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April 14, 2008

Mr. Paul Eisworth
Pennsylvania Department of
Environmental Protection
400 Waterfront Drive
Pittsburgh, PA 15222

Re: Mon Valley Sewage Authority
Combined Sewer Overflow
Long Term Control Plan
NPDES Permit No. PA 0026158

Dear Mr. Eisworth:

Enclosed are three (3) copies of the revised Chapter 4 of the Mon Valley Sewage Authority Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP) dated Revision: April 2008. The only change to the LTCP as detailed in Chapter 4 amends the implementation schedule to consist of three phases over a 12-year period vs. the original 10-year period proposed in the document dated July 2007. As requested, we have also updated Chapter 4 to include a more detailed breakdown of the projects to be implemented in each of the three phases.

If you have any questions, please do not hesitate to contact us. We look forward to DEP approval of the enclosed LTCP.

Very truly yours,

GANNETT FLEMING, INC.

David E. MacIntyre | Jason J. McBride

DAVID E. MACINTYRE, P.E.
Senior Project Manager

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Assistant Project Manager

Enclosures

cc: Mon Valley Sewage Authority (w/c)
File (w/c)

Mon Valley Sewage Authority
City of Monessen, Westmoreland County
Borough of Donora, Washington County

NPDES PERMIT NO. PA0026158

Combined Sewer Overflows
Long Term Control Plan

VOLUME I

GF Project Number 45988

July 2007
Chapter 4 Revised: April 2008

Gannett Fleming

Pittsburgh, Pennsylvania

Mon Valley Sewage Authority
City of Monessen, Westmoreland County
Borough of Donora, Washington County

NPDES PERMIT NO. PA0026158

Combined Sewer Overflows Long Term Control Plan

GF Project Number 45988

July, 2007

Gannett Fleming, Inc.
Pittsburgh, Pennsylvania

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1.1 Background

The Mon Valley Sewage Authority (Authority) sewerage system was constructed in 1968-70 to intercept and treat wastewater from the Combined Sewer Systems (CSS) owned and operated by the City of Monessen (Monessen), in Westmoreland County, and the Borough of Donora (Donora), in Washington County. In the mid-1970s, part of the Separate Sanitary Sewer System (SSS) owned and operated by the Carroll Township Authority (Carroll Authority), Washington County, was connected to the Authority system. The Authority system consists of six (6) sewage regulators and fifteen (15) diversion manholes, 16,900 linear feet of intercepting sewer, seven (7) sewage pumping stations, 11,500 linear feet of force main, and a 4.96 MGD wastewater treatment plant (WWTP). Monessen, Donora, and Carroll Authority currently maintain their own individual sewage collection systems. The construction of these collection systems, with the exception of the Carroll Township system, predates the inception of the Authority with much of the sewer systems dating to the early 1900's. Both systems were constructed as combined sewer systems (CSS). The NPDES Permit issued on October 2, 2002 approved re-rating of the WWTP from 3.66 MGD to 4.96 MGD.

The Monessen and Donora collection systems reportedly do not experience overflows within their respective systems. Therefore, the City of Monessen and the Borough of Donora are not required to obtain NPDES Permits (PA CSO General Permit PAG-6). Because the Authority owns and operates the seventeen (17) combined sewer overflows (CSOs) along the main interceptor, it is obligated to meet the requirements of the National CSO Policy (CSOP) first adopted by the United States Environmental Protection Agency (EPA) in 1994. This report evaluates the feasible alternatives available to the Authority to continue to successfully comply with the provisions of the CSOP.

In August 1995, the Pennsylvania Department of Environmental Protection (PaDEP) issued an NPDES Permit for the Authority sewerage system. The Authority's NPDES Permit No. PA0026158 allows for the discharge from seventeen (17) CSOs. These CSO structures are located along the Monongahela River and are designed to activate when hydraulic conditions in the CSS exceed 350% of the average dry weather flow. These conditions occur only during wet weather events when these overflows discharge dilute raw sewage to the Monongahela River.

Additionally, the August 1995 NPDES Permit required the Authority to undertake a number of tasks necessary to comply with the requirements of the CSOP. These requirements included:

TABLE 1-1
NPDES PERMIT REQUIREMENTS

Item	Date Due	Date Submitted
System Inventory and Characterization	January 1996	July 1996 (Under approved "no cost time extension") as CSO Plan of Action
System Hydraulic Characterization	August 1996	July 1996 as CSO Plan of Action
Documentation of Implementation of Nine Minimum Controls	August 1997	July 1996 as CSO Plan of Action, Draft 2nd NMC Documentation submitted September 2002
Long Term Control Plan (LTCP)	August 1998	January 2003
Begin Implementation of LTCP	Upon approval by PaDEP	Upon approval by PaDEP
Submit Annual CSO Status Reports	March 31 of each year	March 31 of each year

The Authority began implementation of these steps in 1996 when they received a $25,000 grant from DEP to conduct a CSO study leading to the implementation of the NMCs and development of a LTCP. This "Plan of Action" as approved by PaDEP included tasks consisting of:

- System Inventory and Characterization Report (SICR);
- CSO System Hydraulic Characterization Report (SHCR);
- Implementation of Nine Minimum Controls (NMCs); and

- Proposed Approach to the Long-Term Control Plan (LTCP).

This Plan of Action report was prepared and submitted to DEP on August 1, 1996. In 1999, PaDEP provided notice of violation to the Authority for failure to submit the above referenced Plan of Action. The Authority provided documentation that the report had been submitted in 1996, and subsequently resubmitted the report in March 1999. PaDEP reviewed the report and submitted its comments in January 2000. In turn, the Authority transmitted correspondence to PaDEP addressing those comments in February 2000 and received approval of the SICR and SHCR.

In accordance with its NPDES Permit, the Authority developed and submitted an Interim LTCP (ILTCP) in May 2000, although this document was not approved. In May 2002, Gannett Fleming presented a Sewer Separation Study to the Authority which identified six (6) alternatives for CSO compliance. The alternatives were complete sewer separation, sewer system equalization (EQ) basins, partial sewer separation and sewer system EQ basins, sewer system EQ basins and treatment at CSOs, expanded conveyance facilities and EQ basin at WWTP, and expanded conveyance facilities and WWTP expansion.

In August 2002, PaDEP issued an Order that required the Authority to cease all CSO discharges, within thirty-six (36) months, from the diversion structure at the headworks of the WWTP, except those that meet the terms and conditions of Section B.1.f and the bypassing provisions of its NPDES permit and certain sections of the Code of Federal Regulations. In addition, the Authority was required to submit its Long Term Control Plan (LTCP) by January 1, 2003. A re-rating study of the WWTP was performed to address the hydraulic overload situation by evaluating an increase in the permitted design capacity from 3.66 MGD to 4.96 MGD, which was approved through issuance of the NPDES renewal on October 2, 2002. In addition, CSO Nos. 008, 009, 012, and 020 were removed from the NPDES Permit renewal.

A great deal of correspondence occurred throughout 2002 regarding the Authority's NMCs and LTCP. In January 2003, the Authority submitted their Final Documentation of Implementation of the NMCs as well as a LTCP that did not select a capitally intensive construction alternative, but outlined the programs that will allow ultimate selection of a construction alternative. The plan also addressed continued implementation of the NMCs, consideration of sensitive areas, public participation, and pre/post construction monitoring in accordance with the requirements of a small community. The primary tasks the plan called for were implementation of a flow monitoring program and a water quality sampling program.

Although the Authority received an approval of their NMC document shortly after their submittal, PaDEP sent a LTCP Review letter dated June 21, 2005 regarding the Authority's January 2, 2003 LTCP submittal thereby disapproving the submittal based on the failure to set forth a defined course of action designed to not cause or contribute to a violation of water quality standards.

1.2 History of the CSO Control Policy

The following excerpt is from EPA's Combined Sewer Overflow Guidance for Long-Term Control Plan.

Historically, the control of CSOs has proven to be extremely complex. This complexity stems partly from the difficulty in quantifying CSO impacts on receiving water quality and the site-specific variability in the volume, frequency, and characteristics of CSOs. In addition, the financial considerations for communities with CSOs can be significant. The U.S. Environmental Protection Agency (EPA) estimates the CSO abatement costs for the 1,100 communities served by CSSs to be approximately $41.2 billion. To address these challenges, EPA's Office of Water issued a National Combined Sewer Overflow Control Strategy on August 10, 1989 (54 Federal Register 37370). This Strategy reaffirmed that CSOs are point source discharges subject to National Pollutant Discharge Elimination System (NPDES) permit requirements and to Clean Water Act (CWA) requirements. The CSO Strategy recommended that all CSOs be identified and categorized according to their status of compliance with these requirements. It also set forth three objectives:

- *Ensure that if CSOs occur, they are only as a result of wet weather*
- *Bring all wet weather CSO discharge points into compliance with the technology based and water quality-based requirements of the CWA*
- *Minimize the impacts of CSOs on water quality, aquatic biota, and human health.*

In addition, the CSO Strategy charged all States with developing state-wide permitting strategies designed to reduce, eliminate, or control CSOs. Although the CSO Strategy was successful in focusing increased attention on CSOs, it fell short in resolving many fundamental issues. In mid-1991, EPA initiated a process to accelerate implementation of the Strategy. The process included negotiations with representatives of the regulated community, State regulatory agencies, and environmental groups. These negotiations were conducted through the Office of Water Management Advisory Group. The initiative resulted in the development of a CSO Control Policy, which was published in the Federal Register on April 19, 1994 (59 Federal Register 18688). The intent of the CSO Control Policy is to:

- *Provide guidance to permittees with CSOs, NPDES permitting and enforcement authorities, and State water quality standards (WQS) authorities*
- *Ensure coordination among the appropriate parties in planning, selecting, designing, and implementing CSO management practices and controls to meet the requirements of the CWA*
- *Ensure public involvement during the decision-making process.*

The CSO Control Policy contains provisions for developing appropriate, site-specific NPDES permit requirements for all CSSs that overflow due to wet weather events. It also announces an enforcement initiative that requires the immediate elimination of overflows that occur during dry weather and ensures that the remaining CWA requirements are complied with as soon as possible.

1.3 Key Elements of the CSO Control Policy

The following excerpt is from EPA's Combined Sewer Overflow Guidance for Long-Term Control Plan.

The CSO Control Policy contains four key principles to ensure that CSO controls are cost-effective and meet the requirements of the CWA:

- *Provide clear levels of control that would be presumed to meet appropriate health and environmental objectives*
- *Provide sufficient flexibility to municipalities, especially those that are financially disadvantaged, 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 for implementation of CSO controls considering a community's financial capability*
- *Review and revise, as appropriate, WQS and their implementation procedures when developing long-term CSO control plans to reflect the site-specific wet weather impacts of CSOs*

In addition, the CSO Control Policy clearly defines expectations for permittees, State WQS authorities, and NPDES permitting and enforcement authorities. These expectations include the following:

- *Permittees should immediately implement the nine minimum controls (NMC), which are technology-based actions or measures designed to reduce CSOs and their effects on receiving water quality, as soon as practicable but no later than January 1, 1997.*
- *Permittees should give priority to environmentally sensitive areas.*
- *Permittees should develop long-term control plans (LTCPs) for controlling CSOs.*
- *A permittee may use one of two approaches: 1) demonstrate that its plan is adequate*

to meet the water quality-based requirements of the CWA ("demonstration approach"), or 2) implement a minimum level of treatment (e.g., primary clarification of at least 85 percent of the collected combined sewage flows) that is presumed to meet the water quality-based requirements of the CWA, unless data indicate otherwise ("presumption approach").

- *WQS authorities should review and revise, as appropriate, State WQS during the CSO long-term planning process.*
- *NPDES permitting authorities should consider the financial capability of permittees when reviewing CSO control plans.*

Exhibit 1-1 illustrates the roles and responsibilities of permittees, NPDES permitting and enforcement authorities, and State WQS authorities.

In addition to these key elements and expectations, the CSO Control Policy also addresses important issues such as ongoing or completed CSO control projects, public participation, small communities, and watershed planning.

1.4 Guidance to Support Implementation of the CSO Control Policy

EPA has developed a large number of guidance documents to help permittees and NPDES permitting and WQS authorities to implement the CSOP. They are all available on EPA's website at www.EPA.gov.

1.5 Goal of this Document

The goal of this document is to set forth a defined course of action for the Authority to implement which will thereby eliminate the CSO discharges' cause or contribution to the non-attainment of WQS in the Monongahela River.

1.5.1 Target Audience

The audience of this document is the general public and more specifically the residents of the Borough of Donora and the City of Monessen, the members of the Authority, and the regulatory agencies in the form of DEP and EPA.

1.5.2 Document Organization

Chapter 1 provides a background of the Authority and more specifically their road to compliance with the CSOP. Chapter 2 describes those activities the Authority has conducted in order to collect the information and data necessary to prepare their LTCP. Chapter 3 identifies the alternatives that were selected to evaluate, as well as the methodology that was used throughout the process. Chapter 4 selects the alternative to be implemented as part of the LTCP, as well as its associated implementation schedule and financing plan.

1.6 Long-Term Planning Approach Summary

The Authority implemented the overall planning approach recommended by the LTCP Guidance Document consisting of system characterization, development and evaluation of alternatives, and selection and implementation of the controls. In addition, all nine elements of a successful LTCP were carefully considered:

1. Characterization, Monitoring, and Modeling
2. Public Participation
3. Sensitive Areas
4. Evaluation of Alternatives
5. Cost/Performance Considerations
6. Operational Plan
7. Maximization of Treatment at the Existing POTW Treatment Plant
8. An Implementation Schedule
9. A Post-Construction Compliance Monitoring Program

1.6.1 Initial Activities

As recommended by the LTCP Guidance Document, the Authority developed a CSO program team which consisted of the consulting engineer, the members of the Authority, the General Manager and Superintendent of the POTW, as well as staff members of the Authority responsible for field activities and data collection.

1.6.2 Public Participation and Agency Interaction

The Authority is comprised of volunteers, which hold regularly scheduled public meetings that provide a good forum to explain proposed programs and receive public input on matters related to the sewer system. The Authority committed to instituting a public education program by April 1, 2003. The Authority began to hold a series of public meetings with Monessen and Donora Councils to inform them of the Authority's efforts. In addition, the Authority installed signs at all of the CSOs and at the public boat launch, and they raise a CSO flag at the WWTP for 48 hours following each wet weather event. The flag is visible from the aforementioned sensitive area (boat launch) and provides an additional method of advising the public of the potential impacts from CSO discharges. Each year, the Authority teams with the local newspaper to develop an article that speaks to the Authority's efforts and describes the CSO sign and flag warning system.

EPA's CSO Control Policy states that in developing its long-term CSO 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 Authority instituted this process by providing educational forums for elected officials from Monessen and Donora on the CSO Policy. The Council of each municipality began discussing these issues at their public meetings. An advertisement will be run in the local daily newspaper and a 30-day public comment period will be conducted as part of finalization of this LTCP document. Copies of the draft plan shall be placed for public review at the City of Monessen and Borough of Donora offices. Any public comments received will be considered prior to finalizing the plan.

1.6.3 Coordination with State Water Quality Standards Authority

The Ohio River Valley Water Sanitation Commission (ORSANCO) is the primary body in the area that has put forth efforts to conduct significant water quality studies. Since 1948, ORSANCO and its member states have cooperated to improve water quality in the Ohio River Basin so that the river and its tributaries can be used for drinking water, industrial supplies, and recreational purposes; and can support a healthy and diverse aquatic community. ORSANCO operates monitoring programs to check for pollutants and toxins that may interfere with specific uses of the river, and conducts special studies to address emerging water quality issues. We have and will continue to use ORSANCO as a resource for collected water quality monitoring data and how it can be used to in conjunction with the Authority implementation of their LTCP.

1.6.4 Integration of Current CSO Control Efforts

The Authority has implemented those CSO control efforts identified in the Nine Minimum Controls and is presently evaluating additional substantial capital improvements as part of this LTCP.

1.6.5 Watershed Approach to CSO Control Planning

The Authority is in favor and very aware of the significance of a watershed based approach to CSO control planning. Non-point source discharges as well as the unsewered Village of Webster will have a lasting effect on the attainment of WQS after implementation of CSO controls in the Authority's service area. For this reason, our water quality sampling program included sample collection of the Webster stream where it discharges to the Monongahela River, as well as the Seneca Street stream upstream of where it enters the Authority's combined system. The post-construction compliance monitoring program will have to adequately take into account these other impacts on the attainment of WQS.

1.6.6 Small System Considerations

The LTCP Guidance document indicates that small systems with populations of less than 75,000 need only include the following elements:
Implementation of NMC
Public participation
Consideration of sensitive area
Post-construction compliance monitoring program

While the intent of the original National CSO Policy was to allow small communities this leniency, EPA and PaDEP have now required communities of all sizes to develop comprehensive LTCPs that must set forth a defined course of action to not cause or contribute to a violation of water quality standards.

1.6.7 Sensitive Areas

The primary sensitive area in the Authority service area is a public boat launch, which qualifies as a primary contact area for recreation. This boat launch is approximately 1,400 feet downstream of the largest CSO in the Authority service area (CSO No. 007 at Seneca Street). This CSO includes flow from a stream that is tied into the combined sewer system. All of the evaluated alternatives include separation of this stream from the combined sewer system.

The Authority implemented a water quality sampling program on April 1, 2003. The goal of this program was to determine whether the Seneca Street stream meets water quality standards prior to any sanitary connection points, and to characterize the water quality of the Monongahela River. Sampling of the Monongahela River occurred below three (3) bridges in the service area and at the public boat launch as discussed in Section 2.5.3.1. It is believed that the Seneca Street stream may be contaminated by malfunctioning septic systems or other non-point sources prior to any sanitary sewer connections within Monessen. This is valuable information in evaluating the option of separating the Seneca Street stream from the combined sewer system due to the possibility of Storm Water Phase II NPDES Permit violations.

1.6.8 Measures of Success

The CSO Guidance Document stresses that serious consideration should be given to "measures of success." In terms of this document, "Measures of Success" are objective, measurable, and quantifiable indicators that illustrate trends and results over time. The CSO Guidance Document establishes the following four categories:

- Administrative measures that track programmatic activities;
- End-of-pipe measures that show trends in the discharge of CSS flows to the receiving water body, such as reduction of pollutants loadings, the frequency of CSOs, and the duration of CSOs;
- Receiving water body measures that show trends of conditions in the water body to which the CSO occurs, such as trends in dissolved oxygen levels and sediment oxygen demand; and
- Ecological, human health, and use measures that show trends in conditions relating to the use of the water body, its effect on health of the population that uses the water body, and the health of the organisms that reside in the water body, including beach closures, attainment of designated uses, habitat improvements, and fish consumption advisories. Such measures would be coordinated on a watershed basis as appropriate.

The following excerpt is from EPA's Combined Sewer Overflow Guidance for Long-Term Control Plan.

Chapter 2 focuses on the establishment of existing baseline conditions. The objective of this chapter is to provide an overview of how the components of the system characterization contribute to LTCP development. As a prelude to the description of the technical activities that make up the system characterization, this chapter discusses the importance of input from the public and the appropriate regulatory agencies during LTCP development and integration of the nine minimum controls (NMC) with the LTCP. The chapter includes a case study documenting the watershed approach to system characterization used by a small CSO municipality. Combined Sewer Overflows-Guidance for Monitoring and Modeling (EPA, 1995d) contains a more comprehensive description of these components.

2.1 Public Participation and Agency Interaction

Public Participation and Agency Interaction was discussed in Section 1.6.2. The Authority held nine public meetings between 2002 and 2005. Specific to the system characterization, Monessen and Donora supplied information for the mapping and cleaning and televising project, as well as street sweeping and catch basin cleaning and repair information for the Annual CSO Reports as part of the Chapter 94 Municipal Wasteload Management Report submitted to DEP.

2.2 Objective of System Characterization

The following excerpt is from EPA's Combined Sewer Overflow Guidance for Long-Term Control Plan.

The primary objective of system characterization is to develop a detailed understanding of the current conditions of the CSS and receiving waters. *This assessment, a crucial component of the planning process, establishes the existing baseline conditions and provides the basis for determining receiving water goals and priorities and identifying specific CSO controls in the*

LTCP. In the context of the CSO Control Policy: "The purpose of the system characterization, monitoring and modeling program initially is to assist the Permittee in developing appropriate measures to implement the nine minimum controls and, if necessary, to support development of the long-term CSO control plan. The monitoring and modeling data also will be used to evaluate the expected effectiveness of both the nine minimum controls and, if necessary, the long-term CSO controls, to meet WQS" (II.C. 1).

