There are bar screens located on the influent side of the building to prevent trash and debris from entering the pumps. Entrance to the bar screens is through the steel Bilco door located on the control level.

The wet well is a confined space. Confined Space Entry Procedures must be followed in these areas.

4.2.5 Combined Sewer System

As mentioned above, about 60% of the collection system within Philadelphia is comprised of combined sewers with the balance being serviced by separate sewers. The combined sewers and interceptors have been designed to convey all dry weather flow to the WPCPs while bypassing flows greater than this to adjacent surface waters. This arrangement provides treatment for all dry weather wastewater flow, a majority of the stormwater runoff that results from small storms, and the first flush runoff of larger storms. Occasionally, malfunctioning regulators or choked effluent sewers, which connect the regulator chambers with the intercepting sewers, cause minor discharges of dry weather flow through the outfall sewers directly to the receiving stream. The operational status of the regulators and inspection results are reported to PADER in PWD's monthly Interceptor Report. As detailed in Section 2.4.5 Current Studies/Pending Legislation of this report, there are currently several studies underway to determine the impact of these wet weather overflows on the receiving waters, including one for the Delaware Estuary by the Delaware River Basin Commission. Also discussed in Section 2.4.5, new Combined Sewer Overflow (CSO) regulations are expected that will impose further restrictions on the combined sewer system.

Wet weather overflows are inherent in the concept of a combined sewer system, and are a product of the design and purpose of the system. Without the relief provided by the regulator chambers, many areas of the City would experience severe flooding during significant rain events, there would be excessive flows within the collection system, and wastewater would pass through the treatment plants without receiving adequate treatment. The combined system also provides for the treatment of stormwater runoff for many small storms that are not large enough to produce flows which exceed the capacity of the interceptors and the first flush of the larger storms by diverting those small flows to the WPCPs. The highest concentrations of pollutants in urban runoff are reported to be carried off in these small storms and first flushes. The quantity of wet weather overflow depends on the intensity and duration of the storm event, stream tide levels, and background dry weather flow quantities.

Flow through Philadelphia's combined sewer system is controlled by the 175 regulating chambers and 23 diversion chambers located throughout the interceptor system. The basic function of each regulator is the same; however, the goal is achieved through several different methods by the six types of regulators that are utilized by PWD. Basically, the regulator is designed to divert all dry weather flow within the combined sewers to the interceptors and then to the water pollution control plants for treatment. During wet weather events, as the hydraulic capacity of the interceptors is reached, the regulator diverts excess flow to adjacent surface waters. As the storm flows subside, the regulators discontinue direct discharge to the adjacent surface waters and contain all of the flow within the combined sewer system. The breakdown of the types of regulators and the extent of their respective use in service within the Philadelphia system is presented here:

Regulator Types In Use In Philadelphia:

Regulator Type	Number in Service
Slot	69
Brown & Brown	72
Manual Gate	4
Dam	8
Water Hydraulic Cylinder	14
Computer Controlled	8
Total	**175**

Detailed lists of the locations of the discharge points are included in the NPDES permit documents included in Appendix H.

The slot, dam, and manual gate regulators have a preset discharge opening to the interceptor system that does not change as the stormwater and wastewater flows vary. The preset opening is normally set to allow only the amount of flow that the receiving interceptor can hydraulically convey. The Brown & Brown and water hydraulic cylinder regulators are mechanically controlled to vary the flow diverted to the interceptor system and receiving waters as the stormwater and wastewater flow varies within the system. The controls are set to limit the flow to the interceptor system to flows which it is hydraulically capable of passing. Each system is equipped with a backflow preventer to ensure against contamination of the potable water system. Additionally, in the late 1970s, the PWD constructed three prototype computer controlled regulator chambers in the Northeast Drainage District (Magee, Dark Run Lane, and Ash) as an experimental program.

In response to the Consent Decree Agreement between the U.S. Environmental Protection Agency, Delaware River Basin Commission, Sierra Club of Maryland and Pennsylvania in 1978, five additional regulators were automatically controlled by computer as part of the $1.8 million CSO automation project for the Northeast drainage basin. These regulators are controlled by a local programmable logic controller (PLC) and are monitored by a centralized computer center at the Collector System Headquarters in order to minimize dry weather overflows and increase the storage capacity of the trunk sewers, thus reducing the amount of wet weather overflow during significant storm events. Each PLC monitors flow levels in the trunk, effluent, and outfall sewers at the regulator and automatically adjusts the discharge openings to the interceptor sewers and outfalls to minimize wet weather overflow. Also, as part of this project, sewer flow level monitors were installed at 45 regulator chambers within the Northeast Drainage District. The data from these CSO monitoring sites is used to indicate when the regulators and tide gates are malfunctioning and alert maintenance personnel of the need for repair. By identifying malfunctioning regulators, this system could minimize the effort spent on inspecting good order regulators, which occurs under the current regularly scheduled maintenance program in the Southeast and Southwest Drainage District. In August 1990, the PWD began to use the computerized data from the Northeast CSO Automation Project to dispatch maintenance crews to suspected trouble spots. At this time, the program remains in the developmental stage and has resulted in mixed success. If data reliability can be improved, this system may become more attractive and expanded in light of the potential regulations for wet weather combined sewer control.

Although there has not been a comprehensive hydraulic analysis of the effect of the automated computer system on the quantity of wet weather overflow, it has been noted by the PWD that the in-line storage levels within those computerized trunk sewers already involved has increased dramatically.

As another element of the CSO system, 24 rain gauges have been installed throughout the City in order for PWD to monitor storm events and eventually estimate the amount of wet weather overflow from the combined system. Data collected from these gauges will assist in developing a program to maximize the amount of in-line stormwater storage and reduce the amount of flow discharged to the adjacent surface waters.

Eighty-nine of the regulators in the Philadelphia combined sewer control system are tidally affected and have tide gates that control the direction of flow, depending on the depth of tide. In the past, inflow at some of these tidally affected regulators has been a problem, transmitting river water to the water pollution control plants. These tide gates currently serve a dual purpose, to prevent the discharge of dry weather flow to the receiving streams and to prevent river water from entering the collection system during high tides. Most tide gates have emergency overflow weirs above the gate to allow the discharge of stormwater in the event of a hydraulically surcharged or malfunctioning tide gate. In the future, these tide gates may be utilized to increase trunk sewer storage during wet weather events.

The breakdown of the types of tide gates in service within the Philadelphia system is presented below:

Name	Number of Sites	Number of Gates
Coldwell Wilcox Pontoon	36	65
Brown and Brown Cast Iron	33	38
Computer Controlled	8	10
Brown and Brown Timber	8	15
Water Hydraulic	3	3
Manual Gate	1	1
Total	**89**	**132**

4.2.6 Private Sewers

There are some sewers within the City that have never been recorded with, nor are considered owned by, PWD. Most of these private sewers were built on private property before the turn of the century and eventually tie into the City's wastewater collection system. Therefore, they are generally found in the older sections of the City in alleyways, cellars, and backyards. Concentrations of private sewers are found in the following areas:

- In North Philadelphia bounded by Girard Avenue on the south, Allegheny Avenue on the north, Front Street on the east, and the Schuylkill River on the west.

- In West Philadelphia bounded by Market Street on the south, 32nd Street on the east, 40th Street on the west, and the Pennsylvania Railroad Main Line on the north.

- In Northwest Philadelphia bounded by Cheltenham Avenue on the north, Germantown Avenue on the south, Cresheim Creek on the west, and the Reading Railroad on the east.

Since private sewers have never been recorded with PWD, it is difficult to determine the extent of these sewer lines; however, when compared to the size of the Philadelphia collection system the number of homes that are served by these sewers is minimal. Private sewers are generally brought to PWD's attention only when there is a problem with the line and citizens register complaints. Some private sewers have been eliminated with the demolition of older homes. However, some properties are being restored and the new owners are faced with the problems associated with antiquated, inadequate private sewers.

PWD does have an adequate policy which responds to private sewer situations periodically raised by residents and is implemented as these situations arise. Complaints concerning private sewers are taken by PWD's Customer Service Department, which issues a work order for a response to the situation. PWD maintenance crews are directed to inspect the sewer line in question to determine the cause and extent of the problem. PWD then notifies all users of the problem sewer line and their responsibility for repair of the sewer. If no action is taken by the residents, the PWD will contract with a private contractor experienced in such work and bill the residents for the services accordingly. Through this effort, the problem is rectified, service is restored, and the repair paid for by the those parties serviced by the sewer line.

Although these private sewer lines are connected to the public system, PWD does not own them and has no responsibility for maintaining them. These sewers cannot be incorporated into the public system because they do not meet the minimum standards for public sewers. They are not built in locations served for the construction of public sewers, do not have manholes, and are mostly 6-inch and 8-inch lines. Their location in backyards and other confined areas makes it impossible for PWD to clean them.

Construction of public sewers within bordering streets may not be a reasonable solution for the homeowner since costly reversal of internal plumbing is required to service the property.

4.2.7 Maintenance of the Collector System

The Philadelphia Water Department has a well established and effective maintenance program that provides inspections, evaluations, cleaning, rehabilitation, and repairs to the various components of the collection system through ongoing and preventive maintenance. Operation and maintenance of the collector system is the responsibility of the Waste and Storm Water Collection Group, which is comprised of the following units:

- Sewer Maintenance
- Inlet Cleaning
- Data and Flow Control
- Collector System Support

Repairs and maintenance beyond operational capability are recommended to the Planning and Engineering Division for inclusion in the Capital Improvement Program. The Planning and Research Unit then prioritizes and gives direction to this future work.

4.2.7.1 Sewer Maintenance

The Sewer Maintenance Unit is charged with the maintenance of the city-wide combined, sanitary, and stormwater systems and their appurtenant structures. Included in this category are all branch, interceptor, and main sewers; the maintenance of inlet laterals, inlets and manholes; cleaning and repair of drainage ditches and outlets; maintenance of drainage right-of-ways, and lands for public use; and CSO outlets. In addition to repairing sewers, much of the unit's work involves cleaning and clearing choked sewers using high pressure water jet machines, mechanical bucket machines, and rodder machines.

Cooperation with other City agencies and Department units is necessary in order to perform thorough investigations and prepare reports, on all sewer related conditions. In the past, Sewer Maintenance has examined branch and main sewers and prepared lists of sewers to be reconstructed, under the Sewer Reconstruction Program. If in preparation of the plans and specifications the Engineering Division requires more information, Sewer Maintenance conducts additional surveys and may even excavate the sewer to obtain the additional data. When new water main relays are to installed or the roadway is to be repaved, Sewer Maintenance will perform an inspection of the sewer in the area.

Customer Service uses the resources of Sewer Maintenance to solve drainage and flooding problems in building and private dwellings. The Construction Unit has found the TV capabilities of Sewer Maintenance a good way to document sewer conditions at the end of a job, or to locate defects in a sewer too small or too dangerous for physical inspection. Sewer Maintenance also works with the Distribution Unit on street cave-ins. The Unit follows up on repairs to the sewer and laterals where a water main break has caused sewer system damage, and backfills trenches. The Unit also works with Industrial Waste in performing investigations for cross connections, illegal discharging of fats and grease, or other materials that clog the sewers.

The Unit works with Vector Control Services of Philadelphia Department of Public Health in identifying breaks in the collection system, including private drainage systems, which may result in the issuance of a violation notice to the homeowner.

4.2.7.2 Inlet Cleaning

The Inlet Cleaning Unit is primarily responsible for the inspection and cleaning of 75,000 storm water inlets within the City. The Unit is also charged with the following additional responsibilities: retrieving and replacing inlet covers, installing original replacement covers, and installing locking covers; unclogging choked inlet traps and outlet piping so that inlets can take water; alleviating flooded streets and intersections when hydrants are opened during fire-fighting operations.

In order to insure the efficient operations of the City's inlets and connecting storm sewers, it is necessary to work with various units of the Department, as well as other City agencies. For example, close cooperation is maintained with Sewer Maintenance, since our functions are interrelated. The Unit is also called upon periodically by the Police Department to perform searches of inlets for various law enforcement reasons.

The Unit is also involved with the cleaning of choked sewer manholes and regulating chambers; and retrieving keys for the public. Referrals are made to Sewer Maintenance in connection with repairs to inlets, and flooded cellars in need of pumping due to clogged inlets.

The Unit's specialized cleaning equipment is also involved in assisting other City agencies with the cleaning of their inlets.

4.2.7.3 Data and Flow Control

The Data and Flow Control Unit is responsible for the operation, inspection, cleaning, maintenance, and repair of regulators, tide gates, diversion chambers, syphon valves, and related wastewater control devices. The Unit's area of responsibility cover all 175 combined sewer regulator chambers, 89 tide gates chambers and 23 division chambers within the City. These chambers are located along with Delaware and Schuylkill Rivers and Pennypack, Frankford, Tacony, and Cobbs Creeks. In addition, the Unit is available to respond to oil and chemical spills, fires or any other type of emergency involving the combined sewer regulator system.

Strict safety precautions are followed at all times. Regulator chambers are considered confined spaces. Thus, the employees of the Unit perform confined space entry work on a daily basis. They are continually exposed to the hazards associated with turbulent flowing water, domestic sewage, industrial wastes, oxygen deficiency, and toxic and explosive gases.

As a result of the recent merger with Data Acquisition, the Unit is now also responsible for: the Northeast CSO Control and Monitoring system, wastewater metering chambers, citywide rain gauge network, CCTV inspection equipment maintenance, and the calibration and repair of confined space gas meters.

4.2.7.4 Collector System Support

The Collector Support Unit works with other Departmental Units, various City agencies, and federal and state regulatory agencies, on projects related to waste and storm water collection. However, the primary function of the Unit is to provide technical expertise to the operating units, through engineering evaluations and studies. The major operating units within the Section are Sewer Maintenance, Inlet Cleaning and Data and Flow Control.

Collector Support is often requested to conduct engineering studies in order to resolve a problem that may be caused by age-related deterioration, past building practices, or new regulatory mandates. The study usually involves the development of a plan of action, coordination of physical and videotape inspections by operational forces, analysis of field data, and the preparation of a final report. The report normally includes alternative solutions and a recommended course of action.

Collector Support also investigates complex drainage and flooding problems. These investigations may involve the review of construction and return plans, analysis of historic data, citizen interviews, and surface and underground inspections of the collector system. The information gathered in the field is evaluated and then used to develop a plan for corrective action. The implementation of the plan often involves the coordination of repairs by operational forces or participation with the Design Branch in plan and specification preparation.

Collector Support conducts hydraulic analyses of the collector system through field surveys and theoretical and computer aided calculations. The installation of flow monitoring equipment is coordinated with the Data and Flow Control Unit. Afterwards, the data is reduced and analyzed, and a final report is prepared.

Major construction projects are coordinated with the operating units to ensure that construction activities do not adversely affect the operation of the existing collector system. When required, Collector Support coordinates the activities of the operational forces through project completion.

Collector Support is also responsible for management of maintenance contracts on collector system equipment. The contract documents and specifications are prepared by the Section and completed work is inspected to insure adherence to contract specification.

4.3 WATER POLLUTION CONTROL PLANTS AND SLUDGE PROCESSING

4.3.1 Northeast Water Pollution Control Plant

4.3.1.1 Ownership

The Northeast Water Pollution Control Plant (NEWPCP) is owned by the City of Philadelphia and operated as a self-supporting utility by PWD. PWD is responsible for planning, construction, operation and maintenance, budgeting, detailed cost accounting, and setting sewer rates.

4.3.1.2 Point of Discharge

NEWPCP is permitted to discharge treated effluent to the Delaware River (Zone 3 of the Delaware Estuary) from Permit Source 001, which is located at latitude 39°58'50.6" and longitude 75°04'34.9". National Pollutant Discharge Elimination System (NPDES) effluent limitations have been established for this WPCP and outfall in permit No. PA 0026689 which is included in Appendix H. Also included in this permit are 59 other discharge points that serve as combined sewer reliefs, necessitated by the collection of stormwater and sanitary sewage in a combined system as detailed in Section 4.2.5. These reliefs act to prevent a hydraulic overload of the collection system and NEWPCP. These discharges do not have specific effluent limitations; however, a discharge is permitted only when the collection system and NEWPCP maximum hydraulic capacities have been reached.

4.3.1.3 NEWPCP Effluent Discharge Limitations

As mentioned above, NEWPCP has been issued an NPDES Permit for the plant effluent and is responsible for complying with the effluent quality and quantity limitations established in that permit. The permit under which NEWPCP is currently operating expired on August 28, 1991. Provisions in this permit allow continued operation of and discharge from NEWPCP after this date. Permit limitations remain in effect until a new permit is issued, provided that a timely and complete permit application has been filed. The permit application and applicable fees were transmitted to PADER on March 21, 1991.

The permitted average monthly flow of effluent discharged from the NEWPCP shall not exceed 210 million gallons per day (mgd). The plant is to be operated to provide treatment for the maximum design wastewater flow of 315 mgd (maximum daily average) and 420 mgd (peak) without causing treatment process upsets. Throttling of influent flows to NEWPCP resulting in premature and avoidable sewer system overflows is prohibited.

A summary of the effluent limitations is presented in Table 4.3.1. The permit establishes specific monitoring requirements and effluent limits for BOD_5, suspended solids, first stage oxygen demand, fecal coliform, pH, zinc, Acrylonitrile, 1.2-Dichloroethane, Bis(2-chloroethyl ether) and Alpha BHC. Other parameters (i.e., TKN, Chloroform) are required to be monitored but do not have specific discharge limitations at this time. All parameters are reported in monthly Discharge Monitoring Reports (DMRs) submitted to PADER, EPA, and the Delaware River Basin Commission (DRBC).

The Delaware River Basin Commission has established enforceable BOD_5 limitations for Zone 3 of the Delaware River Estuary, into which NEWPCP discharges. The requirement includes an 86% of BOD_5 monthly average reduction from the influent to effluent. The percent reduction is calculated from analysis results of 24-hour composite samples of the influent and effluent. The influent sample must reflect the true characteristics of the raw wastewater and must not be affected by the plant recycle flows. Values reported in the DMR have been adjusted for recycle loads.

TABLE 4.3.1

NEWPCP NPDES EFFLUENT LIMITATIONS FOR POINT SOURCE 001

Discharge Parameter	Discharge Limitations						
	Mass Unit (lbs/day)			Concentrations (mg/l)			
	Average Monthly	Average Weekly	Maximum Daily	Average Monthly	Average Weekly	Maximum Daily	Instantaneous Maximum
BOD-5[1]	42,400	63,600		30	45		60
BOD-5 % Removals[1]	DRBC	Zone 3 Requirement		86% reduction			
Suspended Solids[1]	52,540	78,810		30	45		60
FSOD[2]	72,500						
Fecal Coliform (5/1 - 9/30)		See Footnote[3]					
Fecal Coliform (10/1 - 4/30)		See Footnote[3]					
pH	Within 6 - 9 Standard Units at all times						
Zinc, Total				0.250			0.500
Acrylonitrile						0.020	
1,2-Dichloroethane						0.500	
Bis(2-chloroethyl ether)						0.015	
Alpha BHC						0.010	

[1]In no case shall the arithmetic means of the effluent values of the BOD5 and Suspended Solids discharged during a period of 30 consecutive days exceed 14 percent and 15 percent, respectively of the associated arithmetic means of the influent values for those parameters during the same time period, except as specifically authorized by the permitting authority.

[2]FSOD - First stage oxygen demand (20 day Biochemical Oxygen Demand test with nitrogenous oxygen demand inhibited).

[3]Effective disinfection to control disease producing organisms during the swimming season (May 1 through September 30) shall be the production of an effluent which will contain a concentration not greater than 200/100 ml of fecal coliform organisms as a geometric average value, nor greater than 1,000/100 ml of these organisms in more than 10 percent of the samples tested.

[4]Monitor only required for: NH_3-N, TKN, NO_2-N, NO_3-N, Total Beryllium, Total Cyanide, Free Cyanide, Phenolics, Chlorobenzene, Chloroform, Methyl Chloride, 1,2-Transdichloroethylene, 2-Chlorophenol, Trichloroethylene, 3,3-Dichlorobenzidine, Phenanthrene, and Pyrene

Exceedances of the permitted effluent quantity and quality limits are reported to EPA, PADER, and DRBC in the monthly DMRs. All instances of exceedance in the past three years were related to O&M problems. Storm events precipitated some of the problems, causing CSO violations. During this period, there have also been problems associated with the grit chamber and the chlorination system. A detailed listing of these exceedances and causes thereof are shown in Appendix I.

Some other permit provisions that apply include requirements to operate an Industrial Pretreatment Program, management of toxic pollutants, and self-monitoring and reporting requirements.

NEWPCP has also had several plant upsets, interferences, or permit violations directly related to industrial user discharges to the sewer system. A summary of the Industrial Waste Unit (IWU) investigations of these incidents since 1989 is presented in Table 4.3.2. The preliminary treatment building (PTB) at NEWPCP is the first venting site along the sewer system for several industrial plants. Occasionally, volatile hydrocarbons have caused odors in the PTB. These odors are generally short-lived and result in restricted access to the building while the odor is present. These restrictions can impact the completion of maintenance operations in this area, but usually do not affect the treatment process or effluent quality.

The IWU has installed a gas chromatograph (GC) to identify the presence of 14 industrial chemicals in the sewer headspace in the PTB. The chemical identification can help pinpoint the source of the discharge based on industrial process information collected by the IWU. The IWU can then respond and inspect the suspected facility and require that the discharge be discontinued and information collected related to the release.

4.3.1.4 Municipal Wasteload Management Reports (Chapter 94)

Through Chapter 94 of PADER's Title 25: Rules and Regulations, the Commonwealth of Pennsylvania requires the owners and operators of sewage facilities to manage the wasteloads discharged to their facilities and prevent the occurrence of overloaded sewage facilities. If a facility is frequently overloaded, the regulations require a limitation on additional extensions and connections made to the system. To determine compliance with the requirements, each plant must submit an annual report that not only details and projects the loadings to be received by the treatment facility, but also describes the basis for the projections. The annual report must also present discussions of the condition of the sewer system, programs in place to monitor and repair the sewer system, the condition of sewage pumping stations, a description and map of all sewer extensions constructed in the past year, and a report of industrial waste discharge programs in place.

