Third Party Review of the ALCOSAN Regional Long Term Wet Weather Control Concept Plan

Submitted to the Third Party Review Committee of the Allegheny County Sanitary Authority

June 2002

Greeley and Hansen LLC
In association with
HydroQual, Inc.
McGuireWoods LLP
THIRD PARTY REVIEW COMMITTEE  
OF THE  
ALLEGHENY COUNTY SANITARY AUTHORITY  
Allegheny County, PA  

THIRD PARTY REVIEW of the  
ALCOSAN  
REGIONAL LONG TERM WET WEATHER CONTROL CONCEPT PLAN  

June 2002  

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Acknowledgements

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We would like to acknowledge the cooperation and assistance provided to us by the following organizations and their staff:

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3 Rivers Wet Weather Demonstration Program
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and
3RWWDP Core Basin Group
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INTRODUCTION

The ALCOSAN Regional Long Term Wet Weather Control Concept Plan (Concept Plan) was developed to address sewer overflows in the ALCOSAN service area. The Third Party Review of the ALCOSAN Concept Plan was conducted under the direction of the Third Party Review Committee formed by the ALCOSAN Board of Directors to address questions raised about the plan by the communities served by ALCOSAN (the Partner Communities). This executive summary focuses on the issues and findings that need to be addressed into the future. To utilize these findings it is necessary to understand the technical and institutional conditions that have made past efforts to address sewer issues in Allegheny County difficult or impossible.
These include the following:

- **Designed to Overflow** - The original design intent and the constructed condition, of the ALCOSAN and the Partner Community systems is that the sewers overflow to the streams and rivers of Allegheny County a mixture of rainwater and sanitary sewage during wet weather. This is not a system that has exceeded its capacity, or has deteriorated and as a result is overloaded and overflows. This is a system that was first designed, then approved by state regulatory authorities and finally constructed to overflow during wet weather. The system was likely built and approved to function with overflows based on the belief that overflows during wet weather would be acceptable.

- **CSO/SSO?** - Some of these sewers are “combined” sewers that are designed and built to convey all the rainwater and sanitary sewage from their drainage area. Other Partner Community sewers have been labeled “separate” sewers, containing only sanitary wastewater. However, the Partner Community separate sewers all carry a large amount of wet weather increased flow. In addition, the combined areas and the separate areas are connected and cause inter-related overflows. While combined sewer interceptor systems are designed to overflow during wet weather, the sewer systems labeled as separate in Allegheny County appear to have been sized to carry more flow than a typical separate sewer system. The ALCOSAN interceptors are designed to overflow excess rainfall induced flow at the point of connection to the ALCOSAN system irrespective of the label placed on the sewer feeding the ALCOSAN system. It is unclear as to the regulatory status of these systems as separate or combined; however, it is clear that the systems were originally designed and approved with designated overflow structures. In any case and irrespective of the label placed on these systems, the water quality impacts caused by the overflows need to be addressed. It should be understood, however, that the label of separate or combined does not necessarily have the same meaning in Allegheny County as intended by national policy on these matters.

- **Small Communities** - The 83 Partner Communities of ALCOSAN include many very small municipalities, some fewer than 1,000 people. It is impractical for these very small communities to address the administratively complex requirements of today’s clean water regulatory environment on their own.

- **Authority** - The tradition, politics and legal agreements between ALCOSAN and the Partner Communities vest limited central authority in ALCOSAN to address local sewer issues. As a result, neither the large capable authority, nor the small Partner Community is equipped to fully address the issues and needs.
**Progress** - In spite of these difficult institutional and technical issues, the Partner Communities have moved forward with rainleader disconnect programs, and significant monitoring and rehabilitation has occurred. In addition, ALCOSAN has attempted through planning, construction and multiple reviews of its plans to address wet weather needs within the confines of these institutional issues.

**Ineffective Enforcement** - The historical regulatory programs have not recognized the institutional, technical or water quality issues. Historical enforcement has been selective and ineffective at dealing with the institutional issues. For example ALCOSAN has a permit that requires the development of a CSO Long Term Control Plan for its 24 CSO outfalls. The permit does not discuss SSO. The Partner Communities will ultimately have to develop their own plans. However, the Partner Communities cannot develop their own plans without knowing the extent to which they can rely on ALCOSAN to accept their flows. To date there are no means of addressing the coordination needs. Water Quality Standards (WQS) are not being addressed by the regulators, in permits or in the planning for facilities. While there has been verbal commitment to considering these issues, the proposed enforcement documents have not yet been able to address the full range of issues and needs.
Overall Findings

In the following sections there are key findings with respect to the details of the Concept Plan. These overall findings need to be understood at the political level of Allegheny County.

Watershed Approach Needed

1. The waters of Allegheny County are impaired by sewer overflows and other sources of pollution (such as acid mine drainage). A watershed approach that addresses sources of impairment beyond sewer overflow is needed to address this impairment.

Money Needed

2. The total costs of addressing the impaired waters of Allegheny County will be substantial. It is likely that State and Federal Grant funding will be needed to address the issues.

New Regulatory Approach

3. The previous regulatory and institutional approach to LTCP development was impracticable. A new approach is needed that recognizes and addresses the institutional and technical issues of all impacted parties.

Concept Plan

4. The ALCOSAN Concept Plan will be an important part of addressing County water quality needs. The Plan needs to evolve into detailed facility plan(s) that address Clean Water Act requirements with implementation that is affordable and fair.

Balance of Rehabilitation and Treatment

5. Municipal rehabilitation and conveyance for treatment at an expanded ALCOSAN plant will be important aspects of the solution. However, it is imperative that the cost of specific types and locations of rehabilitation be known and balanced against conveyance and treatment before large investment in rehabilitation is made.
SUMMARY AND KEY FINDINGS

Background and Purpose

The Allegheny County Sanitary Authority (ALCOSAN) has provided wastewater conveyance and treatment to Allegheny County member communities since the late 1940s. This service has been extended to include 83 diverse communities ranging in population from 400,000 to less than 500 people. These Partner Communities own and operate their own collection systems. Most of these collection systems existed prior to the creation of ALCOSAN and its system of tunnels and treatment plant. The ALCOSAN system was designed to convey dry weather flow from the Partner Community collection system to the ALCOSAN treatment plant (WWTP) located on the Ohio River. The ALCOSAN interceptor system was designed to include more than 300 overflow points throughout the County. During wet weather conditions, the designed carrying capacity of the ALCOSAN system and in some cases the satellite collection system is exceeded. During these wet weather conditions, a mixture of stormwater, groundwater and sanitary sewage can be discharged into the streams and rivers of Allegheny County at these 300 plus overflow points. This was the original design intent of the system.

The satellite collection systems in the communities have been categorized into two types:

- **Combined Sewer Systems** – These systems are designed so that all sanitary wastewater and generally most or all storm water are conveyed in a single pipe. In some cases the combined sewer has replaced the original creek. Overflows from these systems are referred to as Combined Sewer Overflows or CSOs.

- **Separate Sanitary Systems** – By definition these are sewer systems that are designed to carry only sanitary wastewater. In practice, these systems are usually designed to carry some groundwater that infiltrates into the sewer through leaks in the system. In the case of the ALCOSAN Partner Communities, the systems designated as separate have the capacity to carry much more flow than a typical separate sewer system. In practice and historically these separate systems carry some stormwater from rainleaders (roof drains) and storm water induced infiltration and foundation drains. As such, many of these satellite systems are not truly separate. Overflows from Separate Sanitary Systems are referred to as Sanitary Sewer Overflows or SSOs.

These wet weather sewer overflows cause water quality impacts on the receiving streams and create a potential threat to public health. The receiving waters impacted by sewer overflows in the ALCOSAN system are also impacted by other pollutant sources. A short list of sources include:

- Separate Sewer Overflows
- Combined Sewer Overflows
- Urban Stormwater
- Acid Mine Drainage
- Upstream sewer overflows from other Communities
- Wildcat sewers – communities with sewers, but no treatment
A Regional Long Term Wet Weather Control Concept Plan was issued in 1999 principally to address the separate and combined overflows from the ALCOSAN system. This Third Party Review has been conducted to address questions raised about the Concept Plan and to suggest a way forward.

The Regulatory Environment

Point source discharges that include sewer overflows, wastewater treatment plant discharges and urban stormwater discharges are regulated under the Federal Clean Water Act and the Clean Streams Act of Pennsylvania. The Pennsylvania Department of Environmental Protection (PaDEP) is charged with regulating SSOs and CSOs through the permits issued under the National Pollution Discharge Elimination System (NPDES). The United States Environmental Protection Agency (EPA) has delegated NPDES permitting authority to PaDEP, but continues in an oversight and discretionary enforcement role. The principal goal of the NPDES permitting program is to ensure that these discharges include limitations that prevent violations of Water Quality Standards. ALCOSAN’s NPDES permit requires the development of a Long Term Control Plan to address the CSOs it owns. With the exception of Pittsburgh, the Partner Communities with CSOs also have permits requiring them to develop individual Long Term Control Plans for their CSOs. The SSOs are not permitted.

Due to the continuing water quality problems and inadequacy of permits, there are a number of enforcement actions underway through lawsuits and the regulatory agencies. ALCOSAN has attempted to address issues beyond its CSOs by extending its CSO LTCP to address satellite system SSOs at the point of connection to ALCOSAN's system. This extended LTCP is the Regional Wet Weather Long Term Control Concept Plan (RWWLTCCP or Concept Plan).

The Concept Plan

The Concept Plan was developed to address both CSO and SSO at the point of connection to the ALCOSAN service area. The plan has been developed to a “conceptual” level to establish the outer boundary financial requirements for the region and to propose an approach to achieve regulatory compliance. The meaning of a Concept Plan - as opposed to facility plans of more detail - has been a source of much confusion and concern.

The key components of the Concept Plan are summarized as follows:

- Modify and expand the wet weather treatment capacity of the ALCOSAN wastewater treatment plant to accept the maximum practicable amount of flow that can be conveyed by the existing dropshafts, river crossings and tunnel system configuration. This maximized flow is proposed to be treated utilizing an expanded WWTP with 310 mgd peak secondary treatment capacity and 565 mgd wet weather treatment for a total of 875 mgd. The treatment plant portion of the Concept Plan has advanced to the facilities planning stage. Specific facilities, site and costs for these facilities have been developed. It is a cost effective component and should move forward.
Third Party Review of the ALCOSAN
Regional Long Term Wet Weather Control Concept Plan

- To address CSOs, capture for treatment 85% of the Combined Sewer System Wet Weather Flow.
  - Generally for flow not able to be conveyed at river crossings or through the existing tunnel system to the wastewater treatment plant, utilize remote treatment technology built in the Partner Communities to treat overflows to a primary treatment level without disinfection. The Concept Plan uses a treatment technology referred to as “Swirls” for developing concept costs.
  - Increase ALCOSAN’s conveyance capacity to the wastewater plant. Where conveyance to the wastewater treatment plant or swirl treatment was considered impractical, sewer separation was used to develop a cost placeholder during this conceptual phase.
  - The resulting community CSO treatment facilities include 10 swirl facilities ranging in size from 10 mgd to 131 mgd with a total combined capacity of 481 mgd.
  - These CSO facilities costs were estimated at a concept level including costs for ALCOSAN interceptors and treatment only. Costs to convey flow to the ALCOSAN owned interceptors were not included.

- Eliminate SSOs by providing for conveyance and secondary treatment of all (wet and dry) separate area flow by the following means:
  - Increase conveyance capacity along ALCOSAN’s interceptors to the tunnel system.
  - Where increasing conveyance facilities is impractical, provide storage facilities to hold flow for conveyance and treatment after wet weather conditions had passed.
  - The resulting community SSO facilities include 5 previously planned storage facilities plus 12 newly proposed storage facilities ranging in size from 1.1 mg to 26 mg for a total of 17 remote storage facilities with approximately 138.6 million gallons of total storage volume.
  - The SSO elimination costs were estimated at a concept level including the costs for ALCOSAN interceptors and storage only. Costs to convey flow to the ALCOSAN owned interceptors were not included.

- Complete comprehensive municipal collection system rehabilitation and/or reconstruction program for both the combined and separate sanitary sewer systems to be carried out over a 50-year time frame with 40% of the effort complete in the first ten years and 15% completed each of the following decades.
The cost for this Concept Plan is summarized as follows:

<table>
<thead>
<tr>
<th>Plan Element</th>
<th>Cost - Millions</th>
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<tr>
<td>Expand the ALCOSAN WWTP Wet Weather Capacity</td>
<td>$210</td>
</tr>
<tr>
<td>Provide Conveyance and Swirl Treatment to meet the Presumptive Approach in each basin</td>
<td>$155</td>
</tr>
<tr>
<td>Provide Conveyance and Storage facilities to prevent SSOs along the ALCOSAN System</td>
<td>$745</td>
</tr>
<tr>
<td>Provide CSO conveyance or treatment to address combined flows not reaching the ALCOSAN System</td>
<td>Not Included</td>
</tr>
<tr>
<td>Provide SSO conveyance, storage or rehabilitation for flows not reaching the ALCOSAN System</td>
<td>Not Included</td>
</tr>
<tr>
<td>Rehabilitation and or replacement of collector system</td>
<td>$1,900</td>
</tr>
<tr>
<td><strong>Total Estimated</strong></td>
<td><strong>$3,000 Plus</strong></td>
</tr>
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The expansion of the wet weather capacity of the ALCOSAN Wastewater Treatment Plant (WWTP) to maximize the use of the tunnel system is an effective and worthwhile project. It should move forward. This was the basis of the Long Range Facilities Plan in the mid-1990s and was one of the precepts of the ALCOSAN Concept Plan. Phase I of this program is underway. The other elements of the plan are still in the conceptual phase of development.

**Issues Raised and Addressed**

A number of issues have been raised with respect to the Concept Plan. These include the following:

- What Are The National Trends For The Plan To Consider?
- Is The Municipal Collection System Rehabilitation and Reconstruction Program Reasonable?
- Is The Allocation Of Resources Reasonable?
- Does The Plan Meet Regulatory Requirements Of CSO And SSO?
- Does The Plan Address Water Quality Standards?
- Are There Technical Aspects Of The Plan That Need To Be Reconsidered?
- Is The Plan Affordable?
- How Can The Plan Be Funded?
- What Institutional Changes Are Needed?
- How Can The Watershed Approach Be Used To Prioritize The Program?
- What Is The Path Forward?

Each of these is discussed below.
National Trends

**Key Finding:** The Concept Plan was developed prior to Congress requiring all Permits and Orders to comply with the National CSO policy. With this change there are a number of national trends relevant to the Concept Plan. These include:

- **Enforcement Trends**
- **Trends in Technology**
- **Trends in Funding**
- **Trends in Goals**

Un-permitted SSO and CSO discharges have been illegal since Congress passed the Federal Water Pollution Control Act (now the Clean Water Act – CWA) in 1972. Permitting and enforcement for SSOs was largely a State matter until specific Federal policies for these discharges were developed in the 1990s. Some states began aggressively addressing wet weather overflows in the 1970s and 1980s. Until very recently PaDEP has not seen SSOs or CSOs as a high priority. However, as a result of recent congressional action and Presidential directive, state and federal enforcement of permitting requirements for overflows has become a priority. The state agencies, including PaDEP are being required to put these discharges under permits or enforcement orders.

In a survey of 275 Long Term Control Plans the ten most common technologies applied to CSOs are shown as follows:

<table>
<thead>
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<th>LTCP Control Technology</th>
<th>Category</th>
<th># of Plans With Technology</th>
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<tr>
<td>Sewer Separation</td>
<td>Collection</td>
<td>223</td>
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<tr>
<td>Sewer Rehabilitation</td>
<td>Collection</td>
<td>72</td>
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<tr>
<td>Retention Basins</td>
<td>Storage</td>
<td>71</td>
</tr>
<tr>
<td>Primary sedimentation</td>
<td>Treatment</td>
<td>69</td>
</tr>
<tr>
<td>Disinfection</td>
<td>Treatment</td>
<td>67</td>
</tr>
<tr>
<td>Storage Tunnels and Conduits</td>
<td>Storage</td>
<td>66</td>
</tr>
<tr>
<td>Upgraded WWTP Capacity</td>
<td>Treatment</td>
<td>64</td>
</tr>
<tr>
<td>Outfall/Relocation/Elimination</td>
<td>Collection</td>
<td>62</td>
</tr>
<tr>
<td>Upgraded Pump Stations Capacity</td>
<td>Collection</td>
<td>53</td>
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</table>

The communities represented in the table above range from small communities under 50,000 people to very large communities with over a million people in the metropolitan area. As shown, most plans incorporate some sewer separation. In some cases it is the only technology applied. However, sewer separation will not necessarily address water quality concerns if the stormwater discharged after separation continues to pollute the receiving stream. Some communities have demonstrated that sewer separation increases total pollution over even a moderate level of CSO control (Richmond, Virginia; Washington, DC). As a result separation is being used less and...
less by large cities with significant water quality problems. Sewer Rehabilitation is included in many plans to reduce flows. Retention, tunnel storage and treatment plant improvements are also quite common. The swirl technology proposed is applied in relatively few locations. In some locations where swirls have been built for demonstration or pilot testing, the results of these tests have concluded that additional swirl technology will not be installed. For larger municipal systems, convey and treat or store, convey and treat at the WWTP appears to be the most common approach.

The large CSO programs that were begun in the 1970s received substantial federal funding. The local costs of some of the programs have been funded by a combination of sales taxes, real estate taxes and sewer use fees. The federal grant program of the 1970s and 1980s has largely been converted to a state revolving fund (SRF) loan program. Although a substantial amount of this SRF money has gone to CSO work in other states, Pennsylvania has not funded CSO programs with its SRF money. In addition, direct congressional grants to cities to fund CSO programs have continued on a site-specific basis.

In the past, many programs have focused on meeting a technology level of treatment rather than focusing on meeting Water Quality Standards. Codification of EPA’s CSO Policy and EPA’s renewed commitment to ensuring LTCPs will achieve appropriate WQS mandates that the final ALCOSAN LTCP be integrated with WQS.

### Municipal Collection System Rehabilitation And/Or Reconstruction Program

**Key Finding(s):** The costs and cost effectiveness associated with the municipal rehabilitation plan are not well defined and not yet balanced with the convey, store and treat aspects of the plan. This needs to be done before facilities in the Partner Communities move forward.

One aspect of the Concept Plan that has been controversial is the Municipal Collection System Rehabilitation and/or Reconstruction Program to reduce infiltration and inflow (I/I) into the sewers. Important issues with respect to this program include the following:

- Peak wet weather flows from the separate areas are relatively high in comparison to truly separate systems. The Concept Plan is based on existing flows from the separate areas of approximately 1,000 gallons per person per day. Typical water consumption would be 50 to 100 gallons per day per person. The difference between the water consumption and the peak flows is comprised of water that infiltrates into the sewers from groundwater and inflow that reaches the sewers through roof drains and other stormwater. This additional flow is referred to as infiltration and inflow or simply I/I.

- The Concept Plan estimates the cost of abating this infiltration and inflow at $2 billion. This investment is intended to reduce the wet weather peak flow from all collection systems in the direction of the state design standard of 250 gallons per person per day for separate systems. Due to the nature of the separate systems it is unclear that this standard is achievable, even with this investment.
In the 1970s and 1980s, federal grants to build treatment facilities were sometimes contingent on removing “cost effective I/I identified through a Sewer System Evaluation Study (SSES). The cost effective level of abatement that would be recommended out of a typical SSES is well below the level of investment recommended in the Concept Plan. However in many of the Partner Communities, the SSES level of control would not likely reduce I/I to the state design standard. This raises the issue of should I/I be reduced to the cost effective level or to a “state design standard”.

There are a number of specific I/I problems in the satellite systems for which the cost of abatement is not yet known.

Even though the cost of extensive rehabilitation is included as a part of the Concept Plan, ALCOSAN Concept Plan facilities were planned as if no reduction in flow were achieved by the investment in the satellite systems. This has raised the following questions:
- If storage, conveyance and treatment are being provided by ALCOSAN for this I/I, why does it also have to remove from the system?
- After the sewer rehabilitation is complete, will the storage basins always be empty?

These issues are addressed under the Path Forward discussed below.

**Allocation of Resources**

*Key Findings:* The costs for the Partner Communities to convey their flow to ALCOSAN’s enhanced interceptors has not been developed or estimated. There is a need to determine how costs will be equitably allocated among the Partner Communities that are served by ALCOSAN interceptors as well as to those with their own interceptors.

The Concept Plan is designed and costed to identify facilities that address all CSOs and SSOs at the point of connection to the ALCOSAN interceptors. Specific facilities required away from the ALCOSAN owned system are not addressed, except through the Municipal Collection System Rehabilitation and/or Reconstruction Program. As a result the Concept Plan includes only storage, conveyance and treatment facilities adjacent to the ALCOSAN owned interceptors and tunnels.

This has the following cost implications:

- For the four interceptor systems that are owned by ALCOSAN there may be a need for additional trunk sewer conveyance capacity to get the wet weather flows to the ALCOSAN system. Trunk sewers are the sewers within a drainage basin that convey flow to the interceptor. The cost of trunk sewer capacity improvements are not included in the Concept Plan.

- For the 16 interceptor systems that are owned by the Partner Communities, it is likely that these interceptors, (like the ALCOSAN interceptors), will require additional conveyance, storage and treatment facilities. Additional trunk sewers may also be required. These non-ALCOSAN interceptor costs and trunk sewer costs are not included in the Concept Plan.
Because the Concept Plan does not include all the necessary costs described above and there is an uneven distribution of investment between the ALCOSAN owned interceptors and the community owned interceptors, there is a concern that an inequity may develop in the implementation and funding of the plan. This inequity may arise under the following conditions:

- The Concept Plan was to proceed and be funded under the current ALCOSAN cost recovery method (the water bill). Most communities would pay the same rate per gallon of water delivered.
- The communities served by the 16 non-ALCOSAN interceptors and the communities served by the 4 ALCOSAN interceptors would participate in paying for the facilities needed for the 4 ALCOSAN interceptors.
- The communities served by the 16 non-ALCOSAN interceptors would have to pay for their own interceptor without contribution from ALCOSAN. This would be in addition to contributing to the 4 ALCOSAN interceptor costs.

It is important to note that the Concept Plan does not specifically address how to pay for any proposed facilities. The potential cost inequity could be addressed in a variety of ways. An approach to addressing these issues is discussed hereafter. However it is paid for, the infrastructure to convey flow to the interceptors is not fully addressed by the facilities or costs identified in the Concept Plan.

**Regulatory Requirements CSO and SSO**

**Key Findings:** The Concept Plan does not yet completely address certain regulatory issues including:

- Water Quality Standards
- Certain aspects of public participation
- Sensitive areas
- Evaluation of a range of alternatives
- Financial Capability – Particularly that of disadvantaged communities

Some of these issues have developed into requirements after the plan was called for in ALCOSAN’s permit or after the Concept Plan was issued. Some of the issues are more appropriately addressed during facility planning.

The Concept Plan was developed to address requirements in the 1995 ALCOSAN NPDES permit. The original permit required ALCOSAN to address only 4 of the area CSOs that PaDEP attributed to ALCOSAN. An additional 17 CSO points were later added by permit amendment. ALCOSAN extended the scope of the plan to address SSOs along its system. There were a series of specific reports due to PaDEP on a schedule. It is the understanding of the Third Party Review that ALCOSAN has met its obligation by delivering these reports in accordance with the permit deadlines. Since the issuance of the permit, a number of developments in law, policy and guidance have changed the regulatory requirements for addressing CSO and SSO. In addition, as a result of discussions with EPA and others, the plan was proposed at a Concept Level, not a facility planning level.
As a result of all these factors, issues that need to be addressed in a regulatory context include the following:

- Detailed Monitoring and Modeling to Assess Water Quality Impacts. Water Quality monitoring and modeling are needed not only to determine what needs to be done, but also to determine what actions and controls will provide the most cost effective benefit in a timely manner. Eliminating a small once a year SSO located 100 yards downstream of a large CSO that overflows once a week should not be as high a priority as taking a CSO out of a park area. Monitoring and modeling under a watershed approach will reveal these contrasts and help prioritize the investment of limited public funds. Other cities have invested large funds in overflow controls, only to find the public to be dissatisfied that priority problems (such as overflow in parks) have not been addressed. These cities have faced subsequent and draconian enforcement.

- A Public Participation Program, which specifically involves impacted stakeholders in the selection of facilities plans should be developed.

- PaDEP in cooperation with the stakeholders needs to better address sensitive areas. The facility plans need to evaluate elimination or relocation of CSOs from these areas.

- A wider range of alternatives needs to be evaluated to establish a knee of the curve analysis to show the point where the increment of pollution reduction achieved in the receiving water diminishes compared to the increased costs.

- As indicated in the EPA CSO report to Congress last year, during the LTCP process Water Quality Standards should be reviewed and where appropriate revised. This process requires the cooperation and participation of PaDEP during the development of facility plans. Unfortunately, PaDEP has refused to review water quality standards in conjunction with LTCP development and implementation. Instead, PaDEP is proposing to explore water quality standards reviews in their next triennial review. It is imperative that PaDEP conduct a WQS review as the final LTCP is developed during the facilities planning process. ALCOSAN and the Partner Communities should insist on this approach.

- A full financial capability analysis needs to be conducted, in particular, considering the full Clean Water Act financial impacts on disadvantaged communities.

**Technical Aspects**

The Concept Plan relies heavily on the use of swirl concentrators as a treatment technology. The effectiveness of the swirl concentrator technology has been inconsistent across the country. While this technology has been a success in some places, demonstration projects in other locations have concluded that the technology does not meet local needs. A review of the effectiveness of the technology to provide water quality use improvements to the specific waters of Allegheny County should be conducted prior to investing in this or any technology. Further, the plan calls for many treatment and storage facilities away from the main ALCOSAN treatment plant. The operation and maintenance of such remote facilities can be burdensome and sometimes even impractical approach. Some communities have had considerable difficulty in
Third Party Review of the ALCOSAN
Regional Long Term Wet Weather Control Concept Plan

maintaining even a limited number of such remote facilities (Atlanta, Georgia). Other communities have embarked on plans for multiple facilities in the community only to find out that it was a practical impossibility to place sewage treatment facilities in neighborhoods (New York City). While the remote facilities approach has been successful and economical in some communities (Columbus, Georgia), this aspect of the plan should be carefully considered before proceeding.

**Address Water Quality Standards**

**Key Findings:** The Concept Plan uses the Presumption Approach to select the level of control. To use the Presumption Approach, PaDEP must be able to reasonably determine, based on the monitoring and modeling, that Water Quality Standards will be met. Conceptual Modeling done as a part of this review indicates that Water Quality Standards are unlikely to be achieved with the Concept Plan. For the Concept Plan, or any other plan to be approved, Water Quality Standards must be addressed. It is recommended that a wet weather use and water quality standards review/revision be conducted as a part of the Long Term Control plan under a watershed approach.

The conceptual screening level modeling conducted under this review indicates that the bacteriological water quality standards are unlikely to be met by the Concept Plan. These standards are intended to protect the public health of people using the waters of Allegheny County and the nation. Addressing CSOs is important to addressing this problem, but it cannot be the only pollution issue addressed. EPA’s National CSO Policy includes two approaches for selecting a level of control to address water quality problems associated with CSOs. These are the Presumption and the Demonstration Approaches.

The presumption approach in the National CSO policy calls for a defined level of CSO control. In the case of the Concept Plan, the level chosen is primary treatment for 85% of the total combined flow. Under the alternate demonstration approach of the National CSO Policy, there is no defined level of control; rather the plan must demonstrate that the level of control is adequate to meet Water Quality Standards.

The CSO Policy provides that a community may follow the presumption approach where the presumption that water quality standards will be met by the proposed long-term controls "is reasonable in light of the data and analysis conducted in the characterization, monitoring, and modeling of the system and the consideration of sensitive areas…."

Thus under the presumption approach, where water quality standards are unlikely to be met, either the water quality standards must be revised so the presumption approach is adequate or the demonstration approach must be used to determine a program that will meet current or revised Water Quality Standards at a level of control greater or lesser than the presumption approach.

ALCOSAN and its Partner Communities have the option of pursuing either the demonstration or presumption approaches (or a combination in different basins/subbasins). In either approach, water quality standards must be achieved. The demonstration approach offers more flexibility on the levels of control applied.
The Concept Plan does not include disinfection at facilities remote from the treatment plant. Providing disinfection may assist the Concept Plan in meeting water quality standards, however, this would increase the cost and operational complexity of the plan. In any case, there is a need to determine if water quality standards are likely to be met for this approach to be approvable by PaDEP.

The Clean Water Act requires PaDEP to evaluate the waters of the state, including the waters of Allegheny County, to determine which are not meeting water quality standards and why. Ultimately, PaDEP must determine the Total Maximum Daily Loads (TMDLS) of each impacting pollutant receiving water can assimilate and still meet water quality standards. A plan to address these loads must be developed so WQSs can be met. The waters of Allegheny County are impacted by a variety of sources. As discussed above these potentially include:

- Urban Stormwater
- Wet Weather Sewer Overflows
- Acid Mine Drainage
- Upstream Sewer Overflows from other Communities
- Wildcat Sewers – Areas with Sewers, but no treatment
- Failing Septic Systems
- Agricultural Loads

Wet Weather Overflows are only one of many sources that PaDEP and the municipalities must address to meet water quality standards. The Concept Plan alone cannot meet water quality standards. If the above pollutant sources were significantly reduced, it is not clear that standards would be met with the Concept Plan. The watershed approach, discussed below, is suggested as a way to address these issues holistically.

Watershed Approach and How to Prioritize the Program

**Key Finding:** Much of the work to date has been in response to isolated regulatory requirements imposed in permits and orders. In contrast, a watershed approach seeks to determine what uses in the watershed are most important to stakeholders and how they can best be addressed and funded. Watershed planning ensures that community preferred actions and improvements would be given priority, within the context of regulatory requirements. It is the recommended approach to setting priorities for the LTCP. In addition, such an approach could significantly change the degree to which SSOs, CSOs, stormwater and other loads are addressed overall and from basin to basin. Stakeholders in the watershed must be involved including, political leaders, public interest groups, pollution control entities and regulators.

The current driving force for the Concept Plan is regulatory enforcement. There will always be a regulatory aspect to these programs. However, an alternative approach to find solutions to water quality issues is the Watershed Approach. The watershed approach was put forth by the EPA in the late 1990s as the preferred method of handling the large variety of point and non-point source pollution that impact the nations water ways. This process involves the cooperative efforts of the varied interested parties (stakeholders) in the development of a unified approach to solving the water quality problems and improving water uses in an area. Through the process, many complex issues can be integrated, assessed and prioritized. Once this is done an action plan for
achieving meaningful water quality improvements within the basin can be developed by the stakeholders. It is a process where many varied interests are brought together for the common goal of improved water quality.

The Basin groups currently organized by the Three Rivers Wet Weather Demonstration Program (3RWWDP) could form the nexus for taking the watershed approach. Typically the watershed stakeholders are those with the greatest interest in achieving benefits from the investments made. The watershed approach can be described as three phases:

Stage 1 - Identify Challenges and Objectives - Identify concerns, valued watershed features, seek and analyze data, prioritize challenges and opportunities, determine critical areas and establish objectives.

Stage 2 - Develop a Plan - Select management alternatives, including the types of actions to be taken, with stakeholders’ input.

Stage 3 - Implementing and Evaluating - Prioritizing actions, funding the actions, implementing, measuring success and further needs.

There are several reasons the watershed approach should be considered for the LTCP. These include:

- There are a variety of water quality impacts from a wide range of sources that need to be addressed in Allegheny County. The regulatory approach cannot address these sources holistically.

- It is essential to gain the support of the people who will pay for the actions and improvements. The watershed approach lets the stakeholders determine what is important to implement first. Priorities can and should be driven by the watershed approach.

There are a number of entities that could lead the watershed approach. See the Institutional issues below for a discussion of institutional issues.

The Concept Plan takes the approach that all SSOs will be eliminated, but only 85% of the wet weather combined area flows must be eliminated. This approach does not account for differences in receiving water conditions. Some waters may require higher or lower levels of protection under a watershed approach. To some extent these differences in control needs can be addressed within facilities plans to be completed in each basin. However, ALCOSAN should be open to considering a redistribution of its capacity and potentially the expansion of its tunnel system in the next phase of planning.
Data examined under this review indicate that fecal coliform (the principal criteria used to assess public health risk to people in contact with the waters) regularly exceed acceptable levels. Rough-cut calculations further indicate that, while the Concept Plan will provide benefits, the Plan will not achieve compliance with Water Quality Standards. There is a need to conduct detailed assessment of the water quality. This assessment needs to go beyond stream monitoring to identify pollutant sources impacting water quality with particular attention to public health risks. This should be done on a watershed basis.

**Affordability**

**Key Finding:** Even without the complete costs to the Partner Communities included, the Concept Plan calls for investments in excess of the resources of many of the Partner Communities. Alternative methods of funding are needed.

As discussed above, the Concept Plan does not include all the costs needed for addressing wet weather overflows or meeting dry weather water quality standards. As such, care should be taken in discussing the affordability of the plan, as ratepayers or others will have costs attributable to the solution for each watershed that are not identified in the plan. However, even without considering the total costs, the cost of the Concept Plan would be unaffordable to many of the communities under EPA criteria.

**How to Pay**

**Key Finding:** There is a need to evaluate and develop alternate methods of funding.

The following methods of funding infrastructure improvements and Operations and Maintenance (O&M) costs are available:

1. Fund all costs through ALCOSAN’s present rate methodology; i.e., prorating costs on water consumption.

2. Adopt a “Pay to Play” concept; i.e., base rates on an actual cost of service for gallon treated but bill individual Partner Communities based on their flow.

3. Use ad valorem or “sin” taxes to fund capital improvements while selecting either Item 1 or 2 above to fund O&M costs.

4. Impervious area fee approach to fund capital O&M costs. Under this approach, fees would be charged proportional to the amount of impervious areas (such as paved surfaces and roof top) included in a real estate parcel.

5. County, State or Federal Grants.

Based on the nationwide trends for funding these programs, the ultimate solution is likely to be a combination of these methods and the combination may vary depending on ultimate institutional arrangements. In addition to funding sources, there are multiple means of raising capital money. These include the State Revolving Fund loans, general fund municipal bonds, revenue bonds, and cooperative municipal bonds. Whatever means of obtaining capital, there will be a need to address the “how to pay” issue first.
Institutional Issues

Key Findings: To take advantage of potentially significant economies of scale in terms of collection system management and compliance with existing and future water quality regulatory requirements, the Partner Communities will have to restructure themselves. Unless a move toward regional management and operation is made, the wet weather difficulties of today may never be fully resolved. Funding from ALCOSAN and grant funding at the County, State, and Federal levels is essential to optimizing future regionalization opportunities.

The resolution of wet weather discharges for ALCOSAN and the satellite system must address the following institutional issues:

- Operational and financial responsibility for systems with cross-jurisdictional boundaries.
- Significant variations that exist with respect to the condition of the collection systems.
- Significant variations in terms of peak per capita flow rates exist among Partner Communities regardless of whether they have separate or combined collection systems.
- Legal practicality of existing and future inter-jurisdictional arrangements.
- Development of inter-jurisdictional agreements on a rational basis such as by drainage basin.
- Delineating a specific role for 3RWWDP and the basin groups in developing a control plan.
- Should the Partner Communities singularly or in groups develop their own plan(s) or should they be part of an overall ALCOSAN service area control plan.
- The need to address affordability for low MHI jurisdictions due the interdependence of the collection systems and receiving water.
- The current regulatory and enforcement approach requires each of the Partner Communities regardless of size to address each regulatory requirement. This produces a proliferation of sewer management programs that are too small to be efficient and, as a practical matter, able to respond to the complex regulatory environment.
These issues should be addressed in a phased approach which is described below.

**The Path Forward – What the Communities, the Regulators and ALCOSAN Need to Do**

**Take a Phased Approach**

In order to address the issues raised above, a phased approach is recommended as follows:

**Phase I**

- Implement the portions of the Concept Plan that are clearly cost effective and that will be part of any final plan for the region (such as expanding the wet weather capacity of the WWTP).

- Proceed to inspect priority areas of the collection system and correct structural deficiencies. This could include the beginning of an SSES process.

- Gather the information needed to complete comprehensive facilities plans designed to achieve appropriate water quality standards. Principal among the information needed is to demonstrate I/I control cost effectiveness.

- Conduct a comprehensive Financial Capability Analysis and a revised funding strategy.

- Set up and put into motion a process to determine the ultimate wet weather water quality requirements.
  - Establish organization and structure for final LTCP development and facilities/watershed planning group(s).
Phase II

- Implement additional abatement projects identified as a result of the system inspections. Utilize the information collected to prepare facility plans for each of the watersheds under the umbrella of a LTCP process. Address the ultimate wet weather designated uses and Water Quality Standards to be attained. Conduct a full public participation program.

Phase II Strategy

- Initiate Basin Facility Planning
- Conduct Public Participation
- Construct Cost effective sewer Rehabilitation
- Water Quality Uses and Standards Review
- Complete LTCP for Allegheny County
- Phase II
**Phase III**

- Implement the LTCP actions identified and prioritized in accordance with a Watershed Approach.

In order to move forward with this phased approach it will be necessary to make certain institutional changes. A framework for beginning those changes is described as follows:

**A Framework for Deciding the Institutional Changes**

In order to develop a workable approach to the wet weather issues in the Partner Communities, the following realities must be acknowledged:

- That sufficient data does not exist for the Partner Communities to develop control plans that address water quality standards and are cost effective.

- That it is impractical for each Partner Community to develop the necessary data in a usable format; i.e., some degree of consolidation is necessary. Enforcement actions must recognize this need.

- There is a need to manage these efforts under a study coordinator. The coordinator could be administered by ALCOSAN, PWSA, 3RWWDP or one of the regional authorities that have significant technical and management resources for the task. This coordination is needed to provide economies of scale and to ensure that priority problems are addressed.

- The regulators will require real progress in the near future.

- A source of immediate funds is needed which will necessitate the short-term use of a funding method that may not be acceptable to the jurisdictions in the long-term.

If these items are accepted, the following institutional tasks must be accomplished:

**Immediately**

- Determine an immediate source of short-term funds. ALCOSAN should consider being a principal source. A trust funding level of $25 million per year is suggested.

- Establish a Trust Fund Entity with a board of stakeholders to approve the distribution of funds. Consider including on the board, Partner Community representatives, regulators and impacted...
environmental and public interest groups.

- Select a Program Coordinator to facilitate and coordinate the Regional Watershed Initiatives of each of the Partner Communities. Facilitate the activities of a Trust Fund Entity to distribute funds to Watershed Initiatives that accomplish the goals and needs under Phase I. These watershed efforts will initially include the first stages of an SSES program, rehabilitation demonstration projects to provide cost effectiveness data to facility planning in Phase II, Water Quality Analysis and critical sewer repairs.

- Negotiate Phase I of a multiphase plan with the regulators. It will be imperative for ALCOSAN to convey to the regulators each of the important elements that must be completed, the time needed and the State and Local resources needed to accomplish these tasks. The Core Basin Group has been facilitating negotiations for the Partner Communities. It is important that ALCOSAN and the Partner Communities participate together with each other in negotiating with the regulators.

- Organization of the Partner Communities into functional groupings to facilitate effective data collection, demonstration projects, SSES work and critical repairs.

- Develop an infrastructure management system (IMS) to facilitate data handling and priority setting.

- Establish a Blue Ribbon Funding and Regionalization Committee to begin addressing how the system will be re-organized and managed under Phase II. This group should include people of recognized regional stature sufficient to address the substantial change needed to the current sewer management structure.

**Before the Development of a Report and Plan**

- Develop a comprehensive on-going public outreach program.

- Develop a long-term financial strategy with Partner Communities agreement.

- Determine if the organization structure used for the data collection will be that used for plan implementation. If changes or improvements are indicated, make the necessary adjustments.

Once a proposed plan that includes both a technical, management and financial strategy has been developed, it needs to be the subject of a significant public outreach effort. Finally, agreement needs to be reached with all jurisdictions before presenting a final plan to the regulators.

It is recognized that the stakeholders have both common and conflicting interests. Historically, this has made working together on this complex problem difficult for everyone. This graphic suggests a framework for starting a process to make institutional changes that will provide a means to resolve these conflicts. It shows the need to establish a trust agency in Phase I. Others could also take on this role initially or in subsequent phases. However, whatever group or entity leads the effort, there is a need to work together more closely and openly than in the past. This is particularly true in dealing with the regulators. If a solution to these conflicts cannot be found, the regulators will take charge. This will not be in anyone’s best interest.
1.1 BACKGROUND

The Allegheny County Sanitary Authority (ALCOSAN) serves a wastewater collection system comprised of separate and combined sewers. The boundaries of its service area encompass 311 square miles; of this approximately 204 square miles are currently sewered with the remaining 107 square miles non-contributing. Approximately 143 square miles (70%) of the sewered service area is served by separate systems, which consist of two independent piping systems: one system for “sanitary” wastewater (i.e. sewage from homes and businesses) and one system for storm water. The remaining 61 square miles (30%) is served by a combined sewer system (CSS), which conveys both storm water and sanitary wastes in one piping system. Figures 1-1 and 1-2, on the following page, shows how typical combined sewer systems and separate sewer systems function.

Eighty-three communities and approximately 124 major industries discharge to the sewer system. During dry weather, wastewater collected in the sewer system is conveyed to ALCOSAN’s wastewater treatment plant. During periods of rainfall, the capacity of the sewer system is exceeded and the excess flow, which is a mixture of storm water and sanitary wastes, is discharged directly to the Allegheny, Monongahela, and Ohio Rivers and to local streams and creeks as combined sewer overflows (CSOs) or sanitary sewer overflows (SSOs).
As shown in Figure 1-1 on Combined Sewers, these systems are designed to overflow in Wet Weather. Purely separate systems as shown below should not overflow. However, in the ALCOSAN system, there is little to distinguish the SSOs system from the CSO system, other than the presence of a storm sewer in the separate areas. The separate systems and the combined systems have designed overflow regulator structures at the point of connection to the ALCOSAN system.
There are 317 outfall structures in the ALCOSAN system; EPA has identified over 50 of these outfalls as SSOs, the remaining outfalls are classified as CSOs. The total number of SSOs and CSOs within the satellite sewer systems owned by the municipalities has not yet been determined.

ALCOSAN’s operates under a National Pollutant Discharge Elimination System (NPDES) Permit. The NPDES Permit is issued and administered by the Pennsylvania Department of Environmental Protection (PA DEP). In addition to other conditions, the permit required preparation of a Long Term Control Plan (LTCP) for the combined sewer system in accordance with the National CSO Policy. As a response to U. S. Environmental Protection Agency (EPA) concerns with SSOs occurring in the ALCOSAN service area, ALCOSAN incorporated SSO control into its CSO control planning efforts and developed a Draft Regional Long Term Wet Weather Control Concept Plan (RLTWWCCP or Concept Plan), which was submitted to regulatory agencies in March 1999. Since that time the Concept Plan has been under review by regulatory agencies and ALCOSAN member communities. ALCOSAN is currently in consent decree negotiations with EPA.

1.2 REVIEW HISTORY

A number of municipal comments were received and responded to by ALCOSAN; these are compiled in the ALCOSAN Regional Wet Weather Long Term Control Concept Plan, Municipal Comments and ALCOSAN Response document. In addition as part of the ongoing LTCP development process, several formal Review bodies have been formed to evaluate the Concept Plan. These include the following:

1.2.1 The Review Committee

In 1998, the ALCOSAN Board of Directors established a Review Committee headed by retired Executive Director William C. Trefz to review the draft Concept Plan.

1.2.2 Engineering Peer Review Committee

The ALCOSAN Board of Directors established the Engineering Peer Review Committee in 1999. This committee was made up of engineers representing ALCOSAN’s service area communities and chaired by Dr. Bruce Dixon, Director of the Allegheny County Health Department. The committee finalized a report documenting their comments and concerns in November 2000. One of the recommendations of the Engineering Peer Review Committee was to have an independent third party review of the Concept Plan be performed by knowledgeable consultants. This report is the result of that recommendation.

1.2.3 The Third Party Review Committee

The Third Party Review Committee selected a consulting team to complete the independent review and held periodic progress meetings with the Third Party Review Team. The members of this committee and the participating firms that carried out the review are noted in the Acknowledgements.
1.3 METHODOLOGY AND PURPOSE

The Third Party Review Team was provided with documents and information relevant to the development of the Concept Plan to evaluate and review. In addition, the Third Party Review Team conducted a series of information gathering meetings. Information collected and reviewed by the Third Party Review Team is noted in the References section. A list of information gathering meetings held during the review is listed in Appendix A. The Third Party Review Team completed limited water quality modeling based on the existing data provided. The Third Party Review report has been prepared to provide data and to present observations and findings relevant to the continued refinement and development of a cost effective LTCP for ALCOSAN and the communities it serves.
2.1 ALCOSAN

ALCOSAN was chartered in 1946 to meet a Commonwealth of Pennsylvania mandate to control water pollution. The original collection system consisted of approximately 69 miles of interceptor sewers, including 30 miles of deep tunnels ranging in diameter from 2 ft to 10.5 ft. The tunnels are typically at a depth of 80-100 feet although some are as shallow as 20 feet and some as deep as 175 feet. This system was placed in service in 1959 and has been in continuous service for 43 years. The collection system has expanded over the years and now includes the following facilities:

- 85 miles of interceptor sewers
- 6 pumping stations
- 317 regulator structures
- 10 access shafts
- 1 ejector station

The ALCOSAN service area covers a total area of 311 square miles of which 107 square miles are undeveloped or served by other localized treatment systems. Of the 204 square miles that are sewered, approximately 70% (143 square miles) utilize separate sanitary sewer and storm water systems while the remaining 30% (61 square miles) utilize a combined sanitary and storm sewer system. The ALCOSAN system, as well as the interceptors owned by the local jurisdictions, basically follows the tributaries that flow to the Allegheny, the Monongahela, and the Ohio Rivers and then continue along the riverbanks until the flow reaches the ALCOSAN Wastewater Treatment Plant, which is located on the banks of the Ohio River in the City of Pittsburgh. ALCOSAN’s wastewater treatment plant currently has a permitted capacity of 200 mgd for secondary treatment utilizing the processes shown in Figure 2-1, on the following page.

2.1.1 ALCOSAN’s Partner Communities - (satellites)

There are 83 municipalities served by ALCOSAN as listed in Table 2-1, on page 2-3. These municipalities own and operate their own system of sewer collection infrastructure, but do not have a WWTP. In a few cases, a community may own a treatment plant for a portion of its service area with the rest being served by ALCOSAN facilities. From a NPDES permitting point of view these systems with flow delivered to ALCOSAN are considered satellites of the ALCOSAN NPDES permit. Some of the CSO Partner Communities have been issued NPDES permits for their CSO discharges. These are still considered satellites of the ALCOSAN permit.
Figure 2-1 Process Schematic of Existing ALCOSAN Treatment

Main Pump Station  Screening & Grit Removal  Preaeration  Primary Sedimentation  Secondary Treatment Aeration Basins  Final Clarification  Chlorination  Outfall (up to 225 MGD)

Note:
1. Permitted monthly average capacity of 200 MGD
### Table 2-1
**Tributary Municipalities to the ALCOSAN Service Area**

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<tr>
<th>No.</th>
<th>County</th>
<th>Municipality</th>
<th>Total Sewered Area Served by ALCOSAN (acres)</th>
<th>Total Sewered Area Served by ALCOSAN (sq.mile)</th>
<th>Population Served by ALCOSAN*</th>
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<td>McKees Rocks Borough</td>
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Table 2-1
Tributary Municipalities to the ALCOSAN Service Area

<table>
<thead>
<tr>
<th>No.</th>
<th>County</th>
<th>Municipality</th>
<th>Total Sewered Area Served by ALCOSAN (acres)</th>
<th>Total Sewered Area Served by ALCOSAN (sq.mile)</th>
<th>Population Served by ALCOSAN*</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>Allegheny</td>
<td>McKees Rocks Borough</td>
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# Table 2-1
Tributary Municipalities to the ALCOSAN Service Area

<table>
<thead>
<tr>
<th>No.</th>
<th>County</th>
<th>Municipality</th>
<th>Total Sewered Area Served by ALCOSAN (acres)</th>
<th>Total Sewered Area Served by ALCOSAN (sq.mile)</th>
<th>Population Served by ALCOSAN*</th>
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</table>

Source: March 1999 Draft ALCOSAN Concept Plan
* Service populations were based upon 1990 Census Data.
** It was determined after the completion of the Concept Plan that approximately 8 homes in Pleasant Hills drain to the ALCOSAN system.
The following demographics illustrate the diversity of the communities:

- 13 municipalities have a median household income (MHI) of less than $25,000.
- 12 municipalities have a MHI of over $50,000.
- 73 municipalities have a population of less than 20,000.
- The City of Pittsburgh comprises almost half of the total population served.
- 10 municipalities compromise over 60% of the population of ALCOSAN’s service area.
- The number of miles of sewer per 1,000 customers varies by municipalities in the range of 4 to over 40 miles.

The MHI incomes noted above were inflated from 1990 census numbers by a 2.6% per annum rate which was an overall accepted value for the entire Commonwealth during this period. The impact of this approach will be discussed latter under the review of affordability. The municipalities’ MHIs should be updated once the 2000 Census data is available.

2.1.2 ACT 537

The Pennsylvania Sewerage Facilities Act of 1965, more commonly known as Act 537, significantly expanded the mandates contained in the 1937 Pennsylvania Clean Streams Law. Specifically, reports required under the Law to document sewage discharges and related remedial plans required by the Pennsylvania Department of Environmental Protection (PaDEP) were classified as official plans. These plans must address the following:

- Delineation of the existing sewerage systems including an outline of problems
- Planned service improvements planned for the next ten years
- Demonstration that adequate treatment facilities are available
- A schedule of construction of facilities of proposed community sewer systems
- A financial plan to address the above issues

In 1996 ALCOSAN submitted the present 537 Plan that also addressed, by PaDEP’s request, non-ALCOSAN communities in the watershed that presently were experiencing problems with their wastewater collection and/or treatment systems. As such, the ALCOSAN 537 Plan addresses sewer systems that extend beyond the Allegheny County line into both Westmoreland and Washington Counties. It should also be noted that the water quality in the small streams and the main rivers in the ALCOSAN service area are significantly impacted by drainage from outside its jurisdiction. Approval of the 537 Plan by the City of Pittsburgh, as the host city to the ALCOSAN WWTP, was required prior to submittal of the Plan to PaDEP. This 537 Plan calls for the following facilities and actions:

- Expanding the wastewater treatment plant’s capacity to handle projected population growth and urban development.
Expanding the wastewater treatment plant’s capacity to handle wet weather flows up to 875 mgd.

Converting the disinfection process to hypochlorination for public safety and security.

Providing odor control at various process units throughout the plant.

Shallow cut interceptor improvements.

Various solids management and process improvements.

As a part of its long term planning, ALCOSAN has adopted a three-tier approach to meeting its obligations under the Federal Clean Water Act, the Pennsylvania Clean Streams Law and the provisions of its NPDES Permit as follows:

1. Implementation of the Nine Minimum CSO Controls.
2. Development of a Regional Long Term Wet Weather Control Concept Plan (Concept Plan) to provide a technology-based approach to remediate sanitary sewerage overflows (SSO) and substantially reduce combined sewer overflows (CSO).
3. Participation in regional and interstate planning to further improve water quality in area waters.

In the spring of 1999 ALCOSAN issued the Concept Plan that outlines a conceptual approach to SSO and CSO control issues in its service area.
Section 3
Regulatory History and Issues

3.1 INTRODUCTION

A wet weather control plan is intended to address issues of water quality and public health. These issues are regulated by a series of Federal, State and local laws, regulations, policies, guidance, permits and orders. This section is intended to address the principal regulatory framework, the local application of this framework, and suggest a way forward to not only address the regulatory issues, but to do so in a manner that addresses water quality and public health in a practical way for ALCOSAN and its Partner Community systems.

The principal regulatory areas to be understood and addressed include the following:

- Separate Sanitary Overflows (SSOs)
  - National Policy
  - Allegheny County

- Combined Sewer Overflows (CSOs)
  - National Policy
  - PA CSO Policy
  - Allegheny County

- ALCOSAN’s permit and the Concept Plan

- Enforcement Actions

- Future Regulatory Strategy

3.1.1 Sanitary Sewer Overflows (SSOs)

3.1.1.1 National SSO Perspective

Although regulatory requirements to address sanitary sewer overflows have imposed tens of billions of dollars in mandates on communities across the United States, the Federal Clean Water Act only includes the words "sanitary sewer overflows" as a result of a funding authorization in the Consolidated Appropriations Act, 2001. The Act, passed on December 15, 2000, authorized federal grant funding assistance for CSO and SSO control. That is the only reference to SSOs in either the Clean Water Act or the Pennsylvania Clean Streams Law.

State and Federal laws prohibit the unauthorized discharge of any pollutants to waters of the Commonwealth and United States, respectively. While some historical discharge permits may have authorized certain sanitary sewer overflow structures and the overflows themselves, the regulatory agencies now take the position that all such overflows will no longer be authorized or
permitted. The regulatory agencies have taken the position that these discharges are or will be unauthorized and, accordingly, are or will be violations of law.

After the successful negotiation of EPA's National CSO Policy in 1994, EPA established the Urban Wet Weather Federal Advisory Committee ("FACA") in 1995 in an effort to develop a holistic approach to urban wet weather flows, including SSOs. Unfortunately, the FACA discussion proved controversial and the Clinton Administration backed away from seeking a resolution through this process.

During the summer of 1999 President Clinton, by Executive Order, directed U.S. EPA to develop regulations to address SSOs within one year. The initial draft regulations appeared to ignore compromises negotiated during the FACA process.

In October of 1999 a consensus SSO policy was developed in what has been dubbed as the "miracle in Williamsburg" where EPA and municipal groups and environmental groups agreed on a series of principals. However, the "miracle in Williamsburg" continues to be viewed as unacceptable by municipalities nationwide because it was negotiated within the boundaries of the regulatory agencies' interpretation of existing law as prohibiting SSOs as unauthorized discharges. This circuitous logic states that SSOs are illegal because they are not authorized and not authorized because they are illegal. There is nothing in the clean water act that fundamentally prohibits the discharge from an SSO. It must, however, meet the technology and water quality provisions of the act. That said, the pre-draft SSO regulation that has emerged supports the view that SSOs, (outside of truly extraordinary circumstances such as hurricanes) are violations of the CWA. If the pre-draft regulation is ultimately adopted, SSOs will be illegal and not possible to permit.

During the final year of the Clinton Administration, EPA released pre-draft SSO regulations that followed closely the recommendations that came out of the Williamsburg meeting.

The consensus approach to the SSO regulations that was reached included the following principals:

- Capacity, management, operation and maintenance ("CMOM") programs for municipal sanitary sewer collection systems.

- A prohibition on SSOs, which includes a framework for raising a defense for unavoidable discharges.

- Reporting, public notification, and record keeping requirements for municipal sanitary sewer collection systems and SSOs.

- Remote treatment facilities (or peak excess flow treatment facilities).

- Satellite systems must be addressed in the regulations.

- The watershed approach should be encouraged.
Each of these issues is discussed in more detail in Section 5.

Ultimately, EPA was unable to publish the draft SSO regulations before President Bush came into office on January 19, 2001. President Bush has since stayed the publication of the draft SSO regulations. However, the Bush EPA has recently indicated that they are prepared to publish the draft SSO regulations for public comment within the next couple of months. Thereafter, it is likely to take 12-24 months for a final rule to be promulgated. While there is considerable controversy about aspects of the rule, it is expected that it will require a substantial increase in the operation and maintenance of sewer systems across the nation.

Notwithstanding the absence of federal and state regulatory programs for SSOs, EPA and State NPDES permitting agencies have aggressively enforced the prohibition against SSOs for several decades. In the past five or six years, wet weather SSO enforcement has been a particular priority for EPA Headquarters and Region III. Dozens of federal and state SSO-related enforcement actions have been taken. A few recent examples include:

- Atlanta, GA
- Boston, MA
- Houston, TX
- Miami-Dade, FL
- Baton Rouge, LA
- Mobile, AL
- New Orleans, LA
- Norfolk, VA
- Roanoke, VA
- Baltimore, MD
- Erie, PA
- St. Mary's County, MD
- Parkersburg, WV
- Galax, VA
- Washington Suburban Sanitary Commission, DC

The regulatory agencies are removing all SSO-related authorization language from discharge permits and have asserted a "near zero" tolerance for SSOs. Frequently, the agencies seek to impose strict liability on collection system owners for SSOs that occur. For example, Maryland has recently announced an initiative whereby they will issue fines for each SSO that is reported similar to a traffic ticket approach. Serious or chronic overflows will not be eligible for a simple ticket-type fine. They will be addressed via administrative or judicial order.

Communities across Pennsylvania have been subjected to SSO-related enforcement actions.

In July of 2000, EPA headquarters issued an enforcement directive to the EPA Regions to identify communities in each state that experience SSOs and to develop a priority list of communities for enforcement actions. The directive called for the regions to enforce against 20 percent of the communities on their lists each year.

Thus, SSO enforcement actions really have been the norm rather than an exception over the past decade at the national, regional and state levels.

### 3.1.1.2 Allegheny County SSO Developments

In the mid-1990s, EPA and PaDEP were pressuring ALCOSAN to develop a long-term control plan for ALCOSAN's CSOs. At the same time, EPA issued multiple information requests in the form of Clean Water Act Section 308 letters to the Partner Communities seeking information about combined and sanitary sewer overflows in their systems. At that time, it appeared that
EPA would aggressively initiate enforcement actions against the communities that are also ALCOSAN’s satellite sewer systems.

In an effort to head off individual lawsuits by EPA, ALCOSAN offered to try to address wet weather SSOs and CSOs occurring in the Partner Communities in its conceptual LTCP, the Concept Plan. ALCOSAN staff has indicated ALCOSAN took on this task in order to:

- Help the region address the issues.
- Protect ALCOSAN’s bond ratings.
- Prevent individual lawsuits against the Partner Communities with unwise or inconsistent court-ordered solutions.
- Have one LTCP, instead of 20 or more.
- Avoid a proliferation of treatment plants throughout the County as a result of local litigation.

ALCOSAN proceeded on that path and EPA did not follow up on its information requests with enforcement actions against the Partner Communities.

Although ALCOSAN did not miss any of the deadlines for delivering LTCP products called for under the ALCOSAN permit, EPA became impatient with the time it was taking ALCOSAN to develop its LTCP. Accordingly, EPA submitted an information request to ALCOSAN for the draft conceptual LTCP. This forced ALCOSAN to release the draft Concept Plan to EPA and the public ahead of the required schedule.

EPA reviewed the draft Concept Plan and decided that further development and implementation of a LTCP should be done via federal consent decree. At the same time, EPA decided that the Partner Communities should be put under administrative orders requiring them to develop a greater understanding of their systems and to participate in the further development and implementation of ALCOSAN's LTCP.

The subsequent consent decree (ALCOSAN) and consent orders (Partner Communities) are discussed below in Section 3.1.4.

### 3.1.2 CSO Policy Perspective

#### 3.1.2.1 National CSO Policy Perspective

EPA’s 1994 National CSO Policy outlined a process and key considerations for the development of both short and long-term CSO controls. However, because it was only a policy and would not have the force of law, it was negotiated within the existing framework of the Federal Clean Water Act.
Leading up to the development of the CSO Policy and since its issuance, there has been isolated litigation and enforcement actions brought against CSO communities by NPDES permitting agencies and citizen groups. Some of the cities that have been subject to enforcement actions include: Boston, Atlanta, Portland, Bremerton (WA), Cumberland (MD), Manchester (NH), Akron, Richmond, Lynchburg, New York, and Cincinnati.

Generally, a community's liability for CSO discharges depended upon how their NPDES permit is written. In the Atlanta and Portland cases, their CSO permits expressly required the CSO discharges to meet dry weather water quality standards which they were unable to achieve. Other states and CSO communities have negotiated more realistic CSO-related requirements.

Since the CSO Policy was issued in 1994, EPA and the states frequently focused on CSO communities that did not implement the Nine Minimum Controls by the January 1, 1997 deadline in the policy. More recently, communities have been targeted where they have not done the following:

- Documented implementation of NMCs.
- Progressed toward timely development of a LTCP.
- Progressed toward timely implementation of their LTCP.

Within EPA Region III, the District of Columbia and the City of Wilmington are examples of communities facing litigation over their NMC programs. Numerous other communities are under administrative or judicial orders to develop and implement long-term control plans.

Because EPA Region III has an enormous number of CSO communities and CSO outfalls, the Region has recently made CSO implementation a priority. EPA has conducted dozens of inspections to assess CSO compliance.

The CSO Policy expressly contemplated that it would be implemented through Phase I and Phase II NPDES permits. Phase I permits would generally require the development and implementation of the Nine Minimum Controls while Phase II permits would require the development of a LTCP and associated analyses.

With the enactment of the Consolidated Appropriations Act, 2001, the CSO Policy was incorporated by reference into Section 402(q) of the Clean Water Act. The operative requirement in Section 402(q) is that all NPDES permits, administrative orders, and judicial decrees "shall conform" to the CSO Policy.

EPA and other stakeholders are still trying to determine what the "shall conform" language means in practice. Some legal observers believe it requires a fundamental change in EPA's approach. For example, some have raised the idea that CSO discharges are no longer illegal providing communities are complying with the requirement to implement the NMCs and to timely develop and implement a LTCP. Moreover, there is a view now that EPA and the State NPDES permitting agencies must facilitate wet weather designated use and water quality standards reviews at the request of CSO communities. This interpretation of the current law could have important impacts on ALCOSAN and its CSO satellites.
The CSO Policy is discussed in detail in Section 5. From a local regulatory perspective, the CSO Policy is a planning document laying out procedures, roles and responsibilities for various parties to ultimately come into compliance with the goals of the Clean Water Act. It has been characterized as a three-legged stool that stands on three fundamental principals:

- Permittees are to implement the NMCs to address and provide for the logical optimization of system operation without large capital investment and ensure that there are no dry weather overflows.

