

**City of Philadelphia
Combined Sewer Overflow Program**

CSO Documentation

Implementation of the Nine Minimum Controls

Submitted to:

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Bureau of Water Quality Management**

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Executive Summary

The Philadelphia Water Department recognizes that its efforts to address combined sewer overflows from Philadelphia's combined sewer system is a significant undertaking. In order to develop technically sound, cost-effective plans to address CSOs that satisfy NPDES permit conditions, help meet PaDEP's objectives for water quality improvement and improve Philadelphia's water environment, PWD has established a CSO program to which it has already committed significant resources. The Department has been operating and maintaining the City's sewer system competently for many years. However, this NPDES permit-inspired CSO program has led to a more thorough and comprehensive examination of the collection system than has ever been performed at any time in the past. The program is helping the Department to learn more about the sewer system and to look for better and more efficient ways to operate and maintain it.

The CSO Program currently is staffed by 5 consultants and 2 full-time PWD personnel located in a 1000 square foot program office at PWD's downtown headquarters, and by more than the equivalent of 2 full-time PWD staff positions located at the Fox Street computer facility. Initial program efforts have focused on development and integration of state-of-the-art tools for the CSO management: computer models of the combined sewer system which demonstrate how the system currently performs and simulates alternative strategies for enhanced performance; a database of the physical system and of the maintenance activities performed on it; a geographic information system (GIS) used to manage and interpret spatial information; and a computerized monitoring network to provide field measurements of the depth of sewage flows at key locations throughout the Northeast drainage district, used to optimize operational efficiency. Each of these elements is now in place and operational, and together these resources provide PWD with the tools necessary to successfully develop and implement Philadelphia's CSO program by providing an accurate characterization of the combined sewer system components and inputs, the system condition, measurements of its behavior and simulation of its performance both now and in the future.

The computer facility at the Fox Street location and the field monitoring system currently are undergoing a major expansion. Beginning in the late 1980's, the PWD began implementing a

comprehensive program of sewer system monitoring which employs the latest electronic technology to measure sewer system flow levels and automatically collect and process the data at a centralized location. This program of electronic surveillance, currently being expanded in a \$6.5 million equipment installation project which will greatly increase the number of monitored sites and add the capability to measure flow rates as well as levels, is a key element in PWD's CSO program. By continuously monitoring sewer system conditions in real time, PWD is reducing the need for frequent visits to remote sites to verify proper operation, thereby freeing up resources which can be deployed for system-wide operational improvements to optimize the performance of PWD's existing system in minimizing CSO impacts.

PWD is developing a state-of-the-art computer model of Philadelphia's combined sewer system. This model will be a fundamental part of PWD's CSO program, supporting all phases of CSO related activities - evaluation of plan alternatives, sizing and design of facilities, and analysis of the efficacy of controls. Because Philadelphia's combined sewer system is one of the largest and most complex systems in the U.S., PWD is implementing a suite of computer models in a modeling process that has been carefully designed to evolve in a growth path that parallels the planning process. This modeling process, employing a two-tiered modeling strategy, enables PWD to meet their permit requirements for hydraulic characterization, NMC implementation and long-term planning by focusing model detail on the key system elements first, and expanding the level of model detail to support the needs of the planning process for increasingly detailed information.

Initial model development in the first tier effort has therefore focused on detailed simulation of the system of interceptor sewers and regulators, using the **EX**tended **TRAN**sport (EXTRAN) block of the U.S. EPA's **Storm**Water **Management** **Model** (SWMM). Initial characterization of the capture and overflow of combined sewer flows has been developed using the U.S. Army Corps of Engineers' **S**torage, **T**reatment, **O**verflow, **R**unoff **M**odel (STORM) to support hydraulic characterization and NMC implementation. Additional detail on the trunk sewer system and combined sewersheds currently being added to the model in the second tier effort to support long-term control planning. This effort will enable PWD to more precisely characterize the combined sewer system using the RUNOFF and TRANSPORT blocks of SWMM. The process of model expansion and refinement will continue throughout PWD's CSO program, as the models evolve to support each phase of the program - from concept planning through implementation and post-construction assessment.

The City of Philadelphia has made a significant commitment to the proper collection and treatment of waste water and storm water. There are over 300 employees in the Department's Waste and Storm Water Collector Group dedicated to the operation and maintenance of Philadelphia's sewer system, with an annual operating budget in excess of 15 million dollars. In this upcoming year, the City will spend an additional 16 million dollars for a capital improvements program for sewer rehabilitation that is beyond the scope of the operation and maintenance budget. The City's combined annual operations and maintenance budget for the three water pollution control plants and the sludge processing facilities is almost 45 million dollars. Over 500 employees work at those facilities.

Much of the work of the Waste and Storm Water Collector Group relates directly to maximizing the storage of wet weather flows in the combined sewers and their transport through the sewer system to the water pollution control plants. For instance during this past year, in addition to the Departmental staff's cleaning of many miles of sewers, an outside contractor was retained for over \$80,000 of specialized, large sewer cleaning work. This coming year, \$300,000 is budgeted for specialized large sewer cleaning efforts.

A good example of the City's commitment to CSO control, and one that also was influenced by the CSO NPDES permit process, is the recently instituted practice of regularly cleaning and maintaining grit pockets at two critical locations in the trunk and interceptor system. For instance, the quarterly cleaning of the 100-foot deep siphon grit pocket located at the Central Schuylkill wastewater pumping station is a major undertaking requiring specialized equipment and the commitment of significant labor resources. This practice has been shown to reduce the hydraulic grade surface at the siphon, increasing the wet weather flow capacity to the Southwest treatment plant. Prior to the recent institution of this cleaning practice, the grit pit at this location had not been cleaned regularly in over 40 years.

Operation condition inspections of regulator chamber and backflow prevention devices are conducted for each structure approximately weekly, resulting in more than 10,000 inspections conducted each year. Additionally, comprehensive structural and preventative maintenance inspections are performed annually. The PWD staff is in the process of revising their comprehensive inspection forms to provide a more convenient format for their newly instituted computerized maintenance documentation and reporting procedures. The new forms will be

similar to those used for the third-party verification activity that was documented in the PWD System Inventory and Characterization Report (March, 1995). The new forms will be customized for each structure. The City-wide expansion of the electronic surveillance monitoring of the sewer system is expected to supplement the inspection program, reducing the labor required for the weekly inspections, making more resources available for the comprehensive inspections.

The Waste and Storm Water Collector Group has made provisions to detect and deal with emergencies associated with the sewer system. The Emergency Response Program provides electronic notification of responsible individuals under certain conditions such as pump station failure, dry weather overflows (currently in the Northeast drainage district but soon to be City-wide), and certain other equipment failures. The system provides for the automated notification through equipment located in the field that automatically electronically pages supervisors, alerting them to the possible emergency condition so that on-call crews can be dispatched. In addition, calls handled through the City's main Emergency Desk are routed directly into the PWD's Emergency Program.

The City recently has begun a construction project that is installing emergency back-up electrical power generation at 8 wastewater pump stations that currently do not have dual power supply capabilities. Records from 1994 reveal that 95% of the pump station-related dry weather overflows occurring in that year (14) were related to power failures. The installation of the emergency power generation equipment is expected to greatly reduce the potential for pump station-related overflows. In addition, Department staff presently are developing a City-wide pump station predictive maintenance program that is intended to optimize station operation and minimize avoidable pump station-related dry weather overflows.

Another measure aimed at maximizing the wet weather flow of combined sewage to the wastewater treatment plants and the available effective treatment capacity at the plants is the planned construction project intended to provide backflow prevention devices for the emergency overflow weirs at a number of tide gates throughout the system. This will reduce the transmission and treatment capacity losses caused when extreme high tides enter the system over the top of some tide gates. This project is currently in the design phase and is scheduled to enter the construction phase in the near future.

In response to concerns raised during the process of developing of the System Inventory and Characterization Report (PWD, March 1995), the Department has installed temporary flow meters in several locations around the City. The Department has committed to reporting the results of these monitoring activities to PaDEP by March of 1996, along with an evaluation of any overflow conditions that may be documented. This is another good example of how the CSO permitting process has caused the Department to look more closely at a portion of the sewer system and to attempt to find ways to operate it better.

The operation and maintenance of the sewer system is comprehensively documented. Innovative computerized record keeping, data management and reporting techniques developed internally by departmental staff have provided a new basis for better operational management of the sewer system. These same techniques allow the preparation of timely and accurate overflow activity reports to satisfy CSO permit requirements.

Planned action items for flow maximization and sewer system operation optimization under the Nine Minimum Controls include the implementation a number of improvements in the ways that the collection system is operated. A key element among the early-action items is the addition of dams to the 57 slot regulators in the combined sewer system that do not currently have dams. Although these structures generally do not bypass during dry-weather, the absence of a diversion dam at the downstream side of the orifice opening renders these sites more susceptible to dry-weather overflow. The addition of a dam will not only provide greater factor of safety in preventing dry-weather overflows, but will also provide greater hydraulic head on the orifice, increasing the flow into the interceptor sewers and in some cases potentially increasing the maximum hydraulic gradient in the interceptor sewer prior to overflow. The net effect of these improvements will be better protection against dry-weather overflows and better capture of combined flows in the interceptor during wet weather. PWD is committed to installing dams in all 57 locations within the next 2 years.

A key element of PWD's NMC plan is the adjustment and modification of the regulator structures at the interface between the combined trunk and interceptor sewer systems. These structures were revealed in the development of the System Hydraulic Characterization Report (PWD; June 27, 1995) to protect the WPCPs by significantly constraining the release of combined sewer flows to the interceptor sewers during wet weather. NMC4 describes a program to more effectively utilize the capacity of the interceptor sewers and WPCPs treatment processes

to capture and remove pollutants from the combined sewer system during wet weather. The proposed modifications are predominantly the adjustment of the float-operated gate (“Brown & Brown”) regulators and the addition of dams at slot regulators that currently do not have diversion dams in place. These modifications will be implemented in a staged program of modification and evaluation, to enable PWD to properly adapt to changes in the wet-weather operation of the collection and treatment system as the modifications are implemented.

PWD recognizes that solids and floatables discharged from CSOs may represent a potentially significant impact to Philadelphia’s receiving streams. The City currently expends considerable effort to minimize the potential discharge of solids and floatables. The Department performs over 50,000 inlet cleanings each year preventing many tons of street surface-related materials from discharging to waterways through CSOs. As mentioned previously, the significant pipe cleaning and grit removal activities conducted by the department also removes a great deal of material that otherwise might discharge through CSO outlets during wet weather. The City sponsors a number of public education and public involvement programs aimed at solids and floatables pollution prevention and source control.

Further control of solids and floatables may be a significant undertaking, and one which should be predicated on a solid understanding of the location of the impacts, the extent of the impacts, and the source or sources of the pollutants. Only when this information is available can specific approaches that will effectively control solids and floatables be developed. In order to obtain the necessary information, PWD is developing a program to monitor the impacts of solids and floatables on the receiving streams and characterize their sources. As PWD gains a better understanding of the solids and floatables issue, appropriate strategies for addressing the impacts will be developed.

Over the years, the Water Department has implemented a rigorous industrial pretreatment program. The effectiveness of this program has allowed the City to develop one of the largest and most successful biosolids beneficial reuse programs in the nation. As part of the nine minimum controls effort, the Department is committed to taking actions to encourage industries to better manage their process water discharges to the sewer collection system during wet weather periods.

Pollution prevention programs can help to reduce the amount of contaminants and floatables that enter the CSS. Such measures include street sweeping, catch basin cleaning, litter control, public education, etc. Philadelphia has implemented a number of pollution prevention programs and established city ordinances that address these concerns. Public education programs are considered an effective method of reducing the amount of litter and contaminants on the streets and ultimately the amount of floatables and pollution reaching the receiving water. The Public Affairs Division of the Water Department will conduct eight new public education initiatives in direct support of the City's efforts to implement minimum control technologies for CSOs, including:

- Developing a comprehensive educational package to include:
 - General information on the City's combined and separate sewer systems
 - Maps of the sewer systems and the locations of CSOs
 - Explanations of the EPA national CSO Policy and the Nine Minimum Controls
 - Tips on what citizens can do
 - A CSO/stormwater newsletter
- Develop materials for and set-up meetings with City Council members, friends groups, Environmental organizations, etc.
- Media workshops focused on expected environmental improvements associated with the City's CSO program
- Produce newsletters twice each year for sewer shed areas served by combined sewer systems
- Set up community CSO workshops with friends groups
- Produce bill stuffers for stormwater, CSOs and Household Hazardous Waste Programs
- Work with local newspapers to develop articles to discuss general awareness of CSOs and their potential impacts on receiving waters and the potential impact within the regional receiving waters
- Expand the mission of the City's existing Stormwater Advisory Committee to integrate CSO issues and work with the Committee to set CSO education priorities and objectives.

Understanding of the Nine Minimum Control Documentation Requirements

On April 11, 1994, the Environmental Protection Agency (EPA) issued the final Combined Sewer Overflow (CSO) Control Policy. This Policy establishes a comprehensive national strategy to ensure that municipalities, permitting authorities, water quality standards authorities, and the public engage in a coordinated planning effort to develop and implement cost effective CSO controls that ultimately meet appropriate environmental and health objectives. The Policy is implemented through the National Pollution Discharge Elimination (NPDES) permit program under the provisions of the Clean Water Act (CWA).

There are two key objectives of the CSO Policy: (1) the implementation of the Nine Minimum Control (NMC) measures, and (2) the development and implementation of the Long-term CSO Control (Facilities) Plan (LTCP). The NMCs represent low cost technology-based actions or measures that can help to reduce CSO pollutant discharges and their effects on receiving water quality. These controls, as detailed in the NPDES permits for Philadelphia's CSO discharges, include:

- Review of operation and maintenance programs
- Maximum use of the collection system for storage
- Review and modification of pretreatment programs
- Maximizing flows to publicly owned treatment works (POTW)
- Prohibiting CSO discharges during dry weather
- Control of the discharge of solids and floatable materials in CSOs
- Pollution prevention programs
- Public notification
- Inspection/Monitoring/Reporting

These nine measures are recognized by EPA as minimum technology-based limitations for combined sewer overflow permits to meet minimum Best Conventional Technology/Best Available Technology (BCT/BAT) requirements on a best professional judgement (BPJ) basis. The sections of the three Philadelphia Water Department (PWD) NPDES permits that cover the CSOs suggest that, at a minimum, technology-based control measures must include best

management practices and/or other non-capital intensive measures to minimize discharges and water quality impacts. The permit also contains a condition that control measures suggested in the EPA guidance documents should be considered for implementation but only where their implementation is feasible.

The nine minimum controls are essentially EPA's "action now agenda" for CSO control. That is, they are beneficial, appropriate for particular aspects of systems, and able to be safely, economically, and effectively applied early-on in the planning process. The intent of the NMCs is not to eliminate CSOs, but to provide some level of control of CSO discharges while long-term CSO control plans are being developed and implemented. NMCs should not require significant engineering studies or construction and generally should be implementable in a relatively short time frame by proper operation and maintenance of CSO systems. It is the intent of the CSO Control Policy that the NMC measures be compatible with the Long Term Facilities Plan.

The PWD NPDES permits directs the Department to immediately undertake a process to demonstrate implementation of the nine minimum controls. This report is the direct result of that requirement. The remainder of the report is divided into nine sections, one addressing the documentation of each of the Nine Minimum Controls.

Section 2

Minimum Control No. 2

Maximum Use of the Collection System for Storage

This section provides the documentation for Minimum Control Measure No. 2 (NMC2)- Maximum Use of the Collection System for Storage. NMC2 is defined as: “As a minimum control, maximum use of the collection system for storage means making relatively *simple* modifications to your CSS to enable it to store wet-weather flows until downstream sewers and treatment facilities can handle them.” Use of the collection system for storage (referred to herein as “in-system storage” has long been recognized as a potentially cost-effective means to mitigate the occurrence and impacts of CSOs. U.S.EPA research reports dating back at least as far as 1971 describe the use of the collection system for storage of combined wastewater (Maximizing Storage in Combined Sewer Systems; U.S.EPA; Project No. 11022 ELK; December, 1971).

A number of technical approaches to utilizing in-system storage are available, which range in cost and complexity from static tide gates and minor modifications to overflow weirs, to sophisticated multiple sluice gate structures controlled in real-time with digital computers. PWD has been implementing in-system storage in Philadelphia’s combined sewer system for nearly twenty years, using a variety of technologies. The strategy for continued implementation of the various approaches for in-system storage, evaluation of the available storage in PWD’s combined sewer system, and proposed implementation of in-system storage are described in the following sections.

2.1 IN-SYSTEM STORAGE STRATEGY

PWD has been evaluating and implementing facilities for in-system storage in the combined sewer system for many years. In the 1980's, PWD designed and installed eight computer controlled outfall/regulator gate facilities in the Northeast Drainage District that use level monitors to control the position of the dry-weather outlet (DWO) gate and tide gate at each CSO location. The tide gate is maintained in a closed position for as long as possible, and when opened is maintained at the smallest possible opening allowed by a maximum water surface elevation. This operation retains as much flow as possible within the combined sewer system, minimizing the release of combined wastewater as CSO, and maximizing the use of in-system storage.

The computer controlled outfall facilities described above apply real-time control (RTC) mechanisms to maximize in-system storage. The use of RTC allows the capture and delivery to the treatment works of flow at the maximum rate at which it can be treated, with storage in the combined sewer system of as much of the excess flow as possible. This approach is attractive in terms of optimizing the use of the existing sewer system to capture combined wastewater and minimize CSOs. However, PWD's experience in the use of RTC facilities demonstrates that this approach is not feasible on a system-wide basis as a **minimum** control (under NMC #2) for a system as large as Philadelphia's, since the costs (both capital and O&M) for such a system would be significant, and the cost-effectiveness of system-wide RTC facilities cannot be determined until the LTCP defines the costs for other CSO control approaches. Since the incremental cost to increase the capacity of other CSO control facilities could be less than the cost of RTC facilities, it would be inappropriate to implement system-wide RTC facilities prior to LTCP evaluation of the full range of CSO control alternatives.

Although RTC allows the optimal use of the collection system for capture of combined wastewater, other less complex system improvements (without RTC) can also allow the

available in-system storage volume to be used for control of CSOs. One approach that is particularly effective is to use the natural tidal variation at tidally affected outfalls to raise the wet-weather water surface in the combined trunk sewers prior to overflow. By installing a tide gate at the outfall to prevent tidal intrusion into the regulator, the overflow elevation is effectively raised from the overflow weir elevation to the tidal stage, which causes additional flow to be stored within the system. PWD maintains tide gates at each of the 88 CSO locations which are tidally affected (System Inventory and Characterization Report; Philadelphia Water Department; March 27, 1995), and Section 1 of this report described PWD's program of inspections and maintenance operations to ensure the continued proper operation of these facilities.

Another approach that can be implemented to gain additional in-system storage is to raise the overflow elevation by physically modifying the overflow structure (e.g. raising an overflow weir). However, this approach must be implemented cautiously, since raising the overflow elevation also raises the hydraulic grade line in the combined trunk sewer during storm flows, and therefore increases the risk of basement and other structural flooding within the upstream sewer system due to backup or surcharge problems.

2.2 ANALYSIS OF AVAILABLE IN-SYSTEM STORAGE VOLUMES

A certain volume of storage of combined wastewater occurs incidentally during wet-weather, as flow depths increase within the system to achieve the hydraulic gradient necessary for flow conveyance through the network of sewer conduits. This incidental storage can be thought of as dynamic storage, to distinguish it from static storage, or that storage which exists as the volume of the "pool" behind flow controls constructed within the combined sewer system. At a minimum, there is generally at least a small volume of static storage available behind the regulator structure at each CSO location (the exception in PWD's system is at slot regulators without diversion dams). Although termed "static" storage here to denote the static nature of pooled storage available behind regulators or other structures, it

should be noted that the actual volume of the available static storage that is occupied will vary dynamically throughout wet-weather events.