2.3 Implementation of the Nine Minimum Controls

As described previously, the Authority submitted their NMC document in January 2003 and subsequently received PaDEP approval. The Authority NMC report provided specific documentation that demonstrated implementation of the nine NMCs throughout their service area. The nine NMCs are as follows:

1) Proper Operation & Regular Maintenance Programs
2) Maximum Use of the Collection System for Storage
3) Review and Modification of Pretreatment Requirements
4) Maximization of Flow to the POTW for Treatment
5) Elimination of CSOs during Dry Weather
6) Control of Solid & Floatable Materials
7) Pollution Prevention Program
8) Public Notification of Overflow Occurrences & Their Impacts
9) Monitoring to Characterize CSO Impacts and the Efficacy of Controls

In accordance with NPDES requirements, the Authority continues to prepare and submit Annual CSO Reports as part of the Chapter 94 Municipal Wasteload Management Report which documents the Authority's continued implementation of the nine technology based minimum controls.

2.3.1 Existing Baseline Conditions

As discussed later, the Authority implemented extensive water quality and flow monitoring programs.

2.3.2 Summary of Minimum Controls

The nine minimum controls are summarized above.

2.4 Compilation and Analysis of Existing Data

The following section will discuss watershed mapping, analysis of existing collection system information, CSO and non-CSO source characterization, field inspections, and receiving water characterization.

2.4.1 Watershed Mapping

The Mon Valley Sewage Authority sewerage system map is included as Exhibit 2-1 in Appendix A, the City of Monessen sewer system map is included as Exhibit 2-2 in Appendix A, and the Borough of Donora sewer system map is included as Exhibit 2-3 in Appendix A. These maps were created through a comprehensive Global Positioning System (GPS) and Geographic Information System (GIS) development project where over 460,000 feet of sanitary, combined, and storm sewers and approximately 4,000 inlets and manholes were inventoried. The locations of the 4,000 inlets and manholes were identified via survey-grade GPS and the verification of interconnectivity of the sewers was completed through an internal cleaning and inspection project of approximately 350,000 feet of combined and sanitary sewers. The storm sewers were mapped with the use of existing mapping and as-built drawings.

2.4.2 Collection System Understanding

Sewage first enters the sewer system through municipal street sewers. The street sewers were built by Monessen and Donora, which were both incorporating municipalities in the Mon Valley Sewage Authority joint project. Large portions of the sewer systems in these communities date back to the early 1900's. The Monessen and Donora sewer systems consist of approximately 226,600 feet and 102,100 feet of pipe, respectively. The intercepting sewers of the Authority intercept these street sewers and transport all of the sewage flow to the Authority WWTP. At each point of interception, either a regulator chamber or a diversion manhole is provided to separate and transfer the sanitary sewage to the intercepting sewers. Pumping stations and force mains augment the intercepting sewers as required by the topography. Along the Monongahela River, on the west side of Monessen, sewage first enters the Authority system in the Aubrey Avenue interceptor and flows to the Aubrey Avenue Ejector Station, where it is pumped through a force main to the South interceptor. The South Pumping Station receives sewage from the South interceptor and lifts it through a force main to a Monessen sewer on Schoonmaker Avenue near Morgan Avenue, which in turn flows to the Donner Avenue interceptor and the Donner Avenue Pumping Station. The sewage flow is lifted through the Donner Avenue force main, then flows through the Monessen interceptor to the Monessen Pumping Station, and is pumped across the Monongahela River to the WWTP.

Sewage from Donora enters the sewer system in the North interceptor on Gilmore Avenue near Boundary Alley, and also near the intersection of Meldon Avenue and Eleventh Street. Flows from the northern and southern sections of the North interceptor discharge to the North Pumping Station and are then pumped through the North force main to the Donora interceptor and the Donora Pumping Station. Also, flow from the north and south sections of the Donora interceptor from Walnut Street to Eighth Street join together at the pumping station and are then lifted through the Donora force main to the Authority WWTP.

The WWTP is located in Carroll Township near Donora on the north bank of the Monongahela River. The plant was originally designed to treat an average sewage flow of 3.66 million gallons per day, contributed by a design population of 36,000 persons. A re-rating study was recently conducted to demonstrate that the WWTP could adequately treat 4.96 million gallons per day and is reflected in the NPDES Permit. The design flow and population are based on the estimated ultimate development of Monessen, Donora, and a portion of Carroll Township.

2.4.3 CSO and Non-CSO Source Characterization

As previously noted, the Authority sewer system presently includes seventeen (17) CSOs that reduce surcharge problems within the combined sewer system and protect the Mon Valley WWTP during wet weather events. Table 2-1 describes each CSO. The general locations of the

CSOs are indicated on the sewer maps included in Appendix A. Detailed information regarding the condition and operation of each CSO is included in the Authority's *NMC Documentation* submitted in September 2002.

TABLE 2-1
COMBINED SEWER OVERFLOWS

Name	Type	CSO Number	Receiving Stream	Location	
				Latitude	Longitude
Monessen					
Seventeenth Street	Diversion Manhole	002	Monongahela River	40°09'19"	79°54'15"
Eleventh Street	Sewage Regulator	003	Monongahela River	40°09'48"	79°51'49"
Third Street	Sewage Regulator	004	Monongahela River	40°09'47"	79°52'57"
Second Street	Diversion Manhole	005	Monongahela River	40°09'46"	79°52'48"
River Street	Diversion Manhole	006	Monongahela River	40°09'45"	79°52'45"
Seneca Street	Sewage Regulator	007	Monongahela River	40°09'43"	79°52'34"
Seneca Street	Diversion Manhole		Monongahela River		
Seneca Street	Diversion Manhole		Monongahela River		
Donora					
Walnut Street	Diversion Manhole	010	Monongahela River	40°09'51"	79°51'35"
Locust Street	Diversion Manhole	011	Monongahela River	40°10'02"	79°51'21"
Chestnut Street	Diversion Manhole		Monongahela River	40°10'03"	79°51'19"
Bradford Alley	Diversion Manhole	013	Monongahela River	40°10'30"	79°51'17"
Fifth Street	Sewage Regulator	014	Monongahela River	40°10'30"	79°51'06"
Seventh Street	Diversion Manhole	015	Monongahela River	40°10'44"	79°51'06"
Eighth Street	Diversion Manhole	016	Monongahela River	40°10'48"	79°51'07"
Eleventh Street	Diversion Manhole	017	Monongahela River	40°11'10"	79°51'14"

Kenyon Alley	Diversion Manhole	018	Monongahela River	40°11'13"	79°51'15"
Scott Street	Diversion Manhole	019	Monongahela River	40°11'22"	79°51'17"
Fifteenth Street	Sewage Regulator	021	Monongahela River	40°11'34"	79°51'32"
Boundary Alley	Sewage Regulator	022	Monongahela River	40°11'37"	79°51'37"

2.4.4 Field Inspections

The Authority has formed a two (2) man CSO crew that is responsible for the operation and maintenance of the diversion manholes and regulator structures. The crew conducts weekly inspections, which are summarized in Appendix B.

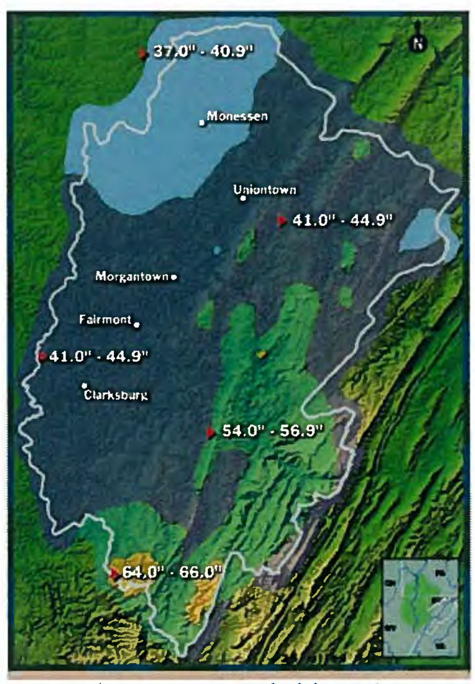
2.4.5 Receiving Water

The Monongahela River (also known as the Mon) is a river on the Allegheny Plateau in West Virginia and Pennsylvania in the United States. At Pittsburgh, it meets the Allegheny River to form the Ohio River. The Monongahela is formed by the confluence of the West Fork River and the Tygart Valley River at Fairmont, West Virginia. The river is navigable its entire length with a series of locks/dams ensuring a 9' depth. In Pennsylvania, the Monongahela is met by two major tributaries: the Cheat River, which joins at Point Marion; and the Youghiogheny River, which joins at McKeesport. The Monongahela has been heavily used by industry, and several U.S. Steel plants, including the Homestead Works, were built along its banks. The Monongahela Watershed has an area of 7,340 square miles; the river has a length of 116 miles and an elevation change of about 1600 feet. Figures 2-1 and 2-2 display the Monongahela River Watershed Map and Precipitation Map. Table 2-2 displays the land use in square miles and as a percentage of the Mon watershed.

FIGURE 2-1
MONONGAHELA RIVER WATERSHED MAP

(source www.watershedaltas.org)

FIGURE 2-2
MONONGAHELA RIVER WATERSHED PRECIPITATION MAP



(source www.watershedaltas.org)

TABLE 2-2
MONONGAHELA RIVER WATERSHED
LAND USE BREAKDOWN

Land Uses:	sq. mi. (approx)	Percentage (%)
Water (Large Rivers and Lakes)	59.4	0.81
Wetlands (Palustrine, Lacustrine, and Riverine)	36.7	0.50
Mixed Forest	5157.9	70.27
Evergreen Forest	272	3.71
Hay/ Pasture	505.5	6.89
Row Crops/Fields	1036.7	14.12
Urban (Towns and other impervious surfaces like roads, parking lots, houses)	179.7	2.45
Barren (Includes Mines, Quarries and other extensive earthmoving)	83.6	1.14
Lawns, parks, golf courses	5.1	0.069

Soils in the watershed area of steep slope are commonly shallow, weakly developed, poorly drained and have low fertility and high erosion potential. Soils on gentler slopes and soils over unconsolidated sediments are generally deep, well drained, and fertile. The average annual precipitation in the area is 42 inches. Average annual runoff between 1951 and 1980 ranged from 25 to 40 inches per year in the mountainous southeastern areas and from 18 to 26 inches elsewhere in the area. The average annual recharge is estimated to range from 8 to 15 inches. The remainder of the average annual precipitation is considered evapotranspiration.

Monessen and Donora are located on opposite sides of the Monongahela River in Southwestern Pennsylvania, at the lower end of the Monongahela and are located upstream of the confluence of the Youghiogheny River with the Monongahela River. The Youghiogheny has the largest watershed of the Monongahela tributaries, 1,764 square miles and is not contributing to the Monongahela River flow at Monessen.

Monessen has a population of about 8,500 and occupies roughly 3.1 square miles on the east bank of the Monongahela River in Westmoreland County. Donora which occupies the west bank of the Monongahela River in Washington County has a population of approximately 6,500 and occupies 2.0 square miles. Both Monessen and Donora are located about 20 miles southeast of Pittsburgh.

Monongahela River flow data for this report was obtained from the flow gauge at the Elizabeth Locks downstream of the Charleroi Locks during the flow monitoring and water quality monitoring period. Flow data was not available at the Charleroi Locks. Daily flow totals are provided in Appendix C.

2.5 Combined Sewer System and Receiving Water Monitoring

Prior to design of wet weather management facilities, the Authority realized the importance of initiating an extensive monitoring program throughout the system. The purpose of this plan was to establish existing baseline dry and wet weather conditions and capture wet weather conditions of the existing CSS discharges. This program included flow metering and water quality sampling of the CSOs, and water quality sampling of the receiving waters.

2.5.1 Monitoring Plan Development

Part of the monitoring program consisted of a flow metering program with flow meters installed at each CSO to determine the volume of water produced in each drainage area, the actual volume of the CSO discharges, and verification that the regulators and diversion manholes are conveying 350% of the Average Dry Weather Flow (ADWF) to the interceptor. An extensive water quality monitoring plan was implemented to document dry and wet weather conditions of the receiving streams, as well as contaminant levels present in CSO discharges to determine the impacts due to overflows of the system.

2.5.2 Combined Sewer System Monitoring

As mentioned above, the ongoing flow metering program consists of flow meters at each CSO. The placement of these meters quantifies the amount of flow conveyed to the diversion structure, the overflow and to the interceptor from those watersheds that are metered. These meters have continuously taken readings every 15 minutes since the installation, however some of the meters may have been removed for repairs at various times.

2.5.2.1 Selection of Monitoring Stations

Four (4) of the seventeen (17) CSOs are very rarely active since weirs were raised to maximize flows to the WWTP and therefore were not metered. There are 13 regularly active CSOs, three of which have multiple diversion structures that convey flow to them. In order to determine that each of the diversion structures is conveying 350% of the ADWF, the Authority purchased eighteen (18) flow meters to monitor seventeen (17) of the diversion structures and the diversion pipe at the WWTP. Table 2-3 identifies each CSO structure and the monitoring device used.

TABLE 2-3

DIVERSION STRUCTURE MONITORING EQUIPMENT

Discharges to CSO No.	Diversion Manhole Location	Diversion Manhole No.	Structure Type	Monitoring Device
002	Seventeenth St. - M	M300A	Diversion MH	Flow Meter
003	Eleventh St. - M	M202	Regulator	Flow Meter
004	Third St. - M	M113	Diversion MH	Flow Meter
005	Second St. - M	M111A	Diversion MH	Flow Meter
006	River St. - M	M110 A	Diversion MH	Chalking Method
007	Seneca St. - M	M107A	Regulator	Flow Meter
	Seneca St. - M	M106A	Diversion MH	Flow Meter
	Seneca St. - M	M106B	Diversion MH	Flow Meter
010	Walnut St. - D	D123A	Diversion MH	Flow Meter
011	Locust St. - D	D121A	Diversion MH	Flow Meter
	Chestnut St. - D	D118A	Diversion MH	Flow Meter
013	Bradford Alley - D	D100A	Diversion MH	Chalking Method
014	Fifth St. - D	D106	Regulator	Flow Meter
	Sixth St. - D	D111	Regulator	Flow Meter
015	Seventh St. - D	D114A	Diversion MH	Flow Meter
016	Eighth St. - D	D116A	Diversion MH	Flow Meter
017	Eleventh St. - D	D213A	Diversion MH	Flow Meter
018	Kenyon Alley - D	D211A	Diversion MH	Chalking Method
019	Scott St. - D	D208A	Diversion MH	Chalking Method
021	Fifteenth St. - D	D205	Regulator	Flow Meter
022	Boundary Alley - D	D207	Regulator	Flow Meter

M – Monessen, D – Donora. Chalking Method involves marking the chamber with chalk and indicating the height of which the chalk was washed away due to overflow events during the weekly field visits.

2.5.2.2 Frequency of Monitoring

The Authority purchased and installed all of the meters during 2003 and continues to maintain, download, and process the data on a weekly basis. The CSO crew is also responsible for the collection of meter data and the maintenance of the meters. Flow meters installed in the diversion structures and at the plant are programmed to take a reading every 15 minutes in order to capture instantaneous flow rates.

2.5.2.3 Pollutant Parameters

Pollutant parameters for the water quality monitoring program are described below in paragraph 2.5.3.3.

2.5.2.4 Rainfall Monitoring and Analysis

Daily and monthly precipitation has been measured by a totalizing rain gauge at the WWTP (from 8 AM to 8AM). In addition, as part of this LTCP and the flow metering program, the Authority installed a rain gauge on May 15, 2003 that measures rainfall at 15-minute intervals allowing analysis of increase in influent flow and overflow volume based on rainfall intensity. The 15-minute rainfall data has been compiled with the flow data for each CSO.

2.5.2.5 CSO Flow Monitoring and Analysis

Flow monitoring data collected at the CSOs was utilized in developing the System Model and the Percent Capture tables for each Diversion and Regulator structure. Data for each monitoring point can be found in Appendix D, which contains spreadsheets that display summary tables and graphs.

Beginning in May 2003, flow meters were placed in a number of the diversion structures with the intent to monitor influent and overflow data with over 3 years of data having been recorded for the majority of the CSOs. An analysis of consecutive 365 day periods of recorded rain data versus the average of the past 50 years of historic rainfall for Pittsburgh concluded that the closest rain total for any yearly span of the data recorded was from September 1, 2004 to August 31, 2005. The rain total during that time was 41.32, and the fifty year average for the city of Pittsburgh was 37.26 inches. It was determined to be conservative to use a year where the total was greater then the 50 year average. Two of the diversion structures where influent flows were recorded did not have complete data during this yearly span, so a separate span was chosen for each where a full year of data had been recorded. For Site 003 the span between June 1, 2004 to May 31, 2005 with a total of 46.61 inches of rain was chosen, and for Site 010 the span between May 1, 2004 to April 30, 2005 with a total of 48.73 inches of rain was chosen. Historic precipitation for the City of Pittsburgh can be found in Appendix E.

For each diversion structure where influent data was recorded, a Percent Capture Evaluation and a Dry Weather Flow calculation were performed. All percent capture equations are computed on 15 minute data which is then averaged into daily data and displayed as daily total volumes. Dry weather flow equations are done on hourly data, once the calculations are complete; the Annual Average Dry Weather Flow is calculated as the average of the year's hourly dry weather data points.

Under the presumption approach, controls adopted in the LTCP should be required to eliminate or capture for treatment no less than 85% by volume of the combined sewage collected in the Combined Sewer System during precipitation events on a system wide annual average basis. Through conversations with representatives of PaDEP, we have determined that a precipitation event is defined by any recordable rainfall lasting the duration of the rain plus some time of concentration. Therefore, a spread sheet has been created that calculates the percent capture for a diversion structure based entirely on the time of concentration of a rain event. Terms and calculations of this sheet are described below.

Terms Defined

Annual Average Dry Weather Flow (AADWF) is defined as the average of the data where wet weather flow is discounted.

Annual Average Dry Weather Flow is calculated as the average of the entire year's hourly data where wet weather hourly flow data is discounted.

Wet Weather Flow Hourly Data is considered hourly flow data that meets the following conditions:

An hourly rain data point was recorded.

Or

The flow during that hour exceeds the average of the previous three day's flow rate during the same hour multiplied by 150%, and any rainfall was recorded during the past 72 hours.

If any of these conditions are met, then that hour's data is considered Wet Weather Hourly Flow and not averaged in the Annual Average Dry Weather Flow calculation.

Precipitation Event is considered any recordable amount of rainfall that has a duration of the recorded time plus the Time of Concentration for that respective drainage area.

For the purposes of our calculations the precipitation event is considered any recorded amount of rain and lasts from the time that the first rain data was recorded lasting consecutively until the time that the last rain data was recorded plus the calculated Time of Concentration.

Time of Concentration is defined as the time it takes for the last drop of rain of a precipitation event, falling on the most hydraulically remote point of the watershed to travel to the discharge outlet or design point of that watershed.

The Time of Concentration for each watershed was calculated using the September 8, 2004 storm, which equated to roughly a 2 year 24-hour storm. The September 8, 2004 storm totaled 2.87 inches and lasted for 29 hours. The 2-year 24 hour storm for this area is 2.5 inches. The time of concentration was then calculated as the amount of time between the last drop of rainfall and the point where each site's flow returned to dry weather flow conditions. Table 2-4 displays the time of concentration for each monitoring point.

TABLE 2-4

TIME OF CONCENTRATION

Site	Time of Concentration (hrs)
CSO 003 - Eleventh Street MH M202A	34
CSO 004 -Third Street MH M113A	44
CSO 005 - Second Street MH M111A	14
CSO 007 - Seneca Street MH M107A	16
CSO 0070 -Seneca Street MH M106A	12
CSO 00700 - Seneca Street MH M106B	18
CSO 010 - Walnut Street MH D123A	31
CSO 011 - Locust Street MH D121A	39
CSO 0110 -Chestnut Street MH D118A	26
CSO 014 - Fifth Street MH D106A	10
CSO 0140 - Sixth Street - D111	28
CSO 015 - Seventh Street MH D114A	10
CSO 016 - Eighth Street MH D116A	50
CSO 017 - Eleventh Street MH D202	16
CSO 021 - Fifteenth Street - D205	6
CSO 022 - Boundary Alley - D207	0*

* - For CSO 022 – Boundary Alley – D207 line flow return to the AADWF the same time that last rainfall point was recorded.

Line Flow Included in Percent Capture Calculation is defined as all flow greater then the AADWF that was recorded entering the diversion structure during a precipitation event.

Flow Conveyed to the Plant Included in Percent Capture Calculation is defined as the flow greater then the AADWF and up to 350% that entered the diversion structure during a precipitation event, and was conveyed to the STP. Where recorded flows exceed 350% of the AADWF, 350% of the AADWF is considered conveyed to the plant and all excess flows are considered Overflow Included in Percent Capture Calculation.

Overflow Included in Percent Capture Calculation is defined as any flow that entered the diversion structure which was not conveyed to the STP. This flow is calculated as the Line Flow Included in Percent Capture Calculation minus 350% of the AADWF.

Flow Treated By Satellite Facility Included in Percent Capture Calculation is defined as the flow that is overflowed from the diversion structure and is conveyed to and treated by the satellite facility during a precipitation event.

The Flow Treated By Satellite Facility is calculated as the Overflow Included in Percent Capture Calculation up to but not exceeding the capacity of the facility. Where recorded flows exceed the capacity of the facility, the flow capacity of the facility is considered treated by the Satellite Facility and all excess flows are considered untreated to the river.