- Permittees with the guidance of the regulatory agencies are to develop and ultimately implement a Long Term Control Plan that at its completion will meet Clean Water Act water quality standards.

- Regulatory agencies participating in the LTCP development are to review, and where appropriate, revise water quality standards in concert with the development and approval of the Long Term Control Plan.

The most important feature from a CSO community perspective is the opportunity to develop a site-specific plan together with a PaDEP led wet weather designated use and water quality standards review. If appropriate, based upon that review, PaDEP is expected to refine the applicable designated uses and water quality standards consistent with the LTCP and Clean Water Act requirements. The reason this is so important is the understanding that the WQS as originally adopted by the States (in this case Pa DEP) did not consider the impacts of CSOs. The municipalities that originally negotiated the CSO policy with EPA believed that when the WQS are examined together with the development of the LTCP the following will happen:

- The public will understand wet weather realities and the true impact, if any, of CSOs.

- The true cost of achieving various levels of water quality benefit will be revealed and examined by the public.

- A level of CSO control, together with the resulting beneficial use will be chosen through a public process that has the support of those that will have to pay for the controls.

- Without the support of the paying public, no pollution abatement program is likely to succeed.

3.1.2.2 Allegheny County CSO Developments

Within Allegheny County, the CSO situation is highly complex and uncertain due to the interconnection of many collection systems as well as ALCOSAN's interceptor system. The ownership of CSO outfalls is the subject of controversy between the Partner Communities and ALCOSAN, as is their true status as CSO or SSO structures. Of the outfalls identified as CSO, some are permitted to ALCOSAN, others to Partner Communities. Some do not appear to be permitted at all. According to PaDEP records there are 34 legal entities with CSOs in Allegheny County. Seven of these communities have only one known CSO.
The municipalities and authorities with 8 or more PaDEP identified CSOs include the following:

**MUNICIPALITIES AND AUTHORITIES WITH 8 OR MORE PADEP IDENTIFIED CSOs**

<table>
<thead>
<tr>
<th>Partner Community</th>
<th>No. of Identified CSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Pittsburgh</td>
<td>216</td>
</tr>
<tr>
<td>McKeesport City Municipal Authority</td>
<td>28</td>
</tr>
<tr>
<td>ALCOSAN</td>
<td>21</td>
</tr>
<tr>
<td>Upper Allegheny Joint Sanitary Authority</td>
<td>19</td>
</tr>
<tr>
<td>Turtle Creek</td>
<td>10</td>
</tr>
<tr>
<td>Borough of Wilmerding</td>
<td>9</td>
</tr>
<tr>
<td>Girty’s Run Joint Sewer Authority</td>
<td>9</td>
</tr>
<tr>
<td>Braddock</td>
<td>8</td>
</tr>
<tr>
<td>Etna</td>
<td>8</td>
</tr>
</tbody>
</table>

This list illustrates the wide range of communities with CSOs. Of these all except Pittsburgh has been issued a permit authorizing all or some of their CSOs. Pittsburgh has applied for a permit, but PaDEP has yet to publish a draft permit.

### 3.1.3 ALCOSAN’S Permit and Concept Plan

The ALCOSAN NPDES Permit was issued on March 28, 1995. There are several requirements of the permit relevant to the Concept Plan which include:

- Basic WWTP Discharge Limitations
- Authorized CSO outfalls
- Power Failure or Equipment Failure outfalls

#### 3.1.3.1 Basic WWTP Limitations

The ALCOSAN WWTP is a secondary treatment plant with flow, pollutant mass and concentration limits as follows:

**ALCOSAN WWTP MONTHLY AVERAGE LIMITATIONS**

<table>
<thead>
<tr>
<th>Discharge Parameter</th>
<th>Lbs/day</th>
<th>mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>200 MGD</td>
<td></td>
</tr>
<tr>
<td>CBOD5 – May thru Oct</td>
<td>33,360</td>
<td>20</td>
</tr>
<tr>
<td>CBOD Nov thru April</td>
<td>41,700</td>
<td>25</td>
</tr>
<tr>
<td>Suspended Solids</td>
<td>50,040</td>
<td>30</td>
</tr>
<tr>
<td>Ammonia N May thru Oct</td>
<td>25,020</td>
<td>15</td>
</tr>
<tr>
<td>Ammonia-N Nov thru April</td>
<td>41,700</td>
<td>25</td>
</tr>
</tbody>
</table>
In addition, there are weekly limits of 1.5 times these limitations, a pH limit of 6 to 9, and a dissolved oxygen limit of 4 mg/l at any time and 5 mg/l daily average. Finally, a requirement to achieve 85% removal of BOD (not CBOD) and suspended solids is imposed.

An important aspect of these basic limitations is that the mass loads and the average daily flow limits result in limiting the flow to 200 MGD, unless the plant can achieve lower concentrations limits than required. In addition, the plant is not designed to remove ammonia nitrogen. The ammonia limits are achieved due to limited ammonia in the influent. Substantial removal of I/I could raise these influent concentrations and require that facilities be installed to control ammonia unless PaDEP agrees to enforce only the mass loading. Additional treatment requirements would likely limit the available space and facilities at the plant site for treating wet weather flow.

3.1.3.2 Authorized CSO Outfalls

There were initially three CSO outfalls listed as authorized in the ALCOSAN permit. These are listed below:

- Outfall 005 a 54 inch outfall discharging to the Monongahela River in Braddock between 11th and 13th Streets.
- Outfall 006 a 54 inch outfall discharging to Chartiers Creek in McKees Rocks about 200 yards from the Ohio.
- Outfall 007 a 24 inch outfall on Chartiers Creek about 2 miles up from the Ohio near the Scully Railroad Yard.
In addition, the March 1, 1998 permit amendment included the addition of 18 CSO outfalls located along the Saw Mill Run Interceptor. These 21 CSO outfalls are required to be monitored monthly for cause, frequency, duration and volume. It is important to note that there are many more CSOs in Allegheny County that have not yet been permitted.

### 3.1.3.3 Power Failure or Equipment Failure Outfalls

There are four outfalls authorized to discharge from pump stations in the event of power or equipment failure, three on the upper Allegheny and one at the Main Pump Station at the WWTP. At least one of these appears to serve a separate sewered area.

### 3.1.3.4 Combined Sewer Outfall Requirements

The NPDES permit requires ALCOSAN to prepare a series of reports with respect to CSOs as follows:

- System Inventory and Characterization.
- System Hydraulic Characterization.
- Documentation of Implementation of Nine Minim Controls and Schedule.
- Submittal of Long Term CSO Plan and Schedule.

Each of these documents has been developed and submitted by ALCOSAN. Considerations for each of these documents include the following from the NPDES permit perspective:

- The System Inventory calls for identification and description of the CSOs listed in the permit and identification of other overflow points “likely to have a significant impact”.

- Selected representative monitoring of overflow points to report on frequency duration and volume of each CSO, in stream water quality impacts and their causes, and the effectiveness of the NMC.

- Documentation the implementation of NMCs.

- A Long Term Control Plan that “must address controls necessary to meet water quality standards.” Including the following:
  - A reasonable range of alternatives
  - Evaluation of the NMC
  - Modeling and Monitoring of the CSO system
  - Consideration of Sensitive areas (such as drinking water intakes)
  - Financial Capability
  - Implementation schedule

It appears that each of the CSO required elements of the NPDES permit were submitted in a timely manner. However, there are a number of elements absent from the permit that are worth noting:
The permit does not appear to require ALCOSAN to address CSOs beyond those listed in the permit.

The permit does not require ALCOSAN to address SSOs.

Although many of the basic requirements of the EPA CSO policy are included, the permit does not appear to meet the requirements of the Wet Weather Water Quality Act of 2000 for permits and orders to comply with the National CSO policy. In particular, it does not include provisions for a wet weather water quality standards review. These aspects are discussed further in Sections 5 and 7.

### 3.1.3.5 1997 Soldiers Meeting and the Agreement to do a Wet Weather Concept Plan

As discussed above the ALCOSAN permit does not require a plan that addresses non-ALCOSAN CSOs. It does not require that the issues of SSOs be addressed. ALCOSAN staff has indicated they took on the expanded roll of examining issues beyond the requirements of the permit as a result of a meeting with the regulatory agencies at what has come to be referred to as the “1997 Soldiers Meeting”. Although the Third Party Review Team has not had the opportunity to review any documentation of this meeting it is understood from ALCOSAN staff that at this meeting the regulatory agencies indicated that it was their intention to move forward on enforcement against the Partner Communities based on information they had obtained from the 308 letter information requests to the communities. For the reasons discussed above, ALCOSAN offered to extend its LTCP into a Regional Wet Weather Long Term Control Concept Plan incorporating issues of SSOs and the CSOs of the Partner Communities. This led to the development of a Concept Plan that addresses concept facilities to address CSOs and SSOs along ALCOSAN owned facilities. It does not completely address the specifics of conveying flow to ALCOSAN facilities or the need to address CSOs and SSOs beyond ALCOSAN facilities.

### 3.1.4 Enforcement Actions

#### 3.1.4.1 ALCOSAN Federal Consent Decree

EPA has initiated an enforcement action against ALCOSAN. ALCOSAN and EPA have been communicating intermittently on this enforcement action for many months. These communications have been kept confidential and the Third Party Review Team has not been provided with any of the drafts of the decree or correspondence associated with the negotiations with the exception of Reference No. 1 noted in the References section. However, based on EPA’s enforcement history elsewhere in the region it is likely that EPA is alleging a failure to fully implement the NMCs and to develop an approvable LTCP.

It appears that after EPA was provided with a draft LTCP in response to EPA's information request to ALCOSAN, EPA responded to ALCOSAN's draft by forwarding to ALCOSAN a draft consent decree. ALCOSAN, no doubt anticipated constructive criticism and helpful suggestions from EPA. Instead, it was presented a consent decree that has been under negotiation for approximately 18 months.
The key issues in the decree appear to be (1) further implementation of the NMCs, (2) the process to arrive at a final LTCP, and (3) maximizing flow to the treatment plant.

With regard to maximizing flows, EPA has been willing to provide some flexibility in terms of balancing CSO and SSO flows treated at the ALCOSAN plant. However, EPA is pressing a "core flow" approach whereby ALCOSAN must demonstrate that it has enough primary and secondary capacity to treat all dry weather sanitary flow from the Partner Communities (both combined and sanitary) along with a reasonable factor for inflow and infiltration. If ALCOSAN can demonstrate that amount of secondary capacity, then EPA and PADEP will allow ALCOSAN to "blend" (bypass secondary treatment and recombine with flow that received both primary and secondary) the excess flows. The pending consent decree between ALCOSAN and EPA is expected to address this core flow arrangement.

When word of the draft consent decree first surfaced, a number of the Partner Communities were concerned that EPA would impose requirements on ALCOSAN that would bind the Partner Communities. They did not want to incur obligations without the opportunity to understand and negotiate on their own behalf.

Subsequently, it appears that EPA now intends to use the consent decree as a vehicle to establish the process going forward for ALCOSAN to develop and implement a final LTCP, rather than to implement the draft conceptual LTCP. Thus, EPA's view has been that the Partner Communities are not necessary parties to the negotiations.

The Third Party Review Team disagrees. Because the Partner community ratepayers provide 100 percent of ALCOSAN's revenues, they are the true parties at interest here. Moreover, to the extent there will be substantial civil penalties and/or supplemental environmental projects (SEPs), the Partner Communities have a clear stake in those issues and may well have a different perspective and priority than ALCOSAN. The type of SEP is a good example. ALCOSAN may prefer something relating to its operations or infrastructure while the Partner Communities might prefer community-based (SEPs).

Also, the Partner Communities, with the exception of the City of Pittsburgh, all qualify as "small" communities under the CSO Policy. As such, they are entitled to a variety of concessions and streamlined requirements. ALCOSAN is not a small system and, accordingly, cannot assert this right under the CWA on its own.

Finally, a consent decree can often provide opportunities for communities in terms of helpful provisions that can be included. EPA is preventing the Partner Communities from taking advantage of this opportunity by excluding them from the consent decree negotiations.

It is important to note that it is not unreasonable for EPA to want to keep 83 communities from joining them and ALCOSAN at the table for negotiations. Such an approach would be very difficult for all parties. However, if the communities can work through the Core Basin Group (or other small group of representatives), then their participation would not be unreasonable or burdensome. Accordingly, the Third Party Review Team recommends that the Partner
Communities, through the Core Basin Group, petition EPA Region III management and request the opportunity to participate in the consent decree negotiations.

### 3.1.4.2 Chartiers Citizen Suits

While the ALCOSAN consent decree negotiations have been ongoing, citizen suit litigation has been brought against approximately 12 of the Partner Communities. ALCOSAN has been brought into that litigation against its will as a defendant. That litigation appears to be an attempt by special interest groups in the Chartiers watershed to force ALCOSAN and the communities to focus priority remedial attention to CSOs in that watershed.

While there are no guarantees, it appears that the communities are hopeful that the combination of an ALCOSAN consent decree along with the communities' execution of individual consent orders with ACHD/DEP, will lead to the dismissal of these citizen suits. This kind of piecemeal litigation could damage efforts to develop regional solutions.

### 3.1.4.3 Partner Community Consent Orders

As a result of information collected through 308 letters, and after EPA obtained and reviewed ALCOSAN's Concept Plan, EPA concluded that extensive work needed to be done in the satellite systems. For ALCOSAN to develop an implementable LTCP, the participation and cooperation of the satellites is needed. Accordingly, EPA has proposed individual consent orders for the satellite sanitary systems to address SSO-related maintenance, excess inflow and infiltration, and require the satellites to cooperate in LTCP development. The orders are primarily intended to yield meaningful flow information for use in a final, implementable LTCP. For CSO communities, the orders would be with PaDEP. ACHD is proposed to take the lead on orders with SSO communities.

In October 2001, EPA attended each of the three 3RWWDP Basin Groups meetings. At these meetings they presented their proposed approach to representatives of the Partner Communities. EPA explained that they believe there is considerable noncompliance by most, if not all, of the Partner systems as evidenced by the CSO and SSO discharges. However, in lieu of an aggressive and punitive approach to address noncompliance, EPA offered the communities the chance to voluntarily enter consent orders with DEP/ACHD, as appropriate. These voluntary orders would not include any civil penalties for past noncompliance. EPA also announced other incentives, such as a waiver of TAP bans while communities are compliant with the orders.

As a further incentive to the Partner Communities to enter into the consent orders that EPA/ACHD and DEP have offered, EPA has initiated a number of inspections of the Partner Communities. It is implicit from these inspections that EPA will likely take more traditional enforcement actions should the Partner Communities decline to enter into the proposed consent orders.

As initially presented by EPA in October 2001, the concept of these consent orders was seen by many of the communities as a significant opportunity to manage their collection system issues, relieve impediments to development, and provide a way to address the regional long term issues. The initial draft of the orders was received in February 2002. These orders are comprehensive in
nature and go far beyond what the communities understood would be addressed from the October presentations by EPA. The areas of concern associated with the agreements can be categorized as follows:

- **Scope** – The proposed agreements seek to impose too many requirements, some prematurely. For example, CSO communities are being asked to buy into a LTCP that has yet to be developed. SSO communities are being asked to commit to CMOM programs before a requirement to implement CMOM has even been published in draft form by EPA.

- **Timing** – Concern has been raised that the deadlines proposed are infeasible. There is simply too much too soon.

- **No Targeting** – For each issue in the orders, there is a universal requirement to address all of the issue, e.g. all sewers to be examined, all I/I to be addressed, etc. This is an unreasonable requirement and would be very wasteful of public funds. It is clear from the Concept Plan work to date that targeting I/I abatement on the most cost effective areas is imperative.

- **Need for Facility Planning Basis** – It is clear that an important aspect of facility planning for each of the watersheds will be trade offs between I/I abatement and conveyance for storage or treatment. The orders do not address how this information will be obtained and by whom.

- **Cost** – The orders require communities to agree to implement the requirements of the orders without regard to cost. This requires the communities to agree to pay for the construction and operation of ALCOSAN facilities, and facilities in their own communities not yet identified, without regard to cost. It is unreasonable to ask a community to agree to something for which the cost is unknown and may be unaffordable.

### 3.1.5 Future Regulatory Strategy

#### 3.1.5.1 A Phased Approach to Achieve Specific Goals

The initial agreement proposed by the agencies should be broken into two or more agreements and the individual work to be performed should be tailored to each system by the Community’s engineering consultants. A regional program manager should be hired to facilitate the development of the individual community plans and to facilitate the regulatory agencies’ review and approval of those plans.

The Third Party Review Team has suggested the following outline of an alternative approach for the consent orders proposed by the agencies.
3.1.5.2 Goals

The goals of these agreements are to avoid miring the Partner Communities and regulatory agencies in enforcement actions (with or without litigation) and all the baggage that typically accompanies such enforcement actions.\(^1\) They will also serve the following purposes:

1. Allow the regulatory agencies to address the noncompliance they see and which they believe has gone on for far too long.
2. Establish a clear set of requirements for everyone in the region going forward, in order to meet state and federal collection system requirements.
3. Collect meaningful information about collection system inflow and infiltration and system flows so that an affordable and cost-effective regional long-term control plan can be developed.
4. Address critical collection system problems that may otherwise interfere with the development of an affordable and cost-effective LTCP.
5. Facilitate regional cooperation and the investigation of regional collection system operation and/or management
6. Lead to an affordable, cost-effective, and implementable long-term control plan.
7. Lead to enhanced collection system management and investment over the long-term.
8. Develop a watershed approach and solutions to countywide water quality issues including SSO, CSO, and TMDLs.
9. Promote a phased, multi-agreement approach with aggressive but achievable consent orders.

The orders will be designed to allow the communities to comply with ultimate wet weather designated uses and water quality standards in the region. Each jurisdiction will need to provide timely information into the planning process. Each jurisdiction will have to invest in critical infrastructure and operation and management areas as these areas are identified. The region will need to acknowledge, accommodate, and integrate the various requirements and approaches of the State and national CSO, SSO, and TMDL policies.

3.1.5.3 Proposed Phased Approach

A three-phased approach is outlined below. The concept of each phase can be described as follows:

- Phase I – Move forward with critical repairs. Develop information needed to do LTCP facility planning and develop a regional approach to sewer and watershed management. This Phase is achievable with the current community structure.

- Phase II – Move forward on the cost effective projects identified in Phase I as expected under any future LTCP. Implement a regional approach to funding and watershed management and complete the LTCP. With a regional approach it will be feasible to move forward projects that are currently impractical and do coordinated LTCP facility plans.

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\(^1\)Such as stiff fines, onerous injunctive relief, stipulated penalties, legal costs, and lost productive time.
Phase III - Implement the specific plans needed to meet the requirements of the Clean Water Act. Under Phase III, a regional watershed and funding approach will be in place. These regional initiatives will be designed to implement the plans required to meet appropriately revised water quality standards.

This approach suggests roles and responsibilities for the principal stakeholders including:

- The Partner Communities
- ALCOSAN
- 3RWWDP
- The Regulatory Community

In the first phase, discussed below, there is a role for the 3RWWDP to develop a regional approach to the management of watershed and wastewater issues. Within this development will be the need to identify how the facility planning associated with the LTCP will be done. ALCOSAN will need to be a major participant in the planning effort as well as the Partner Communities. However, the entity responsible for leading facility planning group(s) and the organization and structure of this group(s) still needs to be established.

**Description of Phase I**

*Concept - Move forward with critical repairs. Develop information needed to do LTCP facility planning and develop a regional approach to sewer and watershed management. This Phase is achievable with the current community structure.*

The Facility Basin Planning that will be done in Phase II will be dependent on knowing the flows from the sewersheds and having the information needed to balance conveyance and treatment against the cost effectiveness of I/I abatement. Phase I will include demonstration projects to establish the I/I cost effectiveness. The SSES work will provide the flow data needed for basin facility planning and critical repairs will be addressed. In addition, Phase I will form the basis for a regional approach to watersheds, funding and the management of sewer systems.
Phase I - Roles and Responsibilities

For the Partner Communities:
- Obtain physical survey data needed to construct a model for LTCP development
- Determine the flows
- For separate areas determine the I/I and collect data needed to determine runoff
- For combined areas determine the captured runoff flow characteristics
- Fix critical collection system maintenance and structural problems
- For CSO communities, implement regionally-developed nine minimum controls
- Development of a consensus regional sewer overflow response plan
- Participate in the selection of a regional approach to the management of watershed and sewer issues

For 3RWWDP:
- Assist in managing the Partner Communities’ overall efforts
- Lead in developing regional NMCs
- Determine the cost effectiveness of I/I control in each basin and sewer type relevant to the selection of basin facility plans
- Assist in the development of a regional sewer overflow response plan
- Lead the development and selection of the regional approach to the management of watershed and sewer issues
For ALCOSAN:
- Proceed with the expansion of the WWTP to maximize wet weather treatment
- Address issues of maximizing flow to the WWTP
- Implement regionally developed NMC for ALCOSAN facilities
- Participate in the selection of a regional approach to the management of watershed and sewer issues

For the Regulators:
- Assist in the development and approve regional NMCs for community implementation
- Organize and encourage a team to identify and begin to evaluate EPA’s wet weather use and water quality standards review process and necessary inputs
- Provide feedback on the regional sewer overflow response plan
- Remove the TAP bans for communities participating in Phase I

All Parties:
- Establish organization and structure for final LTCP development and facilities planning group(s)
Description of Phase II

Concept - Move forward on the cost effective projects identified in Phase I as expected under any future LTCP. Implement a regional approach to funding and watershed management and complete the LTCP. With a regional approach it will be feasible to move forward projects that are currently impractical and do a coordinated LTCP facility plans.

Phase II Strategy

Phase II - Roles and Responsibilities

For the Partner Communities:

- Proceed with clearly effective I/I controls
- Cooperate with ALCOSAN in the development of an affordable, implementable and cost-effective LTCP
- Make decisions about regional or basin-wide collection system management
- Participate in the LTCP beyond the cost effective I/I and the facilities planning and modeling for each basin
For ALCOSAN:
- Participate in the LTCP development beyond the cost effective I/I control and conduct/facilitate facilities planning and modeling for each basin

For 3RWWDP:
- Assist in the development of the LTCP
- Assist with a wet weather use/WQS review
- Assist with decision on basin wide collection system management and watershed management issues
- Assist in NMC implementation
- Assist Partner overall efforts

For the Regulators:
- Lead WQS review
- Participate in the development and approve LTCP and any related designated use/WQS refinements
- Prepare TMDLs coordinated with the LTCP – address all other watershed pollutant issues and use impairments

Phase III - Roles and Responsibilities

For the Partner Communities:
- Implement LTCP
- Participate in the development of a Regional CMOM
- Implement regional CMOM
- Address non-LTCP Watershed Issues

For 3RWWDP:
- Assist in the development of a regional CMOM
- Assist Partner overall efforts
- Coordinate Watershed issues of the Partners

For ALCOSAN:
- Implement LTCP for ALCOSAN facilities
- Implement regional CMOM for ALCOSAN Facilities
- Participate in the implementation of programs to address Watershed Issues

For the Regulators:
- Approve regional CMOM approach
- Develop permitting of point sources coordinated with the Watershed approach
- Address non-point sources in the Watershed
3.1.6 Assessment of The Agreement Proposed By EPA/ACHD/PA

The Partner Communities have raised substantial concerns with the proposed agreements. Silence from the Communities would have been a signal that they were not focusing on this or taking it literally (and seriously). Nothing would be worse than having the Communities sign such agreements without a strong commitment to make best efforts to live up to them.

The conundrum here is that the agencies don’t want to negotiate 83 individual orders, while the communities want orders that are narrowly tailored to their collection systems and ultimately address the issues described above. From the communities’ perspective, this tailoring is essential to allow them to focus their resources to develop the information that is necessary for the regional long-term control plan and to identify and address critical system deficiencies.

The best way to accommodate these divergent interests is to propose back to the agencies orders that would have the individual communities develop and submit for approval tailored plans addressing each of the requirements in the order. The agencies will be understandably averse to such an approach because they will end up reviewing many local plans covering the four main Phase I tasks. This is a legitimate concern and needs to be addressed. The following is suggested to make their approach practical:

- First, a generic form of a plan for each requirement (or group of requirements) could be developed as a guide for community engineers to use. This customization will make it easier for everyone to understand what is required and for the agencies to review the proposals.

- Second, it is clear that in return for the ability to tailor their activities going forward, the Partner Communities will have to provide a project manager or management firm. The project manager's role would be to serve as a resource to the Partner Communities and their engineering consultants. The project manager would facilitate consistency among the communities’ approaches and the development of appropriately tailored community plans. Finally, the project manager would work with the agencies to ensure their prompt approval of those plans.

Thus, the agencies would end up reviewing fairly standardized plans that had been vetted by the regional manager/management firm(s).

This approach is practical and may offer the greatest chance of carefully targeting regulatory requirements (and the resources that would follow) to the development of meaningful information. It should also allow expeditious attention to and the resolution of major collection system deficiencies.

It is recommended that the Partner Communities and ALCOSAN aggressively pursue this type of approach with EPA Region III and its partner agencies. If they agree to this, then sleeves get rolled up and negotiations/drafting begins. If they reject it out of hand, then the basin communities should immediately seek support from political sources that may include the Allegheny County Executive and the County's State and federal legislative delegations.
Failing that, those that have carefully analyzed the agreements and conclude they can reasonably comply with the agreements as written should sign. The others should NOT sign the agreements and, instead, should develop their own approach and propose it to PaDEP/ACHD/EPA and proceed to implement it. EPA/ACHD/PaDEP may seek to enforce against those that refused to sign. These targeted communities will be able to tell the judge that they could not sign the earlier agreement because they could not comply and that they did the next best thing by trying to move forward as best they could. A judge is likely to see merit in this and might even allow them the time, tailoring, and flexibility they need out of a consent decree.

EPA has recently written to the Core Basin Group and inquired about its role to aid in communications between the basin communities and the regulatory agencies.

EPA should recognize several factors relating to this issue:

- The Core Basin group has been constituted to lead the communication of issues from the communities through the 3RWWDP.

- If the regulatory agencies do not agree to the Core Basin group, they will have to go the route of negotiating with each community.

- If the regulatory agencies can come up with an agreement that addresses issues raised by the communities through the Core Basin Group, an agreement will have been achieved that most of the communities will sign. Communities that refuse to agree will have substantial pressure on them to agree.

The 3RWWDP and the Core Basin Group can play a helpful role in moving the region to a more manageable regional effort to address watershed issues. EPAs support of this approach would be to foster a watershed approach. To ignore this group would be antithetical to EPAs announced aspirations to promote local watershed planning and management.

Because we do not believe that the basin communities can comply with the draft consent orders that have been presented, we believe the communities have no choice but to try to negotiate an alternative approach with the agencies. Whether such an effort will be successful is unknown. However, the basin communities should not give the agencies the high moral (and legal) ground by agreeing to an order which they cannot comply with. In the unlikely event that EPA insists on the original orders, it would be best for the region if all of the basin communities reject it. That will make clear to EPA management and others just how unreasonable the agencies' proposal is.

There are far more difficult, complex, and expensive requirements ahead than are presently embodied in the current orders. If the region does not stand together now, it does not bode well for the future.
Finally, if the basin communities can stand together to negotiate tough, but appropriate, attainable agreements and then implement those agreements, it will set the stage for future regional cooperation on the more difficult issues that remain. To the extent the basin communities can investigate regionalization opportunities, it may also reduce the number of entities that will have to negotiate the regime’s future water quality progress.
4.1 GENERAL

As detailed in the regulatory history, the Concept Plan was developed to address both CSO and SSO issues within the ALCOSAN service area. From review of the written documentation and meetings with ALCOSAN and their consultant, CDM, it has been conveyed that the draft Concept Plan has been developed to a “conceptual” level to establish the outer boundary financial requirements for the region and to propose an approach to obtain regulatory compliance. The meaning of a Concept Plan as opposed to plans of more detail has been a source of much confusion and concern with the Partner Communities. For the purposes of this review a Concept Plan and a facilities plan are defined as follows:

Concept Plan – A plan that:
- Identifies the overall issues to be addressed
- Establishes the extent of the problem
- Describes the general approach to solve the problems
- Includes a cost estimate sufficient to understand the magnitude of the impact on financial resources
- Lays out an approach to develop specific facilities plans

Facilities Plan – A plan that:
- Identifies the specific issues to be addressed with a specific facility or group of facilities
- Defines the problem in quantitative terms
- Develops the specific solution
- Defines the size and nature of facilities
- Selects particular sites for facilities
- Develops a facilities plan cost adequate for budgeting purposes
- Does not include a preliminary design

Stakeholders have provided many comments and questions on the Concept Plan. This report will attempt to address these questions. However, many of the more site-specific questions will most likely obtain complete resolution during the facility planning or the design process.

4.1.1 Overview of the Concept Plan

The key components of the Concept Plan are summarized as follows:

- Modify and expand the wet weather treatment capacity of the ALCOSAN wastewater treatment plant to accept approximately the maximum practicable amount of flow that can be conveyed by the existing drop shafts, river crossings and tunnel system configuration. This maximized flow is proposed to be treated utilizing an upgraded WWTP with 310 mgd peak secondary treatment capacity and 565 mgd wet weather treatment for a total of 875 mgd as shown on the following page:
The treatment plant wet weather expansion was investigated by ALCOSAN during the Act 537 update and preliminary site layout, facilities, and cost estimates for these facilities have been developed.

Utilize the EPA CSO Policy Presumption Approach (see Section 8) by capturing for treatment 85% of the combined sewer area flow.

- Generally for flow not able to be conveyed at river crossings or through the existing tunnel system to the wastewater treatment plant, utilize remote treatment technology to treat to the levels called for under the presumption approach. The Concept Plan uses a treatment technology referred to as “Swirls” for developing concept costs.
- Increase ALCOSAN’s interceptors’ capacity to convey flow to treatment facilities. Where conveyance to the wastewater treatment plant or swirl treatment was considered impractical, sewer separation was used to develop a cost placeholder during this conceptual phase.
- Result: 10 swirl facilities ranging in size from 10 mgd to 131 mgd with a total combined capacity of 481 mgd.
- The presumption approach costs were estimated at a concept level including costs for ALCOSAN interceptors only. Costs to convey flow to the ALCOSAN owned interceptors were not included.
Eliminate SSOs by providing for secondary treatment of flow equivalent to the flow from separate sewered areas by the following means:
- Increase conveyance capacity along ALCOSAN’s interceptors to the tunnel system.
- Provide storage facilities, where increasing conveyance facilities were considered impractical, to hold flow for conveyance and treatment after wet weather conditions had passed.
- Result: 5 previously planned storage facilities plus 12 newly proposed storage facilities ranging in size from 1.1 mg to 26 mg for a total of 17 remote storage facilities with approximately 138.6 million gallons of total storage volume.
- The SSO elimination costs were estimated at a concept level including the costs for ALCOSAN interceptors only. Costs to convey flow to the ACLSOSAN owned interceptors were not included.

Complete comprehensive municipal collection system rehabilitation and/or reconstruction program for both the combined and separate sanitary sewer systems, to be carried out over a 50-year time frame with 40% of the effort complete in the first ten years and 15% completed each of the following decades.

### 4.1.2 Current and Planned Activities

Currently, ALCOSAN has moved forward with upgrading the treatment plant in accordance with Phase I of its Act 537 Plan, which includes odor control and the expansion of the plant’s secondary treatment capabilities to a maximum monthly average daily flow capacity of 250 mgd and a peak secondary treatment capacity of 310 mgd.

In addition, ALCOSAN and its member communities are in consent decree and consent order negotiations, respectively, with regulatory authorities. Future planned activities will be greatly influenced by the outcome of these agreements. However it is generally expected that after a period of additional system characterization, detailed facilities planning will begin. Subsequent sections of this report layout issues to be considered as a final LTCP is developed; and make recommendations on how to address those issues.

### 4.1.3 Modeling

This section discusses the Concept Plan application of a multi-phased modeling approach for hydrologic (rainfall runoff) and hydraulic (sewer) modeling of the ALCOSAN system. Water Quality Modeling of the receiving streams was not conducted as a part of the Concept Plan.

#### 4.1.3.1 Overview

The planning work conducted in the Concept Plan relies on a “Two-Tier” approach to simulate sewer flows and overflows. The completed early phases of the work employed Tier 1 level models. These models included simplifications of system elements to provide economical simulations for screening of area-wide alternatives. ALCOSAN staff have indicated that future phases of the facility planning will employ much more detailed Tier 2 models of sewers within sub-basins of the ALCOSAN service area.
In following a multi-phased (the so-called “Two-Tier”) approach, the Concept Plan has chosen a commonly used course of action. The resulting Tier 1 modeling efforts produced a rough means to identify possible system bottlenecks/shortcomings, to determine the relative magnitudes of system-wide dry- and wet-weather sewage capture/discharge, and to help develop a conceptual remediation plan. However, as CDM has pointed out, Tier 1 model results are not appropriate as a basis for final Long Term Control Plan (LTCP) or for specific facility planning. This is especially true when the Tier 1 models are uncalibrated or calibrated with hydraulic monitoring data limited in spatial or temporal scope. Testament to this is the difference in results between the Tier 1 and Tier 2 modeling efforts performed for the Saw Mill Run sewer shed. The Tier 2 model results, which reflect both refinements of detail to the hydrologic and hydraulic elements as well as some level of wet-weather calibration, are defensibly accurate and more suitable to develop a wet-weather LTCP and specific facility planning.

4.1.3.2 Introduction

To develop hydrologic and hydraulic models appropriate for facilities planning in large, complex sewersheds, an extensive and time-consuming effort is necessary. Such an effort requires field inspections, sewer-system monitoring, and model development/calibration. For example, the City of Cincinnati, Ohio has recently embarked on an $11 million dollar effort to develop a highly refined model of the sewer network based on an extensive amount of sewer monitoring and detailed sewer network configuration. Unfortunately, useful model results are typically not available until late in the project, after the model has been developed. This approach may not fully satisfy the needs of the regulating agencies or allow the project to be completely responsive to changing regulatory practices and remediation technologies.

A solution to this problem is a “phased” approach that first develops models suitable for system-wide assessments needed to satisfy interim regulatory reporting requirements and to identify the most important factors affecting system performance. The project then evolves, with more detailed modeling/monitoring work focusing on the issues that are shown to be most important. In this manner, efforts can be appropriately focused early in the project and not unnecessarily wasted developing detailed information about less significant issues. Even in the case of the Cincinnati modeling effort, this extensive $11 million dollar effort is following a more simplified approach to assess combined sewer flows conducted in preceding years.

Using a simple model first allows the problem to be quickly defined in general ways and helps to provide a direction and a check for subsequent efforts with more complex models.

4.1.3.3 Tier 1

Hydrologic and Hydraulic Models - The Concept Plan Tier 1 approach initially focused on the hydraulic details of the sewer-system network, rather than hydrologic features of the drainage area. The Concept Plan used a hydraulic modeling framework capable of simulating dynamic hydraulic effects (e.g. unsteady flow and surcharging) in complex, branched or looped networks such as found in ALCOSAN’s combined-sewer interceptors, separate-sewer trunks, and flow-control devices (e.g. combined-sewer diversion weirs, variable orifices, and pump stations). This modeling framework, EPA’s Storm Water Management Model (SWMM) Extended Transport (EXTRAN) module, has been perhaps the most widely used modeling framework of its kind in
the U.S. over the past three decades. SWMM EXTRAN also allowed for future adaptation of increasingly complex details that inevitably arise in the later stages of the project.

To develop base dry-weather flows throughout the system, the Concept Plan employed geographic population-distribution information, as well as water/sewer metering and dry-weather sewer flow monitoring. The initial wet-weather hydrologic representation of the sewershed took the form of a simple, ramp-function hydrograph loaded directly to EXTRAN. These synthetic hydrographs were used to assess the hydraulic response in the shallow-cut and deep interceptors. The advantage to using synthetic ramp hydrographs, rather than results of hydrologic (rainfall-runoff) models for actual storms, is that modelers can more easily distinguish response behaviors of the sewer-system from behaviors associated with hydrology (rainfall-runoff). These more detailed elements of the Tier 1 model were employed to develop an estimate of the amount of wet weather flow (SSO/CSO) that is currently being treated at the wastewater treatment plant.

Later in the process, a simple hydrologic modeling approach employing the “Rational Method” and lumped “runoff coefficient” (such as the United States Army Corps of Engineers (USACOE) Storage, Treatment, Overflow, Runoff Model (STORM)) was used to provide a coarse-level characterization of the actual hydrologic forcing and system response. In this way, the Concept Plan was able to estimated annual overflow volume, frequency, and capture statistics for the system. These calculations served to satisfy reporting requirements by permitting agencies and were also useful to make initial assessments of wet-weather impacts, to screen proposed control alternatives, and to establish a direction for subsequent, more detailed analyses.

An alternative approach might have been to start with a simpler version of the sewer system, employing estimates of regulator hydraulic capacities in a pseudo-hydraulic system wherein travel times and flow attenuation are not explicitly calculated (but are instead mimicked using rough estimates of travel times and smoothing of incident rainfall functions). Incorporating a simple, Rational Method-based hydrologic model would round out this simple model, which would be capable of quickly running continuous, long-term simulations. Using available rainfall records and wet-weather sewer flow monitoring (if only at the treatment plant) would allow rudimentary calibration to long-term data. This approach has been used in New York City with surprisingly good success, although the relative dominance of permeable areas and relatively long interceptor runs of the ALCOSAN system would tend to strain the applicability of such an approach.

**Data Collection** - The Concept Plan used information from rainfall monitoring and sanitary-sewer flow monitoring to develop rainfall-dependent inflow and infiltration relationships to represent the hydrologic contributions from separately sewered areas. These relationships were incorporated both into the synthetic hydrographs used in EXTRAN and directly with the STORM model. They were also used to help calibrate the model for dry-weather flows.

The data collected for this calibration effort was limited. One particular parameter that has been controversial is the estimate of runoff captured in the separate sewer system (RDI/I). The Concept Plan used a value of 7.5% in the modeling efforts for RDI/I. Discussions held during this review with area engineers indicated anecdotal information or RDI/I varying by area from a low of 2% to a high of 12%. These same engineers generally concurred that the average for the
ALCOSAN service area might well be in the 7.5% range. It can be concluded from this, that the modeling conducted gives a reasonable first cut at the separate area flows for the whole of the ALCOSAN area. However, these estimates cannot be used to assess the needs of a particular sub-basin. Facility planning will require detailed monitoring of the specific watershed that the facility is planned for.

**Simulation Period** - For the generation of long-term CSO statistics, including average annual frequency and volume, single-event or design-storm simulations are not as suitable as long-term, continuous simulations. Continuous simulation more thoroughly accounts for antecedent conditions and inter-event dynamics in the system.

**Use of Tier 1 Modeling** - The Tier 1 models provided a basis for initial characterization of the hydrology and hydraulics of the sewage interceptor transmission and treatment system. ALCOSAN is also using them as an initial means to estimate system-wide statistics for CSO frequency, duration, and volume as required for NPDES Phase I permit compliance. ALCOSAN has also used the Tier 1 models to estimate the operating capacity of interceptors, trunks and treatment systems and the capability of that infrastructure to provide future service needs. The Tier 1 models supported ALCOSAN development of conceptual planning for system expansions, such as proposed relief sewers, and selection of alternatives for regional long-term wet-weather controls.

**4.1.3.4 Tier 2**

The focus of the second phase of the modeling effort will be to refine the representation of hydraulic and hydrologic processes of the sewershed. The intent of the “Tier 2” effort is to develop a model appropriate for facilities planning. The Tier 2 models will be developed for individual sub-areas that have been identified as priorities by ALCOSAN based on the Tier 1 model results. In this way, model refinement efforts are being appropriately targeted to the areas and issues that are of primary importance.

**Hydrologic and Hydraulic Models** – The particular focus of Tier 2 models involves refining the hydrologic models; in particular, more accurately simulating infiltration in pervious areas to estimate the rainfall-dependent flows that enter the sewer system. This refinement moves the approach from the Rational Method of STORM to an approach such as the Horton or Green-Ampt method in SWMM’s RUNOFF module. Linking RUNOFF with EXTRAN enabled the initial dry-weather EXTRAN calibration to be expanded and refined using wet-weather flows.

The Tier 2 phase of the modeling effort also involves adding finer detail to various hydraulic elements of the physical system. It also involves refining flow routing within the sewersheds, developing in-system storage computations for the modeled sewers, and evaluating the influence of the in-system storage on routing and overflows.

**Collected Data** - The precision of the input data for some parameters will also be refined in Tier 2 models. For example, the sewershed-specific wastewater flow rates and the sewershed-specific impervious-cover allocations can be refined from previous values estimated regionally. These data may continue to be updated as the life of the project continues and more data becomes available from ongoing monitoring work.
Other refinements involve precipitation information. In addition to the long-term hourly record, data collected at 5 to 15-minute intervals at local rain gages can allow Tier 2 models to be used in simulations for whatever period of record is available. In this way, for example, the effect of short bursts of rainfall can be simulated to ensure that short-term dynamics are not missed. Another refinement can be the application of NEXRAD rainfall data to establish typical spatial fluctuations in precipitation. Application of uniform or averaged rainfall intensities over the sewershed is sometimes satisfactory for long-term simulations, but this practice tends to eliminate precipitation fluctuations that are reflected in the system’s hydrologic response. Using enhanced spatial resolution of precipitation is especially useful in the model calibration and verification process.

Initial hydrologic (RUNOFF) and wet-weather hydraulic (EXTRAN) calibrations will performed using stage- and flow-monitoring data that will be develop intensively within each sewershed undergoing detailed facility planning evaluations. Tier 2 model calibrations will improve as additional monitoring data become available. As model refinements are made and the model’s accuracy can be demonstrated against sufficient monitoring data, the model becomes more robust and able to meet the requirements of a design tool for facility planning.

**Simulation Period** - For the generation of long-term CSO statistics, including average annual frequency and volume, single-event or design-storm simulations are not as suitable as long-term, continuous simulations. Continuous simulation more thoroughly accounts for antecedent conditions and inter-event dynamics in the system. RUNOFF/EXTRAN can be run in continuous mode for this purpose, although run times to simulate a 50-year rainfall record can be long and results can be impractical to analyze. To overcome this problem, ALCOSAN has adopted a more efficient method wherein EXTRAN simulations of single events are used to generate the model representation of the trunk and interceptor system in an enhanced, continuous-simulation version of EXTRAN, which is in turn used to perform the actual continuous simulations of the sewer system. This method appears to work well, although the effect of diurnal dry-weather flows on sewer system performance is not clear. It could be noted that other modeling frameworks claim to have shorter run-time requirements.

**Use of Tier 2 Modeling** - The Tier 2 models will be refined and updated versions of there Tier 1 counterparts. Once sufficiently calibrated, Tier 2 model results will replace Tier 1 results to provide refined quarterly CSO discharge estimates for NPDES permit reporting, where required. ALCOSAN is using the Tier 2 Saw Mill Run model for this purpose. Tier 2 models can also be used to determine the operating capacity of system elements and their capability to provide future service needs. Most importantly, Tier 2 models can support the facility planning and design phases for the implementation of wet-weather overflow control planning, including CSO and sanitary-sewer enhancement programs.

**Receiving Water Modeling** - Receiving water modeling was not discussed or presented in the Concept Plan. However, ALCOSAN staff has indicated that they are willing to participating in regional and interstate comprehensive watershed based planning and analyses. A water quality sampling and analysis program will be needed to provide the baseline calibration for this effort.
4.1.3.5 **Recommendations and Use of Output**

It is recommended that the sewer system models be refined to the Tier 2 level tools before concluding on a final facilities plan for any particular sub-basin of the ALCOSAN service area. Tier 2 modeling is required to select the trade off between sewer rehabilitation and conveyance or storage for treatment. Decisions made to site and control facilities should only be made after the Tier 2 models are developed and fully calibrated to local data collected within the urban watershed for which facility planning is being conducted. It is recommended that flowing and level monitoring be conducted at simultaneously at points in the main interceptor for each basin and key system interconnections to perform the model calibration and to fully asses the possible benefits of real time control. In addition, it is recommended that receiving water modeling be utilized as a tool in subsequent facilities planning stages in combination with a watershed approach to aid in identifying benefits and balancing these benefits against costs.

With respect to the efficacy of the current model results, it should be understood that these estimates should be used at the conceptual level only, and only for the purpose of the next stage of planning to move beyond the conceptual level. The specific flows from a reach or sub-basin are a result of averaged data over the entire ALCOSAN service area. Although the review team has used the model output in subsequent evaluations, it should be understood that these are also conceptual estimates because these evaluations also rely on the conceptual model output.
Section 5
Evaluation of Concept Plan – Regulatory Policies and National Trends

5.1 INTRODUCTION

This section evaluates the draft Concept Plan against key regulations that affect the development and selection of the CSS Long Term Control Plan. Governing regulations are concerned with water quality and sensitive areas; and establish criteria upon which a LTCP should be selected. National Trends for other CSO cities are also discussed.

5.2 EPA COMBINED SEWER OVERFLOW (CSO) POLICY

As described in Section 3 and as a result of changes in Federal Law in December of 2000, all permits and orders relating to CSOs are required to conform to the 1994 National CSO Control Policy. Although ALCOSAN’s 1995 permit referenced the 1994 Policy, it did not strictly conform to it. This review examines the Concept Plan from the standpoint of the existing law requiring permits and orders to conform to the policy. It is important to note that the Concept Plan was not developed under this law and this section in no way should be interpreted to convey that permit requirements or other obligations have not been met. To the contrary as described in Section 3, because of the “Soldiers Meeting” the scope of the Concept Plan was extended beyond permit requirements.

The Policy is framed around these concepts (EPA 2001):

- Provide clear levels of control that would be presumed to meet appropriate health and environmental objectives.

- Provide sufficient flexibility to municipalities, especially financially disadvantaged communities, to consider the site-specific nature of CSOs, and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements.

- Allow a phased approach to implementation of CSO controls considering a community’s financial capability.

- Review and revise, as appropriate, water quality standards and their implementation procedures when developing CSO control plans to reflect the site-specific wet weather.

- Implementation of minimum technology-based CSO controls.

- Development of long-term CSO control plans which evaluate alternatives for attaining compliance with the CWA, including compliance with water quality standards and protection of designated uses, and modifications to the standards if warranted.
Under the policy, a long-term CSO control plan comprises several principal elements, set forth below. This report evaluates the draft Concept Plan in relation each of the elements.

1. **Characterization, Monitoring, and Modeling of the Combined Sewer System**, which includes compilation of background information, field monitoring and development of predictive models tailored to the complexity of the CSO system and information needs associated with evaluation of CSO control options and water quality impacts.

Modeling, system characterization and limited monitoring activities were carried out as a part of development of ALCOSAN’s Concept Plan development effort. It is clear that significant progress has been made in documenting and understanding the backbone of the sewer system, which is ALCOSAN’s interceptor and tunnel system. This work provides the basis for proceeding with the expansion of the WWTP capacity.

Yet to be accomplished is a thorough understanding of the combined and separate systems in the Partner Communities. It is recommended that an integrated approach be taken during the facilities planning stage such that in each basin each CSO and SSO outfall is modeled and understood so that appropriate alternatives may be developed. Detailed commentary on the modeling is included in Section 4 of this report. In regard to evaluation of water quality impacts, the Concept Plan provides a brief discussion indicating only percent of compliance of the sample data with Pennsylvania Water Quality Criteria under current dry and wet weather flow conditions without any improvements. Water quality improvements from the Concept Plan are not presented or analyzed in the draft Concept Plan report. Based on the significant expenditures required to implement the Concept Plan, it is recommended that benefits of alternatives be evaluated during the facilities planning phase through receiving modeling.

2. **Public Participation** which requires the permittee to employ a public participation process that actively involves the affected public in the decision-making to select the long-term CSO controls.

It is our understanding that public participation for the development of the Concept Plan began once ALCOSAN completed draft Concept Plan. At that point ALOCSAN conducted multiple presentations to inform community officials about the draft Concept Plan. This approach appears to have left many communities feeling they did not have voice in the decision making process for selecting the plan, which they will ultimately be required to finance. In addition it is important to include persons who enjoy the use of the impacted waters. It is recommended that as the basin facilities planning efforts move forward, alternatives for each basin be developed with the benefit of stakeholder involvement from the very start. The stakeholder process allows people to have input into formulation and development of the plan and allows concerns to be addressed fostering consensus. It is also recommended that general public meetings be held to invite all citizens to have a voice in the plan development. These meeting should be held periodically prior to the public hearing required for final plan selection. However, it is recognized that with the large number of community stakeholders this will be an involved task. Public Participation is discussed further under the Watershed Approach described in Section 7.
3. **Consideration of Sensitive Areas** - Permittees are required to give the highest priority to controlling overflows discharging to sensitive areas such as outstanding natural resource waters, above public drinking water intakes and to protected areas, such as waters with threatened or endangered species and their habitat, waters with primary contact recreation, and shellfish beds. These sensitive areas are to be determined by the permittee and NPDES authority.

Under the National CSO policy, designated sensitive areas require very specific consideration under the LTCP. For CSOs in Sensitive areas, each should be:

> “Eliminated or relocated wherever physically possible and economically achievable, except where elimination or relocation would provide less environmental protection than additional treatment.”

This requirement has been interpreted to mean that relocation or elimination alternatives should be developed for sensitive area CSOs under the LTCP. While it is often not possible or economically achievable to eliminate or relocate these CSOs, the alternatives analysis should be developed for the purposes of weighing the costs and the benefits.

The September 1996 ALCOSAN *Implementation of the Nine Minimum Controls* report states that areas of concern for environmentally sensitive areas might include the following:

- Public drinking water intakes, agricultural and industrial intakes
- Fishing and primary and secondary contact recreation areas
- Public and private marinas and parks and other high public visibility and aesthetic impact areas

Moreover, the NMC Report indicates that a sensitive areas analysis will be conducted as part of the Long Term Control Plan development effort. The draft Concept Plan, however, is silent on this issue. Information provided to the Third Party Review Team regarding sensitive areas investigations carried out by ALCOSAN indicates several public water supply intakes are located in close proximity to certain CSO Outfalls; that threatened and endangered fish species are listed for Allegheny County; and that secondary contact activities such as boating occur in the receiving waters impacted by CSOs. However, there appears to be no information on PaDEPs response to this information. Under the CSO policy sensitive areas are:

> “…as determined by the NPDES authority in coordination with State and Federal agencies”

In practice, the permittee (ALCOSAN) often does the background work to determine the likely sensitive areas. However, under the new federal requirement to conform to the CSO Policy, it would appear that PaDEP has a specific responsibility to make the sensitive area determination.

It is recommended that PaDEP be engaged on this issue and that each of these sensitive area issues be thoroughly discussed in an open and public forum. Of particular concern are the Safe Drinking Water Act issues that are highlighted below.
Drinking Water Intakes

Drinking water intakes are located downstream of ALCOSAN CSOs for the following water suppliers in Allegheny County:

- Pennsylvania American Water
- West View Borough Municipal Authority

The PWSA intake is above the ALCOSAN CSO discharges, but there are other CSO systems upstream. The issue of CSO discharges as it relates to the water intakes is complex. However, the principal impact issue can be understood through the Safe Drinking Water Act.

Safe Drinking Water Act

General - Drinking water quality is regulated by the US Environmental Protection Agency (USEPA) under the Safe Drinking Water Act (SDWA), which was initially enacted in 1974. This law, its amendments, and the current body of regulations promulgated since its enactment were the result of much debate and concern over ensuring the safety of drinking water from naturally occurring contaminants and contaminants introduced from both point sources and non-point sources of pollution. The SDWA currently regulates a total of 92 contaminants by Maximum Contaminant Levels (MCLs) (19 inorganic, 60 organic, 8 microbial/indicator organisms, 4 radio nuclides, filtered water turbidity) and treatment techniques are required for 9 contaminants.

Source Water Quality Assessment - The 1996 amendments to the SDWA required that each State establish a new state program for Source Water Quality Assessment (SWQA). The SWQA includes the delineation of the boundaries of the source waters for public drinking water supplies including identification of contaminants regulated under the SDWA and those that present a threat to public health. The results of the SWQAs must be made available to the public.

Interim Enhanced Surface Water Treatment Rule - The original Surface Water Treatment Rule (SWTR) was promulgated and became effective in 1993 and included regulations for filtration, disinfection, turbidity, Giardia lamblia (Giardia), viruses, Legionella and heterotrophic bacteria. The SWTR was designed to control microbiological contamination in general. Cryptosporidium (Crypto) data was not considered adequate in 1993 to allow it to be included in the SDWA requirements until additional field data was collected. The SDWA required that a minimum of 3 Log reduction in Giardia levels by treatment be provided by removal or inactivation. The Interim Enhanced Surface Water Treatment Rule (IESWTR) became effective on January 1, 2002 and added Crypto requirements to SWTR with a requirement that surface water supplies provide treatment for a minimum of 2 Log reduction in Crypto levels regardless of source water quality. The Milwaukee Crypto episode where over 400,000 people became sick and dozens of people died was the reason the water utilities and EPA have enhanced their operations and increased regulatory requirements.
Long Term 2 Enhanced Surface Water Treatment Rule - EPA is scheduled to finalize and promulgate the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) in 2002 and local water systems will have to comply with the rule by 2008, if additional treatment facilities are needed. This Rule will apply to all public water systems that use surface water. The major focus of this rule is to control microbial pathogens, including specifically (Crypto). This rule will require that higher levels of treatment be provided where higher levels of contaminations are present in the raw water. The rule requires that a minimum of 2-log inactivation/removal be provided for Crypto for surface water treatment facilities. The rule provides a 2-log removal credit for conventional treatment plants provided that Crypto concentrations in the raw water are below 7.5/100L. Crypto concentrations in the Allegheny River have been reported to average 31/100L with maximum exceeding 2,200/100L. These higher Crypto concentrations levels in the source water would require that the surface water treatment facilities go to higher levels of treatment in order to comply with the LT2ESWTR.

Because Crypto concentrations in CSO can be expected to be very high, downstream water treatment plants will need to provide a higher level of treatment (ozone, UV, membranes, etc.) over the long term in order to provide an effective barrier. Chlorine disinfection is effective for inactivation of Giardia and viruses but is not effective for inactivation of Crypto.

Synthetic Organic Chemicals Rule - The Synthetic Organic Chemical (SOC) Rule was promulgated by USEPA in 1992, and other contaminants have been added to the list of regulated chemicals since the rule was promulgated. USEPA is required by the SDWA to regulate a minimum of 5 additional contaminants every three years that can be expected to include additional SOCs.

In the future SOC chemical contaminates which are shown to be endocrine disruptors can be expected to be regulated. The proliferation of SOC from synthetic organic rubber to modern pharmaceuticals is expected to continue into the future. The Endocrine Disrupter issue has arisen in the past few years represents a new, more sophisticated concern that some of these SOCs may be affecting the environment in a subtle manner by potentially interfering with the endocrine systems found in humans.

Future Regulations - Future regulatory requirements for new chemical compounds (like Endocrine Disrupters for example) can be expected as additional information becomes available and health effects are established.

Source Water Quality Protection programs will be enhanced in the future and will include requirements for removal or control of potential sources of contaminants, such as CSOs and SSOs.

Nitrate and Nitrite - Nitrate and Nitrite currently have regulated limits of 10 mg/l and 1.0 mg/l respectively. Concentrations of these contaminants in the raw waters sources would have major impacts on the water treatments facilities because of the inability of conventional plants to remove these contaminants.
Concept Plan SDWA Principal Issues

The most important of these SDWA issues to the Concept Plan is the potential impact of Crypto in the short term and Source Water Protection requirements over the long term.

In the case of the Allegheny County water intakes, preliminary data on Crypto concentrations indicate that the highest level of treatment will likely be required at the drinking water plants. This treatment will be required within 5 years. Even if the abatement proposed under Concept Plan were able to completely address the issue of Crypto in the water supply, it is impractical to complete such an abatement program within 5 years. This leaves the question of how to address the issue of Crypto in CSO. It is recommended that CSO controls for Crypto control be considered in the following context:

- Although the Water Treatment Plants will be required to provide a high level of control for Crypto, it is difficult for these processes to completely prevent all disease-causing organisms from passing through the plant. This is why source water protection is a part of the rule.

- Crypto in the source water is coming from many sources; each of these should be assessed and to the extent practicable addressed. These sources include:
  - Agricultural practices
  - Urban stormwater
  - CSOs wastewater treatment plant discharges

- Crypto is not effectively controlled by Chlorination. Filtration, ultraviolet and ozone disinfection processes are increasingly used.

- CSO abatement should consider giving priority to abate CSOs closest to the water intakes or providing effective Crypto removal.

It is not recommended at this time that additional CSO control facilities be specifically included or modified to address this issue. However, as the discharges that have the potential to impact water supply are addressed, consideration should be given in the final LTCP to reducing the risk of Crypto where possible and in the context of the other sources.

Safe Drinking Water Act issues highlight the need for PaDEP to take an aggressive role in seeing that water quality issues are addressed in a Watershed Approach. Resolving the CSO issue and leaving upstream direct sewer discharges or agricultural practices that allow livestock to directly pollute streams will undermine the in stream progress from CSO abatement. Moreover, these sources will pose ongoing health concerns.

4. Evaluation of Alternatives - to achieve a range in frequency of overflow events. The plan should, for example, examine from one to twelve per average year and expansion of treatment capacity or alternately controls that achieve 100% capture, 90% capture, 85% capture, 80% capture and 75% capture of wet weather flows for treatment.
A limited range of alternatives was addressed to achieve 85% capture (presumption approach) for CSOs and full capture of SSOs; however the full range of capture alternatives for CSOs has not yet been analyzed. A full discussion on the presumption approach is included below in Section 8.

5. **Cost/Performance Consideration** - which requires that appropriate cost/performance curves be developed to demonstrate the relationships among a comprehensive set of reasonable control alternatives that correspond to the specified range of control levels. This should include analysis to determine where the increment of pollution reduction achieved in the receiving water diminishes compared to increased cost.

Cost/performance considerations were discussed in the Concept Plan; however cost curves were not developed for a range of control levels. Section 8 discusses cost performance consideration with respect to money saving measures. It is recommended that cost curves related to receiving water benefits/pollution reduction can be developed as basin facility plans are developed.

6. **Operational Plan** - which requires that after the NPDES permitting authority and permittee agree on necessary CSO controls to be implemented under the LTCP, the permittee will revise their operation and maintenance program to include the agreed-upon long term CSO controls.

Within the Concept Plan, ALCOSAN commits to make necessary changes to its operational plan to carry out the selected long term CSO controls once agreed upon with the regulatory agencies.

7. **Maximizing Treatment at the Treatment Plant** - one goal of the CSO Control Policy is to increase the amount of wet weather flow receiving full treatment.

The Concept Plan incorporates plant expansion activities laid out in ALCOSAN’s Act 537 Facilities Plan; which proposes to significantly increase of the amount of wet weather flow reaching the treatment plant. A peak capacity of 310 mgd of flow will receive full secondary treatment and disinfection. Additional wet weather flow up to 565 mgd will receive preliminary treatment, primary clarification and disinfection. In depth discussion and an assessment of the Concept Plan elements is discussed in Section 6.

8. **Implementation Schedule** - which requires the development of a construction and financing schedule for the implementation of the LTCP. Schedules for implementation of CSO controls may be phased based on the relative importance of adverse impacts upon WQS and designated uses, identified priority projects and on financial capability.

The Concept Plan has addressed this requirement by proposing a nineteen-year implementation schedule for planning, design and construction of the proposed facilities and a fifty-year schedule for municipal collection system rehabilitation. The financial aspects of such a schedule are discussed in Section 6.
9. **Post-Construction Compliance Monitoring Program** - which requires implementation of a post-construction water quality-monitoring program adequate to verify compliance with water quality standards and protection of designated uses.

ALCOSAN commits to make necessary changes to its operational plan to carry out and verify the effectiveness the selected long-term CSO controls once agreed upon with the regulatory agencies.

10. **Coordination with State Water Quality Standards** - As indicated in its CSO report to congress last year EPA has stated that during the LTCP process that WQS should be reviewed and where appropriate revised. EPA regulations and guidance provide states with the flexibility to adapt their WQS, and implementation procedures to reflect site-specific conditions including those related to CSOs. For example, states could adopt partial uses by defining when primary contact recreation such as swimming is suspended, such as during a particular type of storm event. In making such adjustments to their uses, states must ensure that downstream uses are protected, and that after the storm event passes, the use is fully protected.

PaDEP did not conduct a WQS review in conjunction with the development of the Concept Plan. Unfortunately PaDEP has resisted participating in the WQS review process. The EPA *Report to Congress on Implementation and Enforcement of the CSO Control Policy* (December, 2001) included the following statement:

> “**Pennsylvania has indicated that it does not currently intend to review water quality standards in conjunction with LTCP development and implementation, but will explore water quality standards reviews in their next triennial review.**”

It is imperative that PaDEP facilitate a WQS a review as the final LTCP is developed during the facilities planning process.

Conducting a wet weather designated use and water quality standards review is a required step under the National CSO Policy. It is also a practical one given the coming reality of total maximum daily loads throughout Allegheny County. In particular, water quality data reveal that few streams meet bacteria standards during and following wet weather events. Unless wet weather uses and standards are developed, TMDLs will be prepared to meet unattainable water quality standards for bacteria. This will force excessively stringent CSO and urban storm water controls where no ambient benefit will be achieved. Put another way, unless we refine designated uses and WQS to reflect wet weather realities, we will spend enormous public funds with no return - not another single day of public use of the water body in question. Only by refining designated uses and WQS will we be able to set attainable goals against which we can tailor wet weather controls.
5.3 EPA DRAFT SANITARY SEWER OVERFLOW POLICY

As described in Section 3, EPA has been working for a number of years to develop regulations for the control of Sanitary Sewer Overflows and to improve operation of municipal sanitary sewer collection systems through revisions to the NPDES permit regulations. The key components of the most recently proposed SSO Regulations are as follows:

- A prohibition on SSOs, which includes a framework for raising a defense for unavoidable discharges.
- Capacity, management, operation and maintenance ("CMOM") programs for municipal sanitary sewer collection systems.
- Reporting, public notification, and record keeping requirements for municipal sanitary sewer collection systems and SSOs.
- Expanding permit coverage to satellite systems.
- Satellite systems must be addressed in the regulations.
- Remote treatment facilities (peak excess flow treatment facilities).
- The Watershed approach should be encouraged.