Dynamic storage is very difficult to measure, as it varies from event to event as a function of the rate of runoff and solids deposition conditions in the combined sewer network, and from sewer reach to sewer reach as a function of the hydraulic characteristics of each sewer segment. Although it is theoretically possible to deterministically model the transport of flows within the combined sewer network (which inherently determines dynamic storage volumes), it is generally impractical to do so at the planning stage, where dynamic storage is more appropriately handled as a lumped calibration parameter together with static storage. Static storage on the other hand can be measured, which provides the basis for the lumped storage parameter, leaving the dynamic storage component to be estimated.

In order to support the implementation of in-system storage, the available static storage volumes within the combined trunk sewers upstream of each CSO location in the PWD system were determined. This was accomplished by collecting the required trunk sewer data (invert elevations, cross-sectional size and shape, and length) for each sewer segment at an elevation sufficiently low to be available to provide static storage. Storage availability was determined by comparing the critical elevation (elevation at which overflow begins, typically the overflow weir elevation or tide elevation) to combined sewer invert elevations. Sewer segments with at least one endpoint (node) invert below the critical elevation were determined to be available for static storage. Where CSO locations are tidally affected, both the mean tide and mean high tide elevations were used to compute static storage volumes for both tidal conditions.

Storage volumes were computed for each available sewer segment by calculating the static storage depth at each node (the difference between the critical elevation and the node invert elevation), from which the average submerged conduit cross-sectional area was computed. This value and the sewer segment length were used to compute available volume. The upstream-most available pipe segment volume was computed using an adjusted length to include only the submerged portion of the segment.

The available static storage volumes have been summarized for each CSO location in Tables 2-1a, 2-1b and 2-1c. These tables indicate storage volumes available during both mean tide and mean high tide conditions. The additional storage volumes available due to tidal variation at gate-protected tidal outfalls has been incorporated into the lumped storage parameter used in the models of the combined sewer system. Tables 2-1 also indicate the incremental storage that is potentially available if the critical elevation (overflow activation elevation) were to be modified with a nominal 1.0-foot increase. This information is useful in screening the various regulator locations to identify the locations where the greatest increases in storage can be realized by regulator modifications to increase the effective overflow elevation. Although modifications would need to be determined on a site-specific basis, the nominal 1-foot increase across all locations is useful as an indicator for screening purposes.

As Table 2-1b shows, the Southeast Drainage District has available considerably greater in-system storage volumes (by roughly one order of magnitude) than the other two districts. This reflects the relatively large, flat combined trunks in this district. In-system storage in all three districts is very sensitive to tidal variation, with in-system storage values at mean high tide exceeding mean tide values by a factor of roughly 3-4 in each district.

2.3 PROPOSED IMPLEMENTATION OF IN-SYSTEM STORAGE

Given the significant in-system storage volumes that are utilized at the tidally affected outfalls, especially during the higher tidal cycles, it is important that PWD continue to inspect and maintain the tide gates in good working order at each of the 88 tidally affected outfall

***** Table 2-1a ----- summary storage tables ----- (Tim)

Table 2-1b

Table 2-1c

locations. In particular, the eight existing computer-controlled gate facilities in the NEDD are effective in maximizing the use of in-system storage and should continue to be maintained in good working order.

Although not affected by tidal fluctuations in the receiving water, it is possible for regulators at elevations above the tidal stages to be subjected to backflows from the smaller streams during periods of high streamflows. In order to protect these regulators from potential inundation, PWD is initiating a program to install tide gates or other backflow prevention structures at these regulators. As with tide gates, these structures will prevent in-system storage and combined sewer flow capture capacities from being depleted by inundation from the receiving stream. The specific locations and schedules for implementation of this program will be documented in future updates to this report.

The relatively large in-system storage volumes that are available in the PWD, especially in the SEDD where more than 0.1 inches of storage is available at the mean high tide elevation, suggests that RTC-based facilities for utilization of this storage may represent a viable option for CSO control under the LTCP. It is recommended that PWD's LTCP carefully evaluate RTC-based in-system storage as an alternative long-term CSO control strategy, with particular emphasis on this approach in the SEDD.

As a means to increasing the hydraulic capacity of slot regulators without diversion dams, it is recommended under NMC4 that the flow maximization plan include the addition of dams at these locations. There are 57 locations at which the addition of dams has been identified; 40 locations in the SWDD, 15 locations in the NEDD and 2 locations in the SEDD. These locations are identified on Table 2-2. The additional storage volume that will be realized with the addition of dams at these locations can and should be estimated and factored into the implementation plan for these facilities.

As a means to increase both the hydraulic capacity of the regulators and the available in-system storage, it may be possible to raise the overflow weir elevation at selected regulator locations. For example, it may be possible to add one or more rows of bricks, stoplogs or concrete to a diversion dam. However, this technique must be implemented with great caution, as it is generally impractical to evaluate *a priori* the potential increase in the risk of flooding of building structures connected to the combined sewer system. It is generally more appropriate to implement the modification incrementally, e.g. add a single row of bricks, and observe the performance of the system during several relatively large rainfall events to evaluate the possibility of flooding problems before possibly raising the weir further. This approach should only be applied to outfalls above which there are no known flooding problems. Where flooding problems are observed, the reduced flow conveyance area associated with the higher diversion dam may exacerbate the existing problems.

The specific locations for any modifications to increase available in-system storage will be determined by merging the locations where potential storage increases can be most effectively realized (based on the information in Tables 2-1) with the regulator improvement locations to be defined under NMC4 (see Section 4 of this report). The specific locations and implementation schedules for any modifications will be documented in future updates to this report. This information will be developed considering operating criteria which define where improvements will be most effective, fiscal constraints on increased operating costs associated with greater flow volumes treated at the WPCPs, and the ability of the WPCPs to accept higher flowrates while continuing to meet NPDES permit conditions.

Table 2-2
Potential Additional Dams at Slot Regulators

Regulator	Type	Drainage District	Trunk Dia.-in.	Dam Height-in.
S03	SLOT	SW	36	6
S12	SLOT	SW	24	4
S12A	SLOT	SW	42	7
S13	SLOT	SW	36	6
S17	SLOT	SW	36	6
S35	SLOT	SW	30	5
S36	SLOT	SW	27	4
C01	SLOT	SW	42	7
C02	SLOT	SW	30	5
C04	SLOT	SW	30	5
C04A	SLOT	SW	63	10
C05	SLOT	SW	28	5
C06	SLOT	SW	48	8
C07	SLOT	SW	36	6
C09	SLOT	SW	54	9
C10	SLOT	SW	27	4
C12	SLOT	SW	39	6
C13	SLOT	SW	54	9
C16	SLOT	SW	30	5
C18	SLOT	SW	54	9
C32	SLOT	SW	42	7
C34	SLOT	SW	36	6
C35	SLOT	SW	24	4
C36	SLOT	SW	24	4
C37	SLOT	SW	24	4
S28	SLOT	SW	39	6
S30	SLOT	SW	39	6
S39	SLOT	SW	42	7

S40	SLOT	SW	66	10
S51	SLOT	SW	30	5
C19	SLOT	SW	42	7
C21	SLOT	SW	42	7
C23	SLOT	SW	27	4
C24	SLOT	SW	39	6
C25	SLOT	SW	42	7
C26	SLOT	SW	27	4
C27	SLOT	SW	39	6
C28A	SLOT	SW	36	6
C29	SLOT	SW	36	6
C30	SLOT	SW	42	7
D42	SLOT	SE	42	7
T03	SLOT	NE	60	9

Table 2-2, continued

Regulator	Type	Drainage District	Trunk Dia.-in.	Dam height-in.
T04	SLOT	NE	48	8
T05	SLOT	NE	42	7
T07	SLOT	NE	36	6
T09	SLOT	NE	48	8
T10	SLOT	NE	60	9
T11	SLOT	NE	36	6
T12	SLOT	NE	24	4
T13	SLOT	NE	57	9
T15	SLOT	NE	66	10
P01	SLOT	NE	42	7
P02	SLOT	NE	60	9
P04	SLOT	NE	39	6
F03	SLOT	NE	84	13
F12	SLOT	NE	54	9

Section 3

Minimum Control No. 3

Review and Modification of Pretreatment Programs

3.1 INTRODUCTION

Minimum Control Measure No. 3 (NMC No. 3) requires the examination of industrial pretreatment programs and the development of program modifications as appropriate to reduce the environmental impact of combined sewer overflows (CSOs). Through the implementation of Control No. 3, EPA anticipates the control of "nondomestic discharges" to the combined sewer during storm flow. In this context, EPA defines non-domestic as "... industrial and commercial —restaurants, gas stations, etc..."

The process by which the implementation of these controls should be accomplished is identified in the EPA draft guidance, and in general, consists of three components:

- Prepare an inventory of nondomestic discharges to the system
- Assess the significance of the nondomestic discharges to the system
- Consider/evaluate alternatives and select new pretreatment program requirements to regulate the significant nondomestic discharges to the system

If the total number of nondomestic users contributing to the system is so large that regulations would be excessively burdensome, then the guidance allows that the emphasis of the program should be on those discharges having the greatest potential impact relative to CSOs.

The evaluation performed under NMC3, and details of the intended program modifications based on the evaluation, must be documented as part of the control. Documentation should include:

- The inventory of "nondomestic discharges" to the system
 - An assessment of the significance of the "nondomestic discharges" to the system
- A description of the program modifications
 - An assessment of the feasibility and effectiveness of pretreatment program modifications
- An estimate of the loading reduction of pollutants of concern based on the implemented changes
- A schedule for implementation of the program modifications

The remainder of this report identifies all actions taken by the Philadelphia Water Department (PWD) to evaluate NMC3.

3.2 OVERVIEW

The initial consideration for the effort is the extent of the nondomestic sewage discharge inventory. Before assessing the potential impact of nondomestic sewage discharges on CSOs and selecting new controls for these discharges, it is necessary to determine the criteria for identifying nondomestic discharges that are significant to CSOs.

3.2.1 PWD Sewer System

The sewers in the combined service areas accept and transport domestic sewage and industrial wastewater, along with stormwater runoff and some groundwater infiltration. Dry weather flow, consisting primarily of domestic sewage and industrial process wastewater, is intercepted at the system's diversion structures and conveyed by the interceptor system to one of the WPCPs for treatment. These interceptors also are conveying domestic sewage and industrial wastewater from separate sewer areas, which are located outside of the combined areas. While stormwater runoff from the combined areas is collected by the interceptors with the sanitary and industrial wastewater flow, runoff from the separate areas normally does not contribute to the interceptors.

In addition to interceptor system flow from the separate areas, there are direct discharges to interceptors from several industrial users located in the combined areas. These flows have minimal impact on CSOs because they are discharged directly to the interceptor system rather than to the combined sewer.

During wet weather, the stormwater runoff and the sanitary and industrial wastewater flow from the tributary combined areas usually exceed the capacity of the combined sewer. This results in the initial mode of overflow at the CSO points. The secondary mode occurs when the high volume of stormwater runoff causes the interceptors to exceed capacity and forces the interceptor flow out into the CSO points.

There also are portions of the separate sewer areas where flow ultimately discharges through intercepting sewers. Where ever process flows enter intercepting sewers, these process flows may impact CSOs in those combined areas during storm flow.

3.2.2 Existing Industrial Pretreatment Program

The PWD has wastewater control regulations that prohibit any discharges to the collection system that may be detrimental to the wastewater treatment processes, or ultimately, to receiving waters. These regulations establish specific load limitations for discharges to the system. The program also sets forth permitting requirements for certain wastewater dischargers.

All Significant Industrial Users (SIUs) contributing to the system must hold a wastewater discharge permit. SIUs are industrial users subject to any National Categorical Pretreatment Standard; any industrial users that discharge an average of 25,000 gallons per day or more of process wastewater to the system or contributes a process wastestream that makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the of the treatment plant; or any industrial users that are found by the City, PADEP, or EPA to have a reasonable potential, either alone or in conjunction with other discharges, to adversely affect the system. The program enables the PWD to monitor and enforce the requirements for discharging wastewater.

The City's sewer system serves 143 SIUs, which includes those located in the City of Philadelphia and those located in outlying communities. In Philadelphia, there are 118 nondomestic dischargers classified as SIUs. Table 3-1 lists these Philadelphia SIUs and provides the GIS Identification Number of each facility, depicting the geographical locations within the City of Philadelphia as shown in Figure 3-1 (located in the back of this report). The table also indicates the drainage district accepting flow from each user, and whether the service area for each facility location is combined or separate.

In addition, there are 15 SIUs that are not located in Philadelphia, but that have process flows conveyed through the City's sewer system. Discharges from these SIUs are located in other systems that flow by gravity into the City's sewer system. These SIUs are presented in Table 3-2, and will be incorporated into applicable program efforts.

Table 3-1 List of SIUs - 2 pages

Table 3-2

There are 10 SIUs located in the Delaware County Regional Sewer Authority (DELCORA) service area that have process flows that are pumped by a force main to the plant. The DELCORA SIUs are not considered potential contributors to CSOs and are not addressed by this program effort.

All of these SIUs are required to conduct periodic monitoring of their process flow, develop spill prevention plans, and are subject to facility inspections by the PWD industrial staff.

The remaining nondomestic dischargers to the system are subject to the general provisions of the City's Wastewater Control Regulations under the Industrial Pretreatment Program in the PWD service area and are not considered to be a major impact to the system based on individual discharge volume or pollutant loading.

3.3 PWD APPROACH TO MINIMUM CONTROL NO. 3

The PWD recognizes that the CSO Policy requirements are intended to control discharges upstream of CSOs during wet weather, should the discharges have the potential to adversely impact water quality. In general, the overall objective is to develop and implement effective modifications to the existing pretreatment program as appropriate for minimizing CSO impacts from industrial facilities for the long term. Current wastewater or industrial discharge permit holders within the service area, the current SIUs, clearly are encompassed by EPA's definition of nondomestic user. These nondomestic users have discharge permits due to the size and nature of their process discharges, and they have the greatest nondomestic potential impact with regard to CSOs based on these discharges. For these reasons, PWD has focused on the currently permitted users SIUs in the Philadelphia area in developing the inventory of nondomestic users, and the evaluation has been performed using the process flow information from the SIUs located within the City of Philadelphia.

The assessment of the significant nondomestic discharges, as conducted for this minimum control, provides an understanding of what potential impacts on CSOs can be expected in terms of discharge volume and pollutant loadings.

3.4 DETAILS OF MINIMUM CONTROL IMPLEMENTATION

As described in Section 3.2, process flow from both separate and combined service areas can discharge through CSOs. For this reason, the examination of the pretreatment program and the assessment of nondomestic discharges will include all SIUs in the Philadelphia area. For the purpose of the process flow assessment, the inventory of nondomestic discharges to the system has been developed from the 118 permitted system users in PWD's system, and the geographical locations of these users are shown in Figure 3-1.

3.4.1 Development of Inventory of SIUs and Process-related Pollutant Loadings

In accordance with EPA's guidance, PWD has prepared an inventory of the pretreatment program permittees and the loadings for the pollutants for which the process flow is monitored. The locations of these nondomestic discharges have been identified in Figure 3-1 for documentation under this Minimum CSO Control. For the purpose of this report, the data summarized for each of the SIUs includes the process flow as monitored by PWD and the parameters as they appear in each user permit. This information is included in Appendix B.

3.4.2 Process Flow Assessment

The assessment was performed to determine the relative potential impacts on CSOs based upon process flow quantities from the users and the associated potential contribution of pollutants. The effort consisted of first estimating flow volumes and pollutant mass loadings in process discharges from industries at each plant, all of which was obtained from the PWD monitoring data. The process flow volumes then were compared to wastewater flow volumes from other sources in the combined sewer areas of the City to determine whether the industrial process water flows are significant in a relative sense. Finally, the estimates of process water flows were compared with all sources of flow, including stormwater runoff volumes from the CSO areas.

The evaluation of the industrial process flows from the entire City relative to the City's total dry weather wastewater flows and the total stormwater runoff flows from the combined sewer areas was performed on an annual basis to elucidate the potential significance of process water flows to the City's CSO discharges.

Table 3-3 provides a summary of the flow sources at each of the three plants, including the industrial flow contributed by the SIUs in the City of Philadelphia. To assess the CSO impact of

process flow, specific information relative to wet weather and industrial discharge procedures was required. The real potential for CSO discharges of industrial wastewater flow is limited to periods of actual runoff, which is approximately 500 hours on an annual basis (PWD CSO System Hydraulic Characterization Report; June, 1995).

Table 3-3 shows the flow during the annual runoff period for each of the wastewater treatment plants and the corresponding percentages of process flow to dry weather flow and source stormwater flows. City-wide, on an annual basis, industrial wastewater process flows, including water treatment plant (WTP) discharges, are estimated to contribute approximately 5.3% of the total dry weather wastewater flow and 1.4% of the total of dry weather flows and CSO-area-related stormwater runoff volumes. WTP discharges in the City's system account for an annual 4,748 million gallons (MG) of industrial flow, or about 271 MG during runoff periods. These discharges comprise some process sludge; however, the majority of the flow is filter backwash which is nonindustrial in nature. Therefore, an evaluation of the flow excluding the WTP discharges indicates that process flow contribution to total dry weather flow and total flow from all sources is as low as 2.5% and 0.6%, respectively.

Table 3-3

These estimates of the potential industrial process flow that discharge through CSOs are believed to be highly conservative for the following reasons:

- Contribution of process flow to overflow can only exist during actual periods of industrial discharges, and only the portion of process flow that is in the system during overflow periods may be discharged through a CSO. Since the majority of the current SIUs discharge during a 5-day work week and for an 8-hour shift, process flow from these industries may contribute to overflows during as little as 120 hours per year.

- The 500 hours used in the calculation represent the average annual hours of runoff. The actual average hours of CSO discharge is estimated to be closer to one half of that value.

- Some industrial flows discharge directly to the interceptor system. Some of the largest SIUs in the PWD service area, including Rohm & Haas, Allied Fibers, CCA and Connelly, discharge directly to interceptor system, where the opportunity for contributing to CSOs is reduced.

In accordance with EPA's CSO guidance, the process flow assessment should include a review of the system to ascertain whether the industrial discharges are concentrated in certain areas, thereby having the potential to impact specific overflow points. A review of the SIUs within the PWD system determined that the geographical distribution of these SIUs is such that there are no concentrated areas of permitted industrial discharges to an outfall. Based on the process flow assessment performed for this minimum control, no significant contributors of specific pollutants implicated in water quality problems were identified. In summary, the assessment indicates that the process flows are not significant contributors to CSOs.

3.4.3 Evaluation of Feasible Program Modifications

Because the relative contribution of industrial flows from the SIUs to the total dry weather flow to the City's system is small, the effect of increasing pollutant controls is expected to be small. However, the PWD proposes a proactive approach to evaluating opportunities for minimizing discharges of process flow during wet weather. PWD will accomplish this through the collection of information from the SIUs during interviews by PWD Industrial Waste Unit (IWU) inspectors during the semi-annual facility visits.

The PWD will utilize the information obtained to evaluate, on a site-by-site basis, the feasibility and effectiveness of process flow controls. In the event that low cost/no cost opportunities exist to reduce the discharge of process flows during wet weather, PWD will work with the industries to establish a protocol for reducing these flows.

3.5 SUMMARY

In accordance with EPA's CSO Policy and the requirements for NMC3, the industrial pretreatment program has been examined. Although modifications of the pretreatment program, based on the examination, do not appear to be necessary, continued efforts by PWD will include consideration of process flow controls deemed effective. PWD will document inspections, interviews, evaluations of no cost/low cost opportunities, scheduling and implementation of wet weather discharge minimization as part of this effort.