The annual report submitted by the PWD contains the information required by the Chapter 94 regulations. Presented here is a discussion of the hydraulic and organic overload determinations reported in recent Chapter 94 submissions. PADER's rules require graphs of hydraulic and organic loading from average daily data for each month over the past five years. They also require a projection of the anticipated loading for each of the next five years along with a

TABLE 4.3.2

INVESTIGATION SUMMARIES OF INDUSTRIAL RELEASES TO THE NEWPCP SEWER SYSTEM

BCM

Date	Source	Explanation
1989	Rohm and Haas DVI	DDT/DDD/DDE residues were identified in the NEWPCP sludge due to a build-up of contamination in the sewer system section. The sludge must be landfilled. Rohm and Haas has paid the disposal costs and is investigating remedial measures to clean up the sedimentation.
2/27/1991	Rohm and Haas DVI	A solvent odor in the PTB initiated an investigation of Rohm and Haas' discharge. An excessive discharge from a rail tank car overloaded their solvent separator, resulting in a release of a variety of alcohols and surfactants. No plant damage occurred, but access to the PTB was restricted. The company was fined for the incident.
3/04/91	Rohm & Haas DVI	Rohm and Haas reported a diisobutylene (DIB) and Xylene release to the IWU. The source was reported to be a hose that ruptured during product transfer. No damage to the plant occurred, but PTB access was temporarily restricted. Rohm and Haas was required to investigate the cause and develop methods to prevent a recurrence.
5/29/91	Allied Chemical	A solvent odor in the PTB initiated an investigation of the Allied Chemical discharge. The material released was believed to be cumene and may have resulted from maintenance of flow monitoring equipment. No plant damage occurred, but access to the PTB was restricted. No fine was levied for this incident.
10/31/91	Allied Chemical	A solvent odor in the PTB initiated an investigation of the Allied Chemical discharge. The material released was believed to be cumene and may have resulted from operations conducted to install new flow monitoring equipment or from start-up of a pretreatment air stripper. No plant damage occurred, but access to the PTB was temporarily restricted. A fine was levied for this incident.
12/3/91	Allied Chemical	A solvent odor in the PTB initiated an investigation of the Allied Chemical discharge. The material released was believed to be cumene. The cumene is suspected to have migrated into the sewer during heavy rains from a subsurface release.

discussion of the basis for the projections. However, PWD has not included the basis for projections in the annual report submission.

A hydraulic overload condition is identified by a comparison of the measured average daily flow with the average daily flow upon which the permit and plant design are based. The plant design criteria are included in Appendix J, Basis of Design for Water Pollution Control Plants. An overload condition exists when the recorded monthly average daily flow exceeds the permit and monthly design average daily flow for each month of a contiguous three-month period, or when the flow in any portion of the system exceeds its hydraulic carrying capacity, thus causing a bypass. The average daily flows for the 1992 fiscal year from July 1991 through March 1992 are presented in Table 4.3.3. As can be seen in this table, the average daily flows have recently been below the plant design flow.

An organic overload occurs when the average daily organic load exceeds the organic load capacity upon which the plant was designed. A comparison of the recorded BOD_5 loading at the plant versus the design BOD_5 loading can indicate whether the plant is overloaded.

The plant design BOD_5 loading is 510,000 pounds per day based upon an initial design concentration of 245 mg/l at a flow of 250 mgd; subsequently, the SPDC design was based upon a projected loading of 350,000 pounds per day at a flow of 210 mgd or 200 mg/l. The average daily BOD_5 loadings recorded for fiscal year 1991 are presented in Table 4.3.4, along with the flow and BOD_5 in mg/l. These values are consistently below the plant design loading. Projected values of the flow and organic loading are provided in Chapter 5.0.

4.3.1.5 NEWPCP Treatment Process Description

NEWPCP provides primary and secondary treatment for the raw wastewater entering the plant. This treatment is accomplished by passing the wastewater through a series of unit processes. Each designed to treat the flow so that the effluent ultimately meets the discharge criteria. A site plan of the NEWPCP which illustrates each of the unit operations is presented in Figure 4.3-1. Table 4.3.5, NEWPCP Process Evaluation Summary, provides a summary of the plant design criteria. The following discussion describes each unit process.

Wastewater Collection

The raw wastewater enters the plant from three collection system interceptors, including the Frankford High Level Interceptor, Somerset/Frankford Low Level Interceptor, and the Delaware Low Level Interceptor. The average influent flow from each interceptor for the month of April 1992 was 54 mgd, 36 mgd and 97 mgd, respectively.

Screening

The influent wastewater passes through bar screens that remove large suspended or floating objects in the wastewater. At NEWPCP, the bars are designed with one inch of clear space. Rakes are automatically timed to travel up the bar screens to remove objects caught on the bar

BCM

TABLE 4.3.3

FISCAL YEAR 1992 AVERAGE DAILY FLOWS FROM THE NEWPCP

Month/Year		Average Daily Flow (mgd)
July	1991	194.73
August	1991	198.77
September	1991	200.81
October	1991	197.99
November	1991	187.34
December	1991	205.17
January	1992	186.78
February	1992	184.59
March	1992	191.16
Average Flow		194.15

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BCM

TABLE 4.3.4

FISCAL YEAR 1991 AVERAGE DAILY BOD_5 LOADING TO THE NEWPCP

Month/Year		Plant BOD_5 Loading (lbs/day)	Flow (MGD)	BOD_5 (mg/l)
July	1990	232,348	214.39	147
August	1990	210,851	193.36	126
September	1990	201,604	212.81	163
October	1990	210,258	208.96	157
November	1990	244,979	205.72	156
December	1990	221,562	195.36	180
January	1991	215,427	203.39	182
February	1991	243,341	182.36	167
March	1991	274,660	200.81	174
April	1991	258,220	195.96	172
May	1991	251,034	191.72	158
June	1991	275,280	182.36	166
Average		236,630	198.93	164

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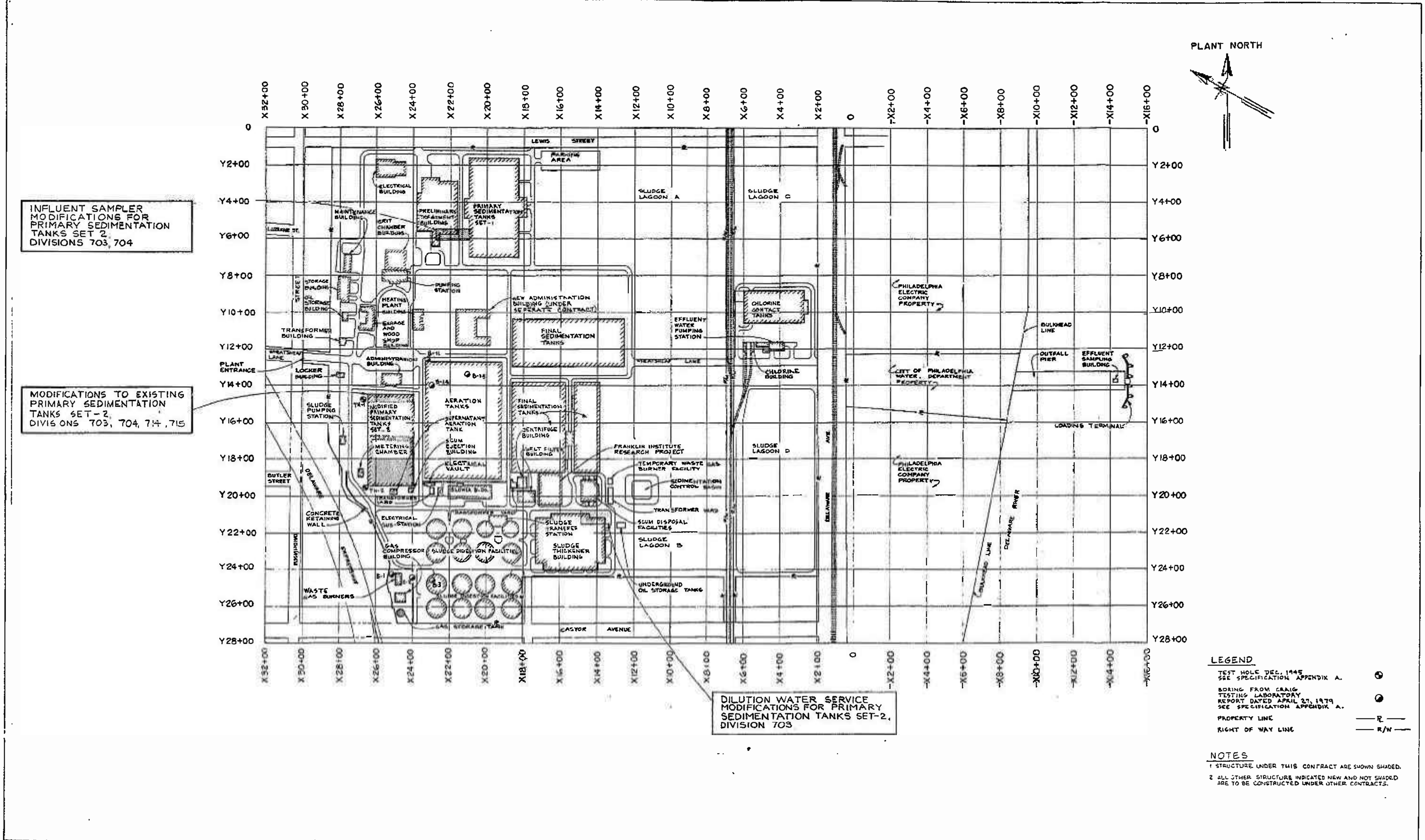
TABLE 4.3.5

NEWPCP PROCESS EVALUATION SUMMARY

Unit	Number	Dimensions	Existing Capacity	Design Parameter	NEWPCP Design Basis
Mechanical Sewage Screens	8	8 ft. channel width 1 inch bar spacing	1.70 cf/MG screenings removed	Bar spacing Velocity	1 inch 3.0 FPS minimum
Grit Removal	4	55' x 56'	6.4 cf/MG Grit removal	Velocity Maximum flow	---- 125 MGD each
Primary Sedimentation Set 1 Set 2	 8 4	 240' x 65 x 10' swd 250' x 125' x 10' swd	 105 MGD 105 MGD	Surface Loading Average Peak BOD removed	 840 gpd/ft^2 --- 22.5%
Aeration Tanks	7	371'7" x 21'8" x 15' swd	23 MG - Total		
Rotating Biological Contractors	280	25'l x 12' diameter		Loading rate	7.5 gpd/ft^2
Final Sedimentation Tanks Set 1 Set 2	 8 8	 214' x 75' x 11' swd 231' x 70' x 13' swd	 105 MGD 105 MGD	Design Surface Loading Rate Weir loading	815 gpd/ft^2 810 gpd/ft^2 15,200 gpd/ft
Disinfection	6	300' x 28' x 11' swd	4.11 MG	Contact period Average Peak chlorine dose	 35 minutes --- 8 mg/l
Sludge Thickening	12	90' x 20' x 12' swd	237,600 ft^3	Solids loading overflow rate	11.0 ppd/ft^2 420 gpd/ft^2 (0.29 gpm/ft^2)
Sludge Digesters Set 1	 8	 110' diameter x 30' swd	 17.95 MG	 Side water depth Volatile solids loading	 30' 99 lbs VSS/1,000 cf/day



BCM Project No. 00-0740-02

NOT TO SCALE

Figure 4.3-1

Northeast Water Pollution Control Plant Site Plan

BCM

screens. There are six bar screens available for the low level interceptor influent and two available for the high level interceptor influent. A considerable amount of material is removed from the sewage flow in the screening process. For example, in April 1992, a total of 67,620 pounds of screenings were removed.

In the plant design, it was envisioned that the screenings would be incinerated onsite to reduce the volume of material requiring disposal. However, due to the large quantities of plastic material, and the potential for dioxin emissions from incineration, the screenings are not incinerated. Presently, they are combined with lime to reduce pathogen levels and vector attraction and then landfilled.

Influent Pumping

The low level interceptors (Delaware and Somerset/Frankford) are physically at a lower elevation than the plant's influent chamber. The wastewater is pumped to the elevation of the grit basins for subsequent treatment. Dry weather flow usually requires two pumps to be in operation. During increased flow periods, additional pumps are used. Six variable speed raw wastewater pumps are available.

Grit Removal

Grit consists of heavy mineral material present in the raw wastewater. Grit usually settles rapidly from the wastewater flow and can accumulate in channels or treatment tanks if it is not removed prior to treatment in these facilities. Furthermore, grit can be very abrasive to pumps or other mechanical equipment if it is not effectively removed during preliminary treatment.

At NEWPCP, four detriters are used to remove grit from the raw sewage. Two of the detriters are required to accommodate dry weather flow. After removal from the wastewater, the grit is pumped through hydrogritters and then conveyed into storage bins.

The collected grit is incinerated in two multiple hearth incinerators that are fueled from gas produced in the sludge digestion process. Usually one incinerator can accomplish the required grit reduction and the other incinerator is used as a backup. Fuel oil is used as a backup fuel, but there has been a limited requirement for operation using fuel oil.

During April 1992, 176.3 tons of grit were incinerated at a rate of 2.2 tons per hour. Approximately 92 tons of ash remained and were taken to a landfill for disposal.

Primary Sedimentation

Primary sedimentation removes floating and settleable material from the wastewater by allowing the wastewater velocity to be significantly reduced. This reduced velocity allows the floating material or scum to collect on the water's surface where it is collected and removed; likewise, heavier solids settle and accumulate as sludge on the bottom where it can be collected.

Two sets of primary sedimentation tanks are used at NEWPCP. The sets are similar in size, but one set has eight individual tanks and the other has four.

The sludge removed from the primary sedimentation tanks is further processed. Sludge is digested, stored, and sent to the Sludge Processing and Distribution Center (SPDC) for dewatering and composting.

Surface Aeration

NEWPCP utilizes a Surfact Aeration process that uses rotating biological contactors (RBCs) and fine bubble diffusion. The RBCs consist of rotating shafts with high density plastic discs attached to them. The discs rotate with the shaft and are approximately 40% submerged in the wastewater. The discs support a biological slime growth that utilizes organic matter in the wastewater for food and atmospheric oxygen to digest wastes in the wastewater.

The Surface Aeration process at NEWPCP uses 280 RBCs in seven aeration tanks with four channels in each tank. Additional oxygen is supplied by adding air to the aeration tanks through six blowers. This process operates in a step-feed mode. Primary sedimentation tank effluent is fed to the aeration tanks at multiple points in the tank. This mode of operation establishes several zones of high biological activity throughout the tank.

A portion of the sludge is recycled from the final sedimentation tanks to the aeration tanks. The recycled sludge ensures that a sufficient quantity of microorganisms is present to feed on organic material in the wastewater.

Final Sedimentation

The aeration process in the Surface Aeration System converts colloidal solids into settleable solids that have to be removed from the wastewater. Final sedimentation tanks provide an area of slow-flow velocity that allows the solids to settle and be removed. Additional floating material (scum) is also removed from the surface of the tanks.

At NEWPCP, the final sedimentation tanks are configured into two sets, with the first being equal in size to the second.

As mentioned above, a portion of the sludge collected in the final sedimentation tanks is recycled to the aeration tanks, and the remaining sludge is thickened, digested, then sent to SPDC to be dewatered and composted.

Chlorination

Chlorine is added to the plant effluent to disinfect and kill pathogens in the wastewater prior to discharge to the Delaware River. Chlorine is supplied in rail tank cars and added to the wastewater through solution feed chlorinators. Once the chlorine is added, the plant flow remains in the chlorine contact tank from 20 to 30 minutes with an additional 10 minutes through the outfall.

Sludge Thickeners

Secondary sludge is thickened in 12 tanks by the Dissolved Air Flotation (DAF) process. Air is put into solution under pressure, added to the excess secondary sludge, and released in the tank at atmospheric pressure. The air attaches to the solid particles in the DAF tanks and floats these solid particles to the tank surface. The floating sludge is then skimmed off the top of the tank and sent to the sludge digesters through mixing chambers. Some sludge settles to the bottom of the DAF tanks. The settled sludge is also sent to the mixing chambers. All of the DAF tanks are similar in size and dimensions.

Sludge Digestion

Primary sludge and thickened secondary sludge is anaerobically digested to further reduce the organic content of the sludge, and methane gas is collected as a by-product of this process. The methane is used as a fuel to provide heat for various heating loops, the digesters and incinerate the grit collected in the detriters. The digestion tanks are kept at a temperature around 95°F to facilitate optimal digestion. NEWPCP utilizes 8 digesters with an average retention time of over 15 days.

Periodically, excess methane is produced and cannot be stored. Automatic flares ignite and burn the excess to reduce the potential for releasing offensive odors.

Sludge Storage and Transfer

Liquid digested sludge (biosolids) is transferred from NEWPCP to the SPDC by barge where it is dewatered and composted. Two storage tanks with a working volume of 1.5 million gallons are used for temporary storage. Each barge can transport one million gallons of sludge. Two are available to NEWPCP for sludge transfer. A barge load is sent to the SWWPCP on an average of six days per week.

4.3.1.6 Maintenance of Treatment Plant

A computerized preventive maintenance (PM) program assists maintenance personnel in the performance and tracking of maintenance activities. Preventive maintenance work orders are printed each week and distributed to work leaders for completion. Distribution on a weekly basis allows work leaders to prioritize the completion of emergency, corrective, and PM requirements.

Preventive maintenance schedules are based on manufacturers' recommended maintenance periods. However, it is possible to alter the schedule if historical records or worker insight indicate a need to change. Completed work orders are added to the historical files.

Corrective maintenance (CM) operations are initiated by filling out a work order request. Most work order requests are filled out by staff members of the Operations Group as they discover broken or inoperable equipment. Each CM request is categorized by priority and craft (electrical, mechanical, etc.) and assigned to a maintenance worker or team. The CM request is then processed by computer to issue a CM work order in the program's open work order file. Upon completion, the work order is added to the historical files.

The historical files can be used to track maintenance activities conducted on equipment and produce statistical reports of the maintenance conducted over time. The reports can be useful in determining if a piece of equipment has reached the end of its useful life by comparing maintenance versus replacement costs. Time budgeting can also be better estimated from records of past activities and performance.

4.3.2 Southeast Water Pollution Control Plant

4.3.2.1 Ownership

The Southeast Water Pollution Control Plant (SEWPCP) is owned by the City of Philadelphia and operated as a self-supporting utility by PWD. PWD is responsible for planning, construction, operation and maintenance, budgeting, detailed cost accounting, and setting sewer rates.

4.3.2.2 Point of Discharge

SEWPCP is permitted to discharge treated effluent to the Delaware River under NPDES Permit No. PA 0026662 (see Appendix H) from discharge point 001 located at latitude 75°08'09", longitude 39°54'07" (Delaware River Estuary Zone 3). Thirty-five (35) combined sewer overflow discharge points are also identified in the permit. These discharge points are necessitated by stormwater intermittently entering the sewer system and exceeding the hydraulic capacity of the sewer and/or wastewater treatment plant. The combined sewer overflow system is discussed in Section 4.2.5.

4.3.2.3 SEWPCP Effluent Discharge Limitations

SEWPCP is regulated by an NPDES Permit that establishes plant effluent quantity and quality limitations. The current permit expired on September 22, 1991; however, provisions in the permit allow for continued operation of and discharge from SEWPCP after this date. All of the permit limitations remain in effect until a new permit is issued.

The permitted average monthly flow of discharged effluent is 112 mgd. The plant is permitted to provide treatment for a maximum design wastewater flow of 168 mgd (maximum daily average) and 224 mgd (peak) without causing treatment process upsets. Premature and avoidable sewer system overflows caused by throttling of the influent flow are prohibited.

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A summary of the permit effluent limitations is presented in Table 4.3.6. Specific monitoring and effluent limits are established for BOD_5, suspended solids, first stage oxygen demand, fecal coliform, and pH. Other parameters (i.e., TKN, Chloroform) are required to be monitored but do not have specific discharge limitations at this time. All parameters are reported to PADER, EPA, and DRBC in monthly DMRs.

DRBC has established an enforceable BOD_5 reduction requirement for discharges into Zone 3 of the Delaware River Estuary. The requirement includes an 86% monthly average reduction of BOD_5 from the influent to effluent. The percent reduction is calculated from analysis results of 24-hour composite samples of the influent and effluent. The influent sample must reflect true characteristics of the raw wastewater and must not be affected by plant recycle flows.

Exceedances of the permit limitations are reported to EPA, PADER and DRBC in the monthly DMRs. Over the past three years, there were exceedances in instantaneous maximum flow, suspended solids, solids percent removal and fecal coliform. Storm events and high sludge blankets caused most of the problems, but in some cases, plant operations were responsible. A detailed listing of these exceedances and causes thereof are shown in Appendix I.

Some other provisions that apply include requirements to operate an Industrial Pretreatment Program, management of toxic pollutants, and self-monitoring and reporting requirements.

4.3.2.4 Municipal Wasteload Management Reports (Chapter 94)

The plant design flow is 120 mgd, while the permitted average monthly effluent discharge limit is 112 mgd. The WPCP has a maximum daily average of 168 mgd and a 224 mgd peak flow. The average daily flow for the 1992 fiscal year from July through March are presented in Table 4.3.7. As can be seen in this table, the average daily flows are below the plant design flow except for the months of July, August and September.

The plant design loading is 196,000 pounds BOD_5 per day at the design flow rate of 120 mgd. This roughly converts to 196 mg BOD_5/l. Table 4.3.8 presents the average daily BOD_5 loading for each month in fiscal year 1991 along with the flow and BOD_5 calculated in mg/l. From this table it is apparent that most loadings are well below the plant's design except for April 1991.