SSO Prohibition

EPA’s position is that the existing Clean Water Act prohibits SSOs and the only relief for an occurrence is due to extreme weather such as a hurricane or where no reasonable action could have prevented the occurrence and no water quality standard is violated. The SSOs in the ALCOSAN service area have characteristics that require further consideration before concluding they must be eliminated. The definition of CSO system is included in the CWA by reference to the National CSO policy. That definition is as follows:

“A combined sewer system is a wastewater collection system owned by a State or municipality that conveys sanitary wastewaters and storm water through a single-pipe system to a Publicly Owned Treatment Plant.”

Many of the ALCOSAN satellite sewer systems currently designated as separate sanitary sewers appear to have been designed to convey both sanitary sewage and storm water in a single pipe to an overflow point. The magnitude of the flows conveyed indicates sewer sizing designed to convey storm flows. These systems were designed with overflow points that appear similar to the design of CSO points. In the field these facilities and designated CSO structures are indistinguishable from each other.

Changing the designation of an area from separate to combined is likely to be resisted by PaDEP. However, it is important to keep the focus of the abatement priority on addressing water quality
problems. If a particular discharge is causing a significant water quality problem and can be addressed cost effectively, it should receive priority in abatement. If an outfall designated as an SSO does not appear to be relatively significant and it appears that it may have been improperly designated as an SSO a discussion should be conducted with PaDEP or in a watershed approach on how to best address the status of the outfall and its priority under the abatement plan.

CMOM

The CMOM portion of the regulation requires that the collection system operator prepare and put in place the following:

- General Standards – comply with the five general performance standards below.

- Management Program - to designate responsible administrative and maintenance positions for implementing the CMOM program with clear lines of authority and a chain of communication for reporting SSOs to appropriate authorities and the public.

- Overflow Response Plan - to protect public health and the environment that includes trained personnel ready to investigate and correct SSOs when they occur and to notify and report occurrences. The plan should provide for possible emergency operations.

- System Evaluation & Capacity Assurance Plan - to identify SSO locations, identify hydraulic deficiencies, provide estimated capacity of system components, provide capacity enhancement measures to relieve deficiencies and plan updates.

- Audit - Conduct periodic program audits and report results. EPA has developed a reduced checklist to assist in evaluating systems.

- Communication – have in place a system that provides interested parties with information regarding the implementation and performance of the program and allows for feedback and input as the program is developed and implemented.

As described above a CMOM program can be extensive. It will require considerable technical capacity and administrative resources. Many of the Partner Communities may find it impractical to meet the requirements of this federal mandate. As indicated in Section 3, it is recommended that the Partner Communities pursue a regional approach to accomplishing the goals of CMOM and only do so once the priority tasks relating to the development of the ALCOSAN LTCP are completed.

Satellite Permits

It is contemplated that the CMOM requirements and SSO regulations will be imposed on the Partner Communities through an NPDES permit. The proposed SSO regulations call for satellites collection systems to be permitted, even if there are no SSOs. This permitting could be under the ALCOSAN permit, or an individual satellite permit. In general, municipal wastewater authorities have resisted conditions in their permits that impose requirements on their satellite systems. This is often because the treatment authority lacks the legal or the political authority to
address collection system requirements. This understandable resistance must be balanced with the practicality of a small satellite meeting the requirements of a permit with CMOM and other requirements.

As described in Section 3, a regional approach to permitting should be developed.

**Peak Excess Flow Treatment (PEFTs)**

PEFTs are facilities in separate sewer systems designed to abate the impact of an SSO. Typically, these facilities are retention basins that retain a portion of the potential overflow, but in large storms overflow to the receiving stream. PEFTs have been authorized in NPDES permit issued in Texas, California, and New York. Those permits do not require secondary treatment. Generally, PEFTs are considered a last resort to addressing SSO impacts. Although PEFTs may be evaluated in the basin facility planning process, these facilities have a number of drawbacks that make their application to the ALCOSAN service area unlikely. These include:

- PaDEP has resisted permitting such facilities.
- EPA policy is not yet defined and may eventually require secondary treatment for these facilities.
- The ALCOSAN satellite SSOs are generally close to relatively small bodies of water where PEFTs may be less effective.

**Watershed Approach**

Both the CSO policy and the proposed SSO regulations preamble encourage the use of the watershed approach in establishing an abatement plan. This encouragement centers on using the watershed approach to set priorities. In the case of the ALCOSAN watersheds there are a number of water quality issues and pollutant sources that need to be addressed and prioritized in a watershed approach. For CSOs and SSOs this may mean that other pollutant controls should be implemented prior to CSO or SSO abatement. The watershed approach is discussed further in Section 7.

**5.4 NATIONAL TRENDS**

Combined sewers are located in many older U.S. cities. There are currently 859 CSO permit holders with 9,471 identified CSO outfalls in 31 states and the District of Columbia. The general locations of these systems are shown in the following chart. These CSO systems serve approximately 43 million people (EPA, 2000 and 2002). Appendix B includes a summary of national trends from EPA’s report to Congress. There are a number of trends that have evolved in addressing CSOs in these Cities. The trends are grouped in the following areas:

- Permitting
- Enforcement
- Status of NMC
Permitting

The general locations of the nation's CSO communities are shown in the following chart. These CSO systems serve approximately 43 million people (EPA, 2000 and 2002). Permit holders are at various stages of LTCP development and implementation as shown in the chart. There are approximately 155 CSO permit holders in Pennsylvania.

As shown, only 13 percent of communities have long-term controls in place, 19 percent have not yet been required to conduct a LTCP, 41 percent are currently under permit to conduct a LTCP and 27 percent are at some stage of their LTCP implementation. ALCOSAN and most of its Partner Communities are in the 41 percent with a LTCP requirement in their permit, but not yet in implementation. The City of Pittsburgh does not yet have a requirement to do a LTCP.

Enforcement

In April 2000, EPA issued a revised enforcement strategy for CSOs and SSOs. Key elements of this policy include the following:

- For CSO discharges, the strategy requires by end of FY 2000:
  - Examine all CSO communities to ensure they are under enforceable mechanisms for NMC and LTCP.
  - If existing permit does not require NMC/LTCP, an enforcement action should be started to impose these requirements.
  - Plan to inspect all CSO communities by end of FY 2001.
For SSO discharges, the strategy requires:
- Development of inventory of SSO systems with violations.
- Identification each year of 20% of the priority systems with first 20% due by July 28, 2000.
- Initial SSO inventory should be based on the “best available information that the Region has at the time of development.” Regions should use “every tool available” to identify SSO violations.

This policy has resulted in multiple actions being taken on CSO and SSO communities across the nation. In the past, enforcement has been on a case-by-case basis. The April 2000 policy, and congressional attention to CSO and SSO, has resulted in a more organized, systematic federal enforcement program.

**Nine Minimum Controls**

Approximately 90 percent of the communities nationwide with permits have documented some aspect of the NMCs. In addition, about a third of the communities have gone beyond the NMC in some way. In many of these communities the abatement has included a capital program planned before the 1994 CSO policy. Examples of this include the deep tunnel project in Chicago, the Swirl facilities in Washington, DC, and the surface tunnel system in San Francisco. In addition, many communities have concentrated on reducing CSO and SSO through extended Sewer System Evaluation Study work.

EPA data indicate the following NMCs in place in a survey of 811 permits:

<table>
<thead>
<tr>
<th>NMC Category</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1—Proper O&amp;M</td>
<td>567</td>
<td>70%</td>
</tr>
<tr>
<td>2—Maximize use of collection system for storage</td>
<td>571</td>
<td>70%</td>
</tr>
<tr>
<td>3—Pretreatment program review and modification</td>
<td>526</td>
<td>65%</td>
</tr>
<tr>
<td>4—Maximize flow to the POTW</td>
<td>561</td>
<td>70%</td>
</tr>
<tr>
<td>5—Eliminate dry-weather overflows</td>
<td>567</td>
<td>70%</td>
</tr>
<tr>
<td>6—Solids and floatables control</td>
<td>478</td>
<td>59%</td>
</tr>
<tr>
<td>7—Pollution prevention</td>
<td>455</td>
<td>56%</td>
</tr>
<tr>
<td>8—Public notification</td>
<td>450</td>
<td>56%</td>
</tr>
<tr>
<td>9—Monitoring of CSO impacts and efficacy of controls</td>
<td>430</td>
<td>53%</td>
</tr>
</tbody>
</table>
The 10 most frequently used NMCs were reported to be the following:

<table>
<thead>
<tr>
<th>Activity</th>
<th>NMC #</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street sweeping and cleaning</td>
<td>6</td>
<td>181</td>
<td>48%</td>
</tr>
<tr>
<td>Catch basin cleaning</td>
<td>6</td>
<td>158</td>
<td>41%</td>
</tr>
<tr>
<td>Public education programs</td>
<td>8</td>
<td>101</td>
<td>27%</td>
</tr>
<tr>
<td>Sewer flushing</td>
<td>1</td>
<td>90</td>
<td>24%</td>
</tr>
<tr>
<td>Screens and trash racks</td>
<td>6</td>
<td>84</td>
<td>22%</td>
</tr>
<tr>
<td>In-sewer storage</td>
<td>2</td>
<td>77</td>
<td>20%</td>
</tr>
<tr>
<td>Solid waste reduction and recycling</td>
<td>7</td>
<td>68</td>
<td>18%</td>
</tr>
<tr>
<td>Infiltration and inflow control</td>
<td>2</td>
<td>66</td>
<td>17%</td>
</tr>
<tr>
<td>Industrial pretreatment</td>
<td>3</td>
<td>61</td>
<td>16%</td>
</tr>
<tr>
<td>Area/foundation drain, roof leader disconnection</td>
<td>2</td>
<td>57</td>
<td>15%</td>
</tr>
</tbody>
</table>

**LTCP Status**

Again based on EPAs survey of 811 communities the following status of LTCPs was reported:

<table>
<thead>
<tr>
<th>LTCP Activity</th>
<th>Percent of Permittees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft LTCP Submitted</td>
<td>34%</td>
</tr>
<tr>
<td>Documented Implementation Efforts of LTCP</td>
<td>17%</td>
</tr>
<tr>
<td>NPDES Authority Approved LTCPs as sufficient to meet WQS</td>
<td>17%</td>
</tr>
<tr>
<td>Initiated implementation of LTCP without a Permit requirement</td>
<td>3%</td>
</tr>
<tr>
<td>Initiated LTCP without a permit requirement</td>
<td>1%</td>
</tr>
</tbody>
</table>

Of the 275 submitted LTCPs the approach utilized was reported to breakdown into the following:

- 35% followed the demonstration approach
- 25% followed the presumption approach
- 40% combined the approaches or it was unclear

**Technology**

In a survey of 275 Long Term Control Plans the ten most common technologies applied to CSOs are shown as follows:

As shown, most plans incorporate some sewer separation. In some cases it is the only technology applied. However, sewer separation will not necessarily address water quality concerns if the stormwater discharged after separation continues to pollute
Third Party Review of the ALCOSAN Regional Long Term Wet Weather Control Concept Plan

the receiving stream. EPA has an initiative to determine if separation achieves water quality benefits. Sewer Rehabilitation is included in many plans to reduce flows. Retention, tunnel storage and treatment plant improvements are also quite common. The swirl technology proposed is applied in relatively few locations. In some locations where swells have been built for demonstration or pilot testing, the results of these tests have concluded that additional Swirl technology will not be installed. For larger municipal systems, convey and treat or store, convey and treat at the WWTP appears to be the most common approach.

Funding

The Estimated Cost of the Concept Plan approximately $3 billion dollars. This would translate to approximately $3,500 per person in the ALCOSAN service area. This cost is substantially higher than that actually paid to date by communities around the country. Consider these data collected by USEPA on selected cities:

<table>
<thead>
<tr>
<th>Community</th>
<th>Cost to Date $M</th>
<th>Total $ Expected</th>
<th>Grants $Million</th>
<th>% Grants (Grants/ Cost to Date)</th>
<th>Sq-Miles</th>
<th>Population</th>
<th>To Date $1000/ Sq-Mile</th>
<th>Total $/ Person</th>
<th>Local $/ Person (Cost to Date Minus Grants)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bremerton, WA</td>
<td>$23.00</td>
<td>$44.00</td>
<td>$7.20</td>
<td>31%</td>
<td>5.2</td>
<td>36,000</td>
<td>$4,423</td>
<td>$1,222</td>
<td>$439</td>
</tr>
<tr>
<td>Burlington, LA</td>
<td>$14.80</td>
<td>$35.10</td>
<td>$7.00</td>
<td>47%</td>
<td>2.9</td>
<td>27,500</td>
<td>$5,103</td>
<td>$1,276</td>
<td>$284</td>
</tr>
<tr>
<td>Rouge River, MI</td>
<td>$350.00</td>
<td>$1,300.00</td>
<td>$193.00</td>
<td>55%</td>
<td>93</td>
<td>1,600,000</td>
<td>$3,763</td>
<td>$813</td>
<td>$98</td>
</tr>
<tr>
<td>San Francisco</td>
<td>$1,472.00</td>
<td>$1,472.00</td>
<td>$692</td>
<td>47%</td>
<td>49</td>
<td>800,000</td>
<td>$30,041</td>
<td>$1,840</td>
<td>$975</td>
</tr>
</tbody>
</table>

As shown for these example communities, both the actual local cost per person to date and the projected cost are substantially lower than that of the Concept Plan.

For the Communities with large programs, grants have been a substantial part of the solution.

The CWA grant program of the 1970s and 1980s funded CSO and other sewer programs, Secondary Treatment programs and to a lesser extent, Advanced Waste Treatment Programs. In the 1970s, communities such as Chicago and San Francisco were able to get substantial grant funding of their CSO programs. These programs were and are much more expensive on a per capita basis than the secondary treatment programs most other communities were implementing at that time. The main grant program has been converted to a State Revolving Loan Program, however, direct congressional appropriations have continued.
Since 1992 over $600 million in direct federal grants have been given - most to just six cities as follows:

- Rouge River, MI—$253,000,000
- Newark, NJ—$44,300,000
- Onondaga County, NY — $41,089,000
- King County, WA—$35,000,000
- New York City, NY—$34,910,000
- Lackawanna County, PA—$30,000,000

Note: The above data is from EPA’s December 2001 report to Congress. This data does not include MWRA (Boston). Boston, is estimated to have received approximately $600 million - $100 million per year for six years - through EPA's budget.

In addition, about $1,340 million in State Revolving Fund (SRF) Loan money has also gone to CSO projects since 1995. However, according to EPA none of PaDEP’s SRF money has been spent on CSO projects during this period.

Key National Challenges and the Changing Regulatory Responsibility

In the EPA’s 2001 report to Congress, EPA indicated the following areas were key challenges in addressing CSOs.

- Need for additional financial and technical resources
- Complexity of water quality standards review process
- Uncertainty about the roles of EPA and state regulatory agencies
- Applicability of the watershed approach and competing priorities within water programs

These challenges all apply to the Concept Plan. In addition, EPA recognized that the regulatory agencies needed to step up to address these challenges by doing the following:

- Reassess/revise CSO permitting strategy
- Coordinate review of LTCP components throughout LTCP development process and accept/approve permittee's LTCP
- Review water quality standards for CSO receiving waters
- Coordinate review with LTCP development to ensure long-term controls will be sufficient to meet water quality standards
- Revise water quality standards as appropriate, subject to EPA approval
CSO Control Programs in Region III

The following is a description of LTCP Activities being carried out in several other EPA Region III cities.

City of Philadelphia, Pennsylvania

The following are excerpts from Section 1 of the Philadelphia Water Department’s Plan:

The fundamental goal of the Philadelphia Water Department’s (PWD) combined sewer overflow (CSO) program is to improve and preserve the water environment in the Philadelphia area and to fulfill PWD’s obligations under the Clean Water Act and the Pennsylvania Clean Streams Law by implementing technically viable, cost-effective improvements and operational changes.

The PWD’s strategy to attain these goals has three primary phases:

The Phase I Nine Minimum Controls and the Phase II capital improvement program will result in implementation of the highest level of cost-effective, technology-based improvements. They will provide a substantial reduction in CSO volume and frequency and a significantly greater percentage of combined sewer flow transported and treated at the PWD’s three wastewater plants.

In contrast to Phases I, and II the PWD’s Phase III plan is water quality-based. Its emphasis on the completion of watershed planning for each basin is a result of the uncertainty in each watershed regarding the sources of pollution, the relative impact of each source on the attainment of water quality standards, the measures needed to control various sources in addition to CSOs, and, in fact, the ultimate ability to attain water quality standards.

PHASE I – IMPLEMENTATION OF PWD’S NINE MINIMUM CONTROL PROGRAM

In the first phase of the PWD’s CSO strategy, and in compliance with its NPDES permits, the PWD submitted to the Pennsylvania Department of Environmental Protection on September 27, 1995, CSO Documentation: Implementation of Nine Minimum Controls. The nine minimum controls are low-cost actions or measures that can reduce CSO discharges and their effect on receiving waters, do not require significant engineering studies or major construction, and can be implemented in a relatively short time frame. To provide information needed for the development of the Nine Minimum Controls (NMC) program, the PWD instituted a $6.5 million project to upgrade its comprehensive system flow-monitoring network. This program provides information necessary to identify and eliminate dry weather overflows, monitor system performance and operation, and configure and calibrate computer hydraulic models needed to develop the NMCs and long-term CSO control plans.
PHASE II – COMPLETION OF CAPITAL IMPROVEMENT PROJECTS

The second phase of the PWD’s CSO strategy is focused on technology-based capital improvements to the City’s sewerage system that will further increase its ability to store and treat combined sewer flow, reduce inflow to the system, eliminate flooding due to system surcharging, decrease CSO volumes and improve receiving water quality. The recommended capital improvement program is the result of a detailed analysis of a broad range of technology-based control alternatives. The capital improvement plan encompasses the three major areas of the City that are affected by CSOs: the Northeast, Southeast, and Southwest drainage districts. Table 1-1 is a summary of the 17 capital projects were selected by the PWD to provide significant CSO load reduction.

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Capital Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids &amp; Floatables Control Program</td>
<td>$380,000</td>
</tr>
<tr>
<td>Targeted Infiltration/Inflow Reduction Program</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>Integrate Water Quality Objectives into Flood Relief Programs</td>
<td>N/A</td>
</tr>
<tr>
<td>Establish Real Time Control (RTC) Center</td>
<td>$350,000</td>
</tr>
<tr>
<td>RTC – Rock Run Relief Sewer (R-15)</td>
<td>$490,000</td>
</tr>
<tr>
<td>RTC – Tacony Creek Park (T-14)</td>
<td>$450,000</td>
</tr>
<tr>
<td>RTC &amp; Flow Optimization – Southwest Main Gravity Interceptor, Cobbs Creek Cut-off, and Lower Schuylkill West Side</td>
<td>$1,750,000</td>
</tr>
<tr>
<td>RTC – Main Relief Sewer (R-7 through R-12)</td>
<td>$650,000</td>
</tr>
<tr>
<td>Somerset Interceptor Sewer Conveyance Improvements</td>
<td>$300,000</td>
</tr>
<tr>
<td>Upgrade Frankford Siphon</td>
<td>$10,000</td>
</tr>
<tr>
<td>85% CSO Capture Pennypack Watershed (P-1 through P-5)</td>
<td>$230,000</td>
</tr>
<tr>
<td>Eliminate Outfalls: Dobson’s Run Phase I</td>
<td>$6,200,000</td>
</tr>
<tr>
<td>Eliminate Outfalls: Dobson’s Run Phase II</td>
<td>$7,000,000</td>
</tr>
<tr>
<td>Eliminate Outfalls: Dobson’s Run Phase III</td>
<td>$11,700,000</td>
</tr>
<tr>
<td>Eliminate Main &amp; Shurs Outfall (R-20)</td>
<td>$12,000,000</td>
</tr>
<tr>
<td>Eliminate 32nd &amp; Thompson Outfall (R-19)</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>LSWS Conveyance Improvements</td>
<td>$440,000</td>
</tr>
<tr>
<td>Cobbs Creek Low Level Interceptor Conveyance Improvements</td>
<td>$2,500,000</td>
</tr>
<tr>
<td>WPCP Stress Testing</td>
<td>$150,000</td>
</tr>
</tbody>
</table>

**Total Phase II Project Cost:** $48,100,000

Total estimated cost of the capital improvement projects is in excess of $48 million.
PHASE III – COMMITMENT TO WATERSHED-BASED PLANNING AND MANAGEMENT

The third component of the City’s CSO strategy involves a substantial commitment by the City to watershed planning to identifying long-term improvements throughout the watershed, including possibly additional CSO controls that will result in further improvements in water quality and, ultimately, the attainment of water quality standards. The need for this watershed initiative is rooted in the fact that insufficient physical, chemical and biological information currently exists on the nature and causes of water quality impairments, sources of pollution, and appropriate remedial measures. Because of this deficiency, it is currently impossible to determine what needs to be done for additional CSO control or control of other wet weather sources throughout the watershed. This deficiency, especially with respect to the effects of wet weather discharges and receiving water dynamics, is increasingly recognized nationwide and has led to a broader recognition of the need for watershed-based planning and management to properly define water quality standards and goals. The PWD believes that the National CSO Policy, state and federal permitting and water quality management authorities, cities, environmental groups, and industry, now recognize that effective long-term water quality management can be accomplished only through watershed-based planning.

The “demonstration approach” embodied in the CSO Policy literally requires watershed planning in that it directs the establishment of total maximum daily loads (TMDLs) and wasteload allocations where multiple sources are causing non-attainment of water quality standards. TMDLs and wasteload allocations, by necessity, are done on a watershed basis, considering at all sources of pollution. The watershed approach, in fact, is the foundation for the “pollution trading” initiatives that EPA is promoting and which allow targeting resources on the most critical causes of non-attainment in a watershed.

City of Wilmington, Delaware

The City of Wilmington, Delaware, is located on the Delaware River at the confluence of Brandywine Creek and the Christina River. Wilmington is served by a combined sewer system that was constructed in the late 19th and early 20th centuries. The combined system covers an area of 4,300 acres and serves a population of approximately 72,000, nearly the entire population of the City. The system includes thirty-eight combined sewer outfalls, most of which are located in the older densely developed downtown areas of the City. Wilmington also owns and operates (via contract operations) a regional wastewater treatment plant (WWTP) that serves both the City and the majority of surrounding New Castle County, with a total service area population of approximately 500,000 people. Precipitation in the Wilmington area averages just over 41 inches per year.

Wilmington began to evaluate a CSO control program in the early 1990s. Initial activities included a CSO inventory and development of a basic collection system model, water quality and CSO monitoring and modeling to assess CSO impacts on receiving streams, and the evaluation of alternatives to reduce CSO volume and frequency at selected high-priority CSOs. In response to the 1994 CSO Policy, Wilmington implemented their Nine Minimum Control
(NMC) program in 1997 and developed a draft Long-Term Control Plan in 2000. As of February 2002, approval by the State of Delaware of the LTCP is expected shortly.

Wilmington’s CSO program is based on maximizing wet weather flow to the WWTP. This approach was preferred to separation or satellite treatment due to a number of factors, including the cost and disruption of sewer separation and the limited space available for satellite treatment facilities in this densely developed city.

Key components of Wilmington’s CSO program and the draft LTCP include:

- **WWTP Expansion** – a $30 million plant expansion was initiated in 1992 and completed in 1998. The expansion increased average daily capacity to 134 million gallons per day (mgd). The plant is designed to maximize treatment of wet weather flows as follows:
  - Preliminary treatment and disinfection up to 400 mgd
  - Primary treatment up to 250 mgd
  - Secondary treatment up to 168 mgd

  Annual average flow to the WWTP for fiscal years 1996 to 2000 was approximately 88 mgd. Since the plant expansion, capture and treatment of annual average wet weather flow from the City has increased from an estimated 46 percent to 70 percent of total combined wet weather flows. This corresponds to a more than 44 percent reduction in annual CSO volume.

- **Nine Minimum Controls Highlights** – the City has fully implemented the NMCs per the 1994 CSO policy. Key components of the City’s program include:
  - CSO Crew – a four-person crew is dedicated to performing inspections, cleaning and routine maintenance of regulators, outfalls and tide gates to help ensure proper performance of the system. High-priority CSOs are inspected 5 days per week, and all structures are inspected at least once per week.
  - Floatables Control Pilot Project – the City has installed a trash netting system on a large CSO located along the downtown riverfront. The feasibility of using this technology at other CSO locations is being evaluated as part of the implementation of the LTCP.
  - Pollution Prevention – the City has an extensive street sweeping and neighborhood clean-up programs that prevent a significant amount of solids and floatables from entering the combined sewer system.
  - Public Notification – the City has erected and maintains signs at all CSO outfalls and several receiving water access points to alert the public of the presence of CSOs.

- **Long-Term Control Plan** – the City has developed a draft LTCP based on the presumption approach and the capture for treatment of 85 percent of combined wet weather flows on an average annual basis. As proposed in the draft plant, this will be accomplished by a combination of storage, a pump station expansion, regulator improvements and limited partial separation (in areas where storage sites are limited). Storage will provide the majority of the additional capture. Five underground storage facilities, ranging in size from 1.1 to 9.7 million gallons, are proposed. The construction of the first underground storage facility, with a capacity of 2.7 million gallons, is scheduled to begin in July 2002.
A nineteen-year schedule is proposed for implementing the LTCP. This schedule was based on a Residential Indicator Value of 1.5 (1.5 percent of median household income), which was felt to be appropriate for the City due to the number of low-income households in the City. (Based on median household income, approximately 68% of Wilmington households are classified as “low-income” when compared to households in surrounding New Castle County.) Estimated costs of the LTCP include a total of $103 million in capital costs and almost $11 million in cumulative operations and maintenance costs (year 2000 dollars) over the nineteen-year implementation period. Implementation of the LTCP is expected to require a 116 percent increase in water and sewer fees in the City.

CSOs are not the only water quality issue in the Brandywine-Christina watershed. Urban and suburban runoff from areas surrounding the City, as well as agricultural runoff, has been identified as contributing to exceedances of Delaware’s bacteria criteria. The City is developing a strategy for conducting a water quality standards review and use attainability analysis as they proceed with refinement and implementation of their LTCP.

**District of Columbia Water and Sewer Authority (DCWASA)**

Approximately one-third of the District (12,955 acres) is served by combined sewers. The majority of the area served by combined sewers is in the older developed sections of the District. There are a total of 60 CSO outfalls in the combined sewer system. The LTCP modeling effort demonstrated that water quality is affected by many sources other than CSOs, including storm water, upstream sources outside of the District, and in the Anacostia River by the sediments in the bottom of the river. While the LTCP is only required to address CSOs, WASA considered these other sources to identify the impact of CSOs as compared to other sources of pollution to assist in developing a watershed-based approach to improving water quality.

The recommended control plan was selected to provide a significant improvement in water quality in each receiving water while balancing these important benefits with the affordability to ratepayers. The following are key components:

- Low Impact Development – Retrofit (LID-R) – LID-R is the application of microscale storm water management and runoff controls such as rain barrels, cisterns, increased tree cover and other techniques. WASA recommends the implementation of LI-RD throughout the District and will include these measures at WASA facilities where appropriate.

- Rehabilitation of Pumping Facilities – Rehabilitation of existing pumping stations to improve CSO capture and efficiencies

- Storage Tunnels – construction of tunnels in the Anacostia, Potomac and Rock Creek basins to capture CSO when it is raining and hold it underground. The captured CSO will be treated at Blue Plains after the storm passes.

- Improvements to the existing wet weather Excess Flow Treatment facilities at the Blue Plains Advanced Wastewater Treatment Plant.
The draft plan is summarized in the table below and is proposed to be implemented over a 20-year period.

<table>
<thead>
<tr>
<th>Components of Draft D.C. WASA LTCP</th>
<th>Capital Cost Opinion (Millions)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Wide</strong></td>
<td></td>
</tr>
<tr>
<td>A. Low Impact Development – Retrofit (LID-R) – advocate implementation of LID-R throughout entire District. Provide technical and regulatory assistance to District Government. Implement LID-R projects on WASA facilities where feasible.</td>
<td>$3</td>
</tr>
<tr>
<td><strong>Anacostia River</strong></td>
<td></td>
</tr>
<tr>
<td>B. Rehabilitate Pumping Stations – Rehabilitate Eastside, Main and ‘O’ Street pumping stations.</td>
<td></td>
</tr>
<tr>
<td>C. Storage Tunnel from Poplar Point to Northeast–95 million gallon storage tunnel between Poplar Point and the Northeast. Project includes new tunnel dewatering pump station and low lift pumping station at Poplar Point.</td>
<td>$816</td>
</tr>
<tr>
<td>D. Ft Stanton Interceptor – 66” pipeline from Fort Stanton to Poplar Point to convey CSO 005, 006 and 007 on the east side of the Anacostia to the storage tunnel.</td>
<td></td>
</tr>
<tr>
<td><strong>Rock Creek</strong></td>
<td></td>
</tr>
<tr>
<td>E. Separate Luzon Valley – Complete separation of this drainage area.</td>
<td></td>
</tr>
<tr>
<td>F. Storage Tunnel for Piney Branch – 3.8 million gallon storage tunnel</td>
<td>$39</td>
</tr>
<tr>
<td>G. Regulator Improvements</td>
<td></td>
</tr>
<tr>
<td><strong>Potomac River</strong></td>
<td></td>
</tr>
<tr>
<td>H. Rehabilitate Potomac Pumping Station</td>
<td></td>
</tr>
<tr>
<td>I. Potomac Storage Tunnel – 28 million gallon storage tunnel from Georgetown to Potomac Pumping Station. Includes new tunnel dewatering pumping station.</td>
<td>$170</td>
</tr>
<tr>
<td><strong>Blue Plains Wastewater Treatment Plant</strong></td>
<td></td>
</tr>
<tr>
<td>J. Excess Flow Treatment Improvements – Additional four new primary clarifiers, improvements to existing excess flow treatment control and operations</td>
<td>$22</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>$1,050</td>
</tr>
</tbody>
</table>

Note: 2001 dollars

In addition, WASA supports revisions to the water quality standards to better reflect water quality that can be achieved with an affordable level of CSO control. A dialog with the D. C. Department of Health and EPA has been initiated on these issues.

The WASA’s selected CSO control program is expected to provide the following benefits:

- Reduction of CSO Overflows – under the recommended plan, CSO overflow volume will be reduced by 92% in the average year. The number of overflow events will be reduced from 75 to 4 per average year on the Anacostia, 74 to 12 per year on the Potomac and from 30 to 4 per year on Rock Creek.
Improved Water Quality – the Anacostia River, Potomac River and Rock Creek will be cleaner after implementation of the recommended plan. As an example, the number of days that CSOs contribute to high bacteria levels in the Anacostia River will be reduced from about 92 to about 15 days per year.

Reduction in Floating Trash - The plan will virtually eliminate floating trash from the combined sewer system because the majority of CSOs will be captured and treated. Trash from other sources such as storm water and upstream sources may still be present.

From these examples, it can be seen that select Region III CSO cities are moving along a watershed approach.
6.1 INFILTRATION/INFLOW AND SANITARY SEWER OVERFLOW (SSO) CONTROL

Generally the municipalities’ sewer system trunk lines to the ALCOSAN interceptors are interconnected and are managed by both formal and unwritten agreements. In some cases the municipalities are unaware that such agreements exist. Data collected for the Concept Plan indicates that the I/I from the satellites is significant. This is demonstrated by an examination of these data examining water and wastewater on gallons per day per person (capita) basis.

- Approximate ALCOSAN service area water consumption: 92 g/c/d
- Pennsylvania Design standard for peak sewer capacity: 250 g/c/d
- Peak Flow used to evaluate costs in the Concept Plan: 700 g/c/d

The fact that ALCOSAN has used minimum design flow of 700 g/c/d that is significantly above the per capita water consumption of 92 gpd and a normal design standard of 250 g/c/d is an indication of significant I&I. Some areas measured less peak flow, but others were even higher. The following four areas have been identified as potentially significant contributors to the I/I problem.

6.1.1 Private Property Issues

As shown on Figure 6-1, on the following page, there are several potential sources of I/I from a typical home. These include:

- **Rainleaders** – Rainleaders include roof gutter drains and areaway drains. In some satellite communities, these rainleaders were originally designed to be connected to the sewer lateral and drain away to the sewer system. During rainfall these connected rainleaders produce a direct connection of the high runoff roof area to the sewer system.

- **Yard Air Vents** – The BOCA Building Code requires that plumbing traps be installed at each waste fixture in the home to prevent sewer gas from entering the building. However, in Allegheny County, the plumbing code calls for an additional trap and air vent on the lateral in the yard leading to the home. These air vents are often cut off at or below grade and are a source of inflow similar to rainleaders.

- **The Foundation Drain** – Homes with a basement generally have a ring of permeable stone around the base of the foundation. This foundation drain functions to keep groundwater from rising above the basement floor level and leaking into the home. Water from this drain must be conveyed away from the foundation by a sump pump, a French drain (a pipe that conveys flow to a down slope area if available) or by connection to the lateral sewer.
Leaky Laterals – Laterals are the sewers that run from the publicly owned sewer in the street to the home. These small sewers often are cracked and broken. Groundwater leaks into them at the connection to the public sewer and at any failed joint or crack.

During the course of this review information was received on the relative importance and cost of removing these various private property sources. From this information it appears that removing the rainleaders and yard air vents has been formally addressed in most communities but not in all. There is a problem with these sources being reconnected after they have been removed. This reconnection is often due to flooding problems caused by the disconnection. It should be understood that in many cases the homes were designed to have rainleaders discharge to the sewer system. Removing these sources is relatively inexpensive where feasible. However, there will be a set of homes where complete rainleader disconnection is not cost effective or practical.

Addressing foundation drains and leaky laterals is a more difficult undertaking. In some areas these foundation drains were designed to be connected to the sewer system and are serving to control groundwater around the home and possibility for the subdivision. Removing a foundation drain can be very expensive, with some area estimates in the $20,000 per home range.
Leaky laterals can be less expensive to address and studies have shown that they can contribute up to 50% of a systems I&I. However, if the foundation drain is connected to the lateral, it does little or no good to repair the lateral or even the street collector. Where foundation drains are connected to the system, repairs on the laterals and street sewers will simply cause the flow to migrate to the foundation drains.

6.1.2 Public Sewer Issues

As shown in Figure 6-1 the I/I problems of public sewers depend greatly on their location and condition. Consider the following:

Repair of deteriorated street collectors can be effective if the groundwater is above the pipe. However, as discussed above, repair of these collectors will not be effective if the water will simply migrate to the laterals or to connected foundation drains.

Manholes can be a source of regular groundwater infiltration if the groundwater table is above a defective part of the barrel and when the street has rainwater on it direct inflow from leaky covers that are not otherwise sealed.

Valley sewers are a particular problem in the ALCOSAN service area. As shown in Figure 6-1 many of these sewers are influenced by the creek beds they are laid in or cross. Valley sewers laid below the normal surface of the stream are subject to high infiltration at all times while valley sewers laid below high water surface levels will receive high rainfall induced infiltration. Exfiltration may also be a problem in contaminating the creeks during wet and dry weather. No data to confirm the presence of exfiltration was identified during the course of the review, other than the dry weather bacteriological levels.

During the course of this study area engineers were surveyed with respect to the relative magnitude of these problems. These engineers indicated the following:

- The significance of the impact of these sources is subject to widely varying opinions from different municipal engineers and may, in fact, vary from location to location.

- Sewers built prior to the 1940s are generally in excellent structural condition and may not be a major source of infiltration. The quality control on sewers built in the post war years was felt to be inconsistent and they probably contribute disproportionately to I/I.

- The source of I/I flow is very site specific. Foundation drains are not connected throughout the service area or even throughout a given subdivision. Where they are connected, addressing the lateral and street sewers is ineffective.

- In some site specific areas addressing the valley sewers can be very cost effective.

- Very significant reduction in I/I can be accomplished at relatively low cost in some cases (a $1,000 per acre was noted in one study). However, getting all areas down to the state criteria of 250 gpcd will be extremely expensive and will not be cost effective in many areas.
6.1.3 Surface Drainage Issues

The Concept Plan acknowledges that surface streams enter the collection and trunk lines through unique and various methods. The specific volumes are not addressed in the report but field observations indicate that the volumes of these inflows would increase significantly under wet weather conditions. It is recommended that their actual impact be assessed and that they be eliminated where the removal would be cost effective.

A 1999 survey conducted by the Three Rivers Wet Weather Demonstration Program (3RWWDP) indicates the following:

- That most of the local collection systems are over 25 years old and the majority is greater than 50 years old.
- The majority of small and medium municipalities do not have a formal sanitary sewer fund and generally co-mingle funds, even if they charge separate sewer fees, with general fund monies.
- Most small and medium municipalities do not have dedicated sewer personnel and utilize “public works” employees as needed for sewer work.
- Most small and medium municipalities do not have preventative maintenance programs for their sewer systems.

A subset of the municipalities have only anecdotal information about the condition of their sewer systems and little if any flow data that could be used for making informed engineering decisions regarding the cause of their high dry weather flows or what corrective actions would be prudent.

6.1.4 Regulatory Actions and Costs

As discussed in Section 3, The PaDEP and the USEPA are attempting to have the municipalities enter into consent orders by June 2002 to address ongoing litigation issues as well as to preclude enforcement action. In return the jurisdictions would agree to complete elements of a sanitary sewer evaluation study (SSES) and much more. The orders go beyond an SSES by requiring 100% CCTV inspection of all sewer systems, a commitment to develop a Capacity, Maintenance, Operation and Management (CMOM) Plan and a requirement to complete to the corrections of all system physical defects delineated in the SSES by June 1, 2005. Such inspection needs to be focused on identifying critical issues and addressing data needs for the development of the LTCP. It is unlikely that the blanket 100% CCTV inspection program proposed will accomplish this. The use of a more effective comprehensive approach is discussed in Section 9.

In addition, the consent orders would require the municipalities to negotiate a final LTWWCCP with ALCOSAN by March 2007 and to complete all aspects of the plan by the end of 2014. The cost for the inspection portion of the order has been estimated by 3RWWDP at approximately $66 million through 2005 with additional flow monitoring costs over the following three years of approximately $22 million.
The above costs of the proposed orders do not address the monies to repair structural issues delineated during the SSES nor those associated with the implementation of a CMOM plan. It would also require implementation of all collection system solutions to be complete by 2017 rather than over the forty years noted in the present LTCP. The plan anticipated that the collection system up-grade proposal would be a spending commitment of 40% for the first ten years and 15% each of the next four decades.

The municipalities are presently studying the consent order proposal and initial concerns appear to be that the dates are unattainable as well as the over broad extent of the initial SSES requirements.

### 6.2 AFFORDABILITY

Discussion of affordability includes these issues:

- Inclusion of Base Costs
- Income Growth
- Local Sewer Costs
- EPA Affordability Guidance
- Affordability of the Plan
- How Affordability needs to be incorporated into future steps

#### 6.2.1 Inclusion of Base Costs

The affordability study contained in the March 1999 version of the Concept Plan reveals a number of potential conflicts with other ALCOSAN documents. Table 7-10 included in the March version, which was subsequently deleted from the April 1999 versions issued to the municipalities, listed the projected 2002 cost to ALCOSAN’s residential customers as $200 per household. Based on average consumption rates and average residential customer size the actual costs based on rates adopted January 1, 2001 is $235.32 per year. Table 7-10 lists no change for 2003 and shows an increase to only $214 in 2004. However, Black & Veatch’s report issued in November 2000 projects a needed 25% rate increase on June 1, 2004 that would increase the annual residential cost to approximately $294.16 per annum. This increase apparently covers only the debt service costs associated with the 2000 Series Bonds and, as such, does not include any costs associated with the Concept Plan. The additional debt service anticipated with the issuance of the Series 2004 Bonds is anticipated to be $14.6 million annually for 30 years.

#### 6.2.2 Income Growth

The March 1999 Concept Plan estimated future MHI using inflation. The report inflated 1990 Census numbers by an annual rate of 2.6% to arrive at the 1998 MHI outlined in the report. The inflation rate used was average for Pennsylvania for the period between 1990 and 1996 and was selected due to the unavailability of any data at the municipal level. This is a very aggressive rate of income growth for municipalities in economically distressed areas. National trends of income growth indicate that most of the income growth is concentrated in the highest income
brackets. The lower income brackets, which are of most concern here, have not seen this growth in income.

For illustration purposes it should be noted that the use of a 1.3% inflation factor (half the state wide value of 2.6%) for Braddock Borough would show a MHI that would be almost 8% or $1,575 lower than that indicated for 1998 in Table 7-8 in the Concept Plan. Continued use of this inflation factor for twenty years, as was done in Table 7-9, exacerbates this approach. In twenty years the difference between a 1.3% and 2.6% growth results in a 30% difference in MHI and which clearly impacts affordability. It is recommended that only actual census numbers be used in these analyses.

6.2.3 Local Sewer Operations Costs

Table 7-10 in the LTCP lists the 2002 local collection costs as only $72 per year. This cost appears low. From discussions with the satellite communities and their engineers, it appears that few of the communities keep separate accounting of their sewers costs. As a result they are not able to identify their true cost of sewer ownership. By way of example, York County, Virginia is a satellite community with a population of 56,000. It charges $130 per year for its sewer maintenance fee. This system is well maintained and is operated as an enterprise fund with good accountability for its revenues that are kept separate from the general fund. This cost does not include monies for system expansion or up-grade, which are funded by a dedicated portion of the County’s meals tax.

York County is a satellite to the Hampton Roads Sanitary District. A cost of $130/year is in the mid-range of collection system fees charged by other satellite systems in that District. As such it would appear to be a reasonable model to predict collection system costs in the ALCOSAN area once the system problems are addressed.

In addition to wastewater collection costs, municipalities with populations under 100,000 will be incurring storm water management costs under Phase II of EPA’s Storm Water Program. Actual return costs for six municipalities in Virginia, which have established storm water programs and are past the start-up costs, indicate an average ongoing program cost of $46 per year per household.

6.2.4 Consent Order SSES and the “MOM” Costs

3RWWDP’s estimated cost of meeting the requirements of the first year of the proposed consent order for is $20.8 million. Members of the local Engineering Community believe the actual cost will be substantially more and will fall disproportionately on the various communities. One local engineer has examined the costs to individual communities and believes some may see unaffordable costs in the immediate future. Assuming that the consent orders and institutional arrangements are revised in such a way that the $20.8 million cost is spread evenly over the 294,683 ALCOSAN residential customers, and that residential customers will pay 66% of the cost, the annual cost impact of this program will be over $46 and will increase to $48 and $53 for respectively for the following two years. The 66% factor is based on ALCOSAN’s estimate that this is the percentage of their revenues derived from residential customers. This is clearly a very rough generalization as in most ALCOSAN municipalities’ residential customer bear most of the
cost for the sewer system and there is a wide variation in the miles of sewer per capita between areas.

USEPA is moving in the direction of requiring all satellite jurisdictions to implement a CMOM program to improve and document the operations of sewerage collection systems. CMOM stands for a regulatory program whose objective is:

- To establish standard permit conditions addressing capacity, management, operation and maintenance (CMOM) requirements; a prohibition on discharges (with a framework for a defense for unavoidable discharges); and requirements for reporting, public notification, and record keeping for municipal sanitary sewer collection systems and SSOs.

This requirement is contained in the proposed consent order recently forwarded to municipalities in ALCOSAN’s service area. Development of a Collection System program by the City of Norfolk Virginia, which was required under a recent consent order, indicates the cost of the program will approach $10 per year per residential customer. This is the cost associated with the “MOM” portion of the CMOM program, which includes the cost of increased maintenance and record keeping requirements but does not include any costs associated with system up-grades or capacity improvements that may evolve from the program. In addition, Norfolk’s estimated cost does not include the cost of the installation of a new asset management program that Norfolk already has in place. Norfolk is a community of approximately 240,000 people. This $10 per year cost should be considered on the low end of what it will take to institute such a program in the ALCOSAN area.

### 6.2.5 Summary of Costs prior to Concept Plan

Based on a typical household of 2.9 people and a daily water consumption of 92 gallons per person, the following is estimated to be a reasonable breakdown of anticipated household wastewater costs in the ALCOSAN area in 2004, absent any costs for system improvements:

- **Currently Planned ALCOSAN costs** $294
- **Local collection costs** 130
- **Consent order costs/MOM** 53
- **Storm water costs** 46

  **Total** $523

### 6.2.6 EPA Affordability Criteria

The USEPA has developed a guidance document on affordability. This guidance contains a series of issues to be considered in determining affordability, assessing the financial stress of the community, bond rating and a number of other individual criteria. The simplest of these criteria is the cost of clean water act programs to a household as a percent of the Median Household Income (MHI).

The procedure contained in the Concept Plan for determining affordability is essentially as outlined by USEPA guidance for evaluating impact on MHI. However, there are number of criteria and other issues that should be addressed to account for local conditions and other
considerations. USEPA guidance proposes a primary high impact criterion of 2% of a median household income (MHI) for wastewater costs; however, many states recognize that a more reasonable basis is 1.5% of MHI especially in low-income communities.

This 1.5% was also the criteria used in the USEPA grant program to deny grants to permittees on the fear that costs above 1.5% would be unaffordable and grant constructed facilities would not be maintained due to a lack of maintenance funds. It is important to recognize that USEPA originally set the 1.5% criteria as a high impact level because they were concerned that beyond that cost ratepayers would become increasingly delinquent in paying their bills and the water quality control facilities funded by the federal grants would eventually cease to be maintained and eventually not function properly. There are communities paying bills at or above these levels, however, great concern about the affordability of projects that require this level of cost must be addressed through a comprehensive evaluation of financial health and the support of those that will pay. Other communities have worked through affordability issues and concluded that even the 1.5% level is too high due to impact on a particular local economic condition.

The 2% criteria indicates that a bill prior to implementing the Concept Plan costs of $523/year, would have a high impact on households with a MHI of $26,150 or less and the 1.5% criteria would yield a high impact MHI value of $34,867. Regardless of the criteria applied a significant number of ALCOSAN municipalities are subject to high economic impact even without the costs of correcting system problems.

6.2.7 Impact of Concept Plan Sewer Rehabilitation

As indicated above, this cost does not include any costs for system improvement of the Concept Plan with the exception of the costs for determining the condition of the systems that are contained in the proposed consent order. In order to demonstrate in a very simplistic manner the impact of the magnitude of costs facing ALCOSAN customers, the following model is offered:

- Assume that the combined cost of ALCOSAN and municipal sewer rehabilitation program is $2.0 billion and is spread evenly over 15 years as called for in the draft satellite consent orders.
- These costs are paid for by the issuance of bonds at a cost of 8.5% of the funds needed for system remediation.
- That the above base cost of $523 is used for the starting point in 2004 and is held constant over the fifteen-year period.
- The construction costs are not inflated over the fifteen-year period.
All costs for system remediation not funded by outside monies such as grants, whether incurred by ALCOSAN, the municipalities or a third party, eventually fall back to the households. As such it is reasonable to use combined yearly remediation costs when analyzing cost impact. The following “Annual Wastewater Bill” graph below outlines the increasing average monthly bill per household during a fifteen-year remediation program outlined above.

As the indicated monthly wastewater bill increases so does the level of the high impact MHI value increase. The 2004 high impact MHI value of $26,150 increases over the life of the fifteen-year program to $52,750 in 2018. This is exacerbated by the fact that the projected MHIs will increase at nowhere near the rate of the high impact MHI even using the 2.6% inflator previously discussed. A municipality that just met the $26,150 MHI value in 2004 will see its MHI increase to only $37,457 in 2018 well below the $52,750 high impact value resulting from the debt service for remediation projects. The result of this progression is that more municipalities will become highly impacted as the program moves forward. The second graph outlines how the increasing remediation expenditures increase the high impact MHI value at a rate well exceeding the expected increase in the actual MHI.

Once the 2000 Census numbers are available over the coming year it is estimated that over 15% of the ALCOSAN municipalities will be classified as highly impacted by 2004. As monies are spent for remediation it is predicted that this number will increase significantly and the only conclusion that can be drawn from this simplified approach is that a remedial plan of $2.0 billion, let alone the $3.0 billion referenced in the Concept Plan, is clearly unaffordable to a significant number of the municipalities.
The nature of the local collection system is such that a “weakest link” analogy can be made with regard to any proposed remediation plan. Without outside help such as grants or by the wealthier municipalities shouldering a disproportionate share of the financial burden, the monies spent will not be proportional to the improvements achieved. The issues impacting this problem and a possible approach to the issue is addressed in Section 9.

6.3 WATER QUALITY ISSUES

The Concept Plan report indicates in the discussion of existing conditions indicated that water quality in Allegheny County is impacted by sources of wet weather pollution as well as sources of upstream pollution. Although, a number of water quality parameters are impacted in wet weather, fecal coliform bacteria appear to be impacted more directly than others. The Concept Plan did not include an evaluation of the impacts of CSO/SSO on existing or future water quality conditions.

To develop a further understanding of wet weather impacts on Allegheny County receiving waters, in the Allegheny River, Monongahela River, Ohio River and tributaries to these rivers (e.g., Chartiers Creek, Saw Mill Run, Girtys Run), relevant water quality data (bacteria) were obtained from various sources and analyzed. The focus of the analysis was to investigate upstream (outside ALCOSAN service area) to downstream (within ALCOSAN service area)
differences in water quality. Differences were also investigated between the main rivers (Allegheny, Monongahela and Ohio Rivers) and the tributaries.

Data reviewed during this evaluation was a combination of data compiled from both wet and dry conditions during different months and years. To maximize the amount of data available for this review, all of the bacteria data were grouped into a common data set regardless of weather conditions or of time of the year. In addition, as the recreational season water quality standards are more stringent that non-recreational season standards, observed data were compared to the recreational season PADEP and ORSANCO water quality standards to assess the severity of impacts. River flow was also analyzed at a number of USGS gages in the area to provide and overview of available dilution flows for annual and low-flow conditions.

Simple mass balance calculations were also performed using output from the NetStorm model developed for the ALCOSAN conveyance system and used to develop the Concept Plan. The CSO volumes generated from the model were obtained from CDM for the existing and Concept Plan conditions for an average rainfall/runoff year (1959). This model output was used along with river flow conditions (1959), upstream bacteria levels (existing), and typical CSO overflow bacteria levels to estimate instream water quality in the main rivers to assess the water quality benefits of the plan. The following sections provide an overview of these water quality investigations.

### 6.3.1 Current Conditions

#### A. USGS River Flow

USGS gauges river flows at three locations in the ALCOSAN service area on the main rivers and two locations on urban tributaries in the drainage area (Chartiers Creek and Little Pine Creek).

River flow from the following gauges was obtained and analyzed:

- **Allegheny River at Natrona (03049500)** – Drainage Area = 11,410 mi²;
- **Monongahela River at Braddock (03085000)** – Drainage Area = 7,337 mi²;
- **Ohio River at Sewickley (03086000)** – Drainage Area = 19,500 mi²;
- **Chartiers Creek at Carnegie (03085500)** – Drainage Area = 257 mi²; and
- **Little Pine Creek near Etna (03049800)** – Drainage Area = 5.8 mi².

The drainage area from the four gauges upstream from the Ohio River gauge represent approximately 98% of the total drainage area at the Ohio River Sewickley gauge. River flow for 1959 and period of record monthly average flow and range are presented in the figure below for the three main rivers. The year 1959 was selected to represent average rainfall/runoff conditions based on a 45-year period of rainfall records (Personal communication with Bill McConnell, CDM). This year was selected to complete the mass balance calculations presented in Section 6.3.2 for assessing the benefits of the plan. This year is similar to the period of record monthly averages but with lower summer flows (June through October).

The period of record at these gages was also analyzed during this review to develop distributions of annual average and 7Q10 low flows. Probability distributions are presented in the Appendix.
C for the annual average flows and for the yearly minimum 7-day average flows. The 7Q10 flow is approximated as the 10th percentile of the yearly minimum 7-day average flows. A summary of the mean annual average flow and the approximated 7Q10 flows is presented in the table below for the five river gauges. The period of record used for these gauges is: 1938-2000 for the Allegheny and Monongahela Rivers, 1934-2000 for the Ohio River, 1919-2000 for Chartiers Creek, and 1962-2000 for Little Pine Creek.

<table>
<thead>
<tr>
<th>USGS Gage</th>
<th>Mean Annual Average Flow (cfs)</th>
<th>Approx. 7Q10 Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allegheny River</td>
<td>19,724</td>
<td>1,385</td>
</tr>
<tr>
<td>Monongahela River</td>
<td>12,588</td>
<td>1,273</td>
</tr>
<tr>
<td>Ohio River</td>
<td>33,450</td>
<td>2,964</td>
</tr>
<tr>
<td>Chartiers Creek</td>
<td>286</td>
<td>29.5</td>
</tr>
<tr>
<td>Little Pine Creek</td>
<td>6.2</td>
<td>0.03</td>
</tr>
</tbody>
</table>
As indicated in the table, the main river flows are significantly larger than flows in the urban tributaries. Long term average flows in the main rivers are exceeding 19,000 cfs, 12,000 cfs, and 33,000 cfs for the Allegheny, Monongahela and Ohio Rivers, respectively. Chartiers Creek long-term average flows are just less than 300 cfs, while Pine Creek flow is less than 10 cfs. Low flows are about a factor of 10 less than the average flows.

B. ALCOSAN Water Quality Monitoring

ALCOSAN completed a monitoring program in to characterize wet weather impacts on the main rivers and tributaries within their service area and to determine baseline water quality conditions. In addition, historical data was reviewed from area stations as obtained from the USEPA STORET database. The report “ALCOSAN CSO Program Receiving Water Quality Characterization Monitoring (November 2000)” presents the results from this effort. This report presents the collected and historical data in a narrative form along with tables of the data in the Appendices and compares the results for wet and dry conditions, and for upstream and downstream locations.

Graphical presentations of the ALCOSAN data were developed, as part of this review, to do the following:

- Assist in the interpretation of these data
- Assess how the data compare with water quality standards (WQS),
- Investigate receiving water quality conditions upstream of the ALCOSAN service area, and
- Determine potential impacts of the urban areas on water quality conditions.

The sampling locations used in the ALCOSAN monitoring effort are presented in Figure 6-2, on the following page, with the circles representing the 1993, 1994 and 1996 monitoring and the squares representing the 1995 water quality monitoring.

Upstream stations used in the analysis are from the following stations shown in Figure 6-2, on the following page.

- AL-6 (Allegheny River)
- MN-11 (Monongahela River)
- OH-13 and MP1.4 (Ohio River)
- CH-3 (Chartiers Creek)
- SM-5 (Saw Mill Run)
- TU-8 (Turtle Creek)
- TH-10 (Thompson Run)
Downstream stations used in the analyses are from the following locations shown in Figure 6-2.

- AL-14, MP0.8, MP3.2 and MP6.5 (Allegheny River)
- MN-15, MP1.0, MP3.0, MP5.3, MP7.3 and MP9.3 (Monongahela River)
- OH-12, MP2.9 and MP4.8 (Ohio River)
- CH-2 (Chartiers Creek); SM-4 (Saw Mill Run)
- TU-7 (Turtle Creek)
- TH-9 (Thompson Run)
As indicated above this review focused on fecal coliform bacteria. However, data area also available for other parameters including: pH, temperature, DO, BOD, TSS, TKN, NH₃, NO₂⁻, NO₃⁻, TP, PO₄, Al, Cd, Cr, Cu, Fe, Pb, Zn and hardness. A detailed review of these data is summarized in the Concept Plan report, Chapter 2, Existing Conditions. In this review, no differentiation was made between samples taken in wet or dry conditions. Compliance with standards is not assessed in wet or dry weather conditions but rather using data compiled from both conditions. Therefore this data was examined as a whole and not separated into wet and dry data.

The adjacent figure presents probability distributions of main river fecal coliform data for upstream (outside of the ALCOSAN service area) and downstream (within the service area) sampling locations. Probability distributions are useful for presenting the mean and variation of a data set, and also provide a means for determining compliance (percent exceedance) from a given value (e.g., a WQS). The method for developing the distribution is to rank the data set from lowest to highest, calculate a percentage for each point (i/n-1) and to plot the transformed data on a probability scale, which implies a normal or log-normal distribution. In this figure, the filled circles and the downstream data indicate the upstream data by the open squares. The horizontal lines in this figure represent the PaDEP and ORSANCO fecal coliform recreational season WQS. PaDEP and ORSANCO require the geometric mean of the data to be less than 200/100mL (solid line) and require a maximum of 400/100mL (dashed line) not to be exceeded for more than 10% of the samples (i.e., 90% of samples less than 400/100mL).

This figure indicates that for the Allegheny and Monongahela Rivers, downstream fecal coliform levels are greater than the upstream levels by a factor of 10 or so. This indicates an influence of discharges within the ALCOSAN service area on receiving water quality. Whether this influence is from CSO loads, tributary inputs or direct runoff cannot be determined from this
The data only indicate an increase in the fecal coliform levels from upstream to downstream through the ALCOSAN service area.

Data in this figure indicate that upstream fecal coliform levels are greater than the maximum WQS of 400/100mL (approximately 30% of the data for the Allegheny River and 50% of the data for the Monongahela River). Data also exceed the geometric mean WQS of 200/100mL at both of these upstream stations. This observation is very important when assessing remedial alternatives within a watershed or TMDL based concept of water quality improvement. That is, without upstream (outside of the ALCOSAN service area) load reductions (other city CSO load reductions, agricultural BMPs, etc.) water quality compliance cannot be attained through ALCOSAN CSO reductions alone. The downstream data in the Allegheny and Monongahela Rivers are also elevated above the WQS on a geometric mean and maximum level basis.

The Ohio River data indicates little difference between upstream and downstream locations, which should be the case because the upstream station is located within the ALCOSAN service area and is already impacted by urban area CSO/SSO sources. Actually, there is a slight indication of lower levels at the downstream station, which may be due to additional dilution or bacteria decay.

This same analysis was completed for the data available for Chartiers Creek, Saw Mill Run, Turtle Creek and Thompson Run as presented in the adjacent figure. Again, upstream and downstream sampling station data were available for comparison to WQS and ALCOSAN service area influence. This figure also shows a significant increase in fecal coliform levels between the upstream to downstream locations in the tributaries. Although there is an increase in bacteria levels moving through the ALCOSAN service area, relative contributions from CSO loads, direct connections or runoff cannot be determined from this analysis.

Similar to the main river monitoring data, the tributary fecal coliform levels are approximately an order of magnitude greater than the
main river data and exceed both the geometric mean and maximum fecal coliform WQS. Improvements in the ALCOSAN conveyance system will probably not result in compliance with WQS without reductions in the upstream tributary sources of fecal coliform.

Maximum observed fecal coliform levels at the upstream stations are approximately $10^3$ to $10^5 / 100mL$ in the main rivers and $10^4$ to $10^5 / 100mL$ at the downstream stations. In the tributaries, maximum observed fecal coliform levels are approximately $10^4$ to $10^5 / 100mL$ at the upstream stations and $10^5$ to $10^6 / 100mL$ at the downstream stations. Both sets of data show that the urban sources of fecal coliform bacteria result in a factor of 10 in the bacteria concentrations in the rivers and creeks as they pass through the urban area.

Upstream data were further analyzed along with river flow in the Allegheny, Monongahela, Ohio Rivers and Chartiers Creek to provide some insight into sources of the upstream fecal coliform levels. This analysis is presented in the figure below. Upstream fecal coliform data are plotted against river flow (multi-day moving average) at these four locations and a log-log linear regression (solid line) analysis was performed to determine whether the data could be dependent. For the Monongahela, Ohio Rivers and Chartiers Creek no strong correlation exists between fecal coliform and flow, which may indicate that both point and nonpoint sources are present and affecting water quality. In general, positive slopes (increasing trend with flow) indicate the dominance of nonpoint source loads and negative slopes (decreasing trend with flow) indicate the dominance of point source loads. For the Allegheny River, a strong negative slope was observed, which indicates the dominance of upstream point source loads of fecal coliform, whether from other cities CSO systems or direct connections to the river. The large variation in the upstream fecal coliform levels may suggest the need to better define the sources of fecal coliform loadings in the upstream (outside of the ALCOSAN service area) watershed of these river basins.

All of the data presented in the figures in this Section of the report are also contained in the Appendix C as either time series representations of the fecal coliform data or spatial representations along the length of the main rivers during specific sampling events.
C Three Rivers, Second Nature Monitoring

The Three Rivers, Second Nature (3R2N) monitoring program recently completed a study of the Pittsburgh area entitled “Water Quality Phase I Report – Year 2000”. This report was “intended to reveal patterns and relationships between water quality, public use and the functioning ecosystem” of the Pittsburgh receiving waters. The sampling program was conducted in dry weather between June and October 2000 in the Pittsburgh Pool, which extends from Lock and Dam #2 on the Monongahela River (MP11.2), Lock and Dam #2 on the Allegheny River (MP6.7), and Emsworth Lock and Dam on the Ohio River (MP6.2).

The sampling locations monitored during the 3R2N study are presented in Figure 6-3, below, and include the following stations with fecal coliform, E. Coli, pH, temperature and DO measured at each station.

- Allegheny River (MP0.18, MP2.26, MP4.57, MP6.1)
- Allegheny tributaries - Girtys Run, Pine Creek, Sharpsburg Creek, Guyasuta Run, Heaths Run, and a City of Pittsburgh culvert;
- Monongahela River (MP0.23, MP2.82, MP5.66, MP10.21)
- Monongahela tributaries - Four Mile Run, Becks Run, Streets Run, West Run, Nine Mile Run, and Homestead Run Ohio River (OHWE, OHPEG, OHFB, OHNV)
- Ohio River tributaries - Saw Mill Run, and Chartiers Creek.