Flow Untreated to the River Included in Percent Capture Calculation is defined as the flow that is overflowed from the diversion structure and is not treated by the satellite facility during a precipitation event. This flow is calculated as the Overflow Included in Percent Capture Calculation minus the flow capacity of the satellite facility.

Overflow Occurrences is defined as a day when untreated flow was conveyed to the river. An overflow occurrence is considered to have occurred if at any time during that day the Overflow Included in Percent Capture Calculation exceeds the flow capacity of the satellite facility.

Percent Capture by Plant is defined as the percent of the total recorded flow that was conveyed to the plant during precipitation events.

The percent capture by the plant is calculated as the total annual Flow Conveyed to the Plant Included in Percent Capture Calculation divided by the total annual Line Flow Included in Percent Capture Calculation.

Percent Capture by Satellite Facility is defined as the percent of the total recorded flow that was conveyed to the satellite facility during precipitation events.

The percent capture by the satellite facility is calculated as total annual Flow Treated by Satellite Facility Included in Percent Capture Calculation t divided by the total annual Line Flow Included in Percent Capture Calculation.

Percent Untreated to the River is defined as the percent of the total recorded flow that flowed untreated into the river during precipitation events.

The percent untreated to the river is calculated as total annual Flow Untreated to the River Included in Percent Capture Calculation divided by the total annual Line Flow Included in Percent Capture Calculation.

Total Percent Capture is defined as the percent of total recorded flow was either conveyed to the plant or treated by the satellite facility during precipitation events.

Total Percent Capture was calculated as the Percent Capture by Plant plus the Percent Capture by Satellite Facility.

Data evaluation is thorough evaluation and analysis of the data at each site. Some areas of faulty data were found and the erroneous data was deleted. Causes in erroneous data vary from level and velocity drop outs to level being fixed on a certain value for significant amounts of time due to meter malfunction, or an error in the meter programming during set up causing incorrect pipe sizing, recalculation of the influent data due to the probe being placed in the effluent line, and also to surcharges in the manhole. Where the erroneous data was due to either level or velocity drop outs or a fixed level, the data was recalculated using the formulas of the best fit trend line of the scatter plots of all acceptable data during normal, non-surcharged conditions. Flow was recalculated by multiplying the area by the velocity. Where the erroneous data was due to a programming error in the meter, the meter and software were reprogrammed to account for the correct pipe sizing and the data recalculated and inserted into the spreadsheet. Where data had to be recalculated due to the probe being placed in the effluent line, the effluent flow and CSO flow where added together to produce the influent flow. Erroneous data that had been deleted due to manhole surcharge was recalculated using the formulas of the best fit trend line of the scatter plots of all surcharged conditions. Once again the flow was recalculated multiplying the area by the velocity.

Table 2-5 summarizes the flow monitoring data and displays each monitoring point, and the corresponding AADWF, 350% of the AADWF, and Peak Instantaneous Line Flow.

TABLE 2-5
FLOW DATA SUMMARY

Site	AADWF (MGD)	350% of AADWF (MGD)	Peak Inst. Line Flow (MGD)
CSO 003 - Eleventh Street MH M202A	0.713	2.495	47.149
CSO 004 -Third Street MH M113A	0.857	2.998	19.530
CSO 005 - Second Street MH M111A	0.171	0.598	7.883
CSO 007 - Seneca Street MH M107A	0.811	2.839	29.418
CSO 0070 -Seneca Street MH M106A	0.082	0.288	6.666
CSO 00700 - Seneca Street MH M106B	0.019	0.067	6.746
CSO 010 - Walnut Street MH D123A	0.158	0.552	3.234
CSO 011 - Locust Street MH D121A	0.042	0.147	12.475
CSO 0110 -Chestnut Street MH D118A	0.030	0.104	4.161
CSO 014 - Fifth Street MH D106A	0.231	0.808	35.463
CSO 0140 - Sixth Street - D111	0.274	0.957	18.086
CSO 015 - Seventh Street MH D114A	0.063	0.222	3.106
CSO 016 - Eighth Street MH D116A	0.150	0.525	15.976
CSO 017 - Eleventh Street MH D202	0.137	0.479	6.126
CSO 021 - Fifteenth Street - D205	0.286	1.001	8.527
CSO 022 - Boundary Alley - D207	0.006	0.021	6.730

2.5.2.6 CSO Quality Sampling and Analysis

As described below in section 2.5.3, the Authority undertook an extensive water quality monitoring program where the receiving waters and the CSO outfalls where sampled during wet and dry weather events.

2.5.3 Receiving Water Monitoring

In order to assess the impact of the CSOs on the Monongahela River, the Authority conducted a water quality monitoring program. The goals of the monitoring were to:

1. Assess attainment of Water Quality Standards.
2. Define the baseline conditions in the receiving water.
3. Assess the relative impacts of the CSO discharges on the Monongahela River.
4. Gain sufficient understanding of the water quality in the Monongahela River to support further evaluation of proposed long-term control alternatives.
5. Support the review and revision, as appropriate, of the Water Quality Standards.

2.5.3.1 Selection of Monitoring Stations

The program consisted of 10 sampling points on the Monongahela River, the Seneca Street stream, the 15th Street stream, and the stream discharge from Webster during dry weather. During wet weather, all of the above locations were sampled in addition to each of the CSO discharges. Samples were collected near the left and right banks and in the middle of the Monongahela River from the Charleroi-Monessen, Donora-Monessen, and Donora-Webster Bridges. In addition to sampling of the Monongahela River, the Authority analyzed the water quality of the Seneca Street stream in Monessen and a stream located along Fifteenth Street in Donora prior to their conveyance into the combined sewer system. The Seneca Street stream is a seasonal stream that begins upstream of the Authority service area. The streams are tied into the combined sewer systems with discharge to the Authority facilities. The goal of the sampling was to assess water quality prior to any sanitary connections in order to evaluate the feasibility of separating the streams from the combined sewer systems. These locations are displayed on the map included as Exhibit 2-1 in Appendix A. Table 2-6 displays the sample identification number and a description of each sampling location.

TABLE 2-6

WATER QUALITY SAMPLING
LOCATION IDENTIFICATION AND DESCRIPTIONS

Sample Location Identification Number	Sample Location Description
101	Charleroi-Monessen Bridge - Charleroi Bank
102	Charleroi-Monessen Bridge - Center
103	Charleroi-Monessen Bridge - Monessen Bank
201	Donora-Monessen Bridge - Donora Bank
202	Donora-Monessen Bridge - Center
203	Donora-Monessen Bridge - Monessen Bank
301	Donora-Webster Bridge - Donora Bank
302	Donora-Webster Bridge - Center
303	Donora-Webster Bridge - Webster Bank
401	Boat Launch
501	Seneca Street Stream
601	Webster Discharge
701	15th Street Stream

Lastly, samples were collected at the public boat launch, which is designated as a sensitive area because it is located 1,400 feet downstream of the largest CSO in the Mon Valley service area (CSO No. 007 at Seneca Street), and from a stream which discharges into the Monongahela River from Webster. Samples were taken during both dry and wet weather. Dry weather samples were taken to determine the baseline water quality conditions of the Monongahela River and the Seneca Street stream. Four (4) dry weather samples from each sampling point were taken throughout the year with one (1) set of samples being taken each season. Dry weather samples were taken following five (5) days of a total less than 0.1 inches of precipitation. Wet weather samples were taken during a variety of storm events to properly characterize the condition of the river and stream during wet weather. For purpose of this study, wet weather sampling was performed seven (7) times.

Wet weather conditions were considered to exist following a rainstorm of 0.1 inches of rainfall as determined by the rain gauge located at the WWTP. All samples were taken within 24 hours of the start of a wet weather event.

2.5.3.2 Extent of Monitoring

The Authority initiated the water quality sampling program with the first dry weather sampling event occurring on August 19, 2003. The Authority collected their seventh and last wet weather sampling event on July 26, 2004. The Authority has completed the sampling program with a total of four dry weather events and seven wet weather events as displayed in Table 2-7 below. This data was analyzed as part of this Long Term Control Plan to evaluate the baseline water quality of the Monongahela River during both dry and wet weather and the impacts of the CSO discharges within their system.

TABLE 2-7

WATER QUALITY SAMPLING EVENTS

Event	Date	Rain (inches)	Rain Duration (hrs)
Dry Event #1	August 19, 2003	N/A	N/A
Dry Event #2	November 4, 2003	N/A	N/A
Dry Event #3	March 29, 2004*	N/A	N/A
Dry Event #4	June 28, 2004**	N/A	N/A
Wet Event #1	September 19, 2003	0.69	17
Wet Event #2	October 27, 2003	0.54	12
Wet Event #3	November 19,2003	3.29	17
Wet Event #4	February 3, 2004	0.97	14
Wet Event #5	April 1, 2004	0.72	7
Wet Event #6	May 18, 2004	1.71	21
Wet Event #7	July 26, 2004	0.77	13

*- In the five days prior to Dry Event #3 a total of 0.21 inches of rain was recorded. Results from this site may be affected by previous wet weather.
** - Rain was recorded on the same day as Dry Event #4, however all samples were taken before the rain event began.

2.5.3.3 Pollutant Parameters

The following Table 2-8 represents the test source method, and the parameters that were tested for during the water quality monitoring program:

TABLE 2-8
WATER QUALITY SAMPLING PARAMETERS

Parameter	Method Source
Aluminum (Al)	SM 3120 B
Antimony (Sb)	SM 3120 B
Arsenic (As)	SM 3120 B
Barium (Ba)	SM 3120 B
Beryllium (Be)	SM 3120 B
Boron (B)	SM 3120 B
Cadmium (Cd)	SM 3120 B
Chromium (Cr)	SM 3120 B
Chromium, Hexavalent (Cr +6)	SM 3500-Cr D
Cobalt (Co)	SM 3120 B
Copper (Cu)	SM 3120 B
Cyanide, Free	SM 4500-CN G
Cyanide, Total	EPA 335.3
Iron (Fe)	SM 3120 B
Lead (Pb)	SM 3120 B
Magnesium (Mg)	SM 3120 B
Manganese (Mn)	SM 3120 B
Mercury (Hg)	SM 3120 B
Molybdenum (Mo)	SM 3120 B
Nickel (Ni)	SM 3120 B
Selenium (Se)	SM 3120 B
Silver (Ag)	SM 3120 B
Thallium (Tl)	SM 3120 B
Tin (Sn)	EPA 200.7
Titanium (Ti)	EPA 200.7
Zinc (Zn)	SM 3120 B
Parameter	Method Source
Alkalinity (as CaCO3)	SM 2320 B
BOD	
Chlorine	
E. Coli	
Fecal Coliform	SM 922 D
Fluoride	SM 4500-CN G
Nitrogen, Ammonia	EPA 350.2
Nitrogen, Nitrate/Nitrite	DEP 353.2
Oil & Grease	EPA 413.1
Osmotic Pressure	
Oxygen Dissolved	EPA 360.1

pH	EPA 150.1
Phenols	EPA 420.1
Solids, Total Suspended	
Solids, Total Dissolved	SM 2540 C
Temperature	EPA 0170.1

2.5.3.4 Hydraulic Monitoring and Analysis

Hydraulic monitoring of the receiving waters was not completed as part of the LTCP. As discussed in *Section 2.4.5,* flow data for the Monongahela River was available and acquired for the Elizabeth Locks downstream of the Charleroi Locks during the flow monitoring and water quality monitoring period. No Flow data was available at the Charleroi Locks. Daily Monongahela River flow totals are provided in Appendix C.

2.5.3.5 Receiving Water Quality Monitoring and Analysis

Summary tables with the results of each sampling event can be found in Appendix F, summary tables and graphical representation of the results for Fecal Coliforms are included in Appendix G. It was found that, excluding some sampling points, the majority of the parameters sampled for all dry events were within acceptable limits. Also a number of parameters sampled during wet events were within acceptable limits. Due to feedback from DEP that Fecal Coliform is their primary concern and indicator of impairment of Water Quality Standards, the following paragraph will expound only on the data collected for Fecal Coliforms.

During wet weather events, fecal coliforms generally exceeded acceptable limits with levels typically higher at the Charleroi Bank at the Charleroi-Monessen Bridge, the Monessen Bank at the Donora-Monessen Bridge and the Donora Bank at the Donora-Webster Bridge. This is due to these respective banks containing multiple CSO discharges. It also is important to note the non-homogeneous levels of fecal coliforms in the river due to the significantly lower levels of fecal coliforms in the center and opposite side of the river.

During dry weather, with a few exceptions, all samples were in compliance with acceptable limits of fecal coliform. To the contrary, during wet weather events all CSO discharge samples and almost all bridge location samples were above acceptable limits. The exceedances during dry events were due to several reasons. The exceedance of fecal coliform at most sampling locations during Dry Event #3 may have been due to rain and CSO overflows in areas south and upstream of the system. Rain was recorded in the area in the days prior to Dry Event #3. Fecal colfiorm exceedances downstream of the plant during Dry Event #1 were due to an isolated event at the plant on that day. It should also be noted that a number of known CSOs exist upstream of the Mon Valley Sewage Authority system.

2.5.3.6 Sediment and Biological Monitoring and Analysis

Sediment and biological monitoring and analysis were not implemented as part of this project.

2.6 Combined Sewer System and Receiving Water Modeling

As part of the development of this LCTP, the Authority employed the use of a CSS hydraulic and hydrologic model to characterize the CSS and evaluate CSO control alternatives. This section discusses modeling objectives, as well as model selection and application, for the CSS. A receiving water model was not developed as part of this LTCP.

2.6.1 Combined Sewer System Modeling

A computer model of the CSS was developed for use in analyzing the response of the conveyance system under various flow conditions. The model included the Aubrey, South, Donner, and Monessen interceptors, pump stations, and force mains in Monessen, and the North and Donora interceptors, pump stations, and force mains in Donora. The model also included the 21 diversion/regulating structures that regulate flow to the interceptors.

2.6.1.1 CSS Modeling Objectives

As stated above, the CSS Modeling was developed for use in analyzing the response of the conveyance system under various flow conditions. In addition, a hydrologic model of the drainage system was developed to simulate the system rainfall derived inflow and infiltration for various storm events.

2.6.1.2 CSS Model Selection

The model of the system was developed using MWHSoft's InfoSWMM software. InfoSWMM is a fully-dynamic modeling software, which utilizes the Environmental Protection Agency's (EPA) Storm Water Management Model (SWMM 5) to perform its simulations. The software is capable of simulating the time-varying hydraulic and quality conditions in sanitary or combined sewer systems. InfoSWMM is also capable of simulating the effect of storage in a pipeline system, including backwater and surcharging conditions, and the subsequent dissipation of flow over a period of time. InfoSWMM is also capable of simulating flow divides, thus allowing for analyses of complex system features such as CSO structures. Dynamic models can more accurately reflect the true capacity of a system when compared with peak flow spreadsheet calculations using Manning's equation. The various tools of the model, including the graphical results presentation, allow accurate and efficient evaluation of operational and physical system needs and can be used to identify optimal improvements to address these needs.

2.6.1.3 CSS Model Application

The model pipeline network was developed using the system GIS data. Manhole invert and ground elevations and pipeline lengths, materials, upstream and downstream invert elevations, and sizes were obtained and imported into the model. Assumptions regarding model input data were made as needed. The Manning's "n" pipeline roughness coefficients were initially assumed to be 0.013 for all system pipes. Information regarding the pump stations, including pump operating curves, operating criteria, and wet well dimensions, were obtained and input in the model.

The system includes two types of CSO structures: diversion manholes that have a weir, which regulates the flow to the interceptor system and Brown and Brown regulating chambers that utilize a complex weir and variable gate system to regulate flow to the interceptor system. The diversion manholes were represented in the model by the corresponding weir structures. Flow routing curves were developed from available meter data and used to simulate the complex operation of the Brown and Brown regulating chambers.

The drainage sub-catchments of the system were delineated based on available information and input in the model. The collection systems were not modeled. Thus, to simulate the routing of flows in the collection systems, sub-catchments in a drainage system were connected to each other by directing overland flow from one sub-catchment to another. Initial estimates for sub-catchment input parameters including soils, impervious area, geometry, and slope were obtained from available GIS information. The InfoSWMM model utilized the Green Ampt Equation to simulate infiltration and the EPA SWMM/Non-linear Reservoir to simulate overland flow.

Prior to development of the model, three storms were identified:

Long Duration & Low Volume – 4/1/2005 6:00 PM to 4/2/2005 9:00 AM (0.38")

Long Duration & High Volume – 9/8/2004 4:00 AM to 9/9/2004 11:00 AM (2.87")

High Volume & Short Duration – 7/25/2005 5:00 PM to 7/25/2005 7:00 PM (1.13")

Meters were located on the CSO structure influent pipelines and also on the CSO outfall pipelines for 15 of the 21 CSO structures. Flows and depths measurements in 15-minute increments from the meter data were compared with the model results. The calibration included three distinct components: calibration of the hydrological model, verification of the hydraulics of the interceptor system, and calibration of the CSO Structures.

The hydrologic model was calibrated by comparing the simulated rainfall derived inflow and infiltration from each sub-catchment to the corresponding metered flow at the influent pipelines of the CSO structures. The sub-catchments in a drainage area were calibrated to the specific CSO structure receiving flow from that area. The soils, impervious area, and sub-catchment geometry and slope values were adjusted as needed to provide a reasonable match with the meter data. Sub-catchments that convey flow to an un-metered CSO structure were not calibrated. However, the sub-catchment input parameters were modified to reflect similar changes to the adjacent calibrated sub-catchments and to match approximate peak flows.

There were not any flow meters located directly on the interceptor system. Thus, a detailed comparison of model flows and depths along the interceptor could not be performed. A general review of the model simulated flows and depths in the interceptor system along with operations of the pump stations were performed to verify that the model was providing reasonable results.

Flow data from the Donner and Monessen Pump Stations was available and compared with model simulated flows.

The CSO structures were calibrated by setting the CSO structure influent flows based on meter data and comparing model results with field data for depth at the CSO structure and CSO flow. The hydrologic model was used to estimate the inflow at un-metered CSO structures. Several of the un-metered sub-catchments do not flow through a CSO structure and thus simulated flows were routed directly to the interceptor system. It was assumed that the water surface depth in the influent pipeline was the reflective of the water surface depth in the CSO structure. Model input parameters were adjusted as needed to provide a reasonable match with the corresponding field data. All of the un-metered CSO structures were of the diversion manhole type, and were modeled with the known weir geometry and a default weir discharge coefficient of 0.4. A complete list of assumptions and settings used in the development of the model is included as Appendix H, and results of the model can be found in Appendix I.

2.6.2 Receiving Water Modeling

Though the Authority undertook an extensive water sampling program, no modeling was conducted for the Monongahela River.

2.6.2.1 Receiving Water Modeling Objectives

Not applicable.

2.6.2.2 Receiving Water Model Selection

Not applicable.

2.6.2.3 Receiving Water Model Application

Not applicable.

3.1 Public Participation and Agency Interaction

Public Participation and Agency Interaction are discussed in Sections 1.6.2 and 2.1. Development of the Long Term Control Plan has been discussed consistently at the Authority Board Meetings, which are public meetings. The Pennsylvania Department of Environmental Protection (DEP) was consulted on a regular basis during the development of the Long Term Control Plan. Interaction with DEP consisted of phone conferences and face-to-face meetings. In addition, a 30-day public comment period will be conducted prior to finalizing the Long Term Control Plan.

3.2 Long-Term Control Plan Approach

The Combined Sewer Overflow (CSO) Control Policy identifies two general approaches for the attainment of Water Quality Standards: The Demonstration Approach and the Presumption Approach.

3.2.1 Demonstration Versus Presumption Approach

Limited water quality data has been collected at the CSO outfalls. Based on available data, it appears that the existing CSO discharges result in a negative impact on water quality. However, the inter-relationship (if any) between meteorological conditions and water quality, other dischargers impact on water quality, and the impact of the Authority's CSOs on water quality is difficult to quantify. Historically, DEP has not undertaken efforts to review and revise water quality standards or to develop Total Maximum Daily Loads (TMDLs) for combined sewer systems.

The CSO Policy indicates that if the Presumption Approach is followed, it is presumed that Water Quality Standards will be met. However, use of the Presumption Approach does not release municipalities from the overall requirement that Water Quality Standards be attained. The CSO control program must provide a means to ensure that, if other pollution sources were controlled, Water Quality Standards would be attained.

Given the nature of combined sewer system overflows, it is difficult to predict if the implementation of technology based CSO controls will consistently provide adequate treatment to produce effluent meeting National Pollutant Discharge Elimination System (NPDES) Permit effluent limits. It is also difficult to predict if implementation of the CSO Control Program based on the requirements of the Presumption Approach will result in

- water quality standards being attained in the Monongahela River;
- discharges that, if other pollution sources were controlled, would result in attainment of water quality standards;
- discharges that would allow for attainment of revised Water Quality Standards; or
- discharges that would conform to a potential wet weather water quality standards variance.