4.3.2.5 SEWPCP Treatment Process Description

SEWPCP provides primary and secondary treatment for the raw wastewater entering the plant. The basic unit processes utilized to provide sufficient treatment to meet effluent limitations are presented in Figure 4.3-2. Table 4.3.9, SEWPCP Process Evaluation Summary, provides a summary of the plant design criteria. The primary function of each of the unit processes is explained in the following sections:

TABLE 4.3.6

SEWPCP NPDES EFFLUENT LIMITATIONS FOR POINT SOURCE 001

Discharge Parameter	Discharge Limitations						
	Mass Units (lbs/day)			Concentration (mg/l)			
	Average Monthly	Average Weekly	Maximum Daily	Average Monthly	Average Weekly	Maximum Daily	Instantaneous Maximum
BoD-5[1]	19,650	29,475		30	45		60
BoD-5 % Removals[1]	DRBC	Zone 4 Requirement		89.25% reduction			
Suspected Solids[1]	28,035	42,035		30	45		60
FSOD[2]	33,600						
Fecal Coliform (5/1 - 9/30)		See Footnote 3					
Fecal Coliform (10/1 - 4/30)		See Footnote 3					
pH	Within 6 - 9 Standard Units at all times						

[1]In no case shall the arithmetic means of the effluent values of the BOD_5 and Suspended Solids discharged during a period of 30 consecutive days exceed 14% and 15% respectively of the associated arithmetic means of the influent values for those parameters during the same time period, except as specifically authorized by the permitting authority.

[2]FSOD - First stage oxygen demand (20 day Biochemical Oxygen Demand test with nitrogenous oxygen demand inhibited).

[3]Effective disinfection to control disease producing organisms during the swimming season (May 1 through September 30) shall be the production of an effluent which will contain a concentration not greater than 200/100 ml of fecal coliform organisms as a geometric average value, nor greater than 1,000/100 ml of these organisms in more than 10% of the samples tested.

[4]Monitory only required for: NH_3-N, TKN, NO_3-N, NO_2-N, Total Beryllium, Dissolved Iron, Total Aluminum, Free Cyanide, Total Phenolics, Tetra-Chlorethylene, Phenol, Chlorodibrome-Methane, PLB 1260, Phenathrene, Chloroform, Total Cadmium, Total Lead, Total Mercury, Total Nickel, Total Silver, Total Zinc, Total Barium, Total Tin, and Total Titanium.

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TABLE 4.3.7

FISCAL YEAR 1992 AVERAGE DAILY FLOWS FROM THE SEWPCP

Month/Year		Average Daily Flow (mgd)
July	1991	113.93
August	1991	124.87
September	1991	115.71
October	1991	104.72
November	1991	103.07
December	1991	108.97
January	1992	104.10
February	1992	106.28
March	1992	109.00
Average Flow		110.07

Source: Monthly WPC Operations Report, May 5, 1992.

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TABLE 4.3.8

FISCAL YEAR 1991 AVERAGE DAILY BOD_5 TO THE SEWPCP

Month	Year	Plant BOD_5 Loading (lbs/day)	Flow (MGD)	BOD_5 (mg/l)
July	1990	46,426	109.15	51
August	1990	45,570	109.28	50
September	1990	63,896	104.95	73
October	1990	64,304	98.85	78
November	1990	71,934	102.68	84
December	1990	68,053	99.51	82
January	1991	62,318	103.78	72
February	1991	71,749	103.65	83
March	1991	88,001	107.67	98
April	1991	72,526	107.36	81
May	1991	61,867	109.09	68
June	1991	67,249	118.58	68
Average		65,324	106.21	74

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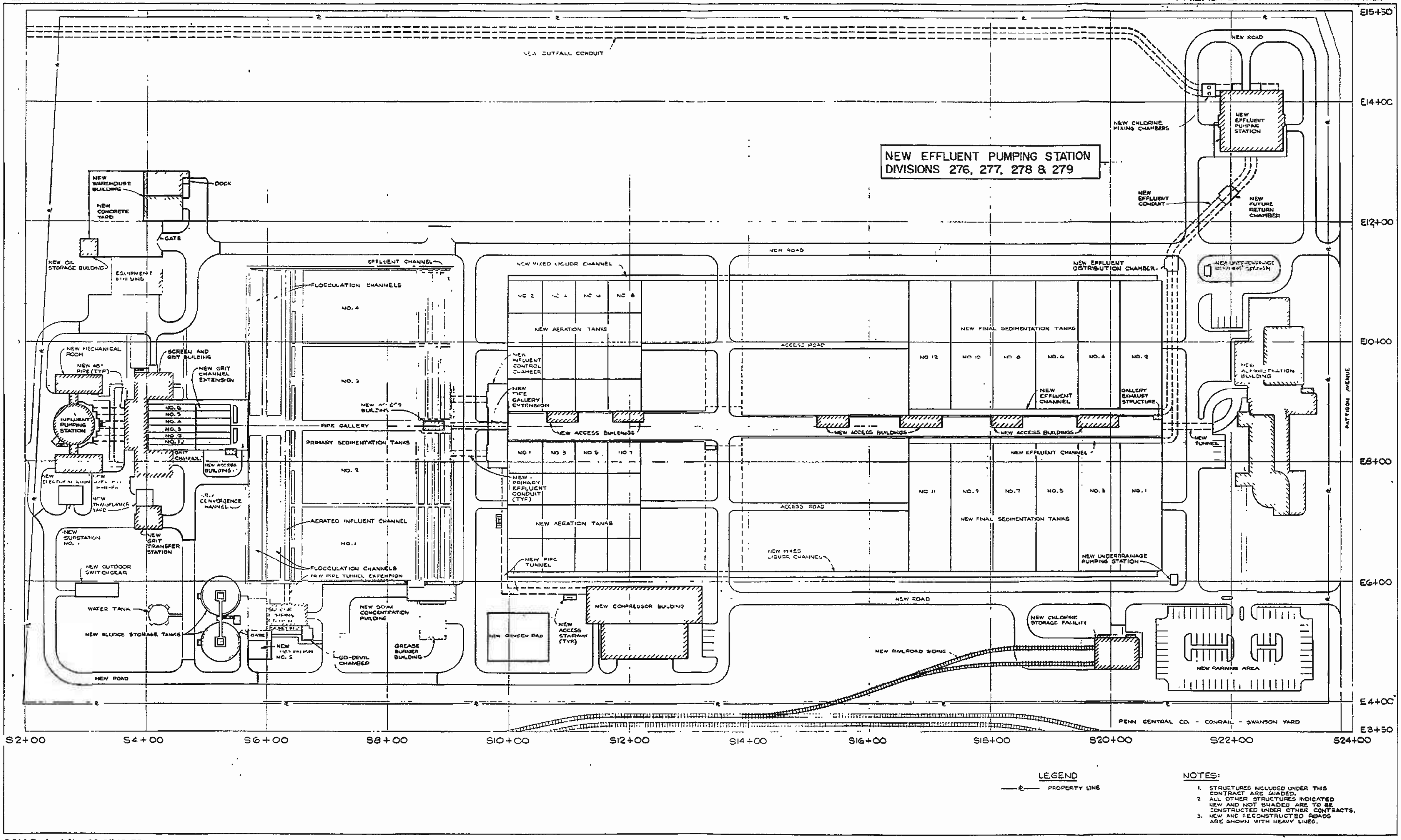

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Figure 4.3-2

Southeast Water Pollution Control Plant Site Plan

TABLE 4.3.9

SEWPCP PROCESS EVALUATION SUMMARY

Unit	Number	Dimensions	Existing Capacity	Design Parameter	SEWPCP Design Basis
Mechanical Sewage Screens	6	8.5' channel width 1 inch bar spacing	0.85 ft^3/MG screenings removed	Bar spacing Velocity	1 inch 2.3 FPS maximum
Grit Removal	5	10W x 140'L	3.7 ft^3/MG Grit removal	Velocity	----
Primary Sedimentation	4	250' x 125' x 12' swd	---	Surface loading Average Peak BOD removed Wier loading	 960 gpd/ft^2 --- 40% 4,700 gpd/ft
Aeration Tanks	8	210 x 52.5' x 14.3 swd	---	Minimum retention period	1.9 hours
				Maximum organic loading	93.5 lbs BOD_5/1000 ft/day
				FM ratio	---
				MLSS	4,000 mg/l
				Dissolved oxygen	---
				Return sludge rate	---

TABLE 4.3.9 (Continued)

Unit	Number	Dimensions	Existing Capacity	Design Parameter	SEWPCP Design Basis
Final Sedimentation Tanks	12	214' x 68' x 11' swd	---	Design Surface Loading	
				Average	685-1030 gpd ft3
				Peak	---
				Wier loading	12,700 gpd/ft
				Hydraulic loading	
				Average	---
				Peak	---
				Solids loading	
				Average	---
				Peak	---
Disinfection	---	214' x 68' x 11' swd	---	Contact period	
				Average	37.2 minutes
				Peak	18.9 minutes
				chlorine dose	8 mg/l

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Coarse Screening

Two mechanically cleaned bar racks are located in the sewer influent channels in the influent pumping station. The bar racks have 4-inch clear opening screens to remove large objects that could damage the pumps. Rakes that are activated by a timer or a differential water level, remove the debris that collects on the bars upward to the screen room. The debris is first collected in hoppers and then transferred into trucks for transport and disposal.

Influent Pumping

The sewers and interceptors conveying wastewater to the SEWPCP are physically below the treatment plant. Influent pumping is required to bring the raw wastewater up to a diversion chamber and ultimately through the treatment plant.

Influent Screening and Grit Removal

Wastewater flow can be diverted into any of six channels in the screen and grit building from the diversion chamber. Channels are placed in service as required to meet the rate of influent flow. The efficiency of grit removal is dependent on the flow velocity in these channels. If the velocity is too high, grit will remain suspended and be carried through the grit channels. If the velocity is too low, organic material will settle with the grit and potentially cause odor problems. When the velocity of the flow is in the optimum range, only heavy inorganic material such as sand and gravel is removed.

The settled grit and other material is collected by flights that transverse the bottom of the channel. The grit is removed from the bottom of the chamber to a horizontal belt conveyor located in the screen room. The belt conveyor collects the grit from the six screw conveyors and transfers it to pneumatic transporters. The transporters automatically transport the grit to storage bins when they are full. The storage bins are handled to the Southwest WPCP (SWWPCP) where the grit is combined with lime and disposed of.

Mechanically cleaned catenary bar screens are located before each grit channel to remove objects larger than the 1-inch clear space openings between each bar. Mechanical rakes are activated by a timer or a significant difference in water level across the bar screens. The rakes lift the screenings to the screen room and deposit them on a screening trough. The screenings are manually removed and placed into containers where they are combined with lime and trucked to a landfill.

Each of the six grit channels can be taken out of service for cleaning and maintenance by closing the sluice gates at both ends of the channel.

Flocculation Channels

Wastewater exiting the grit channels can be diverted into either or both of the east and west flocculation channels. Wastewater is aerated in the flocculation channels to gently agitate the flow and promote the formation of larger particles through the collision and adherence of smaller particles. Larger and heavier particles generally have an increased settling and removal efficiency in primary sedimentation. Aeration also reduces the possibility of a septic condition and promotes separation of scum, grease, and other floating material.

The west flocculation chamber feeds primary sedimentation tanks one and two, and the east flocculation chamber feeds tanks three and four. Each flocculation channel can be isolated and drained for maintenance.

Primary Sedimentation

Wastewater flows from the flocculation channels into the primary sedimentation tank influent channel. The influent channel is aerated to reduce deposition of sludge in this channel. The wastewater enters the primary sedimentation tanks over weirs and under sluice gates. Settled sludge is collected by longitudinal collectors in the cross collector channel located on the influent end of the tanks. The longitudinal collectors remove the sludge off the bottom of the tank and push the floating scum in the opposite direction, to the effluent end of the tanks. The sludge in the cross collector channel is conveyed to a sump in the channel. Sludge is then pumped from the sump to the sludge wet well in the sludge pumping station.

The scum and other floatables are removed by periodically opening slide gates that allow the scum to flow over a fixed weir into the scum collection trough. The scum then flows into channels and to scum ejectors in the scum concentration building. Each primary sedimentation tank has seven scum slide gates and a scum collection trough.

Aeration

The effluent from the primary sedimentation tanks enters the aeration tanks and is mixed with return activated sludge. There are eight aeration tanks, each having four stages. The wastewater and sludge are mixed with pure oxygen above the liquid surface through the use of mechanical mixers in each of the four stages. The activated sludge contains microorganisms that utilize organic material in the wastewater for food. The wastewater and sludge mixture travels in a serpentine pattern through the four stages of the aeration tank to the effluent weir. The aerated wastewater then flows to the final sedimentation tanks.

A portion of the activated sludge is collected from the final sedimentation tanks and returned to the aeration tanks. The rate of sludge return is determined by a complex relationship involving the wastewater flow, BOD_5, temperature, mixed liquor, suspended solids, and sludge level in the final sedimentation tanks.

Pure oxygen is provided to the aeration tanks from two cryogenic oxygen generation plants. The plants remove the contaminants and minor components of air and distill the oxygen. The plants are each capable of producing 50 tons per day of gaseous oxygen. The oxygen feed rate to the aeration tanks is controlled to maintain a preset pressure in the oxygen header supply line.

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Final Sedimentation

The final sedimentation tanks receive the mixed liquor effluent from the aeration tanks. The final sedimentation tanks provide an area of slow flow velocity that allows the solids to settle and be removed. Longitudinal cross collectors push the settled sludge from both the influent and effluent ends of the tank toward a cross collector channel in the center. Cross collectors scrape sludge in this channel toward a sludge sump. The sludge is either returned to the aeration tanks or wasted to the sludge storage tanks and eventually pumped to SWWPCP.

Scum and floating solids are removed from both the influent and effluent ends of the final sedimentation tanks. The scum is collected and transferred through scum header channels to pumps that convey it to the scum concentration building. After concentration, the scum is incinerated in a grease burner.

Effluent Pumping

Due to the tidal influence on the Delaware River, the effluent from the plant must be periodically pumped into the river. To prevent river water from entering the effluent channel, tide gates close when the water level of the river exceeds the elevation of the plant effluent. Under these circumstances, the effluent must be pumped out of the WPCP. At low tides, the effluent can flow by gravity into the river.

Chlorination

Disinfection of the plant effluent prior to discharge occurs in the effluent channel. Chlorine is delivered to the plant in rail cars. Liquid chlorine is pumped from the rail cars to evaporators where it is vaporized. The chlorine gas is mixed with water by injectors to produce a chlorine solution. The chlorine solution is piped to the chlorine mixing chambers in the effluent channel where it is mixed with the effluent by diffusers and flash mixers. The retention time in the effluent channel provides sufficient contact time for disinfection. The rate of chlorine feed is controlled on the basis of chlorine residual and plant flow.

Sludge Storage and Pumping

Primary sludge is pumped to the wet well in the sludge pumping station from the primary sedimentation tanks. The sludge is normally stored in the primary sedimentation tanks until it is pumped to SWWPCP for processing. In an emergency, primary sludge can be removed from the sedimentation tanks and pumped into sludge storage tanks.

Pumping the primary sludge to SWWPCP is done on an intermittent basis. The sludge is pumped through one of two eight-inch force mains. One of the mains is dedicated for primary sludge and the other for waste activated sludge. Either pipeline can be used if one is out of service. Normally pumping of primary sludge takes precedence. After primary sludge pumping is completed, the primary sludge pipeline is flushed with waste activated sludge.

Waste activated sludge is pumped from the storage tanks on a continual basis and transferred through the dedicated force main to SWWPCP for thickening and digestion.

4.3.2.6 Maintenance of Treatment Plant

The SEWPCP utilizes state-of-the-art equipment to perform predictive maintenance investigations on critical components throughout the plant. The predictive maintenance investigations involve vibrational, infrared, and oil analysis on the components where applicable. Vibrational analysis can be used on moving equipment to determine if bearings are worn, if shafts are true, or if rotating equipment is properly balanced. Infrared analysis can be used to determine if components are operating at elevated temperatures. Oil analysis can indicate excessive wear of internal parts, oil breakdown, or whether the correct oil was used on a piece of equipment.

The predictive maintenance investigations are completed on a scheduled basis and can be used to identify potential maintenance requirements on components prior to a destructive breakdown. Predictive maintenance also allows scheduling of certain repairs so that the downtime of critical components can be planned. Equipment that has been rebuilt is also analyzed to ensure that the repairs have been completed correctly. Vibrational analysis of the major pieces of plant equipment is conducted monthly, and oil analysis is conducted on a quarterly basis.

Preventive maintenance (PM) work orders are generated from a computer program that follows manufacturer-recommended maintenance schedules unless alternate schedules have been developed. Preventive maintenance of grit channels, bar screens, primary tanks, and final tanks is scheduled for spring and fall. Work orders are issued and remain open until the work is completed.

Corrective maintenance (CM) is handled in the same manner as at NEWPCP.

Historical data on manpower requirements for completion of work orders is retained for use in next generation Maintenance Management System. The data cannot be used by the present system.

Innovative maintenance activities have resulted in a considerable cost and downtime savings at the SEWPCP. The equipment in the maintenance shop is frequently used to manufacture mechanical parts for wastewater treatment equipment and pumps. In-house machining has saved thousands of dollars over purchasing equivalent parts on the open market. An additional benefit of in-house machining is that a part is quickly available in comparison to obtaining the same part from commercial sources.

In addition, the use of synthetic oils has also proved beneficial. Synthetic oils can last considerably longer than refined oil, increasing the usable lifetime of the oil. Use of synthetic oils has also reduced friction on some parts and this has decreased energy costs.

Training of maintenance workers is an important part of the maintenance program. Trade training is frequently provided and helps ensure that workers perform assigned tasks correctly and efficiently. Safety training is also regularly provided to ensure that workers understand the hazards associated with their jobs and react correctly to emergency situations.

4.3.3 Southwest Water Pollution Control Plant

4.3.3.1 Ownership

The Southwest Water Pollution Control Plant (SWWPCP) is owned by the City of Philadelphia and operated as a self-supporting utility by the PWD. The PWD is responsible for planning, construction, operation and maintenance, budgeting, detailed cost accounting, and setting sewer rates.

4.3.3.2 Point of Discharge

SWWPCP is permitted to discharge treated effluent to the Delaware River (Zone 4 of the Delaware Estuary) from Point Source 001, which is located at latitude 39°52'08" and longitude 75°13'13". National Pollutant Discharge Elimination System (NPDES) effluent limitations have been established for this WPCP and outfall through permit No. PA 0026671. This permit is included in Appendix H.

Eighty three (83) combined sewer overflow discharge points are also identified in this permit. These discharge points serve as combined sewer reliefs, necessitated by the collection of stormwater and sanitary sewage in a combined system and act to prevent a hydraulic overload of the collection system and SWWPCP. These discharges do not have specific effluent limitations; however, a discharge is permitted only when the collection system and SWWPCP maximum hydraulic capacities have been reached.

4.3.3.3 SWWPCP Effluent Discharge Limitations

As mentioned above, SWWPCP has been issued an NPDES Permit for the plant effluent and is responsible for complying with the effluent quality and quantity limitations established in that permit. The permit under which SWWPCP is currently operating expired on September 22, 1991. Provisions in this permit allow continued operation of and discharge from SWWPCP. Permit limitations remain in effect until a new permit is issued, provided that a timely and complete permit application form has been filed. The permit application and applicable fees were transmitted PADER on March 21, 1991.

The permitted average monthly flow of effluent discharged from the WPCP shall not exceed 200 mgd. The plant is to be operated to provide treatment for the maximum design wastewater flow of 300 mgd (maximum daily average) and 400 mgd (peak) without causing treatment process upsets. Throttling of influent flows to SWWPCP resulting in premature and avoidable sewer system overflows is prohibited.

A summary of the effluent limitations is presented in Table 4.3.10. The permit establishes specific monitoring requirements and effluent limits for BOD_5, suspended solids, first stage oxygen demand, fecal coliform, and pH. Other parameters (i.e., TKN, Iron) are required to be monitored but do not have specific discharge limitations at this time. All parameters are reported in monthly DMRs submitted to PADER, EPA, and DRBC.

DRBC has established enforceable BOD_5 limitations for Zone 4 of the Delaware River Estuary, into which the SWWPCP discharges. The requirement includes an 89.25% monthly average reduction of BOD_5 from the influent to effluent. The percent reduction is calculated from analysis results of 24-hour composite samples of the influent and effluent. The influent sample must reflect the true characteristics of the raw wastewater and must not be affected by the plant recycle flows.

Exceedances of the permitted effluent quantity and quality limits are reported to EPA, PADER, and DRBC in the monthly DMRs. Problems with the cryogenic oxygen plant and other plant operations were the cause for most of the exceedances at SWWPCP. High flows and sludge washout caused some of the problems, and in some cases, weak BOD_5 influent level have resulted in decreased BOD_5 percent removal. A detailed listing of these exceedances and the causes thereof are shown in Appendix I.

Some other permit provisions that apply include requirements to operate an IPP, manage toxic pollutants, and self-monitor and report submittal requirements.

In addition to the NPDES permit requirements, SWWPCP is currently operating under the requirements of a Consent Decree due to violations of the Clean Water Act. The Consent Decree established requirements to rehabilitate select pieces of major equipment, a schedule for this rehabilitation effort, and minimum operational standards to define the completion of this rehabilitation effort. The Consent Decree also established interim effluent limits that were valid through December 31, 1990. Furthermore, the Consent Decree required the City to hire an independent consultant to identify factors that have limited performance at SWWPCP, to develop a sequenced program for corrective actions that will result in NPDES permit compliance, and to produce periodic reports monitoring the progress of the program.

The SWWPCP has achieved compliance with the rehabilitation schedule and the interim permit limitations. The sequenced program for corrective actions has also been developed. Several of the program provisions have been implemented; however, the schedule for completion for the entire program extends into 1993.

4.3.3.4 Municipal Wasteload Management Reports (Chapter 94)

The plant design flow is 210 mgd, while the permitted average monthly effluent discharge limit is 200 mgd. The SWWPCP has a maximum daily average of 300 mgd and a 400 mgd peak flow. The average daily flows for the 1992 fiscal year from July 1991 through March 1992 are presented in Table 4.3.11. As can be seen in this table, the average daily flows have been below the plant design flow, except in July and August of 1991.