Appendix B

Summary of SIUs and Monitored Process Flow.

Table 1: Northeast Drainage District

Table 2: Southeast Drainage District

Table 3: Southwest Drainage District

Section 4

Minimum Control No. 4

Maximize Flow to the WPCPs

This section provides the documentation for Minimum Control Measure No. 4 NMC4 - Maximizing Flows to the POTW. NMC4 is defined as: "As a minimum control, maximizing flow to the publicly owned treatment works (POTW) means making simple modifications to your CSS and treatment plant to enable as much wet weather flow as possible to reach the treatment plant and receive treatment. The secondary capacity of the treatment plant should be maximized, and all flows exceeding the capacity of secondary treatment should receive a minimum of primary treatment (and disinfection, when necessary)."

4.1 FLOW MAXIMIZATION STRATEGY

The overall objective of this minimum control is to reduce the frequency, duration, and volume of CSOs by maximizing flows to the POTW through simple modifications to the CSS and treatment plant.

As part of the execution of NMC4 EPA suggests that the following activities/analyses be considered:

- a. Determine the capacity of the major interceptor(s) and pumping station(s) to deliver flows to the treatment plant.
- b. Analyze existing flow records to identify flows processed by the plant during wet versus dry periods and determine relationships between performance and flow.
- c. Compare current flows with the design capacity for the overall facility, as well as for individual unit processes. Identify where available excess capacity exists.
- d. Determine the ability of the facility to operate acceptably at incremental increases in wet weather flows and estimate the effect on POTW's compliance with its permit effluent limits.

- e. Identify any old, currently inoperative/unused treatment facilities on the POTW site and whether or not it's possible to use them to store and/or treat wet weather flows.
- f. Determine the effect of septage discharges to the collection system and/or treatment facility during periods when wet weather flows are being processed. Assess the feasibility of prohibiting septage discharges during these periods.
- g. Develop cost estimates for the physical modifications you intend to make and the O&M costs at the treatment plant due to the increased wet weather flow.

Item a presently is being performed as part of the overall CSS modelling effort and CSO program. Items b and c for currently permitted plant and unit process conditions were performed as part of January 1995 report prepared by Greeley and Hansen, titled "CSO Mitigation Through Rating Analysis for Northeast WPCP, Southeast WPCP, Southwest WPCP". Item d will require the performance of stress testing at each WPCP and will be addressed in the Long Term Control Plan (LTCP) submittal (September 1996). Items e and f are discussed later in this report. Item g will be addressed as part of the LTCP.

Maximization of flow to the WPCPs involves examining both the WPCPs and the system of regulators and interceptor sewers that delivers flow to them. Maximum use of the existing collection and treatment facilities for CSO reduction is achieved when the maximum hydraulic capacity of the collection system is made available to capture combined sewer flows during wet weather, and when the treatment facilities remove the maximum pollutant load from the captured flow that the facilities are capable of processing under the existing permits. Although this may mean that excess flows (flows exceeding plant capacity) are captured more often, this represents positive CSO control for two reasons: (1) maximum pollutant removal is realized during periods when the full plant capacity is used, which only occurs when flows equal or exceed plant capacity; (2) if more flow is captured at upstream CSO locations, along the more sensitive receiving stream reaches, CSO impacts are mitigated, even if the captured flow must later be discharged at locations further downstream, where CSO impacts are less severe.

The flow maximization strategy therefore focuses on identifying modifications to the existing collection system that result in higher rates of combined sewer flow capture, establishing wet-weather WPCP operating protocols that maximize pollutant removal within permit limitations, and defining an implementation plan for staging the proposed modifications to maximize the benefits of increased flow capture.

The EXTRAN model of the interceptor sewers and regulators developed for hydraulic characterization during SHCR development formed the basis for examining various scenarios for maximizing flow capture. The SHCR defined the baseline for existing conveyance capacities in the system and from that analysis it was determined that the regulator structures generally limited the capacity of the existing system to capture wet-weather flow. Flow maximization strategies therefore focused a significant effort on regulator adjustments and modifications that can be implemented to increase flows. Hydraulic control points or other constraints in the interceptor system were also examined to determine if appropriate modifications are feasible for low maximization. The EXTRAN models of the interceptor sewers and regulators were revised to represent in the models the modifications to the regulators and other structures that were developed to maximize flow capture. EXTRAN simulations were performed using the modified representations of the system to quantify the increases in conveyance capacities throughout the system.

Reductions (or increases in some locations) in CSO frequencies and volumes resulting from the simulated flow maximization scenarios have been quantified using the STORM models of the combined sewer drainage area. STORM simulations have been performed for each of the combined sewer drainage areas using the EXTRAN-defined capacities for the flow maximization scenarios and the resulting CSO characteristics have been compiled and compared to those of the existing conditions.

4.2 DEVELOPMENT & SIMULATION OF FLOW CONVEYANCE IMPROVEMENT STRATEGIES

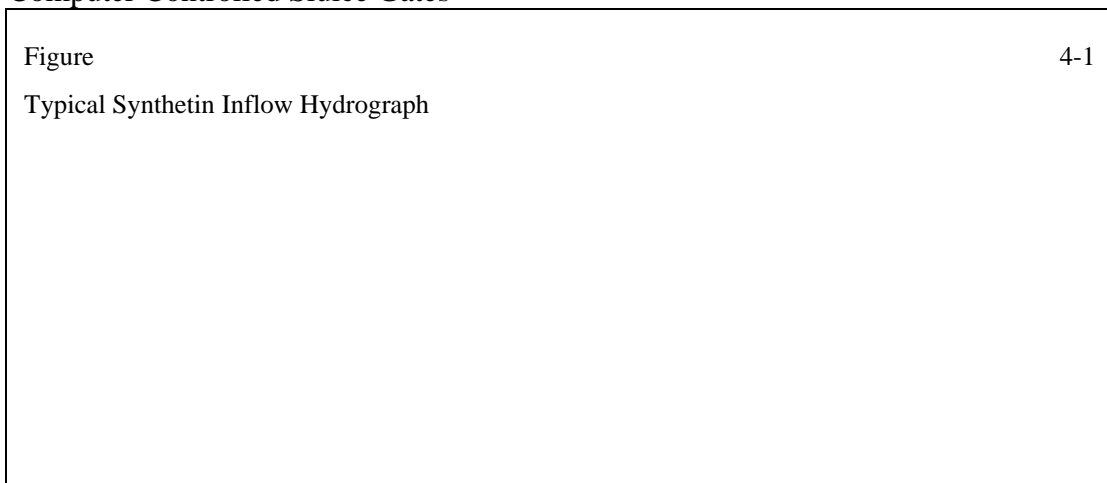
Existing conditions in the PWD combined sewer system do not maximize use of interceptor conveyance. A majority of the combined sewer regulators in the PWD service area limit flow into the interceptors, preventing full use of interceptor capacity. These conditions are documented in the System Hydraulic Characterization Report (SHCR; PWD; June 27, 1995).

Maximization of flow capture from a combined sewer system requires maximum use of interceptor conveyance. Since flow in PWD's interceptor systems is generally limited by regulator capacities, increases in regulator capacities will allow more combined flow to enter the interceptor system for treatment. This will generally decrease combined sewer overflow volumes and/or frequencies. Model simulations show that increases in regulator capacities due to flow conveyance improvements will vary depending on existing conditions. The simulations of conveyance improvement scenarios

show that in some cases, especially at locations near the downstream end of the interceptors, individual regulator capacities may actually decrease due to surcharging of the interceptor caused by the increased conveyance of flow from other regulators within the interceptor sub-system. However, in each case overall net increases in flow capture are indicated for the system-wide conveyance improvement scenarios simulated to-date.

Hydraulic models were developed to represent the hydraulic response to a ramped (linear) inflow hydrograph (see Figure 4-1) for each of the seven types of regulators maintained by PWD:

- Slot Regulators
- Water Hydraulic Sluice Gates
- Static Dam Regulators
- Automatic Brown & Brown
- Manual Sluice Gates
- Computer Controlled Brown & Brown
- Computer Controlled Sluice Gates



The existing condition models of the regulators developed for the SHCR generally operated externally to EXTRAN and generated synthetic outflow hydrographs for input to EXTRAN. These regulator types and existing condition EXTRAN model representations have been described in detail in the SHCR.

Modification scenarios for slot, manual sluice gate, water hydraulic sluice gate, and automatic Brown & Brown regulators were developed and simulated to evaluate maximization of their conveyance capacities. These scenarios comprise system-wide modifications to establish global changes in the system hydraulics associated with the improvements. During implementation of the improvements, it is expected that a wide variety of incremental (rather than system-wide) improvement scenarios will be developed and simulated to establish the specific influence of

specific improvements. Existing conditions for static dam, computer controlled sluice gate, and computer controlled Brown & Brown regulators were not altered in the conveyance improvement scenarios because maximized capacities currently exist for these regulators.

Two flow maximization scenarios were evaluated for the various types of regulators in the PWD service area. The first flow maximization scenario assumes existing regulating gates on all automatic Brown & Brown, water hydraulic sluice gate, and manual sluice gate regulators are opened to the maximum settings and orifice plates are removed. Maximized gate settings were determined using field verified data collected during regulator inspections described in the SHCR. Slot regulators are simulated with slot plates in the full open position, and the DWO pipe is assumed to function as the controlling structure. For slots without dams, a dam was added to the model to divert additional flow to the interceptor. The simulated dam dimensions were based on the dimensions of existing dams at slot regulators in the PWD service area. Analysis of 13 existing slot regulators with dams yielded a consistent relationship between the trunk height (diameter) and the dam height. Trunk diameters ranged from 3 feet to 12 feet for these slot regulators, and the results of this analysis found that dam heights are approximately 15% of the trunk diameter. Therefore, for slots without dams, a dam was simulated downstream of the slot with a height equal to 15% of the trunk height. This first flow maximization scenario represents the maximum capture that can be achieved with reasonable modifications to the existing facilities.

The second flow maximization scenario assumes gates on all automatic Brown & Brown, manual sluice gate, and water hydraulic sluice gate regulators have been removed or modified so that the DWO pipe is the controlling structure. Slot regulators were modeled identically for both alternatives. This scenario represents the existing system operating at the maximum possible capture potential, with any modifications necessary to eliminate hydraulic constrictions at the regulators, and therefore effectively represents a theoretical limit on conveyance capacity, rather than a practical improvement scenario.

Changes were made in the model representations of regulators in both flow maximization scenarios. Unlike model representations of existing conditions, CSO regulators in maximization scenarios were modeled both externally and internally in the EXTRAN. Automatic Brown & Brown, water hydraulic sluice gate, manual sluice gate, and some slot regulators were modeled internally in the EXTRAN model. Ramped hydrographs similar to Figure 4-1 were loaded upstream of these regulators, and capacities were defined as flow rates through the regulator as overflows first occurred. The remaining slot regulators were modeled externally to EXTRAN as orifices with invert elevations and DWO dimensions taken from field verified measurements.

An additional change in model representation of regulators from the SHCR includes the influence of tides on treatment rates. Where tide gates exist, the maximum allowable head on the regulator prior to an overflow was set equal to the mean tide elevation or tide gate invert whichever was higher. If the regulator is not tidally influenced, the maximum allowable head was set equal to the crest of downstream diversion structure. These changes were applied to both flow maximization scenarios.

An example of the increased hydraulic capacity provided by the modification of the Brown & Brown regulators is shown on Figures 4-2a and 4-2b. Figure 4-2a shows the existing hydraulic profile at site D66 at the start of overflow, at which point 6.10 mgd is delivered to the interceptor. Figure 4-2b shows the same profile at D66 after the structure has been modified to eliminate the orifice plate at the connector pipe and the regulating gate maintained in the full open position. In this modified condition, D66 delivers 8.70 mgd (over 40% more flow) to the interceptor at the start of overflow. On a sub-system basis, regulator modifications can increase interceptor capacity utilization. An example of this is shown on Figures 4-3a and 4-3b. Figure 4-3a shows the existing hydraulic profile of the Oregon Avenue interceptor when all associated regulators are overflowing, at which point significant capacity in this interceptor is not being utilized and only 14.3 mgd is being delivered to the main stem from the north branch. Figure 4-3b shows the same interceptor sub-system after regulator modifications have been made, with the interceptor fully utilized and 20.6 mgd being conveyed to the main stem by the north branch.

Combined sewer overflow statistics were generated in the STORM model based on individual regulator conveyance capacities (referred to as “treatment rates” in STORM). STORM performs continuous simulations to characterize CSOs using the Rational Method (modified to account for depression storage) to compute runoff, adjusts flow rate for dry weather flows in the CSO system, and routes these flows through storage and treatment at each time step (a more detailed description of the STORM model is given in Section 2.4 of the SHCR). The STORM model was applied to the PWD combined sewer system under existing conditions and both maximization scenarios to develop CSO frequency and volume statistics. The model was applied to all combined sewer areas tributary to a CSO regulator, storm relief diversion, and flow diversion structure. Overflow statistics (frequencies and volumes) were developed for each regulator which discharges to a receiving stream or to a relief sewer which conveys the overflow to a downstream outfall location.

For each flow maximization scenario, four STORM runs were performed. The first computed average annual frequencies based on the low range of in-system storage and depression storage as defined in Section 3.3 of the SHCR. The second simulation computed frequencies based on the high

range of in-system and depression storage. The third and fourth simulations computed volumes based on high and low ranges of in-system storage.

The STORM model was run for both flow maximization scenarios and compared with output from the existing condition scenario. Both a high and a low STORM treatment rate were obtained from the EXTRAN simulations for each regulator in the conveyance improvement scenarios. Former rate represents the maximum flow through the regulator prior to an overflow, and was used in STORM to generate overflow frequency statistics. The latter rate represents the treatment rate that can be sustained, which is often less than the maximum rate, and was used in STORM to generate volume statistics. This lower treatment rate generally occurs once interceptor capacity has been maximized, and the hydraulic grade line in the interceptor rises high

Figure 4-2a
Figure 4-2b
Figure 4-3a
Figure 4-3b

enough to limit flow at the regulators. Figure 4-4 represents a typical regulator discharge hydrograph (the inflow hydrograph to the interceptor) under the conveyance improvement scenarios which demonstrates this phenomenon. Point A represents the high treatment rate and point B represents the low treatment rate.



High and low treatment rates were found unnecessary for the existing condition scenario because the regulators generally limit flow to the interceptors to very low rates, which generally prevents the interceptors from surcharging and therefore regulators tended to reach a maximum level (at relatively lower rates) and remain at that level.

Results of the STORM analysis are presented as average annual overflow frequency and average annual total volume statistics based on the long-term precipitation record. The results tables also include the number of structures associated with each interceptor sub-system. This number includes CSO regulator structures and storm relief diversion structures. Also listed on the tables are the number of overflow structures. This number may be less than the total number of structures

because, in some cases, multiple structures discharge to a common overflow point (e.g., the Main Relief Sewer).

The maximum and minimum frequency values show the range of overflow frequencies estimated for each sub-system. The minimum frequencies and volumes were obtained from the STORM scenario based on the high-end estimates for in-system and depression storage. Conversely, the maximum values were based on the low storage values. A minimum overflow frequency of 2 means that at least one structure in that subsystem is estimated to overflow 2 times per year and that no other structure overflows less frequently. A maximum overflow frequency of 81 means that at least one structure overflows during virtually every storm that is sufficiently large to produce runoff. The average annual overflow frequency is the sum of the total number of overflows from the CSO regulators and storm relief diversion structures divided by the total number of structures at which an overflow occurred. This computation is performed for both the low estimates and the high estimates. The average annual frequency per subsystem is the average of these two values. The total annual overflow volumes from CSO regulators and storm relief diversion structures are presented as a range of values for each interceptor subsystem.

The results for each drainage district also summarize the estimated percent capture of the existing interceptor system. This value represents the percentage of the average annual wet-weather combined sewer flow volume which each subsystem captures and delivers to the WPCP for treatment. The percentage was estimated based on comparison between the average annual wet-weather combined sewer flow (i.e. runoff volume plus the volume of base wastewater flow during wet-weather) and the average annual overflow volume for each subsystem.

The results for existing conditions reflect updates and refinements to the models since the SHCR. The results from the current models are generally very similar to those reported in the SHCR, however, there are differences in some sub-systems and these statistics should continue to be considered preliminary. Additional model refinement will occur over the next several months enabling more precise predictions of the overflow statistics, both by structure and system-wide. The refined model will then provide a basis for developing and evaluating various control alternatives.

4.2.1 Northeast Drainage District

The Northeast drainage district conveys flow from approximately almost one-half of the combined sewer area in the City of Philadelphia. Six interceptor systems collect combined wastewater diverted by 56 regulators in the Northeast district. Maximization scenarios increased Brown & Brown and slot regulator capacities through modifications of their physical setup as mentioned in

section 4.0. All Brown & Brown and slot regulators in the Northeast district were modeled internally in EXTRAN. Additional alterations were made to the sluice gate regulators in the Northeast district interceptor system in either of the flow maximization scenarios. All sluice gate regulators (MCSG, WHSG, and CCSG) were modeled internally in EXTRAN assuming maximum opening settings.

System wide changes in hydraulic capacities are summarized in Table 4-1. As this table indicates, relatively significant changes can be made on a system-wide basis. The Tacony and Pennypack sub-systems can be modified to convey flow further downstream, although downstream overflows are shown to increase as a result. This table also indicates the effectiveness of the flow maximization strategies in shifting the hydraulic constraints in the system from the regulators to the interceptors. For example, in the Upper Delaware Low Level sub-system 10 of 12 regulators limit capacity under existing conditions, while under the regulator modification scenario only 2 regulators limit the maximum hydraulic capacity.

Combined sewer overflow statistics for the Northeast drainage district under both flow maximization scenarios are listed in Tables 4-2 and 4-3. Existing conditions CSO statistics are also listed to show improvements in volume captured and reduction in frequency of combined sewer overflow events under both maximization scenarios.

Table 4-1
Northeast WPCP Interceptor Systems
Hydraulic Capacity Analysis

Interceptor System	Combined Sewer Area (acres)	Number of Regulators	Existing System		Modified Regulators		Theoretical Limit	
			Regulator Capacity Limits	Maximum Capacity (cfs/acre)	Regulator Capacity Limits	Maximum Capacity (cfs/acre)	Regulator Capacity Limits	Maximum Capacity (cfs/acre)
Lower Frankford Low Level	2,902	6	6	0.004 - 0.012	4	0.006 - 0.015	0	0.021 - 0.033
Upper Frankford Low Level	1,098	10	10	0.013 - 0.047	2	0.016 - 0.043	0	0.006 - 0.057
Pennypack	352	5	5	0.007 - 0.088	3	0.022 - 0.127	1	0.022 - 0.105

Somerset	3,888	9	8	0.005 - 0.014	3	0.001 - 0.011	0	0.006 - 0.027
Tacony	8,657	14	14	0.001 - 0.012	8	0.008 - 0.012	5	0.010 - 0.012
Upper Delaware Low Level	3,036	12	10	0.016 - 0.053	2	0.006 - 0.063	1	0.023 - 0.032
Summary	19,934	56	53	0.001 - 0.088	22	0.001 - 0.127	7	0.006 - 0.105

Examination of detailed model results reveals the following observations that should be used to establish the specific implementation of the flow maximization improvements in the Northeast Drainage District:

Regulator modifications provide the most significant increase in regulator capacities at T03, T04, T07, T11, T12, T13 and T15 in the High Level system. From the standpoint of both relative and absolute increases in hydraulic capacity, minor modifications to these regulators will provide the largest increases in flow delivered to the interceptors in the High Level system.

There are two locations in the High Level system where significant increases in hydraulic capacity were simulated under the scenario where regulator constraints were eliminated. These regulators are T08 and T14. However, if only minor modifications are made, essentially no change in capacity is observed in the simulations. This suggests that regulator modifications at these locations will only be effective if more significant modifications are made.

