Public Comment	Author's Response
General Comments	
General Comment:was this screening assessment done using the 2004 cso report to congress or with more current data? what about CSS with no LTCP? was their data included?	All CSSs within a region were considered in this study, i.e. associated with the nearest VEMAP grid location and used to weight results of the precipitation analysis carried out using data from that location, regardless of the status of LTCPs.
Storm water runoff is the most significant source pollutant loads to surface water during wet weather. To the extent that the screening assessment could or will be used to require larger expenditures for CSO control infrastructure, this is not the best focus. We believe that focus should be on the control of storm water runoff which will be the most efficient way to mitigate wet weather impacts on surface waters.	We appreciate this comment and will consider it when planning future assessments.
These results are based on model predictions that are highly variable with very broad reaching general inputs; decision makers would find it very difficult to make very costly capital investments to day based on these future predictions.	Agree: This study is a screening-level assessment of the potential order of magnitude of climate change impacts on combined sewer overflow mitigation efforts in the New England and Great Lakes Regions. The intent was to assess whether the potential implications of climate change on CSOs in these regions warrant further consideration and study, and to assess the need for decision support tools and information that allow water managers to better incorporate consideration of climate change into their decision making process. As such, this study is only a first step towards understanding a complex issue, the implications of which will vary significantly for specific locations and systems. Results are thus not intended to guide decisions about capital investments for individual systems. Additional study is required to develop the site specific information necessary to guide decision making about investment. We have added text throughout the document (Exec Summary, Introduction, Methods, and Conclusion) to properly caveat results and be more clear about the intent and limitations of this work. We also include a discussion of study limitations in Section 4.3, and suggestions for future work to better address the issue of climate change and CSOs.
The screening evaluation does not specify how or which GLR communities are most or least affected by the modeled precipitation changes which would be helpful to know.	Agree: The general intent was to assess whether the potential implications of climate change on CSOs in these regions warrant further consideration and study, and to assess the need for decision support tools and information that allow water managers to better incorporate consideration of climate change into their decision making process. As such, this study is only a first step towards understanding a complex issue, the implications of which will vary significantly for specific locations and systems. We agree site specific information would be helpful, and will consider this in planning future studies.

While there are some obvious steps utilities can take now to anticipate potential impacts of climate change, more research is needed to improve our understanding of climate change processes and adaptation options. For example, projected impacts of climate change on stream flow include changes in both the total amount and the timing of flows. However, it should be noted that stream flow is affected by a wide variety of factors such as rainfall intensity and frequency, air temperature, and land uses in the watershed. At the same time, a shift towards more intense storms could also decrease infiltration and groundwater recharge, resulting in more frequent and/ or severe low flow periods between rainfall events.	Agree: This study is a screening-level assessment of the potential order of magnitude of climate change impacts on combined sewer overflow mitigation efforts in the New England and Great Lakes Regions. The general intent was to assess whether the potential implications of climate change on CSOs in these regions warrant further consideration and study, and to assess the need for decision support tools and information that allow water managers to better incorporate consideration of climate change into their decision making process. As such, this study is only a first step towards understanding a complex issue, the implications of which will vary significantly for specific locations and systems. Many additional factors, as suggested here, need to be considered to develop a better understanding of this issu. The above text has been added throughout the document.T
Many issues particularly relevant to drinking water treatment deserve specific research attention and increased research funding. For example, more intense storms could produce much wider variations in turbidity which is a major challenge to drinking water treatment plants. From a regulatory perspective under the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), this could translate into a change in the treatment required ("the bin") if the average concentration of *Cryptosporidium* changes in the second round of required monitoring for *Cryptosporidium* starting in 2015. Similar changes could impact Total Organic Carbon (TOC) concentrations that are a significant factor in compliance with Disinfection By-Product (DBP) regulations. Increased sediment loads could challenge treatment plants in meeting the new, more stringent turbidity regulations. The impacts to reservoirs are unknown, and there is a general trend in reservoirs towards eutrophication, which can increase algal blooms that increase TOC concentrations and/or produce algal toxins. In general, decreased water quality due to higher runoff rates or other related factors could challenge water treatment plants in meeting the regulations. ORD's screening assessments of climate change implications for combined sewer overflow (CSO) control systems and publicly-owned treatment works (POTWs) omits these secondary impacts that could result at downstream drinking water treatment facilities attempting to comply with Safe Drinking Water Act (SDWA) regulations to protect public health.	Agree: We recognize that this study is just a first step towards understanding a complex issue, the implications of which will vary significantly for specific locations and systems. We appreciate these very thoughtful suggestions and will consider them when planning future studies.