TABLE 4.3.10
SWWPCP NPDES EFFLUENT LIMITATIONS FOR POINT SOURCE 001

	Discharge Limitations						
	Mass Units (lbs/day)			Concentration (mg/l)			
Discharge Parameter	Average Monthly	Average Weekly	Maximum Daily	Average Monthly	Average Weekly	Maximum Daily	Instantaneous Maximum
BoD-5[1]	21,650	32,475		30	45		60
BoD-5 % Removals[1]	DRBC	Zone 4 Requirement		89.25% reduction			
Suspected Solids[1]	50,040	75,060		30	45		60
FSOD[2]	37,020						
Fecal Coliform (5/1 - 9/30)		See Footnote 3					
Fecal Coliform (10/1 - 4/30)		See Footnote 3					
pH	Within 6 - 9 Standard Units at all times						

[1]In no case shall the arithmetic means of the effluent values of the BOD_5 Suspended Solids discharged during a period of 30 consecutive days exceed 10.75% and 15% respectively of the associated arithmetic means of the influent values for those parameters during the same time period, except as specifically authorized by the permitting authority.
[2]FSOD - First stage oxygen (20 day Biochemical Oxygen Demand test with nitrogenous oxygen demand inhibited).
[3]Effective disinfection to control disease producing organisms during the swimming season (May 1 through September 30) shall be the production of an effluent which will contain a concentration not greater than 200/100 ml of fecal coliform organisms as a geometric average value, nor greater than 1,000/100 ml of these organisms in more than 10% of the samples tested.
[4]Monitor only required for: NH_3-N, TKN, NO_3-N, NO_2-N, Aluminum, Dissolved Iron, Total Silver, Total Zinc, Total Phenotics, Total Tin, and Total Titanium.

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TABLE 4.3.11

FISCAL YEAR 1992 AVERAGE DAILY FLOWS FROM THE SWWPCP

Month	Year	Average Daily Flow (mgd)
July	1991	213.88
August	1991	209.17
September	1991	206.83
October	1991	193.75
November	1991	193.17
December	1991	206.25
January	1992	191.81
February	1992	178.59
March	1992	202.65
Average		199.57

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The plant design BOD_5 loading is 339,000 pounds per day at a flow of 210 mgd or 193 mg/l. The average daily BOD_5 loadings for fiscal year 1991 are presented in Table 4.3.12, along with the flow and BOD_5 in mg/l. These values are consistently below the plant design loading except for April 1991.

4.3.3.5 SWWPCP Treatment Process Description

SWWPCP provides primary and secondary treatment for the raw wastewater entering the plant. The treatment is accomplished by passing the wastewater through a series of unit processes, each designed to treat the flow so that the effluent ultimately meets the discharge criteria. A schematic of the treatment processes utilized at the SWWPCP which illustrates each of the unit operations is presented in Figure 4.3-3. Table 4.3.13, SWWPCP Process Evaluation Summary, provides a summary of plant design criteria. The following paragraphs describe each unit process.

Wastewater Collection

Raw wastewater arrives at the plant in high level and low level interceptors as described in Section 4.2.2. The high level interceptors deliver wastewater to the dispersion chamber just ahead of the bar screens. The high level interceptors consist of a triple barrel gravity sewer and a force main. The low-level interceptors consist of twin conduits that enter the influent pumping station 35 feet below the operating level of the dispersion chamber. The plant drainage also discharges into the influent pumping station.

Influent Pumping

The raw wastewater from the plant drain and low level interceptors is lifted to the dispersion chamber by three two-stage screw pumps. Each pump is in a separate channel and can be isolated from the inlet structure by a slide gate. Each screw pump has a capacity of 32 mgd. Pumps are utilized as the influent flow requires. Two manually cleaned coarse screens are located in the inlet structure to prevent large debris from entering the pumps.

Dispersion Chamber

Wastewater flow from the high level interceptors and that pumped from the low level interceptors and plant drain are combined in the dispersion chamber. The dispersion chamber is equipped with sluice gates and butterfly valves to allow a bypass of the screening and grit removal systems in the event of an emergency.

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TABLE 4.3.12

FISCAL YEAR 1991 AVERAGE DAILY BOD_5 LOADING TO THE SWWPCP

Month/Year		Plant BOD_5 Loading (lbs/day)	Flow (MGD)	BOD_5 (mg/l)
July	1990	157,299	186.74	101
August	1990	164,307	195.06	101
September	1990	150,012	178.09	101
October	1990	142,751	169.47	101
November	1990	135,078	160.36	101
December	1990	147,957	175.65	101
January	1991	160,777	190.87	101
February	1991	144,849	171.96	101
March	1991	157,105	186.51	101
April	1991	159,489	189.34	101
May	1991	154,173	183.03	101
June	1991	155,024	184.04	101
Average		152,402	180.93	101

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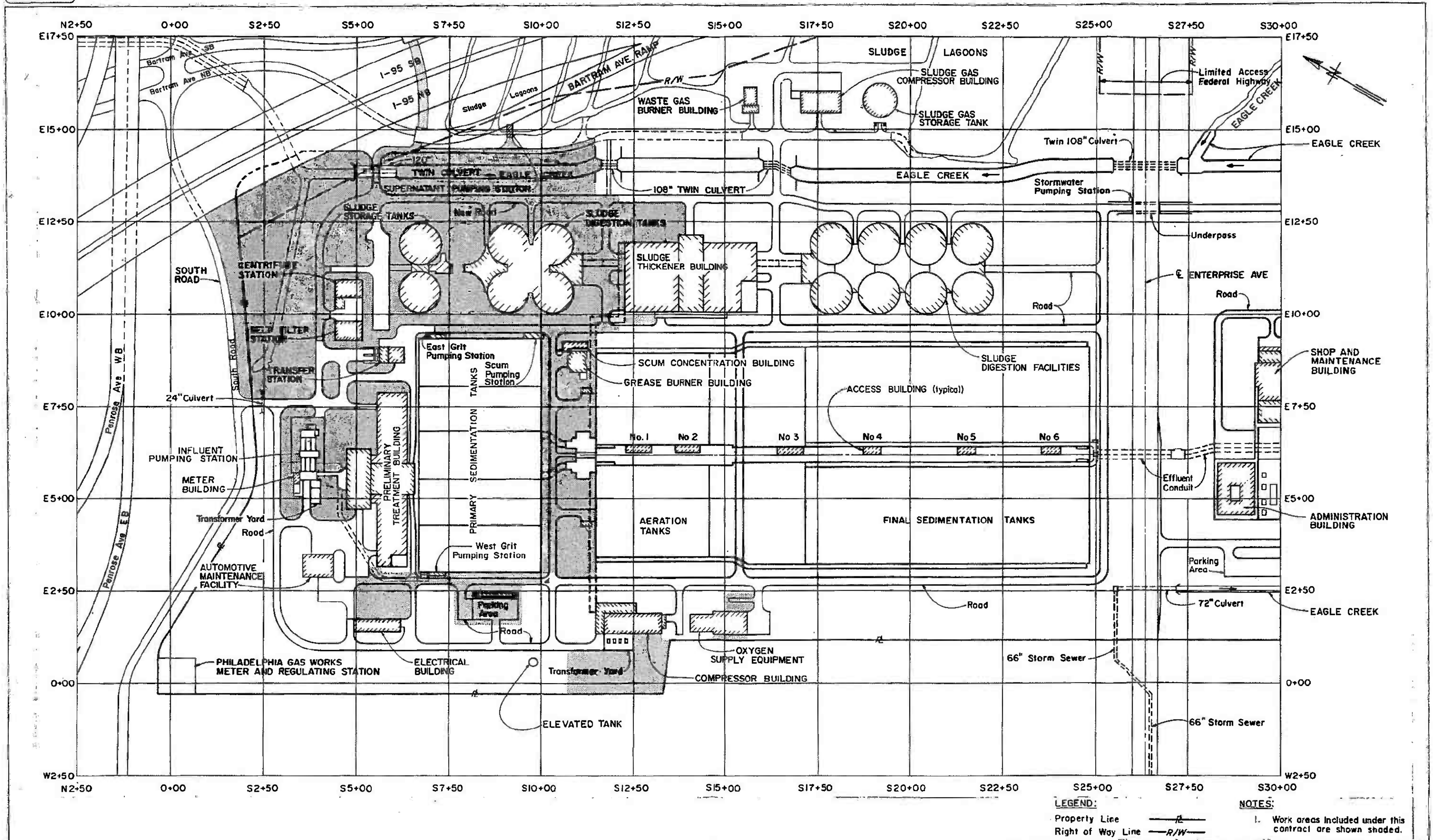

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Figure 4.3-3

Southwest Water Pollution Control Plant Site Plan

TABLE 4.3.13

SWWPCP PROCESS EVALUATION SUMMARY

Unit	Number	Dimensions	Existing Capacity	Design Parameter	SWWPCP Design Basis
Mechanical Sewage Screens	8	6' channel width	570 MGD	Bar spacing Maximum velocity	1 inch 3.2 FPS
Grit Removal	4	60' x 60'	5.20 ft^3/MG	Velocity	----
Primary Sedimentation	5	250' x 125' x 12' swd	210 MGD	Surface Loading Average Peak BOD removed Wier loading	 1,350 gpd/ft^2 --- 25% 45,700 gpd/ft
Aeration Tanks	10	14,500 ft^2 x 16' swd	210 MGD	Minimum retention period	1.96 hours (wastewater flow)
				Maximum organic loading	106 lbs BOD_5/1000 ft/day
				FM ratio	0.45 lbs BOD_5/lbs MLVSS/day
				MLSS	4,900 mg/l
				Dissolved oxygen	---
				Return sludge rate	---

TABLE 4.3.13 (Continued)

Unit	Number	Dimensions	Existing Capacity	Design Parameter	SWWPCP Design Basis
Final Sedimentation Tanks	20	76' x 260' x 11' swd	210 MGD	Design Surface Loading	
				Average	530-795 gpd ft^3
				Peak	---
				Wier loading	12,800 gpd/ft
				Hydraulic loading	
				Average	---
				Peak	---
				Solids loading	
				Average	---
				Peak	---
Disinfection				Contact period	
				Average	32.8 minutes
				Peak	24.5 minutes
				chlorine dose	8 mg/l
Sludge Thickening	8	18' x 70' x 8' swd		Solids loading	17 lbs/day/ft^2
				Overflow rate	---
Sludge Digesters	8	110' diameter x 30' swd	373,000 lbs/day	Side water depth	30'
				Volatile solids loading	88 lbs VSS/1,000 cf/day

Screening

Wastewater normally flows from the dispersion chamber into six mechanically cleaned bar screens. The bar screens have 1-inch clear space openings between bars. The screens are automatically cleaned by mechanical rakes that are activated by a timer or differential water level around the screens. The rakes remove the screenings and deposit them on storage trays at the far end of the screens.

The screenings are raked onto a conveyor that transports them to one of two grinders. A wet spray carries the screenings through the grinders that discharge to a dewatering screen. From the dewatering screen, the ground screenings fall onto a conveyor and are carried to pneumatic ejectors that transfer the screenings to storage bins. The screenings were originally intended to be incinerated but are now limed and landfilled.

Each of the six screens can be isolated by sluice gates at the inlet and outlet. Screens are taken in and out of service by opening or closing the sluice gates. The number of screens in operation at any time is a function of the total plant flow.

Grit Removal

From the screen channels, the wastewater flows to four grit basins for removal of heavy mineral material. Each tank is equipped with a rotating collector that scrapes the settled grit into a collection sump for removal. The grit collected in the sump is moved by screw conveyors to a grit pump. The grit is pumped to hydrogritters to remove water and then conveyed to storage bins for subsequent incineration.

Each grit basin can be isolated by influent and effluent sluice gates. Grit basins are placed in and out of service depending upon the total plant flow.

Flocculation Channels

Wastewater exiting the grit basins can be diverted into either or both of the east and west flocculation channels. Wastewater is aerated in the flocculation channels to gently agitate the water and promote the formation of larger particles by collision and adherence of smaller particles. Larger and heavier particles generally have an increased settling efficiency in primary sedimentation. Aeration also reduces the possibility of a septic condition and promotes separation of scum, grease, and other floating material.

The east flocculation chamber feeds primary sedimentation tanks one, two, and five, and the west flocculation chamber feeds tanks three and four. Each flocculation channel can be isolated and drained for maintenance.

Each flocculation channel is equipped with a grit collection sump, screw conveyor, and grit pump for grit removal. Grit is removed by draining the flocculation chamber and using high pressure hoses to move the grit to the collection sump. From the sump, the grit is moved by a screw conveyor and then pumped to the grit dewatering facilities and storage bins in the preliminary treatment building.

Primary Sedimentation

Wastewater flows from the flocculation channels into the primary sedimentation tank influent channel. The influent channel is aerated to reduce deposition of sludge in the channel. The wastewater enters the primary sedimentation tanks over weirs and under sluice gates. Settled sludge is collected in the cross collector channel located on the influent end of the tanks by longitudinal collectors. The collectors scrape the sludge off the bottom and move the floating scum in the opposite direction, to the effluent end of the tanks. The sludge in the cross collector channel is removed by cross collectors to a sump in the channel. Sludge is then pumped from the sump to the sludge thickening building.

The scum and other floatables are removed by periodically opening slide gates that allow to the scum flow over a fixed weir into the scum collection trough. The scum then flows into channels and to scum ejectors in the scum concentration building. Each primary sedimentation tank has seven scum slide gates and a scum collection trough.

Aeration

The effluent from the primary sedimentation tanks enters the covered aeration tanks and is mixed with return activated sludge. The wastewater and sludge are aerated with pure oxygen injected by mechanical mixers. The activated sludge contains microorganisms that utilize organic material in the wastewater for food. The wastewater and sludge mixture travels in a serpentine pattern through four stages of the aeration tank to the effluent weir. The aerated wastewater then flows to the final sedimentation tanks.

A portion of the activated sludge is collected from the final sedimentation tanks and returned to the aeration tanks. The rate of sludge return is determined by a complex relationship involving the wastewater flow, BOD_5, temperature, mixed liquor suspended solids, and sludge level in the final sedimentation tanks.

Pure oxygen is provided to the aeration tanks from two cryogenic oxygen generation plants. The plants remove the contaminants and minor components of air and distill oxygen. The plants are each capable of producing 90 tons per day of gaseous oxygen. The oxygen feed rate to the aeration tanks is controlled to maintain a preset pressure in the oxygen header supply line.

Final Sedimentation

The final sedimentation tanks receive the mixed liquor effluent from the aeration tanks. The aeration process converts additional suspended solids into a settleable form to be removed. The final sedimentation tanks provide an area of low flow velocity that allows the solids to settle and be removed. Longitudinal cross collectors scrape the settled sludge from both the influent and effluent ends of the tank into a cross collector channel in the center of the tanks. Sludge is then removed via a sludge sump. The sludge is either returned to the aeration tanks or wasted to the sludge thickening facilities.

Scum and floating solids are removed from both the influent and effluent ends of the final sedimentation tanks. The scum is collected and transferred through scum header channels to pumps that convey it to the scum concentration building. After concentration, the scum is incinerated in a grease burner.

Effluent Pumping

Due to the tidal influence on the Delaware River, the effluent from the plant periodically must be pumped into the river. To prevent river water from entering the effluent channel, tide gates close when the water level of the river exceeds the elevation of the plant effluent. Under these circumstances, the effluent is pumped out of the WPCP. At low tides, the effluent flows by gravity into the river.

Chlorination

Disinfection of the plant effluent prior to discharge occurs in the effluent channel. Chlorine is delivered to the plant in rail cars. Liquid chlorine is pumped from the rail cars to evaporators where it is vaporized. The chlorine gas is mixed with water by injectors to produce a chlorine solution. The chlorine solution is piped to the chlorine mixing chambers in the effluent channel where it is mixed with the effluent by diffusers and flash mixers. The retention time in the effluent channel provides sufficient contact time for disinfection. The rate of chlorine feed is controlled on the basis of chlorine residual and plant flow. Measurements of chlorine residual and plant flow are used in a cascade control loop to adjust the chlorine feed rate.

Sludge Thickeners

Waste activated sludge from both SEWPCP and SWWPCP is thickened in eight tanks by these Dissolved Air Flotation (DAF) process. Air is added to the sludge/water (primary effluent) mixture in the mixing chamber. The air attaches to the sludge in the DAF tanks and carries it to the tank surface. The floating sludge is then skimmed off the top of the tank and sent to the sludge digesters. Some sludge settles to the bottom of the DAF tanks. The underflow sludge is returned to the air mixing chamber for reprocessing. All of the DAF tanks are similar in size and dimensions.

Sludge Digestion

The primary and thickened waste activated sludge is anaerobically digested to further reduce the organic content of the sludge, a process that produces methane gas. The methane is used as a fuel to provide heat for the digesters and incinerate the grit collected in the degriters. The digestion tanks are kept at a temperature of around 90°F for optimal sludge digestion. SWWPCP uses 16 digesters with an average retention time of over 15 days. The digested sludge is transferred to the SPDC by pipeline for dewatering and composting.

Periodically, excess methane is produced and cannot be stored. Automatic flares ignite and burn the excess to reduce the potential for releasing offensive odors.

4.3.3.6 Maintenance of Treatment Plant

Both the preventive maintenance (PM) and corrective maintenance (CM) programs at SWWPCP are computerized and scheduled as at the NEWPCP and SEWPCP. An insufficient supply of repair parts has limited PWD's ability to keep equipment operating. Emergency equipment repairs have resulted in using back-up equipment as a source of spare parts. Minimal preventive maintenance and crisis management of maintenance have resulted in a severe reduction in functioning equipment.

The Consent Decree has forced the focus of maintenance activities to be on the equipment itemized in the Decree, to set schedules for repair, and to establish minimum periods the equipment must be operational to be considered functioning. This focus on maintenance activities has substantially improved the operation of the itemized equipment. However, equipment not itemized has suffered from neglect and several pieces of major equipment have become inoperable.

The independent consultant retained to establish maintenance priorities has developed a strategy to improve maintenance operations, increase the repair parts inventory and assess non-compliance issues. The results of this effort have actually established additional Consent Decree obligations. The implementation of these programs is expected to drastically improve the operability and effectiveness of SWWPCP.

4.3.4 Sludge Processing and Distribution Center

4.3.4.1 Ownership

The Sludge Processing and Distribution Center (SPDC) is owned and operated by the PWD. The SPDC is designed to receive, process, and distribute the biosolids removed from the waste streams at the three WPCPs. By performing this operation, the SPDC is an integral part of the wastewater treatment process, providing a centralized unit process for this wastewater treatment operation.

The SPDC is permitted by the Bureau of Solid Waste Management, PADER and holds permit #101264. An application to renew this permit was submitted to PADER on 4/10/92 and is currently under review.

4.3.4.2 Process Description

Sludge is removed from wastewater at Philadelphia's three WPCPs at different points in the treatment process, producing primary and waste activated sludge. The waste activated sludge must be thickened and both the primary and thickened waste activated sludge must be digested prior to composting. Sludge from the Northeast and Southwest WPCPs is thickened and digested

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at both of the treatment plants prior to transport to SPPC. SEWPCP does not have inherent thickening or digestion processes at the plant. Sludge from SEWPCP is pumped via two underground force mains to the SWWPCP for future processing. After digestion, the sludge from the SWWPCP (including SEWPCP sludge) is pumped to SPDC for dewatering and composting. Sludge from the NEWPCP is transported by barge to the SPDC. A site plan of the SPDC which illustrates the layout for the following processes is shown in Figure 4.3-4, SPDC, Site Plan.

Storage

At the SPDC, three storage tanks are available for temporary storage of the sludge. Currently, due to DDX contamination of NEWPCP sludge, it is completely segregated from SEWPCP/SWWPCP sludge in the storage and processing operations. Each storage tank holds approximately one million gallons of sludge. Two tanks are dedicated to SEWPCP/SWWPCP sludge.

Dewatering

Dewatering is the principal means of sludge volume reduction. Dewatering is accomplished in 10 centrifuges that spin at high speed and separate the solids from the liquid centrate. The centrate is pumped back to SWWPCP for treatment with incoming wastewater. The solids removed from the centrifuge are called sludge cake.

The sludge cake produced by the centrifuges was originally intended to contain at least 20 percent solids. The current sludge cake solids concentration averages between 17 percent and 18 percent. The difference in percent solids results in a marked difference in the volume of sludge cake to be processed and also drastically increases the wood chip volume required to produce a compostable mixture. A higher percent solids in the sludge cake is desirable due to the reduced volume of mass to receive further processing and ultimate disposal.

Mixing

The mixing process uses pug mill mixers to combine the sludge cake and wood chips to produce a compostable mixture. A mixture containing too high a liquid content inhibits the formation of voids that are necessary for air transport through the sludge, thus preventing the aeration needed for the biological activity in composting and resulting in anaerobic conditions that produce offensive odors. Wet sludge requires a larger volume of wood chips to produce a compostable mix and is not economical.

Usually, a mixture of one part sludge and two parts wood chips produces the correct consistency for composting. Once mixed, the compost mixture is transported to the composting area for stockpiling.