Regulator modifications provide the most significant increase in regulator capacities at D03, F03, F25, P02, P03, P04 and P05 in the Low Level system. From the standpoint of both relative and absolute increases in hydraulic capacity, minor modifications to these regulators will provide the largest increases in flow delivered to the interceptors in the Low Level system.

There are two locations in the Low Level system where significant increases in hydraulic capacity were simulated under the scenario where regulator constraints were eliminated. These regulators are D05 and F21. However, if only minor modifications are made, relatively small changes in capacity are observed in the simulations. This suggests that regulator modifications at these locations may only be justified if more significant modifications are made.

There are two locations in the high level system where the hydraulic capacity of the interceptor is restricted. The most significant restriction is at Diversion Chamber B. This limits the flow delivered to the plant to approximately 120 mgd. The second restriction is at the Frankford Grit Chamber (R18). The capacity of the interceptor is approximately 145 mgd at R18 when this structure begins to overflow. STORM indicates very frequent overflows at this location.

4.2.2 Southeast Drainage District

The Southeast drainage district conveys flow from approximately one-sixth of the combined sewer area in the City of Philadelphia. Two interceptor systems utilizing thirty two regulators exist in the Southeast district. Maximization scenarios increased Brown & Brown and slot regulator capacities through modifications of their physical setup as mentioned in section 4.0. All Brown & Brown and slot regulators in the Southeast district were modeled internally in EXTRAN. No additional alterations were made to the Southeast district interceptor system in either of the flow maximization scenarios.

Table 4-2
Table 4-3

System wide changes in hydraulic capacities are summarized in Table 4-4. As this table indicates, relatively minor changes in system-wide capacity will result from the regulator modifications. This condition occurs because the maximum system-wide capacity is largely controlled by the WPCP. Table 4-4 indicates the effectiveness of the flow maximization strategies in shifting the hydraulic constraints in the system from the regulators to the interceptors. For example, in the Lower Delaware sub-system all 27 regulators limit capacity under existing conditions, while under the regulator modification scenario only 5 of 27 regulators limit the maximum hydraulic capacity.

Table 4-4

Southeast WPCP Interceptor Systems
Hydraulic Capacity Analysis

Interceptor System	Sewer Area (acres)	No. of Regulators	Capacity Limits	Capacity (cfs/acre)	Theoretical Limit		Regulator Capacity Limits	Maximum Capacity (cfs/acre)
					Regulator Capacity Limits	Maximum Capacity (cfs/acre)		
Lower Delaware	7,222	27	27	0.002 - 0.020	5	0.003 - 0.021	1	0.003 - 0.019

Oregon Avenue	1,409	5	5	0.016 - 0.027	0	0.019 - 0.023	0	0.026 - 0.034
Total	8,631	32	32	0.002 - 0.027	5	0.003 - 0.023	1	0.003 - 0.034

Combined sewer overflow statistics for the Southeast drainage district under both flow maximization scenarios are listed in Tables 4-5 and 4-6. Existing conditions CSO statistics are also listed to show improvements in volume captured and reduction in frequency of combined sewer overflow events under both maximization scenarios. It should be noted that the existing system capacities reported on Table 4-4 are significantly lower than those reported on Table 4.2-1 in the SHCR. Although some difference is the result of model refinements made since the SHCR, the difference is primarily attributed to an error in the reporting of the hydraulic capacity results on Table 4.2-1. This reporting error did not influence the computation of CSO statistics reported on Table 5-2 in the SHCR, or any other results.

Examination of detailed model results reveals the following observations that should be used to establish the specific implementation of the flow maximization improvements in the Southeast Drainage District:

Regulator modifications provide the most significant increase in regulator capacities at D49, D53, D54, D62 and D63. From the standpoint of both relative and absolute increases in hydraulic capacity, minor modifications to these regulators will provide the largest increases in flow delivered to the interceptors in the Southeast district.

There are four locations in the Southeast district where significant increases in hydraulic capacity were simulated under the scenario where regulator constraints were eliminated. These regulators are D39, D45, D70 and D73. However, if only minor are made, relatively smaller changes in capacity are observed in the simulations. This suggests that regulator modifications at these locations may only be justified if more significant modifications are made.

Relatively little overflow reduction can be achieved in the Southeast district with The most significant influence of modifications in the Southeast district that can be achieved is a relatively small reduction in overflows along the Oregon Avenue sub-system, with a commensurate increase along the Lower Delaware Low Level.

4.2.3 Southwest Drainage District

The Southwest drainage district conveys flow from approximately one-third of the combined sewer area in the City of Philadelphia. A total of seven interceptor systems utilizing eighty regulators exist in the Southwest district. Flow maximization of all Brown & Brown and slot regulators in the Southwest district was modeled internally in EXTRAN except for slot regulators on the Cobbs Creek High and Low Level interceptors, which were modeled as orifices based on field verified invert elevations and DWO pipe dimensions.

In addition to the alterations of Brown & Brown and slot regulators for flow maximizing scenarios mentioned in section 4.0, specific changes were made to the Southwest drainage district. These changes include: Full utilization of the Southwest Main Gravity (SWMG) interceptor, and modification of the Cobb's Creek control pipes. Under existing conditions a sluice gate prevents flow from entering the middle barrel of the triple barrel SWMG interceptor at the 70th Street and Dicks Avenue Dispersion Chamber. Full utilization of the SWMG was achieved by setting the sluice gate in the full open position. The Cobb's Creek control pipes constrict flow at two locations in the Cobb's Creek Low Level Interceptor (CCLL). Both constrictions were modified to increase conveyance in the CCLL. The upstream constriction in the Cobb's Creek control pipes was enlarged from 18 to 30 inches. The downstream constriction, a 12 by 18 inch gate opening, was completely removed from the CCLL, leaving the existing 30 inch interceptor as the downstream control. These changes were applied to both flow maximizing scenarios in the Southwest.

System wide changes in hydraulic capacities are summarized in Table 4-7. As this table indicates, relatively more significant changes can be realized in hydraulic capacities (e.g. as compared to the Southeast district). This table indicates that the regulator capacities will still control system-wide capacities after modifications are made, i.e. these changes are less effective in shifting the hydraulic constraints in the system from the regulators to the interceptors than in the Southeast district, but (more importantly) greater capacity increases are possible. For example, in the entire Southwest system 74 of 80 regulators limit capacity under existing conditions, while under the regulator modification scenario only five fewer (69) regulators limit the maximum hydraulic capacity.

Combined sewer overflow statistics for the Southwest drainage district under both flow maximization scenarios are listed in Tables 4-8 and 4-9. Existing conditions CSO statistics are

also listed to show improvements in volume captured and reduction in frequency of combined sewer overflow events under both maximization scenarios.

Table	4-5
Table 4-6	

Table 4.7

Southwest WPCP Interceptor Systems
Hydraulic Capacity Analysis

Interceptor System	Sewer Area (acres)	No. of Regulators	Capacity Limits	Capacity (cfs/acre)	Theoretical Limit		Regulator Capacity Limits	Maximum Capacity (cfs/acre)
					Regulator Capacity Limits	Maximum Capacity (cfs/acre)		
Cobbs Creek HL	2,452	24	21	0.003 - 0.033	22	0.016 - 0.055	22	0.012 - 0.018
Cobbs Creek LL	386	12	9	0.003 - 0.019	9	0.015 - 0.024	9	0.012 - 0.018
CSES	2,186	18	18	0.010 - 0.048	16	0.005 - 0.060	0	0.038 - 0.058
CSWS	1,120	10	10	0.013 - 0.033	9	0.008 - 0.041	1	0.008 - 0.050
LSES	1,956	9	9	<.001 - 0.026	7	0.004 - 0.026	0	0.014 - 0.026
LSWS	746	4	4	<.001 - 0.020	4	0.005 - 0.020	1	0.057 - 0.079
SWMG	4,116	3	3	0.005 - 0.047	2	0.007 - 0.058	1	0.037 - 0.092
Total	12,956	80	74	<.001 - 0.048	69	0.004 - 0.060	34	0.008 - 0.092

Examination of detailed model results reveals the following observations that should be used to establish the specific implementation of the flow maximization improvements in the Southwest Drainage District:

Regulator modifications provide the most significant increase in regulator capacities at C01, C02, C04, C04A, C05, C06, C07, C09, C10, C12, C16, C18, C32, C34, C36, and C37 in the Cobbs Creek High Level system; at S12, S12A, S13, S17, S28, S35, S38, S50 and S51 in the Southwest Main Gravity and tributary sub-systems. From the standpoint of both relative and absolute increases in hydraulic capacity, minor modifications to these regulators will provide the largest increases in flow delivered to the interceptors.

There are no locations in the Cobbs Creek High Level system where significant increases in hydraulic capacity were simulated under the scenario where regulator constraints were eliminated versus that where minor modifications are made. However, there are fourteen locations in the Southwest Main Gravity and tributary sub-systems where this was simulated. These regulators are S05, S06, S18, S20, S24, S25, S26, S27, S34, S36A, S37, S42, S43 and S46. However, if only minor modifications are made, essentially no change in capacity is observed in the simulations. This suggests that regulator modifications at these locations will only be effective if more significant modifications are made. It should be noted, however, that increases in the hydraulic grade line in the Southwest Main Gravity caused by modifications to the regulators and hydraulic control points in that vicinity (S-27, S-28, S-30, S-34, S-39, S-40, S-43, S-47) were observed in the simulations to increase the occurrence of overflows into Cobbs Creek from the Cobbs Creek High Level sub-system, as the available hydraulic gradient across the Cobbs Creek High Level Cutoff is reduced. It is therefore recommended that no modifications be made to the structures along the Southwest Main Gravity identified above.

Regulator modifications provide the most significant increase in regulator capacities at C21, C29 and C30 in the Cobbs Creek Low Level system; and at S38 in the Lower Schuylkill West Side sub-system. From the standpoint of both relative and absolute increases in hydraulic capacity, minor modifications to these regulators will provide the largest increases in flow delivered to the interceptors in the Low Level systems.

There are no locations in the Cobbs Creek Low Level system where significant increases in hydraulic capacity were simulated under the scenario where regulator constraints were eliminated versus that where minor modifications are made. However, there are two locations in the Lower Schuylkill West Side system where significant increases in hydraulic capacity were simulated under the scenario where regulator constraints were eliminated. These regulators are S33 and S45. However, if only minor modifications are made, relatively small changes in capacity are observed in the simulations. This suggests that regulator modifications at these locations may only be justified if more significant modifications are made.

Table 4-8

Table 4-9

The most significant improvements in the Southwest district can be realized at the Cobbs Creek sub-systems. Regulator modifications can realize relatively significant improvements in these systems. In addition, the structure C-17 and those in that vicinity have a significant influence on system-wide CSO occurrences and therefore warrant further investigation during implementation of NMC4.

4.3 PROPOSED FLOW CONVEYANCE IMPROVEMENT STRATEGIES

The results of the hydraulic modeling of the interceptor sewers and regulators documented in the System Hydraulic Characterization Report (PWD; June 27, 1995) clearly demonstrate that the regulator structures “starve” the interceptors and WPCPs during wet-weather; i.e. they restrict flow from entering the system to the extent that CSOs occur before the WPCPs have reached capacity, and in most cases before the interceptor sewers have reached capacity. This is an intentional result of the prevailing regulator design philosophy at the time that these structures were designed and built. Although an appropriate approach when protection of the WPCPs from hydraulic overloading was the principal concern, this approach is now obsolete in the current situation where the primary objective is maximizing the capture and treatment of wet-weather flows. The current philosophy of flow maximization would change the system operation so that the WPCPs, and generally the interceptors, are operating at full capacity before CSOs occur.

Simply stated, the basic strategy of flow maximization is to deliver more flow to the WPCPs more frequently, to enable greater pollutant removals. The results of the hydraulic modeling of the interceptor sewers under the flow maximization scenarios indicate that significantly higher rates of flow can be delivered to the WPCPs more frequently than under current conditions.

An expected result of the flow maximization strategy is that the WPCPs will need to be throttled more frequently to prevent hydraulic overloading. This will occur because the interceptors can deliver significantly more flow to the WPCPs than the plants can process. By modifying the regulators to increase their conveyance of flow to the interceptors, the relatively high interceptor capacities will allow the conveyance of much more flow to the WPCPs much more frequently. The STORM model was used to quantify these increases in flow in terms of frequency distributions of plant inflow rates. These distributions are presented later in this section (Section 4.8 - Summary).

The simulations of the system modification scenarios described in section 4.2 clearly demonstrate that significant increases in flow capture can be achieved in the interceptor sewers. However, increased pollutant removal at the WPCPs under current permit limitations will require careful WPCP operation and evaluation of the response of the various processes to the increased flows. For this reason, the implementation of flow maximization improvements will be staged to allow WPCP operational experience under incrementally increasing flow conditions to be gained and this experience used to define the next stages of improvements.

Based on financial and operational considerations (discussed further in Section 4.8), incremental increases in flow capture will be determined first, then specific regulator modifications will be selected for implementation to achieve the desired flow increase. This staging of regulator improvements will be guided by the following six criteria to define the priority for specific regulator improvements:

1. **Potential for relatively higher industrial process loads.** While NMC3 (Industrial Pretreatment) addresses the reduction in industrial pollutant discharges from CSOs at the source, NMC4 can address industrial pollutant discharges at the outfall. CSO outfalls which drain areas with the potential for relatively higher industrial loads have been identified. Table 4-10a, 4-10b and 4-10c lists the CSO sites ranked highest to lowest for average loading of metals, BOD, and oil and grease, respectively (only sites with non-zero loadings are listed). These loadings are based only on industrial pretreatment limits for these parameters (i.e. does not include surface runoff loads), for the industries currently discharging to PWD's combined sewer system. Based

Table	4-10a	on these rankings, D07, D21, D22, D69, F11, F24, F25, S50, and T14 emerge as outfalls with the highest potential industrial pollutant discharges.
Table	4-10b	2. Population density. Although there are no local outfall quality data yet available to substantiate the assumption, it is often observed and generally expected that there is a tendency for CSO loads to correlate positively to population density in the combined sewersheds, i.e. higher population densities will generally produce greater wastewater-derived
Table	4-10c	

pollutant loads per unit area (e.g. BOD, solids, bacteria, litter/floatables, etc.), and higher population densities may be associated with land-use characteristics that produce greater stormwater-derived pollutant loads for several stormwater constituents (e.g. litter/floatables, BOD, solids, metals, etc.). Table 4-11 lists the CSO sites in PWD's system ranked highest to lowest by population density. This information is useful in indicating outfall locations at which sanitary wastewater pollutant concentrations can be expected to be generally higher than average. Table 4-12 lists the CSO sites in PWD's system ranked highest to lowest by population. This information is useful in indicating the outfalls at which sanitary wastewater pollutant loads can be expected to be generally higher than average.

3. **Outfall location relative to more sensitive receiving stream reaches.** There are CSO locations on Pennypack Creek upstream of Pennypack Park, on Frankford Creek upstream of Tacony Creek Park and on the Schuylkill River upstream of Bartram Gardens Park. These represent potential priority CSO locations due to their potential impact on streams above associated recreational areas. As a more general prioritization strategy, CSOs along the tributary streams will be prioritized above those that discharge directly to the larger Delaware River. Also, the more upstream a CSO location, the higher the priority, since location dictates the extent (length) of stream reach impacted by CSOs. Table 4-13a lists each of the parks within the PWD combined sewer service area impacted by CSOs and indicates the specific CSO sites upstream of each park facility.

Table 4-11, continued

Table 4-11

Table 4-13a

Listing of CSOs Upstream of Parks

<p><u>H. John Heinz National Wildlife Refuge</u></p> <p>C_01, C_02, C_04, C_04A, C_05, C_06, C_07, C_09, C_10, C_11, C_12, C_13, C_14, C_15, C_16, C_17, C_18, C_19, C_20, C_21, C_22, C_23, C_24, C_25, C_26, C_27, C_28A, C_29, C_30, C_31, C_32, C_33, C_34, C_35, C_36, C_37</p>
<p><u>Cobbs Creek Park</u></p> <p>C_01, C_02, C_04, C_04A, C_05, C_06, C_07, C_09, C_10, C_11, C_12, C_13, C_14, C_15, C_16, C_17, C_18, C_19, C_20, C_21, C_22, C_31, C_32, C_33, C_34, C_35, C_36, C_37</p>
<p><u>Morris Park</u></p> <p>C_01, C_02, C_04, C_04A, C_05, C_06, C_34, C_35, C_36</p>
<p><u>Pennypack Park</u></p> <p>P_01, P_02, P_03, P_04, P_05</p>
<p><u>Fairmount Park</u></p> <p>S_01, S_01T, S_02, S_03</p>
<p><u>Juniata Park</u></p> <p>T_03, T_04, T_05, T_06, T_07, T_08, T_09, T_10, T_11, T_12, T_13, T_14, T_15</p>
<p><u>Tacony Creek Park</u></p> <p>T_03, T_04, T_05, T_06, T_07, T_08, T_09, T_10, T_11, T_12, T_13</p>

4. **Hydraulic efficacy.** The regulators for which modifications will produce the most significant increases in hydraulic capacity were identified in Section 4.1, and are summarized in Table 4-13b.

5. **Satisfaction of multiple objectives.** It is expected that integrating operational considerations for regulator improvements (*e.g.* locations particularly subject to debris clogging, etc.) with hydraulic conveyance considerations will enable regulator locations to be identified which should be modified to accommodate both requirements.

Table 4-13b
Regulator Sites with Highest Potential Flow Increases

Drainage District	Minor Modifications	Significant Modifications
Northeast	T03, T04, T07, T11, T12, T13, T15, D03, F03, F25, P02, P03, P04 , P05	T08, T14, D05, F21
Southeast	D49, D53, D54, D62, D63	D39, D45, D70, D73
Southwest	C01, C02, C04, C04A, C05, C06, C07, C09, C10, C12, C16, C18, C32, C34, C36, C37 S12, S12A, S13, S17, S28, S35, S38, S50, S51	S05, S06, S18, S20, S24, S25, S26, S27, S34, S36A, S37, S42, S43, S46, S33, S45, C21, C29, C30, S38

6. Physical modification requirements. A number of factors including the configuration of the regulator, the condition of the mechanisms, the location and accessibility of the structure will determine which regulators can be more or less easily modified. Although a less important criterion than the other three described above, generally those regulators that can be most easily adjusted/modified will be addressed first. These locations will be determined by PWD operations staff.

The six criteria described above will be used to establish the specific staged implementation of regulator modifications. As specific CSO locations are identified for potential modification, and other improvements (e.g. modification of hydraulic control points) are identified, the proposed modifications will be represented in the EXTRAN model of the interceptor sewers and regulators and the hydraulic response of this system to the specific improvements will be simulated to establish the impacts on the collection and treatment facilities. STORM simulations using the improved hydraulic flow conveyance capacities will be developed to quantify the benefits of the flow maximization improvements in terms of reductions in CSO frequencies and volumes. The integration of flow conveyance improvements with WPCP operational impacts, and the specific approach to staging of NMC4, is described later in Section 4.8 (Summary).

4.4 EVALUATION OF WPCPs

Plant tours were conducted on Tuesday, May 23, 1995 (Southwest), Wednesday, May 24, 1995 (Southeast), and Thursday, May 25, 1995 (Northeast). The site tours concentrated on the condition, status, and operation (normal and wet weather) of the WPCP's, particularly on the headwork facilities (pumping, screening, grit removal),

secondary system operation, and solids handling and disposal. Subsequent to the site tours, meetings were held with each plant's management personnel to further discuss plant status and operations, the CSO program as a whole, and NMC4 considerations as they relate to each WPCP.