Section 2.2 of the methodology section of the report (pages 8-10) could be expanded to provide more explanation of the methods used to derive the benchmark storm events from VEMAP. From the current methodology discussion in Section 2.2, it is not clear whether the procedure employed to graft historical precipitation patterns onto future precipitation events takes account of changes in underlying trends that are already apparent in the historical record of the last century. This point is discussed later under limitations and future research on pages 22 and 23, but could have been clarified earlier. The last sentence in the paragraph on benchmarking on page 22 correctly states that the net effect of this omission from the methodology is to understate the potential impact of climate change on the CSO program.	Agree: The presentation of methods in Section 2.2 has been substantially revised to be more detailed and clear.

There are references throughout the report to the fact that the VEMAP GCM runs are rather old. This observation should be explained more fully. This point is reiterated in discussions of limitations, future research and conclusions (pages 21-26), but it could use more explanation to clarify what particular weaknesses stem from this fact and how the results might be improved with newer modeling. It seems that a decision was made that the VEMAP runs were sufficient for a screening level assessment intended to gauge the overall order of magnitude of impacts. It is not clear how modeling improvements, either already in hand or pending, will markedly diminish the uncertainties in downscaling to regional and/or daily levels and hence produce a better screening assessment. It is especially questionable whether such improvement would eliminate the deviation in results between models as asserted in the third bullet under conclusions on page 25.	Agree: The presentation of methods in Section 2.2 has been substantially revised to be more detailed and clear. Additional detail on the VEMAP data has been provided. Additional studies using new climate change projections from newer AOGCMs is suggested as an area for future study.
Section 3.1 discusses double-digit percentage increases in the number of overflow events – an order of magnitude that is significant for EPA's CSO Control Program. The disparity in results from the Canadian model does not detract from this finding. Modeling methods in this arena are attempting a Herculean task and are far from being perfected. But, as a group, GCMs have some directional value and, in this instance, the order of magnitude of the precipitation trends being projected into the future has already been confirmed in the recent hydrologic record. As stated in the fourth bullet under Future Research (page 24), Groisman evaluated historical precipitation data for the US and determined that there were statistically significant trends indicating an increase in the intensity of the heavy precipitation events. Specifically, a 4.6 percent increase in event intensity per decade for the largest 5 percent of precipitation events; a 7.2 percent increase in event intensity per decade for the largest 1 percent of precipitation events; and a 14.1 percent increase in event intensity per decade for the largest 0.1 percent of precipitation events. If CSO storage facilities have been designed on the basis of historic hydrologic record, some of the effects of climate change have already been factored into these designs. However, if the changes that have been occurring over the last century were not recognized as a trend in such design work, then the finding of this screening assessment is correct and the occurrence of overflows will not be abated to the levels that were targeted.	Agree: This is a good point. This simple analysis assumes as the historical benchmark that mitigation is designed with no recognition of historical trend, and thus that there is no recognition of future climate change. Other assumptions about the historical benchmark could have been made. For simplicity, in this study we assumed no adjustment was made for observed historical trends. The point about trends is now mentioned in the text in the Section 3.3.1 on Limtations.