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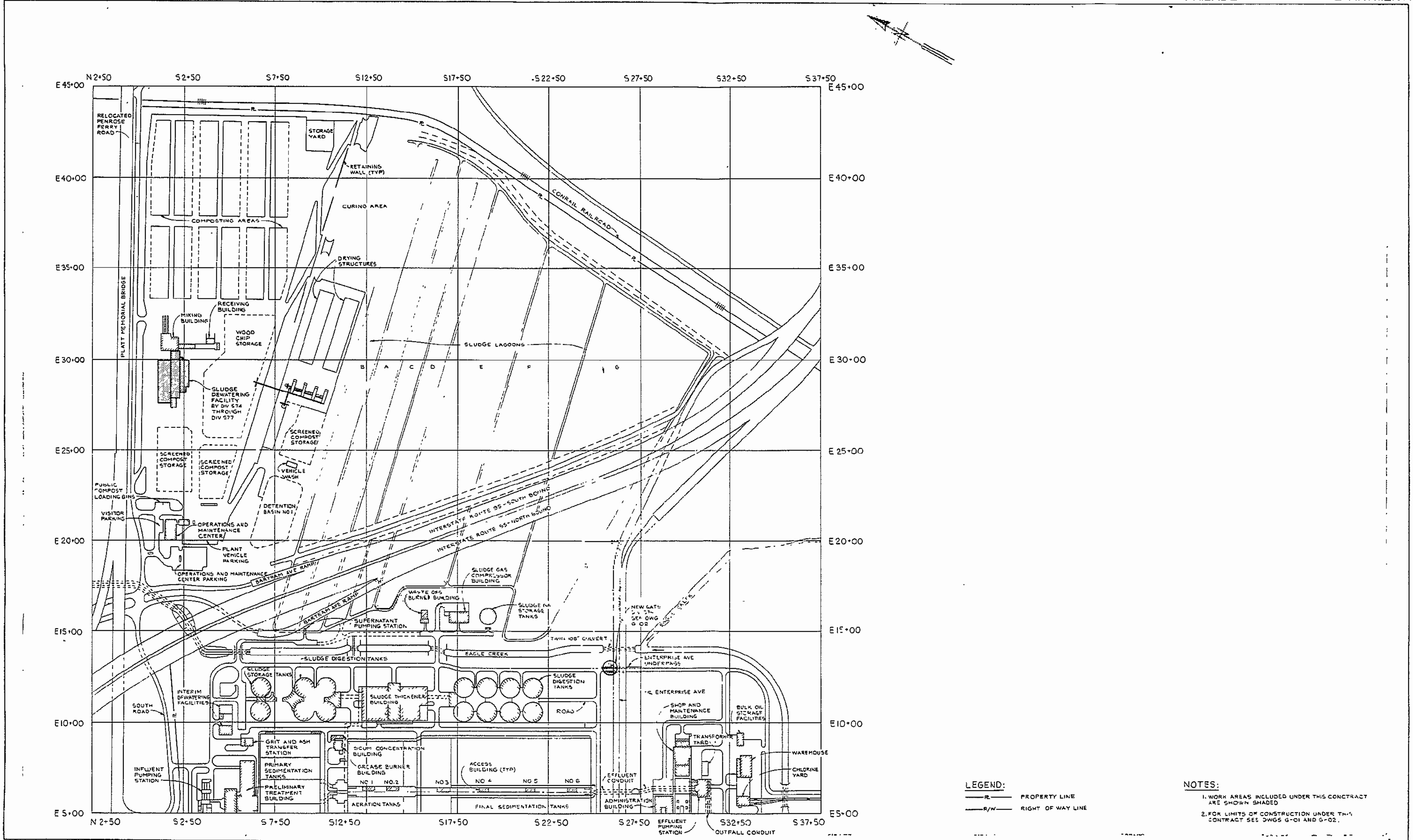

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Figure 4.3-4

Sludge Processing and Distribution Center Site Plan

Composting

The sludge and wood chip mixture is placed on a bed of wood chips with aeration tubes embedded within the wood chips. The compost mixture is formed into large composting piles. The piles remain stockpiled for 21 days during which air is drawn through to enhance aerobic decomposition. During decomposition, the temperature inside the stockpiles rises to at least 130°F, which kills any pathogens still remaining in the sludge. After 21 days, the compost is relatively dry and ready for curing.

Curing

For curing, the composting piles are removed to the curing area, where the sludge is stockpiled for an additional 30 days. Curing allows further bacterial breakdown of the compost and continued drying of the composted mixture. Curing is conducted in uncovered piles without aeration.

Drying

After the 30 days, the cured sludge is moved again and stored on a covered pad. There it is further aerated to dry the cured compost and prepare the mixture for screening. The compost must be sufficiently dry for screening else or the trommel screens can clog.

Screening

The dried, cured compost is passed through rotating trommel screens to remove wood chips from the compost product. Eight trommel screens are used at the SPDC facility. The screened compost is the final processed product. The recovered wood chips are recycled and reused in the composting process.

4.3.4.3 Production and Distribution

Four products result from the composting procedure at the SPDC: Sludge cake, Mine mix, Phillymulch, and Earthlife. The characteristics and use for each are described below.

Sludge Cake - Sludge cake is dewatered sludge containing from 17 to 30% solids. Sludge cake is mainly used on farmland as a fertilizer, thus reducing the required quantities of chemical fertilizer. Sludge cake is used on farmland dedicated to the production of animal fodder rather than crops for human consumption.

Mine Mix - Mine mix consists of a mixture of one part composted sludge and one part sludge cake by volume. Mine mix is used to reclaim areas that do not support vegetation, such as strip mines. It has been used in western Pennsylvania to recover barren land, converting it to healthy green fields in a single growing season. Between 1978 and 1990, mine mix has been used to recover 3,900 acres of mined lands.

Phillymulch - Phillymulch is a composted, unscreened product that is used as a mulch to enrich ornamental gardens and for landscaping. It is not recommended for use in gardens for production of vegetables.

Earthlife - Earthlife is the composted, cured, dried, and screened product from SPDC. It is a fine soil enricher that is primarily used by plant nurseries and landscapers. It is offered for sale to the general public. Again, it is not recommended for use in vegetable gardens.

The rates of production for these different products are primarily determined by the expected markets. Extensive research and planning are conducted to determine the market needs for each product. The expected needs determine the quantity and production schedule for each. Production planning is usually conducted months in advance because the final compost product requires approximately two months to produce.

The utilization of composted sludge products is not the only driving force for production. The dewatering and processing of sludge is the ultimate purpose of the SPDC. The SPDC must process all of the sludge produced by the three WPCPs. Periodically, it is not feasible to process all of the sludge from the WPCPs due to mechanical malfunctions and/or hydraulic limitations. Hydraulically, there is a limit to the maximum capacity of the dewatering facilities, regardless of the solids concentration. This has affected the production of sludge at the WPCPs and resulted in sludge treatment and processing shutdowns. To reduce the hydraulic capacity limitation at the SPDC, it is necessary that a consistent high solids content sludge be produced at the WPCPs. Current studies are evaluating alternative means to produce a consistent sludge.

4.3.4.4 Maintenance

Preventive and corrective maintenance programs have been established to reduce or prevent long-term equipment outages. A computerized preventive maintenance (PM) program has been installed at the facility; however, its use has not been fully implemented. A calendar PM system is currently used to schedule and track PM activities.

Corrective maintenance (CM) activities are initiated by operations staff identifying inoperative or malfunctioning equipment. Repairs are made as craft workers, equipment, and parts become available.

4.4 INDUSTRIAL PRETREATMENT PROGRAM

4.4.1 General

The Philadelphia Industrial Pretreatment Program (IPP) was developed to enforce the Federal Prohibited Discharge Standards of the General Pretreatment Regulations (40 CRF 403), to implement the objectives of the National Pretreatment Program, and to control sludge quality. The purpose of these regulations is to prevent the introduction of incompatible pollutants into the wastewater system that may:

- Interfere with the operation of the treatment systems.

- Contaminate sludge and thus interfere with selected sludge uses or disposal practices.

- Pass through the system, inadequately treated, into receiving waters or the atmosphere.

- Cause the PWD to be in violation of its NPDES permit.

- Be otherwise corrosive to the sewer system.

- Create a hazard for workers in the treatment facility.

PWD adopted the Wastewater Control Regulations, effective June 1990, in response to the Federal Clean Water Act and the General Pretreatment Regulations, which include the following:

1. Enforcement of general requirements for all sewer system users as specified in a sewer use ordinance, in this case, the City of Philadelphia Wastewater Control Regulations

2. Issuance of wastewater discharge permits for Significant Industrial Users or SIUs (SIUs are defined in Section 4.4.2)

3. Implementation of monitoring of SIUs and enforcement of pretreatment requirements

4. Establishment of SIU reporting and compliance schedule submissions to PWD

The City of Philadelphia Wastewater Control Regulations are contained in Appendix A. These regulations apply to direct and indirect contributors to the City's wastewater system. Indirect contributors are those which transport and discharge septic tank waste at the PWD treatment plant.

To comply with the above regulations, PWD has developed and implemented an Industrial Pretreatment Program (IPP). The overall strategy for regulating connected industrial users revolves around various pretreatment limitations: prohibited pollutants, general local discharge limitations, categorical standards, industry-specific limitations, and compatible pollutants. The legal authority to implement and enforce the IPP is specified in the City's Wastewater Control Regulations. The Industrial Waste Unit (IWU) has the responsibility for implementing and enforcing these regulations.

As discussed in Section 3.2 of this report, the City currently has interjurisdictional agreements with ten outlying municipalities/authorities. The contracts with Philadelphia to treat and dispose of wastewater stipulate that the municipalities/authorities adopt PWD ordinances and regulations with regard to the IPP. As these contracts came up for renewal, changes were made which allows PWD the authority to monitor and enforce these ordinances. PWD monitors, inspects, and when necessary, enforces penalties against industries in these outlying municipalities.

Currently, the IWU consists of a Manager, who is also the Pretreatment Coordinator, the Manager's assistant, two engineers, four permit administrators, and eight technicians. In addition, a pretreatment attorney handles legal responsibilities and is involved in fine assessments. Field work, which is the responsibility of the permit administrators and their staff of technicians, includes sampling, routine inspections, comprehensive process inspection, and spill responses.

4.4.1.1 Prohibited Pollutants

Prohibited pollutants are those that present a safety hazard. In addition to the general and specific prohibitions established by the City for discharges to the sewer system, it was necessary to incorporate certain federal pretreatment regulations into the ordinance. State requirements and limitations apply in any case where they are more stringent than federal regulations. The City reserves the right to impose even more stringent limitations than the federal and state guidelines. These regulations prohibit discharging into the sewer system the following substances:

1. Volatile organic compounds

2. Any grease, oil, or other substance that will become solid or viscous and obstruct flow to the treatment works or interfere with the treatment processes

3. Any wastewater with pH lower than 5.5 or greater than 12.0 or having other corrosive properties capable of causing structural damage or hazard to the sewers or treatment works

4. Any wastewater of such character or quantity that it causes interference with the treatment processes

5. Any wastewater containing noxious or malodorous materials which, either singly or by interaction with other wastes, are capable of creating a public nuisance

6. Any substance that may cause WPCP effluent or by-products, such as residues, sludge, or scum, to be unsuitable for reclamation or reuse, or any substance that will interfere with the reclamation process

7. Any substance that will cause the WPCP to violate its NPDES permit or water quality standards

8. Any wastewater with objectionable color not removed in the treatment process

9. Any wastewater having a temperature higher than 40°C (104°F)

10. Any pollutants, including oxygen demanding pollutants (BOD_5, etc.) and suspended solids, released at a flow rate and/or concentration that the user knows will cause interference or pass through to the treatment plant.

11. Any radioactive wastes, except in conformance with federal and state regulations

12. Any wastewater that causes a hazard to human life or creates a public nuisance

13. Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through at the treatment plant

14. Any wastewater containing substances that solidify or become viscous between 32° and 150°F

15. Any trucked or hauled wastewater, except at discharge points designated by PWD

16. Pollutants that will result in the generation of toxic gases, vapors, or fumes within the sewer system or treatment plant in a quantity that may cause acute worker health and/or safety problems

17. Any wastewater with a flashpoint less than 140°F

18. Any wastewater where there is a significant likelihood of producing toxic effects to biota in the receiving body

Volatile organic compounds include gasoline, kerosene, naphtha, benzene, toluene, xylene, ethers, alcohols, ketones, and aldehydes. Prohibited explosive and flammable materials include peroxides, chlorates, perchlorates, bromides, carbides, hydrides, and sulfides. Table 4.4.1 is a list of those materials that the City specifically prohibits from being discharged to the sewer system without prior written permission from the City. Furthermore, the City reserves the right to modify this list should new state or federal regulations be enacted.

4.4.1.2 General Pretreatment Limitations

Limitations for certain pollutants, such as heavy metals, apply to all Industrial/Categorical Users. Categorical Users are those which discharge wastewater from a federally regulated process (see Section 4.4.1.3). While Table 4.4.1 lists substances that are prohibited from being discharged into the sewer system in any amounts, the following list of toxic substances may be discharged within the specified maximum levels:

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TABLE 4.4.1

MATERIALS PROHIBITED FROM DISCHARGE

Acrylonitrile	o-Chlorotoluene
Aldrin	o-Dichlorobenzene
Alpha BHC	p-Chlorotoluene
Aluminum	para-Dichlorobenzene
Barium	PCB-1248
Benzene	PCB-1260
Benzo (a) pyrene	Phenanthrene
Benzotrichloride	Phenols
Beryllium	Pyrene
Bis (2-ethylhexyl) phthalate (DEHP)	Styrene
Bromobenzene	Tetrachloroethylene (Perchloroethylene)
Bromodichloromethane	Tin
Bromoform	Titanium
Carbon tetrachloride	Toluene
Chlordane	Toxaphene (chlorinated camphene)
Chlorobenzene	Trichloroethylene
Chlorodibromomethane	Vinyl chloride
Chloroehtane	1,1,1,2-Tetrachloroethane
Chloroform	1,1,2,2-Tetrachloroethane
Cumene	1,1,2-Trichloroethane
DDT/DDE/DDD	1,1-Dichloroethane
Dibutylphthalate	1,1-Dichloroethlyene
Dichlorobromomethane	1,1 Dichloropropene
Dichloroethyl ether (Bis(2-chloroeth	1,2 trans, dichloroethylene
Dieldrin	1,2,3-Trichloropropane
diisobutylenes	1,2-cis, dichloroethylene
Dimethylnitrosamine	1,2-Dibromo-3-Chloropropane
Ethylbenzene	1,2-Dichloroethane
Heptachlor	1,2-Dichloropropane
Hexachlorobenzene	1,3 Dichloropropane
Hexachlorobutadiene	1,3-Dichloropropene
Iron	1,4-Dichlorobenzene (p)
Isopropylbenzene	2-Chlorophenol
Lindane	2,2-Dichloropropane
M-Dichlorobenzene	2,4-Dinitrophenol
Methyl chloride (Chloromethane)	2,4-Dinitrotoluene
Molybdenum	3,3-Dichlorobenzidiene
o,m,p-Xylenes	

	Daily Maximum (mg/l)	Monthly Average (mg/l)
arsenic	0.01	0.005
cadmium	0.2	0.1
copper	4.5	2.7
lead	0.69	0.43
mercury	0.01	0.005
nickel	4.1	2.6
silver	0.43	0.24
total chromium	7.0	4.0
zinc	4.2	2.6
selenium	0.2	0.1

In addition to the limits for the above toxic parameters, the City has also set maximum discharge limitations for the following pollutants:

free chlorine and/or free ammonia	5 mg/l
hydrogen sulfide	2 mg/l
cyanide	10 mg/l total cyanide 2 mg/l of cyanide readily released at 150°F and pH 4.5
fats, oil, and greases (petroleum or mineral)	100 mg/l

The City also reserves the right to establish more stringent limitations on wastewater discharges if necessary to meet the objectives stated above.

4.4.1.3 Categorical Standards

These standards are set by the EPA and are published in the *Federal Register* for selected categorical industries. Categorical users are those which discharge wastewater from a federally regulated process. Those industries that are subject to the federal standards are listed in Table 4.4.2. In addition to establishing numerical limits on discharges from these industries, EPA has also set reporting requirements for categorical users. The City of Philadelphia has identified approximately 85 categorical users within the drainage basin of PWD.

4.4.1.4 Industry-Specific Limitations

These limitations apply to SIUs identified in the IPP and are included in the connection permit for each SIU. They may be more stringent than the general discharge limitations cited in the Wastewater Control Regulations. The industry-specific limits may also be more stringent than the categorical standards established by EPA.

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TABLE 4.4.2

INDUSTRIAL CATEGORIES SUBJECT TO NATIONAL CATEGORICAL PRETREATMENT STANDARDS

Aluminum Forming	Meat Processing
Asbestos Manufacturing	Metal Finishing
Battery Manufacturing	Metal Molding and Casting
Builder's Paper	Nonferrous Metals Forming
Carbon Black	Nonferrous Metals Manufacturing
Cement Manufacturing	Paint Formulating
Coil Coating	Paving and Roofing (Tars and Asphalt)
Copper Forming	Pesticides
Dairy Products Processing	Petroleum Refining
Electrical and Electronic Components	Pharamaceuticals
Electroplating	Phosphate Manufacturing
Feedlots	Porcelain Enameling
Ferroalloy Manufacturing	Pulp and Paper
Fertilizer Manufacturing	Rubber Processing
Fruits and Vegetables Processing/Manufacturing	Seafood Processing
Glass Manufacturing	Soaps and Detergents Manufacturing
Grain Mills Manufacturing	Steam Electric
Ink Formulating	Sugar Processing
Inorganic Chemicals	Timber Products Manufacutring
Iron and Steel Manufacturing	Plastics Molding and Forming
Leather Tanning and Finishing	Textile Mills

4.4.1.5 Compatible Pollutants

Compatible pollutants such as BOD_5, suspended solids, nitrogen, and phosphorus can be treated by the WPCPs. However, industries that discharge very high quantities of these compatible pollutants are generally subject to surcharges to recover the treatment costs incurred from treating these high strength wastes.

4.4.2 Significant Industrial Users

Not all industrial contributors to the Philadelphia wastewater collection and treatment system are Significant Industrial Users (SIUs). An SIU is defined as one which (1) discharges to the City sewer system an average of 25,000 gallons or more per day of process wastewater, or contributes five percent or more of the average dry weather capacity of the WPCP; or (2) has in its wastes, toxic pollutants as defined pursuant to Section 307 of the Clean Water Act, or Pennsylvania Statutes and Rules; or (3) is found by the City, PADER, or EPA to have the potential for significant impact, either singly or in combination with other contributing users, on the wastewater treatment system, the quality of sludge, the treatment plant effluent quality, or through air emissions generated by or from the system; or (4) is categorically regulated by the Clean Water Act.

Potential SIUs are identified through database searches, directories, referrals, permit applications and interjurisdictional agreements. PWD's Engineering Support Group and the Manager of the IWU are responsible for screening all industrial and other non-domestic dischargers to determine if they should be classified as SIUs.

Other users have been classified as Significant because of high flow, high strength, or use of toxic substances not regulated elsewhere. The City has issued approximately 150 pretreatment permits to SIUs; however, it is expected that more will be issued due to the fact that the process flow discharge limit has recently been reduced to 25,000 gpd. Previously, the flow discharge limit was 50,000 gpd of total wastewater in excess of 350 ppm BOD_5 and/or 400 ppm suspended solids. A list of all categorical and other significant users is included in Appendix H.

In addition, PADER has issued NPDES permits to 33 industries within the City limits. The NPDES permits govern process discharges from these facilities; the City has not currently been delegated the responsibility for monitoring these users which are also listed in Appendix C.

4.4.3 Enforcement Response Plan

In addition to developing and implementing the IPP, the City of Philadelphia has the responsibility for enforcing all pretreatment requirements as specified in the Wastewater Control Regulations. The City's Enforcement Response Plan (ERP) establishes the guidelines for ensuring that this responsibility is met in a consistent, systematic, and timely manner. The goals as stated in the ERP are:

- To identify all instances of non-compliance with the pretreatment requirements

- To ensure that the industrial user returns to compliance as quickly as possible and to ensure its continuing compliance thereafter

- To penalize industrial users for their violations of the pretreatment requirements

- To deter future violations of the pretreatment requirements; and

- To recover any expenses incurred by the PWD attributable to an industrial user's non-compliance.

4.4.3.1 Non-Compliance Identification

As specified in the ERP, the Permit Administrator and the Manager of the IWU within PWD are charged with the responsibility of determining non-compliance. Any user subject to pretreatment standards must periodically submit to PWD a report indicating the nature and concentration of all pollutants in the wastewater discharge from regulated processes and the average and maximum daily flow from the process units limited by pretreatment standards and requirements. The user must provide monitoring facilities to allow inspection, sampling, and flow measurements of the building sewer and/or internal drainage systems. The Permit Administrator must review all SIU reports and take samples at least once each reporting period. Although the Permit Administrator must inspect all SIUs at least once every calendar year, he/she may conduct as many inspections as necessary to ensure the SIU is conforming to all requirements of the IPP and to confirm measures taken to ensure compliance, including inspections of storage, pretreatment, and process facilities. Non-categorical or inactive industries are inspected every three to five years. Non-categorical industries are those which are not subject to federal standards as published in the *Federal Register*. Inactive industries are those which have suspended operation of regulated processes. The Permit Administrator monitors compliance schedules, when issued, and maintains supporting documentation regarding SIUs.

4.4.3.2 Enforcement Response

The ERP provides for typical responses to specific violations of the pretreatment requirements. A violation is an exceedance of effluent limits of a given parameter. A significant violation occurs when the concentration of a pollutant is twice the permitted limit for that pollutant. The ERP also describes the criteria for defining Significant Non-Compliance (SNC). SNC is defined as either two significant violations within a 45-day period or when over five percent of data per parameter collected within a 6-month period is in violation. When limits are set on the basis of a production-based standard, a significant violation is defined as a 20 percent exceedance of the production standard. The following types of violations are subject to the ERP:

- Effluent limit violations
- WPCP verification sampling violations
- Self-monitoring (sampling) violations
- Reporting violations
- Compliance schedule violations

- Unauthorized discharge (no permit)
- Other permit violations

Violations of pretreatment requirements that constitute SNC are subject to strong and immediate enforcement response as stipulated in the ERP. Specific time frames have been established requiring response by the SIU to each type of violation including those constituting SNC. The first step in enforcement response is notification of violation. After notification, the response may take the form of implementation of a compliance schedule, formal civil litigation, fines and damage costs, revocation of permit, termination of service and referral for criminal prosecution, depending on the severity of the violation and the cooperation of the permittee.

Some violations result in mandatory fines of the industrial users, while fines for other violations are discretionary. The Home Rule Charter for the City limits fines to $300 per day per violation; however, House Bill No. 795 of the General Assembly of Pennsylvania, passed in 1992, provides for enhanced penalty authority for Publicly Owned Treatment Works (POTWs) which can assess fines up to $25,000 per day per violation and follows a Civil Penalty Assessment Policy Document.

Compliance schedules establish milestone dates for completion of specific tasks leading to full compliance. Compliance schedules are most often instituted in cases of effluent limit violations, although they may be necessary in other instances of non-compliance. The Enforcement Response Plan for the City of Philadelphia is contained in Appendix L.

4.4.4 Sludge

In response to more stringent sludge quality requirements for land disposal of processed sludge as discussed in Section 4.3, PWD has made concentrated efforts to improve sludge quality. These efforts include the IPP, which has contributed to success in heavy metal reduction. Organics have dropped significantly with the IPP mandated by federal regulations.