Figure 6-3 Three Rivers Second Nature Water Quality Monitoring Location Map

Map Reference: 3R2N Camp Director & Monitor, April 2001

June 2002
The dry weather sampling data was obtained digitally for this review but the wet weather sampling was not obtained in time to include in this report.

The following data analysis summarizes fecal coliform and E. Coli dry weather data obtained from sampling locations in the main rivers and the tributaries. The monitoring data are presented as probability distributions in the same format as the previous figures except the sampling locations are segregated into main river (filled circles) and tributary (open squares) groupings in the Allegheny, Monongahela and Ohio Rivers.

These figures indicate that the main river dry weather fecal coliform data are equal to or lower than the WQS, both on a geometric mean and maximum level basis. PaDEP does not have WQS for E. Coli so the ORSANCO WQS are used for comparison to the dry weather data. The ORSANCO E. Coli WQS are 130/100mL as a geometric mean and a never to exceed value of 240/100mL for the months of May through October. The observed main river dry weather E. Coli data are lower than the WQS on a geometric mean basis but not for the maximum level except in the Allegheny River. Maximum observed fecal coliform levels are approximately 10^3/100mL in the main rivers and 10^4 to 10^5/100mL in the tributaries. E.Coli levels are approximately 10^2 to 10^3/100mL in the main rivers and approximately 2,500/100mL in the tributaries (maximum detection limit).

Tributary data presented in the adjacent figure were collected during the 3Rivers 2nd Nature sampling at the mouth of the tributaries just upstream from the main rivers. In contrast to the main river data, tributary dry weather data summarized for all the tributaries for both fecal coliform and E. Coli are higher than the PaDEP and ORSANCO WQS on both a geometric mean and maximum level basis. This is a similar observation as obtained from the ALCOSAN tributary data but is more significant because the 3R2N sampling occurred during dry weather while the ALCOSAN sampling occurred during both dry and wet weather.

High dry weather bacteria levels in the tributaries may indicate dry weather overflow, direct connection (illegal), groundwater and/or upstream (outside of the service area) sources. Without remediation of these other sources, ALCOSAN CSO improvements may not improve water quality in the tributaries. Again, these data highlight the need to include a watershed perspective.
when assessing remedial alternatives within the ALCOSAN service area.

D. Ross Township Monitoring

In October and November 2001, a monitoring program was completed by Ross Township for tributaries to the Allegheny River for fecal coliform and E. coli (Personal communication with Art Gazdik). This sampling effort was completed during dry weather conditions in Lowries Run, Jacks Run, Girtys Run, Little Pine Creek and a tributary to Little Pine Creek (see Figure 6-4, below). Some of the stations were located in tributaries near CSO’s with the majority of the data obtained from Girtys Run.

Data from this sampling effort is presented in the adjacent probability figure along with the appropriate PaDEP/ORSANCO bacteria standards. Although, sampling data were collected during the non-summer months they are compared, on this graphic, to the summer fecal coliform bacteria recreational standard of a geometric mean of 200 per 100 mL (solid line) and the 90% of 400 per 100mL (dashed line). These observations indicate that the tributary dry weather data from the Ross Township data set would be above the summer recreational WQS, both on a geometric mean and maximum level basis. As with the other tributary data sets, these dry weather data indicate that bacteria sources from dry weather overflows, direct connections (illegal), groundwater and/or upstream (outside of the service area) areas. Maximum observed fecal coliform levels are approximately 2,000/100mL and E.Coli levels of approximately 500/100mL (excluding the one measurement of >2,420/100mL).
E. STORET Database

The STORET data presented in the CDM “ALCOSAN CSO Program Receiving Water Quality Characterization Monitoring (November 2000)” report was not included in this review because of the age of most of the data (Table 3-1 from the CDM report). Data retrievals conducted during this review indicated that STORET data available for the Allegheny, Monongahela and Ohio Rivers after 1990 was limited. Therefore, use of available STORET data would rely on data that pre-date 1990. As other more recent data, as described above, were available none of the STORET data were used to assess Allegheny County receiving water quality.

F. Observations on Existing Water Quality

Although there are indications in the Concept Plan report (Chapter 2) that there are water quality exceedances in Allegheny County water bodies for a number of water quality constituents, review of pathogen data indicate clear problems that are likely associated with urban sources of pollutants in the ALCOSAN service area.

Main Rivers

3R2N data indicate that in dry weather the main river rivers are equal to or lower than the fecal coliform WQS, on a geometric mean basis and very close to the maximum level WQS.

Mixed dry and wet weather data for the Allegheny and Monongahela Rivers show that downstream fecal coliform levels are about a factor of 10 greater than the upstream levels, indicating an influence of the ALCOSAN service area on receiving water quality.

These mixed data also indicate that upstream fecal coliform levels are greater than the maximum WQS of 400/100mL (percent exceedance of approximately 30% for the Allegheny River and 50% for the Monongahela River). Data are elevated above the geometric mean WQS of 200/100mL at both upstream stations.
Elevated upstream pathogen concentrations indicate that remedial alternatives need to be develop within a watershed. A watershed based TMDL concept of water quality improvement is needed. That is, without upstream (outside of the ALCOSAN service area) load reductions (other city CSO load reductions, agricultural BMPs, etc.) water quality compliance cannot be attained through ALCOSAN CSO reductions alone.

**Urban Tributaries**

Dry weather 3R2N and Ross Township tributary data, both fecal coliform and E. Coli, are elevated above the PaDEP and ORSANCO WQS on both a geometric mean and maximum level basis.

In contrast to the main river monitoring, the mixed dry and wet weather tributary fecal coliform levels are approximately an order of magnitude greater than the main river data greater than both the geometric mean and maximum fecal coliform WQS.

In general, these data indicate that there are sources of pathogens upstream of the ALCOSAN service area and within the ALCOSAN service area that cause bacteria levels to increase above the water quality standards. In these highly urban areas the sources of elevated bacteria concentrations could be associated with dry weather overflows, combined sewer overflows, and sanitary sewer overflows. In addition, elevated dry-weather pathogen contamination in the urban tributaries could be associated with eXfiltration from sanitary sewers that are in poor condition or from other sources such as direct sanitary connects, failing septic and concentrated numbers of wildlife.

### 6.3.2 Benefits of the Plan

As part of this review a technical analysis was performed to evaluate potential water quality benefits that would be produced by the Concept Plan. This analysis was completed for the Allegheny, Monongahela, Ohio Rivers and Chartiers Creek. The analysis approach was a simplified and un-calibrated mass balance calculation, which used model output from the conveyance system model (NetStorm) developed by CDM for ALCOSAN, USGS gaged river flows, receiving water and end-of-pipe fecal coliform monitoring data collected by CDM for ALCOSAN. This framework, although un-calibrated, is consistent with the concept planning approach taken during development of the Concept Plan in that it employees screening level calculations to assess CSO/SSO impacts on water quality. Care should be taken in the use of this analysis for purpose other than concept plan review. It is not suitable for a regulatory assessment.

The mass balance analyses completed are not designed to be detailed calculations of water quality conditions but rather to provide screening level information for assessing the water quality benefits associated with the Concept Plan. These calculations simplify many of the water quality fate and transport processes present in the Allegheny River, Monongahela River, Ohio River and Chartiers Creek. In addition, to further simplify the calculations CSO/SSO overflows calculated with the NetStorm model were combined into segment specific total daily overflows as opposed to outfall specific hourly overflows. A more detailed effort is possible but was beyond the goals of this review.
The basic CSO/SSO loadings were obtained from the NetStorm model (personal communication with Bill McConnell, CDM) for the existing conveyance system and the proposed modifications to the system based on the Concept Plan for an average rainfall/runoff year (1959). The mass balance analysis consisted of combining the upstream coliform mass loading with the CSO/SSO mass loading and dividing by the combined river and CSO/SSO flows. This simplified approach provided for an estimate of the downstream receiving water quality fecal coliform concentrations.

Fecal coliform mass balances performed, herein, coupled measured end-of-pipe fecal coliform levels with the NetStorm model output overflows. These sources of wet weather contamination were mathematically added to coupled measured upstream fecal coliform concentrations and river flows. The mass balance equation used is as follows:

\[
C_{\text{mixed}} = \frac{(Q_{\text{us}} \times C_{\text{us}}) + (Q_{\text{cso}} \times C_{\text{cso}})}{(Q_{\text{us}} + Q_{\text{cso}})}
\]

Where:
- \(C_{\text{ds}}\) – downstream fecal coliform concentration (#/100mL);
- \(Q_{\text{cso}}\) – CSO flow (cfs);
- \(C_{\text{cso}}\) – CSO fecal coliform concentration (#/100mL);
- \(Q_{\text{us}}\) – upstream river/creek flow (cfs); and
- \(C_{\text{us}}\) – upstream fecal coliform concentration (#/100mL).
- \(C_{\text{mixed}}\) – downstream fecal coliform concentration (#/100mL).
- \(Q_{\text{cso}}\) – CSO fecal coliform flow (cfs)

**NetStorm Model Output (\(Q_{\text{cso}}\))**

Hourly model output was obtained from the NetStorm model of the ALCOSAN conveyance system and combined into single loadings for each of the 14 interceptor segments in the service area. Since the USGS river flows were only available on a daily average basis, the hourly NetStorm model output was totaled over each day for use in the mass balance analysis. An average rainfall/runoff year was selected based on a statistical analysis completed by CDM (personal communication with Bill McConnell, CDM) for generation of the hourly NetStorm model CSO volume output. The rainfall statistics generated are presented in the table below for 1959, which was selected for the analysis as providing representative river flows and rainfall induced wet weather CSO/SSO point source loadings of fecal coliform bacteria. The hourly NetStorm output is presented in the table below for each of the 14 interceptor segments on an annual overflow volume basis (MG) for both the existing and Concept Plan conveyance systems during the average rainfall/runoff year.

Peak CSO volumes can be as high as 300 or 400 million gallons within a 24-hour period (1-day) for the existing condition and slightly lower for the Concept Plan. For each of these waterways, the Concept Plan does provide for complete elimination of many of the overflow events. For example, in early and late February, there are events for which the existing system creates overflows (presence of a red line) and for which the Concept Plan condition has provided for complete containment (lack of a blue line).
This would indicate that overall CSO/SSO volumes throughout basin are computed to be reduced by 72%. All of that reduced overflow being transmitted to the treatment plan for primary or secondary treatment and disinfection.

The results from these two NetStorm simulations indicate a decrease in annual CSO/SSO volume from existing conditions due to implementation of the Concept Plan of approximately 72% during the average year. In addition, the percent wet weather capture based on the average year model output for the Concept Plan is approximately 85% (i.e., captured wet weather flow/total wet weather flow). The figure above presents the daily CSO volumes discharged to the Allegheny River, Monongahela River, Ohio River and Chartiers Creek for both the existing and Concept Plan conditions based on the hourly model output.

**USGS River Flow (Qus)**

The 1959 USGS river flows from the following gages were used in the mass balance analysis: Allegheny River at Natrona; Monongahela River at Braddock; Ohio River at Sewickley; and Chartiers Creek at Carnegie. The annual average flows for 1959 were 21,982 cfs for the Allegheny River, 10,428 cfs for the Monongahela River, 33,540 cfs for the Ohio River, and 253 cfs for Chartiers Creek. This data was used as the upstream flow in the analysis (Qus) available for dilution of the CSO/SSO overflows discharged into the respective rivers from the ALCOSAN system.
### Rainfall Statistics used for the NetStorm Model Analysis

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<tr>
<th>Variable</th>
<th>Record Average</th>
<th>1959</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Number of Events</td>
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<td>71</td>
</tr>
<tr>
<td>Annual Rain Volume (in)</td>
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<tr>
<td>Mean Event Volume (in)</td>
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<tr>
<td>Mean Event Duration (hrs)</td>
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<td>Mean Event Intensity (in/hr)</td>
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<td>Mean Maximum Event Intensity (in/hr)</td>
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<tr>
<td>Mean Interevent Time (days)</td>
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### NetStorm Annual Overflow Summary (MG)

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<thead>
<tr>
<th>Interceptor Segment</th>
<th>Existing</th>
<th>Concept Plan</th>
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</thead>
<tbody>
<tr>
<td>Upper Northern Allegheny (UNA)</td>
<td>318</td>
<td>63</td>
</tr>
<tr>
<td>Lower Northern Allegheny (LNA)</td>
<td>540</td>
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<td>Upper Southern Allegheny (USA)</td>
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<td>Deep Tunnels in Triangle Area (MR)</td>
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<td>Thompson Run (TR)</td>
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<td><strong>Total</strong></td>
<td><strong>11,505</strong></td>
<td><strong>3,169</strong></td>
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**Fecal Coliform Monitoring ($C_{us}$ & $C_{csd}$)**

In addition to river flows and CSO volumes, fecal coliform data were also required for the upstream flows entering the ALCOSAN service area to complete the mass balance analysis. These data were obtained from the ALCOSAN monitoring completed by CDM at upstream stations on the Allegheny River (AL-6), Monongahela River (MN-11), Ohio River (OH-13) and Chartiers Creek (CH-3). The upstream data used is presented in the adjacent figure as solid blue circles. A lognormal distribution (solid black line) was fitted to the observed upstream data and
randomly sampled for developing the upstream loads \( Q_{us} \times C_{us} \). This representation of the upstream data (solid black line) was used in the mass balance analysis. Each day a mass balance was computed between upstream flows and CSO/SSO flows, a value was randomly sampled from the solid black line representation of the upstream fecal coliform concentration distribution.

The other two lines in this figure (dashed red and solid red lines) represent conditions that were artificially changed so the upstream fecal coliform levels meet the WQS (geometric mean or maximum). As noted in this figure (dashed red line) to meet both of the WQS at the upstream locations it would be necessary to reduce both the upstream concentrations and variability. The solid red line (same upstream distribution) reflects a reduction in upstream sources so that the same variability in the data is obtained when meeting the WQS. In this case, the maximum WQS of 400 #/100mL controls the distribution and the geometric mean of 200 #/100mL is easily attained. The dashed red line (rotated upstream distribution – less variability) reflects a reduction in the upstream sources so that both WQS are met at the 50th percentile (geometric mean) and maximum (90th percentile). These distributions are used in the mass balance analysis presented in the next section. They represent possible cases when upstream actions would be taken to bring the rivers into compliance with the standards before they enter the ALCOSAN service area.

CSO and SSO end-of-pipe monitoring developed by ALCOSAN provided fecal coliform concentrations in CSO and SSO overflows to the main rivers and tributaries for use in the analysis. These data indicate a median fecal coliform level of \( 10^6 \) #/100mL, which was used, herein, to represent the CSOs. SSO data is also presented for reference. These data indicate a median fecal coliform concentration of \( 2.5 \times 10^6 \) #/100mL would be representative of ALOCSAN SSOs. These data are consistent with observed overflow concentrations found in other similar municipal settings.
**Mass Balance Analysis (C mixed)**

Given the above input values \((Q_{us}, C_{us}, Q_{cso}, C_{cso})\), a daily mass balance was calculated between the upstream river flow and the ALCOSAN inflows to estimate the downstream receiving water fecal coliform concentrations for both the existing conditions and Concept Plan condition of 85% wet weather flow receiving primary treatment. This analysis framework is somewhat conservative in that no kinetic processes (i.e., die-off) are included and, therefore, may result in slightly higher calculated downstream levels than would actually occur. The results of the mass balance calculation are presented in the figure below for the Allegheny River, Monongahela River, Ohio River and Chartiers Creek as a probability distribution of the daily fecal coliform concentrations.

Overflows for these areas were obtained from: the UNA, LNA, USA and MR(½) interceptor segments for the Allegheny River; NMM, SMM, UTC, LTC, TR and MR(½) interceptor segments for the Monongahela River; LO, UCC, LCC, USMR and LSMR for the Ohio River; and UCC and LCC for Chartiers Creek. The interceptor segment acronyms are contained in the NetStorm table above.

This figure presents the probability distributions for the calculated downstream receiving water fecal coliform concentrations during overflow events. The red circles represent the existing conditions, the blue squares represent the Concept Plan conditions, and the solid black line represents the upstream distribution used in the analysis. These graphics show the calculated fecal coliform concentrations on the “y-axis” and the frequency of occurrence on the “x-axis”. For example, for the Allegheny River existing fecal coliform concentrations (red circles) are computed to be greater than 200 per 100 mL 90 percent of the time and less than 200 per 100 mL 10 percent of the time. With the Concept Plan, Allegheny River fecal coliform concentrations are computed to be greater than 200 per 100 mL 80 percent of the time and less than 200 per 100 mL 20 percent of the time. In addition, the solid line at about a 45-degree angle represents the upstream condition (Cvs) used in the computation and discussed in the previous section.
Each of these four panels shows that the Concept Plan will reduce the main river and tributary fecal coliform concentration somewhat as is evidenced by the reduction from the red circles (existing conditions) to blue squares (Concept Plan).

For Chartiers Creek, the CSO/SSO fecal coliform used was $2.5 \times 10^5 \#/100mL$. However, two additional existing conditions analyses are presented: solid red line represents a CSO fecal coliform of $10^6 \#/100mL$, and dashed red line represents a CSO fecal coliform of $5 \times 10^5 \#/100mL$. The lower CSO fecal coliform was used for Chartiers Creek to better represent the observed downstream fecal coliform measurements.

The water quality benefit associated with the Concept Plan is highlighted in the figure above by the decreased fecal coliform concentrations (solid blue squares). As noted in the graphics the most pronounced benefit is calculated to occur in Chartiers Creek. It should be noted that based on these calculations, the Concept Plan results in instream fecal coliform concentrations that are greater than the WQS for the geometric mean (50 percentile of 200 per 100mL) and maximum allowable levels (90 percentile of 400 per 100mL). This is, in part, associated with the fact that the upstream fecal coliform concentration themselves are above the WQS for the geometric mean and maximum concentrations. Therefore, ALCOSAN CSO/SSO overflows only exacerbate this upstream problem.

In these analyses, it can be inferred that the fecal coliform distributions approximate a lognormal distribution as evidenced by the fact that the calculated profiles approximate straight lines in these plots. Given that fact, the coliform concentration at the 50% value (median) would be an approximation on the geometric mean. It would be this concentration that would be compared to the geometric mean water quality standard ($q$ 200 per 100mL). Note again however, that this analysis is not sufficiently rigorous for regulatory purposes.

A number of additional calculations were performed for various other upstream
fecal coliform distributions in order to investigate the effect of upstream fecal coliform concentrations on the lower river segments. These simulations represent potential changes in the upstream fecal coliform levels that meet both of the WQS (geometric mean or maximum) given different upstream variability: same upstream distribution (same variability), rotated upstream distribution (less variability), and a constant upstream level of 1 #/100mL (zero background levels). This approach is similar to a watershed or TMDL based approach that inherently considers both point and nonpoint sources when allocating pollutant loads within the watershed.

The results of the first simulation are presented in the figure below with the results from the other two presented in the table below. For this simulation, it was assumed that the fecal coliform concentrations at the upstream end of each river segment, attain the 90% maximum water quality standard of 400 #/100/ml (solid line at 45 degree angle). The analysis further assumes that the shape of the probability distribution remains the same as it is today (i.e., the same coefficient of variation).

The results of this analysis are displayed in the figure on the following page and show that downstream fecal coliform concentrations would still exceed water quality standards with existing ALCOSAN CSO/SSO loadings. However, the impact of the Concept Plan is much more pronounced than calculated above with the downstream concentrations now lower than the geometric mean WQS. The simulations, however, indicate that even with the concept Plan, the fecal coliform concentrations will be greater than the maximum (90%) WQS since overflows continue to exist under the proposed plan.

The table below summarizes the results of the mass balance calculations in comparison to the WQS for the simulation presented above. In general, when upstream fecal coliform concentrations allow room for additional loadings, predicted fecal coliform concentrations will be below the geometric mean WQS with the Concept Plan but achievement of the maximum WQS will be difficult even with near zero upstream concentrations.

<table>
<thead>
<tr>
<th>Waterbody</th>
<th>Existing Condition</th>
<th>Upstream Meets WQS (Same Variability)</th>
<th>Upstream Meets WQS (Less Variability)</th>
<th>Upstream Meets WQS (Constant)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Geometric Mean</td>
<td>Max.</td>
<td>Geometric Mean</td>
<td>Max.</td>
</tr>
<tr>
<td>Allegheny River</td>
<td>19%</td>
<td>30%</td>
<td>40%</td>
<td>66%</td>
</tr>
<tr>
<td>Monongahela River</td>
<td>19%</td>
<td>31%</td>
<td>52%</td>
<td>64%</td>
</tr>
<tr>
<td>Ohio River</td>
<td>5%</td>
<td>13%</td>
<td>60%</td>
<td>73%</td>
</tr>
<tr>
<td>Chartiers Creek</td>
<td>17%</td>
<td>26%</td>
<td>48%</td>
<td>60%</td>
</tr>
</tbody>
</table>
This is due to the reduced but continued overflows with the proposed plan.

Notes: Fecal Coliform WQS: Geometric Mean (50th Percentile) of 200 #/100mL, Maximum (90th Percentile) of 400 #/100mL – May through September
Existing Condition – Measured upstream fecal coliform distribution
Upstream Less Than WQS (Same Variability) – Measured upstream fecal coliform distribution reduced to be lower than maximum WQS
Upstream Less Than WQS (Less Variability) – Measured upstream fecal coliform distribution rotated to be lower than geometric mean and maximum WQS
Upstream less Than WQS (Constant) – Constant upstream fecal coliform assigned of 1 #/100mL
To comply with WQS – Calculated Geometric mean must be greater than 50% and maximum must be greater than 90%

Observations

The following conclusions are developed from these mass balance analyses.

 água Water quality benefits are attained with the Concept Plan but future fecal coliform concentrations are calculated to result in non-attainment of WQ standards.
 água The greatest water quality benefit of the proposed plan occurs in the tributaries (Chartiers Creek) as opposed to the main rivers. This is also concluded based on the NetStorm model output where some of the largest overflow reductions occur in the tributary interceptor segments (see table above).
 água Upstream (outside of the ALCOSAN service area) fecal coliform concentrations have a significant impact on whether downstream water quality is attained under the Concept Plan. Without upstream controls of point and nonpoint sources, fecal coliform water quality standards within the ALCOSAN service area may not be achievable even with the ALCOSAN concept plan.
 água Potential exceedances of the maximum WQS with near zero upstream fecal coliform levels under the Concept Plan may indicate a need to investigate the attainability of the designated uses in the main rivers and tributaries. A use attainability analysis would be required to investigate use re-designation in addition to considerable involvement with stakeholders in the area.
 água Given all of these factors, it maybe in the best interest of all parties involved to work with PaDEP and EPA to institute a watershed planning process that either develops a basin-wide plan to achieve water quality standards or to modify water quality uses and standards. This process of reviewing the water quality standards for appropriate application in wet weather is an integral part of the CSO Policy.
6.3.3 Priorities of SSO/CSO

Although there are regulatory reasons to address SSOs and CSOs differently, from a water quality and benefits point of view, the priority of SSO or CSO abatement in the ALCOSAN service area is driven more by the nature of the receiving water (main river or small creek), the presence of sensitive areas (water supplies, parks), and the frequency volume and duration of the overflow. The CSO volumes are estimated under the concept plan are considerably larger than the SSO volumes. However, the SSOs tend to be high up in the basins of small creeks where the discharge contaminates easily accessible waters. For this reason, it is recommended that in the next stage of plan development priorities for abatement be set based on the use impact of the particular discharge and not the nature of the sewer system causing the impact. Ultimately, due to the regulatory environment, it may be necessary to eliminate SSOs, while there may be some allowance for continuing CSOs. However, current resources and priorities should be focused on obtaining actual benefits from control programs first with regulatory issues addressed after cost effective programs are in place.

6.4 DISTRIBUTION OF CONVEYANCE AND TREATMENT CAPACITY

The ALCOSAN sewer system was originally designed and built to convey all flows during dry weather plus a relatively small portion of additional flow entering the system during wet weather. Although that design was consistent with the practices of the day, it is insufficient to meet today’s requirements during wet-weather conditions. In its Concept Plan, ALCOSAN has developed mathematical computer models to assess the conveyance capacity of the system under a variety of conditions and structural remediation alternatives. ALCOSAN’s selected alternatives involve a combination of upgrades to the existing facilities as well as new, parallel interceptors, and satellite storage elements and treatment facilities. According to computer simulations, the selected alternative will enable the ALCOSAN system to provide secondary treatment for the design year service population in sanitary and combined sewers, and to capture/treat 85 percent of the annual, system-wide wet-weather combined sewage flow.

The “hydraulic capacity” of the ALCOSAN sewer system is a complex parameter that is dependent upon many factors, such as rainfall patterns, sediment deposits in the conduits, and the operation of the pump wet well at the treatment plant. Nevertheless, to understand the limitations of the system to deliver inflows, it is useful to consider the relative capacity of various elements of the system.

6.4.1 Existing Condition

In the existing condition, the secondary treatment processes at the wastewater treatment plant (WWTP) limit the treatment rate to 225 mgd. The WWTP has no ability to bypass secondary treatment, but the primary treatment processes are currently limited to about 280 mgd, and the WWTP pumping capacity is currently limited to about 404 mgd (with the largest pump on standby).

Information was extracted from the ALCOSAN reports to understand the distribution of the 225-MGD flow that presently reaches the WWTP. This information is summarized in Figure 6-5 on...
the following page. This graphic displays boxes, which call out the amount of flow (MGD) that is calculated with the model to pass various points in the system during wet weather when the plant flow is maximized at 225 MGD. RLTWWCP modeling of the interceptors indicate that for the current conditions, some 180 MGD of wet weather flow enter the WWTP from the southern section of the Upper Ohio segment of the tunnels. Another, 15 mgd enter the WWTP from the northern section of the Upper Ohio segment of the tunnels, and 27 mgd from the river crossing at Chartiers Creek. Under conditions, no flow is entering the tunnels from the Loweries Run interceptor.

Also as indicated in Figure 6-5, there are other locations in the system that does not allow any additional flow into the shallow-cut interceptors or deep tunnels because of system limitations. In the current, conditions, no flow can get into the transmission system from various locations such as Lowries Run, Pine Creek, and four other areas.
There are many reasons that flows are not able to enter the transmission system during wet weather under the current conditions. In the case of Pine Creek and other the upstream areas, the transmission system can convey dry weather sanitary flows to the WWTP. However, in wet weather the small upstream interceptors fill, preventing inflows from certain areas from entering them. In the case of Lowries Run, the deep tunnels fill in wet weather raising the hydraulic grade line in the tunnels adjacent to the WWTP, preventing flow from the Lowries Run interceptor from entering them.

6.4.2 Concept Plan Condition

During development of the Concept Plan, much of the effort was focused on using mathematical models to simulate conditions in the transmission system and its elements so that a method could be developed to optimize it.

The Concept Plan selected alternative involves:

- Expansion of the WWTP treatment capacity
- Expansion of the WWTP pumping capacity
- Removal of sediment and grit from the interceptors
- Construction of new, parallel interceptors
- Construction of new, satellite storage facilities
- Construction of new, satellite treatment facilities
- Various other actions designed to minimize extraneous inflows and sedimentation deposits

The following sections describe the benefit associated with each of these plan elements.

**Treatment Plan Expansion** - The maximum treatment rate of the WWTP is currently limited to 225 mgd, the capacity of secondary treatment processes. The proposed WWTP expansion will increase the capacity of the pumping station at the treatment facility to 875 mgd, the maximum limit of the wet-well structure. The WWTP treatment processes will also be increased to provide secondary treatment up to 310 mgd and primary treatment to the remaining 565 mgd. Modifying pumping operations at the WWTP to reduce wet-well elevations from 680 ft to 650 ft during wet weather will increase flow conveyance during wet weather and will also help reduce sedimentation by boosting flow velocities in the interceptors.

It appears that these limitations were selected to make the maximum use of the existing facilities, thereby keeping control costs to a minimum. The pumping capacity as stated above was the limit for the wet-well structure. The 565 mgd of primary treatment capacity was the maximum flow that could be pushed through the existing primary clarifiers without construction of addition settling basins. These higher flows are expected to raise the hydraulic overflow rates to about 4,000 gallons/sq.ft/day and to decrease primary treatment efficiency. The 310 mgd secondary treatment flow rate was selected to provide secondary treatment to all SSO flows that would be retained in the ALCOSAN collection system. Expansion of these facilities from the existing 225 mgd capacity also uses all of the available land at the plant site.

**Maximizing Existing Flow Capacities at Regulators** - Once the WWTP upgrades are complete, the plan calls for modifying the control gates, control orifices, and overflow-weir elevations in the existing regulator structures to increase the wet-weather inflows from the
municipal trunk sewers to the ALCOSAN system. These modifications could involve, for example, opening control gates to their maximum positions, removing all orifice-restrictor plates, and increasing the height of diversion weirs. These actions are typically “best-management” type controls that are not associated with large capital outlays. They could potentially increase the sum-total capacity of the 317 regulators from their current, estimated level of 1,134 mgd to 1,629 mgd. If the control-structure frames were removed to widen the openings to their structural maximum, the sum-total hydraulic capacity of the regulators would increase to as much as 3,412 mgd.

With these changes, it is clear that the regulators will not be limiting to flows that enter the transmission system. In fact, care will need to be given during development of future Phase II plans to balance the flows entering the system so that there are no locations where flows are prevented from entering the system. Typically regulators from separate areas could be set so that all separate locations are at least permitted to put at least 1.5 to 2.0 times the design dry weather sanitary flow into the transmission system. Special consideration must be given to this concept of balancing the system so that in the future Lowries Run interceptor flows or Pine Creek are flows are not blocked from entering the transmission system, as is the current condition. This may require equipping some of the regulators with automated control gates that can be controlled from a central computer (Real Time Control).

Deep-Tunnel Interceptors and River Crossings - Model simulations indicate that the deep-tunnel interceptors can convey at least 1,000 mgd to the WWTP under ideal conditions. The Review Team was not able to ascertain the hydraulic capacities of the deep tunnels for the available information and the time of the review. Information available to the Team, however, did indicate that the hydraulic grade line (HGL) in these deep tunnels associated with the operation of the WWTP wet well does limit inflows to the deep-tunnel system at certain locations. For this reason, the Concept Plan specifies treatment/storage options for four sewersheds (Pine Creek upstream of A-68; Upper North Shore Allegheny upstream of A-72; Becks Run upstream of M-34; and Whittaker Run upstream of M-49). Where possible, it is recommended that Phase II evaluations consider the use of Real Time Controls to prevent the need to construct upstream storage basins because wet weather flows can not enter the transmission system do to increased wet weather hydraulic grade lines.

It is clear from the available information that river crossing tunnels can limit the amount of flows that can be moved across the rivers. There are 10 locations within the transmission system where flow must be transferred across these rivers so that it can reach the WWTP for treatment. During conceptual plan development, ALCOSAN assumed that it would be too costly to add additional capacity to these transmission elements.

Analyses were conducted during development of the Concept Plan using the EXTRAN model to assess the capacity of the system components with the WWTP pumping at a rate of 875 mgd. The results of this analysis are presented in Figure 6-6, on the following page. As indicated in this graphic, some 695 mgd of wet weather flow out of the 875 mgd enter the WWTP from the southern section of the Upper Ohio tunnels. Another 65 mgd is calculated to enter the WWTP from the northern section of this tunnel while the remaining 110-mgd of flow is computed to pass under the river from the Chartiers Creek system. Under these conditions, the system still
encounters some level of surcharging making it difficult to evaluate the ultimate capacity of some of the deep tunnel elements. In Figure 6-6, the capacity of these segments is shown, as “nia” indicating no information was available from ALCOSAN’s modeling consultant.

It should be noted, however, that this analysis indicated that there are some sections of the system where definite limitations do exist. For example, as shown in Figure 6-6, the two river crossings in the Upper Allegheny River cannot carry any flow in the Concept Plan condition because the flow entering the interceptor from regulators on the other side of the river fills the interceptor. As shown in Figure 6-6 where capacity to enter the system is show as zero, similar conditions were calculated for other segments of the system.

Further, because the tunnels are small structures, the only have limited capacity to convey flow through them. For example, the maximum flow that can pass through the Lower Northern Allegheny section of the system is 17 mgd.

**Sedimentation and Grit Deposits** - With the completion of the WWTP upgrades described above, and all regulators re-set to their maximum gate openings, the peak flow that would be conveyed to the WWTP was estimated to be approximately 776 mgd (with wet-well elevation of 643 ft) under worst case grit conditions. Removing the grit and sedimentation from the interceptors and river crossings is calculated to increase the peak conveyance to about 850 mgd (wet-well elevation of about 653 ft).
Analyses were performed during development of the Concept Plan to determine the effect of sediments on the conveyance capacity of the interceptors (as described in Technical Memo #9, “Deep-Tunnel and Shallow-Cut Interceptor Modeling. Results of the analyses indicated that modeled hydraulic grade lines (HGLs) ranged from 1.1 ft lower to 1.0 ft higher than averaged monitored data in some areas, but that these departures were “less than the statistical variance in the data.” These facts suggest that additional monitoring data need to be collected and that additional calibration need to be performed to improve model agreement in areas where such differences could affect the effectiveness of the proposed plan and/or the cost of the proposed plan.

As the technical analyses indicate that the capacity of the transmission system could be limited to 776 mgd, future Phase II analyses should continue to examine the ability of the deep tunnels to deliver flow to the WWTP. Methods of cleaning the interceptor of accumulated grit should also be developed. Although periodic wet-well draw down has been cited in the Concept Plan as a method to clean the interceptors, there is a strong possibility that this method will not be sufficient to remove the sediment from reaches of the tunnels far from the pump stations. Because the interceptors will not be able to convey 875 mgd to the WWTP unless they are sufficiently cleaned, an investigation into cleaning methods and an assessment of their costs is recommended during the next phase of planning.

**Drop Shafts** - ALCOSAN’s consultants developed EXTRAN elements to simulate the hydraulic characteristics of the drop shafts as described in the Carnegie Institute of Technology report, *Flow in Vertical Shafts* (August 1952). Through various calculations ALCOSAN reported that the sum-total capacity of all drop shafts to be about 1,339 mgd. The Review Team was unable to confirm the hydraulic capacities cited by ALCOSAN for these drop shafts. However, using the original design curves shown in that report, the Review Team, was able to confirm that system-wide the capacity of the drop shafts appeared to significantly exceed the 875 mgd capacity being planned for with the WWTP expansion.

Individually, however, drop shafts can potentially limit the amount of flow that can be added to various segments of the transmission system. The Concept Plan, citing the prohibitive expense of constructing new drop shafts, selected alternatives designed to work with the existing drop shafts.

The Review Team has not looked into the costs or the difficulties with constructing new drop shafts. However, in future planning efforts, if there is a choice between constructing a new drop shaft or providing an end-of-pipe CSO control facility (vortex, retention or both), it is recommended that serious consideration be given to the construction of that drop shaft.

**6.4.3 Shallow-Cut Interceptors**

According to the reports developed by ALCOSAN, the capacities of several shallow-cut interceptors are insufficient to carry the Concept Plan “high-end” criteria of the peak flow capacity required to capture all wet-weather flow from separately sewered areas and 85 percent of annual overflow volume from combined areas. A detailed description of the shallow-cut interceptor limitations is provided below for each of the major sewershed areas.
**Lower Northern Allegheny** - The existing shallow-cut interceptor is inadequate to convey the required peak flow, which is roughly 310 mgd. This requirement assumes that 8 mg of storage is provided by two basins that are planned in the Girtys Run sewershed, and that a surface stream directly influent to A-66 is removed. Along its 1.3-mile length, the existing interceptor capacity ranges from about 12 mgd at A-67 to approximately 19 mgd at its downstream end at A-62, the entrance to the deep tunnel. Based on the system-wide alternatives integration, only 17 mgd can enter the deep tunnel at A-62. Existing system-wide wet-weather capture is estimated to be about 53 percent.

The shallow-cut interceptor segment does not appear to have many significant “bottlenecks” (that is, places where the interceptor capacity decreases relative to upstream capacities). However, there is one such constriction at mile point 0.6 (measured upstream from A62), where the capacity falls to approximately 13.5 mgd from about 14 mgd at mile point 0.8. The sum-total capacity of all regulators directly tributary to the shallow-cut interceptor (A-67 to A-62) is between 44 mgd (assuming all control gates are in the full-open position) and 94 mgd (assuming all control gate frames are removed to pass the maximum flow structurally possible).

The existing deep-tunnel interceptor is adequate to convey the concept plan flow requirements. The sum total capacity of all regulators directly tributary to the deep tunnel (A-61 to A-47) is between 161 mgd (assuming all control gates are in the full-open position) and 358 mgd (assuming all control gate frames are removed to pass the maximum flow structurally possible). The sum-total capacity of all drop shafts tributary to the deep tunnel (A-62 to A-47) is 225 mgd. Both of these capacities exceed the capacity of the tunnels in this area.

To meet the objectives of the Concept Plan, a 68-mgd treatment facility is proposed at A-67. In addition, the hydraulic capacities of several inlet connections from the sewersheds along the shallow-cut interceptor will require upgrades.

**Saw Mill Run – Shallow-CutInterceptor** - With the completion of previously planned interceptor segments (4 miles from McNeilly Road to S-01A) and storage facilities (4 basins upstream of S-01A totaling 6.6 MG, plus another in the local system), the nearly 8-mile long shallow-cut interceptor system would be adequate to convey the required “high-end” flows for about 6.5 miles from the upstream end. However, downstream of S-01A (Woodruff Street), the interceptor can deliver to the O-14 drop shaft connection to the only about 100 mgd of the roughly 440 mgd requirement. The drop shaft itself can convey a peak flow of only about 77 mgd, and with the WWTP wet well operating at or below 680 ft, the river crossing connection to the Ohio Interceptor can convey only 69 mgd.

This interceptor segment has significant “bottlenecks” (that is, places where the interceptor capacity decreases relative to upstream capacities). Although the interceptor capacity reaches roughly 220 mgd at mile point 2.0 (measured upstream from O-14), a downstream bottleneck in “Line 1” at mile point 0.8 reduces the effective capacity of the interceptor to about 85 mgd from mile point 0.8 upstream to about mile point 5. Downstream of the 0.8-mile point bottleneck, the interceptor capacity recovers to approximately 110 mgd. At approximately mile point 5.5, another bottleneck reduces the capacity from approximately 85 mgd to about 40 mgd, which is
very close to the “high-end” requirement at that location. The sum-total capacity of all regulators directly tributary to the interceptor (S-24 to S-41) is 16 mgd.

To meet the objectives of the RWWLTCCP, a 75 mgd treatment facility is proposed at O-14. To deliver required flows to this treatment facility, a new, 30-mgd parallel interceptor is proposed between S-02A and O-14.

**Thompson Run – Shallow-Cut Interceptor** - The entire 3.8-mile length of the existing interceptor is inadequate to convey the “high-end” flow requirements, which vary from about 8 mgd in the upstream reaches to about 35 mgd near the junction with the Turtle Creek interceptor at T-9. The existing interceptor can convey from 2 to 5 mgd along its length.

Although the conveyance capacity of the interceptor system reaches about 7 mgd at various points along its length, downstream “bottlenecks” reduce the effective capacity at several locations. A bottleneck at T-08 drops the effective capacity to 5 mgd from mile point 0.0 (measured upstream from T-08) to mile point 0.2; another bottleneck at mile point 0.2 drops the effective capacity to about 4 mgd from that location upstream to milepoint1.6; a bottleneck at mile point 3.0 reduces capacity from about 3 mgd to about 2 mgd from that location upstream. The sum-total capacity of regulator capacities tributary to the interceptor is 16 mgd.

To meet the objectives of the Concept Plan, a new parallel interceptor is proposed to approximately double the conveyance capacity of the system. In addition, a 6 MG storage facility is proposed at TR-03, approximately 0.7 miles upstream of the junction with the Turtle Creek system.

**Turtle Run Shallow-Cut/Deep-Tunnel Interceptors** - The entire 8-mile length of the Turtle Run system (as evaluated from T-29 to M-59) is inadequate to convey the “high-end” flow requirements, which vary from about 20 mgd in the upstream reaches to roughly 800 mgd at the deep-tunnel inlet at M-59. This requirement assumes that 2.85 MG of storage is provided by an already-constructed facility upstream of T-04, and that a small surface stream directly influent to T-01 is removed. The existing capacity of the system can convey about 5 mgd at its upstream end to about 40 mgd in the deep tunnel at the downstream end. Existing system-wide wet-weather capture is estimated to be about 50 percent.

The existing Turtle Creek interceptor system does not have particularly significant “bottlenecks” (that is, places where the interceptor capacity decreases relative to upstream capacities). The sum-total capacity of regulators tributary to the system (T-01 to T-33) ranges from 72 mgd (assuming that all control gates are fully opened) to 78 mgd (assuming that control gates are removed). The capacity of drop shaft T-02 is about 9 mgd.

To meet the objectives of the Concept Plan, a new parallel interceptor is proposed to approximately double the conveyance capacity of the system. In addition, a 22 MG storage facility is proposed at T-29, and a 131 mgd treatment facility is proposed near the M-59 deep-tunnel relief structure.
Chartiers Creek - Nearly all of this 14-mile-long system is inadequate to convey the “high-end” flow requirements, which vary from about 35 mgd to 100 mgd in the upstream reaches to nearly 600 mgd for the downstream half of the system. (In the 0.4-mile-long O-10A to O-7 branch, the flow requirements are approximately 300 mgd.) These requirements assume prior removal of surface stream inflows to the system at the Ella Street (O-06), Cork’s Run (O-13), Sheridan Park (C-7), Forest Grove (C-9), and St. Mary’s Cemetery sewershed areas. However, recently planned wet-weather remediation work in Scott Township, Painter’s Run, and McLaughlin Run is not accounted for. The existing capacity of the system is less than 30 mgd for all but the most downstream 1.0 mile, where capacity increases rapidly in the deep tunnel system to about 110 mgd. (In the O-10A to O-7 branch, existing capacity is about 5 mgd.) Existing system-wide wet-weather capture is estimated to be about 41 percent.

The existing Chartiers Creek interceptor system does not have particularly significant “bottlenecks” (that is, places where the interceptor capacity decreases relative to upstream capacities). A minor bottleneck does occur around mile point 13 (as measured upstream from O-26), where restrictions reduce capacity to about 6 mgd in an area where double that could otherwise be conveyed. The sum-total capacity of regulators tributary to the system is 82 mgd. The capacity of the drop shaft O-07 is about 82 mgd, and the capacity of the O-06 drop shaft is about 12 mgd. The capacity of the deep-tunnel river crossing to the WWTP is approximately 110 mgd.

To meet the objectives of the Concept Plan, a new parallel interceptor is proposed along the entire length of the existing sewer, plus 7 storage facilities with a total capacity of 50 MG.

Upper Allegheny – Northern Bank, East Side (Montrose Pump Station to Morningside Junction Drop Shaft, A-39), Northern Bank, West Side (A-69 to A72), and Southern Bank (A-45 to A-42) - The nearly 2.5 miles of upstream, separate sewer on the roughly 4-mile-long northern bank, east side system is adequate to handle “high-end” CSO-flow requirements, of about 3 mgd. However, the downstream 1.6 miles of the downstream, combined portion of this system is grossly inadequate to convey the high-end flow requirements, which increase rapidly to nearly 140 mgd. The 0.5-mile-long west side system is also inadequate to convey the high-end combined flow requirement, which is about 30 mgd. The southern bank system is not adequate to convey the flow requirement, which accounts for three existing storage facilities totaling 3.13 MG. All these flow requirements assume the prior removal of surface-stream inflows in Sharpsburg (A-69) and Negley Run (A-42). Assuming that the WWTP wet well is operated at or less than 680 ft, the existing capacity of the northern, east-side portion of the interceptor ranges from 5 to 9 mgd, and the west-side capacity is less than about 1.2 mgd.

The most significant flow limitation in the system is the ability of the Allegheny deep-tunnel to accept inflows at A-39 and A-42. Even with the increased flow capacity of about 875 mgd at the WWTP, the corresponding peak flow that can enter the deep tunnel is effectively 0 mgd at A-39 and about 29 mgd at A-42.

The existing northern, east side interceptor has a significant bottleneck at mile point 1.6 (measured upstream from A-39) which reduces the effective conveyance capacity to less than 1 mgd from about 3 mgd, which is the effective capacity upstream of mile point 1.6. Bottlenecks
at mile points 0.7 and 0.2 keep the effective capacity of the interceptor to about 5 mgd and 7 mgd in segments upstream of those locations. The sum-total capacity of regulators tributary to the northern interceptor is 26 mgd (east side) and 14 mgd (west side), assuming that the control gates are fully open (removing the gates increases capacities to 54 mgd and 30 mgd, respectively).

To meet the objectives of the Concept Plan, a combination of regional and local facilities was found to be more economical than the regional-only approach. This combination approach involves the municipalities reducing combined-sewage flows to 3.5 x dry-weather flows (“mid-range” flow criteria) through construction of storage facilities totaling 17 MG and rebuilding sewers in a 19-acre area. These actions would reduce the ALCOSAN flow requirements in the northern interceptor to about 13 mgd (from 140 mgd) in the east side, and to about 1.7 mgd (from 30 mgd) in the west side. Given those requirements, and the limited availability of peak inflows to the Allegheny deep tunnel at A-39 and A-42, regional (ALCOSAN) facilities would include a new, parallel interceptor along the northern interceptor (A-77 to A-72), an 18 MG treatment facility at A-72, an 11 MG storage facility at A-42C, and expansions of the Sandy Creek and Verona pump-station capacities (from 16.6 to 25 mgd, and from 2.16 to 2.4 mgd, respectively).

Monongahela Shallow-Cut Interceptor (M-45 to M-42A) - This 1.3-mile-long “Glenwood” segment is grossly inadequate to meet “high-end” flow requirements, which are roughly 500 mgd for most of its length, and about 700 mgd for the downstream 0.2 miles. Assuming that the WWTP wet well is operated at or less than 680 ft, the existing capacity of this interceptor is roughly 7 mgd for the upstream 1-mile reach, and increases to about 11 mgd along the downstream 0.2 miles.

A significant flow limitation appears to be the 16 mgd available capacity in the main deep-tunnel interceptor at M-30 during peak flow periods. The existing shallow-cut interceptor does not have particularly significant bottlenecks along its length. The sum-total capacity of regulators tributary to the Glenwood interceptor is 50 mgd, assuming that the control gates are fully open (removing the gates increases the capacity to 109 mgd).

To meet the objectives of the Concept Plan, a combination of regional and local facilities was found to be more economical than a regional-only approach. This combination approach involves the municipalities reducing combined-sewage flows to 3.5 x dry-weather flows (“mid-range” flow criteria) through construction of storage facilities totaling 26 MG. This would reduce the ALCOSAN flow requirements in the Glenwood interceptor to about 42 mgd (from about 700 mgd) from mile point 0 to 0.2 (as measured upstream from M-41), and to less than 10 mgd (from about 500 mgd) for the rest of the interceptor. The flow requirement for the upstream 0.8-mile segment is within the existing capacity of the interceptor.

6.4.4 Limitations in the Main River System

Pine Creek Sewershed Inflows to the Allegheny System (at A-68) - Even with the expanded WWTP capacity to 875 mgd, the Allegheny deep-tunnel system has no available capacity for inflows from the Pine Creek sewershed (at A-68) during peak wet-weather flow conditions. To meet the objectives of the Concept Plan, a 65-mgd primary-treatment facility is proposed near A-
68 to handle all wet-weather flow. As a result, this sewershed does not utilize any of the 524 mgd flow allocation for the main river systems.

**Whitaker Run Sewershed Inflows to the Monongahela Interceptor (at M-49)** - Even with the expanded WWTP capacity to 8705mgd, the Monongahela deep-tunnel system has no available capacity for inflows from the Whitaker Run sewershed (at M-49) during peak wet-weather flow conditions. To meet the objectives of the Concept Plan, a 35-mgd primary-treatment facility is proposed near M-49 to handle all wet-weather flow. As a result, this sewershed does not utilize any of the 524 mgd flow allocation for the main river systems.

### 6.4.5 Impacts of Vortex Facilities

In addition to the system limitations discussed above, the Concept Plan recommends construction of 10 swirl concentrators, representing a total treatment capacity of at least 481mgd. The concept plan also calls for construction of 5 previously planned and 10 new storage basins, which with existing basins represent a total capacity of 110 MG (not including additional 43 MG of new storage facilities in the local systems).

An important issue to recognize is that, whereas the Concept Plan has specified swirl concentrators as “treatment facilities” which treat and discharge all flow to the adjacent waterway during periods of peak wet-weather flow, swirl concentrators actually only split flow into two effluent streams: a “clarified discharge” stream, accounting for approximately 85 to 95 percent of the inflow at design-flow conditions, and a “foul underflow” stream, accounting for approximately 5 to 15 percent of the inflow at design-flow conditions. Although the clarified stream is in fact discharged to the waterbody, the foul underflow must be conveyed to the WWTP for treatment. Because the Concept Plan specifies a total swirl-treatment capacity of at least 481 mgd, an additional 24 to 72 mgd will need to be conveyed to the WWTP. This may present a problem for locations where little or no additional flows can be routed into the sewer system. To overcome this difficulty, the Concept Plan specified additional storage basins during the concept phase planning.

### 6.4.6 Observations

Although, some of the modeling of the interceptors and deep tunnels could be considered preliminary and in need of further calibration, some general observations can be made about the transmission system and it’s limitations.

- Bottlenecks are computed to exist at various locations in the system including river crossings and certain shallow-cut interceptor segments.

- The drop shafts probably provide adequate capacity to allow in the full 875 mgd of capacity.

- The majority of the 875 mgd wet weather flow will likely enter the WWTP from the Saw Mill Run, and Upper Ohio/Allegheny/Monongahela River tunnel segments.
Flows entering the system under the Concept Plan simulations were allowed to enter the system with control elements in a full open position so that there was no attempt to provide any system allocations of the wet weather flows treated at the WWTP.

The amount of wet weather flow allowed into the system in the future could be much better controlled if consideration is given to automation of major regulators to prevent excess flows from entering certain interceptor and tunnel elements at the exclusion of wet weather flows from other areas.

However, that being said, the system only has a limited capability to provide that type of allocation.

There is some question as to whether the deep tunnels can provide adequate capacity to deliver 875 mgd of flow in the future because of the amount of grit present in those tunnels. This Review Team can only rely on the made information available to them to assess this limitation. As such, it appears that additional work should be conducted in future phases of planning to better refine the level of hydraulic model calibration so that a higher degree of confidence can be placed on the analyses of delivery capacity.

6.5 ASSESSMENT OF ELEMENTS

The major plan elements are as follows.

- Expansion of WWTP to 875 mgd
- Primary Treatment to 565 mgd
- Secondary treatment to 310 mgd

As indicated earlier and discussed further in Section 8, expansion of the WWTP to 875 mgd appears to the Review Team to be a reasonable first step that should be initiated as soon as practical. Regardless of questions about deep tunnel transmission capacity or other potential limitations to the system, expansion of the WWTP will provide some level of immediate reduction in combined and sanitary sewer overflows. This improvement appears to be very cost effective and consistent with approaches being followed around the nation. However, the following should be addressed:

- The process modeling information presented in the Act 537 Plan uses very low influent concentration at high flows (30 mg/l BOD and 40 mg/l TSS). These concentrations should be confirmed. Further if influent concentrations are low for an extended period of time, meeting the secondary treatment requirement of 85% removal may be come impractical. Application for a CSO system exception may be needed.

- The flow splitting required to operate the proposed wet weather process will be complex. To accomplish this will most likely require sophisticated flow metering, instrumentation and control.
The proposed wet weather treatment concept includes adding sodium hypochlorite to the primary sedimentation units to meet very low fecal discharge limits (200 col/mgl). While the data provided from Bangor, Maine is promising, experience at other large facilities is that these low levels are not achievable. It is recommended that demonstration tests be carried out at the ALCOSAN plant before final selection of a disinfection process.

6.5.1 Regulator Modifications

It will be necessary to modify the regulator settings to allow additional flow to enter the transmission system once the WWTP is expanded to 875 mgd. However, the Review Team recommends that consideration also be given to installation of automated regulators at a number of key locations and the installation of SCADA and Real Time Control (RTC) elements. This will allow ALCOSAN to balance the system in a way that provides for some equitable allocations of wet weather flows to all ratepayers in the system.

6.5.2 Additional Transmission Capacity In Shallow-Cut Interceptors

Addition of a certain amount of transmission capacity to the system to remove bottlenecks in the system appears to be a reasonable thing to do. In many cases, this expanded capacity will move flow from the urban tributaries to the downstream main rivers, which have a large assimilation capacity. However, the Review Team recommends that detailed basin-by-basin facility planning level studies be conducted before additional transmission conduits are designed. Future planning efforts should incorporate reductions that can be achieved by the municipal sewer system improvements being undertaken by the tributary communities. These future analyses should also use the Tier II modeling approach, which relies on calibration of system flows and hydraulic grade lines as well as a thorough evaluation of upstream impervious areas.

6.5.3 Vortex Treatment Facilities

Allegheny County physical features appear to be compatible with vortex concentrators. The steep slopes will provide adequate energy to drive wet weather flows through vortex devices. The location of the deep interceptors in certain sections will also allow construction of vortex facilities that do not require effluent or foul flows to be pumped. However, the Review Team provides the following comments with respect to these facilities.

Consideration should be given to reducing the number of facilities. Where possible consolidation of outfalls to centralized facilities should be considered. The Team believes that siting of these facilities will eventually be a problem in Allegheny County as it has been in other densely populated areas. The “not in my backyard” attitude will develop in the community once ALCOSAN begins to attempt to acquire sites for 10 vortex facilities currently in the Concept Plan. In addition, operation of multiple facilities at remote locations will not be easy.

Where vortex units are to be used consideration should be given to designing them so that typical hydraulic overflow rates remain below 10 gpm/square foot and average 5-gpm/square foot so that they do act as primary treatment devices.
Analyses of future conditions using vortex treatment facilities should consider the ability to transport the foul underflow from the vortex facilities in transmission conduits, some of which appear to have no capacity. This limitation of capacity maybe another reason to consider retrofitting some if not many of the regulators with automated gates and computer controls (RTC) so that room can be made in the flow limited sections for vortex foul flows.

A provision be made to allow the addition of some form of disinfection if required in the future. This should be considered during the facility planning studies so that chemical storage is considered in the facility layout.

There is a general trend away from Vortex facilities (see trends discussion in Section 5). Care should be taken in assuring that these facilities will return actual benefits.

Future planning should consider the use of parallel storage tunnels as an alternative to multiple remote CSO control facilities. This alternative will facilitate cleaning of the existing tunnels. Even if this option is not planned until long into the future, it should be considered.

6.5.4 SSO Retention Facilities

Where possible the need for these multiple retention basins should be re-evaluated. Siting of these basins within the member communities will become a problem. Operation of this many wet weather control facilities at remote locations will also complicate ALCOSAN operations and staffing issues.

Concept planning chose to recommend 17 retention facilities. The Review Team recommends that consideration be given to the following alternatives in future planning.

Where possible remote facilities should be eliminated in favor of centralized facilities.

Consideration should be given in future planning to tunnels. Tunneling costs can be on the order of $3,000 to10,000 per linear foot including drop shafts. However, economies of scale are possible for large tunneling projects. With the rock conditions in Allegheny County the cost could be expected to be closer to $3000 lft.
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An example of a possible storage conduit scenario is shown in the table below:

### Example Tunnel Scenario

<table>
<thead>
<tr>
<th>Item</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Tunnel</td>
<td>16,000 LF</td>
</tr>
<tr>
<td>South Shore Allegheny Tunnel</td>
<td>25,000 LF</td>
</tr>
<tr>
<td>North Shore Allegheny Tunnel</td>
<td>12,000 LF</td>
</tr>
<tr>
<td>Monongahela River Interceptor</td>
<td>47,000 LF</td>
</tr>
<tr>
<td>Chartiers Creek</td>
<td>0 LF</td>
</tr>
<tr>
<td>Saw Mill</td>
<td>0 LF</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100,000 LF</strong></td>
</tr>
</tbody>
</table>

- **Average Diameter**: 10’
- **Storage Volume**: 59 mg
- **Conveyance capacity @ 8 ft/sec**: 400 mgd
- **Unit Construction Cost ($/ft)**: $3,000
- **Construction Cost**
  - Tunnel: 100,000’ x $3,000/ft = $300 M
  - Ancillary facilities @ 1/3 = $100 M
  - Subtotal = $400 M
  - Contingency @ 30% = $120M
  - Total = $520 M

- **Capital Cost** = 1.4 x Construction = $728 M

✔ If a storage conduit concept can be developed, then the planned 875 mgd WWTP capacity can be used to process the CSO/SSO flow stored in the tunnel and no local treatment or retention facilities will need to be sited in local communities. The only sites that will be required will be small sites for drop shafts.

✔ In addition, it maybe possible to plan a way to have a CSO/SSO tunnel that can also function as a backup to the existing deep tunnels that are now over 50-years old. This would provide for a backup in the case there is a failure in the existing tunnels to handle repairs and to allow for regular maintenance activities.
7.1 GENERAL

As discussed in Section 6, water quality in the main Allegheny County Rivers and the urban tributaries is impacted by CSO/SSO overflows. Screening level assessments conducted as part of this review, further reveal that sources upstream of Allegheny County and sources present in dry weather also influence water quality and potentially could impact uses. ALCOSAN with its CSO/SSO overflows exists within this complex myriad of sources and impacts along with many other participants. It appears, based on past action that ALCOSAN, PaDEP, other regulators and the partner communities have focused on issues from a technology point of view. For example the CSO portion of the Concept Plan is directed at achieving a particular percent capture of wet weather flow. This approach does not necessarily address compliance with the water quality standards or that actual quantifiable benefits are being achieved. The watershed approach in contrast, focuses first on uses and benefits and, derives the technology needed to provide those benefits. The approach taken to date appears to start and end at a particular technology target.

Watershed planning is an approach that was put forth by the United States EPA in the late 1990’s as the preferred method of handling the large variety of point and non-point source pollution that impact the nations water ways. This process involves the integration of the varied interested parties (stakeholders) in the development of a unified approach to solving the water quality problems and improving water uses in an area. Through the process, many complex issues can be integrated, assessed and prioritized. Once this is done an action plan for improving water quality within the basin can be developed by the stakeholders. It is a process where many varied interests are brought together to the common goal of improved water quality.

The stages of the Watershed Approach include:

Stage 1 - Identify Challenges and Objectives – Bring together the watershed stakeholders to Identify concerns, valued watershed features, seek and analyze data, prioritize challenges and opportunities, determine critical areas and establish objectives.

Stage 2 - Develop a Plan – Select Management Alternatives including the types of actions by what stakeholders.

Stage 3 - Implementing and Evaluating – Prioritizing Actions, Funding the Actions, Implementing, Measuring success and further needs.
There are several reasons the watershed approach should be considered for the Concept Plan. These include:

- There are a variety of water quality impacts from a wide range of sources that need to be addressed. The regulatory approach will have difficulty approaching these problems in a cohesive manner.

- There is a great need to gain the support of the people who will pay for the actions. The watershed approach lets the stakeholders determine what is important to implement first. Priorities can be driven by the watershed approach.

To utilize the watershed approach it is important to first understand the water quality issues.

### 7.2 WATER QUALITY ISSUES

The watersheds serviced by the ALCOSAN facilities consist of two distinct types of waterways. The three main water bodies are the three rivers; Allegheny, Monongahela, and Ohio. These water bodies are large rivers with drainage areas upstream on the Allegheny and Monongahela of 11,410 square miles and 7,340 square miles, respectively. The other types of waterways that make up the ALCOSAN drainage area are much smaller tributaries such as the Sawmill Run, Turtle Creek, Chartiers Creek and other similar tributaries to the main rivers. Drainage areas for these tributaries are much smaller with Chartiers Creek being one of the larger water bodies with a drainage area of some 250 square miles.

Water quality in the main rivers and the tributaries is impacted by a variety of pollution sources including:

- Urban Stormwater
- Sewer Overflows
- Acid Mine Drainage
- Upstream Sewer Overflows and loads from other Communities
- Wildcat Sewers – Communities with sewers, but no treatment
- Failing Septic Systems

The main rivers receive watershed wide inputs from other municipalities and a wide variety of non-point sources. In addition, there are a variety of issues that relate to the river, their uses and the regulatory environment.

303(d) Listings/TMDLs – PaDEP is the state agency that is charged with the regulatory authority to regularly assess the conditions its waters and their uses. Waters that do not comply with water quality standards should be listed as impaired and subsequently go through the process of developing Total Maximum Daily Loads (TMDLs). Currently, some of the water bodies in the ALCOSAN area are listed on the state of Pennsylvania 303 (d) lists as being impaired and violating water quality standards. River segments listed on the 1996-303(d) list are as follows;
<table>
<thead>
<tr>
<th>Water Body Name</th>
<th>SWP Basin</th>
<th>Pollutant</th>
<th>Pollutant Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allegheny River</td>
<td>18A</td>
<td>Organics/PCBs/Chlordane Organics/PCBs/Chlordane</td>
<td>Unknown</td>
</tr>
<tr>
<td>Monongahela River</td>
<td>19C,G</td>
<td>Organics/PCBs/Chlordane Organics/PCBs/Chlordane</td>
<td>Unknown</td>
</tr>
<tr>
<td>Ohio River</td>
<td>20B, D</td>
<td>Organics/PCBs/Chlordane Organics/PCBs/Chlordane</td>
<td>Unknown</td>
</tr>
<tr>
<td>Streets Run</td>
<td></td>
<td>Metals</td>
<td>Abandoned Mines</td>
</tr>
<tr>
<td>Thompson Run</td>
<td>19A</td>
<td>Metals</td>
<td>Abandoned Mines</td>
</tr>
<tr>
<td>Turtle Creek</td>
<td>19A</td>
<td>Metals</td>
<td>Abandoned Mines</td>
</tr>
<tr>
<td>Pumpkin Run</td>
<td>19B</td>
<td>Metals</td>
<td>Abandoned Mines</td>
</tr>
<tr>
<td>Chartiers Creek</td>
<td>20F</td>
<td>Nutrients, Siltation, Turbidity, Habitat Modification, Metals, Organics/PCBs/Chlordane</td>
<td>Abandoned Mines, Urban Runoff, Storm Sewers, Agricultural Runoff</td>
</tr>
<tr>
<td>Little Chartiers Creek</td>
<td>20F</td>
<td>Nutrients, Siltation, Turbidity, Metals, Organics/PCBs/Chlordane, Suspended Solids</td>
<td>Abandoned Mines, Urban Runoff, Storm Sewers, Construction</td>
</tr>
<tr>
<td>Sawmill Run</td>
<td>20F</td>
<td>Organic Enrichment, Low DO Metals</td>
<td>Municipal Point Source</td>
</tr>
<tr>
<td>Streets Run</td>
<td>19A</td>
<td>Metals</td>
<td>Abandoned Mines</td>
</tr>
</tbody>
</table>

PaDEP has begun the process of developing TMDLs for these water bodies. To date, TMDLs have been developed for the Monongahela and Ohio Rivers and Chartiers Creek for PCBs and Chlordane. The process will continue for development of TMDLs for other river reaches as is outlined in the State’s 5-Year Plan for TMDL Development.