Generally, the topics of discussion during the site tours and meetings included:

Methods currently employed to maximize wet weather flow to the WPCP's.

Discussions on potential operating procedures which can/may be employed to allow more flow to be treated (without capital improvements).

Identification of real or potential headloss conditions within the WPCP's, including unit processes, conduits, channels, etc.

Discussion on existing Standard Operating Procedures (SOP) currently employed at the WPCP's during wet weather operation.

Discussion on Long Term Control Planning measure and requirements which must be considered by each respective WPCP.

Detailed discussions on influent/pumping operation, and control.

Unit process operation.

Potential needs for stress testing.

Discussion on Nine Minimum Controls Schedule; Final report to PaDEP Sept. 27, 1995; Long Term Plan by Sept., 1996.

Copies of available wet weather SOPs were obtained from each plant and are included in the appendix of this report.

The following sections provide an evaluation of each WPCP unit process as they relate to the items identified above and NMC4.

4.4.1 Southwest WPCP (SWWPCP) Evaluation

The SWWPCP has a permitted design flow of 200 mgd; 300 mgd peak daily limit; and 400 mgd instantaneous limit. Plant staff indicated that the plant can successfully handle 400 mgd with all equipment available, and have experienced upwards of 418 mgd while still meeting effluent permit compliance.

Wastewater treatment at the SWWPCP consists of preliminary treatment, primary treatment, pure oxygen activated sludge process, sludge treatment and disinfection.

SWWPCP receives wastewater from a triple-barrel high level sewer, a low level pumping station (screw pumps), and from the DELCORA interceptor. Wastewater from these conveyance systems are combined at the Preliminary Treatment Building (PTB) where the wastewater is screened and degritted.

After preliminary treatment, wastewater is conveyed through the flocculation tanks (2) to the primary settling tanks (5). Primary sludge is collected and transferred to anaerobic digesters. Scum is collected and transferred to the scum concentration process.

From primary treatment, the settled wastewater flows to secondary treatment, which includes the activated sludge process (10 reactors) using pure oxygen and final sedimentation (20 secondary clarifiers). RAS is returned to the aeration tanks to maintain microorganism populations, and wasted sludge (WAS) pumped to dissolved air flotation thickeners. Final sedimentation tank scum is collected and transferred to the scum concentration process. Effluent from final sedimentation is disinfected by chlorination before discharge into the Delaware River.

Sludge treatment at the SWWPCP consists of sludge thickening and anaerobic digestion followed by sludge dewatering and sludge composting at the Biosolids Recycle Center (BRC).

4.4.1.1 Unit Process Status and Operation

Influent Low Level:

Consists of three (3) dual lift screw pumps with a capacity of 30 mgd/screw. One (1) screw is in operation during normal plan flows with a second screw pump added during wet weather events as required. All three screw pumps are operable.

20 mgd of dry weather flow is typically recorded and 35 mgd during wet weather events. 60 mgd wet weather peaks have been reported.

Plant staff indicated that the low level influent facilities can flood during extreme wet weather events.

Low level influent flow is split thru two influent conduits and sluice gates. Downstream of the conduits are two manually cleaned coarse bar racks. These bar racks are raked daily and more frequently if required during wet weather events.

The low level influent facilities are designated a confined space.

The plant manager indicated that grit deposition is at times evident in the screw pump channels.

The operators responsible for the low level influent facilities reside in the PTB and are also responsible for screening and grit operations.

Influent Conduits:

There are a total of five (5) influent conduits conveying flow into the PTB; one (1) low level (discussed above), three (3) gravity (triple barrel), and one (1) DELCORA. DELCORA contributes 50-60 mgd during dry weather and 100 mgd during wet weather events.

Presently only two (2) of the triple barrel conduits are in use due to concerns of solids deposition in the conduits during low flow periods when all three conduits are in use. The triple barrel conduits receive flow from the Central Schuylkill Pump Station.

It was reported that the influent sluice gates are throttled at times during extreme wet weather events. This is true particularly when downstream unit processes (i.e., primary settling tanks) are out of service for maintenance.

Flow Metering:

Each influent conduit has a venturi flow meter except for the low level which utilizes an ultrasonic flow meter. The flow meters are all functional and are calibrated twice/week.

PTB Bypass:

There is a bypass line around the PTB which can be used to bypass flow directly to the flocculation basins during an extreme emergency (i.e. screenings/grit removal failure, PTB power failure, etc). It was reported that this bypass has not been used in the past few years.

Screening:

Screening consists of six (6) 1-in spaced catenary bar screens. The screens operate automatically by timer during normal dry weather flow events. The screens are rotated to equalize time of operation.

Five (5) screens are normally available for operation. One (1) screen is presently being rebuilt and is not available. One (1) screen has recently been rebuilt and is operable.

During normal DWF three (3) screens are in operation and additional screens are added accordingly during wet weather events and operated continually if required.

Grit Removal:

Grit is removed using four (4) Detriters. Two (2) are normally in operation during DWF with the others being added accordingly during wet weather events. Plant staff have effected modifications to the grit removal screw bearings to improve performance reliability. All are available for operation.

Flocculation Tanks:

There are two (2) flocculation tanks preceding the primary settling tanks with both normally in operation. One (1) flocculation tank can handle normal DWF. These tanks do not have mechanical means to remove any solids deposits.

It was reported that heavy grit deposition has occurred in the past in these tanks (most likely due to past mechanical problems with the Detriters), however, no impact to operations was apparent.

Primary Sedimentation:

Primary sedimentation occurs in five (5) primary settling tanks and all are available for operation (chronic mechanical failures in the past have been corrected). Each tank has 7 bays and its associated sludge and scum removal equipment.

Typical operation is with all 5 tanks in service. Sludge is removed daily with the sludge removal collectors being operated for 2 hr./day. Sludge blankets are maintained at 2 - 2.5 ft.

Plant staff indicated that no operational adjustments are presently required during wet weather events.

During the months of June and July only 4 tanks are in operation when preventive maintenance is being performed on the tanks and tank components.

Secondary System (Activated Sludge):

Biological treatment is performed in ten (10) reactor tanks utilizing a pure oxygen and mechanical mixing system. Presently only eight (8) reactors are required for operation, however all 10 are available.

Secondary system SRT (solids retention time) is maintained at 1 - 1.5 days (aeration tank inventory only). RAS is maintained at 32% of influent flow and is automatically flow paced during all flow conditions. Total RAS capacity is 120 mgd (6 mgd/tank). RAS concentration averages 6,500 - 7,000 mg/L. WAS wasting rates are based on maintaining the desired SRT.

Plant staff indicated that no operational adjustments are presently required during wet weather events.

Secondary Clarification:

Biological solids separation is performed in 20 final clarifiers. Under normal conditions 19 final clarifiers are in operation (1 is out of service for preventive maintenance) except during the dry weather summer months when one (1) additional clarifier is out of service for preventive maintenance (total of 18 in service). Sludge blankets are maintained at 1 - 3 ft. with the sludge collectors operating continually.

Disinfection and Effluent Pumping:

Under normal flow and tidal conditions, plant effluent flows by gravity through a triple barrel outfall to the Delaware River. Under high tide and/or high plant flow conditions, plant effluent is pumped utilizing a combination of three variable speed and two constant speed pumps. The effluent wet well is maintained at el. 95 ft. At el. 99 ft overflows occur into Eagle Creek. Disinfection of plant effluent is provided through the use of gaseous chlorine which is stored onsite as liquid in 90-ton rail cars. Chlorine solution is injected to the plant effluent in mixing chambers prior to the triple barrel outfall. Due to corrective maintenance which has been required on the chlorine mixers, only two effluent barrels have typically been in operation.

4.4.1.2 Wet Weather Operation

Appendix C presents the SWWPCP's established influent flow control strategies utilized during wet weather events. Based upon increasing influent flow conditions additional unit processes are put into operation accordingly to accommodate those flow increases. Appropriate plant staff have been instructed in the implementation of these wet weather operation strategies.

Appendix C also includes the plant's hydraulic profile, plant flow schematic and unit process hydraulic capacities.

Based upon historic and typical WWTP operations, equipment availability and process/equipment preventive and corrective maintenance requirements, various unit processes may not be in service at any given time. Taking this fact into consideration recommended upset hydraulic values for the various unit processes and treatment plant as a whole can be derived, as presented in Table 4-14.

The values presented in Table 4-14 are the maximum design hydraulic capacities and do not take into consideration unit process performance and effluent permit compliance requirements. Stress testing of unit processes will be required to determine unit performance and permit compliance at elevated flow values (Stress Testing is discussed in Section 4.7).

From Table 4-14 it appears that the grit removal system presently limits the maximum flow to 430 mgd.

As discussed previously, plant staff indicated that the SWWPCP has successfully treated flows upwards of 418 mgd without impacts to overall plant performance (permit requirements were met). Again, stress testing of the various unit processes is required to determine actual unit process hydraulic capacity in comparison to performance.

Since only 8 of the 10 biological reactors are operated (under most situations) the 2 additional reactors may be available for primary effluent flow equalization or storage during wet weather events. This is further discussed in subsection 4.2.5, Long Term Plan Considerations.

4.4.1.3 Maintenance and Equipment Availability

Plant staff indicated 85% equipment availability for wet train unit processes, which is consistent with industry standards (and consistent with the other 2 PWD WPCP's).

The unit processes associated with the headworks (grit and screenings) typically require more frequent maintenance (PM and CM) and O & M attention. Plant staff indicated that spare parts and supplies are available and appropriate staff dedicated to this area as required to repair malfunctions or breakdowns.

Table 4-14
SWWPCP

REALISTIC UNIT PROCESS AVAILABILITY

Unit Process	Total No. of Units	Units Available for Operation	Hydraulic* Capacity (units in operation)
Low Level Screw Pumps	3	2	60 mgd
Influent Bar Screens	6	5	475 mgd
Grit Removal Tanks	4	3	430 mgd
Flocculation Channels	2	2	570 mgd
Primary Settling Tanks	5	4	460 mgd
Aeration Tanks	10	8	450 mgd
Final Sedimentation Tanks	20	18	510 mgd
Effluent Pumping	5	4	460 mgd

*"Flow-through" capacity, without regard to process performance and permit compliance.

The primary settling tanks which in the past have impacted plant performance (due to mechanical failures) have recently been rehabilitated and are operating properly.

4.4.1.4 Bottlenecks

The following were reported as "bottlenecks" or real or potential headloss conditions within the SWWPCP and that which will require further evaluation as part of the long term control plan (LTCP):

- low level influent facilities (flooding)
- final effluent conveyance when only 2 barrels are available
- flocculation tanks when more than one primary tank is out of service

effluent pumping system

4.4.2 Southeast WPCP (SEWPCP) Evaluation

4.4.2.1 General

The SEWPCP has a permitted design flow of 112 mgd daily; daily maximum flow of 168 mgd; and a 224 mgd maximum instantaneous flow. Presently the plant experiences a 110 mgd average DWF from the Lower Delaware Low Level Interceptor. The plant essentially receives 100% of the design flow but only 45-50% of the design influent loading for BODs and TSS which at times causes difficulty in always meeting the percent removal requirements of the discharge permit.

It was reported that approximately six times per year the plant experiences high flows where wet weather SOPs have to be implemented and where impacts to the plant can be expected.

Facilities at the SEWPCP include: preliminary, primary and biological secondary treatment (oxygen activated sludge process) followed by disinfection. Sludge from the SEWPCP is pumped to the Southwest Water Pollution Control Plant (SWWPCP) for treatment.

Wastewater enters the SEWPCP through an 11-foot diameter influent sewer. Two mechanically cleaned bar racks located in the east and west influent channels of the Influent Pumping Station provide coarse screening.

After coarse screening the wastewater enters either of two suction bays, which are connected to three influent pumps (total of 6). The pumps lift the wastewater to a common diversion chamber. From the diversion chamber, wastewater flows through any of six channels to the Screen and Grit Building. Mechanically-cleaned catenary bar screens (6) located in the channel remove rags and debris. Grit and other materials settle to the bottom of the grit channels and are collected and removed by chain and flight grit collectors and an inclined dewatering screw conveyor. Grit and screening are loaded into trucks and delivered to a permitted landfill for disposal.

From the grit channels, wastewater is aerated in Flocculation Channels (2) before entering the Primary Sedimentation Tanks (4).

Wastewater enters four Primary Sedimentation Tanks over inlet weirs and through submerged inlet sluice gates. Settled sludge is collected and pumped directly to a sludge wet well in the Sludge Pumping Station.

Secondary treatment is provided by the activated sludge process using pure oxygen, in covered plug flow reactors (6). Pure oxygen is generated on site by two cryogenic oxygen generation plants. Each plant is rated at 50 tons per day of gaseous oxygen. The aeration system (6 reactors) consists of two batteries of three 4-stage covered aeration tanks. An influent control structure distributes the primary effluent to each tank. Wastewater passes through the four stages of the tank in a serpentine pattern to an outlet weir.

The Final Sedimentation Tanks (12) are arranged in two batteries of six. Mixed liquor (aeration tank effluent) enters the FSTs through baffled inlets. Effluent from the FSTs is discharged over V-notched weirs. Activated sludge is pumped from the FSTs to each battery of aeration tanks through return sludge headers.

The effluent is mixed with a chlorine solution as it enters the effluent conduit. The effluent conduit provides the necessary contact time for the chlorine to react with the effluent to provide disinfection before the treated effluent is released to the Delaware River.

4.4.2.2 Unit Process Status and Operation

Coarse Bar Screens

Consists of coarse automatic bar racks (2) upstream of influent pumping. Plant staff reports average reliability and that both are usually available for operation. The screens operate on timers or differential pressure.

Influent Pumping Station (IPS):

There are a total of six (6) constant speed (Nos. 1,2,6) and variable speed (Nos. 3,4,5) influent pumps connected to two (2) wet wells. All pumps are operated manually. The original design included automatic control, however, it was reported that the system has never been implemented/debugged. Each pump has a rated pumping capacity of 70 mgd.

The influent pump system can comfortably pump 280 mgd with four (4) pumps. It was reported that five (5) pumps are always available.

During DWF the wet well elevation is maintained between 8-10 ft (el 78 ft) and at 16 ft (el 84 ft) during wet weather events. The wet well elevation is measured in a manhole upstream of the plant.

The minimum operating wet well elevation was reported at el. 71 ft. 9 in (invert of inf. pipe= 68 ft). Wet well levels are monitored or recorded at the IPS and on the computer. At an elevation above 23 ft, CSOs occur in the collection system. The plant is obligated to treat 224 mgd before the "action level" of 23 ft is reached.

The plant has in the past, experienced flow increases from 100 mgd to 276 mgd within a 30 minute time period during a severe wet weather event which necessitated the operation of five (5) influent pumps.

The influent sluice gates to the IPS are manually operated and positioned (85% open) just above the flow to minimize sewer gas entry into the IPS. During wet weather conditions the gates are adjusted to 100% open.

Screening:

Consists of 6 catenary fine screens which are operated on timers or by pressure differential. They are operated continually, if required, during wet weather events. Manual sorting of screenings into buckets (no screenings conveyance to disposal) is required.

Grit Removal

Consists of 6 grit removal channels with mechanical rakes, and grit removal screws which deposits the grit onto a discharge belt conveyor. A pneumatic ejector conveys the grit to truck loading facilities. Operation of grit facilities is completely manual. The channels are rated at 55 mgd/channel.

It was reported that the grit removal conveyor can overflow during times of wet weather events. Additionally, grit tends to lay in the ejector discharge pipe and tends to freeze during cold temperatures.

During wet weather events, if required, additional manpower is stationed in the headworks facilities (overtime).

The screens and grit channels are designed in series (i.e. if either is down they both are down).

Flocculation Tanks

There are two (2) aerated flocculation tanks preceding the primary tanks. Both are normally in operation.

Primary Sedimentation

There are four (4) primary settling tanks each with 7 bays and its associated sludge and scum removal equipment.

Normal operation is with all 4 tanks in service. Typically, the sludge removed has a TSS concentration of 4 percent. When the Queen Lane WTP discharges into the plant the sludge TSS concentration increases to 5.5 percent. Primary effluent BODS and TSS average 45 mg/L.

Secondary System (Activated Sludge)

Biological treatment is performed in eight (8) reactor tanks utilizing high purity oxygen and mechanical mixing system. Presently only four (4) to six (6) tanks are required for operation, however all eight (8) are available. Each reactor has four bays configured in a serpentine flow pattern. Presently one battery is being operated using high purity oxygen and the other just using air.

Secondary system SRT is maintained between 1.3 - 3.5 days. The MLSS concentration in the "oxygen" train is maintained at 1,200 - 2,000 mg/L with an RAS concentration of 6,000 mg/L and the MLSS concentration in the "air" battery is maintained at 1,200 - 2,000 mg/L with a RAS concentration of 4,000 - 6,000 mg/L. RAS flowrate is maintained at 32-40% of influent flow for all flow conditions.

During high wet weather events (above 130 mgd) the additional 2 aeration tanks are put in operation to increase the hydraulic capacity through the plant. Four (4) reactors can handle up to 130 mgd; eight (8) reactors are required for flows above 240 mgd. At high flows without enough reactors in operation it was reported that the weirs in the primary tanks become submerged.

Secondary Clarification

Biological solids separation is performed in 12 final clarifiers. Under normal flow conditions all clarifiers are in operation, however twice per year (spring and fall) only 10 clarifiers are available as preventive maintenance is being performed on two (1/battery) of the final clarifiers.

Sludge withdrawal is accomplished by the use of a telescoping valve (1/final clarifier). There are a total of 8 RAS pumps (4/battery) with only 1-2 per battery typically in operation. Sludge blanket depths are maintained at 1-2 ft.

Disinfection and Effluent Pumping

Under normal flow and tidal conditions, plant effluent flows by gravity through a double barrel outfall. Under high tide and/or high plant flow conditions, plant effluent is pumped utilizing five effluent pumps. It was reported that the effluent pumps are only required about 6-8 times per year (usually 3 pumps).

Disinfection of plant effluent is provided through the use of gaseous chlorine which is stored onsite as liquid in 90-ton rail cars. Chlorine is injected in mixing chambers at the head of the effluent conduits for disinfection.

Sludge Transfer

No problems were reported with the conveyance of sludge to SWWPCP. However SWWPCP has reported past hydraulic overload problems at the DAF system due to the volume of sludge being discharged by SEWPCP. Typically, the sludge concentration discharged to SWWPCP is on the order of 0.5%, however, the design was based on a 2% sludge concentration.

4.4.2.3 Wet Weather Operation

Appendix C presents the SEWPCP's established influent flow control strategies utilized during wet weather events. Based upon increasing influent flow conditions additional unit processes are placed into operation accordingly to accommodate those flow increases. Appropriate plant staff have been instructed in the implementation of these wet weather operation strategies.

Based upon historic and typical WWTP operations, equipment availability and process/equipment preventive and corrective maintenance requirements various unit processes are not in service at any give time. Taking this fact into consideration, recommended upset hydraulic values for the various unit processes and treatment plant as a whole can be derived, as presented in Table 4-15.

The values presented in Table 4-15 are the maximum design hydraulic capacities and do not take into consideration unit process performance and effluent permit compliance requirements. Stress testing of unit processes will be required to determine unit performance and permit compliance at elevated flow values (stress testing is discussed in Section 4.7).

Table 4-15
SEWPCP

REALISTIC UNIT PROCESS AVAILABILITY

Unit Process	Total No. of Units	Units Available for Operation	Hydraulic* Capacity (units in operation)
Influent Pumping (IPS)	6	5	350 mgd

Influent Bar Screens	6	5	350 mgd
Grit Removal Channels	6	5	285 mgd
Flocculation Channels	2	2	420 mgd
Primary Settling Tanks	4	3	285 mgd
Aeration Tanks	8	7	300 mgd
Final Sedimentation Tanks	12	10	300 mgd
Effluent Pumping	5	4	280 mgd

*"Flow-through" capacity, without regard to process performance and permit compliance.