Substantial revisions to the City's Wastewater Control Regulations will be submitted to EPA for approval in 1993. Also being considered are more stringent regulations to address the problem of discharges of volatile organic substances because they cause headworks odor problems and interfere with normal plant maintenance.

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5.0 PROJECTION OF FUTURE CONDITIONS

5.1 GENERAL

5.1.1 Background

The objectives of this chapter are (1) to identify the 5-year wastewater needs of the Philadelphia wastewater system and (2) to determine the long-term trends that may be expected within the greater Philadelphia service area. Projections of future wastewater flows and loadings within the service areas of each of the City's three Water Pollution Control Plants are essential in determining both the short (5 year) and long (10- to 20-year) term needs. Consistent with previous planning for the City of Philadelphia, these projections of future wastewater flows and loadings rely upon the anticipated future population of each service area as the primary gauge of future needs. The following provides a detailed description of the methodology used to develop the forecasted wastewater flows and loadings for both the City of Philadelphia and, to an extent, the ten outlying municipalities/authorities that contribute flow to the Philadelphia wastewater system.

Previous planning documents generated for facilities within Philadelphia have relied exclusively on population counts to evaluate and project wastewater flow and loadings. Comprehensive population projections were provided in the Facility Reports for each of the City's three Water Pollution Control Plants (WPCPs) in the early 1970s (summary of reports provided in Section 2.5.1) and were used to develop the design criteria for the upgrade of the WPCPs from primary to secondary treatment. Per capita wastewater flows and loadings were calculated and used along with the projected populations for each service area to arrive at projected flows, loadings, and design criteria for the WPCPs.

Following the implementation of the upgrades in the 1970s to the WPCPs, the 1980 census reflected a large percentage decrease in population that did not support the population projected in the WPCP Design Reports. The population projections were, therefore, revised to reflect this more significant decline by letter to Mr. John Kennedy, PADER, from Mr. Thomas Walton, PWD dated April 4, 1983 (see Section 2.5.1.4 for summary). The revised population projections presented in Mr. Walton's letter basically halved the percent decrease experienced in Philadelphia during the 1970s for the 1980s and then halved again for every decade afterward. Furthermore, the facilities that remained to be upgraded to secondary treatment at the Northeast and Southwest WPCPs were down-sized to reflect the lower expected wastewater flows and loadings. The 201 Facility Plan for Sludge Management, June 1984 (see Section 2.5.1.6 for summary) that was used to develop design criteria for the Sludge Processing and Distribution Center also reflects these revised population projections.

The population projections provided in the WPCP Facility Plans and 201 Sludge Management Plan described above were based on the population density and resultant population of each of the WPCP service areas to derive flows and loadings. Population densities were derived for regions within the service area, as well as per capita flows and loadings. The densities were then projected to some future level with total populations and wastewater quantities being derived from the projected population density using the per capita flow and loading production level. It is important to note that the wastewater flows and loadings were not determined from separate categorical users within the system. The per capita flows and loadings developed in these documents included allowance for flows from domestic, industrial, commercial, institutional, inflow, and infiltration sources.

5.1.2 Methodology

Wastewater production, characteristics, and trending over time will differ in proportion to the various wastewater sources within the system. More accurate and meaningful results can usually be achieved if the total wastewater flows are broken down into the categorical sources and separate projections performed on each to forecast the total future flows, an approach required by PADER's current sewage facilities planning regulations. This report attempts to provide a logical method for this breakdown of total wastewater flows into component sources and to project future flows based upon the component parts. From the projected wastewater flow and loadings, the 5-year needs will be identified and long-term trends forecasted in Chapter 6.

The primary sources of information used in these population and wastewater flows projections include:

- Facility Reports for each of the Water Pollution Control Plants (circa early 1970s)
- 1990 U.S. Census Data
- Population projections for 1996 provided by the National Planning Data Corporation
- Draft population projections from the DVRPC as well as the planning commissions for Bucks, Delaware, and Montgomery counties.
- Sewer System Evaluation Surveys for each of the WPCP service areas (circa early 1980s)
- Monthly flow records for a 3-year period from the three WPCPs for 1989 to 1991

Since the information compiled in these projections is from several different sources and periods in time, there will be some inherent discrepancies in the cross referencing of data. However, the following methodology to minimize these discrepancies has resulted in a comprehensive projection of future population, wastewater flows, and loadings.

5.1.3 Categorical Use within Philadelphia

As mentioned above, the accuracy and meaningfulness of wastewater projections are increased when the wastewater flows are categorized, separate projections are made for each category, and the separate projections combined to arrive at a total projected flow. Typical categories used in wastewater projections include:

- Domestic - (or residential) wastewater flow is from domiciles. All wastewater generated from normal living habits and activities of an apartment dweller or homeowner are included in the domestic classification.

- Commercial - wastewater flow from laundries, restaurants, office facilities, and other commercial establishments associated with residential communities and business centers.

- Industrial - wastewater that emanates from industrial and manufacturing facilities. This wastewater includes sanitary, cafeteria, and cleanup wastes as well as process wastewater from these facilities.

- Institutional - wastewater generated from sources not included in the other classifications, including that from schools, colleges, universities (both resident and non-resident), nursing homes, hospitals, prisons, etc. Institutional wastewater is primarily sanitary wastes.

- Infiltration - flows primarily originate from groundwater seeping into the collection system, and it has been evaluated and quantified within this report as described above.

The most effective method to break the origin of wastewater into the categorical users described above is to reference and compile water supply accounts that are categorized by user type and thereafter to make a determination of the percentage of potable water that is returned to the collection system. This direct method of determining categorical users is only effective if the water utility has its accounts arranged to identify the user type, which unfortunately the PWD does not.. However, as a part of their methodology in identifying infiltration flows, the SSES reports (see Section 2.5.2 and Section 5.1.2) did categorize the sources of wastewater into Domestic and Industrial users. In the case of these SSES reports, the industrial classification included the commercial, industrial, and institutional categories described above. Therefore, the SSES reports represent the most recent and comprehensive breakdown available of wastewater flows from their component sources. This report utilizes the breakdown of flows contained in the SSESs to describe existing flows and similarly combines the industrial, commercial, and institutional flows into one category hereafter referred to as ICI (Industrial, Commercial, and Institutional) for purposes of future projections. Section 5.3 of this Plan provides a tabulation of the component flows to each of the WPCPs and derives domestic per capita wastewater production by dividing the domestic flow category by the population within the City served by each WPCP as defined by the 1990 Census Data.

The Northeast WPCP and Southwest WPCP SSES reports provide a breakdown of the actual wastewater flows based on the domestic and ICI categories that can be directly applied to this analysis, while the SSES report for the Southeast WPCP provides a breakdown of the wastewater sources by land use categories. In the latter case, the breakdown of the wastewater flows by land use (by acreage and percentages) is not particularly helpful to this analysis since a direct correlation between land use and wastewater production cannot be made. An additional consideration in developing the information presented is that the wastewater flows and categorical breakdown found in the SSESs is based on the base flows measured during the development of the SSESs in the late 1970s to mid 1980s. As this is the only data available, it was necessary to assume that the proportions of the domestic and ICI flows within each service area did not change over this period in time. The percentage of the wastewater flow from each source within the City (excluding infiltration) was then extrapolated to the current base flows to arrive at a categorical flow rate for each source of flow, domestic and ICI. With this completed, domestic per capita flow rates were calculated for the Northeast and Southwest WPCP service areas. In order to derive the domestic and ICI wastewater usage for the Southeast WPCP service area, the domestic per capita flow rates for the surrounding service areas (Northeast and Southwest) were averaged and applied to the Southeast service area's 1990 population to arrive at a domestic flow rate for this service area. The ICI flow rate was then derived by subtracting the domestic from the total averaged base flow (minus infiltration) generated within the service area for the period covering 1989 to 1991.

It is upon this framework that future growth and development trends have been assessed, based not only on the primary sources of information identified above but also upon many other sources including, but not limited to, the City of Philadelphia Planning Commission, Delaware Valley Regional Planning Commission (DVRPC), and Philadelphia Industrial Development Corporation (PIDC). It is noted that the Land Use Planning Reports prepared by the Philadelphia Planning Commission (see Section 2.5.3 for summary) have been reviewed for their relevance to population and growth projections. These studies primarily showed the growth potential for select areas within the City, but they did not include mention of specific projects nor projected growth; therefore, other than for purposes of a subjective evaluation, data was not available for use in development of projected populations and wastewater flows.

The scope of this Act 537 Plan specifically called for a focus on the Philadelphia County needs and projects. To the extent that information was available from the outlying county planning commissions, growth trends and/or population projections were obtained and considered primarily in the 5 year needs. However, the thrust of the information from outside the City of Philadelphia was taken in the context of the current agreements for allocated capacity.

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5.2 FUTURE GROWTH AND DEVELOPMENT TRENDS

Based upon U.S. Census Information, in 1950 Philadelphia reached a peak total population of 2,071,605 persons. Since then, according to the 1990 U.S. Census figure of 1,585,577, the City's population has declined by 23.5 percent, a loss of 486,028 persons. The decade with the largest percentage decline was from 1970 to 1980 with a drop of 13.4 percent. The 1990 Census indicates a leveling-off of the rate of decline with a drop of 6.1 percent since 1980.

The decline in population in Philadelphia is common to many large cities in the United States, reflecting a societal and demographic trend away from the large cities and concentrated population centers. This trend is expected to continue at a stabilized rate over the next several decades. However, successful redevelopment and revitalization programs have and will continue to be developed within the City, which will offset, to some extent these residential trends.

5.2.1 City of Philadelphia

To forecast population changes within the City of Philadelphia, this Plan utilizes population projections from the National Planning Data Corporation. No other source of population projections for the City has been identified at the time of preparation of this report. The National Planning Data Corporation has projected population change within the City from 1990 to 1996. In order to forecast population changes within the City to the year 2015, BCM has assumed that the rate of change projected for each of the twelve planning analysis sections from 1990 to 1996, which reflects the leveled-off population decline rate, will remain constant to the year 2010.

The results of the analysis are shown in Table 5.2.1 and Figure 5.2-1. Based upon the stated methodology, the City of Philadelphia population served by the Northeast Water Pollution Control Plant is forecast to be 750,800 persons in 1996; 744,300 persons in the year 2000; 728,300 persons in the year 2010; and 720,600 in the year 2015. The City population served by the Southeast Water Population Control Plant is forecast to be 333,800 persons in 1996; 325,200 persons in the year 2000; 305,000 persons in the year 2010; and 296,300 persons in the year 2015. The City population served by the Southwest Water Pollution Control Plant is forecast to be 466,700 persons in 1996; 485,800 persons in the year 2000; 439,500 persons in the year 2010; and 430,400 persons in the year 2015.

It is our opinion, based upon discussions with City and regional planning and development officials, that these forecasts may not necessarily be the most accurate barometer of future development activity in the City. This is particularly the case for the area served by the Southeast Water Pollution Control Plant. It is anticipated that Center City will continue to show positive development trends as the Convention Center project proceeds to completion. Therefore, the Center City area deserves further evaluation.

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TABLE 5.2.1

PHILADELPHIA COUNTY POPULATION FORECASTS BY PLANNING SECTION

NEWPCP Planning Section	1990	1996	Percent Change 90-96	Percent Change Per Year	2000	Projections 2010	2015
E	279	269	-4.00%	-0.67%	262	244	236
F	64,878	63,306	-2.48%	-0.41%	62,258	59,681	58,446
G	62,973	61,854	-1.81%	-0.30%	61,108	59,265	58,371
I	60,728	58,899	-3.11%	-0.52%	57,680	54,695	53,279
J	173,794	172,095	-0.99%	-0.16%	170,963	168,150	166,767
K	237,251	234,170	-1.32%	-0.22%	232,116	227,026	224,537
L	160,547	160,158	-0.24%	-0.04%	159,899	159,251	158,929
Total	**760,451**	**750,751**			**744,285**	**728,312**	**720,566**

SEWPCP Planning Section	1990	1996	Percent Change 90-96	Percent Change Per Year	2000	Projections 2010	2015
A	38,913	40,856	4.76%	0.79%	42,152	45,494	47,298
B	92,312	88,581	-4.21%	-0.70%	86,094	80,051	77,241
E	122,516	112,924	-8.49%	-1.42%	106,530	91,449	84,976
F	27,457	27,639	0.66%	0.11%	27,760	28,065	28,218
G	31,742	30,798	-3.06%	-0.51%	30,169	28,628	27,897
I	30,957	30,317	-2.11%	-0.35%	29,890	28,838	28,331
J	2,756	2,663	-3.50%	-0.58%	2,600	2,449	2,377
Total	**346,651**	**333,777**			**325,195**	**304,974**	**296,339**

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TABLE 5.2.1 (Continued)

SWWPCP Planning Section	1990	1996	Percent Change 90-96	Percent Change Per Year	2000	**Projections** 2010	2015
A	6,733	6,478	-3.94%	-0.66%	6,308	5,895	5,7018
B	78,632	75,547	-4.08%	-0.68%	73,490	68,488	66,157
C	81,885	80,440	-1.80%	-0.30%	79,477	77,097	75,943
D	219,713	215,529	-1.94%	-0.32%	212,740	205,857	202,526
E	23,696	22,528	-5.18%	-0.86%	21,750	19,871	19,013
F	13,710	12,909	-6.20%	-1.03%	12,376	11,096	10,522
H	42,525	41,547	-2.35%	-0.39%	40,895	39,291	38,520
I	11,581	11,681	0.86%	0.14%	11,748	11,915	12,000
Total	**478,475**	**466,660**			**458,783**	**439,509**	**430,383**

Based on projections obtained from National Planning Data Corp. (1991).

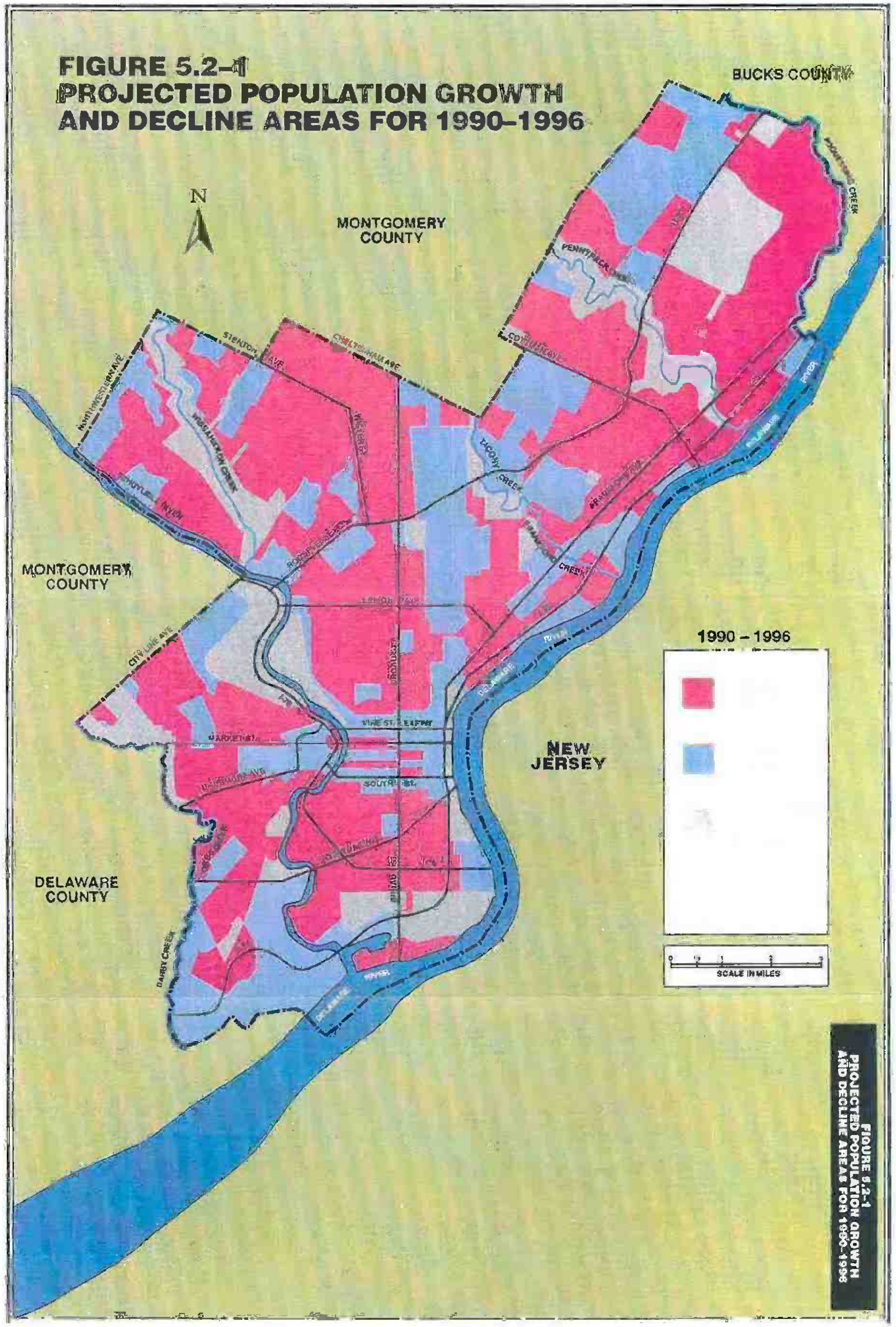

FIGURE 5.2-1
PROJECTED POPULATION GROWTH AND DECLINE AREAS FOR 1990-1996

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The City of Philadelphia Planning Commission has inventoried 55 potential development projects in Center City, these are listed in Appendix M, Center City Project Inventory - 1992. Selected highlights of that inventory include:

Northwest Quadrangle

- Forest City Dillon - 19th and Hamilton, 350 units of elderly housing
- Museum Towers II - 18th and 19th Streets, 400 units of residential housing and a supermarket
- Franklintown Boulevard - 400 units of residential housing, 2,000,000 square feet, mixed use

Southwest Quadrangle

- Orchestra Hall - Broad and Spruce Streets - 3,000 - 4,000 seats and mixed use development
- Meridian Tower - 800,000 square feet of office space

East of Broad Street

- Spectrum II Sports and Entertainment Complex - 21,000 seats
- Federal Detention Center - 750 beds
- City Justice Center
- Convention Center - 400,000 plus square feet
- Gallery II - 1,000,000 square feet of office space
- Gimbels Site - 8th and 9th Streets/Market Street - 2,000,000 square feet of office space
- Delaware River Waterfront - Piers 3, 5, 9, 11, 24, 25, and residential housing and commercial use

In addition to University City and Center City, commercial, residential, and industrial development is expected to occur in the Northeast and Southwest; however, based upon discussion with City development officials, rates of growth will be slower than that of Center City.

According to City development officials, prior to the recent recession, commercial space in Center City was being absorbed at a rate of about 1,000,000 square feet per year. With the predicted economic recovery, absorption rates could once again approach those levels.

As noted in Section 5.1, not all categorical sources of flows at the WPCPs are proportional to the population. For instance, infiltration is not significantly proportional nor are the ICI flows directly contingent on population levels. The purpose of breaking down the flows of the WPCPs is to provide a more realistic analysis of how these flows will vary with the decreasing population. There is, however, some correlation of ICI flows to population levels; people shop in the commercial establishments, work in the industries and manufacturing plants, and attend the institutional facilities. With a decreasing population, we may conclude that the ICI may decrease in a proportional amount. However, as noted above, this may not provide an accurate projection of the potential ICI growth within the City. To compensate for both the potential decrease and the possible growth from projects discussed above, we project the proportion of ICI flow to remain constant.

5.2.2 Contributing Municipalities

To forecast population changes within the contributing municipalities, BCM obtained draft population projections from the Delaware Valley Regional Planning Commission as well as the planning commissions for Bucks, Delaware, and Montgomery Counties. These projections are not considered official, but are the best information available at the time of preparation of this report. The draft projections have been forwarded to the suburban counties for review and comment, but will not become official until subsequent to that review. We will, however, utilize these projections for planning purposes. Table 5.2.2 tabulates the population projections to the year 2020.

5.2.2.1 Montgomery County

Montgomery County contributing municipalities are projected to lose population as a whole by roughly 1.1 percent from 1990 to the year 2000; 1.6 percent from the year 2000 to 2010; and 1.9 percent from the year 2010 to the year 2020.

These townships are established communities that anticipate little or no growth over the 5-year planning period. As shown in Table 3.2.1, Abington, Cheltenham, Lower Merion, and Lower Moreland have contributed wastewater flows well below those stipulated in their agreements for the past two years.

Abington Township is currently preparing an Official Act 537 Plan Revision to determine future wastewater treatment needs, in particular, alternatives for handling flows from the currently overloaded Abington Township WWTP and several existing private treatment facilities. Should Abington decide to proceed with diversion of flows in those areas, there may be an increase in flow to the PWD system, i.e., the NEWPCP; however, it is not anticipated that this additional flow will be in excess of the current capacity agreement since this agreement originally considered saturation (build-out) densities.