In addition, the process of evaluating river reaches to assess their level of compliance with water quality standards is an ongoing bi-annual process. PaDEP is required by the Clean Water Act to revisit and re-assess the State’s waters every 2 years. PaDEP must submit the 303(d) list to the Environmental Protection Agency (EPA) by April 1st of even numbered years. The last update of the 303(d) list was in 1998. As such, the state will be issuing an update to the list sometime in the future.

As discussed in Section 6, the main rivers within Allegheny County experience elevated fecal coliform concentrations. In addition, available data indicate that some of the urban tributaries experience elevated fecal coliform levels in dry weather. The available information indicates that the most of the main River and tributary segments are greater than the fecal coliform water quality standards. Currently, Allegheny County waters are not listed on the 303(d) list as being
impaired for fecal coliform bacteria. Because available data exhibit these elevated fecal coliform concentrations, it is likely that a new 303(d) list will add fecal coliform to the causes of use impairments and require that a TMDL be developed for these pathogens.

By law, the State PaDEP is responsible for development of TMDLs for the ALCOSAN impacted water bodies. Typically, state budgets for TMDL development are limited and the states therefore develop simplistic approaches to preparation of TMDLs that allow state staff limited resources for development of these TMDLs. Currently, this process does not directly impact ALCOSAN, as the state is not developing any TMDLs that would involve ALCOSAN outfalls. However, when the state adds fecal coliform bacteria to the 303(d) list, they will be required to develop a fecal coliform TMDL, which will impose a certain level of control on the ALCOSAN CSOs. This approach will likely result in a numeric wasteload allocation to the ALCOSAN permitted outfalls. This being the case, ALCOSAN can take a number of approaches. One approach would be to wait for the state to come forward with a Publicly Noticed TMDL.

An alternative approach would be for ALCOSAN, 3RWWDP or other lead stakeholder agency to take the lead and work with the state in a stakeholder TMDL process. This more proactive approach would have such a group developing a stakeholder developed TMDL that would serve as the TMDL for the area. Part of such an offer will require that ALCOSAN, as the major stakeholder in the area, provide the leadership and the scientific and engineering evaluations required to develop a scientifically sound TMDL. The clear advantage of such a position, is that ALCOSAN and its’ customers have their interests represented throughout the process. There will be a financial cost to ALCOSAN. However, the advantages clearly out-weigh the disadvantages, as ALCOSAN will be developing the TMDLs, which would be adopted by the state. ALCOSAN can then provide the resources that are required to provide a much more detailed and scientifically sound assessment. This is something that PaDEP will not be able to do, given their budget limitations and the overwhelming number of TMDLs that they must produce over the next 5-years.

**Sensitive Areas** – Waters in the ALCOSAN drainage area are used for many forms of recreation. The main rivers are used for boating (fishing, personal watercraft, canoeing, etc.), marinas, water front parks, water intakes, etc. Tributary uses include fishing, wading and canoeing. In addition, there are drinking water intakes at two locations on the main rivers. The 2nd Nature group in their report entitled “Water Quality, Phase I Report – Year 2000”, presented a summary of area water uses and waterfront access locations. Not all of these uses meet the CSO Policy definition of a Sensitive Area (Outstanding National Resources, National Marine Sanctuaries, waters with threatened or endangered species, waters with primary contact recreation, public
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drinking water intakes and shellfish beds). However, as discussed in Section 5, there are drinking water intakes on the rivers that are within the CSO Policy definition of a Sensitive Area.

Regardless of the CSO Policy definition of a sensitive area, there are current uses that should be identified during the CSO planning process and for which plans should be developed to protect these uses. Currently, some of the uses are limited by the warnings to not use the area waters during and after rainfall. Other uses are impacted by the discharges from SSO/CSOs. River use advisories are issued between 10 and 15 times in a normal summer recreational season. These use advisories warn the public against using the main rivers after a wet weather.

Further, there are other areas that pose potential risks. There are SSO/CSO outfalls located on small tributary water bodies that run through suburban backyards. Pathogens discharged from these outfalls pose a risk to the community. In particular, children who do not know the dangers associated with the outfalls are at risk when they play in the waters downstream of the outfalls. In addition, as pointed out in the 2nd Nature report on water uses, access to most of the main river waterfront is limited because of the steep riverbanks. Some of the only places where there is access down to the main rivers are at the stairways constructed by ALCOSAN to provide access to the ALCOSAN outfall structures. These stairways tend to draw local people to the outfall structure itself where they can be exposed to pathogens and other pollutants in the sewage overflows. In addition, there are a number of overflow structures that appear to present a physical danger as a result of easy access and condition.

ALCOSAN and the partner communities should consider doing a review of the signs posted to notify the exposed public to overflows, and consider examining each structure with respect to its safe access and use.

The major reason for discussing these issues is to point out to both ALCOSAN and the member communities that there are many uses of the rivers and tributaries in Allegheny County. Addressing
them puts ALCOSAN and the member communities in the drivers’ seat in development of solutions and in generating support for actions needed to rectify these items. It allows ALCOSAN to help frame a comprehensive solution as opposed to having one imposed later through a legal action.

**Habitat** – In addition to providing access to the rivers for the public, one of the major reasons for developing SSO/CSO controls is to restore ecosystems that have been damaged by human actions. Removing pathogens and other SSO/CSO pollutants that enter the main rivers and tributaries goes a long way to restoring the chemical quality of the waters. However, there have been other significant activities that have made their mark on the rivers and streams in the area.

**Development** – Development of residential communities and industrial corridors have changed the nature of the runoff to the tributaries. This increased level of urbanization produces runoff flows and velocities that cause erosion of stream banks and deposition of sediments in slow moving stream reaches. There are clear signs of these impacts on the tributaries where stream bank stabilization has been added to prevent further erosion.

**Acid Mine Drainage** – As evidenced by the placement of many of these tributaries on the 303(d) list, drainage from now abandoned mines has created harsh environments in many of the local tributaries. Low pH levels or elevated metals levels do not provide an environment in which many species can survive.

These and other impacts on the tributary streams limit the positive impacts reducing chemical pollution from SSO/CSOs can provide. This is not to say that SSOs will not need to be eliminated or at least reduced significantly or that CSOs will not need to be controlled to some degree. It is pointed out to indicate that there are other issues, which will impact the level to which these tributaries can be restored. As such, an acknowledgement of these factors can be incorporated into the planning phases so that implementation schedules can be set-up with these factors in mind.

### 7.3 WATERSHED PLANNING

Watershed planning is the process whereby various stakeholders are brought together to work toward development of a plan for an entire watershed. Within Allegheny County there are various stakeholders working in different ways to address issues that ultimately impact water quality. These stakeholders are as follows.
Municipal Jurisdictions – The municipalities have wide interests in watershed planning not limited to sewers and stormwater. Parks and recreation departments have interests in watershed planning as do public works and finance officials.

PaDEP – The state environmental agency has many focuses in the region at this time. They are working through a process of developing 303(d) impaired water body listings and developing TMDLs for those water bodies. In addition, they are working with the EPA to enforce compliance with the CSO Policy.

EPA – The EPA has made it a point over the past few years to have their enforcement staff focus on Allegheny County to address SSOs. The focus of this effort although regulatory has an ultimate outcome of reducing pollution and thereby improving water quality. Unfortunately, once an area is involved in the enforcement environment, watershed planning is sometimes difficult to achieve. For example, it is very clear that the sanitary sewers in Allegheny County were not constructed as true sanitary sewers to convey only household and industrial sewage. These sanitary sewers were also constructed to convey roof drainage and foundation drainage in most areas of the county. They were also constructed with regulators and relief points. This nuance could be handled very easily in a watershed-planning environment. However, at this point in time EPA has gone on record as treating these overflows as pure SSOs, when they are in fact a hybrid system somewhere between a sanitary sewer and a combined sewer.

Allegheny County Health Department – This agency is responsible for issues within the county relating to SSOs as well as protection of the drinking water quality.

ALCOSAN – ALCOSAN is the organization responsible for collection and treatment of sewage. As such they own a few interceptors, a number of SSO/CSO control structures, conveyance tunnels and a large sewage treatment plant. This organization took over the planning responsibility for developing wet weather control plans for SSO/CSOs directly connected to elements of the system that they own or operate.
3-Rivers – This organization was formed to serve as a focal point for technical issues dealing with SSOs in the area. They issue and administer grants for pilot projects to assess cost effective ways to correct SSOs. Their mission is:

"The mission of the 3 Rivers Wet Weather Demonstration Program is to establish and to promote the technical means, the institutional structures and the financial mechanisms needed to control existing sewer overloading within the municipalities of Allegheny County and to demonstrate the best wet weather flow management practices to control overflows at the least possible cost and impact. Public awareness and inter-municipal cooperation are fundamental to the success of the program."

3 Rivers 2nd Nature – This is an interdisciplinary team of artists, engineers, landscape architects, policy experts, and scientists, collaborating on a study of the natural (green and blue) infrastructure of Allegheny County river systems. They are located at the Studio for Creative Inquiry, Carnegie Mellon University.

Southwestern Pennsylvania Water and Sewer Infrastructure Project Steering Committee – A group formed by civic leadership of southwestern Pennsylvania, concerned about the significant impact on the public and economic health that results from the lack of adequate water and wastewater infrastructure. This group promotes a regional, multi-county approach and education of public officials and the general public accept responsibility to facilitate the implementation of the regional, watershed-based strategy. This group has proposed the formation of the “Watershed Alliance for the Three Rivers Region” or WATRR. It has been proposed that the basin groups discussed below, be folded into this group with the assistance of Three River Wet Weather.

Southern/Western/Eastern Basin Groups – These are informal groups of municipal public works and elected officials. The focus of these groups is on sewer rehabilitation activities that will be needed to reduce SSO/CSOs.

Southern Engineers Basin Group – This is a group of consulting engineers many whom act as municipal engineers. These professionals are working in an advisory capacity and providing information exchange on sewer rehabilitation issues as they relate to cost effective ways to reduce SSO/CSO.

United States Army Corps of Engineers, Pittsburgh District – Known as the Headwaters District, the Pittsburgh District is comprised of the Ohio River drainage basin above New Martinsville, WV. The District covers an area of approximately 67,000 square kilometers (26,000 square miles), including portions of Pennsylvania, West Virginia, Ohio, New York and Maryland. Major river systems within the District include the upper Ohio, the Allegheny, the Monongahela, and the Beaver.
Environmental Groups – The following is a partial list of environmental groups that are active in the area.

- River Watchers – This is a citizen volunteer monitoring program for the Ohio River and selected tributaries started as a pilot project in 1992 by the Ohio River Valley Water Sanitation Commission (ORSANCO) and now including 31 groups in six Ohio River Basin states, including Pennsylvania. It involves schools students in monitoring the water quality of the river.

- Friends of the Riverfront – A membership based organization dedicated to improved public access and appreciation of the Pittsburgh waterfront and the continued expansion of the Three Rivers Heritage Trail.

- Pittsburgh River Life Task Force – This is a 33-member panel formed in summer of 1999 by Mayor Tom Murphy to create a "vision" for Pittsburgh's three rivers. It is funded by private foundations and co-chaired by Alcoa Chairman Paul O'Neill and Pittsburgh Post-Gazette Editor John G. Craig Jr.

- River Sweep – Involves an annual cleanup on the 3rd Sunday of June to remove trash from the Ohio River and its tributaries. It involves the participation of six-states, and is sponsored by the Pennsylvania Department of Environmental Protection, the Ohio River Valley Sanitation Commission and more than a dozen corporations.

- Three Rivers Habitat Partnership – This group is a cooperative effort among corporations, landowners, conservation groups, intergovernmental agencies, and the public to integrate and enhance efforts to conserve the natural environment of Allegheny County rivers and their urban watersheds, while elevating public appreciation and stewardship for healthy ecosystems and wildlife habitat throughout the metropolitan reaches of Pittsburgh's rivers.

- Turtle Creek Watershed Association – Is a group, which is dedicated to promoting the conservation of the natural resources of the Turtle Creek watershed.

- Wings of Wonder – Wings of Wonder is a partnership between the Three Rivers Habitat Partnership, ASSET, Inc. and Carnegie Science Center that unites the wildlife teams of PPG and Bayer with local schools to study migratory birds and butterflies.
Neville Island Good Neighbor Committee – Is a group of local residents working for the reduction of toxic chemical emissions from industry on Neville Island.

Other groups include the Chartiers Nature Conservancy and the Lower Chartiers Watershed Council.

Although there is some level of interaction between these groups, they have not risen to the level of regional watershed planning. One aspect of watershed planning in the region is the process that is now surrounding the Consent Order review and the municipal sewer rehabilitation evaluations. Here, interested parties are organizing themselves around common goals. To be true watershed groups, these goals would have to be expanded. The current efforts in Allegheny County do not appear to be organized to assess water quality needs in the main rivers and the urban tributaries and to assure that the ALCOSAN Concept Plan or any other efforts will provide for these uses. The planning process that was envisioned by the EPA for such an organized approach to assessing water uses and pollution control needs is described below is a 3-stage multi-step process. The beauty of such a process is that it provides for constant input into the process by the ratepayers. When included in such a process, they will provide immediate feedback that will allow for a balance of expectations and costs.

The multi-step process by EPA for watershed planning is outlined on the following few pages.

**Step 1 - Identify Valued Watershed Features**

The first step of the watershed process is to gather the stakeholders and establish overall watershed goal or set of goals. Several characteristics of the watershed that are especially valuable ecologically, economically or socially, and help achieve and maintain broader watershed goals are identified and agreed to by all involved stakeholders. These may be natural features that help give the watershed a sense of identity. For example, they may include landscape traits that symbolize the watershed, such as abundant old-growth forests, or mixed farmland and woodland settings. Or, an urban watershed group may especially value its watershed's greenways -- undeveloped lands that link natural habitats through suburban settings, or stream corridors whose natural surroundings are managed for recreation and avoidance of flood hazards. Valued features may include natural events such as an annual spawning run of fish such as perch, shad or salmon may have exceptional ecological, recreational, or cultural significance. Valued watershed features may be very diverse.
These valued features should be identified and weighed against the problems and concerns that are brought to the group's attention. The risk of negative impacts upon a valued feature of the watershed is a good basis for evaluating the concerns that are brought to the stakeholder group and, later in planning, for setting priorities for action.

**Step 2 - Prioritize Challenges/Opportunities** - After listing concerns and exploring them by gathering and analyzing data, challenges and opportunities will surface. Unfortunately, there are usually not enough funds or time to address all potential watershed management needs. Priorities must be set that target efforts to the most critical problems/opportunities. This is why stakeholders need to strive for consensus on prioritizing which problems/opportunities to pursue. Many groups begin prioritizing problems by establishing criteria. This might include:

- **Relationship to watershed goals and valued features.** Ask the question, if the problem may alter the watershed's character and condition, or if it poses a risk to some part of the watershed that was identified as a valued attribute. By considering this criterion, stakeholder’s priorities and actions are more likely to be consistent and support the watershed traits that are most highly valued, instead of reacting to one unrelated concern after another.

- **Ability to bring about change.** Ask the question, do the stakeholders have the kind of influence realistically needed to overcome the challenge at hand. Pick stakeholders that can help with the solutions.

- **Time between actions and results.** Try to determine the amount of time between when changes occur and when results can be seen. For example, it may take decades to see results from changes on the land that ultimately affect a deep aquifer, but changes near a stream bank may quickly affect the quality of the stream's water and the surrounding habitats.

- **Willingness to change.** Ask the question, if the reasons are strong enough to motivate those who may need to change, and whether any incentives or regulatory tools may be appropriate.

- **Cost/benefit ratio.** Are the costs going to outweigh the benefits or are the benefits going to outweigh the costs?

**Step 3 - Determine Critical Areas** - Critical areas within a watershed are those areas that play a role in the watershed that is especially important to its ecosystems, to its people, or to both. Despite their important functions, they may or may not have been listed among the valued watershed features identified earlier. Vegetated areas next to a stream or lake, for instance, may not rank high among stakeholders' lists of valued watershed features, but they filter pollution, serve as important...
habitat, help control flooding, and can be critical sites for protection efforts. Or a critical area might be determined by major water uses such as water supply locations, recreational areas and fragile wildlife habitats. An alternative plan may identify a number of areas throughout the watershed with vulnerable characteristics (e.g., unstable stream banks or shallow groundwater). A goal in planning for critical areas is first to recognize what they are and where they occur, and then to maintain their greatest benefits.

**Step 4 - Establish Objectives** - Once problems/opportunities have been defined and documented, establishing objectives is relatively easy. The main purpose for establishing objectives is to focus and guide the planning actions the stakeholders will undertake. Remember these points when establishing objectives:

- Describe the objective in measurable terms (i.e. reduce soil erosion on forested land by 60%, reduce nutrient runoff from agricultural sources by 50%, or reduce sediment loads from urban construction sites by 30%).
- Recognize the objective may change later as more information becomes available. For instance, an initial objective may be to simply "increase trout population." Later stakeholders will have the necessary information to refine the objective to "increase trout population by 225% ".
- Existing regulations and legal constraints need to be considered both as limits to management alternatives and as tools for helping achieve goals.
- Consider all views of those with a stake in the watershed, and seek consensus on how the group envisions the watershed's future.
- Keep objectives acceptable and achievable. Partners need to ask themselves if they can support the objective and if they think it can be done.

The next step in the process is the development of the overall plan ending in a list of actions that are taken by one or more of the stakeholders. It should be recognized that even if ALCOSAN chooses to take a lead role in the formation of the watershed planning process, the actions that result are actions that both ALCOSAN and other stakeholders must take to make the plan successful.

**Step 5 - Select Management Alternatives** - The first step in selecting management alternatives is to draft a list of management alternatives that could help achieve the objective. Many watershed partnerships rely on an advisory team to assist them with this. It's important to list several alternatives, but do not try to rank them at this point. Next, using outside advisors' help, try to determine the effectiveness of each of the alternatives. In this initial screening process,
have the group consider economic, social, and environmental factors. Keep in mind that alternative selection is just beginning at this point, and may require substantial time and effort to get the information you need to make good decisions. The importance of selecting a good management alternative more than justifies spending significant time and funds on alternative evaluation and election.

*Watershed computer models* - Advisors may use a watershed model or models to help them understand the relationships within a watershed. Different types of models allow stakeholders to study different aspects. For example, one model may look at surface runoff of nutrients and pesticides while another might compare the economics of management practices. The advisors might have to use several models to address both economic and environmental concerns within the watershed.

*Models are just the beginning...* - Watershed models aren't an end product, but a tool for evaluation. They allow stakeholders to compare model results representing watershed conditions under the different management alternatives. This is done to see what might be the most economically and environmentally effective -- a process called evaluating "what-if scenarios". The partnership should use not only the scientific results of the models but also consider the social acceptability of those results, and other factors.

*Don't forget to document!* - Be sure to document the alternatives and corresponding advantages/disadvantages by adding this information to the other watershed plan documents. The information may be needed later when implementing the plan. In addition, if the stakeholders try to obtain outside financial assistance, the documentation will be needed to support the request for funding.

At this point, the stakeholders have come to agreement on a general vision for the watershed's future. They have set objectives and selected management alternatives for achieving those objectives. Now attention needs to be focused on how to make the selected alternatives a reality. Most watershed partnerships begin this process with an Action Plan.

**Step 6 - Put Together an Action Plan** - An Action Plan is simply a list of the actions the group decides to do, who is responsible and when it's to be done. To put together an Action Plan, first list all objectives. Under each objective, a list is made of selected management alternatives. Once all the selected alternatives have been listed, actions, responsibilities and time periods need to be defined. Copies are made for each partner and brainstorming sessions held on action items. This gets partners thinking about ways to get the job done. Partners may want to take the papers home and fill in the blanks. A time is then set for the partnership to get back together to share their thoughts. When the group completes this activity, everyone's action ideas are recorded in one place. Partners then combine similar actions and select the top choices for each of the selected alternatives. These actions become the partnership's focus.

The third step in the process is an assessment of funding sources. This is the process by which funds are assessed and set aside. A vital step in this process is associated with prioritization of the funds, as the plan is usually more ambitious than the funding sources.
Next, stakeholders need to associate themselves with the responsibility for each of the action items. This is a good time to involve stakeholders who haven't been as involved as they would like to be. After responsibilities have been determined, a realistic time period for completing each action can be set. Be sure all stakeholders involved understand their responsibilities and the time frame, especially for those actions whose completion is essential before starting other actions.

**Step 7 - Fund Watershed Planning Actions** - Some of the actions the stakeholders will have selected will require little if any money. Often actions require donated time or materials from local individuals, organizations, businesses or industry. The more complex management actions—like cost-share incentives, or implementing technical projects—do require funding. This is when stakeholders will need to explore funding options. Locally led planning is typically limited by available funding more than by any absence of ideas or initiative. Obtaining funding to support the watershed plan may seem difficult at first, or local funding may seem limited or hard to obtain. In fact there are many outside sources of grants and other funding that a group can approach with a proposal. Funding for individual watershed efforts might be found in established federal and state programs. Most small-scale watershed groups, however, start by looking for funding locally. Local utilities, non-profit organizations, municipalities, and others have funded watershed management actions. This is also a good time for stakeholders to ask for assistance in putting together a workshop on grant proposals. Local and state specialists can be invited to inform watershed stakeholders on the art of grant writing. Some organizations are available to conduct workshops specifically on this topic.

**Step 8 - Prioritize Actions** - It won't take long to list more actions than the stakeholders can possibly do, and the group will need to reevaluate priorities. When prioritizing, the following are to be considered:

- Funds available or the ability to finance projects
- Return on funds to be invested
- Time and other non-financial resources
- Ability to get the action done
- Early successes motivate more action
- Some actions rely on other actions for success

Consulting advisors are always included in this process. They may have experience in determining which actions depend on others and how to get the most return on your investment. For example, it's important to get preventive actions underway before taking restoration actions (such as dredging the previously eroded sediment out of a lake).

This multi-step process (watershed planning) would be an important set of activities to be followed within Allegheny County over the next 5 to 10 years. During this time period, the municipalities will be developing plans and constructing solutions to reduce infiltration and
inflow as a partial solution to SSO/CSOs. Also during that period, ALCOSAN will continue to implement its Phase II Long Term Control Plan modeling and design activities with some project likely moving into the construction phase.

Where this watershed process will be of key importance to the area is in the assessment and prioritization of spending. As discussed in other sections of this report, it is very unlikely that this region can afford to spend as much as $2.9 billion on sewage infrastructure over the next 20 to 30 years. That would amount to over $10,000 in capital costs per household on top of the current costs for sewage and the costs to operate any new facilities that are required.

Projects could be prioritized through the watershed planning process to focus on areas that provide benefits to the ratepayers beyond simple compliance with regulations. The projects could be prioritized so those projects, which provide benefits to sensitive environment receptors, can be given a higher priority.

Another important reason to consider entering this watershed planning process is evidenced by the fact that there are sources of pollution to the main rivers and tributaries other than ALCOSAN SSO/CSOs. It is likely that some of these other sources of pollution will be enough to prevent compliance with the water quality standards even in the absence of any ALCOSAN overflows. If ALCOSAN and municipal representatives within the County, are considering large expenditures on sewage infrastructure projects it is their responsibility to assure that these projects will help protect the public health by resulting in compliance with water quality standards.

The approach that ALCOSAN has been taking in the wet weather planning process is to put in a set of controls and then re-assess the situation to determine if water quality is going to comply with the standards. By conducting water quality based CSO facility planning during the Phase II Long Term Control Plan development, ALCOSAN and other interested parties could be assured that the plans will result in water quality compliance or could at least be alerted to the other sources of pollution that are going to result in non-compliance. The public would then be able to determine through the watershed planning process, how they could make the changes required to result in compliance with the water quality standards.

Although it is not directly ALCOSAN’s responsibility to lead a watershed planning process in Allegheny County, it should be recognized that ALCOSAN has accepted on behalf of the region the major responsibility to develop a wet weather control plan for the region. In taking on this responsibility and agreeing to it with EPA and PaDEP, ALCOSAN did accept some responsibility for watershed planning. As part of the CSO Policy, there is a requirement to develop an implementation schedule. This schedule maybe phased based on water quality benefits, designated water uses and financial capability.

In addition, in accepting the wet weather control planning and the development of a LTCP, ALCOSAN took on the responsibility of providing for public participation in the process.
The CSO Policy indicates that;

“**In developing its long term control plan, the permittee will employ a public participation process that actively involves the affected public in the decision-making to select the long-term CSO controls. The affected public includes rate payers, industrial users, persons who reside downstream from the CSOs, persons who use and enjoy these downstream waters and any other interested persons.**”

EPA also expects the LTCP to give priority to controlling overflows to sensitive areas. If one accepts the assumption that sensitive areas do in fact include areas that are used by the public, then a watershed planning process can help in establishing those priorities.

If ALCOSAN does not take the lead in a watershed planning process an alternative would be to acknowledge their “public participation” requirement under the CSO Policy; their responsibilities to develop an implementation schedule that reflects uses; and their responsibility to address sensitive areas all require involvement of the public. A watershed-planning forum would be a process whereby all these requirements could be satisfied. One way to accomplish this goal would be for ALCOSAN to provide funding to an organization and having that organization perform the watershed planning. ALCOSAN could be a stakeholder in such a watershed planning process while funding an independent group to take the lead facilitation role. It is estimated that funding of one full time employee with internal support at a rate of about $150,000 to $200,000 per year would provide the resources that such an organization would be required to facilitate a watershed planning process.

It appears that the organization, which is the best, situated and the most qualified to facilitate such, as process would be the 3-Rivers organization. They currently have the infrastructure in-place to take on this watershed facilitation process. They also have an institutional knowledge of the area and its nuances that make them uniquely qualified for such a role.

### 7.4 WQS/ USE REVIEW AND REVISION

As discussed in Section 6, PaDEP and ORSANCO water quality standards for fecal coliform bacteria have a requirement that bacteria levels during the recreational season be lower than a geometric mean of 200 per 100 ml with 90% of the samples being less than 400 per 100 ml. These standards are difficult to comply with in urban environments where storm water itself will have fecal coliform concentrations that can exceed 10,000 per 100 ml. In a rainy season, an urban area that has only storm sewers will likely exceed 400 per 100 ml 10% of the time.

The Concept Plan developed by ALCOSAN follows the presumptive rather than demonstrative approach to CSO control planning. The decision to follow this approach was made in advance of US Congress's changes to the Clean Water Act requiring all permits and orders to conform to the CSO Policy. Under the EPA CSO policy PaDEP must be actively involved in selection of the presumption/demonstration decision as well as in agreement on the data, information and analyses that will be developed to determine if the presumption approach is "reasonable in light of the data and analysis, and the consideration of sensitive areas." (EPA CSO Policy) It is the responsibility of PaDEP to work with ALCOSAN and the Partner Communities in the
development of a LTCP that will comply with the appropriate water quality standards when it is implemented.

As evidenced by the simplified assessments performed as part of this review, it appears the presumption approach alone will not achieve water quality standards, even with a potential expenditure of some $2.9 billion for control of wet weather flows (CSO & SSO). Thus, either PADEP must agree to facilitate and participate in the wet weather use and water quality standards review process called for in the Clean Water Act and EPA Guidance or the Concept Plan must be revised to attempt the demonstration approach.

The CSO policy calls for a review and where appropriate a revision of water quality standards as an integral part of the CSO planning process. The Policy intended to provide a planning avenue that was flexible and acknowledged the level of protection required and the level of uses desired. The presumption was that the local communities, facing large expenditures for CSO control, would be the people in the best position to balance the costs and the benefits from those investments toward achieving desired wet weather water uses and standards.

ALCOSAN, the Partner Communities, 3Rivers, and EPA need to work together to initiate a comprehensive evaluation of the attainability of existing designated uses and water quality standards for sewer overflow receiving waters as well as the refinements to those uses/WQS necessary to accommodate the final regional LTCP. We note that EPA funding to support such a use/WQS review may be available.

The Policy intended to provide a planning avenue that was flexible and acknowledged the level of protection required and the level of uses desired. The presumption was that the local communities, facing large expenditures for CSO control would be the people in the best position to balance the costs and the desired uses. Toward this end, the Policy calls for a review of the uses and standards during development of the LTCP. The Policy still requires the states to protect the public health and recent guidance has indicated that “In urban areas, where water-based recreational opportunities may be limited, states need to protect children who frequently splash in waters that otherwise would be considered too shallow for adults.”

This statement has particular relevance in Allegheny County where some SSO/CSO impacted creeks run through backyards. In these cases, the level of protection that is appropriate may be complete elimination of the overflow or disinfection of overflows prior to discharge. For the most part, the ALCOSAN plan does acknowledge this risk factor for the local tributaries where there are ALCOSAN overflows by providing for the prevention of these overflows within the streams and relocation of
these overflows to the major rivers downstream. To the extent possible, it makes sense to retain this concept as a goal of the Phase II LTCP planning activities. However, that being said it is still appropriate to go through a watershed planning process to assess where those water bodies are located and assure that the funds are available to construct these controls early in the construction process.

In the case of the main river segments, the CSO Policy and associated guidance recognizes that high levels of protection may not be as necessary as in the shallow urban tributary reaches. In the main rivers, especially with the limited access provided in Allegheny County because of the steep riverbanks, ingestion of pathogens in water is unlikely. In these waters, access is generally by boat or personal watercraft. Water contact will be of limited duration and will be by adults swimming from the boats.

The bacteria standards established by the PaDEP for the main rivers of a geometric mean fecal coliform concentration of 200 per 100ml and 90% not to exceed 400 per 100ml is the same standard that is used in many locations for bathing beaches. It happens to be the same standard that EPA Guidance indicates is appropriate for both primary and secondary contact recreation. State PaDEP and ORSANCO regulations have already allowed some flexibility in these bacteria standards by specifying alternative standards in the non-recreational season.

However, it maybe appropriate to further examine the standards because waters in the region are not currently or likely to be used for primary contact recreation because of the lack of access, water depths (too deep for bathing), water currents (too strong for beaches) and other factors. Secondary contact recreation does occur in the Allegheny River, Monongahela River and Ohio River to some limited extent.

One reason to examine the water quality standards is associated with the general requirement that the permitting agency cannot issue a permit to discharge that does not provide for compliance with the water quality standards. When the state develops TMDLs for this region for fecal coliform bacteria, it must develop a LA (load allocation for non-point sources) and a WLA (waste load allocation for point sources) that result in compliance with the bacteria standards. When this is done, the NPDES permits must require that the CSOs result in compliance with standards. At that time, there will be no option of demonstration or presumption approach. The permitted CSO discharges that are allowed will need to comply with the water quality standards.

The CSO Policy only allows for a re-examination of the water uses and water quality standards during the LTCP planning. The CSO Policy allows for development of cost effective “knee of the curve” CSO solutions during planning under the Demonstration Approach. When the knee of the curve does not result in compliance with water quality standards, there is an allowance for a re-examination of the water uses and water quality standards. When and if it is determined that the standards must be modified and uses restricted, a Use Attainability Analysis must be conducted to provide the justification for such a change in uses and/or standards. With a few changes to the planned Phase II assessments, information can be developed that could be used in the future to re-assess the water uses and standards.
8.1 GENERAL

The current concept plan for addressing wet weather CSO and SSO has estimated costs as follows:

<table>
<thead>
<tr>
<th>Plan Element</th>
<th>Cost - Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expand the ALCOSAN WWTP Wet Weather Capacity</td>
<td>$210</td>
</tr>
<tr>
<td>Provide Conveyance and Swirl Treatment to meet the Presumptive Approach in each basin</td>
<td>$155</td>
</tr>
<tr>
<td>Provide Conveyance and Storage facilities to prevent SSOs along the ALCOSAN System</td>
<td>$745</td>
</tr>
<tr>
<td>Provide CSO conveyance or Treatment to address combined flows not reaching the ALCOSAN System</td>
<td>Not Included</td>
</tr>
<tr>
<td>Provide SSO conveyance, storage or rehabilitation for flows not reaching the ALCOSAN System</td>
<td>Not Included</td>
</tr>
<tr>
<td>Rehabilitation and or replacement of collector system*</td>
<td>$1,900</td>
</tr>
<tr>
<td><strong>Total Estimated</strong></td>
<td><strong>$3,000 Plus</strong></td>
</tr>
</tbody>
</table>

*Included in part to address the costs not included

These costs are a mix of CSO and SSO abatement measures. The national policy regarding how control alternatives should be addressed is described as follows:

8.1.1 CSO

The National CSO Policy calls for an evaluation of alternatives that includes the following:

- Consider a range of alternatives - e.g. zero to 12 CSO/year or capture of 75-100%.
- Consider expansion of the POTW secondary and primary capacity.
- Consider the knee of the curve cost performance.
- Utilize either the Presumption or Demonstration Approach - in either case meet WQS (Water Quality Standards).

8.1.2 SSO

There is a draft regulation under review for SSOs. This rule is typically referred to as the CMOM rule. In general, it is understood that SSOs should be eliminated if feasible. However, there is provision in the draft rule for considering what is referred to as Peak Excess Flow Treatment Facilities (PEFTF). There are permitted PEFTF facilities in California, Texas and New York that do not include secondary treatment requirements. While SSO policy and regulation are in a state of flux, it is important to keep cost effective options open and search for
solutions that make sense. For the purposes of this section SSOs and CSOs will be addressed as a water quality problem and not solely a regulatory one.

8.1.3 Alternative Evaluation Approaches

The two largest areas of cost are in meeting the presumptive approach in the basins and in sewer rehabilitation. The following approaches to cost savings are examined here:

- Presumption Vs Demonstration Approach
- Range of Alternatives and knee of the curve analysis
- Incentive Programs
- Other

8.2 PRESumptIVE VS. DEMONSTRATION APPROACH

8.2.1 General

There has been considerable discussion and controversy over the approach taken in the concept plan to establish the required level of control for CSO and for SSOs. Under the National CSO Policy, a Long Term Control Plan must select either the Presumption or the Demonstration Approach in selecting a level of control to meet water quality Standards. In broad terms these approaches can be defined as follows:

- Presumption Approach – By selecting one of three levels of control defined in the policy a plan can be presumed to meet water quality standards if monitoring and modeling show Water Quality Standards are likely to be met.

- Demonstration Approach – Selecting a level of control that is shown through monitoring and modeling to meet water quality standards in the absence of other pollutant sources.

The concept plan has used presumption option ii from the National policy to select the level of control needed. To assist in understanding the national policy on this issue the exact language from the policy is listed below with emphasis added. A discussion follows the quoted material.

The National CSO Policy defines these approaches as follows:

A. Presumption Approach

“A program that meets any of the criteria listed below would be presumed to provide an adequate level of control to meet the water quality-based requirements of the CWA, provided the permitting authority determines that such presumption is reasonable in light of the data and analysis conducted in the characterization, monitoring, and modeling of the system and the consideration of sensitive areas described above. These criteria are provided because data and modeling of wet weather events often do not give a clear picture of the level of CSO controls necessary to protect WQS.
i. no more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year. For the purpose of this criterion, an overflow event is one or more overflows from a CSS as the result of a precipitation event that does not receive the minimum treatment specified below; or

ii. the elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the CSS during precipitation events on a system-wide annual average basis; or

iii. the elimination or removal of no less than the mass of the pollutants, identified as causing water quality impairment through the sewer system characterization, monitoring, and modeling effort, for the volumes that would be eliminated or captured for treatment under paragraph ii. above.

Combined sewer flows remaining after implementation of the nine minimum controls and within the criteria specified at II.C.4.a.i or ii, should receive a minimum of:

- Primary clarification (Removal of floatables and settleable solids may be achieved by any combination of treatment technologies or methods that are shown to be equivalent to primary clarification.);

- Solids and floatables disposal; and

- Disinfection of effluent, if necessary, to meet WQS, protect designated uses and protect human health, including removal of harmful disinfection chemical residuals, where necessary.

B. "Demonstration" Approach

A permittee may demonstrate that a selected control program, though not meeting the criteria specified in II.C.4.a. above is adequate to meet the water quality-based requirements of the CWA. To be a successful demonstration, the permittee should demonstrate each of the following:

i. the planned control program is adequate to meet WQS and protect designated uses, unless WQS or uses cannot be met as a result of natural background conditions or pollution sources other than CSOs;

ii. the CSO discharges remaining after implementation of the planned control program will not preclude the attainment of WQS or the receiving waters’ designated uses or contribute to their impairment. Where WQS and designated uses are not met in part because of natural background conditions or pollution sources other than CSOs, a total maximum daily load, including a wasteload allocation and a load allocation, or other means should be used to apportion pollutant loads;
iii. the planned control program will provide the maximum pollution reduction benefits reasonably attainable; and

iv. the planned control program is designed to allow cost effective expansion or cost effective retrofitting if additional controls are subsequently determined to be necessary to meet WQS or designated uses.”

C. How Are These Approaches Applied?

It is important to recognize that the LTCP must meet WQS. The selection of the presumption or the demonstration approach does not in any way alleviate the requirement to meet WQS.

The presumption approach has several elements that are important to understand with respect to the Concept Plan:

- PaDEP must agree that WQS are likely to be met using the selected plan.
- Primary Treatment or its equivalent must be provided to the treated overflows.
- Disinfection is required if necessary to meet WQS.
- There are three presumptive approaches described in the policy. The Concept Plan chose one for development purposes. The other two approaches may be more cost effective on a site-specific basis (discussed below).

The Demonstration Approach has these elements:

- Intended to be used where monitoring and monitoring could be sufficient to establish the level of control needed.
- In concept it is written to allow a level of control less than the presumption approach, but in practice may show that more control is required.
- This approach specifically allows the approval of a plan that does not meet WQS “because of natural background conditions or pollution sources other than CSOs.”
- Requires a TMDL or other means for the allocation of loads.

To use the presumption approach in selecting a LTCP, PaDEP (the permitting authority) must agree that it is reasonable to conclude that WQS will be met under the plan. Although not specifically stated in the National Policy, this is also true of the demonstration approach. These concepts are tied together with the requirement that the regulatory agency is assisting by a coordinated review of the WQS together with the development of the LTCP.
In practice, for a large community, these approaches are often tied together. In many large communities it is impractical to meet the water quality standards as written for a variety of reasons. These include:

- Natural or man-made conditions that cannot be removed impair the use. This is true of industrial ship channels that are designated for swimming or channelization and urban development have made the stream inaccessible.

- Other loads, such as urban stormwater prevent the attainment of the use.

- The socio-economic impacts of providing controls to meet the use are substantial and widespread.

The presumption approach provides a benchmark from which a discussion of an appropriate level of control can be initiated. It is not a minimum or a maximum level of control. At the Concept level it is one way of examining the level of cost to be expected. However, there is a requirement for the monitoring and modeling to provide PaDEP with the conclusion that WQS will be met. For such a case to be presented to PaDEP the following needs to be considered:

- PaDEP needs to be actively involved. As stated in the policy:

  Participants (Permittees and PaDEP) should agree on the data, information and analyses needed to support the development of the long-term CSO control plan and the review of applicable WQS, and implementation procedures, if appropriate. Agreements should be reached on the monitoring protocols and models that will be used to evaluate the water quality impacts of the overflows, to analyze the attainability of the WQS and to determine the water quality-based requirements for the permit.

- Disinfection, if necessary to meet WQS, will be required.

- In ALCOSAN’s case, the 85% of flow presumption level was chosen for the Concept Plan. Consideration to how this will actually impact uses needs to be evaluated and presented for public scrutiny. The climatic condition that produces these overflows is likely also to prevent the swimming use. If it is snowmelt, the streams will be too cold to swim. If it is rainfall, the streams will be running high and be unsafe to enter. Under these natural conditions the use is not there to be protected. Conditions in the main rivers would have to be understood through monitoring and modeling. For this approach to be accepted PaDEP would have to agree through its own water quality standards review and revision process.

Under the Demonstration approach, there is the possibility of examining a wider range of use options. Consider the following:

- Under the Concept Plan Presumptive approach, each of the individual basins are planned to have facilities that meet the 85% removal requirement, which is approximately equivalent to 4 overflows per year. Under the demonstration approach, it may be possible to consider eliminating CSOs from very sensitive areas, such as parks while allowing a greater frequency
The demonstration approach allows the consideration of other pollutant sources in selecting a LTCP. Many of the receiving streams in the Concept plan are impacted by upstream sources and acid mine drainage. The demonstration approach can be used to show where these impacts prevent the attainment of the use. While the LTCP will still have to address the controls that are needed to meet the WQS in the absence of these other loads, prioritization of projects can be planned to implement these controls after these loads are addressed and when an actual benefit will be provided.

In conclusion with respect to the use of the Presumption or the Demonstration Approach, it can be said that the Presumption Approach is a reasonable means of establishing a concept level cost. As the individual basin plans proceed, both approaches should be considered together in establishing the LTCP. The Presumption approach can provide a good benchmark to evaluate a typical level of control and the demonstration approach can be used to reveal the cost of achieving site-specific benefits at higher or lower levels of control.

**D. The Other Presumption Options**

The concept plan chose option ii – 85% capture for treatment, as a basis of establishing the facility needs and costs to meet the presumption approach. As described above, there are two other approaches that can be used. The three options summarized from above are:

- Option i. 4-6 overflows per year
- Option ii. Capture for treatment of 85% of the combined flow
- Option iii. Equivalent mass removal to the capture for treatment of 85% of the combined flow

These options are intended to be approximately equal in their result. However, which applies best to a particular community varies considerably. The use of option ii provides a good basis at the concept level for establishing the scope of the need and for estimating costs. As planning proceeds into the facility stages the other alternatives may warrant further examination. In particular consideration should be given to the impact removal at the treatment plant might have on Option iii – Equivalent mass removal. Consider the following:

Under Option ii – 85% capture, the captured flow receives the equivalent of primary treatment. If in a particular basin the pollutant identified as causing water quality impairment is BOD (BOD is a measure of the oxygen demanding component of CSO), the swirls would have to remove the approximate equivalent amount of BOD that would be removed by a primary treatment system. Typically a primary treatment system would remove about 30% of the BOD load. If however, flows to the secondary treatment plant were maximized, much less than 85% of the flow would need to be captured.
For example:

<table>
<thead>
<tr>
<th>Item</th>
<th>Primary Treatment</th>
<th>Secondary Treatment at WWTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Capture Required</td>
<td>85%</td>
<td>30%</td>
</tr>
<tr>
<td>Percent Removal Obtained</td>
<td>30%</td>
<td>85%</td>
</tr>
<tr>
<td>Equivalent Mass Removal</td>
<td>26%</td>
<td>26%</td>
</tr>
</tbody>
</table>

This very preliminary analysis indicates that if the WWTP is capturing 30% of the wet weather flow and providing secondary treatment to it, then the presumption approach may in part be met. Care should be taken in considering this as a solution and as a stand-alone cost saving measure due to a number of balancing factors including:

- The pollutant of concern may not be BOD – In ALCOSAN’s case it is likely to be fecal coliform or some other public health parameter.
- The performance of the WWTP may not provide 85% removal during wet weather events.
- Disinfection may still be required.
- Most importantly, Water Quality Standards must still be met.

With those cautions however, the equivalent mass approach should be considered in presenting the LTCP. It may be helpful if only to show that in comparison to the equivalent mass approach a particular plan meets or exceeds it.

### 8.3 RANGE OF ALTERNATIVES AND KNEE OF THE CURVE ANALYSIS

The National CSO policy calls for the consideration of a range of alternatives as follows:

...consider a reasonable range of alternatives. The plan should, for example, evaluate controls that would be necessary to achieve zero overflow events per year, an average of one to three, four to seven, and eight to twelve overflow events per year. Alternatively, the long-term plan could evaluate controls that achieve 100% capture, 90% capture, 85% capture, 80% capture, and 75% capture for treatment. The long-term control plan should also consider expansion of POTW secondary and primary capacity in the CSO abatement alternative analysis. The analysis of alternatives should be sufficient to make a reasonable assessment of cost and performance as described in Section II.C.5. (Knee of the Curve)

The knee of the curve is defined as follows:

*An analysis to determine where the increment of pollution reduction achieved in the receiving water diminishes compared to the increased costs*
The following are considered in applying the above to the Concept Plan:

- The policy does not require a specific set of control levels. It gives examples, but leaves the selection of the controls to the LTCP development.

- It requires the consideration of the expansion of secondary and primary treatment.

- The range of alternatives is expected to be arranged into a knee of the curve analysis with respect to pollution reduction.

- Nothing in the above relieves the LTCP from achieving WQS.

Why should the LTCP include this analysis if WQS have to be met in any case?

The alternative analysis and the knee of the curve analysis can be used to reveal several important aspects in selecting a LTCP:

- Where WQS are unachievable due to other pollutant sources, it can be used to establish an appropriate level of control based on a cost effective removal of pollutant.

- Where WQS are unachievable due to socio-economic impact, it can be used to establish a reasonable level of use returned for the money invested. This requires the development of a knee of the curve analysis showing cost against returned uses as opposed to the curve showing cost against the increment of pollution reduction.

At the concept level a simple knee of the curve analysis can be prepared by examining the estimated capture of flow and costs as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Individual % Capture</th>
<th>Individual Billion Gal/year</th>
<th>Cumulative % Capture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Overflow</td>
<td></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Separate Overflow</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Combined Overflow</td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>No Action</td>
<td>No cost CSO Capture = 30%</td>
<td>4.2</td>
<td>26%</td>
</tr>
<tr>
<td>Plant Expansion</td>
<td>$210 M -CSO Capture = 65%</td>
<td>9.1</td>
<td>57%</td>
</tr>
<tr>
<td>CSO controls in Basins</td>
<td>$155 M CSO Swirls = 85%</td>
<td>11.9</td>
<td>74%</td>
</tr>
<tr>
<td>Control of SSO</td>
<td>$743 M SSO Storage = 13%</td>
<td>2</td>
<td>87%</td>
</tr>
</tbody>
</table>

This analysis looks at the total wet weather overflow on a capture basis. The presumption approach is normally applied to only the combined flow. However, in the case of the ALCOSAN region there is an unresolved question as to the presence of truly separate systems. Since this is yet to be resolved, and this knee of the curve analysis is valid for the total flow in any case, the capture is presented for the total flow not just the CSO flow. The flow capture and costs are presented as approximate. It is important to remember that the additional community
Conveyance costs need to be included in the CSO and SSO Basin Controls estimates. With these cautions the levels of control can be plotted in as follows:

As plotted, the estimates of cost and capture appear to present a distinct knee of the curve at the completion of the CSO Treatment. This knee is likely to shift to the plant expansion with the addition of the cost to convey flow to the ALCOSAN system. The following considerations can be taken from this analysis:

✦ In comparison to the other elements of the program, the cost of plant expansion is very cost effective in removing load.

✦ The remaining elements of the program return only marginal benefits in terms of load – before proceeding with these elements it will be important to examine what specific benefits are returned by individual projects in each basin.

✦ While these findings do not eliminate the need to meet water quality standards, the poor cost performance of these measures makes it all the more imperative that the plan ensure that actual benefits are returned for the investments made.

✦ The cost elements beyond the plant expansion are not complete costs. Complete costs are needed in order to conduct a true knee of the curve analysis.
This analysis follows the EPA policy in comparing cost to the removal of load. In a watershed approach, it is more useful to compare cost to the actual provision of benefits. From the above analysis it is not possible to determine if any use benefits are returned.

8.4 INCENTIVE PROGRAMS

The following types of incentive programs are discussed:

- Incentives for private property owners
- Incentives for Communities
- Incentives for Regulators
- Incentives for ALCOSAN

8.4.1 Incentives for Property Owners

In the ALCOSAN service areas the property owner generally has ownership of the sewer lateral to his building. The property owner has responsibility for the infiltration and inflow sources in the sewer lateral, foundation drains, and rainleader connections and for actual water consumption. There are a number of ways to provide incentives to the property owner to control these flows:

Water Rates: A progressive water rate structure that charges a higher rate per gallon above some minimum use level has been shown to decrease water use and will result in lower dry weather flows. Current water consumption in the region is approximately 91 mgd of this flow approximately 60 mgd is water billed to homes. With a population served of about 880,000, this translates to about 70 gallons per capita day. This is not an exceptionally high water use rate. It is unlikely that a significant change to the Concept plan could be achieved with progressive water rates.

Rainleader Disconnection: Rainleaders include roof drains and areaway drains. Where these rainleaders are connected, the rainfall on roofs and areaway drains flow directly into the sewer and is delivered to the system as inflow. Discussions with the communities and the area engineers indicated that many communities have already engaged in a program of rainleader disconnection. However, the 3RWWDP has indicated that there has been a significant incidence of reconnection of disconnected rainleaders. If rainleaders are being reconnected it may be that the separation program left the property owner with a flooding problem severe enough to cause the owner to go to the trouble of reconnecting the downspout. There are at least three ways to address this problem through incentives.

Community Takes Responsibility: The community takes responsibility and contracts for or does the disconnection/lateral repair with public funds. This approach includes the following:

- A house-by-house mapping of the rainleaders is conducted.
- The public works department or a contractor makes cost effective disconnections of rainleaders and where possible areaway drains.
A tracking system is developed to show which homes have been allowed to continue with some connections because it was not cost effective to remove them.

A civil fine system is installed for re-connection.

One community in Virginia took this approach on a pilot basis. It cost approximately $400 per home to remove rainleaders and over $1,000 a home in administrative costs. Most of the administrative cost was in discussion about where and how the disconnection would be done and follow up to complaints about how it was done.

This approach has many disadvantages. It is administratively expensive. It will require public access to private property. It has been very unpopular where it has been applied.

**Repair At Time Of Sale:** This approach can include the following:

- As a requirement of any property sale the community can require an inspection of the property to determine if there are connected rainleaders.
- Disconnection is required as a condition of sale.

This approach is not likely to be very effective. The turnover in homes is relatively slow and many of the connections may not be addressed for a generation. Further, it does not address rainleaders or areaway drains that are impractical to remove and property owners may reconnect after the sale, to separate only before sale is contemplated.

**Repair or Fee:** This approach simply requires rainleaders to be disconnected.

- An ordinance is passed that forbids rainleaders.
- For rainleaders that are not disconnected a monthly fee equivalent or greater than the cost of addressing the excess flow is assessed.
- It is up to the homeowner to remove the connections.
- Inspections are conducted once to establish which homes are connected. Fees are assessed based on the number or area of connection.
- Allowance can be made for impractical to remove areaway drains.
- A requirement for inspection on sale can be made, with back costs assessed if connections are found.
Voluntary Incentives: Under this approach the homeowner is paid to disconnect.

- A public information program encourages disconnection.
- Property owners are told they will be paid a one-time fee if they disconnect.
- On homeowner request, an inspection of the property is conducted to determine which rainleaders are cost effective to remove. The property owner is told what must be done to receive payment.
- After disconnection, the property owner calls for and receives a follow up inspection. Payment is made for satisfactory disconnection.
- Through the economic incentive, only the cost effective I/I is removed.
- Liability to the public sector is low because disconnection is by private parties.
- Where this approach has been adopted, community groups generally do most of the disconnection and receive the funds and little or no enforcement has been necessary.
- The community that piloted the Community takes Responsibility Approach listed above ultimately took this approach and dropped their total costs to about $1,000 per home.

All of these programs require significant public outreach, record keeping and follow up. Attempting to enforce impractical disconnection, or imposing disconnection without community acceptance can produce very strong political action on the part of the impacted property owners. Before taking on any of these incentive programs, it will be important to determine how much flow can be removed through cost effective rainleader disconnection. Only where it can be shown to be cost effective will any of these programs work.

8.4.2 Sewer Laterals and Foundation Drains

In the ALCOSAN area the communities and local engineers report that there is a significant I/I problem with Sewer Laterals and Foundation Drains (SLFD). The incentive programs listed above for rainleader disconnection could in theory also be imposed on SLFD. However, application of these approaches to SLFD raises different considerations.

SLFD is a problem in part due to migration of flow. If the street sewers and manholes are made water tight, and the SLFD is not addressed, in many cases infiltration and inflow induced infiltration will simply migrate to the leaky lateral or be drained into the system through foundation drains. A tight lateral may also be ineffective where the foundation drain serves as a local well to drain the area.

The cost of addressing SLFD can be very high. Estimates for removing SLFD where the foundation drain is a significant part of the problem have been reported by the local engineering community to be as high as $20,000 per household. This cost could exceed $6 billion if all homes in the ALCOSAN area needed to have foundation drains removed. However it is unlikely that rehabilitation of all laterals and foundation drains will be necessary, or cost effective. It is
more likely that a limited number of SLFDs in any given drainage area will need to be addressed. There may also be areas of high groundwater, where addressing SLFD will not be cost effective at all.

Each of the incentive programs listed above for rainleaders is discussed hereafter in the context of SLFD:

**Community Takes Responsibility** – Under this approach only homes with significant SLFD infiltration would be addressed. It would not impose a significant economic burden on the individual property owner. It would require public action on private property.

**Repair at time of Sale** – This approach would spend money on any cracked or faulty laterals. It would require the removal of foundation drains, even if it was not cost effective to do so. In addition, it would impose a very significant economic burden on the property owner at the time of sale. Such a large cost could represent a significant and widespread economic impact on real property owners in the ALCOSAN region. This approach is not recommended.

**Repair or Fee** – This approach would focus on the cost effective removal. Repair would only be effective is all the significant SLFD in a given area was removed. It would also be technically and administratively difficult. It would be necessary to evaluate where and how repair should be done.

**Voluntary Incentives** – This approach would also focus on cost effective removals. However, it would have similar problems as the repair or fee option.

The control of laterals has been seen in the ALCOSAN area as a property owner problem. However, as the discussion above shows, it is impractical to expect the property owner to address this problem effectively. This is an area where considerable thought and study need to be developed to determine an appropriate public sector role.

**8.4.3 Incentives for Communities**

Most of the existing agreements between ALCOSAN and the communities provide little or no incentive to control infiltration or inflow. Some of the communities have stated that ALCOSAN is required by agreement to take all the flow the communities generate. While this may be one reading of the agreements, in practice it is unlikely to happen. Even if a single entity such as ALCOSAN were to take responsibility for all flows currently generated, the cost effective solution would require significant construction in the communities served. In addition, the technically logical control will require some action on the part of communities with their individual collection systems and on private property.
Section 9 discusses several cost recovery methods. Each of these can be examined in terms of how it could be used to provide incentives to the communities as follows:

- Cost Recovery Through Water Bills
- Pay to Play
- Ad Valorem

**Cost Recovery Through Water Bills:** This is the current method under which ALCOSAN recovers its costs. Because these costs are shared evenly based on water consumption, with no regard to wastewater flow, there is no incentive in the billing method to reduce infiltration. However, if I/I control is provided through same funds that are collected for ALCOSAN treatment, then local incentive is replaced by the collective incentive to remove the most cost effective I/I wherever it is. If ALCOSAN did not provide funds for this purpose, other incentives that could be imposed on top of this cost recovery method include the following:

- Regulatory enforcement – An argument could be made that by having excessive I/I that the community is contributing to a water quality problem. Enforcement could be through the ACHD, which has the authority to impose limits on development and to impose fines. While this approach has been effective in many places, the circumstances in the ALCOSAN communities may make it only selectively effective. Poor communities have some of the greatest problems. Fines are unlikely to be a significant incentive to these communities, other than the political impacts.

- Grants – A grant program could be established to provide funds to communities that are willing to reduce their I/I. A grant program of this nature can be particularly effective if it is provide in lieu of requiring a NPDES permit. The Chesapeake Bay Program has used this approach effectively to install Biological Nutrient Removal at POTWs without requiring nutrient limits in permits.

**Pay to Play:** This method provides a very high incentive for communities to control their own I/I. Either the I/I is reduced in their community or they must pay ALCOSAN to treat it. While this method sounds very good from an incentive point of view, it will not work in communities that do not have the money in the first place. To address this, regulatory enforcement will not be effective, but grant programs could be.

**Ad Valorem:** Recovery of costs through property taxes is likely to be similar to the incentive provided by recovery through water bills.

### 8.4.4 Incentives for Regulators

The issues for the regulator community with respect to the concept plan include the following:

- Unpermitted Overflows
- Water Quality Standards Violations
- Upcoming TMDLS
- Too many potential Permittees
The 1972 Clean Water Act (CWA) required all discharges to have NPDES permits. Originally, these permits were the responsibility of USEPA. However, PaDEP is now the delegated state authority under the CWA responsible for issuing permits. Unpermitted overflows present a substantial problem for the regulators. The ALCOSAN system was designed with hundreds of overflows that were never addressed in permits. That design approach was approved through the State of Pennsylvania process at the time of design. A general permitting approach was applied to the small CSO communities; however, no permitting approach has been developed for the supposedly separate communities. PWSA applied for a permit for their CSOs in 1998. That permit has yet to be published as a draft. Any program or approach that assists PaDEP in addressing the permitting of discharges can be seen as an incentive.

The goal of the CWA is to provide fishable, swimable waters where feasible. Water Quality Standards Violations represent evidence of where this goal has not been met. Regulators are looking principally for approaches that will ultimately address restoring waters to the fishable swimable goal. An approach and program that focuses on this goal is an incentive to the regulators.

Pennsylvania like many other states is under court order to complete a 303d list update and provide TMDLs for the listed waters. In plain English this means they are required to determine which waters do not meet water quality standards and what specific limits on or actions by point and non-point sources are needed to have these waters meet standards. PaDEP, like most states is underfunded and understaffed to accomplish this task. Any program that assists them in addressing TMDLs will be an incentive to them.

Traditionally, permitting agencies like PaDEP have issued NPDES discharge permits to the WWTP owner (ALCOSAN) and let the WWTP owner take care of the collection system and its satellites (Satellites are communities connected to the ALCOSAN system, but not owned by it). However, the national recognition of the SSO and to some extent CSO problems have shown that WWTP permitees are often reluctant to take on the permitting problems of satellites. This has resulted in an explosion of permitting needs around the county. PaDEP and the other permitting agencies are just now facing the daunting task of issuing hundreds of additional permits throughout the State. Any approach that simplifies this task will be an incentive.

From these considerations the following potential regulatory incentives can be considered:

**Stakeholder TMDLs** – The TMDL guidance from USEPA encourages States to delegate the development of TMDLs to local stakeholder groups. Stakeholder TMDLs assist PaDEP by reducing their TMDL load and by ensuring that Water Quality Standards are addressed.

**Regionalization** – To the extent that any or all of the Concept Plan issues can be addressed through regional approaches, the PaDEP issues are made easier.
8.4.5 Incentives for ALCOSAN

ALCOSAN and other utilities with satellites with SSOs and CSOs are under pressure from the Regulators to take responsibility for collection system issues and discharges. As described in Section 3, ALCOSAN took on the Concept Plan in an attempt to address these wet weather issues for their service area. ALCOSAN is a utility providing a single service, that of conveying and treating wastewater. As described in the institutional section, there are several communities around the country similar to ALCOSAN that provide this single service and have many Partner Communities. In general these utilities have the following characteristics that motivate their actions:

- A Board that provides political level direction and limits.

- A desire to have clear regulatory rules under which to operate.

- Clear delineation between the utility responsibility and the Satellites.

- Often these utilities are loath to take on regulatory responsibilities they are not sure they can meet but will do what their Boards tell them to do.

Incentives for ALCOSAN in the Concept Plan can be considered as follows:

- A clear permit or enforcement mechanism that delineates their responsibilities, including which discharges are ALCOSANs and which are the responsibility of others.

- A clear permit or enforcement mechanism that delineates the responsibility of the satellites.

- Clear political direction from the ALCOSAN board as to their role with the communities.

- Clear agreements with the communities in how they will inter-relate with ALCOSAN.

- It is imperative that the ALCOSAN and Partner Community responsibilities be achievable and politically supported.

ALCOSAN also has a great common interest with the communities in controlling the high levels of I/I. Reduced infiltration will reduce capital and operating needs for dry weather facilities, and reduced inflow will do the same for wet weather facilities.
Third Party Review of the ALCOSAN
Regional Long Term Wet Weather Control Concept Plan

Section 9
Institutional, Regulatory and Financial

9.1 GENERAL

As previously noted, the ALCOSAN service area consists of multiple jurisdictions that are extremely diverse with respect to area, population, population density and economic status. The apparent wide range in the existing conditions of the individual sewerage collection systems further complicates this issue. Another compounding factor is the number of agencies involved in attempting to address the wastewater issues confronting the area.

In reviewing the Concept Plan it must be kept in mind that the initial draft was released over three years ago (March 1999). The Concept Plan was released in 1999, but the supporting data was compiled and analyzed over a period of years prior to 1999. The revenue data that was supplied to the review to support the financial aspect of the plan was a Black & Veatch report dated November 2000 entitled Revenue Requirements, Cost of Service and Rate Design. It was subsequently learned that this report was developed to support the bond issuance and not as a part of the Concept Plan. A recent conversation with ALCOSAN’s financial staff indicates the next bond issue may be required in 2003 as opposed to the 2004 date outlined in the B&V report.