Results discussed in Section 3.2 indicate an average 10 percent increase in precipitation event intensity between the top four historical events per year and the top four projected events per year for the GLR. Results for the NER are once again mixed between the two different models. The discussion on page 15 asserts that if a proportional relationship is assumed between the increase in event intensity and CSO storage capacity, then this result implies a 10 percent increase in the cost of CSO control. This raises several issues. First a 10 percent threshold is an arbitrary suggestion of a screening assessment threshold made in the report that has no real foundation. Secondly, the construction of storage facilities in crowded urban areas for CSO control is affected by diminishing returns in the same manner as most pollution control expenditures. The four-overflow events per year target has, in fact been surpassed in many Long Term Control Plans, indicating that wastewater utilities are climbing the exponential part of the cost curve. To go past that point with the addition of more storage capacity is likely to push things even farther up the cost curve. It would not take a 10 percent impact to be material and a 10 percent increase in storage could cost an enormous amount. Moreover, the assumed linear relation between precipitation intensity and storage capacity may understate the impact. Lang and Balmforth (2005), used GCM and downscaling tools from the Hadley Centre to develop case studies of CSOs in the United Kingdom and found that the amount of additional storage volume required to return a CSO facility to it's designed performance level is on the order of ten times as much as required to return the facility to the design frequency of overflows. The cost analysis presented on pages 19 and 20 assumes linear relations between precipitation, runoff volumes and storage costs that are contrary to both the UK findings about runoff volumes and the law of diminishing returns with respect to control costs. The footnote on the same page acknowledges the contrary opinion of the UK research, but the analysis leaves it out.	Agree: This analysis assumes runoff production ranges from 0.5 to 2.0 times the change in precipitation, and that the required change in CSS storage is approximately equal to the change in runoff, which are conservative compared to the larger proportional storage needs found by Wilkinson and Bamforth for the U.K. We have added additional references to the U.K. study in the Section 1 and elsewhere in the report.
Replication of the methodology with more recent GCM and downscaling tools is suggested at a number of points in the report; however, it is likely that the limits of the screening assessment cannot be stretched too far even with improved inputs. Case studies might be a better next step. Such work as has been performed in the UK might be able to delve deeper into the anatomy of the predicament that faces wastewater utilities with combined sewer systems – pinned between staggering uncertainty on one side and a staggering cost curve on the other. The scale of the CSO control costs could also be made plainer as an issue at the case study level. The scale of capital expenditure involved is such that the opportunity cost cannot help but get noticed. More high level screening analysis is probably less important	Agree: We agree case studies are an important next step for addressing this issue at specific systems. Case studies are suggested for future study in Section 3.3.2.

This assessment was based on the “presumptive approach” of using four CSO events per year as a benchmark (although the state permitting authority may allow an additional two overflow events per year). There are two major concerns with using this as a benchmark. 1. How is a CSO event defined? Different communities across the Great Lakes and the U.S. define overflows in different ways—ranging from rolling all discharges from the entire system from “hydrologically connected” storm events into a single overflow event to counting each discharge “per outfall per day” as a separate overflow event. 2. How does the benchmark of four events, even when standardized across the definition of a CSO event, compare to the number of actual CSO events per year? How many municipalities are currently reporting their CSOs to EPA?	Agree: These are good points, but counts of the actual number of CSOs at differnet systems are beyond the scope of this region-wide screening analysis. The benchmarking approach used here simply assumes mitigation is designed to limit CSOs to 4 per year, however CSO defined, and looks at potential future changes assuming the same definition of CSO events applies in the future. There are, of course, factors related to the definition of CSO event that affect system sensitivity to changes in precipitation, but here we do not consider these factors in detail. Future study is required to address this issue.
The study fails to take into consideration projections for increased development, and therefore increased stormwater volumes, occurring across the Great Lakes region. If development and the associated increase in impervious surfaces occurs at the same or increased pace as it does now, the effects of climate change will have an even larger than predicted impact on communities and their receiving waterbodies. In addition, crumbling infrastructure and increased inflow and infiltration will also continue to cause significant problems with wastewater treatment capacity in combined sewer systems.	Agree: We agree many other factors affect CSO events. This study was intended to focus just on precipitation changes, assuming landuse constant. Text has been added to the Conclusions section, however, stating that climate change impacts should be considered holistically along with other factors affecting impacts and appropriate responses to climate change.