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TABLE 5.2.2

CONTRIBUTING MUNICIPALITIES POPULATION FORECASTS 1990 TO 2020

	1990 US Census	2000	2010	2020
Montgomery County				
Abington	56,322	56,341	55,627	53,710
Cheltenham	34,923	34,023	33,511	32,919
Lower Merion	58,003	57,432	56,349	55,663
Lower Moreland	11,768	12,029	11,789	11,805
Springfield	19,612	18,737	18,303	18,065
Subtotal	**180,628**	**178,562**	**175,579**	**172,162**
Bucks County				
Bensalem Township	56,788	60,625	61,975	60,166
Bristol Township	57,129	55,114	54,400	54,465
Falls Township	34,997	34,386	34,467	33,909
Hulmeville Borough	916	919	917	950
Langhorne Borough	1,361	1,118	1,076	1,059
Langhorne Manor Borough	807	827	826	831
Lower Makefield Township	25,083	28,774	34,815	31,834
Lower Southampton Township	19,860	20,771	21,050	21,951
Middletown Township	43,063	46,315	50,516	53,754
Newtown Borough	2,565	2,442	2,371	2,251
Newtown Township	13,685	18,739	23,240	23,780
Northampton Township	35,406	47,390	49,967	51,062
Penndel Borough	2,703	2,756	2,668	2,533
Subtotal	**294,363**	**320,176**	**338,288**	**338,545**

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TABLE 5.2.2 (Continued)

	1990 US Census	2000	2010	2020
Delaware County				
Darby Township	10,955	10,258	9,626	8,987
Eddystone Borough	2,446	2,349	2,152	1,961
Folcroft Borough	7,506	7,536	7,392	7,214
Glenolden Borough	7,260	7,173	7,103	6,998
Marple Township	23,123	24,078	25,129	26,091
Morton Borough	2,851	3,058	3,288	3,373
Nether Providence Township	13,229	14,185	14,213	14,090
Norwood Borough	6,162	5,872	5,608	5,328
Prospect Park Borough	6,764	6,696	6,644	6,558
Ridley Park Borough	7,592	7,575	7,574	7,535
Ridley Township	31,169	29,282	28,398	27,712
Rutledge Borough	843	807	775	740
Springfield Township	24,160	22,953	21,856	21,585
Swarthmore Borough	6,157	6,169	6,196	6,190
Upper Darby Township	81,177	80,025	78,119	74,751
Subtotal	**231,579**	**228,026**	**224,073**	**219,068**
Total for Contributing Municipalities	**706,570**	**726,764**	**739,940**	**729,775**

Source: Delaware Valley Regional Planning Commission Draft (unofficial) Projections.

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For the past two years, flows from the Erdenheim section of Springfield Township have exceeded those stipulated in the agreement with PWD, and flows from the Wyndmoor area are approaching the agreement limits. This problem will have to be addressed in the near future; however, considering the low flows from these municipalities and the limited amount of potential development, the increased flows will have little impact on the SEWPCP or the SWWPCP by new renegotiated agreements. Moreover, forecasted decreases in population over the 20-year planning period will have a dampening effect on the need to substantially revise the amount of contracted flows and loadings to the Philadelphia WPCPs.

5.2.2.2 Bucks County

Bucks County contributing municipalities are projected to increase population by roughly 8.1 percent from 1990 to the year 2000; 5.7 percent from the year 2000 to the year 2010; and .08 percent from the year 2010 to the year 2020.

As detailed in Section 3.2 of this report, PWD has agreements to treat wastewater from Bensalem Township, Lower Southampton Township, and the Bucks County Water and Sewer Authority (BCWSA). The Bucks County Planning Commission (BCPC) completed a wastewater facilities plan in 1990 that documents the future needs for municipalities within the County. As noted in Section 4.2.1 herein, the flows from BCWSA are conveyed to the Upper Delaware Interceptor via the recently upgraded Neshaminy Interceptor. As stated in the BCWSA Report, the 1990 average wastewater flow from the municipalities contributing to the Neshaminy Interceptor was 16.37 mgd. As shown in Table 3.2.3, the allocated capacity at the NEWPCP for BCWSA is 20 mgd. The BCPC data indicate that the allocated capacity may be exceeded by 1.026 mgd by the year 2000, representing an average need of 21.026 mgd. These flow projections do not include additional flows from existing residential and industrial developments in Northampton Township currently utilizing on-lot disposal systems; according to the BCWSA Report, it is anticipated that these wastewater flows will be treated at the proposed Warwick Township Wastewater Treatment Facility. However, if construction of that facility is delayed or canceled, it is possible that those flows would contribute to the Neshaminy Interceptor, resulting in a further exceedance of the current capacity allocation. Based on the potential flows by the year 2000, it is expected that the agreement with BCWSA and PWD will have to be revised to provide additional capacity. Conversely, Bristol and Lower Makefield Township propose to direct existing and projected wastewater flows from the Neshaminy Interceptor. Should this diversion occur, the BCWSA allocation would still be exceeded by 0.052 mgd by the year 2000 to an average flow of 20.052 mgd. The current allocations would be sufficient if this diversion of flows was coupled with the reduction of I/I and reduced development pressure in the service area. Consideration of these potential measures and those included in the 1990 Report are key to the scope of this report.

The Townships of Bensalem, Lower Southampton, and Upper Southampton contribute wastewater flow to the Poquessing Interceptor, which also discharges to the NEWPCP. The Bucks County Wastewater Facilities Plan states that the 1990 average flow to the NEWPCP from those municipalities was 5.524 mgd, and the projected flow for 2000 is 6.632 mgd, which is well within the combined allocated capacity of these municipalities of 13.27 mgd.

5.2.2.3 Delaware County

Delaware County contributing municipalities are projected to lose population as a whole by roughly 1.4 percent from 1990 to the year 2000; 1.7 percent from the year 2000 to the year 2010; and 2.2 percent from the year 2010 to the year 2020.

As presented in Section 3.2 of this report, PWD has agreements with Upper Darby Borough and the Delaware County Regional Authority (DELCORA). The Central Delaware County Authority (CDCA), the Muckinapates Authority, and the Darby Creek Authority (DCA) are those authorities included in DELCORA that contribute to the PWD system. These service areas are conveyed to the Philadelphia SWWPCP via the Central Delaware Pump Station, Muckinapates Pump Station, and the Darby Creek Pump Station, respectively. All regional planning for this area is primarily conducted by the Delaware County Planning Commission (DCPC) with assistance from DELCORA.

The DCPC is currently conducting an Act 537 Plan for the County. The Countywide Plan has been split into a Western Service Area and an Eastern Service Area, the latter concerning the planning area tributary to Philadelphia. Information from the Planning Commission indicates that the focus of the Eastern Plan is primarily sewer system evaluations, with most construction being redevelopment and in-fill. Furthermore, DELCORA is presently considering the diversion of flows from the Central Delaware County Authority drainage area, which is currently tributary to Philadelphia SWWPCP, to the Chester WWTP in order to optimize operating costs and utilize more of that treatment plant's reserve capacity. This diversion would represent an average flow of approximately 11 mgd, thereby lowering DELCORA's usage of allocated flows from approximately 80 percent to approximately 60 percent. The CDCA and DCA are also currently engaged in storm water management programs and are metering flows to determine the capacity of their sewer systems.

With a negative growth factor, it appears that the current allocations for both DELCORA and Upper Darby are sufficient to meet the future needs of the area. Based on the wastewater flows to PWD from 1990 and 1991, as shown in Table 3.2.3, DELCORA has available capacity of 8.4 to 9.6 mgd, and Upper Darby has available capacity of 2.5 to 5.1 mgd for future flows.

Based upon these projections, Bucks County contributing municipalities will grow, producing increased flows to the Northeast Water Pollution Control Plant. However, the population in contributing municipalities in Delaware County and Montgomery County will decrease slowly and have no appreciable impacts on flows to their respective water pollution plants.

5.3 FORECAST OF FUTURE FLOWS AND WASTELOADS

5.3.1 Base Flows

The first step in the methodology to project future flows is to develop a base flow for each WPCP and outlying municipality/authority upon which future flows will be projected. It is important to recognize that the WPCP capacity must be evaluated first and foremost on a dry weather basis. Any wet weather or storm flow evaluation is only meanful in the context of relative capacity with the collector system and combined sewer overflows. Since approximately 60 percent of the Philadelphia collection system is combined, the WPCPs are subject to storm water flow during many rainfall events. By design, the collection system currently limits the storm water diverted to the WPCPs. Each of the WPCPs is permitted based upon average monthly flows. This is the primary planning parameter used for evaluation of capacity and projection of future flows. The year 1990 was chosen as a base year to evaluate the flows at the plants since accurate census data, recorded flows, and past projections from the Facility Reports of the WPCPs are all available for this year. Monthly average flows for a 3-year period centered around 1990 (1989 - 1991) were used to develop the current base flows from the City and outlying municipalities/authorities. The monthly average daily flows measured at the WPCPs and metered from the outlying municipalities and total rainfall in inches from January 1989 to 1991 is tabulated in Table 5.3.1. The fact that the flows recorded at each of the WPCPs have actually increased over the last decade while the population served by the same plants has decreased can be attributed, at least in part, to the recent efforts of the PWD to increase the delivery of wet weather flow to the WPCPs. Figures 5.3-1, 5.3-2, and 5.3-3 graphically show for the NE, SE, and SW plants respectively, the monthly average flows, maximum monthly average, minimum monthly average for 1981 to 1991. Therefore, in developing a base flow to each WPCP, the effect of rainfall on the flows to the plant must be minimized with regards to the current use of plant capacity. This is especially important in evaluating the reserve capacity of each of the WPCPs since actual wastewater use must be considered without the effects of storm water from the combined collection system. Otherwise, plans made to increase the capacity of the WPCPs, would not differentiate between dry-weather and wet-weather conditions and would effectively be a combined sewer overflow remediation measure more so than a wastewater treatment improvement.

As discussed in Section 6.4.1, the control of combined sewer overflows has been determined to be a significant goal of PADER and one potential solution may be to increase the primary treatment capacity of the WPCPs to handle more wet weather flows. However, the most effective and economical CSO solution has yet to be determined. Therefore, the projection of future wastewater flows at each of the WPCPs is restricted to increased wastewater streams and not the potential of higher rain induced peak flows at the WPCPs caused by the combined sewer system.

Base flows to each WPCP were derived by averaging the monthly average daily flows of the driest month (month with the lowest total rainfall) of each of the three years in question (1989 - 1991). The base flows from the outlying municipalities/authorities were derived in a similar manner by averaging the flow from the outlying municipalities for the same dry months as those evaluated for the plant flows. These baseflows are presented in Table 5.3.2.

Figures 5.3-4 through 5.3-6 graphically show for the WPCPs, respectively, the average monthly flows, average annual flows, maximum monthly flows, and base flows for the period used to determine the current WPCP base flows (1989 to 1991).

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TABLE 5.3.1

AVERAGE MONTHLY FLOWS AT THE WATER POLLUTION CONTROL PLANTS AND MONTHLY RAINFALL AMOUNTS 1989 - 1991

Month	NEWPCP (mgd)	SEWPCP (mgd)	SWWPCP (mgd)	Rainfall (inches)	Comment
1989					
January	176.52	106.17	175.39	2.41	
February	189.62	105.30	175.98	3.25	
March	192.87	105.98	183.64	4.41	
April	192.52	101.98	191.06	2.27	
May	213.52	106.65	207.50	6.76	
June	219.69	112.72	198.32	4.73	
July	218.53	111.64	206.88	9.44	
August	193.80	110.99	181.54	3.92	
September	197.32	112.63	182.10	5.03	
October	197.15	108.43	187.32	3.44	
November	187.28	104.26	180.25	1.79	
December	176.63	104.08	176.14	1.21	Low
Annual Average	**196.29**	**107.57**	**187.18**	**48.66**	**Total**
1990					
January	193.97	102.36	197.37	4.09	
February	194.35	89.70	184.66	1.48	
March	183.56	57.56	171.92	2.59	
April	210.52	96.90	187.24	3.16	
May	201.94	102.92	193.44	6.08	
June	199.00	106.67	196.17	3.39	
July	189.52	109.15	186.74	2.62	
August	200.65	109.28	195.06	4.07	
September	183.13	104.95	178.09	1.71	
October	178.80	98.85	169.47	1.68	
November	179.11	102.68	160.36	1.17	Low
December	195.34	99.51	175.65	3.81	
Annual Average	**192.45**	**101.71**	**181.71**	**35.85**	**Total**

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TABLE 5.3.1 (Continued)

Month	NEWPCP (mgd)	SEWPCP (mgd)	SWWPCP (mgd)	Rainfall (inches)	Comment
1991					
January	203.39	103.78	190.87	4.17	
February	182.36	103.65	171.96	0.75	Low
March	200.81	107.67	186.51	4.06	
April	195.96	107.36	189.34	2.81	
May	191.72	109.09	183.03	1.82	
June	182.36	118.58	184.04	2.94	
July	194.73	113.93	213.88	4.79	
August	198.77	124.87	209.17	3.86	
September	200.81	115.71	206.83	3.56	
October	197.99	104.72	193.75	1.61	
November	187.34	103.07	193.17	1.96	
December	205.17	108.97	206.25	3.86	
Annual Average	**195.12**	**110.12**	**194.07**	**36.19**	**Total**

FIGURE 5.3-1
Northeast Water Pollution Control Plant - Monthly Flow

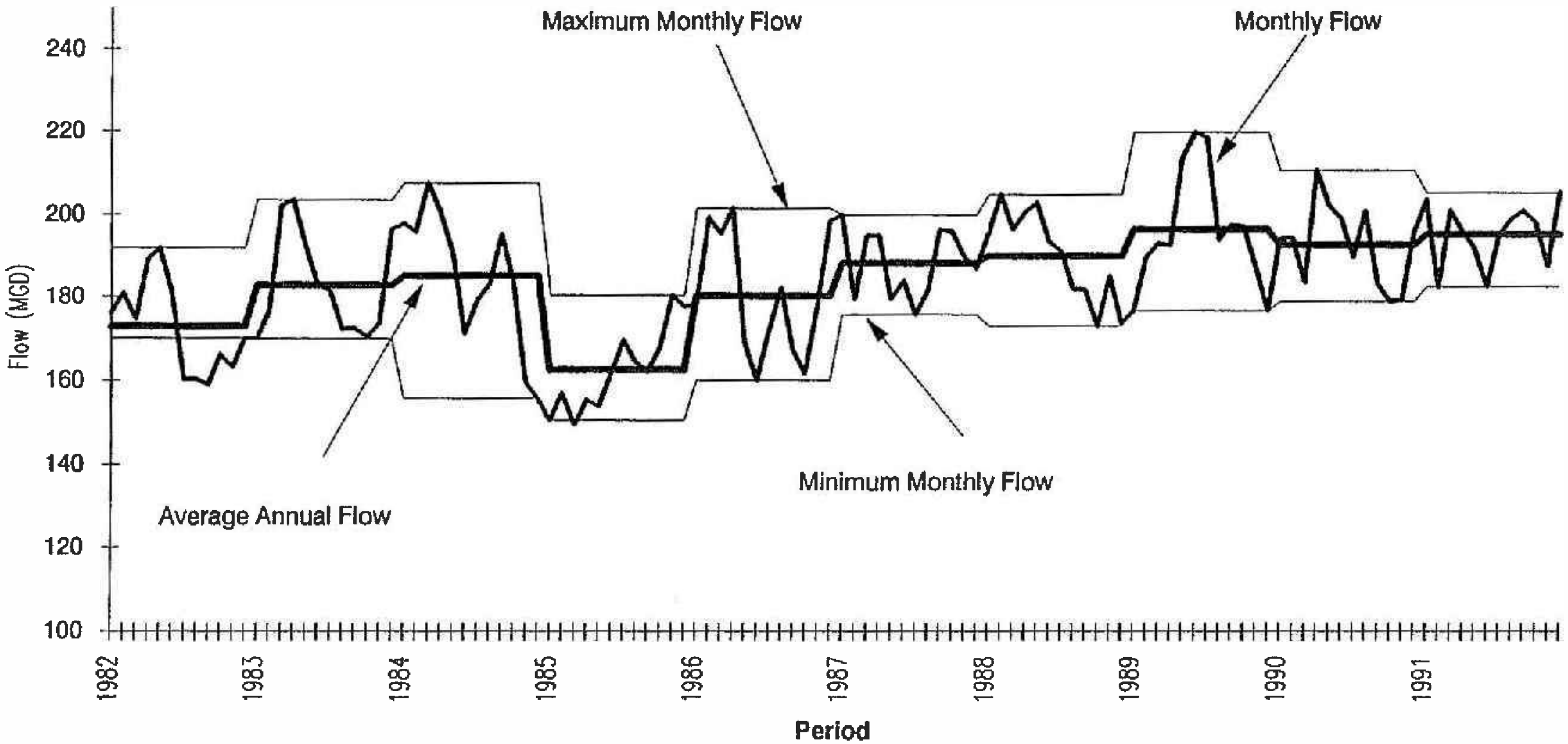

FIGURE 5.3-2
Southeast Water Pollution Control Plant - Monthly Flow

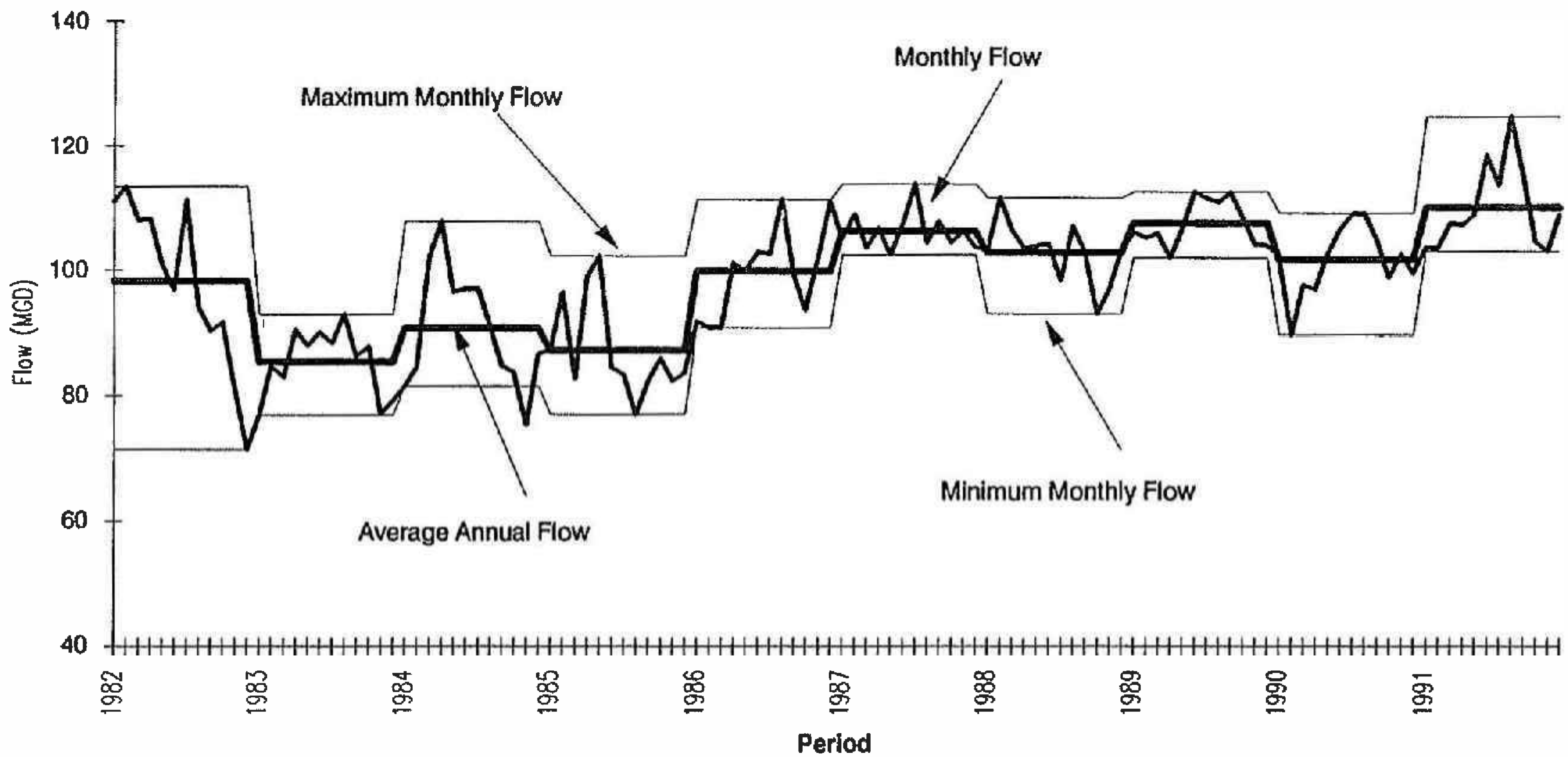

FIGURE 5.3-3
Southwest Water Pollution Control Plant - Monthly Flow

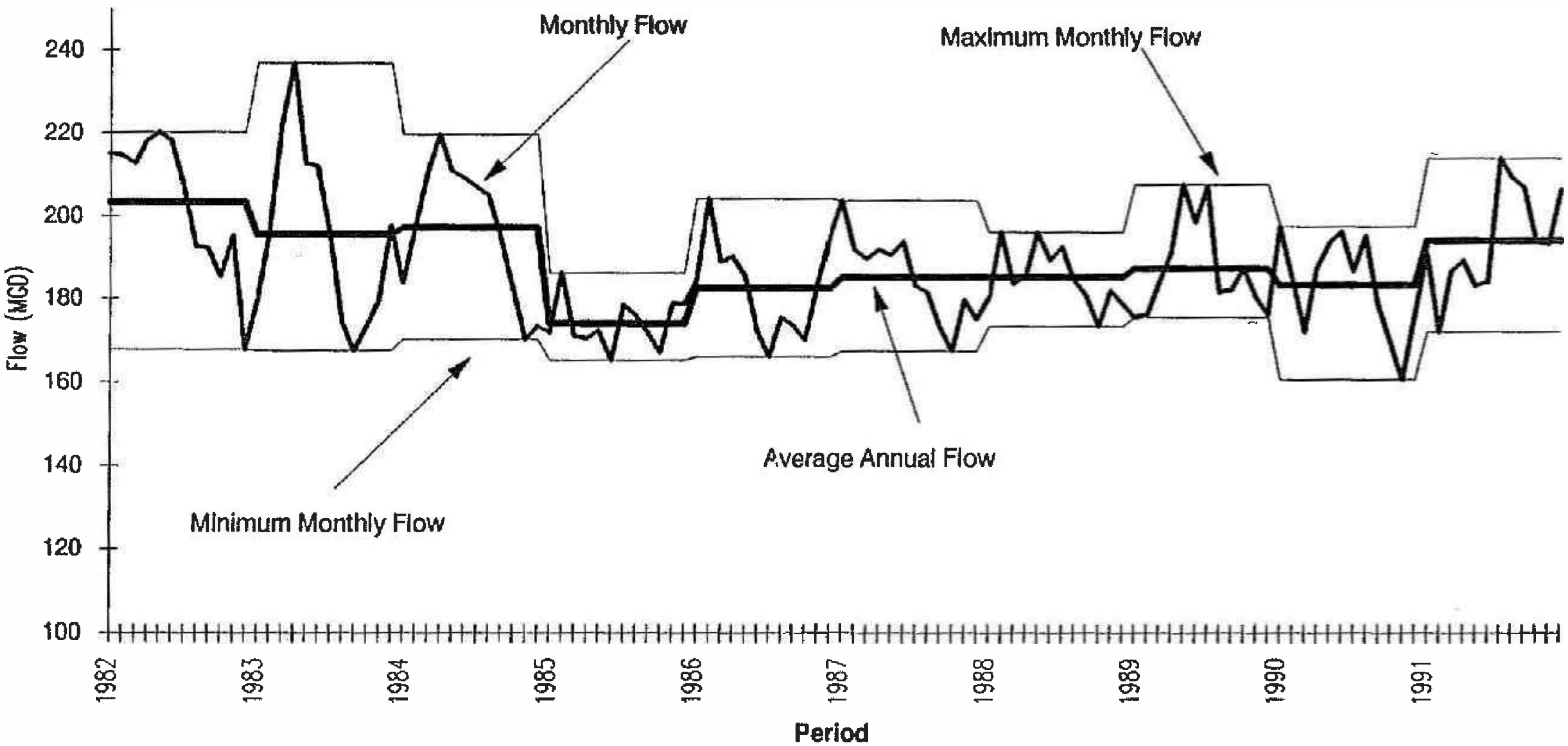

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TABLE 5.3.2

WASTEWATER BASEFLOW DERIVATION FOR EACH OF THE WPCPS

	NEWPCP (mgd)	Outlying Flow (mgd)	SEWPCP (mgd)	Outlying Flow (mgd)	SWWPCP (mgd)	Outlying Flow (mgd)	Rainfall (inches)
December 1989	176.63	31.72	104.08	0.64	176.14	59.83	1.21
November 1990	179.11	32.80	102.68	0.82	160.36	58.15	1.17
February 1991	182.36	35.08	103.65	0.89	171.95	68.15	0.75
Average	**179.4**	**33.2**	**103.5**	**0.8**	**169.5**	**62.0**	**1.04**