The Presumption Approach was used in developing alternatives for CSO control because this approach provides quantitative performance criteria that could be applied to flow monitoring data.

3.2.1.1 Demonstration Approach

The Demonstration Approach requires the combined sewer system to demonstrate that the control program, though not meeting the criteria of 4-6 overflows per year or 85% annual average capture, is adequate to meet water quality based requirements of the Clean Water Act (CWA). All of the following four results must be demonstrated.

1. Control Program meets Water Quality Standards and protects Designated Uses- unless Water Quality Standards or Designated Uses cannot be met due to background conditions or other pollution sources.
2. CSO discharges remaining will not preclude attaining Water Quality Standards or contribute to stream impairment. Where Water Quality and Designated Use are

not met in part because of other pollution sources, Total Maximum Daily Load or other means maybe used to apportion pollutant loads will be used.

3. Control Program will provide maximum pollution reduction reasonably attainable.
4. Control Program is designed to be expanded if additional controls are subsequently required to meet Water Quality Standards.

3.2.1.2 Presumption Approach

The Presumption Approach indicates that if any of the following criteria are met, it would be presumed that water quality based CWA requirements are being met.

1. No more than four (and up to six) CSO discharges per year.
2. On a system-wide average annual average basis, capture for treatment of no less than 85% by volume of combined sewage collected, during precipitation events.
3. Removal of no less than the mass pollutants identified as causing water quality impairment for volumes captured (at least 85%).

The CSO Policy indicates, that under the Presumption Approach, the combined sewer flows within the above criteria should receive minimum treatment. The minimum treatment includes primary clarification, solids and floatables disposal, and disinfection and removal of residuals if necessary to meet Water Quality Standards, protect Designated Uses, and protect human health.

3.2.1.2.1 Minimum Treatment of CSO Discharges

The CSO Policy indicates that under the Presumption Approach, the combined sewer flow captured for treatment must receive "minimum treatment." The minimum treatment includes primary clarification, solids and floatables disposal, and disinfection and removal of residuals if necessary to meet Water Quality Standards, protect Designated Uses, and protect human health. "Primary Clarification" is not defined in the 1994 CSO Policy or in the 1995 Environmental Protection Agency (EPA) LTCP guidance document. PaDEP has not provided guidance on quantifying "Primary Treatment."

The PaDEP wastewater facilities manual indicates that preliminary tanks not receiving waste activated sludge should not exceed a hydraulic loading of 2,500 gpd/ft^2 for peak hourly flow and that a Biological Oxygen Demand (BOD) removal of 30 percent to 35 percent will indicate efficient primary treatment. The Recommended Standards for Wastewater Facilities (10-State Standards) indicate that primary settling of normal domestic wastewater can be expected to remove approximately 1/3 of the influent BOD when operating at an overflow rate of 1,000 gpd/ft2 (0.7 gpm/ft^2) Significant reduction in BOD removal efficiency will result when the peak hour overflow rate exceeds 1,500 gpd/ft^2. Based on these references, 35% removal of BOD during peak flows appears to be a reasonable performance criteria for "Primary Clarification."

Wastewater Engineering Treatment and Reuse (Metcalf & Eddy, 2003) states that the objective of treatment by sedimentation is to remove readily settleable solids and floating material and thus reduce the suspended solids content. Efficiently designed and operated primary sedimentation tanks should remove from 50 to 70 percent of the suspended solids and from 20 to 40 percent of the BOD. *Wastewater Engineering Treatment and Reuse* discusses detention time in primary sedimentation tanks. The normal design detention time based on average flow rate is 1.5 to 2.5 hours. Tanks that provide shorter detention periods (0.5 to 1 hour), with less removal of suspended solids, are sometimes used for preliminary treatment ahead of biological treatments. Detention times of 0.5 to 1 hour result in typical total suspended solids removal rates of about 35% to 50% (Total Suspended Solids (TSS) removal is also a function of constituent concentration). Wastewater temperature also plays a role in required detention time; however, temperature effects will not be considered in providing "Primary Clarification."

Water Environment Federation (WEF) Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, Design of Municipal Wastewater Treatment Plants Volume I also includes information related to primary settling tanks. These references indicate that, based on an idealized curve, an overflow rate of 2,000 gpd/ft^2 would produce a suspended solids removal of about 40%. As noted above, the PaDEP wastewater facilities manual allows an overflow rate of up to 2,500 gpd/ft^2 for peak hourly flow in preliminary tanks not receiving waste activated sludge. Therefore, removal of approximately 35% of suspended solids during peak flows appears a reasonable performance criteria for "Primary Clarification."

Based on the above references, in the LTCP, 35% removal of both BOD and Total Suspended Solids constitutes acceptable performance for facilities providing "Primary Clarification" under peak flow rates.

3.2.2 Small System Considerations

The EPA 1995 *Combined Sewer Overflows Guidance for Long-Term Control Plan* document indicates that at its discretion, the NPDES permitting authority may not require municipalities with populations less than 75,000 persons to complete each of the formal steps outlined in the CSO Control Policy. MVSA serves approximately 15,000 persons in the City of Monessen, Donora Borough, and Carroll Township.

3.3 Development of Alternatives for CSO Control

3.3.1 General Considerations

Concepts used in developing CSO control alternatives include interaction with the Nine Minimum Controls, interaction with other collection and treatment system objectives, and creative thinking.

3.3.1.1 Interaction with Nine Minimum Controls

The Nine Minimum Controls include technology based actions or measures to reduce CSOs and their effect on receiving water quality. The two controls that have the largest impact on LTCP development are maximization of flow to the Waste Water Treatment Plant (WWTP) for treatment and pollution prevention programs to reduce contaminants in CSOs.

In recent years, collection system operating procedures have been aimed at maximizing flow into and through the interceptor to the WWTP. Therefore, data obtained during the extensive flow metering program is reflective of peak flows that may be observed during precipitation events. Pollution prevention programs include street sweeping and a public awareness program (catch basin stenciling). These pollution prevention efforts will improve the effectiveness of potential CSO treatment facilities.

3.3.1.2 Interactions with Other Collection and Treatment System Objectives

The Authority has completed a system mapping project that identifies sewershed areas, separate and combined sections of the system, and CSO outfall locations. System mapping is included as Exhibits 2-1, 2-2 and 2-3 in Appendix A. The Authority has also developed a hydraulic model of the interceptor. The Authority is currently conducting a program to video inspect and clean all sewer pipe in the system. These projects are part of the Authority's continuing effort to characterize and maintain the integrity of the collection system, interceptor, and pumping stations. In addition, the Authority successfully re-rated the WWTP in 2002. Information obtained during these projects, in conjunction with the flow metering program data, was utilized to identify and evaluate areas of sewer separation, storage facility location and sizing, treatment facility location and sizing, and WWTP upgrade and improvement alternatives.

Two previously planned collection system improvement projects are incorporated into the LTCP. The first is a stream separation project in the Seneca Street area of Monessen (Exhibit 2-2, Map Area 7). The Seneca Street project includes removing stream flow from the combined sewer system. Dedicated sanitary sewers will be constructed to provide a separate sewer system in this area. The stream will be routed to the Monongahela River via the existing combined sewer piping.

The Authority has completed a feasibility study for constructing a dedicated sanitary sewer system in the 15th Street area of Donora (Exhibit 2-3, Map Area 21). This project will provide sewer service to customers that are not presently sewered and eliminate CSO 021.

3.3.1.3 Creative Thinking

Numerous approaches for integrating the existing conveyance and treatment systems and proposed CSO control facilities were identified and evaluated during LTCP development. The plan proposes innovative methods to integrate the existing collection and conveyance system with state of the art technologies while maximizing the capabilities of the existing WWTP.

3.3.2 Definition of Water Quality and CSO Control Goals

The ultimate goal of the LTCP is compliance with the requirements of the CWA, within the framework provided by the CSO Control Policy. The LTCP was developed based on the "Presumption Approach". Accordingly, it is presumed that if the minimum performance criteria (no more than 4-6 annual overflows and/or capture for treatment of 85% by volume of combined sewage) are met then an adequate level of control to meet water quality based requirements of the CWA is provided. However, numerous upstream point and non-point pollution sources can potentially prevent attainment of water quality standards and designated uses. Therefore, based on the ultimate goal of the LTCP, provisions of the CSO Control Policy, and the reality of wet weather water pollution in the receiving body, the following Water Quality Goal was established.

- To attain applicable Water Quality Standards in the Monongahela River at all times, provided all non-CSO and other upstream pollution sources are adequately controlled by others so as to allow this attainment.

CSO Control Goals refer to specific levels of pollution control for CSO sources. CSO Control Goals are established with the objective of providing the means to allow attainment of the Water Quality Goal. The following CSO Control Goals were established.

1. To provide a sufficient level of control so that remaining CSO discharges will not prevent attainment of Water Quality Standards or contribute to impairment of the Monongahela River.
2. To eliminate the impacts of the Authority's CSOs on the Monongahela River.

The CSO Control Goals provide two levels of CSO Control.

Level 1: CSO Control Goal No. 1 allows limited CSO discharges consistent with the CSO Control Policy Presumption Approach.

Level 2: CSO Control Goal No. 2 seeks to meet the Water Quality Goal by eliminating untreated CSOs or completely eliminating all CSOs.

3.3.2.1 Approaches to Structuring CSO Control Alternatives

The first step in identifying CSO control alternatives to provide the means to meet the CSO control goals was to review the operation of the existing collection and conveyance systems. The collection system consists of a network of combined sewer and dedicated sanitary sewer sub-sewersheds. The majority of the sub-sewersheds drain to diversion structures upstream of the main interceptors (Monessen Interceptor and Donora Interceptor). Normal flows are directed to the interceptors. Excess flows are diverted to combined sewer overflow outfalls. Several small pump stations are located along the interceptors. The interceptor sewers terminate at the two main pump stations, Monessen Pump Station and Donora Pump Station. Sewage from the two main pump stations is pumped directly to the WWTP. Sewage from Carroll Township is pumped to the WWTP via a pump station owned and operated by Carroll Township.

The existing collection system is extensive with the majority of the system being combined sewers constructed prior to the Monessen and Donora interceptor sewers. The existing Monessen and Donora interceptor sewers and diversion structures were designed to accommodate the pre-existing collection system and topography along the interceptor sewer routes, which parallel the Monongahela River. Pump stations along the interceptor were located and designed based upon anticipated sewage flows and proposed interceptor sewer elevations.

The flow metering data analysis provided estimates of average dry weather flow for the combined sewer sub-sewersheds. Other methods were used to estimate the average dry weather flow for sewersheds with existing or proposed dedicated sanitary sewer systems. To maximize flow to the WWTP, CSO Control Alternatives were based on

- conveying 350% of the average dry weather flow to the interceptor sewers for combined sewer sewersheds located in Donora,
- conveying 350% or greater than 350% of the average dry weather flow to the interceptor sewers for combined sewer sewersheds located in Monessen, and

- conveying 400% of the average dry weather flow to the interceptor sewers for sewersheds with existing or proposed separate sanitary sewer systems (Monessen and Donora areas).

For the majority of the combined sewer sub-sewersheds, the flow metering data analysis also provided an estimate of the peak combined sewage flow rate received at the existing diversion structure. Any CSO control facilities would be expected to handle these peak flow rates. Therefore, the peak observed flow rates were used to size potential CSO control facilities. The analysis of average annual flow volume and overflow occurrence provided estimates of individual CSO satellite treatment facility capacity necessary to achieve the CSO Control Goals. The analysis provided estimated satellite treatment facility capacity needed to

- provide capture and treatment of 100% of the wet weather flow entering the combined sewer system on an average annual basis,
- provide capture and treatment of 85% of the wet weather flow entering the combined sewer system on an average annual basis,
- limit combined sewer overflow events to 4 to 6 events per year,
- provide treatment of the wet weather flow entering the combined sewer system on an average annual basis corresponding to the percent capture representing the "point of diminishing returns" or knee of curve for treatment facility capacity, and
- provide treatment of the wet weather flow entering the combined sewer system on an average annual basis corresponding to the number of annual combined sewer overflow events representing the "point of diminishing returns" or knee of curve for treatment facility capacity.

Using the methodology described above, CSO Control Alternatives were developed with the goal of integrating as much of the existing sewer system infrastructure as technically and economically feasible and utilizing the capabilities of the existing WWTP to the maximum possible extent. The tables developed as part of the above analysis are included in Appendix J.

3.3.2.2 Projects Common to All Alternatives

Two previously planned collection system improvement projects are incorporated into the LTCP.

1. Stream separation project in the Seneca Street area of Monessen (Exhibit 2-2, Map Area 7). The Seneca Street project includes removing stream flow from the combined sewer system. Dedicated sanitary sewers will be constructed to provide a separate sewer system in this area. The stream will be routed to the Monongahela River via the existing combined sewer piping.
2. Construction of a dedicated sanitary sewer system in the 15th Street area of Donora (Exhibit 2-3, Map Area 21). This project will provide sewer service to customers that are not presently sewered and eliminate CSO 021.

Upgrading the capacity of the Monessen and Donora interceptor sewers is also a proposed system improvement that is common to all alternatives. Hydraulic modeling results indicate that the interceptors lack the required capacity to convey anticipated sewer flows. The extent of interceptor upgrades varies among alternatives.

A major proposed modification to system operation that is common to all alternatives involves limiting the peak sewage flow rate that is accepted from Carroll Township. Sanitary sewage from Carroll Township is pumped directly to the WWTP via the Grandview Pump Station. The Grandview Pump Station is owned and operated by the Carroll Township Authority (CTA). There is no agreement in place between the Authority and CTA that grants CTA the right to discharge a specific volume or rate of flow to the WWTP. A review of design data for the Grandview Pump Station indicates that the peak flow rate intended to be discharged to the WWTP is 0.634 mgd (440 gpm). Therefore, CSO Control Alternatives are based on a maximum sewage flow rate of 0.634 mgd from Carroll Township.

3.3.2.3 Outfall-Specific Solutions

Outfall specific solutions include localized sewer separation and end of pipe treatment.

3.3.2.4 Localized Consolidation of Outfalls

Consolidation of several outfalls is proposed. Outfalls selected for consolidation were based on existing infrastructure, system hydraulics, topography, and existing land use and availability.

3.3.2.5 Regional Consolidation

The layout and limited size of the MVSA collection and conveyance system do not provide a basis for regional consolidation. Outfalls are located relatively close together and in proximity to the main Monessen and Donora Pump Stations. Therefore, deep tunnels were not considered for consolidating outfalls.

3.3.2.6 Utilization of POTW Capacity and CSO-Related Bypass

The development of all CSO Control Alternatives included utilizing the WWTP's existing peak hydraulic capacity of 12.0 mgd. Four alternatives include upgrades at the WWTP to provide the equivalent of primary treatment to a bypass stream of combined sewage. The equivalent of primary treatment would be provided by new treatment units constructed at the WWTP site. In these alternatives, the combined sewage bypass stream would receive conventional or high rate clarification and disinfection prior to being combined with WWTP effluent. One CSO Control Alternative includes increasing the treatment capacity of the WWTP in order to treat anticipated peak sanitary sewage flows (from a dedicated sanitary sewer collection system) without bypassing the secondary treatment units.

3.3.2.7 Consideration of Sensitive Areas

The Designated Use (as specified in Pennsylvania Code Title 25, Chapter 93) for the portion of the Monongahela in the vicinity of Monessen and Donora is Warm Water Fishes (WWF). The river is also used for recreational activities such as fishing, swimming, boating, and jet skis. Therefore, the entire area can be considered sensitive. One area of particular concern is a small marina located at Seneca Street in Monessen, directly downstream of CSO 007.

3.3.3 Goals of Initial Alternatives Development

Once the CSO Control Goals were established and approaches to structuring CSO Control Alternatives were identified, specific alternatives to achieve the CSO Control Goals were developed.

3.3.4 Identification of Control Alternatives

Several CSO Control Alternatives were identified to achieve the CSO Control Goals. These alternatives are classified under the categories of Source Control, Collection System Controls, Storage Technologies, and Treatment Technologies.

3.3.4.1 Source Controls

Source controls affect the quantity or quality of runoff that enters the collection system. The City of Monessen and Donora Borough maintain street sweeping programs. Street sweeping can prevent the accumulation of dirt, debris, and associated pollutants that can wash off streets and other tributary areas to the combined sewers during a storm event.

3.3.4.2 Collection System Controls

Collection system controls and modifications affect CSO flows and loads once the runoff has entered the collection system. Collection system controls include maximizing use of the existing collection system, sewer separation, and flow diversion.

3.3.4.3 Storage Technologies

Equalization storage facilities are proposed to store excess flow for subsequent treatment at the WWTP. Excess flow volume is stored and then conveyed to the WWTP when treatment and conveyance capacity become available. Off-line, near surface storage is proposed to store diverted wet weather combined sewage flows.

3.3.4.4 Treatment Technologies

Treatment technologies are intended to reduce the pollutant load to receiving waters from CSOs. Proposed treatment technologies include coarse screening, high rate clarification, disinfection, and removal of disinfectant residual.

3.3.5 Preliminary Sizing Considerations

Preliminary sizing of CSO Control Alternative components was based on data obtained from the flow metering program and from estimates of peak sanitary flows. Proposed collection and conveyance system upgrades are based on maximizing flow to the WWTP. Proposed equalization storage capacity is based on estimated peak flows and the existing hydraulic capacity of the WWTP. Proposed satellite treatment facility capacities and WWTP upgrades are based on achieving the CSO Control Goals via the CSO Control Policy Presumption Approach. In addition, a "knee of curve" analysis for percent capture and annual overflows, and the complete elimination of CSOs by 100% capture were also used to size satellite treatment facilities.

3.3.6 Cost/Performance Considerations

In identifying potential CSO Control Alternatives, engineering judgment was used to eliminate alternatives and prepare a skeletonized LTCP. The effort included weighing anticipated benefits and technical feasibility against rough cost estimates.

3.3.7 Preliminary Siting Issues

Recent aerial photographs, system mapping, and USGS quadrangle maps were used to identify potential sites for storage and treatment facilities. The location and elevation of existing diversion structures, as well as land use along the Monongahela River, were factors that influenced preliminary siting results.

3.3.8 Preliminary Operating Strategies

Operating strategies for potential CSO Control Alternative facilities were developed to determine the feasibility and estimate the cost of the alternative. For example, collection system controls would be required to be compatible with the existing collection and conveyance systems. Treatment facilities would require diversion of excess flow, waste flow pumping and solids handling, and chemical treatment. Storage facilities would require diversion of excess flow, interim treatment (aeration), and means to return the stored flow to the system for treatment.

3.3.9 Summary of CSO Control Alternatives

A total of 35 CSO Control Alternatives were selected for evaluation. CSO Control Alternatives are shown graphically on Figure 3-1 on the following page and summarized in Tables 3-1 through 3-35 included in Appendix K. Proposed CSO control facilities are shown on Exhibits 2-1 and 2-2 included in Appendix A.

The CSO Control Alternatives are divided into two Main CSO Control Alternative categories based on proposed modifications to the collection system: Main CSO Control Alternative I-Partial Sewer Separation and Main CSO Control Alternative II-Complete Sewer Separation.

The partial sewer separation main alternative includes separation of combined sewers in selected sub-sewersheds. Sub-sewersheds are shown on Exhibits 2-1 and 2-2. The selection of sub-sewersheds designated for separation of sewers was based on anticipated dry and wet weather peak flows, the cost of sewer separation compared with treatment or storage of the associated CSO, and previously planned collection system upgrade projects. The complete sewer separation main alternative includes the separation of all combined sewers in the collection system.