From Table 4-15 it appears that the effluent pumping station limits the maximum flow to 280 mgd and the grit removal channels and the primary settling tanks to 285 mgd. Plant staff indicated that the SEWPCP has successfully treated flows upwards of 270 mgd without impacts to overall plant performance (permit requirements were met). Again, stress testing of the various unit processes is required to determine actual unit process hydraulic capacity in comparison to performance.

Presently two aeration tanks are used for flow equalization and storage during wet weather events.

4.4.2.4 Maintenance and Equipment Availability

Plant staff report an 85% equipment availability for all equipment and processes within the SEWPCP. Sufficient spare parts and supplies are maintained on-site to effect the majority of expected repairs.

Various major equipment systems are undergoing upgrade and refurbishment as follows:

Primary settling tanks (mechanical equipment replacement, repairs to expansion joints and concrete)

Final Settling Tanks (mechanical equipment replacement, repairs to expansion joints and concrete)

Influent Pumps (new impellers and internal components)

The rehabilitation of the influent pumps is scheduled for completion by January 1996. The primary and final settling tanks are scheduled for completion by the end of summer, 1995. At any given time only one influent pump, one primary settling tank and two final settling tanks are out of service for rehabilitation.

The grit removal system is reported to be maintenance intensive, particularly the grit conveyor and ejector system. Appropriate plant personnel are dedicated to this area as required to repair malfunctions or breakdowns.

4.4.2.5 Bottlenecks

The following were reported as "bottlenecks" or real or potential headloss conditions within the SEWPCP and that which will require further evaluation as part of the LTCP:

Grit removal conveyor (overflows during wet flow events)

Grit ejector discharge pipe (grit lays in ejector pipe and freezes during cold weather)

Primary tank effluent weirs (when insufficient aeration tanks are in service)

4.4.3 Northeast Wpcp (Newpcp) Evaluation

4.4.3.1 General

The NEWPCP has a permitted design flow of 210 mgd, 350 mgd maximum daily flow, and a 420 mgd maximum instantaneous flow.

The NEWPCP includes preliminary, primary, and biological secondary treatment followed by disinfection. On-site sludge treatment includes thickening and anaerobic digestion prior to off-site transport by barge.

NEWPCP receives wastewater from the Delaware Low Level, Somerset Low Level, Frankford Low Level, and Frankford High Level Sewers. Once within the plant site, the wastewater is combined at the Preliminary Treatment Building. In the Preliminary Treatment Building, wastewater is screened, pumped (except for the Frankford High Level flows) and dewatered. Collected screenings and grit trucked off-site for disposal at a permitted sanitary landfill.

After preliminary treatment, wastewater flows to the Primary Sedimentation Tanks (2 sets; total of 12 tanks), where heavy settleable solids, as well as scum are collected and removed. Primary sludge is pumped to the Sludge Thickener Building and scum is pumped to the Scum Disposal Facility.

After primary sedimentation, wastewater flows to the Aeration Tanks (7 reactors), where it is biologically treated by the SURFACT system which is a combination of suspended and attached growth biomass technologies.

From biological treatment, wastewater flows to the Final Sedimentation Tanks (2 sets; total of 16 tanks), where secondary sludge and scum are collected and removed. Most of the secondary sludge is returned to the Aeration Tanks; the remainder, excess secondary sludge, is wasted to the Sludge Thickener Building. Secondary scum is pumped to the Scum Disposal Facility.

After final sedimentation, the treated and clarified wastewater flows to Chlorine Contact Tanks, where it is disinfected prior to release into the Delaware River.

Primary sludge and excess secondary sludge are combined in the Sludge Thickener Building. Excess secondary sludge is thickened by the dissolved air flotation (DAF) process, then mixed with primary sludge. Primary and thickened excess secondary sludge are pumped as a mixture or can be separately pumped to the Sludge Digestion Facilities, where the sludge is anaerobically digested. Digested sludge is transported off-site by barge for further processing at the BRC.

4.4.3.2 Unit Process Status and Operation

Diversions Chamber "B"

Receives flow from the Frankford High level Interceptor (gravity). DWF averages 50 mgd and upwards of 100 mgd during wet weather events.

Meter Vault "A"

Contains venturi flow meters for the Frankford High Level and the Frankford/Somerset high level interceptors. The Frankford/Somerset high level interceptor averages 40-50 mgd DWF and 100 mgd wet weather flow.

Diversions Chamber "A"

Low level flows coming in Diversion Chamber "A" prior to the PTB. The Delaware low level interceptor averages 70 - 80 mgd DWF and 200 mgd wet weather flow. The Delaware low level is not metered but is calculated.

The level in Diversion Chamber is maintained at 6 - 9 ft. (maximum 12 ft). There is an action level of 18.5 ft. (measured in the collection system) where above this overflows occur.

Screening

Consists of a total of eight (8) rope screens; six (6) for low level flows and two (2) for high level flows. Normally during DWF one (1) high level screen and 2 - 3 low level screens are in operation. Both high level screens and 4 - 5 low level screens are operated during wet weather events. During wet weather events the screens are operated continually.

It was reported that one (1) high level screen can handle wet weather flows if the screen does not blind.

The low level screens have a 6-minute cycle time which is considered too slow during severe wet weather events and first flush periods.

The influent screens are I/C interlocked with each screens influent sluice gate and influent pump.

Blinding of the screens, particularly during the first flush was reported as a major problem and flooding of the basement area occurs.

Influent Pump Stations (IPS)

Includes six (6) variable speed pumps each rated for 85 mgd. Each pump is in series with an influent screen.

The IPS is presently operated "somewhere between manual and computer mode". Interlocks require 15 minutes between pump starts. The wet well level is typically maintained 5-7 ft above the pump suction. Redundancy has been designed into the control system (i.e. multiple pump controls). In manual control the wet well is maintained between 6 - 9 ft; in the automatic/computer mode between 4.5 ft - 10 ft. Each pump has a vibration monitoring and alarm system.

It was reported that a total of five (5) pumps can operate at one time. All low level flows are pumped. High level flows are not pumped.

The IPS operator is also responsible for the operation of the screenings and grit removal facilities. Additional staff is added during wet weather events if required.

Grit Removal

Grit removal is accomplished using four (4) Detriters. Two (2) are normally in operation during DWF. The other two (2) are added as required during wet weather events. Each Detritter is rated for 125 mgd. It was reported that the Detritter influent sluice gates act as emergency overflow weirs during extreme wet weather events where overflows can occur into the Detriters.

Primary Sedimentation

There are two (2) sets of primary settling tanks (set 1; 8 tanks, set 2; 4 tanks). Flow is metered into each set by venturi meters (2 meters for set 1 and 1 meter for set 2).

Sludge collector mechanisms are operated 1 - 2 hours per day; sludge is removed daily (15 - 20 min./tank); and sludge blankets are maintained at 2 - 2.5 ft.

Secondary System (SURFACT)

Usual operation is with six (6) reactors in operation, however during the months of January, February and March all seven (7) reactors are in service (with 80% of the RBC's turning).

RAS is flow paced from the computer system and maintained at 30 - 33% of the influent flow. Maximum RAS capacity is 150 mgd.

Recent and more frequent RBC shaft and media failures are becoming a serious concern. This issue is presently being addressed by PWD.

Secondary Clarification

Biological solids separation is accomplished in 16 final settling tanks (2 sets). Sludge blankets are maintained at 4 - 5 in. Secondary effluent is metered downstream of the tanks.

It was reported that during construction of set 1 final settling tanks when influent flow exceeded 170 mgd, set 2 effluent weirs became submerged and solids losses occurred.

Disinfection

Disinfection of plant effluent is accomplished through the use of gaseous chlorine which is stored on-site as liquid in 90-ton rail cars. Chlorine is injected in mixing chambers at the head of two (2) parallel chlorine contact tanks. Final effluent is conveyed through a triple barrel outfall into the Delaware River.

4.4.3.3 Wet Weather Operation

Appendix C presents the NEWPCP's established procedures for both dry and wet weather events. Based upon increasing influent flow conditions additional unit processes are placed into operation accordingly to accommodate the flow increases. Appropriate plant staff have been instructed in the implementation of the wet weather operation procedures.

Based upon historic and typical WWTP operations, equipment availability and process/equipment preventive and corrective maintenance requirements various unit process are not in service at any given time. Taking this fact into consideration, recommended upset hydraulic values for the various unit processes and treatment plant as a whole can be derived, as presented in Table 4-16.

The values presented in Table 4-16 are the maximum design hydraulic capacities and do not take into consideration unit process performance and effluent permit compliance requirements. Stress testing of unit processes will be required to determine unit performance and permit compliance at elevated flow values (stress testing is discussed in Section 4.7).

Table 4-16
REALISTIC UNIT PROCESS AVAILABILITY

Unit Process	Total No. of Units	Units Available for Operation	Hydraulic ⁽¹⁾ Capacity (units in operation)
Influent Pumping (IPS)	6	4	340 mgd
Influent Bar Screens	8	6 ⁽²⁾	460 mgd ⁽³⁾
Grit Removal	4	3	375 mgd

Primary Settling Tanks	8	7	440 mgd
AS/RBC	7	6	360 mgd
Final Sedimentation Tanks	16	14	370 mgd
Chlorine Contact Tank	2	2	420 mgd
Effluent Conduit	3	3	400-510 mgd

(1) "Flow-through" capacity, without regard to process performance and permit compliance.

(2) 1 low level and 1 high level unit out of service.

(3) Hydraulic capacity with 4 low level = 340 mgd;

Hydraulic capacity with 2 high level = 120 mgd;

Total PTB capacity with 6 bar screens = 460 mgd.

From Table 4-16 it appears that the aeration system presently limits the maximum flow to 360 mgd. However, the permitted maximum instantaneous flow required to be treated is 420 mgd, which is significantly higher than the realistic 360 mgd flow. Additionally, all four (4) Detriters and all 16 final settling tanks are required to be in operation to hydraulically pass the 420 mgd flow.

Plant staff indicated that on December 5, 1993 the plant received and successfully treated 414 mgd. However, plant staff noted that this flow rate is questionable and may be a high estimate. It was reported that flooding of the aeration tank platforms occurred during this event. This gives credence to limiting the hydraulic capacity to 360 mgd through the aeration system. This must be reconciled in the long term control plan. Again, stress testing of the various unit process is required to determine actual unit process hydraulic capacity in comparison to performance.

It was reported that the plant experiences the 420 mgd instantaneous maximum flow about twice/year for a 2 hour duration.

4.4.3.4 Maintenance and Equipment Availability

Plant staff indicated 85-90% equipment availability for the entire plant.

The plant manager indicated that the influent screens require substantial maintenance efforts. Spare parts and supplies are available and appropriate staff dedicated to this area as required to repair malfunctions or breakdowns.

Set 2 of the primary settling tanks have recently been completely rehabilitated.

The SURFACT RBCs are exhibiting more frequent shaft and media failures which will limit the secondary system removal capacity. PWD is presently evaluating this problem to determine the long term ramifications and impact to overall plant performance.

4.4.3.5 Bottlenecks

The following were reported as "bottlenecks" or real or potential headloss conditions within the NEWPCP and that which will require further evaluation as part of the long term control plan:

Frankford High Level Interceptor Venturi Meter (2-3 ft headloss across meter)

Influent Bar Screens (blinding during first flush)

Detritter influent sluice gates and potentially the effluent channel

Aeration tank platforms (above 400 mgd)

Final settling tank channel at the confluence of Set 1 and Set 2 discharges

PWD installed bar racks at aeration tank discharge (to capture RBC media)

4.5 Septage Evaluation

NMC4 requires an evaluation to determine the effect of septage discharges the collection system and/or treatment facility during periods when wet weather flows are being processed and if required, to assess the feasibility of prohibiting septage discharges during wet weather periods.

NEWPCP and SEWPCP do not receive septage. SWWPCP receives approximately 10,000 - 20,000 gpd which is minimal with respect to the average DWF and indeed is only 0.01% of the DWF treated. The septage discharges at SWWPCP have no impact on plant operations and performance and no further evaluation is required.

4.6 Stress Testing

NMC4 also requires a determination of the ability of a POTW to operate acceptably at incremental increases in wet weather flows and to estimate the effect on POTW's compliance with its permit requirements. The most effective way to accomplish the requirements of this task is to perform stress testing of the plant and plant's unit processes.

The objectives of plant stress testing would be to establish:

Maximum and average flows that should be treated in various unit processes for current and future operations;

Ranges of hydraulic loadings, and solids and BOD₅ loadings that could be applied to the various unit processes and yet obtain maximum removal efficiencies in each unit process;

Changes in plant processes and operations (such as increased loads, MLSS levels, changes in sludge wasting, return activated sludge (RAS) ratios, detention times, etc.) that would increase removal efficiencies; and

Magnitudes of excess capacity, if any, in each unit operation of the plant (increased flow through plant process units) that could be achieved and still meet the discharge permit requirements for each plant.

Plant stress testing and optimization is usually carried out in two stages. During the first stage, current plant operations are observed, the treatment system and process operation and performance is assessed and a stress test and sampling and analysis protocol developed. In the second stage, actual stress testing of the plant and plant unit processes is performed.

During stress testing selected treatment trains or unit processes would be isolated for conducting the process optimization and stress testing. Flows through these treatment trains would either be increased or decreased and the resulting impacts on treatment and removal efficiencies would be established from sampling and analysis. Field measurements would be conducted during the observation period to make sure that the plant hydraulics could be changed as desired without causing operational upsets. Field surveys of weir elevations at various locations in the processes are usually performed during the first stage to assure that appropriate flows are treated in selected process units.

It will be necessary to conduct stress testing with minimal changes and disruptions to the existing plant operations. To achieve the desired flows through the various process units to demonstrate their respective treatment capacities

and ensure that the stress testing of the unit processes would not degrade treatment plant effluent quality, operational adjustments to the various unit operations would be made slowly.

The results of stress testing will allow a determination of existing and future optimum flows, loads, and operations of the various unit processes.

It can be expected that the actual field stress testing would take about eight to twelve weeks before conclusive results could be obtained from changed/adjusted operations.

4.7 Other Related Issues

Two related issues which must be considered within the overall context of the CSO program initiative are: 1) PWD's plan to convert each plant's disinfection system from chlorine to sodium hypochlorite, and 2) WTP residuals discharge effects on the SEWPCP, NEWPCP and SWWPCP.

Conversion to hypochlorite for disinfection must take into consideration future capacity requirements and potential additional application locations (i.e. primary effluent). Sufficient expansion and flexibility capabilities should be designed into the hypochlorite system(s).

The SEWPCP is benefited by the WTP discharges from the Queen Lane WTP since it increases the plants' loading and aids in meeting the BOD₅ and TSS percent removal requirements. Results of the Residuals Management Project may potentially eliminate these WTP discharges to SEWPCP. If the discharges are to be eliminated PWD may need to negotiate with PaDEP/EPA to eliminate the percent removal requirements in the SEWPCP's discharge permit.

4.8 Summary

It appears that all reasonable methods are presently being employed by each respective WPCP to treat existing maximum wet weather flows within the requirements of their discharge permits. Each plant has established operating procedures for wet weather conditions. However, as wet weather flows can be expected to increase in the future, and the plants will be obligated to treat these flows, actual plant and unit process capabilities must be determined.

Increases in the wet-weather flows at each of the three WPCPs was analyzed using the STORM models of the combined sewer systems. This analysis was performed using STORM to compute the flows captured by the

interceptor sewer system under existing conditions and under each of the two flow maximization scenarios (modified regulators and the theoretical limit). The long-term precipitation record used to simulate the occurrence of overflows (1948 - 1992) was appended to include the full period from 1948 through July 1995. This updated precipitation record was used to perform the WPCP flow analysis and was compiled for the National Weather Service rain gauge at the Philadelphia International Airport. The long-term precipitation data used in this study are described in greater detail in the System Hydraulic Characterization Report (PWD; June 27, 1995). Simulation of flow capture using this precipitation record enabled the computation of cumulative probability distributions of plant flows which indicate the probability of exceedence over the range of flow values. Changes (increases) in the frequency of the occurrence of higher flows at the WPCPs has significant implications for WPCP operations, thus the plots are useful in assessing potential plant impacts associated with conveyance improvements.

Seven flow frequency plots have been produced for each of the three WPCPs. Figures 4-5a, 4-5b and 4-5c provide background on existing WPCP flow characteristics for each of the three plants. These plots show the distribution of daily plant inflow frequencies as simple histogram plots prepared using the plant flow data for the period from July 1991 to December 1994.

Figures 4-6a, 4-6b and 4-6c indicate the expected increases in flow for each of the three plants simulated using the entire precipitation record for the period from 1948 to 1995, which therefore represent average conditions. For example, Figure 4-6a shows that under existing conditions, 360 mgd is exceeded on average 125 hours per year in the current storm simulations, but this rate would be exceeded 310 hours per year with full implementation of the regulator modifications and 460 hours per year under the theoretical limit scenario for conveyance improvements. This information is useful in assessing the impacts on the WPCPs that can be expected as the conveyance improvements are implemented. As these plots indicate, significant increases in high flows can potentially be experienced.

Figures 4-7a, 4-7b and 4-7c show the influence of extreme climatological conditions on the flow distributions which would be experienced under full implementation of the regulator modifications. These plots were produced using the precipitation data for only the fiscal year shown in the simulations to produce the highest volume of flow at the WPCPs, (July 1, 1979 - June 30, 1980 at the NEWPCP and SEWPCP and July 1, 1994 - June 30, 1995 at the SWWPCP), representing the extreme annual conditions in terms of flow volume treated. Each figure shows the cumulative frequency distribution of plant inflow with full implementation of the regulator modifications under average conditions (from Figures 4-6a-c) and under the extreme year conditions described above. For example, Figure 4-7a shows that 360 mgd at the NEWPCP would be exceeded 400 hours per year under the extreme precipitation conditions of FY 1979-80 (with full implementation of the regulator modifications), an increase of almost 30% above the 310 hours per year that this rate would be exceeded under average precipitation conditions and an increase of 220% above the 125 hours per year on average that this rate is currently exceeded. This

information is useful in assessing potential extent of the impacts on the WPCPs that can be expected as the conveyance improvements are implemented under reasonable “worst case” precipitation conditions.

The increases in flow at the WPCPs should occur incrementally, to enable plant operations to adjust to the increased flows, and to enable the actual hydraulic changes in the system of regulators, interceptors and treatment processes to be evaluated before further increases occur. The incremental increases in flow at the WPCPs will be staged with incremental implementation of the conveyance improvements, as described in Section 4.3. Staging of improvements will be on an annual basis, with full implementation in a multi-year period. PWD intends to meet with PaDEP in the near future to discuss the information currently being developed to better quantify the impacts of the increased wet-weather flow rates and volumes that will be delivered to the WPCPs. This information will be used to define in greater detail the implementation plan for the conveyance improvement program.

Each year during the implementation period the specific conveyance improvements and associated WPCP operational requirements will be defined on a schedule that enables the potential fiscal impacts to be factored into PWD's annual operating budgets. The specific goals for conveyance improvements to be implemented each year will then be included in the annual CSO status report submitted to PaDEP under the Chapter 94 reporting requirements.

The WPCP responses to the increased flows that will be delivered to the plants as the conveyance improvements are implemented will be guided by the determination of process-specific treatment capabilities. Although useful information for wet-weather operation of the WPCPs is provided in the "CSO Mitigation Through Rating Analysis for Northeast WPCP, Southeast WPCP, Southwest WPCP" report prepared by Greeley and Hansen, comprehensive process-specific determinations of treatment capabilities are above and beyond the results presented in the report. Stress testing of each plant's unit processes is required to accomplish this, and stress testing will be addressed in the Long Term Control Plan.