The Concept Plan was intended to address wet weather issues in the ALCOSAN system and, as such, the plan only addresses the problems created by those flows that arrive at the interface with their system. With the exception of recommending the Municipal Collection System Rehabilitation and/or Reconstruction Program, it does not address other issues, costs and significant hurdles that the satellites must resolve under the present approach. This section is intended to delineate these issues and outline alternate approaches that may be considered in the following areas:

- Institutional Issues – Including the various government and non-government agencies that influence or need to influence any concept plan.

- Regulatory – Including the regulatory agencies that influence the plan, the law, regulation, policy and guidance that must be addressed, enforcement issues and agreements.

- Financial – Including the cost of the plan, means of funding, institutional arrangements to fund the plan, the affordability of the plan and revenue raising options.
9.2 INSTITUTIONAL ISSUES

9.2.1 General

The principal stakeholders in the sanitary sewer remediation issue in the ALCOSAN service area are as follows:

- ALCOSAN
- Local jurisdictions (83) including 12 overlying Authorities
- The City of Pittsburgh Water and Sewer Authority
- Environmental organizations such as Three Rivers 2nd Nature
- Allegheny County Health Department
- 3 River Wet Weather Demonstration Project
- US Environmental Protection Agency
- Pennsylvania Department of Environmental Protection
- Federal Court System*

* The Federal Courts are listed due to pending litigation

These stakeholders have both common and conflicting interests. Some jurisdictions have moved forward with significant investments in their sewage collections systems while others have not. Some are under greater regulatory scrutiny than others and may have resulted in particular stakeholders ‘holding their cards close to their vest”. There is a wide spread feeling, either actual or perceived, by the various stakeholders that ALCOSAN could have been more open in interacting with the Satellites in the development of the Concept Plan. The same comment is made about the status of the negotiations with the regulators with respect to ALCOSAN’s pending consent order. Common comments heard include:

“How can I plan when I don’t know what the biggest player’s approach involves?”
“How can I do a LTCP when I don’t know how much flow ALCOSAN will take?”
“ALCOSAN should take all the flow we produce”
“We met with them and consulted with them on that, how can they say they were not involved…..”

ALCOSAN staff appears to feel that they have been open and inclusive. The satellites feel they did not participate in the development of the plan. In moving forward it will not be particularly helpful to resolve which group is correct about the past. There will, however, be a need to work together more closely and openly than in the past in developing the way forward and in dealing with the regulators.

While the role and concerns of the stakeholders is obvious, it is appropriate to address the unique role of the Three Rivers Wet Weather Demonstration Project (3RWWDP) which was established in 1997 with the following mission:
The mission of the 3RWWDP is to establish and to promote the technical means, the institutional structures and the financial mechanisms needed to control existing sewer overloading within the municipalities of Allegheny County and to demonstrate the best wet weather flow management practices to control overflows at the least possible cost and impact. Public awareness and inter-municipal cooperation are fundamental to the success of the program.

The 3RWWDP provides these services principally through grants to the communities. These grants are funded from Federal, State and local resources including ALCOSAN. In addition to administering grants, 3RWWDP has been acting as a conduit between the regulatory agencies and the communities on enforcement issues. The 3RWWDP is governed by a board comprised of two appointees nominated by the ALCOSAN Board, two appointees from the Allegheny County Board of Health, and one active member of the Allegheny County delegation.

**9.2.2 Operational Issues**

The 83 communities that are tributary to ALCOSAN, in addition to PWSA, are responsible for their separate and combined collection systems. The trunk and interceptor systems that pass through their communities are, in most cases, covered by inter-jurisdictional agreements to convey flow from upstream communities to downstream communities or ALCOSAN and SSO points and CSO points within their community. Twelve (12) Sewer Authorities overlie many of the 82 communities providing sewer construction and maintenance for member communities although a significant number of communities, including smaller jurisdictions, operate their sewer system independently. These jurisdictions include cities, boroughs, townships and towns that are governed by elected officials and subject to specific responsibilities based on their classification by the Commonwealth.

The largest jurisdiction in the ALCOSAN system is the Pittsburgh Water and Sewer Authority (PWSA), which is responsible for the City of Pittsburgh collection system including separate and combined areas serving approximately 400,000 people. PWSA also has a water supply system that supplies only a portion of its sewerage collection area but collects its entire sewer maintenance revenue only from these water customers. The PWSA system includes numerous CSOs and a significant number of the principal conveyance/drainage areas tributary to the ALCOSAN system. PWSA has conveyance agreements with approximately 40 other communities in the ALCOSAN service area, which are the means of sharing the cost of the “common facilities”, used by both PWSA and these surrounding communities. A Board of Directors appointed by the Mayor of Pittsburgh governs the PWSA.

Each of the local governments, to a greater or lesser extent has attempted to limit their responsibility for the problems. The facilities recommended in the plan address flows that arrive at the ALCOSAN interceptors. The plan does not provide facilities needed to get those flows to ALCOSAN. Some communities argue that ALCOSAN is required to provide facilities that address all their flows under the current agreements relieving the local community of the responsibility to control infiltration and inflow to the ALCOSAN system. While some communities and authorities have established improved sewer monitoring and maintenance programs, others have done little beyond the minimum required to respond to the 308 letter information requests.
9.2.2.1 Interim Overflows

Other communities are concerned that ALCOSAN is addressing the flows from the communities closest to their interceptors, while leaving the flow problems remote from the ALCOSAN interceptors to them. This is perceived as unfair to the communities that have addressed their own flows without expanded facilities from ALCOSAN. As shown in Section 6, due to the limitations of the tunnel system, certain drainage basins are excluded from the ALCOSAN system during wet weather conditions. The Concept Plan addresses this by providing treatment or storage facilities in the plan for the flows excluded from the collection system. There are several issues associated with this aspect of the plan that need to be examined openly with the satellites and the regulatory agencies as follows:

- The plant expansion will be complete long before the storage and satellite treatment facilities are in place. During the interim period, communities close to the plant will generally have more flow abated than those far from the plant. It is important that these remote communities are not singled out for enforcement during this period for Interim Overflows.

- No exceptional costs should be laid on the communities that are served less by the tunnel system and more by facilities in the satellite communities.

- How should the tunnel system be operated to minimize regulatory issues and provide benefits?

These issues will not be easy to resolve, in part do to differences in the satellites. A survey conducted by the 3RWWDP in 1999 attempted to collect data with respect to the operation, maintenance and funding of the sewer systems from the 83 jurisdictions. However, the data that was submitted was inconclusive. The principal finding of the survey, other than to show the advanced age of most of the systems, was to confirm that a wide variation in the operation, maintenance and funding of the sewer system exists between communities.

9.2.3 Historical and Present Engineering Approaches

The Concept Plan approached the wet weather discharge remediation issue through the use of eight (8) separate drainage areas to the extent of their perceived system responsibility. However, the 3RWWDP facilitated the organization of the Satellites and their engineers into three basin groups labeled East, West and North to address regulatory issues. These Basin Groups are defined by the natural boundaries created by the Allegheny, the Monongahela and the Ohio Rivers. Based on antidotal comments by the principals involved, this arrangement resulted from the difficulty of coordinating the activities of a greater number of groups. At present the basin groups are becoming increasingly active and knowledgeable of the issues facing the Satellites. This practical experience should be considered when looking at an organization structure at least in the initial approach to the problem.
9.2.4 Institutional Conclusions

Based on the above, it is clear that the resolution of wet weather discharges in the satellite system must address the following institutional issues:

- Operational and financial responsibility for systems that cross jurisdictional boundaries
- Significant variations that exist with respect to the condition of the collection systems
- Significant variations that exist with respect to per capita flow rates exist from each Satellite regardless whether they are separate or combined collection systems
- Practical and regulatory aspects of interim overflows (see above for definition)
- Legal practicality of existing and future inter-jurisdictional arrangements
- Development of inter-jurisdictional agreements on a rational basis such as by drainage basin
- Delineating a specific role for 3RWWDP in developing a control plan
- Should the Satellites singularly or in groups want to develop their own plan(s) or should they be part of an overall ALCOSAN service area control plan
- The need to address affordability for low MHI jurisdictions due the interdependence of the collection systems

9.3 REGULATORY ISSUES

9.3.1 General

Section 3 provides an in-depth review of the significant regulatory background that frames the present wet weather issues facing this area. The following is an attempt to look at these issues in light of what is required to develop a practical approach to the resolution of the issue.

9.3.2 Regulatory Agency Roles

The Allegheny County Health Department (ACHD) serves as the delegated local enforcement agency for Pennsylvania Clean Streams Act and the Sewage Facilities Act. Under this authority, the ACHD provides facilities review and oversees the enforcement issues of Allegheny County’s collection systems, 91 publicly owned wastewater treatment plants and 141 industrial dischargers. The ACHD also oversees the county septic systems, however improper maintenance and poor soil conditions throughout Allegheny County limit the future use of private sewage disposal systems as an alternative to public sewers. Failing septic systems are a significant problem in the County and are likely sources of stream contamination of streams in the ALCOSAN service area.

The Pennsylvania Department of Environmental Protection (PaDEP) is the Federal Clean Water Act delegated agency for issuing and enforcing discharge permits. There are 24-sewage conveyance and/or treatment systems in the ALCOSAN service area that are presently under PaDEP tap-in restrictions due to overloaded sewage facilities.

The United States Environmental Protection Agency (USEPA) has oversight responsibility of PaDEP through its Region III office in Philadelphia and Headquarters in Washington D.C. Region III must approve major permits.
Regulatory Agencies have three separate roles in the control plan process. These are:

- Water Quality Standards Development and Review. This role includes establishing attainable uses for the waters impacted by the concept plan and the criteria that will support those uses.

- Permitting – The Permitting responsibility includes the requirement to develop technology and where necessary, water quality based permits for each watershed. The purpose of these permits is to obtain the uses designated by the Water Quality Standards.

- Enforcement – The enforcement role of regulatory agencies is to ensure that the permits are met. Agencies have the power to deny discharge permits (which as a practical matter limits growth), impose fines and require plans and construction of facilities to meet permit limits.

To date the regulatory agencies have only approached the concept plan from an enforcement point of view. This has included the issuance of the ALCOSAN permit requiring the concept plan, 308 letters to the communities requiring information indicating violations of the clean water act, submitting a draft consent decree to ALCOSAN in response to the draft LTCP and recently calling for consent orders for the Partner Communities requiring unrealistic and punitive measures. An example of this approach is the latest proposed consent order for the ALCOSAN Satellites that contains the following unrealistic requirement:

*By June 1, 2005, the Municipality shall complete corrective actions to ensure the removal of sources of extraneous surface water and/or groundwater from that entire portion of its sanitary sewer system that may be directly or indirectly tributary to the ALCOSAN Sewer System. These corrective actions shall include the diligent prosecution of enforcement actions against private property owners to remove illegal connections.*

To be effective, the regulatory role needs to be expanded beyond enforcement to consideration of watershed issues and water quality standards. The issues not adequately addressed to date by the regulators include the need to examine the water quality of the streams to determine where and why the uses are not being met. The permitting process should be conducted to result in water quality standards being met. Upstream loads, stormwater issues and other pollutant sources are not yet quantified, yet alone considered in the permitting process. Addressing these responsibilities takes resources that the regulatory agencies presently do not have available.

**9.3.3 Regulatory Status**

From the regulator’s enforcement point of view, the separate communities have unpermitted overflows. However, these overflow points were designed into the system. In many ways the areas designated as separate were designed by using combined sewer design concepts and were approved by the regulators at the time of construction. The current regulatory agency staff sees these designed overflows as illegal and are loath to consider permitting them as they have for the CSO communities.
With the exception of PWSA, the satellite CSO communities have been issued permits. These permits call for the implementation of two of the three requirements of the National CSO Law as follows:

- Documentation of the Nine Minimum Controls. These controls are technology-based controls expected to be implemented on a site-specific basis. However, in calling for these NMC in permits, PaDEP did not appear to have conformed to the EPA CSO policy (now law) by requiring that they be implemented on a site-specific basis.

- Development of a Long Term Control Plan. The CSO permits called for in each partner community will have to include a requirement to develop a long-term control plan that will meet water quality standards. As a practical matter this is an impossible task for the communities without knowing what ALCOSAN’s plan is.

The requirement to review and, where appropriate, revise the water quality standards is not addressed in the CSO permits. However, the inclusion of this requirement would have presented the communities with an impossible task because PaDEP has indicated they will not address Water Quality Standards in a LTCP process. This does not conform to the EPA CSO policy or federal law.

PWSA applied for a permit for their CSOs, however PaDEP has not responded to their application. However, even if PWSA were issued a permit for their CSOs, they would not know how to proceed with their CSO plan. To proceed they, as any other community, need to know what flows and loads ALCOSAN can accept and they need a coordinated review of the WQS with PaDEP. Although this review has examined the available information on drop shaft capacity and how the tunnel capacity can be distributed, simply having capacity information does not resolve how to develop a LTCP in each community. There is a great need for these plans to be developed together with ALCOSAN’s ultimate plan for the operation of the system.

Recently, the 83 jurisdictions were presented with proposed Consent Orders from the regulatory agencies that would require them to commit to a compliance plan with significant associated costs of an undetermined magnitude and specific penalties for non-compliance. At this time, this proposal is under consideration by the jurisdictions and drawing considerable concern and comment from the jurisdictions.

### 9.3.4 Needed Regulatory Changes

The regulatory institutions need to re-evaluate their role in developing a practical solution for the waters of Allegheny County. These changes include, but are not limited to, the following:

- Take an active part in determining the source and the solution to water quality problems. This includes participating in monitoring of the waters, establishing the point and non-point sources of pollution that prevent use attainment and conducting a use attainability analysis for the waters.

- Establish the permitting and non-permitting actions needed to address and meet the designated uses.
Establish an enforcement policy in concert with addressing the watershed needs in an organized and prioritized approach that recognizes the institutional and economic conditions of the permittees.

From a practical point the regulatory agencies may not have resources available to them to complete their responsibilities in a timely manner to develop a rational solutions to the area’s wet weather issues. As the lack of availability of this data may result in a more severe approach than is justified, it may be in the overall best interest of the jurisdictions to partner with the regulatory agencies to accomplish this work through the watershed approach described in Section 6.

9.4 FINANCIAL CONSIDERATIONS

9.4.1 General

Before discussing financial issues it must be recognized that expenditures by the satellites and ALCOSAN, are eventually borne by the same people (households). It does not matter if ALCOSAN or the satellites spend the money, the local people will have to pay for it, unless there are outside grants.

The total cost of wastewater control for the ALCOSAN service area is presently a very loosely defined number with present estimates ranging from $2.0 to $3.0 billion. If it is assumed that residential customers pay this cost, this program represents a per-household investment between $6,800 and $10,000. Even at the lower end of the estimated cost per household this level of investment will be unaffordable to a significant number of the financially challenged ALCOSAN Partner Communities that operate satellite systems in this service area. (See Section 6.)

Financing is further complicated by the fact that any cost-effective solution to the area’s wet weather problems can only be achieved through the implementation of a comprehensive plan based on a drainage basin approach where timely participation by all the satellites in that basin is critical. Affordability problems for one satellite then become an issue with other satellites in the basin that may not have an affordability problem.

The effective approach to provide use benefits would be to start remediation of the satellite systems at the upper end of each trunk system and work down the trunk system to the ALCOSAN interceptor system. Under a typical Sewer System Evaluation Survey (SSES) Approach sewer systems are remediated only when it is less expensive than conveyance for treatment. To take this approach, the cost of remediating sewer systems has to be compared to the total cost of wet and dry weather conveyance and treatment. This approach would insure that the full value of the up-gradient rehabilitation investment and any achievable reduction in I&I would be realized in the costs associated with correcting the down-gradient trunk system issues. This would include the minimization or elimination of any online storage that would be required to resolve SSO issues as well as any treatment facilities (swirls) that would eventually be required at the main rivers to resolve the CSO issues.
The immediate expansion of the ALCOSAN treatment plant to a capacity of 875 MGD as indicated by the knee-of-the-curve analysis in Section 8 is clearly compatible with this approach. Proceeding with other elements of the Concept Plan is not as clear.

To realize the full value of such an approach the remedial work would have to proceed on sequential basis and projects could not be delayed due to a satellite system’s lack of financial resources. If the entire ALCOSAN service area was one jurisdiction, such a concept would be obvious and it would fall neatly into the regulatory box. However, as there are multiple jurisdictions involved, such a solution has received little or no attention as a viable approach to date.

In addition to the interdependency issue, sufficient technical background data does not presently exist to develop an effective and efficient remedial program to correct the problems associated with the ALCOSAN’s service area wet weather overflow issues. Each basin will likely have different costs of remediation and different costs of conveyance and treatment. Each basin’s trade off in costs must be assessed.

### 9.4.2 Methods Available for Financing Remediation Programs

This issue is initially driven by the necessity to move ahead with some progress in the near future to address the needs of the regulators and the courts. As it has been estimated by 3RWWDP, the cost of the system assessment proposed in the draft consent orders will exceed $20 million per year for the first three years of the program. Accordingly, it would appear that a two-phase funding strategy is necessary due to the following:

- The immediate need for funding is significant.
- The practical aspect here is that it will take significant time to develop a long term funding strategy that will be acceptable to the diverse jurisdictions. It is likely that if consensus is reached on a long term funding strategy, some initiative and legislative action may be involved.

The development of a long-term funding strategy must resolve the following basic issues:

- The cost of service issue with respect to ALCOSAN’s present billing methodology; i.e., billing on the amount of water consumed that has no relation to either their facilities (debt service) costs or O&M costs due to the I&I and CSO issues. Can the jurisdictions agree that the costs associated with this issue can be considered a “heritage cost” to be shared over the entire service area; or,

- Should these costs be allocated to the jurisdictions with wastewater flows that are disproportionate to water consumption?

- If the latter alternative is either selected by all the jurisdictions, or is in fact the position of only a small number of jurisdictions, how is the affordability issue addressed with respect to proceeding on a cost-effective long-term plan?
With these concerns in mind, the following methods of financing the needed infrastructure improvements and increased O&M improvements are available:

1. Water Rate - Fund all costs through ALCOSAN’s present rate methodology; i.e., prorating costs equally on water consumption.
2. “Pay to Play” concept; i.e., base rates on an actual cost of service per gallon treated and bill individual satellite facilities on flow. Let each Partner Community find a way to pay ALCOSAN or fund its own facilities.
3. Taxes - Use ad valorem or “sin” taxes to fund capital improvements while selecting either Item 1 or 2 above to fund O&M costs.
4. Impervious Area - Institute fee to each parcel of land in proportion to the impervious area of the parcel. Use this to fund capital, operations and maintenance costs.
5. Seek County, State and Federal grants.

With respect to these limited alternatives above the following comments are made:

Option 1 – Water Rate:

- Many jurisdictions find this aspect to be unfair, especially those that have striven to upgrade their collection system.
- It does not provide an incentive to either reduce water consumption or reduce I&I.
- It is simple.

Option 2 – Pay to Play:

- Requires significant metering and associated ongoing metering maintenance and calibration as the flow data represents money title community.
- Cannot be implemented in the near term.
- Promotes water conservation and I&I reduction.
- Would probably impact lower MHI jurisdictions the hardest.

Option 3 – Taxes:

- Technically could be implemented in a reasonably short term but not soon enough to fund the initial system survey work.
- Can be seen as placing disproportionate costs on satellites that have better maintained systems.
- Is seen as a progressive tax that impacts the higher property value communities unfairly.

Option 4 – Impermeable Area Fee:

- This approach is non-traditional but has been used recently in funding storm water programs.
- Has been generally used in jurisdictions that have the good GIS mapping capabilities necessary to work up the impermeable area calculations.
- Has not raised much criticism where it has been used but generally the costs associated with storm water programs are significantly below the costs that are involved here.
Assigns significant costs to facilities that have large impermeable areas such as shopping centers, but which generally produce low levels of sewerage.

Clearly this alternative could not be implemented in the near term.

Based on the nationwide trends for funding these programs, the ultimate solution is likely to be a combination of these methods.

### 9.4.3 Grants and Loans

The traditional source of funds for water pollution control projects has been the federal government. The level of this funding is described in Section 5 – Trends.

The emphasis on Federal Clean Water Act grants has shifted to State Revolving Fund (SRF) Loans and direct Congressional appropriation grants. The SRF funds normally require the money to be paid back often at low interest rates. At times, repayment has been forgiven.

The Pennsylvania Infrastructure Investment Authority (PENNVEST) the Commonwealth’s revolving loan fund, recently awarded $82.5 million in low interest loans and $13 million in grants for water and wastewater in Pennsylvania. Almost $6.0 million was awarded to PWSA for a water line project and over $500,000 to Plum Borough for a new collection line to replace failing septic tanks.

The Pennsylvania legislature created the Growing Greener program in 1999 with an anticipated 5 year funding level of $650 million of which $100 million was to come from the State general fund. However, the fiscal condition of the general fund is such that this appropriation has been spread out over a longer time frame. It is expected that the full amount will eventually be received. It is expected that these funds will be most available to small programs.

Another issue to be considered with respect to grant funding is that most of the monies that become available go to projects that have been developed very carefully to show the financial need of the host community. It is good financial policy to continue to pursue grant funding when and where it becomes available but this needs to be a full time policy not one that is implemented when a specific need arises. The communities that have been most effective in obtaining significant grants (30 to 90% of the program costs) are those that make grant pursuit a long-term priority.

### 9.4.4 Financing Recommendation

For the Concept Plan to evolve into an implementable facilities plan, it is necessary to obtain information about the flows and condition of the satellite systems and to determine the level of cost effective I/I removal. It is recommended that ALCOSAN fund a significant part of this effort. Consideration should be given to a rate increase to generate approximately $25 million per year. The monies would be used to kick-start a comprehensive remediation program with cash in a manner such as is outlined below. It would be poor financial policy to use debt funding for this work, as no actual assets would be added to the system as a result of these expenditures.
During the period when the evaluation work is being done, and hopefully when it becomes clearer what type of long range control plan the regulators will accept, a blue ribbon panel representing a cross section of the stakeholders should develop a long range financial strategy. It will be imperative all of the jurisdictions involved buy into this work product, as it would be expected that this financial plan would become an integral part of any long-range accommodation reached with the regulators.

This investment is in the best interest of ALCOSAN and its satellites for many reasons, including:

- The flows from the various sub-basins are needed to move on to the next phase of ALCOSAN facility planning.

- These monies will be used to reduce cost effective I/I in the next phase. This will reduce flows to ALCOSAN during wet and dry weather, reducing capital and operating costs for all ALCOSAN ratepayers.

### 9.4.5 Precedence for a Pragmatic Approach

The City of Norfolk, Virginia recently found itself in a situation with the regulators not unlike that presently facing the satellites to the ALCOSAN system. The city has an aging sewer system that had been neglected for a long period of time and the wettest summer of record caused problems that attracted USEPA Region III’s attention. The first approach by the Virginia’s Department of Environmental Quality (DEQ) was that the City would be required commit to a capital program to totally resolve the problem or face enforcement action.

As the City demonstrated that it had already developed a plan to address the issue, DEQ was willing to go along with the City’s approach. The agreed to plan was to address the problem through a short-term (3-year) special consent order under which a full Sanitary Sewer Evaluation Study would be completed and a report forwarded to DEQ. This report would become the basis for the negotiation of a second longer-term consent order that would address needed capital improvements. The understanding that a second order was contemplated by both parties was referenced in the first order. In addition, the first order also contained some minor capital and operating commitments that the City was already in the process of implementing. It is also interesting to note that the Hampton Roads Sanitation District, of which Norfolk is a satellite, was also a party to the order although their only commitment in the order was to basically agree to work with Norfolk by supplying needed system information to the City’s consultants.

Region III initially objected to this approach and threatened to over-file if DEQ accepted this solution. However, once it was demonstrated that the City had a constrained ability to do everything at once and that the study approach would insure that the improvements with the biggest environmental impacts would be done first, USEPA agreed to accept the process outlined. In effect, it is felt that USEPA Region III’s acceptance of the Norfolk solution has set a precedent for a phased approach in other areas.
9.4.6 A Framework for Phase I

To effectively address the area’s wet weather overflow issues and at the same time show progress in the near term, the only viable approach is to divide the work into phases. A detailed list of roles and responsibilities for the various parties is discussed in detail in Section 3. The overall goals of Phase I can be summarized as follows:

- Implement the portions of the Concept Plan that are clearly cost effective and that will be part of any final Plan for the region (such as expanding the Wet Weather Capacity of the WWTP).
- Proceed to inspect priority areas of the collection system and correct structural deficiencies.
- Gather the information needed to complete comprehensive facilities plans designed to achieve appropriate water quality standards.
- Set up and put into motion a process to determine the ultimate wet weather water quality requirements.
- Establish organization and structure for final LTCP development and facilities/watershed planning group(s).

An implementation framework for addressing these roles and responsibilities is shown on the following figure.
It is important that a number of initiatives proceed. It is equally important that others await the development of the information needed to proceed logically.

The above chart suggests particular Phase one actions proceed as follows:

- ALCOSAN proceed with the Plant and Tunnel Expansion.
- ALCOSAN raise funds to assist the partner communities in projects that are ultimately in ALCOSAN’s and the Partner Communities’ interest.
- Establish a Trust Fund Entity to administer these funds.
- Constitute a Blue Ribbon Committee to determine long term Funding and regionalization actions.
- Initiate a regional watershed approach using a program manager.
- Use this program manager to assist Partner Communities in conducting the Phase I actions described above.

It is anticipated, that it will take considerable time to complete these tasks, given the limited amount of information available at this time from several jurisdictions.

While this may seem like an extended time frame, such an approach must include time for report preparation, public outreach, and consensus building between the 83 jurisdictions as well as the negotiations with the regulatory agencies. The time frame allowed in Norfolk was only three years but the City did have the basis for an asset management system in place and was not confronted with the issue of dealing with 83 diverse jurisdictions.
REFERENCES


2. Allegheny County Sanitary Authority, CSO Evaluation Project, Status of NPDES Permits for CSOs, April 6, 1999.


8. Allegheny County Sanitary Authority Agreement, February 17, 1953


10. Allegheny County Sanitary Authority, Regional Long-Term Wet Weather Control Concept Plan, Municipal Comments and Alcosan Response.


APPENDIX A

Third Party Review
List of Information Gathering Meetings
1. Attended Project Kick-Off meeting at ALCOSAN.
2. Carried out site visits to a portion of the ALCOSAN Sewer System.
3. Attended meeting with Southern Basin Engineer's Committee.
4. Attended meeting with ALCOSAN and CDM to review our questions.
5. Attended meeting with 3Rivers Director on 3Rivers 2nd Nature Reports.
6. Attended meeting with 3Rivers Technical Advisory Committee.
7. Attended meeting with Pittsburgh Water and Sewer Authority.
APPENDIX B

Summaries of National Trends From EPA’s Report to Congress Implementation and Enforcement of the Combined Sewer Overflow Policy December 2001
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Community Case Study

Number of CSO Outfalls
- 10 (originally)
- 7 (currently)

Combined Sewer Service Area
- 19 square miles

Sewer Service Area
- 260 square miles

Wastewater Treatment Capacity
- 194 mgd (secondary)

Receiving Water(s)
- South River, Chattahoochee River

Background on Atlanta CSOs

The CSS service area is centered in central downtown Atlanta. The city is situated on a ridge between the South River to the southeast and the Chattahoochee River to the northwest. Most of the city's CSOs are in the headward area of small watersheds that are tributary to these rivers. The CSO facilities are grouped according to the watershed in which they are located.

Atlanta's CSS covers approximately 19 square miles. It represents a small fraction of the city's sewer service area of 260 square miles, but it includes the most highly developed section in the Metro Atlanta region. This CSS area in the downtown business district serves approximately 103,000 residents and a daytime population of 202,000. Based upon a sewer system evaluation and survey of the East Side sewers, the city estimates that there are approximately 200 miles of combined sewers in the entire CSS.

Program Highlights

- Settlement of a civil judicial enforcement action for violation of the Clean Water Act and Georgia Water Quality Control Act has required the city to develop and implement additional CSO controls.
- Controls implemented as of 2000 have reduced CSO volume by 60 percent and solids loading by 75 percent.
- The LTCP proposed by Atlanta in March 2001 will reduce overflow events from 60 to four per year per outfall.
Atlanta has four permitted POTWS: R.M. Clayton, Utoy Creek, Intrenchment Creek and South River. These facilities treated over 54 billion gallons of wastewater in 2000. There are also seven CSO treatment facilities covered under six permits.

A civil judicial enforcement action was taken jointly against Atlanta by the EPA, the Georgia Department of Natural Resources–Environmental Protection Division (GDNR-EPD), Upper Chattahoochee Riverkeeper Fund, Inc., the Chattahoochee Riverkeeper, Inc., and W. Robert Hancock, Jr. for violations of the CWA and Georgia Water Quality Control Act. Extensive CSO activity by the city during the last three years was undertaken in connection with the resulting CSO consent decree.

### Status of Implementation

**System Characterization**

Atlanta constructed seven CSO control facilities in the mid-1980s and early 1990s to provide a level of CSO treatment that met state and federal regulations. The city also separated a 3.4-square-mile portion of the CSS area.

Three CSO treatment facilities, McDaniel, Custer, and Intrenchment Creek (the latter two covered under one permit), are located in east Atlanta. These facilities were constructed in the mid-1980s. Each one treats wet weather combined wastewater flows in a different manner.

- **McDaniel CSO Facility** – Low flows, up to 5.5 mgd, are captured and diverted to the South River wastewater treatment plant. In the event of higher flows, flow exceeds the interceptor sewer capacity and enters a 6 MG storage vault. While the vault is being filled, the stored storm water-sewage mixture is pumped to the sanitary sewer at a rate of 3 mgd. Any excess flow is coarse bar screened, disinfected, and routed over a weir into a tributary of the South River.

- **Custer CSO Facility** – Low flows are captured in a sanitary interceptor. When flows exceed 20 mgd, a gate closes the entrance to the interceptor sewer and all flow is routed over a weir through coarse bar screens into a concrete channel that leads to the Custer CSO Facility. High flows to the Custer CSO Facility are routed into a storage tunnel that connects to the Intrenchment Creek CSO Treatment Facility—or over the weir into Intrenchment Creek when the tunnel capacity is exceeded.

- **Intrenchment Creek CSO Facility** – The storage tunnel between the Custer outfalls and this facility is designed to capture and treat the first 30 to 34 MG of wet-weather flow to the tunnel. At the Intrenchment Creek CSO Treatment Facility, the captured flow is subjected to a physical and chemical treatment process and the effluent is then discharged into Intrenchment Creek. Treated effluent discharged from this facility contains lower concentrations of pollutants than discharges from the other East Area facilities, meeting the original 1985 reduction goal for biochemical oxygen demand and total suspended solids.

The four CSO facilities in the West Area of Atlanta are Greensferry, North Avenue, Tanyard Creek, and Clear Creek. These CSO facilities provide rotating fine screens and disinfection treatment.

An extensive system characterization and sampling program was conducted under a consent decree during 1999 and 2000 to characterize the CSS and discharges. EPA and GDNR-EPD approved the evaluation program on March 10, 1999 and approved the resulting evaluation report on September 21, 2000. To the best of the city’s knowledge, this was the most extensive CSO characterization in the nation to date. In addition to the intensive system characterization, the city monitors overflows monthly as part of its permit conditions.
NMC

Creation of Maintenance, Operations, and Management Systems (MOMS) plans provided guidance to city personnel regarding the O&M requirements of each of the city’s CSO facilities, as well as management strategies to control CSOs. The completed MOMS plans were submitted in December 1998 and were approved by EPA and GDNR-EPD in June 1999. The development of the MOMS plans addressed the NMC. There have been at least two dry weather overflows covered under the Consent Decree for which EPA and GDNR-EPD imposed a stipulated penalty. The overflows were due to non-sewer related problems (water line break and drinking water plant backwash).

The city has kept citizens informed of CSO developments with an informational website. Six Citizen Advisory Groups have been formed, and these groups have been given tours of CSO facilities and invited to attend public meetings to learn of developments in managing CSOs.

LTCP

The city submitted a proposed LTCP to EPA and GDNR-EPD in March 2001 under the requirements of the consent decree. The Administrative Order requires that EPA and GDNR-EPD authorize a plan, and that the city implement the plan by mid-2007, unless an alternative schedule is approved. It is the city’s goal to complete the CSO consent decree agenda according to the schedule put forth in the Administrative Order.

The construction of two storage and treatment systems and the partial separation of additional areas are proposed in the LTCP. The storage and treatment systems will reduce the current number of overflows from approximately 60 or more per year to an average of four per year. CSO volume and pollution reduction at the outfalls will be at least 80 percent. Although there is already a significant improvement in the East Area with the storage units installed there, it will require three times more storage volume to reduce the number of events to only four per year. Reducing the number of discharges below the average of four per year increases the required storage (and cost) exponentially for only small improvements in pollutant reduction.

Costs and Financing

The city has invested about $244 million (1994 dollars) in the existing control facilities. This figure includes the total capital costs of planning, design, and construction of the CSO treatment facilities. The city has also spent $500 million for integrated wastewater treatment system improvement program and sewer system repair and relief projects, some of which provide additional treatment capacity in the sewer system. This figure does not include the capital cost of implementing the CSO consent decree activities to date, which were approximately $15 million. All of these capital activities were funded by bonds paid by the general funding available from the wastewater utility. The proposed LTCP is expected to require an additional capital cost of about $950 million (2001 dollars).

Financing for the preferred LTCP option is uncertain. While the city has good credit ratings and bonding capacity, the total funding needs may outpace the bonding capacity unless there are significant rate increases. The impact of the whole wastewater program, funded solely by monthly sewer bills, could be at least 2.6 times the current rate. This may constitute a high impact on households in Atlanta and could raise issues about the affordability of the program. The city is seeking assistance from EPA and GDNR-EPD to address this issue.
Water Quality Issues

CSO treatment is provided at each CSO outfall. The West Area CSO facilities have rotating fine screens and disinfection treatment. The East Area CSO facilities have storage and more advanced treatment. Even with these controls, the federal court ruled that Atlanta’s CSOs were violating water quality standards. Because there is little opportunity for dilution at the outfall points, enforcement of water quality standards is at the end-of-pipe.

The CSO sampling results confirmed several characteristics widely known about storm water runoff and CSO. This evaluation also identified compliance issues for metals and toxicity, such as:

- Each sewershed needs individual consideration for developing representative concentrations.
- The hardness of both the CSO effluent and rainfall is relatively low, resulting in more stringent water quality criteria.
- The Intrenchment CSO Facility met the average and the maximum bacteria criteria. Fecal coliform levels from the Westside facilities still occasionally exceed the maximum criteria.
- Highly variable first flush effects were observed early in runoff events. The range of these effects was different from event-to-event and was not always present for every pollutant.
- Residual chlorine from the CSO treatment facility occasionally caused acute toxicity, based on whole effluent toxicity tests, whereas heavy metals did not cause toxicity. Dechlorinated effluent did not cause toxicity.
- The city collected supplemental storm water data using clean methods to better characterize metals and to determine contributions from parking lots and parks. Urban storm water discharges present challenges similar to CSO for complying with water quality standards. However, the majority of pollutants discharged from the CSO outfall were attributed to the deposition of sanitary sewage in the sewers during dry weather, rather than from storm water. The only storm water constituent that made a significant contribution was zinc.

Enforcement Issues

The extensive CSO control activity during the last three years was undertaken in connection with the settlement of a civil judicial enforcement action taken jointly by the EPA, GDNR-EPD, Upper Chattahoochee Riverkeeper Fund, Inc., the Chattahoochee Riverkeeper, Inc., and W. Robert Hancock, Jr., for violations of the Federal Clean Water Act and Georgia Water Quality Control Act. The city is working diligently to meet all consent decree deadlines and will continue to implement its CSO and SSO programs under the settlement terms. The CSO consent decree calls for compliance by mid-2007, unless otherwise amended, and the SSO consent decree calls for compliance by 2014. In addition to the implementation of corrective CSO and SSO measures, the settlement requires Atlanta to create a greenway corridor and to clean up selected streams, as well as to pay a cash penalty of $3.2 million.
The initial projects implemented in the mid-1980s in the East Area had the primary goal of reducing oxygen demanding substances in the South River. In addition to adding storage to the two CSO sewersheds, the South River and Intrenchment Creek wastewater treatment plant discharges were relocated to the Chattahoochee River. As shown in the figure at right, dissolved oxygen levels improved in the South River as a result, with reductions in CSO volume (60 percent), the number of CSO discharges (84 percent), and total CSO loadings (75 percent for total suspended solids).

Despite these improvements, the federal court still found that further improvements were necessary. The proposed LTCP calls for load reductions of approximately 85 percent.

Examples of Progress

Working closely with EPA, GDNR-EPD the Upper Chattahoochee Riverkeeper and other environmental organizations, the city has had no Discharge Monitoring Report violations at Atlanta’s wastewater treatment facilities. However, the city has had dry weather overflows for which they have paid stipulated penalties.

The Atlanta Wastewater Systems Improvement Program accelerated ongoing sewer improvements, including a capacity certification program for new development and an intensive evaluation of sewer pipe conditions throughout the city. Many of the immediate sewer replacement and rehabilitation projects required under the terms of the SSO consent decree are projects that are included in the 1994 Bond Referendum approved by the voters (final bond issuance did not occur until 1999). Most of the major projects have been designed and some are under construction. Many moved forward as a result of the lawsuit and bills passed by the Georgia Legislature. A number of the projects originally included in the 1994 Bond Referendum have become outdated and must be redesigned.

All consent decree construction completion deadlines associated with the LTCP have been met to date. Interim improvements required to protect public health were completed for the East Side CSO facilities.

The city completed an extensive and thorough assessment of the CSS system. They are working with a citizen advisory group, environmental organizations, EPA, and GDNR-EPD to evaluate an array of long-term solutions to Atlanta’s CSO water quality problems.

References

Tyler Richards, City of Atlanta, Atlanta, GA. Personal communication with Limno-Tech, Inc. staff on details of the CSS overflow plan and program, summer 2001.
Community Case Study  Bremerton, WA—Region 10

Number of CSO Outfalls
19 (originally)
16 (currently)

Combined Sewer Service Area
5.2 square miles

Wastewater Treatment Capacity
32.5 mgd (primary)
7.6 mgd (secondary)

Receiving Water(s)
Port Washington Narrows, Dyes Inlet and Sinclair Inlet of Puget Sound

Program Highlights
● CSO outfalls have been reduced from 19 to 16.
● As of 2000, Bremerton achieved a 69 percent reduction in CSO volume and a 56% reduction in frequency of overflow events from baseline conditions.
● A consent order requires the city to limit CSOs to no more than one event per year at each outfall by December 2008.

Background on Bremerton CSOs

Bremerton's collection system serves 36,000 residents of the city and a small unincorporated portion of Kitsap County. The sewer system consists of 188 miles of gravity sewers, 33 pump stations, and 16 miles of force mains. The combined sewer service area comprises 5.2 square miles in ten sewersheds serving East Bremerton and West Bremerton. Inverted siphons carry sewage from East Bremerton under the Port Washington Narrows. All of the city's sewage is treated at the Charleston POTW, along with wastewater from the Puget Sound Naval Shipyard, other U.S. Navy facilities, and Kitsap County Sewer District No. 1. This plant has an average flow of 7.6 mgd and a maximum design flow of 32.5 mgd. It discharges into Sinclair Inlet, southwest of the City. Excess flows from the CSS are discharged from 16 outfalls located along the Port Washington Narrows and Sinclair Inlet of Puget Sound; 70 to 90 percent of this excess flow is estimated to be storm water or rain induced infiltration (RII).
The City of Bremerton began addressing CSOs in the late 1970s and separating its sewers in 1983. State legislation requires the city to limit CSOs to no more than one event at each outfall annually by 2011. The city agreed to meet a 2008 schedule specified in a federal consent decree resulting from a third party Clean Water Act lawsuit. Storm water discharge from new developments into the CSS is prohibited. The city must update its CSO reduction plan with each 5-year NPDES permit cycle, and submit a status report each May on implementation activities. The report provides details on the past year's frequency and volume for each CSO, and whether overflow at a site has increased over the baseline annual condition. Documentation of the previous year's CSO reduction accomplishments and planned projects for the next year are also included.

In 1992, the city completed its first CSO reduction plan in accordance with Washington State Department of Ecology (Ecology) guidelines (CH2M Hill, 1992). This plan included:

- Documentation of the CSO system and improvements.
- Computation of baseline annual frequency and volume of CSO discharges.
- Sampling and analysis of CSO discharges effluent and sediment at CSO structures and outfalls.
- Evaluation and selection of general control, reduction and treatment methods.
- Description (including costs) and evaluation of alternatives and recommendation of CSO reduction projects.
- Analysis of the effects of the proposed projects on the WWTP operation.
- Recommendations for future studies.
- Preparation of an implementation schedule and financing plan.

The 1992 CSO reduction plan proposed sewer separation as the primary means to reach the one event per year level in many of the city's sewersheds.

CSO volume and frequency data became available in 1994 when the CSO and rainfall monitoring system went on-line. Monitoring helped to identify sewersheds that receive direct storm water inflow and areas that had large amounts of RII. It was found that large amounts of roof and parking lot drainage from private properties goes directly into the CSS. A city ordinance provides funding authority for a program to assist private property owners with development and implementation of storm water separation projects by January 2002 and beyond, as funds are available. This program is called the Cooperative Approach to CSO Reduction.

Bremerton has published three educational brochures, hosted workshops, developed an internet website, and produced a how-to video that covers the CSO reduction program goals and requirements (Berthiaume, 2000). Private property owners willing to disconnect storm water inflow can obtain free technical assistance, site assessments and detailed planning from a city representative. The City Council approved a reimbursement schedule that pays the property owner based on the type of connection and the effort it will take to redirect the storm water to its yard, the street, or other conveyance. Separation work completed in the right-of-way is provided at no cost to the property owner. The city representative and property owner work together under this program to complete the site assessment. The method of separation is agreed to in a signed contract. When the separation work has been completed, the property owner calls for a post-separation inspection. If completed per the agreement, payment is made to the property owner and the property status is updated in the city's wastewater account data base. Bremerton established a fee schedule for private properties that have improperly connected storm water to the sanitary sewer system. If a private property has a storm water connection to the sanitary sewer system, the existing storm water fee, based on a per account or equivalent impervious surface unit, is increased 25 percent annually, beginning in 2002 to 100 percent of the fee by January 2005.
In 1999, Bremerton developed a hydrologic and hydraulic conveyance model to support facility planning. The city also carried out additional work including an inflow and infiltration study, installation of flow meters, and smoke and dye testing. The city initiated a source-tracing program to be implemented if contaminants in CSOs exceed marine chronic water quality criteria.

Bremerton updated its CSO Reduction Plan in 2000 (HDR, 2000). CSO reduction alternatives were evaluated based on an October 30, 1997 storm event. This storm has a one-year recurrence interval with a high intensity accumulation of rainfall at the end of the storm with two days of wet antecedent conditions. The storm produced a high flows well suited for developing improvements primarily associated with increasing conveyance capacity. Reduction options that were considered included sewer separation, removal of RII, increased conveyance capacity, storage, and treatment. Significant findings included:

- Separation should be continued, but only to provide a long-term benefit for collection and treatment of sanitary sewage. Separation will not reduce the overflows to one event per year since a major portion of the extraneous flow during major events is from RII.
- Removal of RII is feasible only when cost-effective and achievable within the schedule.
- Providing some storage offers valuable benefits, particularly when combined with onsite treatment or conveyance, but is not cost effective in all sewersheds because of site limitations and the volume of combined sewage.
- Increased conveyance capacity is needed to prevent overflows, but downstream impacts on the sewers and increased flow to the WWTP need to be considered.
- Treatment of CSOs at the old Manette WWTP site was the most cost effective method of reducing untreated overflows from East Bremerton.

Many of the controls were completed in 2000. Flow slipping (intentional blocking of storm water from entering the CSS at catch basins for the purpose of routing, or slipping it, elsewhere) and installation of new storm water sewer mains also contributed to reduced CSO discharges during 2000.

**Nine Minimum Controls**

Bremerton addresses all of the NMC in its annual reports. Monitoring of CSOs and receiving water bodies began in 1995, and there are no ongoing problems with dry weather overflows or floatables. The city has water conservation, rain barrels, recycling, and hazardous waste disposal programs in addition to the programs previously described. The city sweeps all major streets every six to ten weeks, and cleans each catch basin annually. The city also initiated planning in individual storm water basins. These efforts all reduce contaminants in CSOs. Upgrades to wastewater collection system controls and the installation of a Supervisory Control and Data Acquisition (SCADA) system have increased overall system reliability.

### Costs and Financing

Bremerton completed CSO control projects in three sewersheds at a capital cost of approximately $17 million. It is estimated that an additional $27 million is needed to complete improvements for the seven remaining sewersheds. Annual operation and maintenance costs are currently $4.5 million and are expected to increase to $6.0 million by 2008. The city's wastewater utility has no bonding capacity until 2007. Therefore, outside financial resources are necessary to complete the program. Existing projects were funded through Interfund Loans, Public Works Trust Fund (PWTF) loans, Centennial Clean Water Funds (CCWF) loans/grants, State Revolving Funds (SRF) loans, and user fees. Future projects will be funded by these sources plus direct congressional grant appropriations ($3.48 million to date). Current debt service for funding CSO projects...
through these programs adds $1.1 million to the annual cost to the wastewater utility. Assuming $40 million for CSO programmatic capital loan requirements, it is anticipated that annual debt service will increase to $2.6 million in 2008 providing existing low interest loan terms.

Local match requirements are a significant issue for the city. EPA regulations preclude using SRF as matching funds for grants and PWTF also does not allow using grant funds as match. The current implementation schedule is dependent on several revenue assumptions, including continued annual consumer rate increases consistent with inflation, a minimum 1 percent system growth, third party recovery from ongoing litigation, and financing with loans or grants. Without the financing and sufficient match, the city will not be able to meet the implementation schedule. According to the 2000 Washington Water and Wastewater Rate Survey, Bremerton has some of the most expensive wastewater rates in the state (number 36 of 39 surveyed, ranked from lowest to highest) at $45.10 per month (Black and Veatch, 2000).

The Cooperative Approach to CSO Reduction program is supported by a grant from the CCWF and matching funds from Bremerton. Revenues from the grant will be expended by mid-2002 and the city plans to continue the program with O&M funds through 2005. Beginning in January 2002, revenues collected from the new storm water fee will be used to offset the cost of design, construction and the operation and maintenance of the new CSO reduction facilities that are needed to control and treat the extra water from the remaining improper connections.

### Water Quality Issues

Water quality issues in Puget Sound include a ban on commercial harvesting of shellfish, threats to public health, and threats to endangered species. Sinclair and Dyes Inlets have documented water quality problems from a variety of sources, including failing septic systems, urban runoff, industrial and military sites, and CSOs. Efforts to address these sources of pollution have helped to improve, but have not solved, water quality problems in the area.

The Bremerton-Kitsap County Health District has issued a closure advisory for all species of shellfish, crab, bottom fish, and rockfish in Dyes Inlet, Port Washington Narrows, and Sinclair Inlet due to chemical or biological pollution. The closure to commercial harvesting of shellfish, due to point and nonpoint pollution, impacts the economy, reduces jobs, and causes the public to avoid the use of beaches. Additionally, the health district has issued an advisory for areas that periodically experience high levels of point and nonpoint pollution during heavy rains. This advisory includes Dyes Inlet, Port Washington Narrows, and Sinclair Inlet. Public use of Port Washington Narrows includes four major waterfront parks and more than seven other public access sites. Year-round recreational uses of these waters such as sport fishing, scuba diving, and swimming increase the potential risk to the general population.

The US Navy’s ENVVEST program is developing a model that can be used by the Washington State Department of Health (DOH) to determine the transport and fate of fecal coliform if the city were to have an overflow event. This is a cooperative program among the Navy, EPA, Ecology and other organizations. Shellfish beds have been periodically monitored since they have been closed to harvest since 1969. Significant efforts have been made to reduce point and nonpoint pollution.

The Dyes Inlet currently meets water quality standards for shellfish. However, due to the existence of CSO structures and the potential for an overflow event, the DOH has not opened these shellfish beds for commercial harvesting. Discussion of re-certifying the shellfish beds in Dyes Inlet for restricted or limited harvesting is possible once DOH has a tool to calculate the fate and transport of fecal coliform due to a CSO.

There are 22 square miles of critical nearshore salmonid habitat that surround the CSO outfalls and range up to four miles downstream of the discharges. CSOs potentially affect the Chinook and Chum Salmon and Bull Trout, which are threatened under the
Endangered Species Act. Studies are underway to determine the actual extent of the threat and the effects of reducing pollutant sources.

**Enforcement Issues**

In 1993, Bremerton entered into a Consent Decree that further addressed its CSOs but did not include sewer moratoriums. Amendments to this decree were adopted in 1999 through mediation (Ballbach, 1999). The city agreed:

- To achieve a 95 percent reduction in CSO flows by 2003, subject to extraordinary events and extreme year anomalies.
- To accelerate the CSO reduction schedule to achieve the goal of one overflow per year or less at each outfall by December 2008.
- To pay for a Financial Feasibility Study if schedule modifications become necessary.

In November 2000, a second citizens group issued a notice of intent to file suit against the city for failure to meet the requirements of the Consent Decree.

**Results**

Bremerton has eliminated three CSO outfalls. As shown, the city's efforts have reduced CSO volume by 69 percent from baseline conditions (City of Bremerton, 1999). The city also reduced the annual number of overflow events by 56 percent. In 2000, the City achieved a 96 percent reduction in volume, and an 89 percent reduction in frequency of overflow events. Nine of 16 CSO outfalls overflowed only once or did not overflow at all in 2000 (Bertiaume, 2000). Some of the reduction can be attributed to the unusually low rainfall (20 inches less than normal). However, Bremerton believes it is on the way to achieving a goal of one overflow or less per outfall on an annual basis.

<table>
<thead>
<tr>
<th>Annual CSO Volume and Rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measured volume (MG)</strong></td>
</tr>
<tr>
<td>1997</td>
</tr>
<tr>
<td>1998</td>
</tr>
<tr>
<td>1999</td>
</tr>
<tr>
<td>2000</td>
</tr>
</tbody>
</table>

**Measured volume (MG)**

**Baseline Estimate (MG)**

**Rainfall (inches)**
<table>
<thead>
<tr>
<th>References</th>
</tr>
</thead>
</table>
Community Case Study

Burlington, IA—Region 7

Number of CSO Outfalls
20 (originally)
11 (currently)

Combined Sewer Service Area
2.9 square miles

Wastewater Treatment Capacity
18 mgd

Receiving Water(s)
Mississippi River

Program Highlights
- CSO outfalls have been reduced from 20 to 11.
- Burlington developed a plan to eliminate CSO discharges with sewer separation that will be completed by 2017.
- Burlington has merged a wide array of television inspection and existing sewer system information in a common, detailed data base to facilitate inspection and reporting.

Background on Burlington CSOs

Burlington, Iowa is a hilly city located on the banks of the Mississippi River with a population of 27,500. The city's sewer system is a mix of sanitary, storm, and combined sewers. Combined sewers were commonly constructed until the 1960s and primarily serve the downtown area. Downtown Burlington is the largest retail center in Southeast Iowa containing more than 75 shops and restaurants.

The sewer system serves 5,250 acres through 135 miles of sewers, and has 10,451 customer connections. Six sewersheds and 1,870 acres (36 percent of the sewer system) are served by combined sewers. The Hawkeye basin comprises two thirds of the city's sewer system and 18.5 percent (664 acres) of the drainage area is combined. The South and Market Street sewersheds, the next largest in size (493 and 273 acres respectively), are 100 percent combined. The Cascade sewershed is the next largest at 318 acres, and 32 percent (102 acres) combined. The Angular and Locust sewersheds represent 273 and 65 acres of combined sewers, respectively. Four other minor sewersheds, the Silver, Gnahn, Osborn, and Harrison, serve a combined area of 91 acres.

Controls
- Burlington has been separating portions of its CSS since the 1970s through major street reconstruction projects.
- Work on eliminating individual CSOs started in 1982.
- As part of a 1996 CSO study, a number of CSO control alternatives were evaluated, but the city decided to continue to pursue sewer separation.

Photo: Great River Bridge over the Mississippi River in Burlington. Courtesy of Hawkeye Magazine

Photo: Great River Bridge over the Mississippi River in Burlington. Courtesy of Hawkeye Magazine
Burlington operates an activated sludge wastewater treatment plant with an average design flow of 9.0 mgd and a peak flow capacity of 18.0 mgd. The city has worked on eliminating CSOs through separation and has reduced CSO outfalls from 20 to 11. The wastewater treatment plant and the remaining CSOs discharge to the Mississippi River. The Iowa Department of Natural Resources (DNR) has designated this stretch of the Mississippi for primary contact recreation (Class A) and as a significant resource warm water (Class B-WW).

**Status of Implementation**

The DNR's "Special Conditions for CSOs" requires that the city: (1) determine the hydraulic capacity of the sewers between the CSO and the wastewater treatment plant; and (2) develop an operational plan for the combined system. Burlington has adopted a long-range goal of separating the combined sewer systems to comply with DNR and EPA requirements. The City has separated storm and sanitary sewers on major street reconstruction projects since the 1970s. Implementing the long-range goal will extend through 2017 because of the significant cost to completely separate the sewer system.

Burlington eliminated five CSOs through sewer separation projects between 1982 and 1993. In 1993, the City submitted the Report of Combined Sewer Overflows: Part 1 to the DNR (City of Burlington, 1993). The City concluded that the capacity of the sewers was adequate for current average dry weather flows, except for the Hawkeye sewershed. Anticipated development in the Hawkeye sewershed, combined with significant inflow from Hawkeye Creek and an unnamed tributary, was predicted to exceed the capacity of that system, which was calculated to be 15.4 mgd. Burlington also identified dry weather overflows at three locations.

In 1995, the city submitted the Report of Combined Sewer Overflows: Part 2 to the DNR (City of Burlington, 1995). This report addressed NMC activities that are described in the following summary. The city identified a number of repairs to the sewer system and CSO outfalls, located a number of dry weather overflows and CSOs for elimination, and found a previously unknown CSO at a lift station.

<table>
<thead>
<tr>
<th>NMC</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper O&amp;M</td>
<td>Clean, inspect, monitor flows. Conduct regular inspections by wastewater treatment plant personnel after every rainfall event.</td>
</tr>
<tr>
<td>Maximize collection system storage</td>
<td>Raise dam heights. Disconnect all roof drains and smoke test entire collection system to locate unnecessary sources of inflow.</td>
</tr>
<tr>
<td>Review pretreatment requirements</td>
<td>Develop storm water management plans to control storm water from new development sites.</td>
</tr>
<tr>
<td>Maximize flow to POTW</td>
<td>Raise dam heights to increase flow.</td>
</tr>
<tr>
<td>Prohibit CSO during dry weather</td>
<td>Replace pipe at CSO 016. Separate 26 acres at Gnahn and Osborn.</td>
</tr>
<tr>
<td>Control solids and floatables</td>
<td>Study alternatives once data are available.</td>
</tr>
<tr>
<td>Pollution prevention</td>
<td>Institute a recycling program.</td>
</tr>
<tr>
<td>Public notification</td>
<td>Publish results of CSO monitoring in the newspaper.</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Install monitoring at seven active CSOs to measure number of activations, quantity of water discharged, water quality, and notify wastewater treatment plant personnel.</td>
</tr>
</tbody>
</table>
Burlington prepared a 20-year CSO Control Plan in 1996. This plan outlines a 20-year capital improvement program, describes the condition of the sewers, provides flow monitoring information, and analyzes potential flow conditions during a standard storm (5-year, 1-hour event, 2 inches of rain). A number of CSO control alternatives were evaluated. Inlet control storage, in-line storage, off-line storage, deep tunnel storage, and swirl concentrators/disinfection were eliminated due to ineffectiveness or cost. The City elected to use separation as the primary means of CSO control, and established six phases to be implemented by 2017. The schedule and costs associated with each phase is summarized below.

<table>
<thead>
<tr>
<th>Phases and Outfalls Addressed</th>
<th>Schedule</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Modify CSO and sewers, separate combined areas, and conduct inspections and eliminate improper private connections (eliminate eight CSOs; modify five others).</td>
<td>1996</td>
<td>$ 1.5 million</td>
</tr>
<tr>
<td>2. Separate the Hawkeye sewershed (eliminate one CSO).</td>
<td>1998 to 2002</td>
<td>$13.3 million</td>
</tr>
<tr>
<td>3. Separate the Cascade CSS (eliminate two CSOs).</td>
<td>2003</td>
<td>$ 3.1 million</td>
</tr>
<tr>
<td>4. Separate the Locust, Harrison, and South sewersheds (eliminate one CSO).</td>
<td>2003 to 2007</td>
<td>$ 5.0 million</td>
</tr>
<tr>
<td>5. Separate the Angular sewershed (eliminate one CSO).</td>
<td>2008 to 2012</td>
<td>$ 4.9 million</td>
</tr>
<tr>
<td>6. Separate the Market sewershed (eliminate 012) (eliminate one CSO).</td>
<td>2013 to 2017</td>
<td>$ 7.3 million</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$35.1 million</strong></td>
<td></td>
</tr>
</tbody>
</table>

Many of the Phase 1 controls were completed in 1996. Work on Phase 2, the Hawkeye Sewer Separation Project, began in early 1999. The Hawkeye Project has three parts and is expected to take five years to complete. Part 1 of the Hawkeye project includes studying the system (flow monitoring, manhole inspection, smoke testing, dyed water flooding, line cleaning and television inspection) to identify sewer capacities and proper sizing of sanitary trunk lines, and to identify sources of unknown inflow such as roof drain, back yard inlets, etc. Burlington used this opportunity to develop an innovative approach to sewer television inspection and reporting, where the information collected on the sewer system was delivered on digital video discs (DVD). A wide array of television inspection and existing information on the sewer system was merged into a common, detailed data base management system. This approach saved time in collecting, annotating, analyzing and reviewing information as well as providing permanent records with a design life of at least 100 years (Carhoff, 2000). These data are also being entered into a county-wide GIS that should be available in 2002.

Part 2 of the Hawkeye Project consists of separating storm water inlets. The city intends to implement a storm water management plan for each of the main trunks entering the Hawkeye sewer. Part 3 consists of installing sanitary trunk sewers into the Hawkeye trunk sewer to convey sanitary flow to the wastewater treatment plant. Storm water will be conveyed in the existing trunk sewer to local receiving waters.

After the Hawkeye Project is completed, the city will reevaluate the 20-year plan. Separation will continue to the maximum extent possible, and the city will consider using innovative end-of-pipe treatment technologies to address remaining overflows.
Costs, Financing and Results

Burlington used a mix of Community Development Block Grants, federal grants, and bonds to finance CSO control. Prior to the initiation of the Hawkeye project, the city spent more than $2.9 million to separate sewers within 464 acres of the service area and to eliminate five CSOs.

The Hawkeye Sewer Separation Project is a $13.3 million project, where 82 percent of the budget will fund sewer construction, 13 percent inspection and smoke testing, and the remaining 5 percent repairs to the trunk sewers. In 1998, the city was awarded a federal special infrastructure grant for $7 million. The city is providing the local cost-share through bond issuance and user fees. When complete, the Hawkeye Sewer Separation Project should eliminate 60 overflows per year and 1.5 mgd of CSO discharged to the Mississippi River.

The city is facing an additional $20.3 million cost to implement the remainder of the 20-year CSO Control Plan and is seeking a grant to support this completion. The 20-year implementation schedule and financing for the plan are both critical issues for Burlington. Many of the residents are on fixed incomes or earning low wages, and cannot afford increased sewer rates. Federal grant funding is therefore a key component of the city’s LTCP.

References


Community Case Study

Chicago, IL—Region 5

Number of CSO Outfalls
408

Combined Sewer Service Area
375 square miles

Wastewater Treatment Capacity
2,434 mgd (secondary)

Receiving Water(s)
Addison Creek, Calumet River, Calumet Sag Channel, Chicago River, Chicago Ship Channel, Des Plaines River, Flagg Creek, Grand Calumet River, Little Calumet River, North Shore Channel, Oak Lawn Creek, Salt Creek, San & Ship Canal, Weller's Creek

Controls
- Large diameter, deep rock tunnels are used to capture, convey, and store wet weather flows.
- Reservoirs are currently being constructed to provide flood control and additional CSO control benefits.

Program Highlights
- Construction of CSO control projects began in 1975.
- As of 2000, 93% of all CSO outfalls have been intercepted by TARP.
- To date, TARP tunnels have captured and facilitated the treatment of more than 565 billion gallons of CSOs.

Background on Chicago CSOs
CSOs and CSO control are a complex regional issue in the greater Chicago metropolitan area where there are a total of 408 CSOs along 81 miles of waterways. The majority of the outfalls are regulated through NPDES permits issued to 52 municipal jurisdictions, including the City of Chicago. The Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) maintains regional treatment facilities and has responsibility for outfalls near the plants and along the interceptors. The MWRDGC combined sewer service area comprises 375 square miles and serves a population of over 3 million. It is estimated that there are over 5,000 miles of sewers within the combined sewer area. The rated treatment capacities of the seven MWRDGC water reclamation plants (WRPs) are:
MWRDGC is implementing a two-phased approach to address CSO and flood control known as the Tunnel and Reservoir Plan, or TARP. The construction of large diameter, deep rock tunnels for the storage of combined sewage is the centerpiece of TARP Phase I. The construction of reservoirs to primarily address flooding issues is the main component of TARP Phase II.