MON VALLEY SEWAGE AUTHORITY
LONG TERM CONTROL PLAN
SUMMARY OF CSO CONTROL ALTERNATIVES

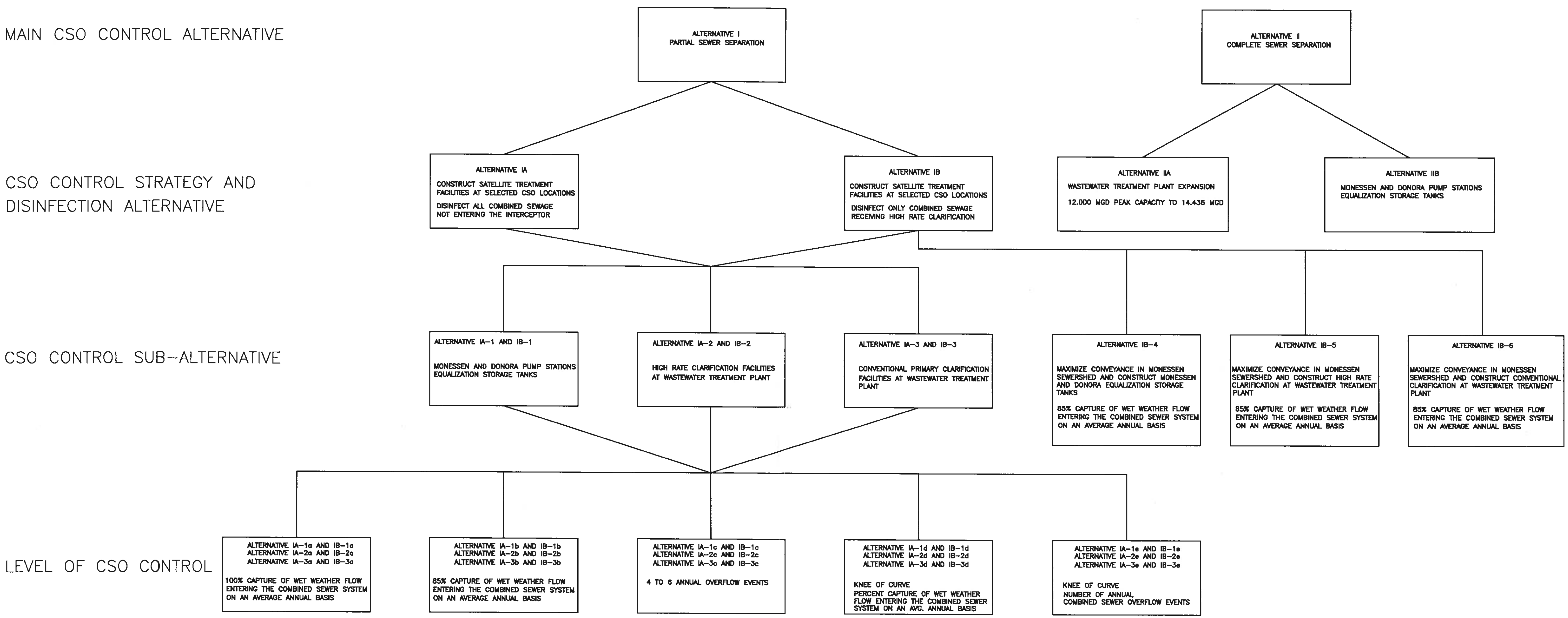


FIGURE 3–1 SUMMARY OF CSO CONTROL ALTERNATIVES

In the Main CSO Control Alternative I-Partial Sewer Separation, the CSO Control Strategy proposed to achieve the CSO Control Goal consists of constructing satellite treatment facilities at selected CSO locations. Under the Main CSO Control Alternative I, the final set of 33 CSO Control Alternatives is based on two CSO Disinfection Alternatives, five CSO Sub-Alternatives, and five Levels of CSO Control. These Disinfection Alternatives, CSO Sub-Alternatives, and Levels of CSO Controls are described below.

Under Main Alternative II-Complete Sewer Separation, all CSOs would be eliminated. Two Complete Sewer Separation Alternatives were identified to include necessary system upgrades associated with operating and maintaining a dedicated sanitary sewer collection, conveyance, and treatment system.

In each main alternative, there is a set of proposed collection and conveyance system upgrades common to each sub-alternative within the main alternative. There is also a set of upgrades common to both main alternatives. These sets of proposed upgrades comprise the Collection System Base Plans.

3.3.9.1 Collection System Base Plans

3.3.9.1.1 Items common to Main CSO Control Alternative I (Partial Sewer Separation) and Alternative II (Complete Sewer Separation) alternatives.

Industries located near the Monongahela River currently discharge waste into the existing outfall sewers. These discharges should be investigated in order to characterize the waste and determine the effect, if any, on system operation and the LTCP. The following presents a plan of action to assess these discharges.

- Characterize waste
    - Determine if waste is sanitary sewage
    - Determine if waste is industrial in nature and discharged under an existing NPDES Permit
- Assess need for connection of industries to existing interceptor
- Assess need for outfall sewer modifications.

- Develop Industrial Pretreatment Program, if necessary.
- Revisit proposed upgrades and facility sizing contained in the LTCP, if necessary

3.3.9.1.2 Main CSO Control Alternative I-Partial Sewer Separation: Collection System Base Plan

Monessen Sewershed

Sub-Sewershed 2

- Sub-Sewershed 2 includes
  - CSO 002 (Diversion Manhole 300A at 17th Street)
  - Aubrey Ejector
  - South Pump Station
- Sub-Sewershed 2 Upgrades include
  - Separate sanitary and storm sewers
    - Construct new sanitary sewer collection system
    - Utilize existing combined sewer system for storm water
  - Connect proposed sanitary sewer system to the existing interceptor at the South Pump Station
- Remove Diversion Manhole 300A connection to the existing interceptor.

Sub-Sewershed 3

- Sub-Sewershed 3 includes
  - CSO 003 (Regulator Manhole 202A at 11th Street)
  - Donner Pump Station
- Sub-Sewershed 3 Upgrades include
  - Remove Regulator Manhole 202A connection to the existing interceptor

Sub-Sewershed 4

- Sub-Sewershed 4 includes
  - CSO 004 (Regulator Manhole 113A at 3rd Street)
- Sub-Sewershed 4 Upgrades include
  - Remove connection from Regulator Manhole 113A to the existing interceptor

Sub-Sewershed5

- Sub-Sewershed 5 includes
  - CSO 005 (Diversion Manhole 111A at 2nd Street)
  - CSO 006 (Diversion Manhole 110A at River Street)

  - Diversion Manhole 117A at 5th Street.
- Sub-Sewershed 5 Upgrades include
  - Remove connection from Diversion Manhole 110A to the existing interceptor.
  - CSO 006 outfall sewer (at River Street) utilized for stormwater only
  - Clean and repair CSO 006 outfall sewer
  - Remove connection from Diversion Manhole 117A to the existing interceptor.
  - Fifth Street outfall sewer utilized for stormwater only
  - Re-open Fifth Street outfall sewer
  - Remove connection from Diversion Manhole 111A to the existing interceptor

Sub-Sewershed 7

- Sub-Sewershed 7 includes
  - CSO 007 (Regulator Manhole 107A at Seneca Street)
  - CSO 0070 (Diversion Manhole 106A at Seneca Street)
  - CSO 00700 (Diversion Manhole 106B at Seneca Street)
- Sub-Sewershed 7 Upgrades include
  - Stream Separation project. Stream is routed in existing storm sewer and outfall pipe.
  - Convey combined flow from the diversion structures to a new outfall sewer

Sub-Sewershed 9

- Sub-Sewershed 9 includes
  - Diversion Manhole 102A
- Sub-Watershed 9 Upgrades include
  - Separate sanitary and storm sewers
    - Construct new sanitary sewer collection system
    - Utilize existing combined sewer system for storm water
  - Connect proposed sanitary sewer system to the existing interceptor
  - Remove Diversion Manhole 102A connection to the existing interceptor

Sub-Sewershed M101

- Sub-Sewershed M101 includes
  - Monessen Pump Station
- Sub-Sewershed M101 Upgrades include
  - No proposed upgrades

Donora Sewershed

Sub-Sewershed 22

- Sub-Sewershed 22 includes
  - CSO 022 (Diversion Manhole 207A at Boundary Alley)
- Sub-Sewershed 22 Upgrades include
  - Separate sanitary and storm sewers
    - Construct new sanitary sewer collection system
    - Utilize existing combined sewer system for storm water
- Connect proposed sanitary sewer system to the existing interceptor
- Remove Diversion Manhole 207A connection to the existing interceptor

Sub-Sewershed 21

- Sub-Sewershed 21 includes
  - CSO 021 (Regulator Manhole 205A at 15th Street)
- Sub-Sewershed 21 Upgrades include
  - Separate sanitary and storm sewers
    - Construct new sanitary sewer collection system
    - Utilize existing combined sewer system for storm water
  - Connect proposed sanitary sewer system to the existing interceptor
  - Remove Diversion Manhole 205A connection to the existing interceptor

Sub-Sewershed 20

- Sub-Sewershed 20 includes
  - Diversion Manhole 202B at Lustig Alley)
  - North Pump Station
- Sub-Sewershed 20 Upgrades include
  - Separate sanitary and storm sewers
    - Construct new sanitary sewer collection system
    - Utilize existing combined sewer system for storm water
  - Connect proposed sanitary sewer system to the existing interceptor
  - Remove Diversion Manhole 202B connection to the existing interceptor

Sub-Sewershed 19

- Sub-Sewershed 19 includes
  - CSO 019 (Diversion Manhole 208A at Scott Street)
- Sub-Sewershed 19 Upgrades include
  - Separate sanitary and storm sewers

      - Construct new sanitary sewer collection system
      - Utilize existing combined sewer system for storm water
  - Connect proposed sanitary sewer system to the existing interceptor
  - Remove Diversion Manhole 208A connection to the existing interceptor

Sub-Sewershed 18

- Sub-Sewershed 18 includes
  - CSO 018 (Diversion Manhole 211A)
- Sub-Sewershed Upgrades include
- Separate sanitary and storm sewers
      - Construct new sanitary sewer collection system
      - Utilize existing combined sewer system for storm water
- Connect proposed sanitary sewer system to the existing interceptor
- Remove Diversion Manhole 211A connection to the existing interceptor

Sub-Sewershed D212

- Sub-Sewershed D212 includes
  - Drop Manhole D212 at 12th Street
- Sub-Sewershed D212 Upgrades include
  - Separate sanitary and storm sewers
      - Construct new sanitary sewer collection system
      - Utilize existing combined sewer system for storm water
        - ◊ Connect existing 8" TCP storm sewer to existing 36" RCP storm sewer.
  - Remove Drop Manhole D212 connection to the existing 36" storm sewer

Sub-Sewershed 17

- Sub-Sewershed 17 includes
  - CSO 017 (Diversion Manhole 213A at 11th Street)
- Sub-Sewershed 17 Upgrades include
  - Remove Diversion Manhole 213A connection to the existing interceptor

Sub-Sewershed 16

- Sub-Sewershed 16 includes
  - CSO 016 (Diversion Manhole 116A at 8th Street)
- Sub-Sewershed 16 Upgrades include
  - Remove Diversion Manhole 116A connection to the existing interceptor

Sub-Sewershed 15

- Sub-Sewershed 15 includes
  - CSO 015 (Diversion Manhole 114A at 7th Street)
- Sub-Sewershed 15 Upgrades include
  - Separate sanitary and storm sewers
    - Construct new sanitary sewer collection system
    - Utilize existing combined sewer system for storm water
  - Connect proposed sanitary sewer system to the existing interceptor
  - Remove Diversion Manhole 114A connection to the existing interceptor

Sub-Sewershed 140

- Sub-Sewershed 140 includes
  - CSO 0140 (Regulator Manhole 111A at 6th Street)
- Sub-Sewershed 140 Upgrades include
  - Remove Regulator Manhole 114A connection to the existing interceptor

Sub-Sewershed 14

- Sub-Sewershed 14 includes
  - CSO 014 (Diversion Manhole 106A at 5th Street)
- Sub-Sewershed 14 Upgrades include
  - Remove Diversion Manhole 106A connection to the existing interceptor

Sub-Sewershed 13

- Sub-Sewershed 13 includes
  - CSO 013 (Diversion Manhole 100A at the Donora Pump Station
  - Donora Pump Station
- Sub-Sewershed 13 Upgrades include
  - Separate sanitary and storm sewers
    - Construct new sanitary sewer collection system
    - Utilize existing combined sewer system for storm water
  - Connect proposed sanitary sewer system to the existing interceptor
  - Remove Diversion Manhole 100A connection to the existing interceptor

Sub-Sewershed 110

- Sub-Sewershed 110 includes
  - CSO 0110 (Diversion Manhole 118A at Chestnut Street)
- Sub-Sewershed 110 Upgrades include

- Remove Diversion Manhole 118A connection to the existing interceptor

Sub-Sewershed 11

- Sub-Sewershed 11 includes
  - CSO 011 (Diversion Manhole 121A at Locust Street)
- Sub-Sewershed 11 Upgrades include
  - Remove Diversion Manhole 121A connection to the existing interceptor

15. Sub-Sewershed 10+D123

- Sub-sewershed 10+D123 includes
  - CSO 010 (Diversion Manhole 123A at Walnut Street
- Sub-sewershed 10+D123 Upgrades include
  - Separate sanitary and storm sewers in the Highland Terrace Area
    - Construct new sanitary sewer collection system
      - Connect proposed sanitary sewer system to the existing interceptor
    - Utilize existing combined sewer system for storm water
  - Combined sewers in the Walnut and Chestnut Street areas to remain.
  - Remove Diversion Manhole 123A connection to the existing interceptor

3.3.9.1.3 Main CSO Control Alternative II-Complete Sewer Separation: Collection System Base Plan

- Separate sanitary and storm sewers in entire collection system.
  - Construct new sanitary sewer collection systems
  - Utilize existing combined sewer system for storm water
- Connect proposed sanitary sewer system to the existing interceptor

3.3.9.2 Estimated Peak Combined Sewage and Sanitary Sewage Flows Conveyed to the Interceptor Sewers

The flow metering data analysis provided estimates of the average dry weather flow discharged to the interceptor sewers for the majority of combined sewer sub-sewersheds. House counts based on aerial mapping, persons per household census data, and estimated per capita sewage production were used to estimate the average dry weather flow for the remaining sub-sewersheds. The fourth of the Nine Minimum Controls is "Maximization of Flow to the POTW for Treatment." In order implement this control, proposed peak rates for combined sewage or sanitary sewage flow to the interceptor sewers for each sub-sewershed were established and utilized in developing the CSO Control Alternatives. Respectively, proposed peak combined sewage flow rates and peak sanitary sewage flow rates to the interceptor sewers are based on

- conveying 350% of the average dry weather flow to the WWTP for combined sewer sewersheds located in Donora,
- conveying 350% or greater than 350% of the average dry weather flow to the WWTP for combined sewer sewersheds located in Monessen, and
- conveying 400% of the average dry weather flow to the WWTP for sewersheds with existing or proposed separate sanitary sewer systems.

Main CSO Control Alternative I-Partial Sewer Separation estimated peak combined and sanitary sewage flows for the Monessen and Donora Sewersheds (based on conveying 350% of the combined average dry weather flow or 400% of the average sanitary dry weather flow to the interceptor sewers) are summarized in Table 3-2 and 3-3, respectively.

Results of the flow metering analysis indicated that in the Monessen Sewershed under the 85% capture scenario, it may be feasible to discharge the flow rate designated to receive "minimum treatment" at several CSO locations to the Monessen interceptor sewer, in lieu of providing "minimum treatment" at a satellite facility. The additional flow rates discharged to the interceptor at CSO 003, CSO 004, and CSO 005 are 0.75 mgd, 0.20 mgd, and 0.30 mgd, respectively. In this CSO Control Alternative, greater than 350% of the combined average dry weather flow is discharged to the Monessen Interceptor. Estimated peak flow rates for the Monessen Sewershed are summarized in Table 3-4.

Estimated sanitary sewage flows are summarized in Tables 3-5 (Monessen Sewershed) and 3-6 (Donora Sewershed) for Main CSO Control Alternative II-Complete Sewer Separation.

3.3.9.3 Main CSO Alternative I-Partial Sewer Separation

CSO Control Alternatives are shown graphically on Figure 3-1 and summarized in Table 3-1.

3.3.9.3.1 CSO Control Strategy

In the partial sewer separation main alternative, the CSO Control Strategy proposed to achieve the CSO Control Goals consists of constructing satellite treatment facilities at selected CSO locations. Satellite treatment facilities would include diversion, high rate clarification, coarse screening, disinfection, and removal of disinfection residual.

At each selected CSO location, combined sewage would be collected at a new diversion structure. Up to the estimated peak flow rate (350% of the average dry weather flow in the Donora Sewershed and 350% of the average dry weather flow or greater in the Monessen Sewershed, see Section 3.3.9.2) would be conveyed into the interceptor sewer. Inflow in excess of the estimated peak flow rate would be diverted. Depending on the Level of CSO Control (refer to Section 3.3.9.3.4), all, a portion, or none of the excess combined sewage would be diverted to a high rate clarification treatment facility. Combined sewage bypassing the high rate clarification unit would pass through coarse screens.

3.3.9.3.2 CSO Disinfection Alternatives

The partial sewer separation main alternative includes two CSO Disinfection Alternatives.

- Disinfection Alternative A- Disinfect all combined sewage not entering the interceptor; and
- Disinfection Alternative B- Disinfect only the combined sewer receiving high rate clarification.

In Disinfection Alternative A, all of the combined sewage diverted from entering the interceptor is disinfected prior to discharge to the river, whether it passes through high rate clarification or coarse screening treatment. In Disinfection Alternative B, only the combined sewage that receives high rate clarification treatment is disinfected. Combined sewage that is bypassed through coarse screening is discharged to the river without being disinfected. In both disinfection alternatives, the disinfectant residual in the discharge would be reduced to a level in accordance with the NPDES permit.

Schematic drawings for Alternatives IA and IB are shown on Figure 3-2.

3.3.9.3.3 CSO Control Sub-Alternatives

Under each disinfection alternative, six CSO Control Sub-Alternatives were identified.

1. CSO Control Sub-Alternative 1
    - Construct Equalization Storage Tanks at the Monessen and Donora Pump Stations.
        - Convey peak sewage flows to the Monessen and Donora Pump Stations.
            - 350% of the combined average dry weather flow and 400% of the average sanitary flow in both the Monessen and Donora Sewersheds.
        - Restrict flow conveyed to the WWTP to the WWTP's existing peak hydraulic capacity (12.0 mgd).
        - Sewage flow in excess of the WWTP's existing peak hydraulic capacity is stored at the pump station sites in lieu of being pumped to the WWTP.
        - Stored sewage is retained until treatment capacity is available at the WWTP.
2. CSO Control Sub-Alternative 2
    - Construct High Rate Clarification Facilities at the WWTP.
        - Convey peak sewage flows to the Monessen and Donora Pump Stations.
            - 350% of the combined average dry weather flow and 400% of the average sanitary flow in both the Monessen and Donora Sewersheds.
        - Convey peak sewage flows to the WWTP.

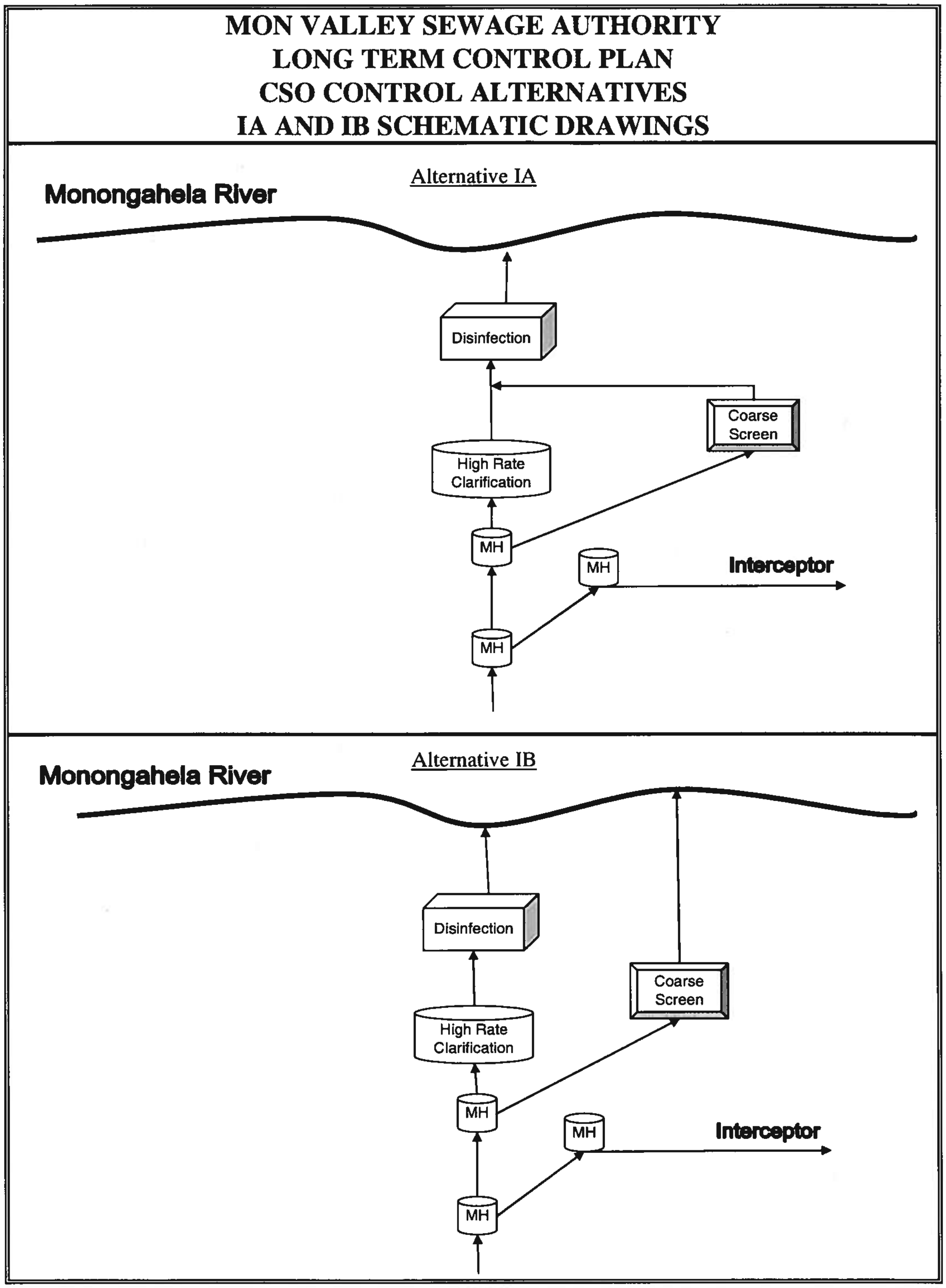


Figure 3-2 CSO Control Alternatives IA and IB Schematic Drawings

        - Modify plant headworks to provide separation of inflows from the CTSA system (Sanitary Sewage) and the Authority's system (Combined Sewage).
        - Restrict flow to WWTP primary and secondary treatment units to the WWTP's existing peak hydraulic capacity of 12.0 mgd (main flow). Main flow consists of all of CTSA Sewage (sanitary) and a portion of the Authority's sewage (combined).
        - Bypass remaining combined sewage flow (from the Authority's system only) around WWTP primary and secondary treatment facilities (bypass flow).
        - Provide High Rate Clarification and Disinfection treatment to the bypass flow.
        - Blend main and bypass flows at WWTP effluent

3. CSO Control Sub-Alternative 3
    - Construct Conventional Primary Clarification Facilities at the WWTP
        - Convey peak sewage flows to the Monessen and Donora Pump Stations.
            - 350% of the combined average dry weather flow and 400% of the average sanitary flow in both the Monessen and Donora Sewersheds.
        - Convey peak sewage flows to the WWTP.
        - Modify plant headworks to provide separation of inflows from the CTSA system (Sanitary Sewage) and the Authority's system (Combined Sewage).
        - Restrict flow to WWTP primary and secondary treatment units to the WWTP's existing peak hydraulic capacity of 12.0 mgd (main flow). Main flow consists of all of CTSA Sewage (sanitary) and a portion of the Authority's sewage (combined).