Portions of this analysis provide contradictory results. Depending on the global circulation model used, the report indicates that in the New England region there would either be more CSOs than projected using current precipitation patterns or, alternatively, fewer CSOs. These ambiguous results underscore the uncertainly associated with making predictions regarding global climate change at this time. While later sections of the report include a discussion of the limitations of the study, very little of this information is included in the *Executive Summary*, which leads to a false sense of greater certainty in the potential impact of global warming.In fact, the Executive Summary states “the results suggest that CSS [combined sewer system] planners are faced with an important decision on whether to invest additional money now to build in an additional margin of safety” to address climate change, implying that there is enough information now to determine that such a choice is necessary, but makes no mention of the numerous limitations listed later in the report. NACWA recommends that the Executive Summary be revised to accurately characterize the limitations of the study and the research gaps also identified that need to be addressed. Language from Section 3.3 regarding the variability of the climate change projections used and how that variability “has important implications for how results should be interpreted” should also be included in the Executive Summary.	Agree: The Executive Summary has been extensively re-written and now includes mention of study limitations including AOGCM uncertainty.

Paragraph starting with line 39. This document does not address the fact that phased long-term control plans (LTCPs) are entirely appropriate under the CSO Policy and that EPA guidance indicates that controls should be expandable based on results of post-construction monitoring. The document should acknowledge this. The report incorrectly implies that if a community develops and builds controls based on historic rainfall patterns that the community will not be able to add additional control without excessive cost.	Agree: The Executive Summary has been re-written. The following text has been added regarding the responding to climate change in the Executive Summary and Conclusions sections: "Faced with the prospect of future climate change, opportunities may exist where current CSO mitigation efforts can be upgraded at little additional cost to provide an added margin of safety to account both for near-term extreme events and the potential future effects of climate change. No-regrets opportunities may also exist where actions taken today to address current, other water quality concerns can provide additional benefits in the context of adapting to climate change. More generally, options should be considered for promoting flexibility and adaptive management, whereby investments can be selected or phased over time in as information becomes available and uncertainty reduced. Finally, it is also important to recognize that each CSS and CSS community has a unique set of attributes, existing challenges, constraints, and other factors that must be considered in determining what reasonable and appropriate actions should be taken to manage any increase in risk associated with climate change. The focus of this report, CSOs, is not meant to imply that CSOs are the single or even the greatest source of water quality impairment in these areas. Other sources of impairment including non-point loading from agriculture, urban development, and other sources also occur in the study regions. Moreover, CSS managers are also faced with a range of regulatory and other challenges not related to climate change. Accordingly, responding to climate change will require a holistic approach that considers climate change in the context of other impacts on CSSs and local or regional water quality to determine what reasonable and appropriate actions can be taken. Although limited in scope, this screening-level analysis provides a first step towards a better understanding of climate change impacts on CSOs in the New England and Great Lakes Regions. Results further suggest that certain systems may be vulnerable to future climate change, and that there is a need for more detailed, site-specific analyses including the development of decision support tools and information for assessing and managing this risk. Ultimately, regardless of whether or not CSS managers choose to include climate change in their long-term planning, it is preferable that the decision be intentional and not due to lack of awareness of the problem."
The report notes that a major weakness of the analysis is that it was conducted in full-day increments and does not distinguish between a two-inch, 24-hour storm and a two-inch, 2-hour storm. The type of precipitation event is extremely important in developing CSO controls. Given the assumptions inherent in the scaling-down process using the WGEN weather simulation model, which appear to be based on existing rainfall distributions, it is unclear whether the global circulation models are at all capable of predicting a future increase in the type of short-term, high-intensity rainfall that has significant impacts on the design of CSO controls.	Agree: This study is a screening-level assessment of the potential order of magnitude of climate change impacts, and subject to several limitations, including AOGCM projections. This work is only a first step towards understanding a complex issue, the implications of which will vary for different systems. The above text has been added throughout the report mentioning these limitations.