Observations during our evaluation indicate adequate emphasis in the area of routine and corrective maintenance to sustain a satisfactory level of system reliability for existing DWF and wet weather flow conditions.

PWD is actively seeking to increase the available wet-weather treatment capacity at the SWWPCP through reduction in the wet-weather flow handled by this facility from the DELCORA service area. PWD has required DELCORA to develop a plan for eliminating wet-weather induced exceedences of the flow limits specified in their service agreement. DELCORA has developed a plan which includes diversion of flow from one of the three major drainage basins in DELCORA's Eastern Service Area currently handled at the SWWPCP to DELCORA's Western Regional Treatment Plant. The elimination of this flow, together with inflow reductions in the service communities to be determined in follow-up planning studies, will reduce the wet-weather flow rates delivered to the SWWPCP

from the DELCORA system, effectively increasing the available wet-weather capacity for treatment of combined sewer flows at this facility by at least 23 mgd. The improvements required to enable this flow reduction from DELCORA are currently expected to be operational in roughly four years.

The related issues of conversion from chlorine to sodium hypochlorite for all plants and the impacts from the potential elimination of Queen Lane WTP discharges to SEWPCP on the BOD₅ and TSS percent removal requirements must also be considered in the overall CSO program initiatives.

Figure 4-5a

Figure 4-5b

Figure 4-5c

Figure 4-6a

Figure 4-6b

Figure 4-6c

Figure 4-7a

Figure 4-7b

Figure 4-7c

Section 5 Minimum Control No. 5 Prohibiting CSO Discharges During Dry Weather

Dry weather discharges at CSO outfalls can occur in any combined sewer system on either a chronic (i.e., regular or even frequent) basis or on a random basis (i.e., as a result of unusual conditions). Dry weather discharges can occur as a result of numerous site-specific conditions. Random dry weather discharges can occur at virtually any CSO outfall following sudden clogging by unusual debris in the sewer, structural failure of the regulator, or hydraulic overloading by an unusual discharge of flow to the combined sewer system. Chronic dry weather discharges can and should be prevented from occurring at all CSO outfalls. Random discharges cannot be prevented, but can and must be promptly eliminated by cleaning repair, and/or identification and elimination of any excessive flow and/or debris sources.

Figure 5-1 CSO chamber maintenance records of inspections and observed discharges: FY 1993-1995

As documented in Section 1, the PWD performs regular inspections and maintenance of the CSO regulators throughout the City. These programs ensure that sediment accumulations and/or blockages are identified and corrected immediately to avoid dry weather overflows. The results of these efforts are reflected in the Department's Monthly CSO Status Report submitted to PaDEP and EPA Region III. These monthly reports include listings and information pertaining to occurrences of blockages or any dry weather overflows that are detected by PWD's staff. Figure 5-1 shows a comparison of the number of CSO chamber inspections and the number of blockages observed for the last three fiscal years. The PWD's emphasis on frequent site visits aimed at clearing minor blockages before they develop into discharges is shown to have resulted in the number of dry weather discharges declining over the years. In addition, between 1977

and 1994, the Department expended over 2.1 million dollars on contractor-performed regulator rehabilitation and major maintenance, ensuring that the regulators operate as they were designed and minimizing the potential for dry weather overflows to be caused by equipment failure.

Since the completion of the initial CSO monitoring contract in 1990, a maintenance dispatch program has been in place in the Northeast drainage district employing electronic surveillance to assist in the detection of blockage conditions that could lead to dry weather discharges. Over the next few years, as the PWD's automated sewer flow and stage monitoring system is expanded to include City-wide coverage, immediate identification of any conditions resulting in changes of sewage flow depth and/or rate anywhere in the City will be possible on the Fox Street facility's computers. The expansion project represents a 6.5 million-dollar investment on the part of the City, aimed at helping the PWD to better operate and maintain the sewer system. This system will be employed on a daily or more frequent basis to schedule the dispatch of maintenance crews to problem areas City-wide.

Periodic dry weather overflows at the D_25 (Somerset) and D_39 (Susquehanna) CSO regulators were experienced in the past and those regulators have been investigated recently. No dry weather overflows have been observed at Somerset since a major pipe cleaning effort was completed in 1994. A sediment trap has been installed, and PWD staff regularly monitor sediment accumulation in the trap and in the downstream pipe to determine when pipe clean-out should occur next.

In the past, aperiodic overflows have been observed at D_39 when certain filter backwash operations were conducted at the Queen Lane Water Treatment Plant; however, these overflows were not chronic or continuous. The overflow dam at D_39 recently was raised six inches. Records indicate that since that time the aperiodic overflows have not recurred. Further corrective source control flow reduction measures at D_39 are being studied within the context of the Department's Water Treatment Plant Residuals Management Study. The Department is investigating these and other locations as part of the ongoing CSO permit compliance program.

Hydraulic modeling analyses conducted during the compilation of the recently completed System Hydraulic Characterization report (PWD June 1995) required detailed scrutiny of regulator hydraulics, including simulations of the dry weather operating characteristics at all diversion structures. The modeling of the regulators revealed no instances of inadequate carrying capacities for domestic and non-domestic waste flows under dry weather conditions.

Section 6

Minimum Control No. 6

Control of the Discharge of Solids and Floatables in CSOs

6.1 GENERAL

The control of floatables and solids in CSO discharges addresses aesthetic quality concerns of the receiving waters. The ultimate goal of NMC No. 6 is, where feasible, to reduce, if not eliminate, by relatively simple means, the discharge of floatables and coarse solids from combined sewer overflows to the receiving waters. The initial phase of the NMC process is focused on the implementation of, at a minimum, technology-based, non-capital intensive control measures. The effectiveness of the minimum controls and the evaluation of the potential need for other methods to more effectively control the discharge of solids and floatables from CSOs are intended to be addressed in the Long Term Control Plan, and in the continuing planning process as documented each year in the Annual CSO Status Report. That is, the need to control the discharge of solids and floatables, the degrees of control that will be necessary, and the determination of the controls that may be required, are intended to be an ongoing process throughout the development stage and the early implementation phases of the Long Term Control Plan.

The NPDES permits authorizing the CSO discharges in Philadelphia require the Department to acknowledge and consider the available methods for solids and floatables control. There are various technologies that can be used to control solids and floatables entering the receiving waters from CSOs. These technologies range from simple devices that remove the material from the CSO flow stream to devices that remove the floatables from the receiving water after they are discharged. Control practices also include efforts to prevent the extraneous solids and floatables from entering the combined sewer system. A discussion of the potential available control measures is included in this Section.

The permits also require that the City implement, where feasible, appropriate controls in environmentally sensitive areas. The first step required to address this issue is the conduct of an

analysis of the environmental sensitivity of the area receiving waters and their directly adjacent lands. The process for this initial step, the conduct of a sensitive area analysis, is underway and is documented in this Section. Also documented in this Section is the proposed next step in the process, a plan to monitor the volume and mass of floatables and solids found in the City's combined sewage and to project the amounts of these materials that actually may emanate from CSO discharges to Philadelphia area receiving waters.

6.2 DEFINITIONS

Floatables are waterborne waste material and debris (e.g., plastics, polystyrene, paper) that float at or below the water surface. Floatables seen in significant quantities are aesthetically undesirable and can cause beach-closings, interfere with navigation by fouling propellers and water intake systems, and impact wildlife through entanglement and ingestion.

Solids are waterborne waste material and debris consisting of sand, gravel, silts, clay, and other organic matter. Significant concentrations of solids are not only a visual nuisance, but can affect turbidity, dissolved oxygen, and carry pathogens in the receiving water. In addition, excessive amounts of solids can affect the combined sewer system by causing decreased hydraulic capacity, thus increasing the frequency of overflows. Solids can enter the system through domestic and industrial wastewater, and debris washed from streets.

6.3 SUMMARY OF ALTERNATIVES CONSIDERED

Floatables and solids control measures consist of non-structural and structural technologies. Non-structural technologies include combined sewer system maintenance procedures such as sewer flushing, street sweeping, and catch basin cleaning. Public education, land use planning and zoning, and ordinances are also considered non-structural technologies implemented to reduce solids and floatables entering the combined sewer system. These technologies are included as part of the Pollution Prevention Program Section (NMC No. 7), and therefore will not be discussed further in this Section.

Structural controls typically consist of abatement devices that would be constructed near the point of discharge. Technologies used to for removing solids and floatables from CSOs include: Baffles, Booms, Catch Basin Modifications, Netting Systems, Swirl Concentrators, Screens, and

Trash Racks. These controls and the potential for their application in Philadelphia are considered below.

Baffles

Baffles are installed at CSO regulator structures to restrict floatables from discharging over the diversion weir. The baffle is placed upstream of the weir and extends from the top of the conduit down into the flow to an elevation below the invert of the weir. As the flow rises in the conduit, floating material is retained by the baffle before it can discharge over the weir. As the flow recedes below the elevation of the weir (and the baffle), the floatable material is carried downstream to the WWTP. Baffles do not collect any solids material. Figure D-1 in Appendix D shows a typical baffle.

Baffles are a simple floatable control technology. However, the layout of a majority of the CSO regulators in Philadelphia may prohibit the practical installation of these devices, at least not without significant capital, operation, and maintenance costs. Without significant redesign and construction, baffles would restrict access to much of the regulating structures, making maintenance more difficult, if not impossible. In addition, this could affect seriously the City's maintenance procedures that have proven effective in ensuring the proper operation of the combined sewer system, as documented in Section 1. The proper installation of baffles would require significant structural alterations to regulators and outfalls in almost all conceivable applications in the City. Costs for a typical installation likely would exceed \$20,000 per location. Accordingly, the use of these structures in the Philadelphia combined sewer system will not be considered further as a minimum, non-capital intensive control measure for use under the NMC process.

Booms

Booms are placed at the CSO outfall to retain floatable materials. Booms float on the surface of the water. They are attached to the shoreline by cable and to the bottom by weights. Floatables captured within the boom are removed by other methods such as skimming devices. Booms typically are used for floatables control and are not effective in collecting solids material. Figure D-2 in Appendix D is an illustration of a typical boom device.

Booms are advantageous because they float with changing river levels, are simple to implement, and can capture/absorb oils and greases floating on the water surface. However, booms do not work well in river environments where high river velocities, tides, and winds may dislodge the booms, and irregular shoreline conditions make it difficult to access the booms for maintenance. In addition, booms collect the floatables after they enter the receiving water, potentially causing unsightly conditions near the regulator outfall. Considerable structural modifications in and around the outfall structure typically are required for a successful implementation of this control under these conditions.

Clean-up of the floatables after a storm also presents a problem. Floatables typically are removed by hand, skimmer vessels, or trucks. Access to most of the outfall locations in Philadelphia is restricted by shoreline conditions, especially for vacuum trucks and/or dump trucks. Because of the low water depths in many of the more protected locations, skimmer vessels are not appropriate for use along the small tributaries in Philadelphia. Only the Delaware and lower Schuylkill Rivers have sufficient draft suitable for potential application of this control, but the open water conditions make their use infeasible without significant structural modifications to protect the device. Thus, cleaning of the floatables captured by the booms may be difficult due to site conditions. As a result, booms will not be considered for implementation in Philadelphia as a minimum, non-capital intensive control measure under the NMC process.

Catch Basin Modifications

Catch basin modifications consist of devices used to prevent floatables from entering the combined sewer system. Inlet grates, as shown in Figure D-3 (Appendix D), are used on many of the City's catch basins and they effectively prevent floatables from entering the catch basin. Figure D-3 in Appendix D was copied from the PWD publication "Standard Details and Standard Specifications for Sewers." Trash buckets, as shown in Exhibit 6-4, can be used to retain floatables entering the catch basin. Other catch basin modifications alter the outlet pipe conditions. As shown in Figure D-4 (Appendix D), hoods, siphons, and submerged outlets can help to restrict floatables from being conveyed to the collection system. These devices require regular maintenance and cleaning to remove trapped floatables and other debris from the catch basin. In addition, topography of the area should be considered to avoid excessive street flooding.

Philadelphia reports that most of the City's some 84,000 inlets basins currently connected to the sewer system are trapped inlets that effectively prevent litter, debris and floatables from being carried through the sewer system either to the sewer plants or to a discharge point in a receiving water. Although the exact number of these installations in the portions of the City served by combined sewers is unknown, City personnel report that the City has had a long standing policy to incorporate this outlet design in all combined sewer system catch basins to prohibit odor releases from the sewer system. Accordingly, Philadelphia is already effectively controlling floatables using this technology. Figure D-5 in Appendix D shows a detail drawing of a trapped storm sewer inlet copied from the PWD publication "Standard Details and Standard Specifications for Sewers."

Netting Systems

End-of-pipe and in-line netting systems can be used to capture floatables before they enter the receiving waters. Currently, netting systems are available commercially, and consist of mesh nets that are suspended downstream of a CSO and capture floatable material as the CSO discharges into the receiving water. Alternatively, netting systems also have been proposed as in-line units where the nets are housed in a vault structure in the CSO discharge conduit. Figure D-6 in Appendix D illustrates a netting device for both in-line and shoreline applications.

Two end-of-pipe netting systems currently are used in Brooklyn, New York and Newark, New Jersey. Typically, each bag is designed to hold about 25 cubic feet of floatables by volume and 500 pounds by weight. The bags are removed from the frame by a hoist or crane system and disposed. Typically, these bags are designed to hold floatables for one or more storms. There are no known examples of in-line, vault installations of nets.

Factors such as the CSO discharge velocity and receiving water currents can influence the effectiveness of end-of-pipe netting systems. In Philadelphia, river bank access restrictions limit the feasibility of end-of-pipe installations (similar to booms) in most conceivable situations. In-line netting systems likely are more suitable for most locations.

Typical purchase, construction and installation costs for the commercially available netting systems are in excess of \$150,000 per site. Obviously, this technology cannot be considered further as a minimum, non-capital intensive control measure under the NMC process.

Swirl Concentrators

Swirl concentrators are compact solids separation and flow throttling devices that provide solids and floatables removal for combined sewers. Flow that enters the swirl concentrator is directed around the perimeter in a long swirling flow pattern. Solids are separated by gravity along the outer flow path, inertial and shear forces between the inner and outer swirl paths, and drag forces along the walls and bottom of the unit. Solids are concentrated inward towards the center of the unit, exiting at the base through a foul sewer and carried to the treatment plant. The clarified flow is discharged through the top of the chamber into the receiving waters. Floatables are collected at the surface of the unit with a floatables trap and then discharged through the foul sewer.

Three types of swirl concentrators have been developed for high-rate CSO treatment. They are the EPA Swirl Regulator/Concentrator, the British Hydro-Dynamic Separator, and the German Vortex Separator. The devices are illustrated in Figures D-7 through D-9 of Appendix D. Although they appear different, these vortex devices operate similarly and have the same mechanisms for solids removal. Costs for a typical swirl concentrator installation in Philadelphia likely would exceed \$250,000 per location.

Swirl concentrators are advantageous because they regulate both flow to the interceptor system and remove floatables and solids from the CSO discharges. However, the installation cost of swirl concentrators is significantly more expensive as compared to other floatable control technologies and they must be eliminated from consideration as a minimum, non-capital intensive control measure.

Screens

Screens can be used to capture solids and floatables from CSO discharges. They typically are designed as stationary units that collect debris which is then scraped off or may be designed as a rotating mechanism where debris is removed by spray jets. There are many types of screens available including drum screens, microstrainers, rotostrainers, disc strainers, rotary screens, and static screens. Bar screens are used for CSO treatment to retain large debris and floating material; however, they are not effective in reducing solids. The proper installation of screens

would require significant structural alterations to regulators and outfalls in almost all conceivable applications in the City. Costs for a typical installation likely would range from \$20,000 per location for static or bar screens to in excess of \$100,000 - \$200,000 for mechanical screen devices.

Static screening devices, in addition to imposing a significant capital cost for design and installation, are expensive to clean and maintain. Although the majority of mechanical type screens provide better removal efficiencies than static screens, mechanical screens are considerably more costly and require a higher level of sophisticated maintenance. Because it is not known if there is a significant contribution of floatables from CSOs in Philadelphia, and the intent of the NMC is to readily implement low cost, low maintenance alternatives, mechanical screens will be eliminated from further consideration as a minimum, non-capital intensive control measure.

Figure D-10 in Appendix D shows a typical static screen installation.

Trash Racks

Trash racks are vertical bars that can remove coarse and floating debris from CSOs. Adequate outfall pipe or land space is essential. The outlet must be placed above the water level in the receiving water body to facilitate required maintenance and cleaning. A typical trash rack installation is illustrated in Figure D-11 in Appendix D.

Factors such as the CSO discharge velocity and receiving water currents can influence the effectiveness of trash racks as an end-of-pipe technology. In addition, access to maintain these structures along the river bank is limited. Overcoming these problems would require significant expenditures of funds. The proper installation of racks would require significant structural alterations to regulators and outfalls in almost all conceivable applications in the City. Costs for a typical installation likely would exceed \$20,000 per location. As a result, trash racks are not considered a practical minimum, non-capital intensive floatables control technology for Philadelphia.

6.4 SENSITIVE AREAS ANALYSIS

The classification of environmentally sensitive areas is a critical factor in determining where, and to what degree, CSO controls will have to be implemented in the Philadelphia area. The definition of environmentally sensitive areas for the purposes of defining CSO control strategies will be governed by a potentially wide range of concerns. These areas of concern might include the locations of:

- Public drinking water, agricultural, and industrial-use water intakes;
- Ecologically sensitive areas in the upper Delaware estuary used by finfish and shellfish as spawning and nursery areas;
- Fishing and primary and secondary contact recreation areas, likely will be important issues, especially in light of the DRBC's Use Attainability studies (USA) results, and their potential effects on new requirements on discharges to segments 2, 3, 4 and 5 of the Delaware River;
- Other high public visibility and aesthetic impact areas concerns, particularly in areas of the expanding waterfront development along the Philadelphia shores of the Delaware and Schuylkill Rivers and the park areas along the creeks within the City.

The PWD is developing a sensitive areas inventory and a set of resource interpretive maps using the CSO project GIS and available resource mapping and environmental data. While the sensitive areas analysis is being conducted under the auspices of the Long Term Control Plan, the task was begun early in the overall CSO compliance process to facilitate both the development of the System Inventory and Characterization and the Documentation of the Nine Minimum Controls. Tasks completed to-date include: the acquisition of most of the required GIS facilities; the assemblage of the base-mapping geographic information; acquisition of basic geopolitical, land use, transportation, watercourse, demographic and water utility coverages; mapping of the interceptor and CSO locations, with approximately 50% of the locations verified using a satellite-based Geo-positioning System (GPS); and acquisition of regional domestic, commercial and industrial water intakes.

The following information is being sought and still must be incorporated to complete the GIS inventory: biological resource mapping information from local research literature; the newly

developed living resource inventory of the Delaware Estuary Program; NOAA marine resources maps; the National and state wetlands inventory; DRBC water intake maps and data; state and local agency recreational resource maps; and other sources as available.

Once the data acquisition and assimilation is complete, quantitative and qualitative geo-analyses will be employed to propose the assignation of "sensitive area" status to various regions of the receiving waters and near-adjacent areas and will identify critical CSO discharge impact zones for use in planning the protection of these resource areas. The EPA draft CSO Guidance for Screening and Ranking will be used in conjunction with the geo-based analyses to establish CSO control priorities and to rank CSOs within the PWD combined sewer system for allocation of limited resources. The screening process will be based on fundamental information retrieved from the GIS to rank the degree of actual or potential water resource problems or impacts associated with the CSOs. It is expected that the initial round of analyses will be completed in the spring of 1996.