        - Bypass remaining combined sewage flow (from the Authority' system only) around WWTP primary and secondary treatment facilities (bypass flow).
        - Provide Conventional Primary Clarification and Disinfection treatment to the bypass flow.
        - Blend main and bypass flows at WWTP effluent.

4. CSO Control Sub-Alternative 4
    - Maximize Conveyance in the Monessen Sewershed and Construct Equalization Storage Tanks at the Monessen and Donora Pump Stations.
    - Convey peak sewage flows to the Monessen and Donora Pump Stations.
            - 350% of the combined average dry weather flow and 400% of the average sanitary flow in the Donora Sewershed.
            - Greater than 350% of the combined average dry weather flow in the Monessen Sewershed.
            - 400% of the average sanitary flow in the Monessen Sewershed.
        - Restrict flow conveyed to the WWTP to the WWTP's existing peak hydraulic capacity (12.0 mgd).
        - Sewage flow in excess of the WWTP's existing peak hydraulic capacity is stored at the pump station sites in lieu of being pumped to the WWTP.
        - Stored sewage is retained until treatment capacity is available at the WWTP.

5. CSO Control Sub-Alternative 5
    - Maximize Conveyance in the Monessen Sewershed and Construct High Rate Clarification Facilities at the WWTP.
        - Convey peak sewage flows to the Monessen and Donora Pump Stations.
            - 350% of the combined average dry weather flow and 400% of the average sanitary flow in the Donora Sewershed.

        - Greater than 350% of the combined average dry weather flow in the Monessen Sewershed.
        - 400% of the average sanitary flow in the Monessen Sewershed.
    - Convey peak sewage flows to the WWTP.
    - Modify plant headworks to provide separation of inflows from the CTSA system (Sanitary Sewage) and the Authority's system (Combined Sewage).
    - Restrict flow to WWTP primary and secondary treatment units to the WWTP's existing peak hydraulic capacity of 12.0 mgd (main flow). Main flow consists of all of CTSA Sewage (sanitary) and a portion of the Authority's sewage (combined).
    - Bypass remaining combined sewage flow (from the Authority's system only) around WWTP primary and secondary treatment facilities (bypass flow).
    - Provide High Rate Clarification and Disinfection treatment to the bypass flow.
    - Blend main and bypass flows at WWTP effluent

6. CSO Control Sub-Alternative 6
    - Construct Conventional Primary Clarification Facilities at the WWTP
        - Convey peak sewage flows to the Monessen and Donora Pump Stations.
            - 350% of the combined average dry weather flow and 400% of the average sanitary flow in the Donora Sewershed.
            - Greater than 350% of the combined average dry weather flow in the Monessen Sewershed.
            - 400% of the average sanitary flow in the Monessen Sewershed.
        - Convey peak sewage flows to the WWTP.

- Modify plant headworks to provide separation of inflows from the CTSA system (Sanitary Sewage) and the Authority's system (Combined Sewage).
- Restrict flow to WWTP primary and secondary treatment units to the WWTP's existing peak hydraulic capacity of 12.0 mgd (main flow). Main flow consists of all of CTSA Sewage (sanitary) and a portion of the Authority's sewage (combined).
- Bypass remaining combined sewage flow (from the Authority' system only) around WWTP primary and secondary treatment facilities (bypass flow).
- Provide Conventional Primary Clarification and Disinfection treatment to the bypass flow.
- Blend main and bypass flows at WWTP effluent.

Alternatives IA-1 and IB-1; IA-2 and IB-2; and IA-3 and IB-3; and IB-4, IB-5, and IB-6 are shown schematically on Figure 3-3.

3.3.9.3.4 Level of CSO Control

Five Levels of CSO Control were established based on two approaches for achieving the CSO Control Goals. The first approach is to eliminate untreated CSOs. The second approach is based on meeting the quantitative performance criteria outlined in the CSO Control Policy Presumption Approach. Each level of control results in a different required capacity for the CSO satellite treatment facilities. The levels of control also include a "knee of curve" analysis based on percent capture for treatment and number of annual overflows.

MON VALLEY SEWAGE AUTHORITY
LONG TERM CONTROL PLAN
CSO CONTROL ALTERNATIVES
IA-1, IB-1, IA-2, IB-2, IA-3, IB-3, IB-4, IB-5, and IB-6 SCHEMATIC DRAWINGS

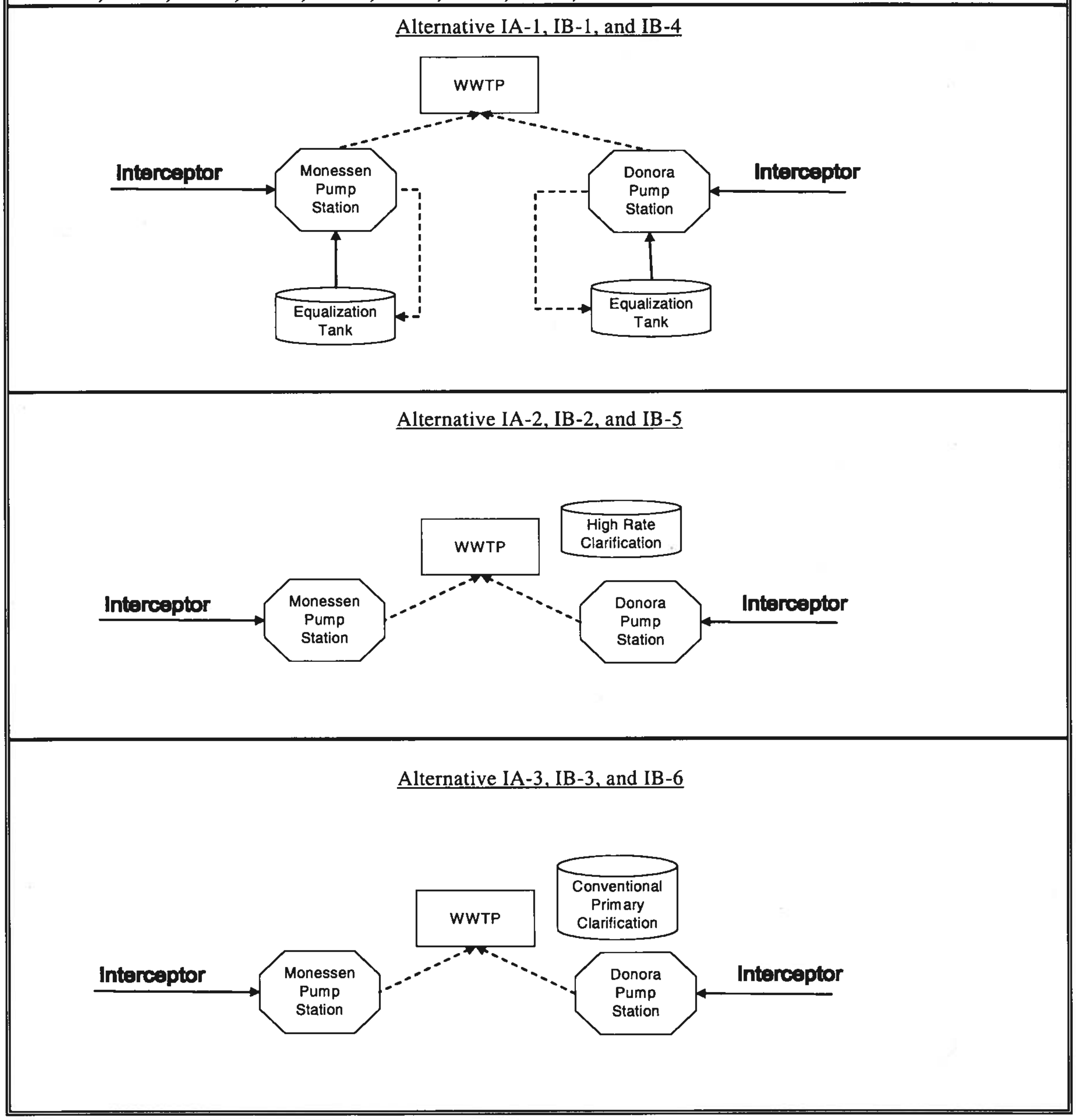


Figure 3-3 CSO Control Alternatives IA-1, IB-1, IA-2, IB-2, IA-3, 1B-3, IB-4, IB-5, and IB-6

The levels of CSO control summarized below.

- Level of Control a — 100% capture and treatment of the wet weather flow entering the combined sewer system on an average annual basis.
- Level of Control b — 85% capture and treatment of the wet weather flow entering the combined sewer system on an average annual basis.
- Level of Control c — Allowing 4-6 combined sewer overflow events per year
- Level of Control d — Providing treatment of the wet weather flow entering the combined sewer system on an average annual basis corresponding to the percent capture representing the "point of diminishing returns" or "knee of curve" for treatment facility capacity.
- Level of Control e — Providing treatment of the wet weather flow entering the combined sewer system on an average annual basis corresponding to the number of annual combined sewer overflow events representing the "point of diminishing returns" or "knee of curve" for treatment facility capacity

3.3.9.3.5 High Rate Clarification Facilities

In the LTCP, proposed high rate clarification facilities include "vortex or swirl" concentrators, sometimes referred to as "hydro-dynamic separators". According to Water Environment Research Foundation's (WERF) *Best Practice for the Treatment of Wet Weather Flows (2002)*, these types of units are typically circular basins with flow entering tangentially to induce a swirl or vortex. The swirling flow path imparts a centripetal force to solids in the flow, forcing solids to the outside of the tank, where they aggregate and velocities are slower. As the mass of solids increases to the outside of the tank, the solids settle and can be removed as underflow from the tank. At least one manufacturer has combined fine screening with hydro-dynamic separation within a single treatment unit.

Hydro-dynamic separators produce a waste stream, referred to as the underflow, of solids collected in the bottom of the treatment unit. These collected solids must be removed from the unit on a continuous or intermittent basis, depending on the unit manufacturer. Therefore, grit removal facilities are proposed to de-grit the underflow prior to discharge for further treatment.

3.3.9.3.6 Proposed Pump Station Capacities

Combined sewage collected in the Monessen sewershed is ultimately conveyed to the sewershed's main pump station, the Monessen Pump Station. The Monessen Pump Station pumps directly to the WWTP. Sewage collected in the Donora sewershed is ultimately conveyed to the sewershed's main pump station, the Donora Pump Station. The Donora Pump Station pumps directly to the WWTP. In each CSO Control Sub-Alternative, the estimated combined sewage peak flow that would be received at the Monessen Pump Station is greater than the existing capacity of the pump station. In addition, the estimated combined sewage peak flow that would be received at the Donora Pump Station is greater than the existing capacity of the pump station. Therefore, each pump station's proposed peak flow capacity is based on the estimated peak combined sewage flow received at each pump station.

3.3.9.3.7 Proposed Equalization Storage Tank Sizing

In each CSO Control Sub-Alternative, the sum of the estimated peak combined sewage flows from the Monessen and Donora Sewersheds is greater than the available WWTP hydraulic capacity. In the CSO Control Sub-Alternatives that include constructing equalization storage at the main pump station locations, only a portion of the peak flow received at each main pump station would be conveyed to the WWTP. The portion of combined sewage pumped to the WWTP would equal the WWTP capacity available for flows from Monessen and Donora.

The proposed peak rates conveyed to the WWTP from each main pump station were assigned based on proportioning pumping rate according to the sewersheds' estimated flow contribution. A proposed modification to system operation that is common to all alternatives is limiting the peak inflow from the Carroll Township Authority's system to 0.634 mgd (440 gpm). Based on the 2002 re-rating study and plant operations experience, the WWTP hydraulic capacity is 12.0 MGD. Therefore, the WWTP plant hydraulic capacity available for flows from the Monessen and Donora Pump Stations is

12.000 mgd	WWTP Hydraulic Capacity
-0.634 mgd	Peak Inflow from Carroll Township
=11.366 mgd	WWTP Capacity Available for Flows from Monessen and Donora

As shown in Tables 3-2 and 3-3, the estimated peak combined sewage flows received at the Monessen and Donora sewersheds are 8.088 mgd and 4.226 mgd, respectively. The Monessen sewershed contributes about 66% of the total estimated peak flow, and the Donora sewershed contributes about 34%. Therefore, the proposed flow conveyed to the WWTP from the Monessen Pump Station is 7.502 mgd or approximately 66% of the available WWTP capacity. The proposed flow conveyed to the WWTP from the Donora Pump Station is 3.865 mgd or approximately 34% of the available WWTP capacity.

Proposed equalization storage tanks are sized to temporarily store the combined sewage that would be received at the Monessen and Donora Pump Stations that is in excess of the proposed flows conveyed to the WWTP from each pump station. Equalization Storage Tanks were sized based on holding the difference in the peak inflow and peak flow conveyed to the WWTP over a continuous 24-hour period.

3.3.9.3.8 Proposed WWTP Bypass Treatment Facilities Sizing

In each CSO Control Sub-Alternative, the sum of the estimated peak combined sewage flows from the Monessen and Donora Sewersheds is greater than the available WWTP hydraulic capacity. Several CSO Control Sub-Alternatives include conveying the peak combined flow from the Monessen and Donora Pump Stations to the WWTP and providing high rate or conventional clarification treatment to a bypass flow stream. These satellite treatment and related facilities were sized based on bypassing and providing "Primary Treatment" to the difference in the peak flow conveyed to the WWTP and the WWTP's existing hydraulic capacity.

3.3.9.3.9 Main CSO Alternative I-Partial Sewer Separation Summary

Table 3-1 is a CSO Control Alternatives Matrix summarizing all CSO Control Alternatives. Tables 3-7 through 3-21 include proposed facilities and system upgrades summaries for each CSO Control Alternative. For each alternative, the CSO Control Alternatives Matrix (Table 3-1) contains a reference to the corresponding upgrades summary table and opinion of probable project and construction cost table.

3.3.9.4 Main CSO Control Strategy II-Complete Sewer Separation

Under Main CSO Control Alternative II-Complete Sewer Separation, the strategy for achieving the CSO Control Goals is to convert the MVSA collection system to a dedicated sanitary sewer system, thereby eliminating all CSO discharges.

The complete sewer separation main alternative includes constructing dedicated sanitary sewers in areas of the system where only combined sewers exist and where existing sanitary sewers are in need of replacement. New sanitary trunk sewers would be connected to the main interceptors to provide conveyance of sewage to the WWTP. It is assumed that the elevation of the existing interceptor sewers would be conducive to connection of the sanitary trunk sewers. The old combined sewer piping would remain in the ground and be used to collect and convey storm water.

3.3.9.4.1 Complete Sewer Separation Alternatives

Two Complete Sewer Separation Alternatives were identified to include necessary system upgrades associated with operating and maintaining a dedicated sanitary sewer collection, conveyance, and treatment system.

Under the complete sewer separation main alternative, the estimated peak sanitary sewage flows that would be received at the Monessen and Donora Pump Stations are greater than the existing pump stations' respective capacities. The sum of the estimated peak sanitary flows from the Monessen and Donora Sewersheds is greater than the available WWTP hydraulic capacity. Estimated peak sanitary flows are shown in Table 3-5 and 3-6. Two alternatives are proposed to address the pumping and WWTP hydraulic capacity deficiencies.

Alternative IIA includes:

- conveying peak sanitary flows to the Monessen and Donora Pump Stations;
- conveying peak sanitary flow to the WWTP
    - upgrading Monessen and Donora Pump Stations to provide adequate pumping capacity to convey peak flows to the WWTP
    - replacing the Monessen Pump Station Force Main;
- providing primary and secondary treatment, and disinfecting peak sanitary flow; and
- increasing WWTP peak hydraulic capacity from 12.000 mgd to 14.560 mgd.

Alternative IIB includes:

- conveying peak sanitary flows to the Monessen and Donora Pump Stations;
- restricting sanitary flow conveyed to the WWTP to the WWTP's existing available peak hydraulic capacity;
- storing sanitary flow in excess of the WWTP's existing available peak hydraulic capacity at the pump station sites in lieu of pumping peak flow to the WWTP.
- Storing sewage until treatment capacity is available at the WWTP.

A major proposed modification to system operation that is common to both alternatives involves limiting the peak sewage flow rate that is accepted from Carroll Township. Sanitary sewage from Carroll Township is pumped directly to the WWTP via the Grandview Pump Station. The

WWTP's existing available hydraulic capacity is based on receiving a maximum sewage flow rate of 0.634 mgd (440 gpm) from the Grandview Pump Station.

3.3.9.4.2 Proposed Pump Station Capacities

In both Complete Sewer Separation Alternatives, the estimated sanitary sewage peak flows that would be received at the Monessen and Donora Pump Stations is greater than the existing capacities of the respective stations. Therefore, each pump station's proposed peak flow capacity is based on the estimated peak sewage flow received at each pump station.

3.3.9.4.3 Proposed WWTP Capacity

In each CSO Control Sub-Alternative, the sum of the estimated peak combined sewage flows from the Monessen and Donora Sewersheds is greater than the available WWTP hydraulic capacity. Complete Sewer Separation Alternative includes conveying the peak sanitary flow from the Monessen and Donora Pump Stations to the WWTP and providing biological treatment. The proposed increase in WWTP capacity (2.560 mgd) is based on providing biological treatment to the difference in the peak flow conveyed to the WWTP (14.560 mgd) and the WWTP's existing hydraulic capacity (12.000 mgd).

3.3.9.4.4 Proposed Equalization Storage Tank Sizing

In Alternative IIB, the proposed equalization storage tanks are sized to store sanitary sewage that would be received at the Monessen and Donora Pump Stations in excess of the peak pump station pumping rates. Equalization Storage Tanks are sized based on holding the difference in peak inflow and peak pumping rate over a continuous 24-hour period.

In Complete Sewer Separation Alternative IIB, the sum of the estimated peak sanitary sewage flows from the Monessen and Donora Sewersheds is greater than the available WWTP hydraulic capacity. Complete Sewer Separation Alternative IIB includes constructing equalization storage at the main pump station locations and conveying only a portion of the peak flow received at each main pump station to the WWTP. The portion of combined sewage pumped to the WWTP would equal the WWTP capacity available for flows from Monessen and Donora.

The proposed peak rates conveyed to the WWTP from each main pump station were assigned based on proportioning pumping rate according to the sewersheds' estimated flow contribution. A proposed modification to system operation that is common to all alternatives is limiting the peak inflow from the Carroll Township Sewer Authority's system to 0.634 mgd (440 gpm). Based on the 2002 re-rating study and plant operations experience, the WWTP hydraulic capacity is 12.0 MGD. Therefore, the WWTP plant hydraulic capacity available for flows from the Monessen and Donora pump stations is

12.000 mgd	WWTP Hydraulic Capacity
-0.634 mgd	Peak Inflow from Carroll Township
=11.366 mgd	WWTP Capacity Available for Flows from Monessen and Donora

As shown in Tables 3-5 and 3-6, the estimated peak sanitary sewage flows received at the Monessen and Donora sewersheds are 9.190 mgd and 4.737 mgd, respectively. The Monessen sewershed contributes about 66% of the total estimated peak flow, and the Donora sewershed contributes about 34%. Therefore, the proposed flow conveyed to the WWTP from the Monessen Pump Station is 7.502 mgd or approximately 66% of the available WWTP capacity. The proposed flow conveyed to the WWTP from the Donora Pump Station is 3.865 mgd or approximately 34% of the available WWTP capacity.

