater cost to undertake such a corrective action.	The costs for drilling a well are highly variable. Well costs are largely dependent on factors that are independent of system size, primarily related to hydrogeologic conditions (i.e., aquifer depth and overlying geologic formations). In addition, larger systems may have many smaller wells as opposed to a few very large wells. Given these factors, EPA believes that a single well cost is not unreasonable to reflect a national average.
Jacangelo	46	The costs for nanofiltration are high for a corrective action. As noted in comments above, the technology of choice should be ultrafiltration. This membrane technology, as compared to nanofiltration, would result in lower capital and operation and maintenance costs.	Please refer to responses to previous comments on this topic.

Jacangelo	47	The text states that no additional costs will be incurred by the system to monitor for disinfection if nanofiltration is installed prior to implementation of the GWR. The author knows of no nanofiltration plant in the country that was installed for disinfection purposes. Rather, most if not all such plants were installed for softening, reduction of disinfection by-product precursor material, or reduction of TDS. Further, most plants assess process efficacy by monitoring conductivity and turbidity. Neither of the parameters is sufficient to measure disinfection performance. There is no current online methodology for monitoring the removal of viruses by nanofiltration. Periodic monitoring may include checking for glue line and seal integrity; such measures are very costly and time consuming. This issue should be addressed in this document.	The text in the Peer Review draft on pg. 6-41 lines 19-22 reads "For systems using nanofiltration technology, the monitoring capability is built into the technology's core process. Therefore, EPA assumes that systems using nanofiltration technology prior to implementaiton of the GWR will incure no treatment monitoring costs to comply with the Rule by using nanofiltration." The reference to monitoring built into the technology's core process in this sentence is for monitoring of 4-log virus removal via physical removal (which is related the the results of the integrity testing of the membrane, prior to purchase), and is not referring to monitoring of disinfenction. Moreover, EPA understands that nanofiltration membranes do not provide any residual disinfection to control microbial growth in the distribution system or inactivate contaminants introduced to the water supply after filtration and assumes that these systems would use a disinfection technology in conjunction with nanofiltration to provide disinfection.
Jacangelo	48	The time (0.5 hours) required to prepare for and to report notification to the state is very low.	EPA has developed and systems will have access to automated forms that will minimize the burden to systems in complying with these reporting requirements.
Jacangelo	49	Please refer to my comment above for systems employing nanofiltration for compliance monitoring.	Please refer to responses to previous comments on this topic.
Jacangelo	50	The notification preparation time of 0.5 hours and the report preparation time of 2.5 hours are very low and probably should be 2 to 4 times the numbers shown.	EPA has developed and systems will have access to automated forms that will minimize the burden to systems in complying with these reporting requirements.
Jacangelo	51	The costs for the chlorine test kits appear low for today's costs. Also, the labor costs are low.	Unit costs for chlorine test kits are obtained from "Products for Analysis" 1998, Hach Co. Model 2231-02. These costs have been updated to 2003$ for this analysis. EPA has developed and States will have access to automated forms that will minimize the burden to systems in complying with this reporting requirement. The text in the EA has been clarified to indicate that compliance monitoring costs only apply to newly disinfecting systems.

Jacangelo	52	Larger systems would not only employ strip chart recorders, but rather would want to incorporate any monitoring into a SCADA system. The capital and operation and maintenance costs should be incorporated into this analysis. Also, the compliance monitoring hours do appear to be adequate for the larger systems.	Systems may choose to install monitoring systems that are more complicated and costly (i.e., SCADA systems) than those presented here However, this level of monitoring is not required under the rule and therefore is not included as part of the cost analysis.
Jacangelo	53	Once again, the labor hours here appear to be very low.	EPA has developed and States will have access to automated forms that will minimize the burden to systems in complying with this reporting requirement.
Jacangelo	54	I assume all the dollars in this exhibit and throughout this analysis will be updated to 2006 dollars.	Costs in the final EA remain in 2003 dollars. The interpretive analyses in the EA rely on comparative measures of costs versus benefits that are not heavily influenced by the dollar year as long as both are using the same year (both are in 2003$). Use of 2003$ has the further benefit of allowing easy comparisons between other recent drinking water regulations (i.e., LT2ESWTR and Stage 2 DBPR) that use the same 2003$ price level.
Jacangelo	55	The costs provided here given all the uncertainties are really at a "reconnaissance level" of estimation. For a typical treatment plant design effort with this level of uncertainty, the capital costs minimum and maximum values would be set at +50 to -30 percent, not the +30 to -30 percent that is currently stated.	These percentages were developed by EPA based on input from engineering professionals and reflect recommendations from the National Drinking Water Advisory Council (NDWAC) (2001) in their review of the national cost estimation methodology for the Arsenic Rule. EPA believes that the uncertainties in capital and O&M costs for a given treatment technology are independent of one another and that uncertainties across all technologies are independent.
Jacangelo	56	The costs presented in this table appear to be inherently low. Some of this may be due to the low labor hours about which have been commented on above. Further, it should be noted that large systems will employ an engineering consulting firm to design and a contractor to install systems or make changes to existing systems. These costs do not appear to have been taken into account.	EPA estimates that, as a whole, households subject to the GWR face minimal increases in their annual costs. Approximately 66 percent of the households potentially subject to the rule are customers of systems serving at least 10,000 people; these systems experience the lowest increases in costs due to significant economies of scale. Households served by small systems that undertake corrective actions will face the greatest increases in annual costs. Only CWSs are included in this analysis because they are the only systems that serve households directly.
Jacangelo	57	The authors may wish to reevaluate the costs provided in these exhibits given the discussion in the above comments.	EPA thanks the reviewer for the comment.