TARP Phase I is the MWRDGC's LTCP. TARP Phase I captures, conveys, and stores wet weather combined sewer flows in excess of interceptor capacity until they can be pumped out to existing WRPs for full advanced secondary treatment when plant capacity becomes available following storms. TARP Phase I consists of 109.4 miles of tunnels 9 to 33 feet in diameter, three tunnel dewatering pumping stations, over 250 drop shafts, and over 600 associated near-surface connecting and flow regulating structures. CSOs are intercepted at all outfalls. The system is designed to facilitate capture and treatment of the CSO first flush from all storms, and all of the CSO from the smaller, more frequent storms. This equates to a reduction of approximately 84 percent of the pollution load. Reservoirs being built under TARP Phase II are primarily intended for flood control and are not part of the LTCP, although they will provide additional CSO pollution control benefits.

TARP was developed through a joint effort of the State of Illinois, Cook County, the City of Chicago, and the MWRDGC. It represents a hybrid of the best eight of over 50 water management plans proposed and studied beginning in the mid-1960s. TARP has been designed to protect Lake Michigan and Chicago-area waterways from CSO pollution, and to significantly reduce local basement flooding. Officially adopted by the MWRDGC in 1972 with construction beginning in 1975, TARP was the first comprehensive Clean Water Act CSO control plan developed for a major metropolitan area.

The design for TARP is based on the presumption approach. The storage tunnels built under Phase I are designed to pick up all 408 CSOs within the service area, but were designed to work with the reservoir system, which is not yet complete. The result has been that when multiple storm events occur within a short period of time, the storage tunnels sometimes do not drain completely, producing short-term capacity reductions. Since the CSOs serve as CSS emergency relief points, TARP has cautioned all 52 member cities and villages not to disconnect their outfalls unless they feel confident their local sewer systems are adequate to handle wet weather flows without surcharging that may lead to street or basement flooding.

Approximately 75 TARP Phase I construction contracts have been completed, with only two remaining. As of September 2001, 93.4 miles of tunnel system were complete and in operation, 8.1 miles of tunnel were under construction, and 7.9 miles of tunnel were expected to be under construction by late 2001. Of the 2.3 billion gallons of CSO storage tunnel capacity, 2.1 billion gallons (92 percent) are online. Phase II, reservoir construction, is not as far advanced. A summary of TARP progress follows.

<table>
<thead>
<tr>
<th>WRP</th>
<th>Design Average Flow (mgd)</th>
<th>Design Maximum Flow (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stickney</td>
<td>1,200</td>
<td>1,440</td>
</tr>
<tr>
<td>North Side</td>
<td>333</td>
<td>450</td>
</tr>
<tr>
<td>Calumet</td>
<td>354</td>
<td>430</td>
</tr>
<tr>
<td>Kirie</td>
<td>52</td>
<td>110</td>
</tr>
<tr>
<td>Egan</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Hanover Park</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>Lemont</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,983</strong></td>
<td><strong>2,506</strong></td>
</tr>
</tbody>
</table>
### Tunnels and Related Facilities (Phase I)

<table>
<thead>
<tr>
<th>System</th>
<th>Construction Costs</th>
<th>Miles Total</th>
<th>Miles Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainstream</td>
<td>$1,142</td>
<td>40.5</td>
<td>40.5</td>
</tr>
<tr>
<td>Calumet</td>
<td>$711</td>
<td>36.7</td>
<td>20.7</td>
</tr>
<tr>
<td>O'Hare</td>
<td>$64</td>
<td>6.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Des Plaines</td>
<td>$469</td>
<td>25.6</td>
<td>25.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$2,386</strong></td>
<td><strong>109.4</strong></td>
<td><strong>93.4</strong></td>
</tr>
</tbody>
</table>

### Reservoirs (Phase II)

<table>
<thead>
<tr>
<th>System</th>
<th>Construction Costs</th>
<th>Capacity Total (Billion Gallons)</th>
<th>Capacity Complete (Billion Gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McCook</td>
<td>$521</td>
<td>10.5</td>
<td>0</td>
</tr>
<tr>
<td>Thornton</td>
<td>$105</td>
<td>4.8</td>
<td>0</td>
</tr>
<tr>
<td>O'Hare</td>
<td>$48</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$674</strong></td>
<td><strong>15.7</strong></td>
<td><strong>0.4</strong></td>
</tr>
</tbody>
</table>

There are no dry weather overflows in the service area. The potential for dry weather flow is greatly reduced by a number of factors including:

- The inherent design of the sewer system.
- Infiltration and inflow (I/I) control programs implemented in separate sewer areas in local villages and cities upstream of the combined sewer area.
- MWRDGC’s sewer construction permit programs governing sewer connections tributary to its interceptors and treatment plants.
- MWRDGC’s own O&M programs and sewer rehabilitation efforts on its 550-mile interceptor sewer system.

### Costs and Financing

TARP Phase I construction progress has been continuous since beginning in 1975. Construction contracts totaling more than 2.2 billion dollars of the budgeted $2.4 billion have already been spent (91 percent). Annual O&M costs between 1997 and 1999 averaged $8.1 million per year. The construction cost for the final TARP Phase I tunnel (the Little Calumet Leg Tunnel) is estimated to cost $160 million.

Early federal and state construction grants greatly reduced the MWRDGC's direct cost-share for the project. After cessation of the federal construction grants program, the MWRDGC committed itself to completing TARP exclusively utilizing its own funding resources. However, due to the large costs involved, funding availability has been the primary reason that construction has not progressed faster.

TARP's large scope, high implementation cost, and unique, untested nature has sparked hot debate and heavy news media coverage, including a segment on CBS' “60 Minutes.” While evaluated as being the most cost-effective solution, TARP opponents offered alternatives they believed to be cheaper and as effective. Other solutions were proposed including smaller scale decentralized facilities, roof-top and street storage, park storage, sewer restrictions, relief sewers, downspout disconnection, and basement sewer backup prevention devices. All suggestions were evaluated, and it was found that none of the TARP alternatives would achieve the stated goals.

After $739 million in TARP construction contracts had been awarded (75 percent federally funded) in 1979, the United States General Accounting Office (GAO) issued a
This report analyzed TARP's cost versus its objectives. A conclusion was in the form of a question: "Both phases of TARP and associated projects offer a promising solution to the (CSO) problem. But can the country afford it?" The GAO recommended ceasing further federal funding of TARP until a reassessment was made to see if less costly alternatives existed, and to consider adopting more flexible water quality goals for the waterways affected by CSOs. The MWRDGC and local political leadership vigorously objected to both recommendations and to GAO’s estimate of TARP’s cost, which was three to four times higher than the MWRDGC’s estimated cost. More studies were conducted and TARP was reaffirmed as the most cost-effective alternative.

**Water Quality Issues**

MWRDGC conducts several water quality monitoring programs in the Chicago and Calumet waterway systems. Water quality samples are taken on a weekly basis for general chemistry and metals. In addition, dissolved oxygen monitoring is conducted on a continuous basis with in-place monitors. MWRDGC also conducts fish population surveys to track changes in the numbers of fish and fish species present in waterways. The results of these studies have documented dramatic improvement in water quality. MWRDGC believes that the completion of TARP Phase I (its LTCP) will result in compliance with the water quality standards.

By letter dated June 28, 1995, the State of Illinois Environmental Protection Agency concurred with the MWRDGC advising that "the Agency believes that the completion of TARP will be adequate to meet water quality standards and protect the designated uses of the receiving waters pursuant to Section I.C of the CSO Control Policy.

**Results**

TARP tunnel fill levels and pumpout are measured to determine total CSO capture during storm events. Major portions of the TARP tunnel system were placed in operation beginning in the mid 1980s, with new segments coming on-line afterwards. To date, the 93.4 miles of completed TARP tunnels have captured and facilitated treatment of over 565 billion gallons of first and second flush combined sewage that would have otherwise spilled to local rivers and streams.

The frequency of CSO occurrences has decreased from nearly 100 times per year to less than 15 times per year.

Marked visible improvement in the condition of waterways has spurred recreational and other uses of the Chicago River including tourism and sightseeing, boating, canoeing, and fishing. Once perceived by many as a virtual open sewer, the river system has been cleaned up by TARP. This has brought about enhanced real estate values and booming riverside development, including hotels, office/apartment buildings, restaurants, riverwalks, marinas, and canoe/kayak launches. Fish, including various species of game fish, and other aquatic wildlife, have returned to the river system in dramatic numbers. The year 2000 Bassmaster Fishing Tournament was held in Chicago on its restored waterways.

TARP has received much recognition and numerous awards from government agencies and technical/professional organizations for its innovative and effective design and performance. The project has garnered favorable press from local media for its performance, and much local support from local villages and cities.
References


The Columbus CSS extends over 2,600 acres of the old downtown area draining to the Chattahoochee River. Until controls were implemented, there were 5,200 acres of combined sewer with 16 CSO outfalls to the river. The average annual river flow is 6,500 cfs, with a flow of 3,500 cfs on average in summer and a regulated low flow of 1,160 cfs. Prior to CSO control, elevated levels of fecal coliform bacteria and visible sewage debris often plagued the Chattahoochee. Columbus began to implement CSO controls in 1995, including two water resources facilities (WRFs). One of the WRFs, in Uptown Park, also serves as a CSO technology testing facility.

Community Case Study

Background on Columbus, GA CSOs

Columbus' CSO program has been fully implemented. Compliance monitoring and performance testing continue. The Chattahoochee River now meets water quality standards for all criteria including bacteria. An extensive public education program involving numerous public hearings, news articles, water bill flyers, watershed workshops, and seminars was a key component of the development and implementation of the LTCP.

Number of CSO Outfalls
16

Combined Sewer Service Area
4.1 square miles

Wastewater Treatment Capacity
42 mgd (secondary)

Receiving Water(s)
Chattahoochee River

Background on Columbus, GA CSOs

The Columbus CSS extends over 2,600 acres of the old downtown area draining to the Chattahoochee River. Until controls were implemented, there were 5,200 acres of combined sewer with 16 CSO outfalls to the river. The average annual river flow is 6,500 cfs, with a flow of 3,500 cfs on average in summer and a regulated low flow of 1,160 cfs. Prior to CSO control, elevated levels of fecal coliform bacteria and visible sewage debris often plagued the Chattahoochee. Columbus began to implement CSO controls in 1995, including two water resources facilities (WRFs). One of the WRFs, in Uptown Park, also serves as a CSO technology testing facility.
Status of Implementation

The Columbus Water Works (CWW) has fully implemented an LTCP based on the demonstration approach of the CSO Control Policy. The LTCP was implemented by December 31, 1995, in compliance with Georgia State law. The Columbus program included characterization of the system and receiving water impacts, implementation of the NMC, pilot testing of alternative technologies, long-term planning, structural controls, and post-construction monitoring to demonstrate compliance with water quality standards.

Program development activities culminated in a $95 million capital program that included:

- Municipal treatment plant upgrades
- Sewer separation
- Diversion structure
- Collector and transport conduits
- Pumping stations
- Two CSO treatment facilities (WRFs)
- Associated river walk, trail and parks
- Five-year technology demonstration testing

The technology demonstration part of the program evaluated technologies for pollutant removal (including screening, vortex separation, filtration processes, flow controls) and several disinfection methods (including ultraviolet light, sodium hypochlorite, paracetic acid and chlorine dioxide). Sodium bisulfite dechlorination was also evaluated for dechlorination (Boner, 2001). Sewer separation was focused mainly in the upstream catchments where this type of solution made economic sense or had a high benefit-to-cost ratio. One strategically placed sanitary relief line eliminated half of the sanitary sewage that entered the CSS.

System Characterization

Columbus began its sampling program in 1990 and has continued the monitoring of area streams, rivers, and municipal infrastructure since then. From 1990 to 1993 the city conducted wet weather sampling of CSOs, streams, rivers and pilot facilities constructed to evaluate alternative CSO treatment technologies. CWW subsequently conducted two national demonstration programs to evaluate CSO controls. These programs included 38 monitoring stations on streams, river, and CSO control facilities including individual process components.

A wet weather monitoring program has been the focal point of Columbus' effort to understand wet weather pollution, its impact on the environment, and cost-effective means to control and reduce the problem. Watershed monitoring stations included flow measurement, automatic sampling and multi-parameter continuous-probe measurements. Analytical tests included E.Coli and fecal coliform bacteria, cryptosporidium and giardia, suspended solids and particle distribution, oxygen demands, nutrients and metals. Probe measurements included dissolved oxygen, turbidity, pH, temperature, and conductivity. Aquatic biology and habitat measurements in over 30 locations were monitored on a quarterly and/or biannual schedule to assess macroinvertebrates and fish populations over a two-year period. Monitoring was conducted to:

- Quantify CSO pollutant loadings
- Measure watershed health and impacts of wet weather pollution
- Determine performance of the various technologies tested
Calibrate the EPA BASINS model

Develop a framework for area TMDLs

Show compliance with the CSO Control Policy for the controls implemented

Characterization findings show that all of these objectives were achieved, and that several protocols for monitoring and modeling have significant national benefit. The CWW monitoring, modeling and technology performance testing was peer reviewed by the Water Environment Research Foundation.

Nine Minimum Controls

In concert with the CSO Control Policy development, CWW evaluated the optimization of its system and organization together with its long-term planning to address NMC requirements. The NMC were identified for the Columbus system, implemented, and documented in a June 1995 report to the Georgia Department of Natural Resources - Environmental Protection Division, the NPDES permitting authority.

The system has been surveyed and hydraulically modeled, and there are no dry weather sewer overflows.

An extensive public education program involving public hearings, news articles, water bill flyers, watershed workshops, and university seminars has been conducted during the planning, implementation, and subsequent testing phases of the CWW CSO program. A continued program is being provided through CWW activities and support of organizations such as Leadership Columbus, the Oxbow Environmental Learning Center, Adopt-A-Stream, and River Kids.

Long Term Control Plan

Columbus developed its LTCP based on the demonstration approach of the CSO Control Policy. Demonstration requires that remaining CSOs after implementation of controls must not preclude the attainment of water quality standards or contribute to water quality impairment. In Columbus, this determination is made through a TMDL allocation process. Columbus was able to quantify pollutant contributions and link the source and the ability to attain water quality standards to water quality targets. This analysis led to a level of CSO control beyond which there is no “reasonable potential to cause or contribute to exceedances of water quality standards.” The result was a post-construction Phase II CSO NPDES Permit that had no numeric limits other than “performance standards based on average design conditions and consistent with the facilities implemented and demonstrated.” Columbus continues to monitor the receiving water and CSO effluent. The data are aggregated with the calibrated BASINS model output to demonstrate on a periodic basis (monthly if possible) that the source contributions and comparison with ambient monitoring data add to the database supporting the TMDL allocation process.

Costs and Financing

Funds for the initial assessment studies, design and early construction were obtained through revenue bonds. To obtain the necessary additional funds, the issue was taken to the public through a series of hearings, workshops and through other outreach vehicles. Incorporating the river walk and park amenities into the project played a key role in drawing public interest to the river and the need for water quality and human health protection. An environmental learning center supported by CWW was created through a partnership with the Columbus State University. The center has since become the focal point for community discussions on environmental resources and municipal infrastructure issues.

CWW furthered its public involvement by developing alternative financing methods including a special options sales tax (SPLOST), Ad Valorem tax, water and sewer rate increases, and a user fee approach. The SPLOST approach was put before public vote and
The net result was that the facilities were paid in full shortly after the construction was completed. This reduced the potential water rate user costs by eliminating the long-term indebtedness and interest that normally accompanies municipal infrastructure projects.

Capital costs for the CSO program are delineated in the table below. The total capital expenditure of $95 million is based upon 1995 completed construction cost. Sewer separation costs amounted to $15,000 per acre. The municipal treatment cost component is not included in the $95 million CSO program because it serves other purposes in addition to CSO, but enables compliance with the NMC by maximizing flow to the wastewater treatment plant, or POTW.

<table>
<thead>
<tr>
<th>CSO Program Element</th>
<th>1995 Construction Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal Treatment</td>
<td>$8,500,000</td>
</tr>
<tr>
<td>Sewer Separation</td>
<td>$5,100,000</td>
</tr>
<tr>
<td>Transport Systems</td>
<td>$43,359,593</td>
</tr>
<tr>
<td>Uptown Park WRF</td>
<td>$22,711,160</td>
</tr>
<tr>
<td>South Commons WRF</td>
<td>$22,126,000</td>
</tr>
<tr>
<td>Technology Demonstrations</td>
<td>$1,736,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$95,000,000</strong></td>
</tr>
</tbody>
</table>

The CWW has an annual CSO operating budget of $1 million which includes labor, power, chemicals, spare parts, materials and equipment replacement. Capital and operating costs by process for the Uptown Park WRF are shown in the tables below. The major capital costs are in the structural components. The dominant operating costs are associated with grit handling and removal.

<table>
<thead>
<tr>
<th>CSO Control</th>
<th>O&amp;M Cost</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grit Handling</td>
<td>$104,880</td>
<td>48%</td>
</tr>
<tr>
<td>Dechlorination</td>
<td>$25,871</td>
<td>12%</td>
</tr>
<tr>
<td>Comp. Media Filtration</td>
<td>$21,400</td>
<td>10%</td>
</tr>
<tr>
<td>Chemical Disinfection</td>
<td>$19,174</td>
<td>9%</td>
</tr>
<tr>
<td>Vortex Separation</td>
<td>$16,320</td>
<td>7%</td>
</tr>
<tr>
<td>Trash Screening</td>
<td>$13,480</td>
<td>6%</td>
</tr>
<tr>
<td>UV Disinfection</td>
<td>$9,320</td>
<td>5%</td>
</tr>
<tr>
<td>Flow Controls</td>
<td>$8,400</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Total O&amp;M</strong></td>
<td><strong>$218,846</strong></td>
<td></td>
</tr>
</tbody>
</table>
Water Quality Issues

Water quality and beneficial use improvements have been the direct result of the CSO control program in Columbus. The Chattahoochee River now meets water quality standards for all criteria including bacteria. The river, especially in the downtown area and location of the CSOs, is aesthetically free of trash, oil and grease and other sewage debris. The old CSO outfalls are no longer visible.

Enforcement Issues

Georgia Law enacted in 1990, and amended in 1991, required five CSO cities in the state to eliminate or control their CSO problem to meet water quality standards by December 31, 1995. The CWW was placed under a CSO NPDES Permit, issued March 31, 1992, and accompanied by an Administrative Order requiring implementation of planning, design and construction of control facilities. The permit also required regular monitoring and reporting of discharges from the existing CSOs. CWW completed all requirements of this permit and Order ahead of schedule.

In 1997 and 1998, the NPDES permit renewal was negotiated with the benefit of having two years of operational and monitoring data of the CSOs, the river, and a start of a calibrated EPA BASINS model of the urban watershed. The negotiated CSO permit is considered a post-Phase II permit with regard to the CSO Control Policy. The permit requires that the facilities be operated in accordance with the demonstrated CSO program. The permit requires monitoring of the facility discharges and receiving water. The results are reported in a mass balance spreadsheet that allows the comparison of the accumulated source contributions and the downstream measurements.

Results

The Columbus CSO program is fully implemented. Compliance monitoring and performance testing continues. Columbus has plans to implement an integrated real-time monitoring network that will collect and manage the data for compliance reporting, measure watershed restoration progress, and provide early warning of watershed disturbances for drinking water protection. The monitoring network will
include urban area creeks and river, CSOs and treatment plants. Watershed characterization data including near real-time displays will be available to the public via the internet.

Performance testing at the Uptown Park WRF has generated the data necessary to evaluate combinations of the technologies tested. The alternative evaluation process considered the annual distribution of rainfall and runoff events such that annual yields (quantity per acre per year) and the reduction in yield can be assessed versus the cost for the treatment scenario. The costs and benefits for different treatment levels provided by technologies demonstrated in Columbus were also evaluated. For example, the capital cost per pound of total suspended solids removal increased from $27 per pound at the 63 percent removal rate to $63 per pound at the 80 percent removal rate.

A new bromine-based chemical is being tested with potential for higher treatment rate capabilities with minimal residuals. This technology evaluation is being undertaken through a collaboration of the Georgia Institute of Technology, the chemical manufacturer, and CWW. It is anticipated that other partnerships will be generated to evaluate various CSO technologies at the Uptown Park WRF.

The primary goal of the Columbus CSO control program was to reduce fecal coliform bacteria to levels meeting water quality standards in the Chattahoochee River. Watershed measurements and a TMDL formulation were required to make this determination. Area watersheds were monitored over a three-year period and the BASINS model was calibrated from the measured data. The results of this evaluation show that the CSOs do not cause or contribute to water quality standards violations. As shown in the table at right, the fecal coliform removal rate was extremely successful, but other pollutants of concern were also significantly reduced.

The 30-day geometric mean fecal coliform represents all contributing sources and is well within the summer and winter water quality criteria of 500 and 1,000 colonies per 100 ml. The maximum daily standard of 4,000 colonies per 100 ml was exceeded periodically (a few days within a two-year period), but was attributed to urban and suburban streams that discharge to the river. Remaining bacteria attributable to CSO after treatment is a small fraction of that contributed by the urban and rural watersheds.

The next challenge for the area is to implement management strategies that will focus on urban watershed protection including area drinking water supplies. In accomplishing these goals, policies and ordinances will be developed and watershed technologies will be demonstrated. Ultimately site-specific criteria defining water body use and protective measures will be developed. The regional and local partnerships and the environmental education network established by CWW will continue to be the focal point of these efforts.

Most of the future needs for Columbus will be associated with storm water controls. The costs of urban watershed management could be very large and demand a sound-science approach to test alternative technology. Columbus has initiated several projects to evaluate wet weather control strategies in which performance results will be applied on a broader basis to quantify costs and benefits of watershed restoration.

### Pollutant Removal as % of Annual Load

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Removal as % of Annual Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>55—61%</td>
</tr>
<tr>
<td>TSS</td>
<td>52—62%</td>
</tr>
<tr>
<td>Fecal coliform</td>
<td>95—99%</td>
</tr>
<tr>
<td>Copper</td>
<td>66—75%</td>
</tr>
<tr>
<td>Lead</td>
<td>62—83%</td>
</tr>
<tr>
<td>Zinc</td>
<td>62—82%</td>
</tr>
</tbody>
</table>

Citations

Boner, Mark. Wet Weather Engineering and Technology (WWETCO), Columbus, GA. Personal communication with Limno-Tech, Inc. staff on details of the combined sewer overflow plan and program. Summer 2001.
### Background on Louisville CSOs

The Louisville and Jefferson County Metropolitan Sewer District (LJ CMSD) provides sewer service as well as storm water utility management to the Louisville, Kentucky community. The sewer customer base is just over 198,000 and has grown at a rate of 12 percent over the past five years. Sewer service is provided by a combination of separate sanitary sewers and combined sewers. The total length of sewers within the service area is over 3,000 miles including 680 miles of combined sewers built before 1995. The combined sewer service area is heavily urbanized and covers approximately 24,000 acres. There are currently a total of 115 CSO outfalls within the CSS.

Wastewater flow is treated at the Morris Forman Wastewater Treatment Plant (MFWTP). MFWTP is capable of providing full secondary treatment for up to 140 mgd and primary treatment for an additional 110 mgd during wet weather periods. A project is currently underway which will increase the wet weather primary treatment capacity from 250 mgd to 350 mgd.

### Controls

- The Louisville and Jefferson County Metropolitan Sewer District (LJ CMSD) has initiated in-line storage projects, separation projects, storage basin projects, and pilot CSO treatment projects.
- LJ CMSD is currently working to expand wet weather capacity at its treatment plant by 40 percent, from 250 to 350 mgd.

### Program Highlights

- Five CSO outfalls have been eliminated.
- CSO frequency has been reduced by 27 percent and CSO volume has been reduced by 13 percent. This keeps 681 million gallons per year of combined sewage out of local receiving waters.
- LJ CMSD’s program to install backflow prevention devices in homes to eliminate sewer backups has been used as a national model.
Status of Implementation

Nine Minimum Controls

All of the NMC have been implemented, and LJ CMSD provided NMC documentation to the State of Kentucky. Many of the NMC activities were being implemented by LJ CMSD before the CSO Control Policy was issued in 1994.

LJ CMSD established a maintenance program in the 1980s to focus on inspection and maintenance of CSO outfalls. Each CSO outfall is inspected on a set schedule. The frequency of the inspection ranges from daily to monthly depending on the particular outfall size, history of the discharge, and past maintenance problems. Dry weather overflows have essentially been eliminated through regular maintenance activity.

Regularly scheduled cleaning of over 25,000 storm water catch basins in the CSS result in the removal of over 600 tons/year of street debris and litter. This program reduces pollutant discharge from CSOs and prevents plugging and dry weather blockages in the sewer system.

For notification of overflows, LJ CMSD located signs at each CSO outfall to inform the public of the outfall and the reason for the outfall. The public is asked to call LJ CMSD customer service if a dry weather overflow is occurring. During extreme wet weather events, LJ CMSD purchases time on local radio stations to inform the public to stay out of the streams for safety reasons. LJ CMSD’s website (www.msdlouky.org) has additional information about CSOs and water quality.

Long Term Control Plan

LJ CMSD developed a flow-monitoring program in 1991 to characterize the CSS. Flow monitors were installed at 50 locations throughout the CSS. This information was used to develop and calibrate a SWMM model to simulate the combined system. Long-term quality samplers are located at 12 overflow locations. Permanent real-time flow monitors are in place in three locations and additional locations are planned as part of real-time control projects.

LJ CMSD has developed an LTCP as required by their NPDES permit and has been implementing the plan within five-year increments for which the LJ CMSD Board can commit funding. The plan is dynamic. It will continue to evolve and improve based upon new data (water quality impacts, land uses), new technology, and emerging regulations. The LTCP has been submitted to the State of Kentucky. LJ CMSD is working to implement the LTCP, although it has not yet been approved by the state.

The LTCP is based upon a mixture of the presumption and demonstration approaches described in the CSO Control Policy. The combined sewer area in Louisville is divided into three regions. CSO controls in Region 1 are based on the presumption approach, and CSO controls in Regions 2 and 3 are based on the demonstration approach. Region 1 discharges to streams, which in turn discharge to the Ohio River; Regions 2 and 3 discharge directly to the Ohio River.

LJ CMSD has prioritized activities outlined in its LTCP so that controls for overflows impacting sensitive areas are implemented first. One key effort has been to address overflows in the most upstream areas of Region 1 that are located in a public park. The location of these outfalls increases the risk of the public coming in contact with CSO discharges and therefore the control of these CSOs has been given a high priority.

Costs

To date, LJ CMSD has spent an estimated $25 million in implementing its LTCP. Full implementation will cost an estimated $210 million; this projection will be affected by the availability of funding for CSO control and the complexity of completing projects in fully urbanized areas.
LJCMSD is using its resources as efficiently as possible to implement the high priority control identified in its LTCP. The specific control measures outlined in the LTCP are continually reviewed in light of changing technology, improved understanding of the system, and the performance of controls that have been implemented. It should also be noted that LJCMSD has numerous programs that result in water quality improvements. LJCMSD attempts to allocate resources based on a combination of regulatory requirements, customer needs, and water quality benefits.

### Water Quality Issues

Based on extensive and ongoing watershed monitoring, LJCMSD believes that, because of the impacts of heavy urbanization, meeting current water quality standards in many local CSO receiving waters will be difficult. In fact, LJCMSD believes that when the LTCP is fully implemented, water quality standards will not be attained. For example, fecal coliform standards will still be exceeded about 30% of the time. Meeting current water quality standards will require an integrated effort that addresses not only CSO discharges, but also other point and non-point discharges (including storm water and sanitary sewer overflows). To help prioritize and address the many programs, LJCMSD is initiating a “Water Quality Tool” computer program that will work to predict the benefits of various projects in specific watersheds and compare them. This “Tool” is being developed by merging the computer models HSPF and SWMM.

### Enforcement Issues

LJCMSD has been aggressively addressing CSOs to improve water quality through O&M efforts as well as capital projects. Dry weather overflows have been virtually eliminated. Various capital projects to eliminate overflows have been completed along with two pilot projects to treat CSO discharges. The State of Kentucky has chosen, for now, to address CSO issues through the permitting program rather than through enforcement. Therefore, to date, no communities in Kentucky have been issued enforcement actions related to the development and implementation of CSO controls, as described in the CSO Control Policy.

### Results

A range of projects have been successfully implemented to date. LJCMSD has initiated in-line storage projects, separation projects, storage basin projects, and pilot CSO treatment projects. These pilot treatment projects are being reviewed by both Water Environment Research Foundation and NSF International.

In an effort to address one of the key issues of CSOs – human contact - LJCMSD has been installing backflow prevention devices in the basements of homes to eliminate sewer backup from surcharged combined sewers. This program has become a national model with 5,100 homes protected to date.

LJCMSD has developed a county-wide geographic information system (GIS) to catalogue and track all aspects of the sewer system (i.e., pipe length, pipe type, etc). Upgrades will include condition ratings and other sewer operation and maintenance information. Work order tracking for operation and maintenance activities has recently been implemented. These attributes are recorded and attached to the infrastructure assets within the GIS.

Visual representation of reductions in average CSO volume and frequency for LJCMSD Regions 1, 2, and 3 and a system-wide description of pollutant load reductions are provided in the accompanying graphs. These numbers reflect the effect of the system improvements and form the basis for measuring the achieved reductions in overflow volumes and frequencies for each region and the CSS as a whole.
Based on system improvements implemented between July 1993 and July 1999:

- Five CSOs have been eliminated through various projects, including separation.
- Average annual CSO volume has been reduced from 5,153 million gallons per year to 4,472 million gallons per year, a reduction of 681 million gallons per year, or 13 percent.
- The frequency of CSO discharges was reduced from 5,361 overflows per year to 3,898, representing an overall reduction of 27 percent.
- CSO loads of biological oxygen demand were decreased from 3.2 million pounds to 2.9 million pounds per year, an overall decrease of eight percent.
- CSO loads of total suspended solids were decreased from 7.2 million pounds to 6.5 million pounds per year, an overall decrease of 10 percent.

LTCP storage projects now under construction will provide further reductions in CSO frequency, volume, and pollutant loading. Based on a system assessment, LJCMSD has also begun implementation of a real-time control project that will result in additional reductions in the next five years.

References

The Massachusetts Water Resource Authority (MWRA) provides wastewater services to 43 communities, including the City of Boston and the surrounding metropolitan area. It owns and maintains 228 miles of interceptor sewers that receive wastewater from 5,400 miles of municipal sewers at over 1,800 separate connections.

As a result of a civil judicial action initiated by EPA, MWRA was required to implement secondary treatment and CSO controls. MWRA’s LTCP addresses 84 CSO outfalls permitted to MWRA or to the Boston Water and Sewer Commission, the City of Cambridge, the City of Chelsea or the City of Somerville (the “CSO communities”). Some of the outfalls have been closed through NMC and LTCP efforts completed to date. Flows at six of the outfalls presently receive screening, disinfection and dechlorination at five CSO treatment facilities owned and operated by MWRA. More than half of the CSO flow discharged to area waters passes through these five facilities.

**Background on Boston CSOs**

**Number of CSO Outfalls**
- 84 (originally)
- 63 (currently)

**Combined Sewer Service Area**
- 14 square miles

**Sewer Service Area**
- 407 square miles

**Wastewater Treatment Capacity**
- 1,270 mgd (primary)
- 540 (secondary)

**Receiving Water(s)**
- Charles River, Upper Mystic River, Alewife Brook

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**Controls**

- The current expanded treatment plant capacity is 540 mgd of secondary treatment and 1,270 mgd of primary treatment.
- Five CSO treatment facilities provide screening, disinfection, and dechlorination for more than half of CSO discharges.
- A network of 70 temporary and 200 permanent flow meters was used to assess system function and develop a collection system model.

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**Program Highlights**

- 21 of 84 CSO outfalls have been eliminated.
- 15 additional CSO outfalls will be eliminated when the CSO plan is fully implemented by 2008.
- It is estimated that CSO volume has been reduced from approximately 3,300 million gallons in 1988 to 850 million gallons in 2000.
- MWRA worked with the State of Massachusetts to collect data sufficient to support revision of water quality standards for segments of the Charles River and the Upper Mystic River and Alewife Brook.
MWRA’s CSS area covers 14 square miles, with a service population of 550,000 people. The separate sewer service area is 393 square miles, with a service population of about two million people. All wastewater flow is conveyed to the new Deer Island Wastewater Treatment Plant, which was upgraded in 1999 to expand capacity and provide secondary treatment.

The Deer Island Wastewater Treatment Plant has an average dry weather design flow of 480 mgd. It currently treats an average dry day flow of 330 mgd and an average daily flow (dry and wet days) of 375 mgd. The plant has a primary treatment capacity of 1,270 mgd and a secondary treatment capacity of 540 mgd. Flows that exceed 540 mgd are bypassed around secondary treatment, blended with primary and secondary effluent, and discharged through MWRA’s 9.5-mile ocean outfall.

**Status of Implementation**

In 1987, MWRA entered into a stipulation in the Federal Court Order in the Boston Harbor Case by which it assumed responsibility for development and implementation of an LTCP for its CSO outfalls, as well as outfalls owned and operated by its CSO communities. In December 1994, MWRA completed the Final CSO Conceptual Plan and System Master Plan (the “Conceptual Plan”), in which MWRA recommended short-term and long-term CSO control plans (MWRA, 1994). The LTCP was developed in the context of a system-wide master plan and in accordance with the new CSO Control Policy issued by EPA in April 1994. In addition to CSO control, the master planning process considered system improvement strategies that addressed transport capacity, treatment capacity, and infiltration/infow removal.

The Conceptual Plan recommended more than 100 system optimization projects that could be implemented immediately at relatively low cost to maximize wet weather conveyance and in-system storage in the short-term. For the long-term, it recommended 28 wastewater system improvements covering a range of CSO control technologies that targeted site-specific CSO impacts and site-specific water quality goals.

In August 1997, MWRA completed the Final CSO Facilities Plan and Environmental Impact Report (the “Facilities Plan”), which carried the Conceptual Plan projects through facilities planning and state environmental review processes, resulting in some plan changes (MWRA, 1997). The Facilities Plan recommended 25 projects to control CSO discharges to 14 receiving water segments.

For each of the projects in the plan, design, and construction milestones have been incorporated into the Federal Court schedule. To date, seven of the 25 projects are complete, and an additional 11 projects are in construction. All projects are to be completed by November 2008.

**System Characterization**

The key performance measures used by MWRA in developing the plan and monitoring achievement of plan goals are frequency and volume of CSO “in a typical rainfall year”. The typical rainfall year was developed by MWRA using 40 years of rainfall records and approved by EPA. MWRA conducted a metering and modeling program in 1992-1993 to support development of the LTCP. Meters were installed at more than 70 CSO outfall locations for a period of at least several months. MWRA also utilized data from more than 200 permanent flow meters it maintains throughout its collection system. MWRA conducts receiving water and sediment sampling to track water quality trends, including fecal coliform, enterococci, anthropogenic viruses and bacteriophage, chlorophyll, nutrients, DO, clarity, toxic contaminants and other parameters.

To meet long-term NPDES monitoring requirements, MWRA is evaluating hydraulic models and will select and build an appropriate model for future applications to assess system and facility optimization. When it becomes available, the new model will be used
to estimate CSO discharges for NPDES reporting purposes and to assess system performance as MWRA continues to implement the LTCP. Along with this new hydraulic model, the MWRA will implement permanent meters located in the collection pipes and at each of the CSO facilities, headworks and pumping stations. Temporary meters will be installed at or just upstream of CSO outfalls. Installation and collection of data from temporary meters will be scheduled on a rotating subsystem basis, with preference given to those outfalls for which the information is most critical (e.g., where a CSO control project has been completed and performance verification is desired). At CSO treatment facilities, the NPDES permit requires sampling and monitoring activities, and MWRA performs additional sampling and monitoring for routine operational control purposes. MWRA’s NPDES permit includes limits on bacteria, residual chlorine, toxicity and pH at CSO treatment facilities.

NMC

MWRA submitted its NMC compliance documentation on December 31, 1996. Dry weather overflows caused by capacity problems or other structural conditions were eliminated in the early 1990’s through a series of fast-track CSO projects. Control of dry weather overflows is now managed through field operations efforts, including frequent system inspections and routine and as-needed maintenance, to remove obstructions.

Public notification is provided through the posting of signs at every CSO outfall, and through a flagging system at beaches and in other high-use recreational areas, such as the Charles River.

LTCP

MWRA’s LTCP was developed using the demonstration approach. This included utilization of a watershed-based analysis to consider CSO and non-CSO sources and the potential for attainment of water quality standards in each of 14 receiving water segments in or as a tributary to Boston Harbor or Dorchester Bay. The contribution of CSO discharges to water quality degradation was evaluated in detail, and a baseline water quality assessment was performed in 1993-1994. The 1997 Facilities Plan became the primary source of information for a use attainability analysis (UAA) that was prepared by the Massachusetts Department of Environmental Protection (DEP) to support its approval of the CSO plan, including review and revision of water quality standards.

The CSO plan proposes elimination of CSO discharges to critical use areas (i.e. beaches and shellfish areas), significant reduction or treatment of discharges to less sensitive waters, and means to control floatable materials where CSO discharges will remain. All 25 projects in MWRA’s LTCP were approved by EPA and DEP in 1997-1998, and are included in the Federal Court Order in the Boston Harbor Case, with detailed design and construction milestones. However, MWRA is reevaluating several projects, which may result in significant project changes that will have to be approved. In addition, the level of CSO control for the Charles River and for the Upper Mystic River/Alewife Brook is under review, pursuant to water quality standards variances issued by DEP. Final water quality standards determinations are expected to be made at the end of the variance periods (currently October 2001 and March 2002).

As of May 2001, CSO discharges have been eliminated at 21 of the 84 outfalls. An additional 15 outfalls are scheduled to be closed to CSO discharges by 2008, when the CSO plan is fully implemented.

Costs

The capital cost for design and construction to implement the LTCP is estimated to be $548 million (in 2001 dollars). Approximately $110 million has been spent. Annual O&M cost for the CSS is estimated to be $2 million per year.
## Water Quality Issues

Implementation of the NMC has resulted in the elimination of dry weather overflows and a significant reduction in CSO discharges. The CSO reductions to date are primarily due to capital-intensive programs to increase conveyance capacity to the new Deer Island Treatment Plant, and to CSO system optimization plans that maximized in-system storage through weir raising and tide gate repair/replacement. Receiving water sampling programs show steady water quality improvement over the past decade.

Completion of MWRA’s LTCP is intended to bring CSO discharges into compliance with water quality standards. Final decisions on what those standards should be for the Charles River, Alewife Brook and Upper Mystic River will not be made until additional water quality information is collected and evaluated by MWRA and the DEP, pursuant to conditions in the water quality standards variances. In all receiving water segments, water quality standards may at times continue to be violated due to non-CSO sources (e.g., storm water) following full implementation of CSO controls in the LTCP.

## Enforcement Issues

Development and implementation of the LTCP are subject to detailed schedule milestones in the Federal Court Order in the Boston Harbor Case. MWRA’s recently renewed NPDES permit (Phase I CSO) also requires implementation of the plan. Phase II CSO requirements are expected to be added to the permit soon, and will require CSO discharges to meet the Facilities Plan CSO activation frequency and volume predictions, as the CSO plan is implemented.

## Results and Accomplishments

MWRA estimates that total annual volume of CSO discharge has been reduced from about 3.3 billion gallons in 1988 to about 850 million gallons today, primarily through improvements to its Deer Island Treatment Plant and transport system. Seven of the 25 CSO construction projects that make up the LTCP are complete, and 11 more are in construction. Full implementation of the LTCP is predicted to further reduce discharges to about 400 million gallons, with approximately 95% of the remaining CSO flows receiving screening, disinfection and dechlorination.

In addition to closing 21 of the 84 outfalls to date, MWRA has virtually eliminated residual chlorine in chlorinated effluent from its CSO treatment facilities, which process more than half of the approximately 850 million gallons of CSO presently discharged to metropolitan Boston waters in a typical year.

## References

Kubiak, David, Massachusetts Water Resource Authority, Boston, MA. Personal communication with Limno-Tech, Inc. staff on details of the combined sewer overflow plan and program. Summer 2001.


Muncie, IN—Region 5

Community Case Study

**Number of CSO Outfalls**
- 30 (originally)
- 24 (currently)

**Combined Sewer Service Area**
- 10.2 square miles

**Wastewater Treatment Capacity**
- 27 mgd (tertiary)

**Receiving Water(s)**
- White River, Buck Creek

Program Highlights

- CSO outfalls have been reduced from 30 to 24.
- Muncie has implemented the NMC.
- Muncie is working on a Use Attainability Analysis (UAA) to request a temporary suspension of designated uses during wet weather.
- Muncie recently completed a $5 million sewer separation projects in response to a 1985 enforcement action.

Controls

- Muncie's CSO abatement efforts have focused on sewer separation and treatment plant upgrades.
- Better O&M practices (e.g., sewer flushing and street sweeping) have improved system performance during wet weather.
- The presumption approach was used as the basis for development of the LTCP scheduled to be submitted to the state by November 2001.
- A SWMM model was used in system characterization and to evaluate the collection system/controls.

Photo: The White River, one of Muncie’s two CSO receiving waters. Courtesy of Nathan Bilger

Background on Muncie CSOs

The Muncie Sanitary District (MSD) provides sewer service to the City of Muncie, Indiana and to a number of developments outside the city. The Muncie Water Pollution Control Facility (WPCF) has a capacity of 27 mgd (Huyck, 2001). It is anticipated that the MSD service area will continue to grow. Two newly developed sewer systems in surrounding areas are expected to eventually discharge to the WPCF.

Status of Implementation

MSD prepared a Stream Reach Characterization & Evaluation Report (SRCER) in 1999 to meet a requirement of its NPDES permit (Amlin, 1999). The SRCER details the impacts of CSOs on the White River. MSD used a SWMM model to facilitate SRCER development and to evaluate its combined sewer system. Total inflow to the collection system, average annual pollutant loadings, and average annual discharge loadings were calculated from.
the SWMM model simulations. The SRCER also includes proposed controls for CSO abatement. SRCER recommendations were considered in the development of Muncie's LTCP, described below.

**Nine Minimum Controls**

MSD has implemented the NMC as described in EPA's 1994 CSO Control Policy. A CSO Operational Plan, required by the state, serves as a reporting mechanism for eight of the nine minimum controls. MSD Operational Plan was approved March 24, 2001. The SRCER, also required by the state, fulfills the monitoring requirement of the ninth minimum control.

MSD has collected water quality and biotic data from affected areas of the White River through baseline studies for the past 26 years. Results of the baseline studies are presented in the SRCER. While the data show dramatic improvement in the water quality in the White River through Muncie, as measured by both chemical and biological indices, improvements are not only due to CSO abatement efforts. Improvements in water quality likely reflect the composite of pollution abatement programs, including CSO control efforts, sewer cleaning, street sweeping, and public education. Currently, MSD is enumerating E. coli populations, on a weekly basis, above and below the MSD CSO outfalls known to potentially affect the water quality of the West Fork of the White River.

MSD has not experienced dry weather overflows. As part of its maintenance program, MSD has recently purchased two new jet-vactor trucks and one new street sweeper. Two sweepers are used five days per week, weather permitting. The jet-vactor trucks clean sewers and manholes on a continuous basis, five days per week.

MSD public notification activities include public meetings and sign placement near the CSO outfalls. Recently, MSD and the Citizen's CSO Advisory Committee held two meetings regarding the LTCP. MSD has prepared warning signs to be placed at selected CSO outfalls to warn citizens about possible health hazards as a result of CSO discharges. The signs direct observers to call MSD if they witness dry weather overflows. Brochures describing the LTCP have been prepared, and MSD plans to distribute them when the LTCP has been finalized. In addition, MSD plans to use its web site to explain CSOs and intends to develop a video for public information and education.

To date, sewer separation and treatment plant upgrades have been important components of MSD's CSO abatement efforts. In addition, MSD has improved the operation of the existing combined system with more extensive O&M practices (e.g., street sweeping and sewer cleaning).

**Long Term Control Plan**

MSD is using the presumption approach in developing its LTCP. Under the terms and conditions of its NPDES permit, MSD must submit an LTCP by November 2001. As stated above, information obtained from SRCER and SWMM model is being used to develop the city's LTCP. MSD is currently in the process of selecting the CSO abatement alternatives for its LTCP.

Muncie's draft LTCP gives priority to eliminating discharges to sensitive areas. Public input is also an important component of the LTCP and is required by EPA and Indiana Department of Environmental Management (IDEM). A subcommittee of the Muncie Citizens CSO Advisory Committee has been established to determine those areas along the White River considered to be the most sensitive (e.g., parks, schools, and places of public use). CSOs that discharge to sensitive areas will be eliminated, relocated, or treated.

**Costs and Financing**

MSD has spent over $5 million on sewer separation over the past 10 years. Currently, MSD is spending $15.5 million for improvement and renovations to its WPCF to provide better treatment of sewage and combined sewage. Upon approval of the LTCP by IDEM,
additional funds will be appropriated for improvements to the WPCF, the conveyance system, and storage facilities. MSD has spent in excess of $200,000 in engineering fees for SWMM modeling, and $550,000 has been spent for two new jet-vactor trucks and a new street sweeper. MSD spends approximately $340,000 per year to keep the jet-vactor trucks and street sweepers operating continuously five days per week.

MSD is currently in the process of selecting cost-effective CSO abatement alternatives for its LTCP. Eight CSO control alternatives under consideration are described in the table below. The impact of local sewage rate increases are considered by MSD when evaluating alternatives and implementation schedule. MSD is working on the financial capability assessment that is required by IDEM when scheduling CSO control projects. The State Revolving Loan program is an important funding source for CSO control projects.

<table>
<thead>
<tr>
<th>Alternative (MG/year)</th>
<th>CSO Volume (lbs/year)</th>
<th>CBOD Load Days/Year</th>
<th>Overflow</th>
<th>Cost</th>
<th>Description of Alternative</th>
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<tr>
<td>1</td>
<td>434</td>
<td>78,328</td>
<td>113</td>
<td>$0</td>
<td>&quot;No Action&quot;</td>
</tr>
<tr>
<td>2</td>
<td>358</td>
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<td>42</td>
<td>$22,176,000</td>
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<tr>
<td>4</td>
<td>286</td>
<td>52,524</td>
<td>113</td>
<td>$6,027,000</td>
<td>Increased pumping and WPCF primary treatment</td>
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<tr>
<td>5</td>
<td>41</td>
<td>6,315</td>
<td>42</td>
<td>$15,687,000</td>
<td>25 MG storage basin, increased pumping, WPCF treatment, and in-system storage</td>
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<tr>
<td>5a</td>
<td>27</td>
<td>5,173</td>
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<td>0</td>
<td>0.4</td>
<td>$45,410,400</td>
<td>Complete sewer separation</td>
</tr>
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</table>

An evaluation of modeling results and monitoring data indicates that the presumptive criteria for the LTCP can be met through the implementation of Alternative 5a at a cost of $19.8 million (in 2000 dollars). Alternative 5a involves a combination of CSO controls including a 25 million gallon storage basin, increased pumping and WPCF treatment, in-system storage, and sewer separation. It is the most cost-effective solution for the MSD CSO control plan, as shown on the "knee-of-the-curve" graph below.
Affordability constraints make the elimination of all CSOs (e.g., Alternative 7) unfeasible. Elimination of all CSOs is estimated to cost $45-65 million. IDEM has not approved any of the CSO abatement alternatives considered by MSD for its LTCP, including Alternative 5a. MSD is scheduled to submit its LTCP in November 2001 for state review.

One of the greatest needs for MSD is the replacement of some of the sewer infrastructure. Many of the sewers are approaching 100 years in age and need to be replaced or restored. For example, the main interceptor from the downtown area to the WPCF is 100 years old. It needs to be completely lined and structurally repaired. The preliminary estimate for this repair work is approximately $2 million, and is included in the cost-effective alternative for CSO reduction.

### Water Quality Issues

MSD believes that the implementation of the NMC has reduced the frequency and duration of overflows over the past several years, primarily through sewer cleaning activities. However, data is not available to document the reductions.

The MSD stream monitoring program has found that non-CSO sources of pollution greatly affect the White River. Consequently, MSD believes that compliance with existing water quality standards will not be achieved even if all CSOs are eliminated. MSD is working on an IDEM required Use Attainability Analysis (UAA) to support a request for a temporary suspension of designated uses during wet weather.

### Enforcement Issues

In 1985, IDEM issued an Agreed Order to MSD as a result of a fish kill in the White River, attributed to pollutant levels from a “first flush” of the CSOs. The $5 million sewer separation project, mentioned above, was completed as a result of the Agreed Order. Since 1985, no fish kills attributable to MSD CSO discharges have occurred.

### Results

MSD has spent $5 million on sewer separation projects. MSD has also improved O&M practices within the collection system (e.g., street sweeping five days per week). In addition, upgrades are being made to the WPCF to increase the treatment efficiency at the plant. MSD has eliminated six CSOs to date.

MSD applied a SWMM model to evaluate its collection system and to investigate impacts of its CSOs on the White River. A SRCER was produced to document model findings, describe monitoring efforts in the White River, and present recommendations for future CSO abatement efforts. MSD is currently in the process of developing its LTCP and the SRCER has been instrumental in this process. The ultimate goals of the MSD LTCP are as follows:

- Capture “first flush” of the CSOs.
- Remove solids and floatables.
- Decrease bacterial levels.
- Reduce discharges to the minimum level affordable.
- Eliminate CSOs to sensitive areas.

Huyck, Richard, Director, Bureau of Water Quality, Muncie Sanitary District. Personal communication with Limno-Tech, Inc. staff on details of CSO system and CSO control planning in Muncie, and review of case study, Spring/Summer 2001.
Background on North Bergen CSOs

The township of North Bergen, New Jersey has a population of approximately 48,000. North Bergen is served by a CSS that covers 1,130 acres. The North Bergen Municipal Utilities Authority (NBMUA) is responsible for all CSOs and control systems within the township. Two wastewater treatment plants service the township. The Central Treatment Plant services the West Side of North Bergen and lies within the Hackensack River drainage basin. The Woodcliff Treatment Plant services the East Side of North Bergen and lies within the Hudson River drainage basin.

There are currently 10 CSO outfalls in the North Bergen CSS that are regulated by 36 flow control chambers. Six of the flow control chambers have mechanical regulators which limit the flow to the interceptor by means of a sluice gate and a float mechanism. The other 30 chambers use static control devices such as weirs, baffles, or orifices to control flow to the interceptor and allow excess overflow to the CSO outfalls.
NBMUA’s control plan has focused on solids and floatables control (Fischer, 2001). Solids and floatables controls have been installed at all CSO outfalls to capture half-inch in diameter and larger materials. Nine CSO outfall pipes have been retrofitted with netting technology, and one CSO outfall uses a stationary bar rack for floatables control. The start-up date for the entire CSO control system was December 17, 1999.

Other infrastructure improvements made by NBMUA as part of their efforts to control CSOs include installation of a new vortex valve regulator upstream of an existing pump station, and installation of a separate 48-inch combined sewer outfall pipe that eliminated the older systems which combined the plant outfall and the CSO.

System Characterization

NBMUA completed a Combined Sewer Overflow Characterization Study in 1997 (Killam, 1997). NBMUA plans to conduct additional flow and water quality monitoring as part of its CSO control plan. The monitoring information will be used to develop a SWMM/EXTRAN model of the CSS. The monitoring and modeling plan is currently under review by NJ DEP.

Nine Minimum Controls

NBMUA has implemented the minimum controls required by their NPDES permit, including:

- Prohibition of dry weather overflows
- Solids and floatables control
- Development and implementation of proper operation and maintenance (O&M) programs
- Maximization of flow to the publicly owner treatment works (POTW)
- Public notification/reporting requirements

Long Term Control Plan

The control plan adopted by NBMUA focuses on the control of solids and floatables. Cost estimates have been computed for disinfection at outfalls that may be added at a future date. Full LTCP development is incorporated into the ongoing statewide watershed management and TMDL processes.

Costs and Financing

The $3.9 million solids and floatables project was funded through a low interest loan provided by the NJ DEP and the New Jersey Environmental Infrastructure Trust (NJEIT). By using the NJ DEP/NJEIT loan, the NBMUA saved the users of the system nearly $1.5 million compared to conventional financing. Cost estimates to add disinfection with ultraviolet lamps have been performed as part of the planning process. Disinfection at nine CSO outfalls is expected to cost approximately $24.2 million.

Budget tracking for CSO-related O&M has been set up, but sufficient data is not yet available to estimate annual O&M costs. O&M primarily consists of changing out the netting bags and disposing of the collected solids. Nets are changed out approximately once per month at each of the sites.

Enforcement Issues

In September 1993, NJ DEP issued an Administrative Order citing NBMUA for failing to meet the CSO permit discharge requirements. In January 1996, NBMUA entered into an Administrative Consent Order to submit, among other things, an Interim/Final Solids and
Floatables Control Plan. The Interim/Final Solids and Floatables Control Plan was approved by NJDEP in July 1996 and involved reducing the number of CSO outlets from 13 to 10 and installing solids and floatables netting devices at each of the CSOs (EPA, 2001).

Results

Since installing the netting systems in 1999, the solid and floatables control facilities have captured more than 68 tons of debris that would have been deposited in the Hudson River and various tributaries of the Hackensack River. It is estimated that over 40 tons of solids will be removed per year through implementation of the Solids and Floatables Control Plan. The tracking of the debris captured is a measure that is well understood by the public.

Lack of historical operating information on the technology was a hurdle for this project. At the time of the planning study, netting technology in in-line chambers had not been installed or operated as a solid and floatable collection technique anywhere in the United States. NBMUA now has extensive experience operating solids and floatables control facilities and can provide other CSO communities with construction and operational information needed to make decisions utilizing netting technology for CSO solids and floatables control.

References


Fischer, Robert, Executive Director, North Bergen Municipal Utilities Authority. Personal communication with Limno-Tech, Inc. staff on details of the combined sewer overflow plan and program. Summer 2001.
### Community Case Study

**Randolph, VT—Region 1**

#### Number of CSO Outfalls
- 6 (originally)
- 3 (currently)

#### Combined Sewer Service Area
- Undetermined

#### Wastewater Treatment Capacity
- 0.4 mgd (secondary)

#### Receiving Water(s)
- White River

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### Controls

- Randolph has implemented the six minimum controls required in its NPDES permit.
- Sewer separation has been the principal CSO control implemented. Randolph has disconnected 44 of its 52 catch basins from the CSS.
- Randolph is planning to upgrade its wastewater treatment plant (WWTP) as part of the next phase of its CSO control efforts.

*Photo: Three branches of the White River flow through Randolph. Gifford Bridge, shown, is located on the Second Branch. Courtesy of Tom Hildreth*

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### Program Highlights

- CSO outfalls have been reduced from six to three through sewer separation.
- Sewer separation has reduced the duration of overflows at the WWTP by 80 percent.
- The target date for completing implementation of CSO controls is 2006.
- A February 2001 Administrative Order requires Randolph to implement a sampling protocol and monitoring for its three remaining outfalls.

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### Background on Randolph CSOs

Randolph has a population of 2,270 and is located in the Green Mountains in central Vermont, approximately 27 miles from the state capital Montpelier. The exact size of the combined sewer system is small but undetermined, and centered in the older downtown area.

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### Status of Implementation

Randolph has completed sewer separation projects in three stages. The main CSO abatement project was completed in 1996, when 44 of 52 catch basins were separated from the collection system in the village area. New storm water collection systems were also constructed throughout much of downtown Randolph and adjacent residential areas at this time. More work was completed in 1997 and 1999 when an additional six catch basins were separated. At the present time, it is estimated that three catch basins...
remain connected to the sanitary system. No monitoring to assess the effectiveness of the work completed is available. At the direction of the State of Vermont, Randolph is undertaking an eight-month study to determine the effectiveness of CSO efforts implemented to date, and to determine if additional work may be required.

**Nine Minimum Controls**

The State of Vermont has not required CSO communities to implement all of the NMC as part of their NPDES permits. Nonetheless, on a community-specific basis, the state has required that systems employ a series of BMPs. As required by their permit Randolph has documented implementation of the following BMPs:

- Proper O&M programs for the sewer system and the CSOs
- Maximum use of the collection system for storage
- Maximization of flow to the POTW for treatment
- Prohibition of CSOs during dry weather
- Pollution prevention
- Monitoring

**Long-Term Control Plan**

The State of Vermont does not require CSO communities to submit formal documentation for its long-term CSO control plans. Instead, communities are required to submit engineering reports to outline their CSO abatement plan and funding needs. On February 3, 1993, Randolph submitted the final engineering report of the "Evaluation of Combined Sewer Overflows for Randolph" to the state. This report was approved on November 19, 1993. To date, sewer separation has been the principal focus of the town's abatement efforts to eliminate CSOs.

The State of Vermont uses a design storm approach to CSO elimination. In Vermont, communities that opted for sewer separation were required to be able to capture and provide full treatment for a minimum design flow generated by a 24-hour, 2.5 inch rainfall.

Randolph completed their initial control plan in November 1996. Upon further investigation, it was determined that the completed sewer separation projects were not fully successful in controlling CSOs. Bypasses still occurred at the WWTP during rain events. Further data was needed to evaluate the town's CSO abatement program, and to plan future abatement projects. The CSO control plan was reopened, and the target date for implementing the revised control plan is 2006.

**Costs**

Preliminary engineering and design work for Randolph’s CSO abatement program took place between 1991 and 1994. This work was funded through a state planning advance program, and costs were approximately $0.25 million. As of 1997, approximately $2.66 million had been spent for Randolph’s main CSO abatement program and development of its first LTCP. Funding was provided through state grants (25 percent), through state revolving loans (50 percent), and from Randolph (25 percent).

A capital plan has been proposed for the next stage of the CSO abatement program. Randolph requested wastewater revolving loan funds on August 8, 2000 to upgrade the WWTP and to address inflow and infiltration issues and other CSO control needs. The plan, which includes infrastructure repairs and sewer separation, spans six years (2001-2006), and has a projected cost of $1.12 million. Approximately $0.5 million is related to CSO control. The planned projects include sewer line replacement and upgrades, collapsed and failing manholes replacement and reconstruction, and continued sewer separation.
Enforcement Issues

Although Randolph has reduced CSOs events through sewer separation projects, overflows still occur. Randolph experienced 17 overflows at the WWTP in the year 2000. For this reason, the state issued an Administrative Order (1272 Order #3-1198) to Randolph, dated February 8, 2001. This Administrative Order requires Randolph to develop a CSO monitoring plan/sampling protocol for its three existing CSO outfalls (Kooiker, 2001).

The Administrative Order requires Randolph to obtain composite samples of the combined discharge from the WWTP during eight CSO events between March 1 and September 30, 2001. The composite samples will be analyzed for biochemical oxygen demand, total suspended solids, and E. coli. to determine compliance with the permitted discharge effluent limits. The other two CSO outfalls are also being monitored for overflow events using “tattle-tale” blocks, or block testing. Blocks of wood will be placed inside the overflow or pump station lines. Movement of disappearance of a block following a precipitation event indicates that an overflow has occurred. A rain gage is being used to document the cumulative rainfall amount, rainfall intensity, and rainfall duration so that local precipitation events can be quantified and related to sewer system performance.

The data collected from implementation of this monitoring plan will provide guidance on remaining CSO control needs and help Randolph identify the best course of action for future CSO abatement efforts. A CSO abatement program effectiveness report will be submitted to the state (due September 30, 2001) to fulfill the requirements set forth in the Administrative Order.

Results

Three CSO outfalls have been eliminated since Randolph initiated its CSO abatement program. Only three known catch basins remain connected to the sanitary sewers as a result of Randolph’s sewer separation efforts. An 80 percent reduction in the duration of CSOs has been observed at the WWTP. This reduction is based upon a comparison of data collected from a recent 20-month period (1/1999-8/2000) with data collected prior to the main CSO abatement project. Overflow (bypass) data at the Randolph WWTP are provided in the accompanying graph. (Note: 1999 was a very dry year and 2000 was a very wet year.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Bypass History at Randolph WWTP (hours per year)</th>
</tr>
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<tbody>
<tr>
<td>1994</td>
<td>510</td>
</tr>
<tr>
<td>1995</td>
<td>435</td>
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<td>227</td>
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<tr>
<td>1998</td>
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<tr>
<td>1999</td>
<td>40</td>
</tr>
<tr>
<td>2000</td>
<td>98</td>
</tr>
</tbody>
</table>

(Note: 1999 was a very dry year and 2000 was a very wet year.)
References


Community Case Study  Richmond, VA— Region 3

Number of CSO Outfalls
31, plus 1 diffuser port in the James River

Combined Sewer Service Area
18.8 square miles

Wastewater Treatment Capacity
75 mgd (secondary)

Receiving Water(s)
James River, Gillies Creek

Richmond, VA—Region 3

Background on Richmond CSOs
Richmond is the capital of Virginia and it is centrally located in the state. The population of Richmond is approximately 210,000, and the city spreads out over 38,000 acres. The CSS is owned and operated by the Department of Public Utilities (DPU), and it occupies 12,000 acres, or one-third of the city. The DPU also owns and operates a 75 mgd wastewater treatment plant (WWTP). The James River bisects the city and is the center of transportation and recreation activities. The Falls of the James area is an important recreational resource and a component of the Virginia scenic river system. It consists of sets of rapids and pools and adjacent parkland that provide substantial habitat and attract whitewater enthusiasts. There are 31 CSO outfalls within Richmond that discharge to the James River or local urban creeks. The Shockoe Creek CSO is the largest, with a drainage area of over 6,000 acres. It discharges to the tidal James River, just below the Falls of the James.

Richmond has been actively implementing CSO controls for over 20 years in a three-phase program. Phase I was completed in 1990 and Phase II will be completed in 2002.

Program Highlights
● Richmond submitted a Draft Long-Term CSO Control Plan Re-Evaluation in May 2001 to the DEQ.
● LTCP Phase I and II controls have reduced overflow volumes by 40 percent.
● LTCP Phase I and II controls provide an additional 131 days per year in which water quality in the James River meets water quality standards, beyond the “no CSO control” condition.
● Restoration of the city's historic canal system occurred as Phase II CSO interceptors were placed in an abandoned canal bed. Restoration of the canal was a centerpiece of a major downtown revitalization project.
● Sampling to support Phase III controls indicates that upstream bacteria loads will prevent attainment of water quality standards even if CSOs were completely eliminated.