Proposed equalization storage tanks are sized to temporarily store the sanitary sewage that would be received at the Monessen and Donora Pump Stations that is in excess of the proposed flows conveyed to the WWTP from each pump station. Equalization Storage Tanks were sized based on holding the difference in the peak inflow and peak flow conveyed to the WWTP over a continuous 24-hour period.

3.3.9.4.5 Main CSO Alternative II-Complete Sewer Separation Summary

Table 3-1 is a CSO Control Alternatives Matrix summarizing all CSO Control Alternatives. Tables 3-22 and 3-23 include proposed facilities and system upgrades summaries for both complete sewer separation alternatives. For each alternative, the CSO Control Alternatives Matrix (Table 3-1) contains a reference to the corresponding upgrades summary table and opinion or probable project and construction cost table.

3.4 Evaluation of Alternatives for CSO Control

3.4.1 Project Costs

A summary of probable opinions of projects costs for each CSO Control Alternative is included in Table 3-24. Tables 3-25 through 3-35 provide a detailed summary of component costs, construction costs, and project costs for each CSO Control Alternative. The opinion of probable project costs for the evaluated alternatives range from approximately $36.5 million to $66.5 million. The opinion of probable project costs for Alternative IA (1-3) – Partial Sewer Separation with disinfection of all combined sewage not entering the interceptor ranges from approximately $54.9 to $61.7 million. The opinion of probable project costs for Alternative IB (1-6) – Partial Sewer Separation with disinfection of only combined sewage receiving high rate clarification ranges from approximately $36.5 to $61.7 million. The opinion of probable project costs for Alternative II A and IIB– Complete Sewer Separation ranges from approximately $63.9 to $66.5 million.

3.4.2 Performance

The range of project costs are based on evaluating levels of treatment ranging from 85% to 100% capture by volume of the combined sewage collected in the CSS during precipitation events on a system-wide annual average basis. This equates to 83 overflow events per year (85% capture) down to 0 events (100% capture). If each diversion/regulating structure were to divert 350% of the dry weather flow to the interceptor, the system would achieve approximately 73% capture by volume and experience approximately 128 overflows during an average year. This represents the no cost alternative.

3.4.3 Cost/Performance Evaluations

Figures 3-4 and 3-5 graph Days of Untreated Overflows in an Average Year vs. Total Project Cost, and Percent Capture by Volume vs. Total Project Cost, respectively. These figures represent the initial high rate of investment to reduce overflows from 128 to 83 per year, then a rapid rate of return for additional investment to eliminate further overflows up to a point of diminishing returns where it becomes increasingly more expensive to eliminate the remaining 4 to 6 overflows or last 1% to 2% by volume under Alternative IB-1. Development of Alternative IB-4 created a more cost effective means to achieve 85% capture and makes additional investment to further increase percent capture and decrease overflows less cost effective until surpassing 95% capture and less than 46 overflows per year. It is also important to note that while the National CSO Policy calls for "85% capture by volume" or "4 to 6 overflows per year" with the intent that they are approximately equal, this was not found to be the case in the Authority system. A percent capture of 85% was found to be equivalent to 83 overflow events per year and 4 to 6 overflow events per year was found to equate approximately 99% capture.

3.4.4 Non-Monetary Factors

There are a number of non-monetary factors when evaluating the different alternatives. When evaluating sewer separation versus satellite treatment, one of the immediate factors that arises is disruption of traffic and the vast system wide construction that would need to occur in paved areas. Utility conflicts with water and gas service would be a major concern. Lastly, successful separation has proved to be extremely difficult both in guaranteeing that no sanitary connections remain tied into storm sewers and that no direct storm water connections are made to the new sanitary sewers.

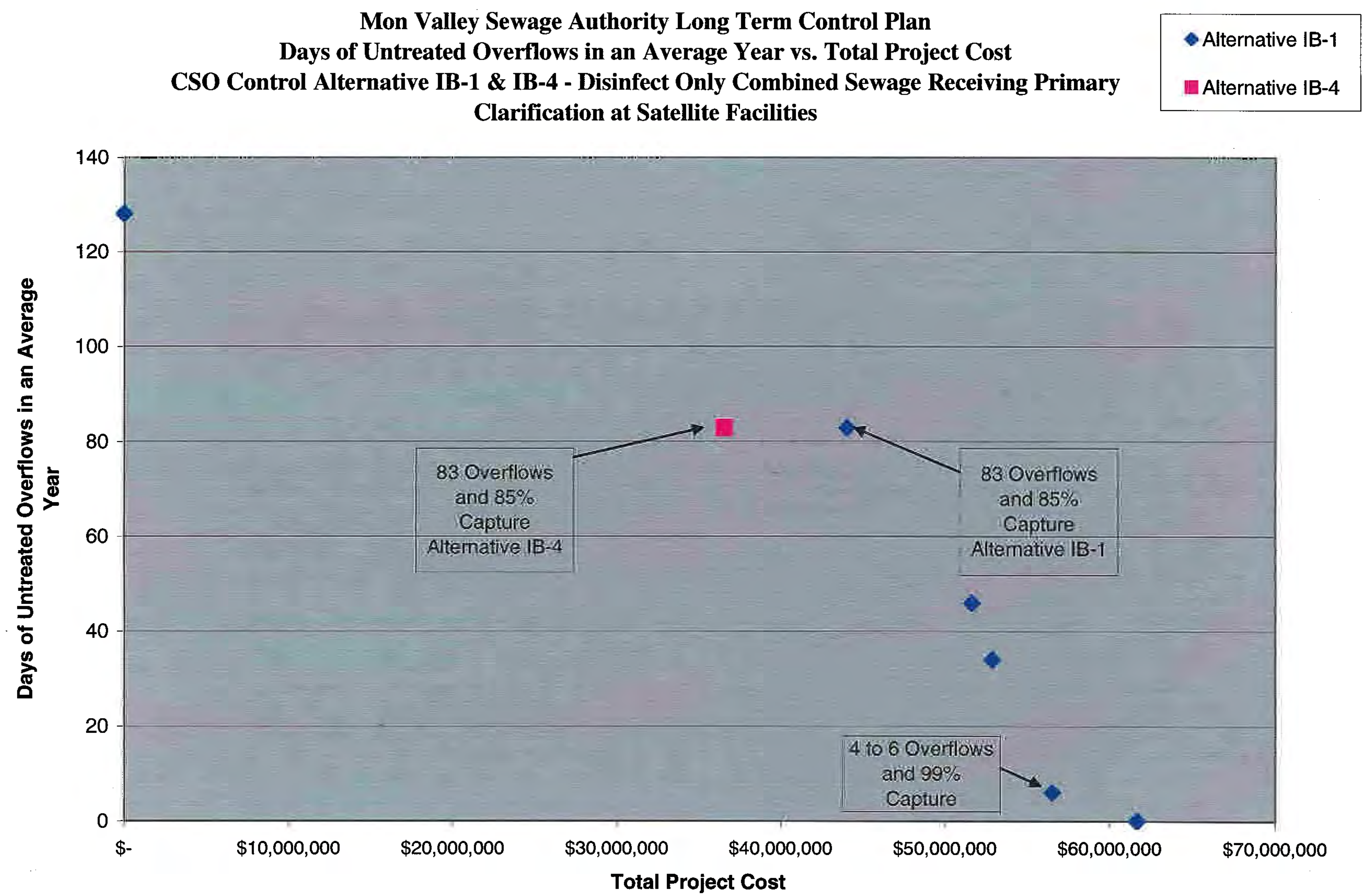


Figure 3-4 Days of Untreated Overflows in an Average Year Versus Total Project Cost

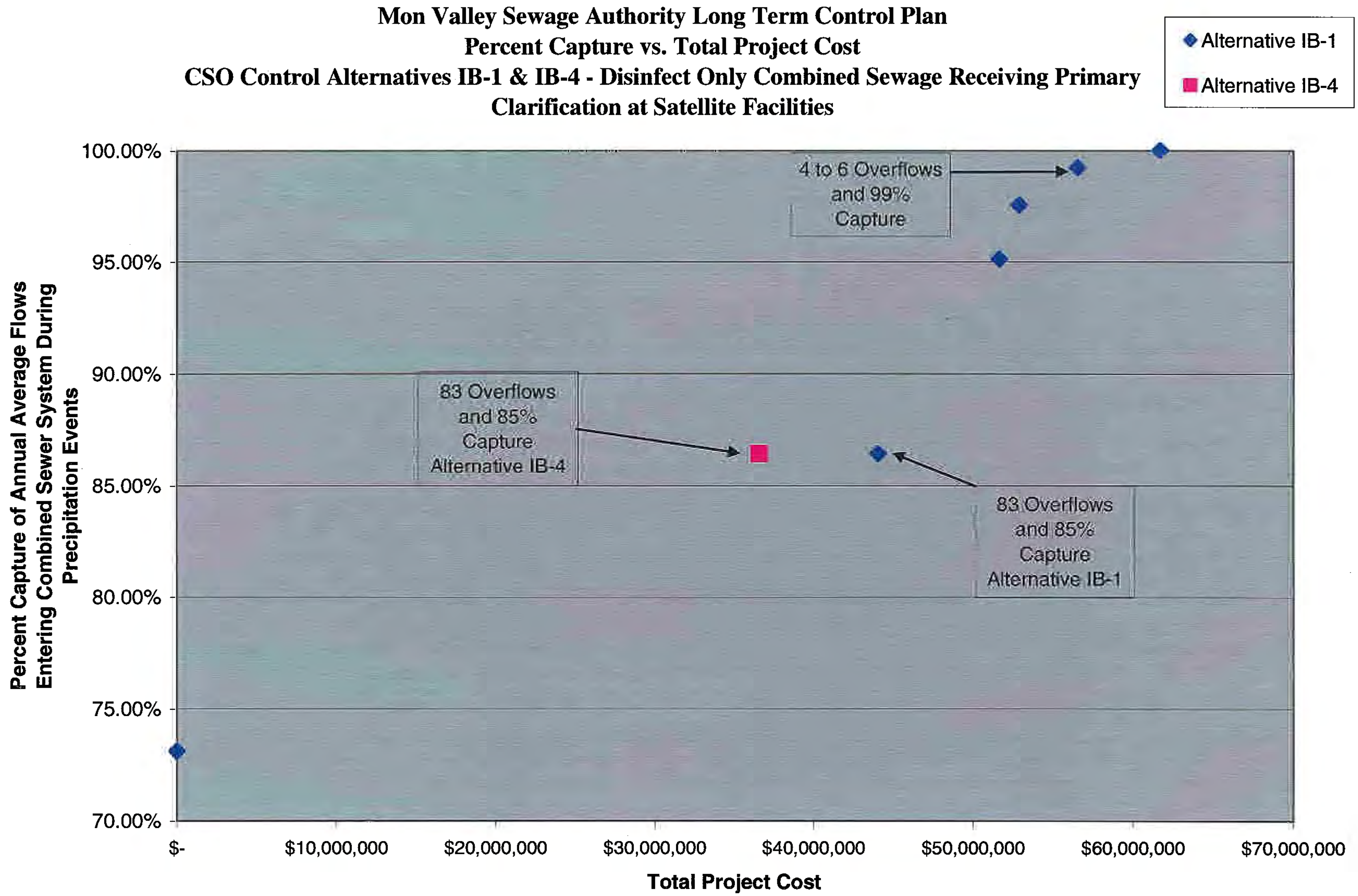


Figure 3-5 Percent Capture by Volume Versus Total Project Cost

While sewer separation has its challenges, satellite treatment is a relatively new concept and clear definition of treatment requirements must be established as part of this project. Deciding to blend the use of equalization facilities with satellite treatment has its positive and negative aspects as well. Equalization facilities can provide a versatile buffer when peak flow rates are experienced that exceed expected conditions that need to be more clearly defined for treatment facilities. Equalization tanks can provide operation and maintenance difficulties as well. Treatment facilities have their own operational challenges that must be considered.

In summary, each alternative possesses non-monetary factors which must be taken into account when ultimately selecting the final alternative.

3.4.4.1 Environmental Issues/Impacts

One objective of the Long Term Control Plan is to provide the Authority with a strategy to meet the established CSO Control Goals. As the Authority begins to implement the selected alternatives contained herein, the impacts of the existing CSOs will begin to lessen.

3.4.4.2 Technical Issues

The concepts, selected alternatives, and proposed facilities that comprise the Long Term Control Plan include emerging technologies that are continually evolving. As the Authority implements the Long Term Control Plan, state of the art technologies will be identified, evaluated, and if appropriate, integrated into the plan.

3.4.4.3 Implementation Issues

The Long Term Control Plan consists of the following four main concepts for providing CSO Control: sewer separation, conveyance system upgrades, equalization storage, and satellite treatment. The proposed phasing for general implementation of the Long Term Control Plan is

1. collection and conveyance system upgrades which include the two stream separation projects along Seneca Street in Monessen and 15th Street in Donora, as well as interceptor sewer/pump station upgrades, and equalization storage construction;

2. sewer separation in selected sub-sewersheds; and
3. screening and full satellite treatment construction.

Conveyance system upgrades include upgrades to the main interceptor sewers and pump stations. Increasing the capacity of the interceptor sewers should be completed prior to introducing increased flows into the system. Pump station upgrades should also be completed prior to increasing flows in the interceptor sewers. Pump station upgrades should begin at the main pump stations (Monessen and Donora Pump Stations) and proceed "upstream" to the upper reaches of the interceptor sewers. Once the pump stations are upgraded to provide the ultimate peak pumping rates, the main pump station equalization storage facilities can be constructed. Once the equalization storage facilities are online, they can be utilized to attenuate the existing CSOs. The next phase of plan implementation would be the proposed sewer separation projects in selected sub-sewersheds. Sewer separation in these areas will completely eliminate CSOs in the selected sewersheds. After the sewers have been separated in the proposed sub-sewersheds, satellite treatment facilities would be constructed at the remaining CSO locations. The implementation of CSO abatement in sensitive areas (i.e. CSO 007) would be considered a priority and would be implemented during the first phase.

3.4.5 Rating and Ranking of Alternatives

Each of the 35 alternatives evaluated in the development of the Long Term Control Plan has the potential to provide the Authority the means to achieve the CSO Control Goals. Each of the alternatives presents unique technical challenges and financial impacts. The selected alternative is based on providing a cost effective set of system upgrades and operating procedures that should provide compliance with the requirements of the CWA, within the framework provided by the CSO Control Policy.

3.5 Financial Capability

The Authority does not have the financial capability to fund the proposed system improvements under its existing operating and construction budgets. As noted herein, project phasing is required to technically and operationally implement the Long Term Control Plan. Therefore, the

Authority will investigate funding alternatives for each phase of the plan as it is implemented over several years. Potential funding sources include rate increases, bond issues, low interest loans via state or Federal sources, or grants including innovative technology grants from state, Federal, or private sources. It is likely that a combination of these funding sources will be utilized to implement the Long Term Control Plan.

4.1 Public Participation and Agency Interaction

The Authority's public participation program which was implemented through the CSO planning process was described above in Sections 1.6.2, 2.1, and 3.1. As a continuation of this effort, the Authority will hold a 30-day public comment period during which time the LTCP will be available for review at the Authority Office, as well as Monessen's City Building and Donora's Borough Building.

The Authority has maintained constant interaction with DEP throughout the CSO planning process. Since the first submittal of the Authority CSO Plan of Action in 1996, the Authority and DEP have traded a great deal of correspondence regarding the progress of the CSO program. A CSO Timeline is included as Appendix L outlining the chronology of correspondence between the Authority and DEP. Most recently, a meeting was held on May 16, 2007 with representatives from the Authority, Gannett Fleming, and DEP to obtain concurrence with the general approach taken to develop the document. The meeting was very positive and the Authority's approach in preparation of this document was very well received by DEP.

4.2 Final Selection and Development of Recommended Plan

In order to meet the requirements of the National CSO Policy via the most cost effective means, the Authority has selected Alternative IB-4b. The opinion of probable construction and project cost for Alternative IB-4 in year 2007 dollars is $28,306,000 (including 20% contingency) and $36,562,000, respectively. Alternative IB-4b was a slightly modified version of previously developed Alternatives that came about as a result of the May 16, 2007 meeting with DEP. Alternative IB-4b implements the general concept of satellite treatment facilities and equalization facilities to handle peak wet weather flows, but eliminates three satellite treatment facilities previously identified in Alternative IB-1 in favor of a larger equalization tank at Monessen Pump Station. This concept adheres to the idea of maximizing flow to the WWTP, where the Authority is conveying as much flow to the WWTP as economically feasible.

As shown in Figures 3-4 and 3-5, Alternative IB-4b creates the most cost effective means to achieve atleast 85% capture (actually 86% capture and 83 overflows per year) and makes additional investment to further increase percent capture and decrease overflows, less cost effective until surpassing 95% capture and less than 46 overflows per year. As a starting point, the no cost alternative represents 73% capture and 128 overflows per year. The initial investment of $36.5 million dollars represents an increase in percent capture of 13% (from 73% to 86%) and a reduction in the number of annual overflows by 45 per year (from 128 to 83). Constructing the additional facilities to achieve 95% capture amounts to an additional $15.5 million investment to increase percent capture by 9% and reduce overflows by 37 per year.

After surpassing 95% capture (46 overflow per year), an additional $5 million dollars increases percent capture to 99% and reduces overflows to only 6 per year (a reduction of 40 overflows). Unfortunately, this Alternative represents a total investment of $56.5 million, or $20.0 million more than the recommended alternative. Finally, it takes an additional $5.1 million or a total of $61.6 million to eliminate the remaining 6 overflow per year. Therefore, if the Authority were to spend any more money beyond the recommended alternative, it would make the most economical sense to achieve 99% capture (6 overflows per year) at a total cost of $56.5 million. Unfortunately, a cost of that magnitude is not economically viable for the Authority. Therefore, as indicated above, the Authority will meet the requirements of the National CSO Policy by achieving 86% capture at a total project cost of $36.5 million in the year 2007 dollars.

4.3 Financing Plan

The Authority does not have the financial capability to fund the proposed system improvements under its existing operating and construction budgets. As noted herein, project phasing is required to technically and operationally implement the Long Term Control Plan. Therefore, the Authority will investigate funding alternatives for each phase of the plan as outlined in the implementation schedule below. Potential funding sources include rate increases, bond issues, low interest loans via state or Federal sources, or grants including innovative technology grants from state, Federal, or private sources. It is likely that a combination of these funding sources will be utilized to implement the Long Term Control Plan.

4.3.1 Capital Funding Options

As indicated above, the four capital funding options are bonds, loans, grants and privatization.

4.3.1.1 Bonds

Bond issues are a common method by which municipalities and authorities obtain money to fund projects. Revenue bond issues are normally calculated to achieve a level annual payment for each year of the issue and are presently issued for a maximum term of 30 years at prevailing interest rates. A 20 year term is more common. The annual payment for debt service (interest and principal) is made from annual operating revenues. Bond Issues normally require 10 to 20 percent coverage on top of the average annual debt service cost.

The costs for legal services and printing of bonds are substantial. As a rule, bond issues may be considered for total project costs in excess of $500,000.

4.3.1.2 Loans

Loans are repaid at an agreed upon rate of return over a stipulated time period. The loan programs which may apply to private as well as public facilities are discussed below.

(1) **Commercial or Bank Loans**

Bank financing is readily accessible and requires a much shorter interval from project start to construction. This loan option requires less administrative costs than expected with a bond issue. The main disadvantage to a bank loan is that the term usually does not extend beyond 15 years.

(2) **Pennsylvania Infrastructure Investment Authority (PENNVEST)**

PENNVEST has been capitalized by State and Federal funds to provide an innovative approach to financing local infrastructure in Pennsylvania. The interest rates for this program are determined based on prevailing economic conditions. A number of grants have also been awarded under this program.

(3) **Rural Utility Service (RUS)**

The RUS loan and supplemental grant program was established to provide human amenities, alleviate health hazards, and promote the orderly growth of rural areas by meeting the need for new and improved water and waste disposal systems. Restrictions with regard to population of the area, financing capability, and project administration must be met. RUS usually provides a combination grant/loan. The CHJA service area exceeds the requirements of RUS and funding would not be available for the project.

4.3.1.3 Grants

A method of financing available to alleviate partial construction costs is grants-in-aid. A grant is a monetary award to a project without provision for reimbursement. The grant programs which may apply to this project are discussed below.

(1) **Washington County/Westmoreland County Community Development Block Grant**

Community Development Block Grants are awarded to communities within the County for various public works projects. These grants are awarded on an individual project basis to service areas of low and moderate income. This funding is for municipalities only and would not be available directly to the Authority although Donora and Monessen may have access to these Grants to fund portions of the overall LTCP.