6.5 RECOMMENDATIONS

As the next phase of the implementation of solids and floatable controls, it has been recommended that a monitoring program be implemented to determine the amount of solids and floatables entering and carried by the combined sewer system and the receiving waters. Results from the sampling program will be used to determine the required level of control and appropriate technology for implementation both prior-to and during the Long Term Plan process. The results of the sensitive areas analysis are expected to have prioritized areas for potential concerns regarding solids and floatables and will therefore set the priorities for the locations of the monitoring sites.

Floatables will be monitored under current operations and maintenance conditions. If significant solids and floatables are identified, more comprehensive best management practices (BMPs) or non-structural controls may need to be implemented. If additional floatables control is warranted, then structural technologies will be considered. Structural technologies that would be considered first are catch basin modifications, including further enhancement of inlet grating and submerged outlet installations, netting systems, and static screens. More structurally intensive controls would be considered only if the application of the controls mentioned above proved not to be feasible under specific site requirements.

Solids and floatables monitoring will continue throughout the CSO abatement program. Monitoring will cease after two years if reports indicate acceptable levels of solids and floatables. The control technologies implemented at this time will continue to ensure that floatables and solids are within acceptable limits.

Figure 6-1 illustrates an implementation flow schematic of the proposed monitoring program.

Figure 6-1
Proposed Floatables Monitoring and Control Flow Chart

Section 7

Minimum Control No. 7

Pollution Prevention Programs

7.1 GENERAL

Pollution prevention programs can help to reduce the amount of contaminants and floatables that enter the CSS. Such measures include street sweeping, catch basin cleaning, litter control, public education, etc. Philadelphia has implemented a number of pollution prevention programs and established city ordinances that address these concerns. This section presents an overview of the City's existing pollution prevention methods.

The effectiveness of these programs is demonstrated by the lack of any reported receiving water impacts related to CSO discharges. However, modifications to these programs may be considered if the DRBC or PWD's proposed Floatables Control Monitoring Program identifies any receiving water impacts in the future.

7.2 EXISTING PROGRAMS AND ORDINANCES

Most of the city ordinances related to this minimum control are housekeeping practices that help to prohibit litter and debris from actually being deposited on the streets and within the watershed area. These include litter ordinances, hazardous waste collection, illegal dumping policies and enforcement, bulk refuse disposal practices, and recycling programs. If these pollutant parameters eventually accumulate within the watershed, practices such as street sweeping and regular maintenance of catch basins can help to reduce the amount of pollutants entering the combined system and ultimately, the receiving water.

Litter Control

The City of Philadelphia has comprehensive ordinances that regulate various aspects of litter generation. These contain provisions for proper litter disposal into trash receptacles, controls on handbills and posters, vacant property cleanup, and requirements for maintenance of private property to avoid unsightly conditions.

To assist in litter control, the City places trash containers in the downtown area and at most public parks where the greatest accumulation of litter is expected.

The City has long realized that litter-free neighborhood streets are very much a function of attitude and behavior. Anti-litter campaigns, such as PhilaPride sponsored by the Greater Philadelphia First Corporation, are efforts to change the attitude of people throughout the City.

Recycling Programs

Recycling programs can help reduce the amount of floatables, especially plastic and aluminum cans and bottles, that can enter the combined sewer system through catch basins. The City of Philadelphia has a curb-side recycling program that accepts glass and metal food and beverage containers and newspapers. In addition, many other forms of recyclable materials are collected by the City at a large network of recycling igloo sites, commercial recycling centers, and community recycling centers.

Hazardous Wastes/Illegal Dumping/Bulk Disposal

Hazardous waste in the CSS can come from two sources; illegal dumping or draining of house-hold and industrial wastes and auto wastes. Philadelphia has a hazardous waste collection program that collects hazardous waste at a specified site on advertised days. Illegal dumping policies also are enforced regularly by the City agencies such as the Streets, Police, Parks, Health, and Fire Departments.

Information regarding the proper disposal of household hazardous waste and the dates and locations of the household hazardous waste events will be inserted in the September 1995 water and sewer bills in the form of a brochure. Approximately 500,000 water and sewer customers

receive this information. Similar brochures will be included with bills from time-to-time in the future, with the next one scheduled for spring of 1996.

Inappropriate disposal of bulk items can also be a source of pollutants within the City. Philadelphia provides residents with the opportunity to have these items picked up by appointment. In addition, illegal dumping regulations prohibit the disposal of these items at any location except by approved methods.

Street Cleaning

Street cleaning prevents waterborne litter, debris, and sand deposited on city streets from entering catch basins and the combined sewer system. The City's regular street cleaning program consists of daily cleaning of commercial areas and annual cleaning of residential areas. Note that in residential areas, the City relies primarily on the efforts of the residents to clean their street frontages. This effort is supported by the Streets Department through the Philadelphia More Beautiful Committee and the Clean Blocks Program and by the Water Department through the Captain Sewer Club.

The Captain Sewer Club distributes educational materials and cleaning tools to block captains who "guard" the inlets on their block. Approximately 600 block captains have been recruited to-date. Weekend residential clean-ups are scheduled regularly through community organizations and block captains. Brooms, shovels, and bags are distributed to assist residents in cleaning their sidewalks and streets. Special truck pickups also are scheduled for these weekends.

Catch Basin Cleaning

As discussed in Section 6, the City of Philadelphia is fortunate to have a system of trapped storm sewer inlets. Trapped stormwater inlets must be maintained in order to prevent flooding and pollution. Catch basin cleaning is performed year round unless frozen conditions occur, which prohibit the cleaning of the catch basin sumps. The objective of the existing Water Department inlet cleaning program is to service each of the City's some 84,000 inlets at least once annually. However, some inlets are visited more frequently in response to complaints from community residents. Clogging inlets have always been and will continue to be

a priority. The City recently has committed to increasing the current level of inlet cleaning by 20% as part of the City's stormwater NPDES permit.

7.3 POLLUTION PREVENTION PROGRAM BENEFITS

As mentioned previously, existing pollutant prevention programs appear to be adequate as no deleterious wet weather receiving water impacts have been reported as a direct effect of Philadelphia's CSOs. While the Commonwealth's 1994 Water Quality Assessment Report indicates that only about 5 miles of receiving waters are degraded in some part by CSOs in the entire lower Delaware River basin, this reporting is based on evaluated information, not from monitoring data. It is difficult to quantify the benefits achieved by each individual prevention practice, but in total the program is considered effective. It has been recommended that the City implement a monitoring program under the Floatables Control minimum control measure to establish if there is a floatables problem associated with Philadelphia CSOs. If floatables or other receiving water impacts are noted, the City could consider enhancements to these pollution programs.

7.4 EXISTING PUBLIC INFORMATION AND EDUCATION PROGRAMS

Educating the public about CSOs and the receiving water impacts can reduce pollutants and floatables entering the receiving waters from CSOs. Public education programs are a potential method of reducing the amount of litter and contaminants on the streets and ultimately the amount of floatables and pollution in the receiving water. Documents (i.e., brochures, newspaper, etc.), television, and radio can be used to educate and encourage the public to properly dispose of all municipal and hazardous wastes.

The City has developed a very proactive approach to employing public information and education as a method of reducing sources of potential contaminants in runoff waters. For instance, the City has supported and developed many public awareness campaigns to reduce litter in the past. The City Water Department, in coordination with the Streets Department and appropriate private organizations, is developing an anti-litter/anti-dumping public education program with the objective of tying together the related problems of litter and dumping to potential water pollution. Currently, as part of the City's stormwater NPDES permit process, this program is targeting specific sections of the City served by separate storm water systems.

During the term of the current CSO NPDES permits, this program will be expanded to include areas of the City served by combined sewer systems.

The City is now participating in a program in the Pennypack Park Watershed area. Together with the Friends of the Pennypack Park and the Delaware Estuary Program, the City has embarked on a program to educate local residents about litter, dumping, and stormwater contamination and related potential receiving water pollution. A turtle logo has been spray-painted on 300 of the Pennypack storm water inlets. Brochures and other materials were developed and distributed that explain the turtle, a symbol of aquatic life, and the importance of keeping trash and other potential stormwater contaminants out of the storm sewers. This program also involves presentations to local organizations and schools.

This Pennypack program is being evaluated and may serve as a model for similar education efforts in other parts of the City. The City appreciates the importance of local volunteer efforts and is seeking partnerships with watershed groups and other local organizations to improve public awareness of the litter/stormwater connection.

The City's public education programs to combat litter will be supported by continuing efforts by the Streets Department to improve trash collection by both private haulers and City personnel.

The City also has developed a public education initiative to persuade the public not to use the sewer inlets as trash receptacles. On an annual basis, the Water Department distributes water and sewer bill brochure inserts explaining the proper use of inlets. This campaign also is supplemented by the use of truck posters on PWD vehicles, public service announcements and articles in local newspapers, usually featured in the Fall when leaves are the greatest contributor to the clogging of inlets.

The City's efforts to address the misuse of sewer inlets for the disposal of wastes also has been focused on school children. The Public Affairs Division of the Water Department has created a superhero mascot, Captain Sewer whose exploits are documented in a comic book. An educational pamphlet also has been developed. Captain Sewer himself, a costumed Water Department employee, makes school and other public appearances to educate children about the problem of litter and clogged inlets.

The City will continue to provide public information about litter and stormwater inlets as part of its implementing this minimum control.

7.5 PROPOSED PUBLIC INFORMATION AND EDUCATION EFFORTS

The Public Affairs Division of the Water Department will conduct eight new public education initiatives in direct support of this minimum control and the eighth minimum control (Public Notification). These include:

- Developing a comprehensive educational package to include:
 - General information on the City's combined and separate sewer systems
 - Maps of the sewer systems and the locations of CSOs
 - Explanations of the EPA national CSO Policy and the Nine Minimum Controls
 - Tips on what citizens can do
 - A CSO/stormwater newsletter (by November-December, 1995)

- Develop materials for and set-up meetings with City Council members, friends groups, Environmental organizations, etc. (begin by January 1996)

- Media workshops focused on expected environmental improvements associated with the City's CSO program (January, 1996)

- Produce newsletters twice each year for sewer shed areas served by combined sewer systems (Fall and Spring editions)

- Set up community CSO workshops with friends groups (Spring 1996)

- Produce bill stuffers for stormwater (August 1995), CSOs (December 1995), Household Hazardous Waste Programs (September 1995 and March and May 1996)

- Work with local newspapers to develop articles to discuss general awareness of CSOs and their potential impacts on receiving waters and the potential impact within the regional receiving waters

- Expand the mission of the City's existing Stormwater Advisory Committee to integrate CSO issues and work with the Committee to set CSO education priorities and objectives.

Section 8

Minimum Control No. 8

Public Notification

8.1 GENERAL

Public notification programs are intended to ensure that the public receives adequate information about combined sewer overflows, the locations of the outfalls, the magnitude of the discharges, and potential impacts on receiving waters. The principal benefit of a notification program is to reduce the potential public health risks in affected areas and to increase public awareness of CSOs. The methods used are intended to be the most cost effective measures that provide reasonable assurance that the affected public will be informed in a timely manner.

The PWD has stenciled identification letters and numbers on each of the CSO outfalls in the City as discussed in the System Inventory and Characterization Report (PWD May 1995). This signing has occurred mostly along the shoreline, in a visible position, at each of the CSO outfalls in the combined sewer system. Other methods to notify the public about the CSO discharges are discussed herein.

8.2 DISCUSSION OF PROPOSED NOTIFICATION MEASURES

The guidance manual suggests several methods (in addition to outfall postings) to inform the public about CSOs and receiving water use restrictions due to CSO discharges. These methods include:

- Posting at Use Areas Affected
- Posting at Selected Public Places
- Notices in Newspapers or on Radio and TV
- Letter of Notification to Affected Residents
- Telephone Hot Line for Use Status Reports

These notification methods are intended to provide the public with "realtime" information on the status of the receiving waters and uses. In areas with large receiving waters like Philadelphia, when the CSO discharge stops, the flushing action of the river moves the pollutants downstream at any one location. Accordingly, the impact at a particular river use point is short lived. Experiences in attempting to provide this type of realtime notice elsewhere in Pennsylvania have proven cumbersome and ineffective at best. In addition, in Philadelphia, there are few established receiving water uses, such as beaches, which are shoreline oriented where postings are appropriate for informing the public about the risks.

Under these affected use/area conditions, it becomes difficult to properly inform the public about the current status of the receiving water impacts except from a general information/education standpoint. As discussed in Section 7, the City intends to develop a series of informational brochures and other materials about its CSO discharges and the potential receiving water impacts. The brochures will provide a telephone number where additional information can be provided by City personnel. The brochures and other proposed materials and actions also will discuss potential direct receiving water impacts (such as fish kills, floatables, etc.) and will request that the public report these incidences as part of the City's CSO documentation and NMC effectiveness monitoring program. In addition, the PWD intends to recruit and solicit the support of watershed groups, enlisting volunteers to act as the Department's "watchdogs" for specific waterways, aiding the Department in getting out targeted CSO information specific to those watersheds.

8.3 SUMMARY

The City's Public Notification Program, to meet the NMC, will consist primarily of public education about CSO discharges and their impacts. As mentioned above, "real-time" notification of the receiving water impacts or use restriction during the activation of the CSO discharges is not feasible (due to its transient and intermittent occurrences). Accordingly, the City will rely on a general education program to keep the public aware of any potential public health risks and will concentrate its energies and resources on the pollution prevention aspects of CSO remediation through education and the requisite changes in lifestyle. The eight-point public information and education program detailed in Section 7 will be used to carry the message of this issue to the public.

Section 9

Minimum Control No. 9

Inspection/Monitoring/Reporting

Monitoring and characterization of CSO impacts from a combined wastewater collection and treatment system are necessary to document existing conditions and to identify any water quality benefits achievable by CSO mitigation measures. This NMC measure requires the development and implementation of an acceptable program for characterization, monitoring and reporting of CSS conditions and CSOs. Elements considered under this measure include:

- Identification of CSO locations in the combined sewer system (CSS)
- Characterization of overflow events including the locations, frequencies and volumes
- Summary of receiving water quality data
- Identification of receiving water impacts directly relatable to CSOs
- Assessments of the relative effectiveness of implementation of the minimum control measures
- Development of the long term monitoring plan for the Long Term Control Plan (LTCP)

The City of Philadelphia has addressed directly and adequately all of these issues. The issues related to water quality, at least for the present time and the near future, are addressed cooperatively with the DRBC as part of the basin-wide water quality strategy.

The PWD's Monthly CSO Status Reports provide information regarding rainfall, inspections and maintenance, dry weather discharges, wet weather overflows, and chronic or continuous discharges. The PWD System Inventory and Characterization Report (PWD May 1995) completely described the CSS and the locations of the CSOs. The PWD Hydraulic

Characterization Report (PWD June 1995) provided a detailed assessment of the natures, causes, location, number, frequency and volume of CSO discharges in the Philadelphia CSS.

This report has supplied the methods and basis for assessing the relative effectiveness of implementation of a number of the NMCs. The City's excellent computerized O&M tracking system described in Section 1 and the sophisticated and expanding flow monitoring systems referenced in Section 5 (and documented in the System Inventory and Characterization Report) provide the basis to track, document and quantify the performance of the City's O&M activities (NMC No. 1) and the compliance with the prohibition of dry weather overflows (NMC No. 5). The hydraulic and hydrologic models of the City's CSS were used to characterize and quantify the relative effectiveness of implementation of NMC No. 2 and NMC No. 4 in Sections 2 and 4 of this report. Analyses performed for and presented in Section 3 of this report supplied a basis for assessing the potential for modifications to the City's pretreatment program to reduce industry-related impacts on CSO discharges.

Section 6 of this report suggests that a floatables monitoring program should be put in place to provide the basis for judging the need for solids and floatables control devices, and if required and installed in sensitive areas, the effectiveness of such devices.

These same tools and measures will be employed each year in the preparation of the Annual CSO Status Report. The progress of the NMC measures will be tracked using these methods, and others that no doubt will evolve over time, and will be reported in the Status Report. Tactical changes and adjustments in the NMC implementation process also will be proposed in the Annual CSO Status Reports.

Appendix A-1

Summary of Training Programs and Materials

1. Programs Offered by Training and Development
2. Video Tape Offerings
3. Audio Tape Offerings
4. Manuals

Appendix A-2

Summary of Field Report Forms & Managerial Reports

I. Field Report Forms:

- A. Flow Control Unit, CSO Maintenance Group
 - 1. Somerset Grit Chamber Debris Removal
 - 2. Brown and Brown Regulator PM/Inspection
 - 3. Tide Gate Preventative Maintenance Report
 - 4. Outfall connection Inspection Record
 - 5. CSO Dry Weather Discharge Report
 - 6. Flow Control Daily Work Report
 - 7. Daily Work Sheet DataBase Entry Listing (Interceptor Maint)

- B. Flow Control Unit, Pumping Station Maintenance Group
 - 1. Station Outage/Discharge Report
 - 2. Wastewater Pumping Maintenance Request
 - 3. Instrumentation Monthly Preventative Maintenance Report
 - 4. Vibration History Report
 - 5. Pump Flow Timings Record
 - 6. Pump Overhaul Report
 - 7. Motor Overhaul Report
 - 8. Pump Station Monthly Mechanical PM Report
 - 9. Pump Station Monthly Electrical PM Report
 - 10. Central Schuylkill PS Daily Station Record
 - 11. Flow Control Daily Work Report
 - 12. Daily Work Sheet DataBase Entry Listing (WW Pumping Unit)

- C. Flow Control Unit, CSO Instrumentation Group
 - 1. ADS Ultrasonic Level Monitor Site Calibration Report
 - 2. Pressure Sensor Level Monitor Site Calibration Report
 - 3. Computer Control Chamber PM Report
 - 4. Township Metering chamber Equipment PM Report
 - 5. Metering Chamber Calibration Record
 - 6. Computer Control Chamber Calibration Record
 - 7. Flow Control Daily Work Report
 - 8. Daily Work Sheet DataBase Entry Listing (Instrument Maint)

- D. Sewer Maintenance Unit
 - 1. Sewer Maintenance Work Order Ticket

- E. Inlet Cleaning Unit
 - 1. Inlet Maintenance Work Order Ticket

Appendix A-2 (continued)

Summary of Field Report Forms & Managerial Reports

II. Managerial Reports:

- A. Flow Control Unit, CSO Maintenance Group
 - 1. CSO Monthly Inspection\Discharge\PM Report
 - 2. Regulating chamber Monthly Inspection Totals
 - 3. CSO Inspections 1989 to 1995 Totals
 - 4. Annual Report Blockages\Inspection Trend Report
 - 5. Collector System CSO Alterations Record
 - 6. Monthly CSO Status Report *

- B. Flow Control Unit, Pumping Station Maintenance Group
 - 1. Dry Weather Discharge Report (Pumping Stations)
 - 2. Station Outage & Dry weather Discharge Record
 - 3. Pump Station Control Level Settings
 - 4. Monthly Pump Run Time Readings
 - 5. Year-To-Date Run Time Report
 - 6. Main Pump Flow Capacity Test Report
 - 7. Pump Performance Report
 - 8. Monthly Flow Report
 - 9. Record of Pump Performance Test
 - 10. Main Pump Unit Out of Service Hours
 - 11. Main Pump Availability History Report
 - 12. Wastewater Pumping Fiscal Year Overhaul Schedule
 - 13. Flow Control Database (Pump Station Maintenance)

- C. Flow Control Unit, CSO Instrumentation Group
 - 1. Temporary Site Meter Request
 - 2. Temporary Level/Flow Monitor Site Record
 - 3. Flow Control Database (CSO Instrumentation)

- D. Sewer Maintenance Unit
 - 1. Sewer Maintenance Work Order Ticket (SMOIS)

- E. Inlet Cleaning Unit
 - 1. Inlet Maintenance Work Order Ticket (SMOIS)

*Note: Due to its length, a copy of this report is not included in this appendix. Copies are

submitted monthly to PA-DEP and US-EPA Region III.