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The plan for Phase III was submitted to the Virginia DEQ as a Draft Long Term CSO Control Plan Re-Evaluation in May of 2001 (City of Richmond, 2001).

### Status of Implementation

Richmond began addressing CSO problems back in the 1970s. Early studies including monitoring and modeling led to the Phase I program. Completed in 1990, the major components of Phase I were construction of the 50 million gallon Shockoe Retention Facility and expansion of WWTP capacity from 45 to 70 mgd.

Phase II controls were planned in the late 1980s and implemented in the 1990s. Phase II was focused on reducing CSO discharges to the Falls of the James. The major components of Phase II included expansion of conveyance facilities on the south side of the James River, expansion of conveyance facilities on the north side of the James River, and construction of a 6.7 million gallon storage tunnel on the north side (scheduled to commence operation in late 2001). Another aspect of Phase II was a requirement to re-evaluate the CSO control plan following implementation and develop a Phase III plan.

### System Characterization

Richmond has engaged in characterization monitoring and modeling activities for nearly 20 years. Key activities include:

- Mapping the combined sewer area to characterize land use and surface features in each drainage area.
- Review of construction documents for collection system to determine sewer diameter, length, and slope.
- Implementation of collection system and receiving water monitoring programs.
- Development and application of collection system and receiving water models.

### Nine Minimum Controls

Richmond has identified and implemented control measures under each of the NMC. Documentation was submitted to DEQ in December 1996 (City of Richmond, 1996) and has been followed by annual reports on continued compliance. Highlights of the NMC program include:

- Adjustment of CSO regulator controls to optimize storage in interceptor system.
- Formation of a 24-hour on-call team to respond to reported dry weather overflows.
- On-going public education programs, including offering advice on proper disposal of waste (e.g., household wastes, leaves, use of fertilizers).
- Continued use of BMPs to control pollutants from runoff.
- Installation of continuous flow monitors and wet weather overflow samplers at the Shockoe CSO to monitor frequency and volume, with annual reports provided to DEQ.

### Long Term Control Plan

Richmond has been developing and refining its LTCP for over two decades. The continuing objective is to abate or eliminate the adverse impacts to the James River from CSOs through the use of innovative and low maintenance solutions.

Richmond developed a thorough characterization of its CSS through extensive inspections, monitoring, and modeling. Monitoring programs have been implemented to quantify:

- Flow and pollutant concentrations at the Shockoe CSO outfall and other select outfalls within the CSS.
- Storage in the Shockoe Retention Facility.
Water quality conditions in the James River above the CSO discharges, through the Falls of the James area, and along a 20-mile area below Richmond.

Richmond also developed computer models of the collection system and CSO-impacted waters for use in the analysis of CSS performance, receiving water impacts, and the evaluation of control alternatives. Monitoring data was used to calibrate and verify the models.

A full range of CSO control alternatives were evaluated as part of the LTCP development. This evaluation included:

- Sewer separation
- In-system storage
- Disinfection
- High-rate filtration
- Retention basins
- Swirl concentrators
- Sedimentation basins
- Screening
- Additional conveyance capacity
- BMPs and source control
- Expansion of the WWTP

The selection of a preferred plan for Phase III involved analysis of CSO volume and frequency, water quality, financial impacts, and public input. The preferred plan builds on projects completed under Phases I and II. The components of the plan for Phase III included:

- Expansion of the Shockoe Retention Facility
- Expansion of wet weather treatment capacity at the WWTP
- Disinfection at key outfalls
- Control of solids and floatables at remaining outfalls

**Costs and Financing**

Richmond has used a variety of funding sources including bonds, low-interest loans from the state, and federal grants to underwrite the cost of constructing, operating and maintaining CSO control facilities. To date, the city has spent nearly $221 million on capital improvements in the CSS and invests another $6.7 million annually on CSO-related operations and maintenance activities. The city estimates that implementation of the Phase III controls will cost an additional $242 million.

**Water Quality Issues**

The implementation of Phases I and II of the city's CSO control program have significantly improved aesthetics and water quality in the James River. Specifically, water quality modeling indicates that these controls provide an additional 131 days per year in which water quality in the James River meets water quality standards, beyond the no CSO control condition. Receiving water modeling results from the Phase III re-evaluation indicates that the upstream bacteria loads will prevent full attainment of the current water quality standards even if the city completely eliminates CSO discharges.
Enforcement Issues

Richmond signed a Special Order with the Virginia DEQ in 1985 that required the city to develop and implement a CSO control program. In 1992, the State Water Control Board issued a consent Special Order requiring implementation of additional controls identified in Phase II of the city's CSO program. Then, in 1996, the DEQ amended the Special Order to accelerate the north side CSO control projects. DEQ issued a consent Special Order to the City in 1999, which advanced the schedule for the re-evaluation of the CSO program in the context of EPA's CSO Control Policy. A draft plan describing the proposed Phase III controls was submitted to the state in May 2001. The city also submits annual detailed reports to the state to allow the state to monitor and verify compliance with the Order.

Results

Richmond has realized many benefits from its CSO control program. The city has reduced overflow volume to the James River by more than 40 percent, from 3 billion gallons per year to 1.8 billion gallons per year. Further, overflows to the sensitive park areas along the James River have been reduced to an average of one event per year. All of the overflows remaining in the park areas now receive local treatment to control solids and floatables prior to discharge to the river. In addition to storage, the Shockoe Retention Facility provides floatables control for more than two-thirds of all overflows.

Richmond's CSO projects have also provided tangential benefits including the restoration of the City's historic canal system as Phase II CSO interceptors were placed in the abandoned canal bed. The restored canal has become a focus for commercial and recreational activities.

Richmond's efforts to control CSOs were recognized in 1999 as the city received a National Combined Sewer Overflows Control Program Excellence Award from EPA. In addition, the Richmond CSO Control Program has received awards and recognition from local environmental and stakeholder groups and from users of the James River.

References


City of Richmond, Virginia. 2001. Draft Long-Term CSO Control Plan Re-evaluation. Submitted to Virginia Department of Environmental Quality, Richmond, VA.
Community Case Study

Rouge River Watershed, MI—Region 5

Number of CSO Outfalls
168

Combined Sewer Service Area
93 square miles

Wastewater Treatment Capacity
1,700 mgd (primary)
930 mgd (secondary)

Receiving Water(s)
Rouge River and tributaries

Program Highlights

● The Rouge River National Wet Weather Demonstration Project coordinates CSO implementation in 16 CSO communities in conjunction with other non-CSO restoration efforts on a watershed basis.

● About 30 miles of the Rouge River that were CSO-impacted in 1994 are now completely free of uncontrolled CSO discharges.

● The amount of combined sewage captured for treatment has increased due to construction of CSO retention treatment basins.

● Untreated overflows in excess of 50 times per year have been reduced to treated overflows occurring one to seven times per year where retention treatment basins have been implemented.

● Monitoring indicates improved dissolved oxygen conditions associated with the implementation of CSO controls in the Rouge River.

Background on Rouge River Watershed CSOs

The Rouge River Watershed occupies 438 square miles in southeastern Michigan. The south and east portions of the watershed are highly urbanized and include parts of Detroit and its suburbs. The Rouge River Watershed is home to approximately 1.5 million people spread across 48 communities and 3 counties. The Rouge River itself extends for more than 100 miles, with 50 miles flowing through accessible public parklands. The Rouge River discharges to the Detroit River and affects water quality conditions in that water body as well as Lake Erie. Congress appropriated money through EPA and Wayne County, Michigan in 1992 for the Rouge River National Wet Weather Demonstration Project (Rouge Project). The Rouge Project is a comprehensive program to manage wet weather pollution to restore the water quality of the Rouge River. This cooperative watershed management effort between federal, state and local agencies is supported by multi-year grants from the federal government with additional funding from local communities.

Controls

● CSO control activities in the Rouge River Watershed are focused on sewer separation and construction of local retention treatment basins.

● The NMC have been implemented for all uncontrolled CSOs for which the construction of permanent control facilities is not imminent.

● Under its NMC program the City of Detroit installed outfall control gates at seven CSOs to eliminate CSO discharges during small events.

● A total of 10 retention treatment basins and one tunnel represent the major new CSO facilities that are planned, under construction, or in operation.
As of 1994, there were a total of 168 permitted CSOs discharging into the Rouge River and its tributaries. These outfalls, owned and operated by Wayne County, the City of Detroit, and 14 other CSO communities, are concentrated in the lower portions of the watershed. Several of the permitted outfalls are reported to be overflow structures which discharge to interceptors, which then discharge into the Rouge River or one of its tributaries. There are 40 CSO outfalls that discharge to the Detroit River that are not included in the Rouge River case study. The combined sewer area comprised 20 percent of the watershed in 1994, or 60,000 acres. All dry weather flows and some wet weather flows from these CSOs are delivered to the Detroit POTW along with other flows from outside the watershed. The Detroit POTW has a primary treatment capacity of 1,700 mgd and a secondary treatment capacity of 930 mgd.

### Status of Implementation

Michigan’s equivalent to the NMC has been implemented for all uncontrolled CSOs for which the construction of permanent control facilities is not imminent. The most significant NMC capital expenditure was the construction of outfall control gates at seven combined sewer outfalls in the Rouge River watershed owned by the City of Detroit. During wet weather events, these gates have eliminated CSO discharges during small rain events by maximizing the use of in-system storage. Other measures have not required significant capital expenditures.

Each CSO community with uncontrolled CSOs has taken measures to prevent the occurrence of dry weather overflows. Each CSO community reports CSO discharges to the Michigan Department of Environmental Quality (MDEQ), which provides public notification by posting the reported information on a website. State law also requires CSO permittees to self-report to downstream communities and one major local newspaper.

LTCPs are implemented in three phases as established through NPDES permits:

- **Phase I**— elimination of raw sewage and the protection of public health for approximately 40 percent of the combined sewer area.
- **Phase II**— elimination of raw sewage and the protection of public health for the remaining combined sewer area.
- **Phase III**— meet water quality standards in the Rouge River.

Under Phase I, six communities separated their sewers and nine communities constructed a total of 10 retention treatment basins. Each of these retention treatment basins is sized for different design storms, and several employ innovative technologies. These facilities also incorporate a variety of additional features or variations in compartment sizing and sequencing in order to improve their effectiveness. The retention treatment basins capture most wet weather flows for later conveyance to the Detroit POTW for treatment. Flows from very large wet weather events that are not captured by the retention treatment basins receive screening, skimming, settling, and disinfection prior to discharge. These projects have effectively eliminated or controlled the discharge of untreated sewage from approximately half of the watershed’s CSOs.

Working with the CSO communities, MDEQ established rigorous “Criteria for Success in CSO Treatment” to evaluate whether the CSO basins met the Phase I goals of elimination of raw sewage discharges and protection of public health. MDEQ established a work group that included state personnel, CSO permittees and consultants to assess the evaluation process.

A detailed evaluation study of the CSO retention treatment basins constructed thus far is underway to examine the performance of the facilities and the water quality impacts of their discharges. Basin influent and effluent flow and water quality are monitored for at least two years at each facility. In addition, river monitoring is performed to identify
benefits associated with CSO control. The results of the evaluation study, coupled with efforts to control storm water and other pollution sources in the watershed, will provide the basis for the Phase II and Phase III CSO control program to address the remaining water quality issues. The information gained from the evaluation of design storms and control technologies will also be useful nationwide in determining cost effective CSO controls to meet water quality standards.

It is important to note that MDEQ has concluded that all six of the CSO treatment facilities that have completed data collection are currently meeting the Phase I criteria of the elimination of raw sewage and the protection of public health. In addition, the first three CSO basins evaluated are achieving the Phase III goal of meeting water quality standards at times of discharge, except for meeting the yet-to-be-evaluated total residual chlorine standard.

**Costs and Financing**

CSO-related capital expenditures are funded by a combination of federal and local funding sources, with some communities using state revolving loan funds. Local funding is being generated by sewer rate increases, or issuance of general obligation bonds that are repaid through property taxes. Capital expenditures for Phase I CSO projects in the watershed total about $350 million, with another $5 million spent annually on CSO-related O&M. Another $1.3 billion of capital expenditure is needed to complete implementation of LTCP facilities in the watershed, along with $15 million annually for additional CSO-related O&M.

**Water Quality Issues**

Before implementation of CSO controls began in 1994, excursions of the water quality standards for dissolved oxygen and bacteria occurred frequently in CSO-impacted reaches of the Rouge River and its tributaries. Evidence of raw sewage was visible in the river during wet weather events, and visible on river bank vegetation and woody debris after events. Implementation of the NMC, the Phase I CSO control projects, and other watershed management measures has resulted in significant improvement in river conditions. In river reaches now free of uncontrolled CSOs, exceedances of the dissolved oxygen standard have been almost eliminated, the amount of bacteria in the river during wet weather events has been greatly reduced, and visible evidence of raw sewage has been eliminated. However, completion of the LTCP will not result in complete compliance with water quality standards due to other pollution sources within the watershed.

**Enforcement Issues**

Several enforcement actions have been taken by MDEQ relative to the Phase I CSO control projects:

- One project was aborted due to construction problems, and MDEQ issued an administrative consent order requiring the community to complete a revised CSO control project. This project is currently under design.

- One project is not yet complete due to construction delays and an enforcement action was initiated to ensure its timely completion.

- An amended federal consent judgment was issued in part for the failure to complete three projects on schedule. These projects are now complete and operational.
Some of the key results and accomplishments of the Rouge Project are as follows:

- About 30 miles of the Rouge River that were CSO-impacted in 1994 are now completely free of uncontrolled CSO discharges.

- Two years of performance monitoring data for the first six CSO basins shows the following:
  
  - About 72 percent (933 million gallons) of the combined sewage that previously went to the river was captured and treated at the Detroit POTW.
  
  - Untreated overflows in excess of 50 times per year have been reduced to treated overflows occurring one to seven times per year.
  
  - Even in areas with remaining uncontrolled CSOs upstream, continuous dissolved oxygen data are showing dramatic improvements in river conditions due to upstream CSO control projects and other watershed management measures/changes.

As shown in the figure below, on the Main Rouge River (Military Road monitoring station) the percent of continuous dissolved oxygen levels meeting or exceeding water quality standards increased from less than 60 percent in 1998 to 95 percent in 2000. On the Lower Rouge River (Plymouth Road monitoring station) the percent of continuous dissolved oxygen levels at or above water quality standards increased from less than 30 percent in 1994 to 96 percent in 2000 (see figure, below).
Work groups have reached consensus with MDEQ that the first six CSO retention treatment basins evaluated are meeting MDEQ-defined criteria for protecting public health and eliminating raw sewage. Additionally, work groups have reached consensus with MDEQ that the first three CSO basins evaluated are achieving MDEQ-defined criteria for achieving water quality standards at times of discharge, except for meeting the yet-to-be-evaluated total residual chlorine standard.

In addition to the above, the aesthetics of the Rouge River and its tributaries are greatly improved, and there is evidence of aquatic habitat improvement. Recreational use of the Rouge River is increasing.

References


Rouge River Project Web Site (http://www.wcdoe.org/rougeriver/).
Background on Saginaw CSOs

The City of Saginaw is located in the east central portion of Michigan's lower peninsula. The city lies within the Saginaw River Watershed, and the river runs through the city for approximately five miles. The Saginaw River flows 15 miles northward from the City of Saginaw into Saginaw Bay, in the southeastern section of Lake Huron. Saginaw Bay is widely used for fishing, boating and recreation. Both the Saginaw River and Saginaw Bay have been defined as two of 42 “areas of concern” by the International Joint Commission on the Great Lakes.

Saginaw owns and operates a wastewater treatment plant (WWTP) and collection system that serve Saginaw as well as the neighboring communities of Zilwaukee, Carrollton Township, Kochville Township, and portions of Saginaw Township. Much of the collection system is combined with CSO outfalls that discharge during wet weather into the Saginaw River. Saginaw’s WWTP began as a primary treatment facility in 1952. Secondary treatment facilities and phosphorus removal equipment were added to the plant in 1975. The WWTP began treating wastewater of the neighboring communities in 1991. (Vasold, 2001).
System Characterization

The combined sewer service area covers approximately 10,325 acres. Only a small portion of Saginaw (200 acres) is served by separate sewers. There were 36 permitted CSO outfalls in Saginaw in 1990, consisting of 31 sewage regulator chambers and five storm water and combined sewer pumping station relief points. The number of permitted CSO outfalls was reduced to 16 by 2000, and includes seven CSO outfalls where primary treatment and disinfection are provided.

The Saginaw WWTP has a 32 mgd capacity during dry weather and 70 mgd during wet weather. Seven CSO retention treatment basins (RTBs) have been constructed to provide primary treatment and disinfection, as shown below.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Capacity (mgd)</th>
<th>Treatment Methods</th>
<th>Discharge Volume (mgd)</th>
<th>Year In Service</th>
<th>Cost (Millions)</th>
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<td>51.3</td>
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<td>3.6</td>
<td>Primary, skimming, disinfection</td>
<td>34.8</td>
<td>1994</td>
<td>$6.6</td>
</tr>
<tr>
<td>Emerson</td>
<td>5.0</td>
<td>Primary, skimming, disinfection</td>
<td>33.4</td>
<td>1994</td>
<td>$15.9</td>
</tr>
<tr>
<td>Salt/Fraser</td>
<td>2.8</td>
<td>Primary, skimming, disinfection</td>
<td>2.0</td>
<td>1995</td>
<td>$22.9</td>
</tr>
<tr>
<td>Fitzhugh</td>
<td>1.2</td>
<td>Primary, skimming, disinfection</td>
<td>2.8</td>
<td>1994</td>
<td>$4.8</td>
</tr>
<tr>
<td>14th Street</td>
<td>6.8</td>
<td>Skimming, settling, vortex sep, disinfection</td>
<td>36.6</td>
<td>1992</td>
<td>$8.5</td>
</tr>
</tbody>
</table>

The pollutant removal effectiveness varied among the RTBs, as shown below.

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Volume</th>
<th>BOD</th>
<th>TSS</th>
<th>Phosphorus</th>
<th>Ammonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hancock</td>
<td>22%</td>
<td>50%</td>
<td>51%</td>
<td>40%</td>
<td>39%</td>
</tr>
<tr>
<td>Weiss</td>
<td>29%</td>
<td>54%</td>
<td>77%</td>
<td>55%</td>
<td>68%</td>
</tr>
<tr>
<td>Webber</td>
<td>38%</td>
<td>52%</td>
<td>61%</td>
<td>33%</td>
<td>62%</td>
</tr>
<tr>
<td>Emerson</td>
<td>36%</td>
<td>57%</td>
<td>39%</td>
<td>38%</td>
<td>67%</td>
</tr>
<tr>
<td>Salt/Fraser</td>
<td>48%</td>
<td>60%</td>
<td>68%</td>
<td>53%</td>
<td>73%</td>
</tr>
<tr>
<td>Fitzhugh</td>
<td>42%</td>
<td>57%</td>
<td>84%</td>
<td>56%</td>
<td>85%</td>
</tr>
<tr>
<td>14th Street</td>
<td>59%</td>
<td>83%</td>
<td>79%</td>
<td>76%</td>
<td>80%</td>
</tr>
</tbody>
</table>

Status of Implementation

Saginaw considered two alternatives for control of its CSOs: sewer separation and storage and treatment. A cost comparison of the two alternatives was conducted in 1990, and the results are as follows:

<table>
<thead>
<tr>
<th>Alternative (Millions)</th>
<th>Construction Cost (Millions)</th>
<th>Present Worth (Millions)</th>
<th>Annual Equivalent Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewer Separation</td>
<td>$309.8</td>
<td>$285.1</td>
<td>$31.0</td>
</tr>
<tr>
<td>Storage and Treatment</td>
<td>$170.8</td>
<td>$78.1</td>
<td>$18.0</td>
</tr>
</tbody>
</table>

The storage and treatment alternative was selected because of the cost advantage. This alternative was then divided into Phases A, B and C. Phases A and B have been completed, resulting in the elimination of all untreated CSOs.
**Community Case Study: Saginaw, MI—Region 5**

### Phase CSO Control(s)

<table>
<thead>
<tr>
<th>Phase</th>
<th>CSO Control(s)</th>
</tr>
</thead>
</table>
| A     | Storage for the two-inch, one-hour storm event  
Two-thirds of storage volume will be provided for settling, skimming, and disinfection |
| B     | Additional collector sewers and retention basin capacity, in order to eliminate all untreated combined sewer overflows |
| C*    | Additional retention basin capacity to meet the MDEQ definition of adequate treatment (total retention of the one-year, one-hour rainfall event and one-half hour detention of the ten-year, one-hour event.) |

*Note: Whether or not Phase C will be required will be determined by the MDEQ after review of a facilities evaluation report. The determination will be based on whether additional controls are necessary to comply with water quality standards.*

### Nine Minimum Controls

Saginaw has implemented the NMC. There are no dry weather overflows in Saginaw’s system, except in emergency situations. When CSO discharges occur, state and county officials, as well as local media are contacted as part of the city’s notification procedure. Within 24 hours, volume estimates are furnished, and a written report is supplied within five days of the conclusion of the overflow event. Upstream and downstream E.Coli levels are monitored during CSO discharge events, and reported to the state and to the Bay and Saginaw County Health Departments.

### Long Term Control Plan

Saginaw has adopted a modified version of the presumption approach in its LTCP. Phase C of the CSO Control Plan is to construct additional capacity in the retention and treatment basins to meet Michigan’s presumption approach. Twenty of 36 CSO outfalls have been eliminated.

Capital costs for Phase A were approximately $80.7 million. Capital costs for Phase B were approximately $24.5 million. The primary funding mechanism employed by Saginaw to cover the costs of CSO control was the Michigan Clean Water State Revolving Fund. The average household user cost in Saginaw is currently approximately $243 per year (debt service, operation, maintenance, and replacement). Phase B projects are anticipated to increase costs by approximately $32 per year. Estimated costs for Phase C projects are $65.6 million.

### Results and Accomplishments

It was estimated in 1990 that nearly three billion gallons per year of untreated CSO was discharged by the City of Saginaw. Implementation of Phase A and Phase B CSO controls are estimated to have reduced the volume of overflow to 760 million gallons per year, a 74 percent reduction. Direct discharge of untreated combined sewage has been eliminated under virtually all circumstances with the completion of Phase B CSO controls.

The City of Saginaw received a first place award in EPA’s National CSO Control Program Excellence Awards in 1998 for progress made in implementing its CSO Control Program.

### References

John Vasold, Saginaw Wastewater Treatment Division, Saginaw, MI. Personal communication with Limno-Tech, Inc. staff on details of the combined sewer overflow plan and program. Summer 2001.
Community Case Study

San Francisco, CA—Region 9

Number of CSO Outfalls
- 43 (originally)
- 36 (currently)

Combined Sewer Service Area
- 49 square miles

Wastewater Treatment Capacity
- 272 mgd (primary)
- 194 mgd (secondary)

Receiving Water(s)
- Islais Creek, San Francisco Bay, Pacific Ocean

Controls
- San Francisco completed implementation of its LTCP in 1997; initial CSO control began in the early 1970s.
- Wet weather treatment facilities provide 272 mgd of primary treatment and disinfection for wet weather flows.
- Storage and transport structures hold flow until treatment plant capacity becomes available.

Program Highlights
- CSO outfalls have been reduced from 43 to 36.
- CSO events have been reduced by over 75 percent, and CSO volume by 81 percent.
- An estimated 94 percent reduction in beach postings has occurred since implementation of CSO controls.
- CSO control has improved City assets and enhanced water quality of nearshore areas of the Bay and Ocean.

Background on San Francisco CSOs

The combined sewer service area of the City and County of San Francisco is approximately 31,360 acres and serves an estimated population of 800,000. There are no significant separated sewer service areas within the city. There are six main drainage basins within the service area and approximately 898 miles of combined sewer.

Prior to the implementation of CSO controls, an average of 7.5 billion gallons of CSO discharged during the wet weather season (October to April) each year. The overflow frequency was approximately 58 times per year, and there were 43 CSO outfalls. All of the CSOs discharged into marine waters.

The city and County of San Francisco own and operate three wastewater treatment plants in addition to the storage/transport facilities constructed for CSO control. The Southeast Water Pollution Control Plant (WPCP) is the city's largest wastewater treatment plant and has a peak secondary treatment capacity of 150 mgd. The plant discharges through an outfall to San Francisco Bay. The outfall has a capacity of 100 mgd, and flows...
in excess of 100 mgd are discharged to Islais Creek, a saltwater embayment. The Southeast WPCP was expanded in 1982 to provide a wet weather capacity of 250 mgd for peak wet weather flows. This was achieved using the 150 mgd of available secondary treatment capacity and 100 mgd of primary treatment capacity.

The North Point Wet Weather Facilities serves an area of approximately 6,500 acres in the northeastern part of the city. The facilities provide primary treatment (i.e., screening and settling), disinfection, and dechlorination of combined wet weather flows up to 150 mgd.

The Oceanside WPCP has a peak secondary treatment capacity of 43 mgd and a wet weather treatment capacity of 65 mgd. The capacities of the treatment facilities used by San Francisco to treat dry weather and wet weather flows are summarized in the table below.

<table>
<thead>
<tr>
<th>Treatment Plant</th>
<th>Secondary Capacity (mgd)</th>
<th>Primary Capacity (mgd)</th>
<th>Peak Flow Capacity (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeast WPCP</td>
<td>150</td>
<td>100</td>
<td>250</td>
</tr>
<tr>
<td>North Point Wet Weather Facilities</td>
<td>None</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Oceanside WPCP</td>
<td>43</td>
<td>22</td>
<td>65</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>193</strong></td>
<td><strong>272</strong></td>
<td><strong>465</strong></td>
</tr>
</tbody>
</table>

**Status of Implementation**

**CSO Planning History**

Planning for CSO control began in the early-1970s. The city Department of Public Works assessed various measures to upgrade treatment and control CSOs between 1970 and 1974. The Wastewater Master Plan was approved in concept by the San Francisco Board of Supervisors in January 1975. Based upon this planning effort, the San Francisco Regional Water Quality Control Board issued the city its first NPDES permit for the CSO structures. This permit was issued in the mid-1970s and set monitoring requirements and tentative control levels at some of the structures, as well as requiring additional studies of CSO control measures. In late 1978 and 1979, the permits were revised and the required CSO control levels were established based upon cost-benefit analyses.

**System Characterization**

The revised permits allowed a long-term average of 10 overflows per year where the shoreline usage is predominantly industrial and maritime, between eight and four overflows per year in areas where water contact recreation occurs, and only one overflow per year in an area where there are shellfish beds. The permits also require that:

- Wet weather treatment facilities are at maximum capacity before CSOs are allowed.
- Industrial source control and BMPs to control nonpoint source pollution must be implemented.
- Floatables are contained in the storage/transport structures.
- Treatment plant effluent, CSOs, and receiving waters are monitored for pollutants.
- Beaches are posted following CSO events.

To intercept the flows, a series of large underground storage and transport structures (referred to as storage/transport boxes) were constructed along San Francisco’s shoreline. Gravity and pumping are used to transport the stored wet weather flows to the treatment plants as treatment plant capacity becomes available. In addition to these
storage/transport boxes, the treatment plants were upgraded to expand the secondary and wet weather treatment capacities.

The system is designed and operated so that all dry weather flows are kept in the sewer system and routed to either the Southeast WPCP or the Oceanside WPCP for treatment. In wet weather the storage/transport boxes allow primary sedimentation to occur and are designed to remove floatables and reduce suspended solids concentration by approximately 30 percent. The capacities of these structures are summarized in the accompanying table. After a rain event, the settled solids are conveyed to the wastewater treatment plants. Therefore, all overflows from the storage/transport boxes receive some treatment prior to discharge through the outfalls.

<table>
<thead>
<tr>
<th>WPCP System</th>
<th>Storage/Transport Structure</th>
<th>Capacity (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Westside Core System</td>
<td>Westside</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>Richmond</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>Lake Merced</td>
<td>10.0</td>
</tr>
<tr>
<td>Bayside Core System</td>
<td>Northshore</td>
<td>17.5</td>
</tr>
<tr>
<td></td>
<td>Mariposa</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Islais Creek</td>
<td>37.0</td>
</tr>
<tr>
<td></td>
<td>Yosemite/Fitch</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>Sunnydale</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>Channel</td>
<td>28.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>170.4</strong></td>
</tr>
</tbody>
</table>

The Bayside Core System consists of seven miles of underground storage/transport boxes. These boxes drain to major pump stations where all dry weather flows are pumped to the Southeast WPCP for treatment before being discharged into San Francisco Bay. During wet weather, the North Point Wet Weather Facilities are brought online. Flows in the boxes exceeding the combined wet weather capacity of the Southeast WPCP and the North Point Wet Weather Facilities receive partial treatment in the boxes before discharge.

The Westside Core System consists of a 2.5 mile long storage/transport box, the Oceanside WPCP, and the Southwest Ocean Outfall. The city has also constructed consolidation conduits, tunnels, and new pump stations to intercept overflows and divert them to the storage/transport boxes.

In addition to the massive capital improvements, the city embarked on a program of toxics source control and pollution prevention. The Water Pollution Prevention Program was developed in response to several state and federal permits, orders, and waste minimization strategies. It consists of best management practices targeting educational and technical outreach, increased inspection and sampling of non-traditional pollutant sources, mandated waste minimization, and storm water pollution prevention plans.

**Nine Minimum Controls**

San Francisco has implemented the NMC. Wet weather-related monitoring activities include characterization of CSO discharges for various chemical constituents. Following a CSO event beaches are posted as not meeting state recreational water contact standards. Local surf shops and swim clubs are contacted and a toll free recreational water quality hotline is available to the public. The city is also in the process of developing access to EPA's BEACH Watch website.

**Long Term Control Plan**

San Francisco completed implementation of its LTCP in 1997 and the planned capital improvements for controlling CSOs to the allowed number of annual overflows. The city's LTCP gave priority to eliminating discharges to sensitive areas; a CSO outfall at Baker...
Beach in the Golden Gate National Recreational Area has been eliminated given the sensitivity of the habitat and potential human exposure.

**Costs and Financing**

The total capital costs associated with completing the LTCP were approximately $1.45 billion. The annual CSO-related O&M costs are approximately $20 million. Nearly $700 million in federal and state grants were received by San Francisco to assist in the planning, design, and construction of the CSO control system. The remaining $750 million, raised by revenue bonds and to be repaid by sewer rate, were city funds.

The North Point Wet Weather Facilities, which are more than 50 years old, are in need of improvement. Certain equipment is obsolete and some spare parts are no longer available on the market. Pollutant removal is less than optimal and in some instances discharges approach current effluent limits. With the consideration of future expansion, an upgrade is being planned for the facilities. The project involves: 1) upgrading primary sedimentation tanks and equipment with high rate clarification units, 2) replacing chlorine-based disinfection system with a more environmentally-friendly, medium pressure, ultraviolet radiation disinfection system capable of achieving current NPDES fecal coliform standard, and 3) upgrading ancillary equipment (pre-treatment, pumps, piping, electrical/instrumentation) to meet needs of treatment processes. The upgrade is projected to cost $38 million.

There are also plans to increase the capacity of the outfalls in conjunction with the North Point upgrades described above. The outfalls were constructed in the 1950's and the diffusers were added in the 1970's. Both are necessary to meet the discharge permit requirements of a minimum 10:1 dilution. Since the North Point Facilities are used for wet weather treatment only, and are not always in operation, barnacles and crustaceans inhabit the outfall system and have created blockages, thereby reducing its capacity and efficiency. The projected cost for increasing the capacity of the outfalls from 150 mgd to 300 mgd is $22 million.

Depending on the outcome of current negotiations between the city and the Navy, the city may be responsible for system upgrades and expansion at Hunters Point and Treasure Island. San Francisco's remaining needs also depend on potential changes to water quality standards previously discussed.

**Water Quality Issues**

Since 1972 the city has conducted ongoing sampling to evaluate the impacts of CSO discharges and to assess the environmental improvements gained from CSO control. On the Westside, where prior to the program as much as 83% of the storm flows were discharged untreated at the Pacific Ocean shoreline, only 13% of the storm flows are discharged at the shoreline and all of this overflow receives partial treatment.

Although San Francisco's LTCP has been completely implemented there are unresolved issues regarding water quality standards compliance. The state anticipates that it will be reviewing the appropriateness of the water quality standards in the near future. The city may have to implement additional programs depending on the outcome of that review.

**Results**

CSO volume and frequency have been reduced greatly since CSO controls have been implemented. Citywide pollutant reductions resulting from the city's LTCP are summarized as follows:
San Francisco developed its LTCP in conjunction with the regulatory agencies and started to implement the plan in 1974. Within 20 years the following systems were complete: (1) the Westside system, which reduced overflows to eight times per year into the Pacific Ocean along the central portion of Ocean Beach; (2) the Northshore system, which reduced overflows to four times per year along the northshore of the city the Golden Gate and Bay Bridges; (3) the Channel system, which reduced overflows to 10 times per year from the Bay Bridge to Mission Creek; and (4) the Sunnydale/Yosemite system, which reduced overflows to one time per year south of Islais Creek to the southern city boundary.

In 1994, the Lake Merced Transport system was tied to the Westside system, which further reduced overflows to the Pacific Ocean from the southwestern section of San Francisco. Shortly thereafter the Islais Creek system was completed, which reduced overflows to 10 times per year from Mission Creek to Islais Creek along the eastern boundary of the city. In 1997, the Richmond Transport connected flow from the northwestern edge of the city to the Westside system, diverting flow that previously spilled onto Baker and China Beaches.

Prior to CSO control implementation, San Francisco beaches were routinely posted from October to April during the wet weather season for not complying with state recreational water contact standards. Rainfall in excess of 0.02 inches per hour resulted in CSOs around the entire city. As CSO control structures were put in service, the number of CSOs to San Francisco shoreline areas have been reduced as described above. The number of CSOs that occur is dependent upon the amount of annual rainfall and the duration and intensity of each rainfall event.

From 1994 through 1996, a significant portion of control structures were in place and the number of days the beaches were posted ranged from 196 to 217, while rainfall ranged from 23.7 to 26.3 inches. In 1997, the first partial year of complete CSO control implementation, the number of days beaches were posted dropped to 54, but rainfall was only 19.1 inches. In 1998, the first complete year of full implementation, the number of days beaches were posted dropped to 48 and rainfall was significantly higher, measuring 33.5 inches. Since 1998, annual rainfall in San Francisco has ranged from 22 to 27 inches and the days that beaches were posted decreased to between eight and 15 days. In recent years, beaches remain posted only while sampling indicates that bacteria concentrations are above state bacteria standards. This is typically only a period of one to three days. An estimated 94% reduction in beach postings has occurred due to implementation of CSO controls. As shown in the following figure, these reductions have been achieved during both wet and dry years.

<table>
<thead>
<tr>
<th>Item</th>
<th>Before Control</th>
<th>After Control</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of CSO events</td>
<td>58 - 80</td>
<td>1-10</td>
<td>98-75</td>
</tr>
<tr>
<td>Annual CSO Volume (MG)</td>
<td>7,500</td>
<td>1,350</td>
<td>81</td>
</tr>
<tr>
<td>Suspended Solids Discharge (tons/yr)</td>
<td>3,550</td>
<td>450</td>
<td>87</td>
</tr>
<tr>
<td>BOD₅ Discharge (tons/year)</td>
<td>2,700</td>
<td>300</td>
<td>89</td>
</tr>
<tr>
<td>Beach Postings (days/year)</td>
<td>200</td>
<td>12</td>
<td>94</td>
</tr>
</tbody>
</table>
This reduction in the numbers and volume of CSO events during the past 25 years has facilitated the transition of San Francisco’s coastline from industrial uses to tourist, recreational, and residential uses by improving and enhancing the water quality of nearshore areas of the bay and ocean. The continuing economic development of the Fisherman’s Wharf area south to Pac Bell Park and the water contact recreation enjoyed at Crissy Field, Fort Point, Baker, and Ocean Beaches (all within the Golden Gate National Recreational Area) have been supported in part by the control and treatment of combined sewer overflows (Lavelle, 2001).

San Francisco Bay has been listed for several pollutants under CWA Section 303(d). The listing has resulted in a need for developing TMDLs for certain pollutants, such as copper and nickel. The outcome of TMDLs may require further control measures for CSOs. These control measures have not been determined at this time.

References

South Portland, ME—Region 1

Community Case Study

Number of CSO Outfalls
35 (originally)
25 (currently)

Combined Sewer Service Area
12 square miles

Wastewater Treatment Capacity
56 mgd (primary)
22.9 mgd (secondary)

Receiving Water(s)
Fore River, Casco Bay

Program Highlights
● 25 of 35 CSO outfalls have been eliminated.
● 80 percent reduction in CSO volume was achieved between 1988 and 1993.
● Real time flow monitoring is used to quantify flows. All CSO outfalls are continually monitored.
● The Friends of Casco Bay have recognized South Portland for the positive impact of its CSO control program on the Bay.

Controls
● South Portland’s program has relied on sewer separation, removing private inflow sources (roof leaders and sump pumps), expansion of wet weather treatment capacity, and upgrading sewer lines.
● Technical advice and financial incentives have been used to encourage inflow control.
● Wet weather wastewater treatment plant capacity was expanded from 12 mgd to 56 mgd.

Background on South Portland CSOs
South Portland has a population of 22,300 and is located in southern coastal Maine. South Portland is served by a CSS which is comprised of 16.6 miles of combined sewer pipes that cover an area of 7,680 acres. CSOs in the system discharge directly (or indirectly via ponds, creeks, and brooks) to the Fore River and Casco Bay. Both of these water bodies are classified by the Maine Department of Environmental Protection (DEP) for swimming, fishing, and shellfish harvesting. Casco Bay was also designated by EPA as an Estuary of National Significance in 1987. It is an important economic resource for Maine, supporting commercial fishing, tourism, shipping, manufacturing, and service businesses.

Photo: Lighthouse at Portland Head on Casco Bay. Photodisc
Status of Implementation

Characterization

South Portland initiated their CSO Control program in 1988. City staff inventoried, numbered and mapped all of the sewer pipes, catch basins, and manholes. Thirty-five CSO outfalls were identified. Inflow and infiltration was high in the city's aging sewer system. The average age of the system was approximately 50 years, and the oldest sewer pipes date to the 1880s (City of South Portland 1992 and 1993).

South Portland installed an extensive system of real-time flow monitoring equipment to characterize their CSS and existing CSOs. All CSO outfalls in the system are continuously monitored, and the duration, overflow rate, total volume, and time of day of each CSO is recorded. South Portland also maintains rain gauges to be able to correlate overflow and precipitation events. Flow monitoring has provided many benefits for South Portland's CSO control program. The real-time flow data: (1) provide basic information for the city to understand CSS performance, (2) enable the progress of the CSO control program to be tracked, (3) produce information for comparison of CSO control alternatives, and (4) serve as an important component of compliance monitoring. South Portland has maintained rainfall records and flow records from the CSO outfalls and pump stations since 1992. Other monitoring efforts related to the CSO program include collection of bacteria data (enterococci) at swimming beaches. These efforts have enabled South Portland to collect site-specific data on existing CSOs, and to calculate pollutant loadings and receiving water impacts. This comprehensive monitoring program has also aided the development of South Portland's LTCP.

Nine Minimum Controls

The NMC were required for South Portland as part of the DEP CSO Discharge License, and an enforcement action (consent agreement with EPA Region 1, dated January 28, 1992). South Portland has been recognized by the DEP for its implementation and documentation of the NMC, considered to be one of the best of 44 Maine CSO communities (City of South Portland, 1997).

Proper O&M was recognized to be an important component of CSO control. The city's sewer maintenance division is responsible for cleaning and inspection of the collection system. In addition, they maintain an emergency on-call system to quickly identify, eliminate, or mitigate any problems that might arise. No dry weather overflows occurred in 1999. In the previous three years, dry weather overflows occurred due to power or equipment failures that have since been corrected with backup power arrangements. Because South Portland continuously monitors flows at all CSO outfalls, dry weather overflows are quickly discovered and eliminated.

Signs are placed at all CSO locations to inform the public of possible wet-weather hazards. The signs are regularly checked and replaced if damaged or missing. The Willard Beach outfall is recognized as a sensitive area for CSO activity because it is a public swimming area. Bacteria testing has been performed at the outfall twice weekly during the summer since 1991. While beach closings have occurred, none corresponded directly with CSO discharges.

South Portland has implemented an aggressive program to reduce inflow to the CSS. Homes and commercial establishments with roof leaders and basement sump pumps directly connected to the CSS were identified. South Portland provided technical and financial support to owners to have roof leaders and sump pumps redirected from the CSS. A summary of CSO source control measures implemented by South Portland follows.
### Source Control Activity and Progress as of 1999

<table>
<thead>
<tr>
<th>Activity</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Leader Disconnection—257 homes</td>
<td>Stormwater Inflow Reduction</td>
</tr>
<tr>
<td>Sump Pump Removal—213 removed</td>
<td>Stormwater Inflow Reduction</td>
</tr>
<tr>
<td>Catch Basin Cleaning—460 tons debris annually</td>
<td>Pollution Prevention</td>
</tr>
<tr>
<td>Street Sweeping—2,000 cy debris removed annually</td>
<td>Pollution Prevention</td>
</tr>
<tr>
<td>Annual community hazardous waste collection</td>
<td>Pollution Prevention</td>
</tr>
</tbody>
</table>

### Long Term Control Plan

South Portland has been implementing CSO controls since 1988. The LTCP is based upon the demonstration approach. Priority has been given to eliminating the CSO discharges near the bathing beach, a sensitive area. Sewer separation, adjustment of weir heights, upgrading of pumps stations, upgrading of POTW capacity, and many other in-system controls have contributed to substantial reductions in the number of CSO outfalls and the volume of CSO discharge. The types of in-system control measures implemented since 1988 by South Portland are listed below.

<table>
<thead>
<tr>
<th>System Controls Implemented as of 1999</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infiltration/inflow control</td>
<td>Collection System Optimization and Control</td>
</tr>
<tr>
<td>Real-time flow control (50% overflow decrease realized by adjusting weirs)</td>
<td>Collection System Optimization and Control</td>
</tr>
<tr>
<td>Sewer cleaning</td>
<td>Collection System Optimization and Control</td>
</tr>
<tr>
<td>Manhole/pump station maintenance</td>
<td>Collection System Optimization and Control</td>
</tr>
<tr>
<td>Sewer rehabilitation</td>
<td>Collection System Optimization and Control</td>
</tr>
<tr>
<td>Sewer separation (680 acres separated between 1986-1998)</td>
<td>Collection System Optimization and Control</td>
</tr>
<tr>
<td>Outfall elimination</td>
<td>Collection System Optimization and Control</td>
</tr>
<tr>
<td>In-line netting</td>
<td>Floatables Control</td>
</tr>
<tr>
<td>Baffles (installed at 11 locations in CSS)</td>
<td>Floatables Control</td>
</tr>
<tr>
<td>Screening improvements at discharge point</td>
<td>Floatables Control</td>
</tr>
<tr>
<td>In-line storage (weirs adjusted to maximize in-line storage)</td>
<td>Storage (In-Line and Off-Line)</td>
</tr>
<tr>
<td>Upgraded pump stations (6 pump stations upgraded)</td>
<td>Storage (In-Line and Off-Line)</td>
</tr>
<tr>
<td>Upgraded POTW capacity (with additional wet weather primaries)</td>
<td>Storage (In-Line and Off-Line)</td>
</tr>
</tbody>
</table>
Costs and Financing

South Portland has spent over $9 million to control CSOs. Most of this has been financed through voter-approved bonding. Costs for sewer separation of 680 acres of the combined system were approximately $6 million and the separation projects scheduled over 10 years. Capital costs for the POTW upgrade were $9.2 million, but only a small portion of this is associated with CSO control. The cost to upgrade six pump stations was $1.3 million. Capital costs for planned LTCP controls are $13.8 million, including $5 million for partial sewer separation (to be complete by December 2005). Annual O&M costs are approximately $350,000 per year.

Enforcement Issues

South Portland was the first non-National Municipal Policy referral in EPA Region 1 in which the EPA sought relief for wet weather discharges only. As part of the consent agreement (entered into court on April 16, 1992), South Portland paid $30,000 in penalties for violations of the CWA and its Maine CSO Discharge License. The consent agreement required, among other things, that yearly CSO progress reports be submitted to the DEP.

Results

South Portland initiated its CSO control program in 1988. The city's initial CSO master plan focused on maximizing flow to the POTW. This involved increasing pump station capacity, maximizing flow (conveyance capacity) to the treatment plant, and upgrading treatment and storage capacity at the plant. The current CSO control program primarily relies upon separating and upgrading (replacing) sewers and removing private inflow sources through roof leader and sump pump redirection. The removal of inflow and infiltration sources has eliminated approximately 700 million gallons per year from entering the CSS. Overall, South Portland had achieved an 80 percent reduction in total CSO volumes in an average rainfall year by 1993. In addition, 25 of 35 CSO outfalls have been eliminated through sewer separation and other system improvements.

Prior to the POTW upgrade, 60 percent of the total CSO volume was discharged at the plant. Secondary treatment capacity at the POTW was upgraded from 12 to 22.9 mgd. Wet weather flows in excess of the upgraded secondary treatment capacity are diverted to empty storage/treatment tanks for primary treatment. CSO bypass of secondary treatment is permitted under peak flow conditions. In total, maximum treatment capacity was expanded to approximately 56 mgd (22.9 mgd secondary, plus 33 mgd of primary treatment). The wet weather treatment capacity has not been exceeded since the upgrade.

South Portland has also observed a reduction in summer CSOs. Monitored volumes for summer CSOs from 1992 through 1997 are shown in the figure at right. South Portland has been recognized by the Friends of Casco Bay for its positive impact on the Bay.

### Summer CSO Volume Reductions, 1992 — 1997

<table>
<thead>
<tr>
<th>Year</th>
<th>CSO Volume (million gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>27</td>
</tr>
<tr>
<td>1993</td>
<td>17</td>
</tr>
<tr>
<td>1994</td>
<td>1</td>
</tr>
<tr>
<td>1995</td>
<td>10</td>
</tr>
<tr>
<td>1996</td>
<td>4</td>
</tr>
<tr>
<td>1997</td>
<td>4</td>
</tr>
</tbody>
</table>
References


City of South Portland, Maine. 1993. Combined Sewer Overflow Facilities Plan. South Portland, ME.


Pineo, David, Engineering Department, City of South Portland, ME. Personal communication with Limno-Tech, Inc. staff on details of the combined sewer overflow plan and program. Summer 2001.
Background on Washington, D.C. CSOs

The District of Columbia Water and Sewer Authority (WASA) operates a wastewater collection system consisting of separate and combined sewers. Approximately one-third of the District, or 12,955 acres, is served by a CSS. The remaining two-thirds is served by separate sanitary sewers and a separate storm water system (SSWS). The combined sewer service area is located primarily in the older central part of the District, and it was primarily constructed by the federal government.

Wastewater from the District and surrounding suburban areas is treated at WASA’s Advanced Wastewater Treatment Plant at Blue Plains, a 370 mgd regional facility. Most of the flow that is conveyed to Blue Plains from suburban jurisdictions passes through the CSS. During wet weather events, the combined sewer portion of the system produces
CSOs that discharge into receiving waters. There are a total of 60 CSO outfalls listed in WASA's NPDES permit that discharge to Rock Creek, the Anacostia River, the Potomac River and tributary waters. The WASA NPDES permit is administered by EPA Region 3.

<table>
<thead>
<tr>
<th>Status of Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>WASA and its predecessor organizations have been addressing CSO issues for several decades and have spent over $35 million for CSO abatement. Phase I CSO controls were completed in 1991 and featured: the Northeast Boundary Swirl Facility, inflatable dams for in-system storage, expanded pumping capacity, and expanded wet weather treatment capacity at Blue Plains.</td>
</tr>
</tbody>
</table>

**Nine Minimum Controls**

WASA has an NMC program in place to address CSOs. WASA first provided documentation on its NMC program in December 1996 (DHA, 1996). In July 1999 WASA prepared a report which updated the earlier NMC documentation (EPMC III, 1999). The summary report provided an update on various activities undertaken by WASA as part of the NMC program and included recommendations for enhancement of several activities associated with this program. An NMC Action Plan prepared in February 2000 details a schedule for implementing recommended enhancements. Examples of measures that have been implemented include:

- Regular inspections of critical facilities such as outfalls, regulators, pump stations and tide gates.
- Maximization of storage in the collection system through the use of inflatable dams.
- Inspections and maintenance of regulators and outfalls to prevent and correct dry weather overflows.
- Operation of the Northeast Boundary Swirl Facility to control CSOs and floatables.
- Operation of skimmer boats on the Anacostia and screens at certain pump stations to control floatables.
- Installation and demonstration evaluation of an end-of-pipe netting system for floatables control at CSO outfall 018.
- Placement of signs at outfalls for public notification.
- Development of a CSO web page on the WASA website.
- Major maintenance projects such as the cleaning of the Eastside Interceptor and the sonar inspection of the Anacostia siphons.

**Long Term Control Plan**

WASA initiated development of an LTCP in 1998. Extensive monitoring and modeling was undertaken to characterize the system during LTCP development. Flow and water quality monitoring in both the CSS and SSWS were employed to determine the hydraulic response of the system to rainfall. Receiving water monitoring was used to assess in-stream conditions, impacts, and upstream sources. The evaluation of CSO control alternatives involved development and application of CSS and SSWS models and receiving water models for Rock Creek, the Anacostia River and the Potomac River.

WASA submitted a draft LTCP to EPA Region 3 and the District of Columbia Department of Health in June 2001 (EPMC III, 2001). The recommended CSO control program is based upon the demonstration approach. The major elements of the draft LTCP and associated costs are summarized by receiving water in the following table. It is anticipated that WASA's final recommended LTCP will be submitted to the regulatory agencies for approval at the end of 2001.
Community Case Study: Washington, District of Columbia—Region 3

As shown below, the recommended LTCP is expected to reduce the volume and frequency of CSOs.

<table>
<thead>
<tr>
<th>LTCP Alternative</th>
<th>Anacostia River</th>
<th>Potomac River</th>
<th>Rock Creek</th>
<th>System Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSO Overflow Volume (MG/year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Controls</td>
<td>2,142</td>
<td>1,063</td>
<td>49</td>
<td>3,254</td>
</tr>
<tr>
<td>Phase I Controls (1991)</td>
<td>1,485</td>
<td>953</td>
<td>52</td>
<td>2,490</td>
</tr>
<tr>
<td>Recommended LTCP</td>
<td>96</td>
<td>157</td>
<td>11</td>
<td>264</td>
</tr>
<tr>
<td>Number of Overflows Per Year</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Controls</td>
<td>75</td>
<td>74</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>With Phase 1 Controls (1991)</td>
<td>75</td>
<td>74</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>Recommended LTCP</td>
<td>4</td>
<td>12</td>
<td>4</td>
<td>—</td>
</tr>
</tbody>
</table>

Cost and Financing

Implementation of the recommended CSO control program is estimated to cost more than $1 billion (2001 dollars). WASA conducted a financial capability assessment and affordability analysis to evaluate the impact of the recommended program on ratepayers. The analysis considered existing rates, the rate increase associated with WASA’s current non-CSO capital improvements, and the rate increase associated with the addition of the recommended CSO control program.

Using EPA guidance, wastewater treatment costs, including the recommended CSO control program, are projected to impose a medium burden based on median household income. For lower income households, current wastewater treatment costs are projected to impose a medium burden without any additional CSO controls. Addition of the recommended CSO control program greatly increases the burden level. At this time, WASA cannot predict whether financial assistance in the form of grants or other mechanisms will be available. Without such assistance, the cost of implementing CSO controls will place a major burden on rate payers, particularly those least able to afford it.

A 20-year implementation schedule for the recommended control plan was developed based on the financial capability assessment and practical aspects associated with long linear construction operations. WASA identified several early action items where
implementation can proceed without waiting for approval of the complete LTCP. Early action items include low impact development retrofits, rehabilitation and improvements at pumping stations, completion of sewer separation in Luzon Valley, and monitoring and regulator improvements along Rock Creek.

**Water Quality Issues**

Water quality assessment concentrated on bacteria and dissolved oxygen. The CSO control program is expected to significantly reduce bacteria concentrations in all receiving waters, and improve dissolved oxygen levels in the Anacostia River. However, current water quality standards will not be attained in Rock Creek and in the Anacostia River unless upstream point and nonpoint sources are controlled in conjunction with CSO control. The draft LTCP includes a suggestion to revise provisions in the current District of Columbia water quality standards to reflect the wet weather nature of CSOs. The LTCP meets the allocation requirements of the Anacostia TMDL for biochemical oxygen demand as published by the DC Department of Health (DC Department of Health, 2001).

**References**


The City of Wheeling is located in the northern panhandle of West Virginia. The Wheeling Water Pollution Control Division (WPCD) operates a CSS that covers 7,040 acres, and a POTW with a secondary treatment capacity of 10 mgd. There are 168 CSOs in Wheeling.

The WPCD has made progress in implementing CSO controls in the face of several challenges. One challenge is steep topography. The City is surrounded to the north, east, and south by steep terrain, and it is bounded to the west by the Ohio River. The steep terrain on three sides results in rapid runoff to the CSS. As little as 0.1 inches of rain will cause flows received at the POTW to increase by three to four times their average daily flow, and CSOs begin to occur. Another challenge is that various components of the city’s CSS date back to the mid-1800s, leading to substantial inflow and infiltration. Wheeling is also facing a declining population and a depressed financial condition. Ultimate compliance with water quality standards may be nearly impossible for the community unless the full benefit of the flexibility provided in the CSO Control Policy is utilized.
Status of Implementation

The WPCD has completed several CSO discharge characterization studies, has implemented the NMC, and has submitted an LTCP to the West Virginia Department of Environmental Protection (DEP) for approval.

System Characterization

Wheeling developed a Conceptual Plan for the Analysis and Minimization of Combined Sewer Overflow Discharges in 1993. The plan outlined CSS deficiencies and prioritized subsequent CSO control activities. The plan was based on collection system analysis using SWMM and STORM models. At the time of this report, the annual percent capture of total flow entering the CSS was estimated to be 25 percent, with virtually 100 percent capture during dry weather flow conditions. In addition to the conceptual plan, Wheeling has also completed several studies in effort to characterize its CSO discharges, including:

- Analysis of water quality upstream and downstream of CSO discharges.
- Monitoring of rates and durations of representative discharges during rainfall conditions.
- Analysis of the quality of representative discharges.

Nine Minimum Controls

Wheeling developed its implementation plan for NMC in August 1996 (Smith Environmental Technologies Corporation, 1996). This plan was approved by the DEP and the Ohio River Valley Water Sanitation Commission (ORSANCO) in December 1996. The City has successfully demonstrated implementation of each of the NMC. Examples of activities conducted to fulfill the NMC requirements include:

- Daily inspection and maintenance of the collection system.
- Modification of CSO structures and sewer cleaning to maximize in-system storage.
- Installation of wire mesh traps for solids and floatables control.
- Maximization of flow to the WWTP (assisted by use of a CSO-related bypass).
- Flow monitoring and sampling.
- Development and distribution of educational and public notice materials.

Dry weather overflows continue to occur. These overflows are attributed to temporary blockages in the collection system, and to occasional surface water tie-ins that drain into overflow pipes. During dry weather conditions, the drainage from these tie-ins does not contact sanitary sewage flowing in the collection system. All observed dry weather overflows are immediately inspected when identified or reported, and blockages are removed.

Long-Term Control Plan

Wheeling submitted its LTCP on April 28, 2000 in accordance with their compliance schedule. The LTCP is under review by the DEP.

The proposed LTCP follows the demonstration approach. This is considered the necessary approach since the City cannot meet the 85 percent capture requirement of the presumption approach. Wheeling's draft March 2001 permit requires that, at a minimum, the LTCP must consist of continued maintenance and implementation of the NMC, provided there are no adverse water quality impacts. As part of its LTCP, Wheeling commits to the continued maintenance and implementation of the NMC.

The city submitted data (collected as part of the NMC requirements) to demonstrate no adverse impacts to receiving water quality due to CSO discharges. This data is presented
in the 1998 report entitled Evaluation of Small System CSO Discharges on Water Quality (City of Wheeling WPCD and BCM Engineers, 1998). It includes more than four years of quarterly monitoring data collected during wet and dry weather periods at several points along the Ohio River and its tributaries, including locations upstream and downstream of CSO outfalls. Parameters sampled include: pH, hardness, ammonia nitrogen, total suspended solids, five-day biochemical oxygen demand, dissolved oxygen, oil and grease, fecal coliform, total coliform, lead, zinc, cadmium, and copper.

The city is also undertaking small sewer separation projects at critical locations, outside the scope of the proposed LTCP.

### Costs and Financing

An April 2001 CSO Needs Survey for the City of Wheeling identified the most immediate capital needs for the Wheeling wastewater collection and treatment systems (GGJ Consulting Engineers, Inc., 2001). It was estimated that $29.5 million was needed to complete priority projects directly related to CSO control, including sewer separation projects at critical locations. An earlier 1989 engineering study estimated that complete CSO control could cost up to $350 million (in 1989 dollars).

Wheeling lacks the funds necessary to complete priority projects. The WPCD's annual budget of approximately $4 million is expended on existing O&M expenses and debt service. The WPCD and the City of Wheeling Economic and Community Development Department jointly expend approximately $1 million per year on priority sewer separation projects within the City. These separation projects have been on-going for more than 10 years.

The industrial and residential revenue base is decreasing. The city's population declined by 70 between 1930 and 1990. Between fiscal years 1999-2000 and 2000-2001, WPCD revenues decreased by more than five percent. The remaining population has limited resources to compensate for the losses. Approximately 17 percent of the city's population lives below the poverty line, and more than 25 percent are on a low or fixed income. Sewer rate increases have been pursued by the WPCD, but no increases have been enacted since 1995. Wheeling has made several requests for state and federal grant monies in recent years for their priority projects, but no grants have been provided to date. Additional revenue bonds and SRF loans are being considered to assist in raising funds.

### Enforcement Issues

High river levels occur in the Ohio River during the winter and spring, due to runoff and operation of locks and dams by the Army Corps of Engineers. Backflow preventors on approximately 80 CSO outfalls along the Ohio River are not designed for high flow conditions. Consequently, a substantial amount of river water enters the CSS through approximately 80 CSO outfalls and is conveyed to the WWTP for treatment. This inflow of river water disrupts system operations related to biological processes. The result is WWTP permit effluent violations for biochemical oxygen demand, total suspended solids, and mass limits, even at lower flows. Plant operators do what is possible with treatment chemicals and system adjustments, but they are unable to fully address the problem. It will cost the City approximately $1 million for improvements to prevent the river inflow.
Implementation of the NMC, sewer separation in priority areas, and other controls have increased the flow captured for treatment from 25 percent to 40 percent of the 7.2 billion gallons entering the CSS annually, as shown in the figure below.

The City has reduced the number of CSO outfalls from 259 to 168. This reduction includes 64 CSO outfalls that have been structurally modified to become inactive (i.e., plugged), and 27 CSO outfalls that have been eliminated through localized sewer separation.

References

City of Wheeling WPCD and BCM Engineers, 1998. Water Pollution Control Division Evaluation of Small System CSO Discharges on Water Quality. Report prepared for submittal to the West Virginia DEP. Wheeling, WV.


King Campbell, Superintendent, City of Wheeling Water Pollution Control Division. Personal communication with Limno-Tech, Inc. staff on details of the combined sewer overflow plan and program. Summer 2001.
APPENDIX C

Third Party Review Water Quality Analysis Figures
Section 6.3.1 Appendix Figures

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- pcdm_trib.pdf – time-series plots of the tributary data 2
- alleghenyf.pdf – spatial plot of the Allegheny fecal data 1
- monf.pdf – spatial plot of the Monongahela fecal data 1
- ohiof.pdf – spatial plot of the Ohio fecal data 1
- alleghenye.pdf – spatial plot of the Allegheny Ecoli data 1
- mone.pdf – spatial plot of the Monongahela Ecoli data 1
- ohioe.pdf – spatial plot of the Ohio Ecoli data 1

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- pcos_sso.pdf – probability plot of end-of-pipe data 1
- ns_calc2a.pdf – probability plot w/ rotated upstream distribution 1
- ns_calc2b.pdf – probability plot w/ 1 #/100mL upstream 1
Pittsburgh Area Annual Average River Flow Distributions
Pittsburgh Area River Minimum 7-day Average Low Flows
Allegheny River (9/12-13/1995 - WET)

Monongahela River (9/12-13/1995 - WET)

Ohio River (9/12-13/1995 - WET)

Miles from Confluence

(Dashed Line - PADEP Fecal Coliform Standard as Geometric Mean)
Allegheny River (10/3/1995 - DRY)

Monongahela River (10/3/1995 - DRY)

Ohio River (10/3/1995 - DRY)

(Dashed Line - PADEP Fecal Coliform Standard as Geometric Mean)
Allegheny River - Dry Weather Fecal Coliform Data

- Main Rivers
- Tributaries
Monongehela River - Dry Weather Fecal Coliform Data

- Main Rivers
- Tributaries
Ohio River - Dry Weather Fecal Coliform Data

- Main Rivers
- Tributaries
Allegheny River - Dry Weather E. Coli Data

- Main Rivers
- Tributaries
Monongehela River - Dry Weather E. Coli Data

- Main Rivers
- Tributaries
Ohio River - Dry Weather E. Coli Data
- Main Rivers
- Tributaries
Combined Sewer Overflow

Sanitary Sewer Overflow

Percent Less than or Equal to

ALCOSAN CSO/SSO Bacteria Sampling (August 1994)
Main Rivers & Chartiers Creek Mass Balance Results for Average Year
(Red Circle - Existing, Blue Square - LTCCP, Line - Upstream)
Main Rivers & Chartiers Creek Mass Balance Results for Average Year
(Red Circle - Existing, Blue Square - LTCCP, Line - Upstream)
Third Party Review of ALCOSAN’s RLTWWCCP