(2) **Pennsylvania Infrastructure Investment Authority (PENNVEST)**

PENNVEST has been capitalized by State and Federal Funds to provide an innovative approach to financing local infrastructure in Pennsylvania. The PENNVEST Board meets several times each year to consider funding applications and award funds to water and sewage infrastructure development projects. This is usually a grant and loan program. Worthy projects may receive PENNVEST grant awards of up to $1,000,000 per project in conjunction with a loan offer for additional project funds.

(3) **Department of Community and Economic Development (DCED)**
DCED has funds available under the Community Revitalization Program. The Community Revitalization Program supports local projects that improve the stability of communities and enhance local economic conditions. Eligible projects include construction or rehabilitation of infrastructure. Assistance from this program is in the form of a grant.

4.3.1.4 Privatization

Privatization is an option for the Authority, but not one that has been explored at this time. A private entity would need to be identified with an interest in inquiring the Authority's system. Nonetheless, the Authority has not expressed an interest in selling their system.

4.3.1.5 Other Capital Funding Options

One of the above financing methods will be used to finance the projects identified in the LTCP.

4.3.2 Annual Funding Options

Annual Funding will continue to be generated via sewer user fees collected by the Authority.

4.3.3 Selection of Financing Method

Individual financing methods will be selected as part of each phase that is carried out in accordance with the implementation schedule below. Although, we have included financing tables in Appendix M reflecting the impact on the Authority's customers if Alternative IB-4b were to be implemented in its entirety immediately.

4.4 Implementation Schedule

The Long Term Control Plan consists of the following four main concepts for providing CSO Control: collection and conveyance system upgrades, equalization storage, sewer separation, and satellite treatment. The proposed phasing for general implementation of the Long Term Control Plan is

1. collection and conveyance system upgrades which include the two stream separation projects along Seneca Street in Monessen and 15th Street in Donora, as well as interceptor sewer/pump station upgrades, and equalization storage construction;
2. sewer separation in selected sub-sewersheds; and
3. screening and full satellite treatment construction.

Collection and conveyance system upgrades include include the two stream separation projects along Seneca Street in Monessen and 15th Street in Donora, as well as interceptor sewer and pump station upgrades. Increasing the capacity of the interceptor sewers should be completed prior to introducing increased flows into the system. Pump station upgrades should also be completed prior to increasing flows in the interceptor sewers. Pump station upgrades should begin at the main pump stations (Monessen and Donora Pump Stations) and proceed "upstream" to the upper reaches of the interceptor sewers. Once the pump stations are upgraded to provide the ultimate peak pumping rates, the main pump station equalization storage facilities can be constructed. Once the equalization storage facilities are online, they can be utilized to attenuate the existing CSOs. The next phase of plan implementation would be the proposed sewer separation projects in selected sub-sewersheds. Sewer separation in these areas will completely eliminate CSOs in the selected sewersheds. After the sewers have been separated in the proposed sub-sewersheds, satellite treatment facilities would be constructed at the remaining CSO locations. The implementation of CSO abatement in sensitive areas (i.e. CSO 007) would be considered a priority and would be implemented during the first phase. Tables 4-1, 4-2, 4-3, and 4-4 outline the implementation of Alternative IB-4 including timing, costs, and facility sizes. Table 4-1 is a brief summary of the Implementation Schedule. Table 4-2 is a more detailed schedule that outlines implementation of design, permit, bidding and construction phase services and the cashflow of the Authority over the estimated 10 year period to implement the LTCP.

TABLE 4-1

IMPLEMENTATION SCHEDULE

Phase	Scope of Projects	Year 2007 Construction Cost	Year 2007 Project Cost	Construction Complete
I	Seneca Street Stream Separation	$570,000	$736,300	4 Years from DEP Approval of LTCP
	15th Street Stream Separation (1)	$193,800	$251,000	
	Conveyance Upgrades	$1,266,000	$1,635,300	
	Pump Station Upgrades	$948,000	$1,244,500	
	Equalization Facilities	$1,617,600	$2,089,400	
	Phase I Subtotal	$4,595,400	$5,936,500	
II	Seneca Street Satellite Facility	$6,229,200	$8,046,100	6 Years from DEP Approval of LTCP
	Sewer Separation Projects	$2,084,500	$2,692,200	
	Phase II Subtotal	$8,313,500	$10,738,300	
III	Remaining Satellite Facilities	$13,074,000	$16,887,200	12 Years from DEP Approval of LTCP
Total	**Alternative IB-4b**	**$25,982,900**	**$33,562,000**	12 Years from DEP Approval of LTCP

(1) $3,000,000 included elsewhere in this plan in the Overall Project Cost for Alternative IB-4b has been removed from the above Implementation Schedule. Originally identified as part of the 15th Street Stream Separation Project due to a Feasibility Study conducted by the Authority, Donora Borough Council is planning to provide sewer service to approximately 230 unsewered homes as part of an Act 537 Plan Special Study.

TABLE 4-1A

IMPLEMENTATION SCHEDULE

PHASE I

Phase	Scope of Projects	Year 2007 Construction Cost		Year 2007 Project Cost	Construction Complete
I	Seneca Street Stream Separation (1)		$570,000	$736,300	4 Years from DEP Approval of LTCP
	15th Street Stream Separation (2)		$193,800	$251,000	
	Conveyance Upgrades				
	Monessen Interceptor	$1,116,000			
	Donora Interceptor	$150,000			
	Total Conveyance Upgrades		$1,266,000	$1,635,300	
	Pump Station Upgrades				
	South Pump Station	$30,000			
	Donner Pump Station	$180,000			
	Monessen Pump Station	$460,800			
	North Pump Station	$60,000			
	Donora Pump Station	$217,200			
	Total Pump Station Upgrades		$948,000	$1,244,500	
	Equalization Facilities				
	Monessen Equalization Facilities	$1,150,800			
	Donora Equalization Facilities	$466,800			
	Total Equalization Facilities		$1,617,600	$2,089,400	
	Phase I Subtotal		**$4,595,400**	**$5,936,500**	

(1) Covers work identified in Table 4-3 under Collection System in Sub-Sewershed Areas 7, 7A, and 7B.

(2) Covers work identified in Table 4-3 under Sub-Sewershed Area 21

TABLE 4-1B

IMPLEMENTATION SCHEDULE

PHASE II

Phase	Scope of Projects	Year 2007 Construction Cost	Year 2007 Project Cost	Construction Complete
II	Seneca Street Satellite Facility [1]	$6,229,000	$8,046,100	6 Years from DEP Approval of LTCP Plus 1 Additional Year for Satellite Facility Evaluation
	Sewer Separation Projects			
	Sub-Sewershed Area 2	$798,400		
	Sub-Sewershed Area 5	$60,000		
	Sub-Sewershed Area 9	$46,000		
	Sub-Sewershed Area 13	$408,400		
	Sub-Sewershed Area 15	$171,400		
	Sub-Sewershed Area D212	$297,700		
	Sub-Sewershed Area 18	$38,200		
	Sub-Sewershed Area 19	$87,100		
	Sub-Sewershed Area 20	$ 68,800		
	Sub-Sewershed Area 22	$108,500		
	Total Sewer Separation Projects	$2,084,500	$2,692,200	
	Phase II Subtotal	**$8,313,500**	**$10,738,300**	

(1) Covers work identified in Table 4-3 under Collection System Satellite Treatment Facilities in Sub-Sewershed Areas 7, 7A, and 7B.

TABLE 4-1C

IMPLEMENTATION SCHEDULE

PHASE III

Phase	Scope of Projects	Year 2007 Construction Cost	Year 2007 Project Cost	Construction Complete
III	Remaining Satellite Facilities [1]			12 Years from DEP Approval of LTCP
	Sub-Sewershed Area 3	$339,600		
	Sub-Sewershed Area 4	$270,000		
	Sub-Sewershed Area 5	$236,400		
	Sub-Sewershed Area 10	$165,600		
	Sub-Sewershed Area 11+110	$3,918,000		
	Sub-Sewershed Area 14+140	$4,206,000		
	Sub-Sewershed Area 16	$3,758,400		
	Sub-Sewershed Area 17	$180,000		
	Total Remaining Satellite Facilities	$13,074,000	$16,887,200	
	Phase III Subtotal	**$13,074,000**	**$16,887,200**	

(1) Includes three primary treatment and disinfection satellite facilities in Areas 11+110, 14+140, and 16 as well as five solids and floatables removal facilities consisting of automatic coarse screening units in Areas 3, 4, 5, 10 and 17.

4.5 Operational Plan

Standard Operating Procedures and Operation and Maintenance Manuals would be developed for all facilities and infrastructure constructed as part of the LTCP as part of final design of each respective facility.

4.6 Post-Construction Compliance Monitoring

Based on conversations with DEP at our May 16, 2007 meeting, it is our understanding that a post-construction monitoring plan consisting of flow metering at each satellite facility and any other location necessary to document at least 85% capture would be adequate to address the Authority's Post Construction Monitoring Plan.

4.7 Re-Evaluation and Update

The Authority will continue to evaluate its progress throughout the implementation of the LTCP and will be held to its implementation schedule by way of its NPDES Permit. Based on conversations with DEP, those projects that fall within each 5 year cycle of future NPDES Permit renewals will be listed within the Permit itself and will be used to monitor the success of implementation of the LTCP.

MON VALLEY SEWAGE AUTHORITY
COMBINED SEWER OVERFLOW LONG TERM CONTROL PLAN
TABLE 4-2
IMPLEMENTATION SCHEDULE FOR NPDES PERMIT RENEWAL AND AUTHORITY CASHFLOW

Phase	Project Description	Year 1 [1]	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
I	Seneca Street Stream Separation	Design, Permit, and Bid		Construction									
	15th Street Stream Separation												
	Conveyance Upgrades												
	Pump Station Upgrades												
	Equalization Facilities												
II	Seneca Street (CSO 007) Satellite Facility			Design, Permit, and Bid		Construction		Satellite Facility Evaluation					
	Sewer Separation Projects												
III	Three Remaining Satellite Facilities (CSOs 011, 014, and 016)							Design, Permit, and Bid			Construction		
Projected Yearly Cashflow in 2007 Dollars		$0.75M	$0.75M	$3.5M	$3.5M	$4.1M	$4.1M	$1M	$1.4M	$1.4M	$4M	$4.5M	$4.5M
Projected Cumulative Cashflow in 2007 Dollars		$0.75M	$1.5M	$5M	$8.5M	$12.6M	$16.7M	$18.7M	$19.1M	$20.5M	$24.5M	$29M	$33.5M
Projected Yearly Cashflow in Future Dollars		$0.80M	$0.8M	$3.9M	$4.1M	$4.9M	$5M	$1.3M	$1.8M	$1.9M	$5.5M	$6.4M	$6.6M
Projected Cumulative Cashflow in Future Dollars		$0.80M	$1.6M	$5.5M	$9.6M	$14.5M	$19.5M	$20.8M	$22.6M	$24.5M	$30.0M	$36.4M	$43.0M

Notes:
(1) Years represent time beyond DEP approval of Long Term Control Plan.

Mon Valley Sewage Authority
Long Term Control Plan
Table 4-3
Selected CSO Control Alternative IB-4b
Opinion of Probable Construction and Project Costs

Main CSO Control Alternative	I	Partial Sewer Separation
CSO Control Strategy		Satellite Treatment Facilities at Selected CSO Locations
CSO Disinfection Alternative	B	Disinfect Only Combined Sewage That is Diverted from the Interceptor and Receives Satellite Treatment
CSO Control Sub-Alternative	4	Maximize Conveyance at 85% Capture in Monessen Sewershed-Monessen and Donora Pump Station Equalization Storage Tanks
Level of CSO Control	b	85% Capture on an Average Annual Basis

Collection System

Monessen Sewershed Area

Sub-Sewershed Area	Sewer Separation Cost	Upgrade Cost	Total Cost
2	$ 665,300	$ -	$ 665,300
3	$ -	$ 5,000	$ 5,000
5	$ -	$ 50,000	$ 50,000
4	$ -	$ 5,000	$ 5,000
7, 7A, 7B	$ -	$ 475,000	$ 475,000
9	$ 38,300	$ -	$ 38,300
M101	$ -	$ -	$ -
Monessen Collection System-Subtotal			$ 1,238,600

Conveyance System

Sewershed Area			Total Cost
Monessen			$ 930,000
Donora			$ 125,000
Conveyance System Subtotal			$ 1,055,000

Donora Sewershed Area

Sub-Sewershed Area	Sewer Separation Cost	Upgrade Cost	Total Cost	Notes
22	$ 90,400	$ -	$ 90,400	
21	$ 2,097,000	$ -	$ 2,097,000	
20	$ 57,300	$ -	$ 57,300	
19	$ 72,600	$ -	$ 72,600	
18	$ 31,800	$ -	$ 31,800	
D212	$ 248,100	$ -	$ 248,100	Storm Sewer Construction to Delsandro Drive
17	$ -	$ 5,000	$ 5,000	
16	$ -	$ 5,000	$ 5,000	
15	$ 142,800	$ -	$ 142,800	
140	$ -	$ 5,000	$ 5,000	
14	$ -	$ 5,000	$ 5,000	
13	$ 340,300	$ -	$ 340,300	
110	$ -	$ 5,000	$ 5,000	
11	$ -	$ 5,000	$ 5,000	
10, D123	$ -	$ -	$ -	
Donora Collection System-Subtotal			$ 3,110,300	

Collection and Conveyance System Construction Subtotal $ 5,404,000

Pump Station Upgrades

Monessen Sewershed Area

Pump Station	Upgrade Cost
Aubrey Ejector	$ -
South Pump Station	$ 25,000
Donner Pump Station	$ 150,000
Monessen Pump Station	$ 384,000
Monessen Pump Stations Subtotal	$ 559,000

Donora Sewershed Area

Pump Station	Upgrade Cost
North Pump Station	$ 50,000
Donora Pump Station	$ 181,000
Donora Pump Stations-Subtotal	$ 231,000

Pump Station Upgrade Construction Subtotal $ 790,000

Equalization Tanks

Monessen Pump Station EQ Tank $ 959,000

Donora Pump Station EQ Tank $ 389,000

Equalization Tanks Construction Subtotal $ 1,348,000

Collection System Satellite Treatment Facilities

Sub-Sewershed Area	CSO	CSO Control Alternative IB-4a 100% Capture	IB-4b 85% Capture	IB-4c 4-6 Annual Overflows	IB-4d % Capt. Knee of Curve	IB-4e Annual Overflows Knee of Curve
Monessen						
3	003	$ -	$ 278,000	$ -	$ -	$ -
4	004	$ -	$ 220,000	$ -	$ -	$ -
5	005	$ -	$ 197,000	$ -	$ -	$ -
7+7A+7B	007	$ -	$ 5,191,000	$ -	$ -	$ -
Monessen-Subtotal		$ -	$ 5,886,000	$ -	$ -	$ -
Donora						
17	017	$ -	$ 145,000	$ -	$ -	$ -
16	016	$ -	$ 3,127,000	$ -	$ -	$ -
14+140	014	$ -	$ 3,495,000	$ -	$ -	$ -
11+110	011	$ -	$ 3,255,000	$ -	$ -	$ -
10	010	$ -	$ 138,000	$ -	$ -	$ -
Donora-Subtotal		$ -	$ 10,160,000	$ -	$ -	$ -
Satellite Treatment Facility Construction Subtotal		$ -	$ 16,046,000	$ -	$ -	$ -

Summary of Construction and Project Costs

CSO Control Alternative	NA	IB-4b	NA	NA	NA
Construction Subtotal	$ -	$ 23,588,000	$ -	$ -	$ -
Contingency (20% of Construction Subtotal)	$ -	$ 4,718,000	$ -	$ -	$ -
Project Costs (35% of Construction Subtotal)	$ -	$ 8,256,000	$ -	$ -	$ -
	$ -		$ -	$ -	$ -
Total Project Cost	$ -	$ 36,562,000	$ -	$ -	$ -

Notes:
(1) Costs are presented in 2007 dollars.

Mon Valley Sewage Authority
Long Term Control Plan
Table 4-4
Summary of Selected Alternative IB-4b

Main CSO Control Alternative	I	Partial Sewer Separation
CSO Control Stategy		Satellite Treatment Facilities at Selected CSO Locations
CSO Disinfection Alternative	B	Disinfect Only Combined Sewage That is Diverted from the Interceptor and Receives Satellite Treatment
CSO Control Sub-Alternative	4	Maximize Conveyance at 85% Capture in Monessen Sewershed and Construct Monessen and Donora Pump Station Equalization Storage Tanks
Level of CSO Control	b	85% Capture on an Average Annual Basis

CSO or Facility Location	Sub-Sewershed Map Area	Sewage Classification	Average Dry Weather Flow (ADWF) (mgd)	Peak Flow Conveyed to Interceptor (mgd)	Percent of ADWF Conveyed to Interceptor (mgd)	Coarse Screening Facility Capacity (mgd)	Satellite Treament Facility Capacity (mgd)	Pump Station Peak Capacity (mgd)	Equalization Tank Volume (Mgal)	Flow Conveyed to WWTP (mgd)
Monessen Sewershed										
Aubry Ejector								0.072	-	-
CSO 002	2	Sanitary	0.022	0.086	400%	-	-	-	-	-
South Pump Station								0.259	-	-
CSO 003	3	Combined	0.713	3.246	455%	43.904	-	-	-	-
Donner Pump Station								3.505		
CSO 004	4	Combined	0.857	3.200	373%	16.331	-	-	-	-
CSO 005	5	Combined	0.170	0.895	526%	6.988	-	-	-	-
CSO 006	5	Storm	-	-	-	-	-	-	-	-
CSO 007	7A+7B+7	Combined	0.465	1.628	350%	37.461	4.167	-	-	-
Manhole M101	M101	Sanitary	0.028	0.111	400%	-	-	-	-	-
Monessen Pump Station Peak Flow Capacity								9.338		
Monessen Pump Station Equalization Tank Volume (min)									1.837	
Monessen Pump Station Flow Conveyed to WWTP										7.501
Monessen Sewershed Opinion of Probable Project Cost =			$ 14,838,000							
Donora Sewershed										
CSO 017	17	Combined	0.146	0.516	353%	5.651	-	-	-	-
CSO 018	18	Sanitary	0.004	0.018	400%	-	-	-	-	-
CSO 019	19	Sanitary	0.004	0.018	400%	-	-	-	-	-
CSO 021	21	Sanitary	0.026	0.104	400%	-	-	-	-	-
CSO 022	22	Sanitary	0.006	0.024	400%	-	-	-	-	-
Diversion MH 202B	20	Sanitary	0.002	0.009	400%	-	-	-	-	-
MH 212	D212	Sanitary	0.015	0.061	400%	-	-	-	-	-
North Pump Station								0.74902	-	-
CSO 010	10+D123	Combined	0.162	0.571	351%	2.681	-	-	-	-
CSO 011	11+10+D123, 110	Combined	0.072	0.252	350%	14.483	2.111	-	-	-
CSO 013	13	Sanitary	0.006	0.022	400%	-	-	-	-	-
CSO 014	140+14	Combined	0.520	1.829	351%	49.586	2.444	-	-	-
CSO 015	15	Sanitary	0.062	0.248	400%	-	-	-	-	-
CSO 016	16	Combined	0.157	0.555	352%	11.955	3.889	-	-	-
Donora Pump Station Peak Flow Capacity								4.226		
Donora Pump Station Equalization Tank Volume (min)									0.361	
Donora Pump Station Flow Conveyed to WWTP										3.865
Monessen Sewershed Opinion of Probable Project Cost =			$ 21,724,000							
Total Monessen and Donora Pump Station Capacity								13.563		
Total Monessen and Donora Pump Station Equalization Storage									2.198	
Total Monessen and Donora Pump Station Flow Conveyed to WWTP										11.366
Flow Conveyed to WWTP From Carroll Township										0.634
Total Flow Conveyed To WWTP										12.000
Total Opinion of Probable Project Cost=			$ 36,562,000							

Notes:
(1) Costs are presented in 2007 dollars.

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1. 2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, Pennsylvania Department of Environmental Protection, 2004.

2. Combined Sewer Overflow (CSO) Control Policy; Notice, Environmental Protection Agency Federal Register, Tuesday April 19, 1994.

3. Combined Sewer Overflows Guidance for Long-Term Control Plan, Environmental Protection Agency, September 1995.

4. Domestic Wastewater Facilities Manual, Pennsylvania Department of Environmental Protection, October 1997.

5. Memorandum-Implementation of the CSO Control Policy, Environmental Protection Agency, May 1998.

6. Memorandum-Water Quality-Based and Technology-Based CSO Requirements, Environmental Protection Agency, July 1999.

7. Pennsylvania Code Title 25 Chapter 93

8. Recommended Standards for Wastewater Facilities, Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Manager, 1997 Edition.

9. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, 2003

10. Water Environment Federation (WEF) Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, Design of Municipal Wastewater Treatment Plants Volume I, Water Environment Federation and American Society of Civil Engineers, 1992.