...it is important to properly characterize the limitations of the studies and ensure that reports summarizing the results of the research or impact assessments do not cross the line and become policy statements. NACWA is concerned that, as written, these assessment reports imply that clean water agencies should take specific actions to account for impacts that can not yet be accurately predicted. Clearly, the Nation's clean water agencies should consider these and other possible future impacts in their long-range planning discussions and many of NACWA's members are already actively doing so at the community and regional level. Still, as both of these reports accurately describe, the Nation's clean water agencies are already facing what often seem to be insurmountable challenges in meeting the current regulatory and financial demands of managing wastewater today. The predicted impacts detailed in these reports are not insignificant and are potentially only a fraction of the possible water quality impacts that might be realized in the future. It is inappropriate to suggest that clean water agencies need to take action now on any one of these potential impacts. These and other possible demands on clean water agencies must be taken together and examined in a more holistic fashion before reasonable and responsible action can be taken.	Agree: We agree that this study is a simple, screening-level assessment of the order of magnitude of climate change impacts, is limited in scope, and is subject to several methodological limitations. The work is just a first step towards understanding a complex issue, the implications of which will vary significantly for specific locations and systems. We have added the above text throughout the document (Exec Summary, Introduction, Methods, and Conclusion) to properly caveat results and be more clear about the limitations of this work. We also include a discussion of study limitations in Section 3.3. Regarding future actions for responding to climate change, we have added the following text to the Executive Summary and Conclusions section: "Faced with the prospect of future climate change, opportunities may exist where current CSO mitigation efforts can be upgraded at little additional cost to provide an added margin of safety to account both for near-term extreme events and the potential future effects of climate change. No-regrets opportunities may also exist where actions taken today to address current, other water quality concerns can provide additional benefits in the context of adapting to climate change. More generally, options should be considered for promoting flexibility and adaptive management, whereby investments can be selected or phased over time in as information becomes available and uncertainty reduced. Finally, it is also important to recognize that each CSS and CSS community has a unique set of attributes, existing challenges, constraints, and other factors that must be considered in determining what reasonable and appropriate actions should be taken to manage any increase in risk associated with climate change. The focus of this report, CSOs, is not meant to imply that CSOs are the single or even the greatest source of water quality impairment in these areas. Other sources of impairment including non-point loading from agriculture, urban development, and other sources also occur in the study regions. Moreover, CSS managers are also faced with a range of regulatory and other challenges not related to climate change. Accordingly, responding to climate change will require a holistic approach that considers climate change in the context of other impacts on CSSs and local or regional water quality to determine what reasonable and appropriate actions can be taken. Although limited in scope, this screening-level analysis provides a first step towards a better understanding of climate change impacts on CSOs in the New England and Great Lakes Regions. Results further suggest that certain systems may be vulnerable to future climate change, and that there is a need for more detailed, site-specific analyses including the development of decision support tools and information for assessing and managing this risk. Ultimately, regardless of whether or not CSS managers choose to include climate change in their long-term planning, it is preferable that the decision be intentional and not due to lack of awareness of the problem."

It was brought to my attention that there is a statement in your draft report, "A Screening Assessment of the Potential Impacts of Climate Change on Combined Sewer Overflow (CSO) Mitigation in the Great Lakes and New England Regions" that misinterprets a slide from a DEP presentation. This is the statement: "States and local municipalities are already struggling to meet the demands of water resource management, and climate change would add an additional factor to the equation when weighing the price of clean water. The New York City Department of Environmental Protection estimates that the cost of increasing wet weather capture from 75 percent to 95 percent in response to climate change would cost $12-$40 billion for New York City alone(NYCDEP 2005) (footnote 5)." I believe that his statement is based on a PowerPoint presentation that Commissioner Lloyd gave at the U.S. Climate Change Program workshop in DC in November 2005. Please note that the range of cost estimates referred to were for DEP's CSO program in general at the time of the presentation - not costs "in response to climate change" directly. The numbers were for illustrative purposes. I think it's best to not quote them, especially as currently stated.	Agree: The text concerning CSO costs for New York City was deleted.