FIGURE 5.3-4
Northeast Water Pollution Control Plant -
Monthly Flow Per Day

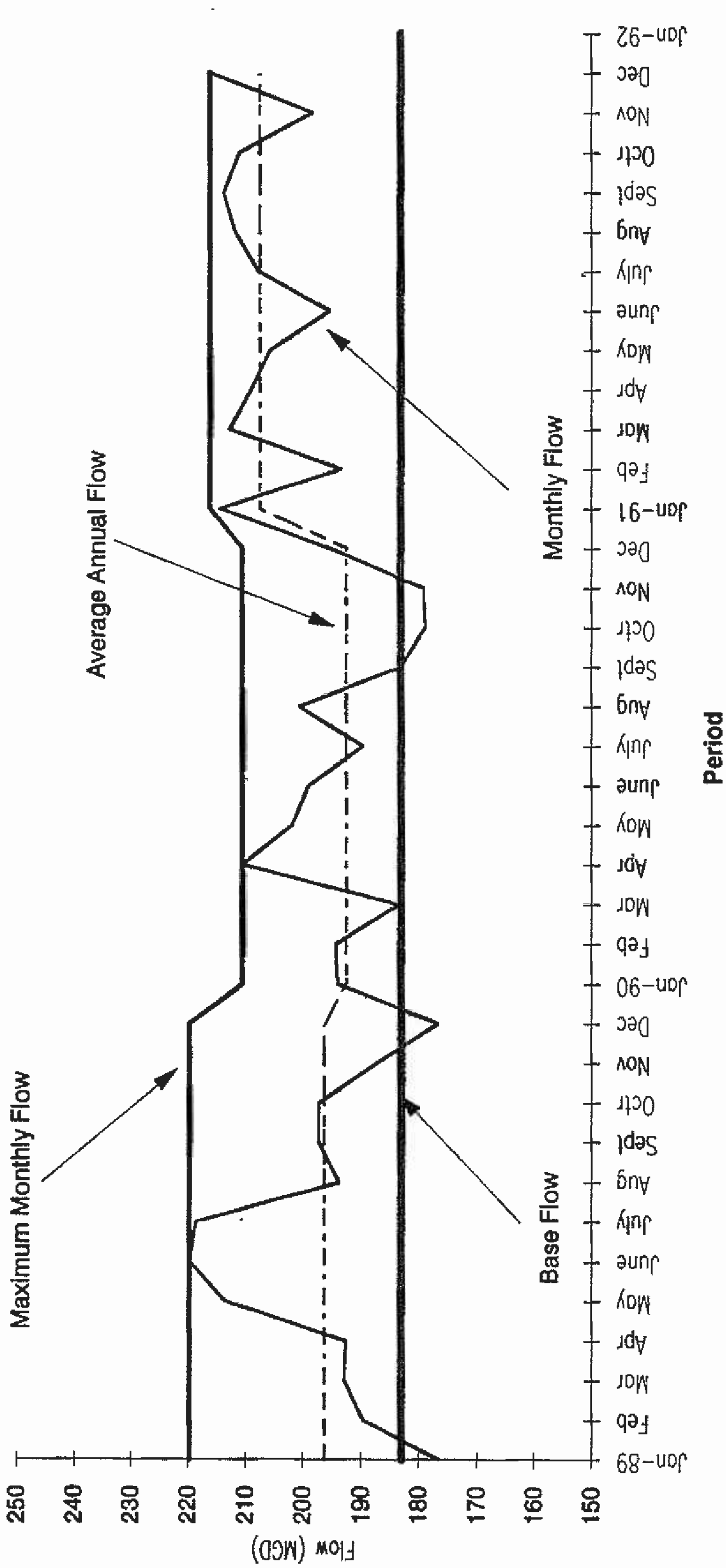


FIGURE 5.3-5
Southeast Water Pollution Control Plant -
Monthly Flow per Day

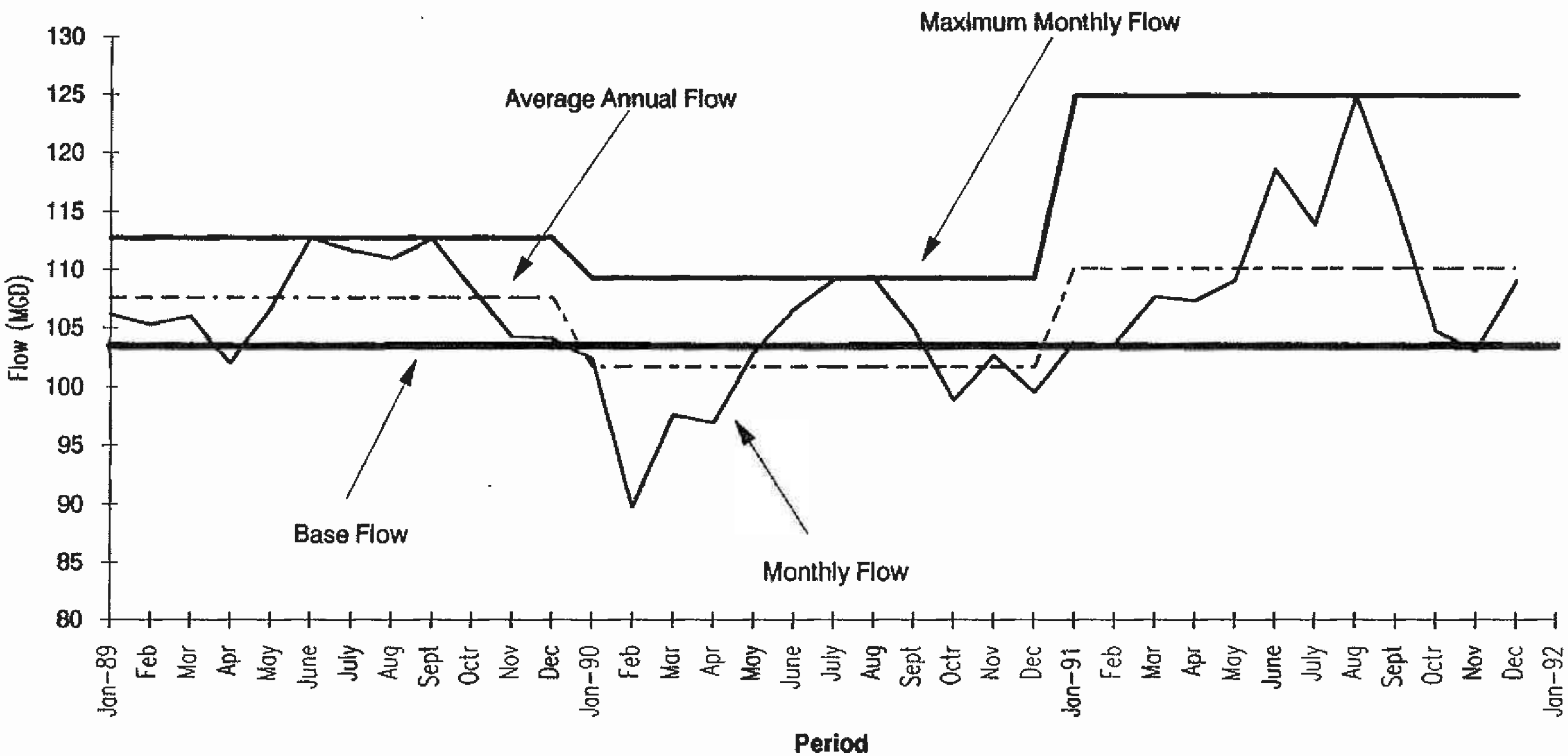
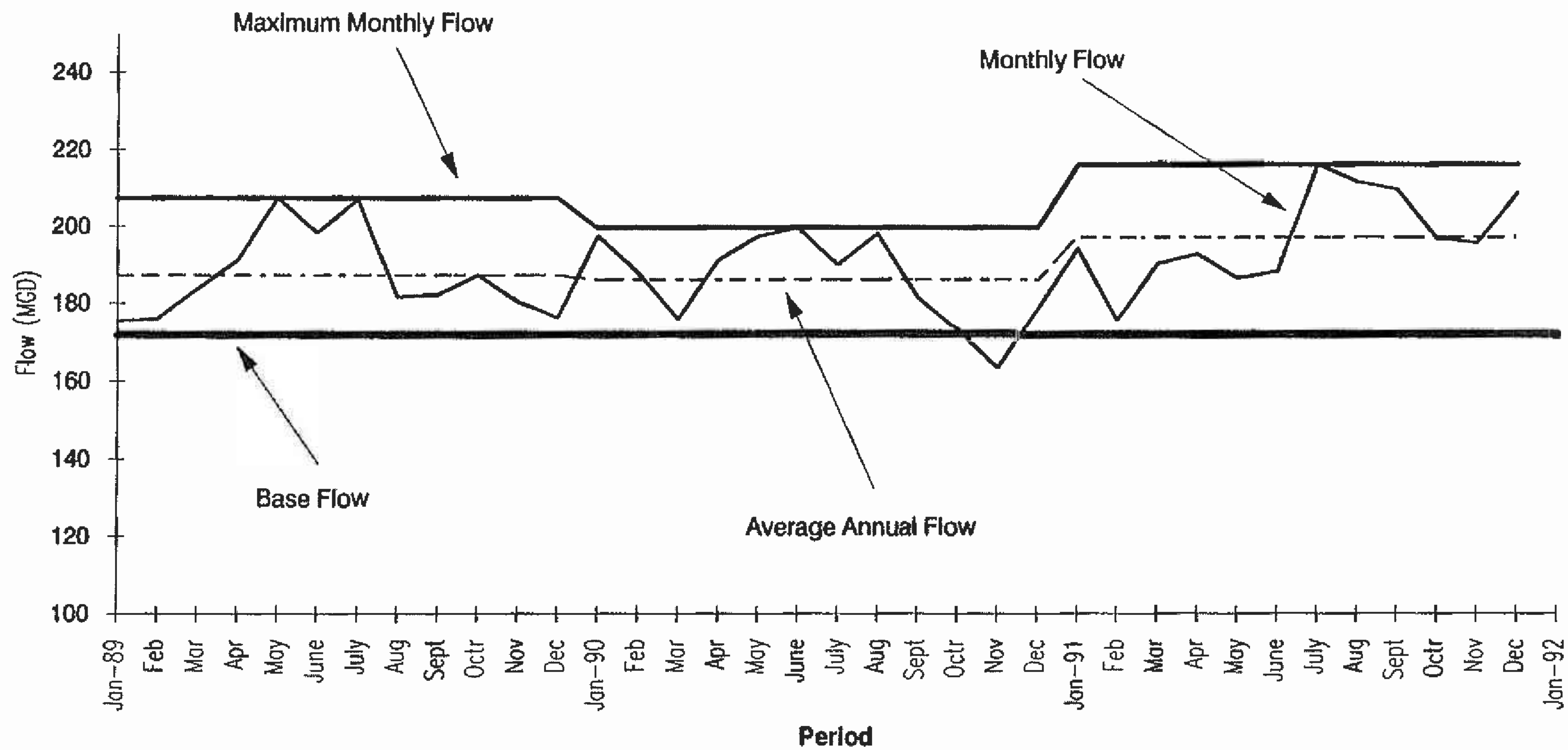


FIGURE 5.3-6
Southwest Water Pollution Control Plant
Monthly Flow per Day



It is recognized that there is some storm water included in the base flows and that these flows are not true dry weather flows since some rainfall did occur, albeit small, for those months from which the base flow is calculated. The base flow is that flow which is expected with a minimal effect by storm water inflow from the combined collection system. In order to verify this approach, a least squares linear regression statistical model has been applied to the monthly flow and rainfall data for this 3-year period (1989 to 1991) in order to calculate a statistical relationship between rainfall, wastewater flows from the outlying municipalities, and at the WPCPs. Regressing rainfall and wastewater flows essentially defines the ratio of these two values and can be used to project the dry weather flow (zero rainfall) as well as determine the statistical significance of the ratio. Although not included here, the regression model showed a significant statistical relationship between rainfall and WPCP flows and predicted base flows within 1.7 percent of those determined in Table 5.3.2 above (NEWPCP = 184.6 mgd, SEWPCP = 102.5 mgd, SWWPCP = 171.6), thus supporting this approach.

5.3.2 Infiltration/Inflow (I/I)

I/I rates were determined for each of the WPCPs City service areas in the three Sewer System Evaluation Surveys (SSESs) summarized in Section 2.5.2. These SSES reports represent the most comprehensive analysis of infiltration and inflow within the City to date. While recognizing that this information is somewhat dated, it has been incorporated into the categorization of the wastewater flows as the most definitive infiltration and inflow quantification conducted to date on the Philadelphia system.

Inflow is largely comprised of rainfall induced flow and is discounted in the development of the base flow to the WPCPs described above. In this evaluation, the base flow, use and reserve capacity of the WPCPs is considered during dry months to minimize the significant effects of storm water runoff on WPCP flows during and after rainfall events. Infiltration primarily originates from groundwater and represents a much more consistent impact on WPCP use and reserve capacity. When considering the present and future use and capacity of the City's wastewater facilities, infiltration must be included due to its consistent and significant impact on the hydraulic capacity of the wastewater system.

The infiltration and inflow from the collection system, not to be confused with storm induced flows from the combined sewer system, for the City service areas for each of WPCPs has been established as follows:

Northeast WPCP	74.9 mgd
Southeast WPCP	45.8 mgd
Southwest WPCP	62.4 mgd

I/I rates within a collection system would be expected to increase over time due to the continued aging of the collection system and deterioration of sewer lines. However, the PWD has a well established maintenance program (investing up to $13.5 million per year on the rehabilitation of sewer lines, see Section 4.2.1), that includes the rehabilitation of sewer lines subject to large amounts of I/I. Since there is no accurate way of projecting increasing levels of I/I over time, particularly when factoring in significant rehabilitation efforts, the I/I rates have been assumed to remain constant on a drainage basinwide basis. Therefore, the same I/I levels to each of the WPCPs from the service areas within the City are assumed to remain constant for both the current and future projections. Based upon the above information, Table 5.3.3 indicates the breakdown of current flows.

5.3.3 Base Loadings of Suspended Solids (SS) and Biochemical Oxygen Demand (BOD)

As in common engineering practice, the loadings of suspended solids (SS) and Biochemical Oxygen Demand (BOD) are evaluated as significant indicators of the treatment capacity of each of the WPCPs. The Facility Reports for the WPCPs and the 201 Facility Report for the Sludge Processing and Distribution Center (SPDC) discussed above used SS and BOD loadings to derive the design criteria for treatment and capacity for these facilities. The evaluation presented herein is limited to comparing the current average loadings (1989 to 1991 averaged to arrive at a 1990 loading) to those levels assumed in the Facility Reports. The presumption in this evaluation is that the WPCPs and SPDC adequately handle the design loadings. Further, this methodology concludes that if the actual loadings experienced at the plant are lower than the design then there will be no significant problems with the facilities handling the loadings. A tabulation of the monthly wastewater flow and loadings for each of the WPCPs is presented in Tables 5.3.4 through 5.3.6 with a graphical representation of this data provided with each table as Figures 5.3-7 through 5.3-9.

In Table 5.3.7, the base loadings for SS and BOD measured at the WPCPs and averaged from Tables 5.3.4 and 5.3.6 above are compared to the design loadings presented in the WPCP and SPDC Facility Reports. As can be seen in this comparison, the actual influent concentrations and loadings of SS and BOD measured at each of the WPCPs are significantly less than those values projected in the design reports for these facilities. For instance, BOD concentration is 60.8, 48.8 and 54.4 percent of the design concentration for the Northeast, Southeast, and Southwest WPCPs, respectively. As mentioned above, our methodology concludes that since the actual loadings recently experienced at the WPCPs are significantly less than the loading levels that the WPCPs are designed to adequately treat, we expect no problems with loadings at the treatment facilities.

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TABLE 5.3.3

DERIVED WASTEWATER FLOWS AND INFILTRATION RATES AVERAGED FROM 1989 - 1991

WPCP	PHILADELPHIA					Outlying Municipalities(A)	Total(A)
	Domestic		Industrial Commercial Institutional	Infiltration	Total City Flow		
	(mgd)	Per Capita (gpcpd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)
Northeast(B)	54.5 (30.4%)	71.7	16.8 (10.78%)	74.9 (41.7%)	146.2	33.2 (18.5)	179.4 (100%)
Southeast(C)	22.0(E) (21.3%)	63.5(E)	34.9 (33.7%)	45.8 (44.2%)	102.7	0.8 (0.8%)	103.5 (100%)
Southwest(D)(F)	26.4 (15.6%)	55.2	18.7 (11%)	62.4 (37%)	107.5	62.0 (36.0%)	169.5 (100%)

Note: Wastewater production and infiltration rates were derived from the sewer system evaluation surveys (SSESs) referenced below. Infiltration rates were assumed to be constant with increases in infiltration rates due to increase age offset by on-going maintenance and rehabilitation programs. Domestic, industrial, commercial, and institutional wasteload sources were increased to current production rates in proportion to rates derived in the SSESs. Total plant flows and outlying municipality flow were derived from wastewater management reports.

(A) Mean of average low month flow 1989 -1991.

(B) Final report and Task B reports for sewer system evaluation, Northeast drainage district, City of Philadelphia, December 1981.

(C) Final report and Task B reports, sewer system evaluation survey, Southeast drainage district, City of Philadelphia, August 1981.

(D) Phase II evaluation of sewer infiltration/inflow, Part F - Cost-effective analysis and final report and task B reports, Southwest drainage district, City of Philadelphia, June 1983.

(E) Domestic flow derived from average of calculated per capita production rates derived for the Northeast and Southwest water pollution control plants.

(F) Phase II Evaluation of Sewer Infiltration/Inflow - Tide Gate/Regulator Evaluation Final Report, Southwest Drainage District, City of Philadelphia, 1982.

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TABLE 5.3.4

TABULATION OF THE MONTHLY FLOWS AND LOADINGS AT THE NORTHEAST WATER POLLUTION CONTROL PLANT 1989-1991

Month/Year	Flow (mgd)	SS Influent (mg/l)	Plant SS Loadings (lb/day)	BOD_5 Influent (mg/l)	Plant BOD_5 Loadings (lb/day)
January 1989	176.52	227	334,184	179	263,520
February	189.62	220	347,915	140	221,400
March	192.87	213	342,618	162	260,583
April	192.52	224	359,658	163	261,716
May	213.52	213	379,301	140	249,306
June	219.69	241	441,564	149	273,000
July	218.53	218	397,314	106	193,189
August	193.80	263	425,085	129	193,955
September	197.32	297	488,758	111	182,667
October	197.15	285	468,606	118	194,019
November	187.28	273	426,403	127	198,363
December	176.63	264	388,897	157	231,276
Year Ave.	**196.29**	**245**	**400,025**	**139**	**226,916**
January 1990	193.97	215	347,808	146	236,186
February	194.35	186	301,483	144	233,407
March	183.56	204	312,302	156	238,819
April	210.52	224	393,285	154	270,383
May	201.94	220	370,520	138	232,417
June	199.00	245	406,617	138	229,033
July	189.52	289	456,792	147	232,348
August	200.65	293	490,312	126	210,851
September	183.13	243	371,135	132	201,604
October	178.80	239	356,395	141	210,258
November	179.11	250	373,444	164	244,979
December	195.34	200	325,827	136	221,562
Year Ave.	**192.49**	**234**	**375,493**	**144**	**230,154**
January 1991	203.39	183	310,418	127	215,427
February	182.36	210	319,385	160	243,341
March	200.81	214	358,398	164	274,660
April	195.96	227	370,988	158	258,220
May	191.72	244	390,143	157	251,034
June	182.36	261	396,950	181	275,280
July	194.73	282	457,982	183	297,201
August	198.77	274	454,221	168	278,501
September	200.81	261	437,111	175	293,082
October	197.99	280	462,346	173	285,664
November	187.34	266	415,603	159	248,424
December	205.17	249	426,068	167	285,757
Year Ave.	**195.12**	**246**	**399,968**	**164**	**267,216**
3-Year Ave.	**194.63**	**242**	**391,829**	**149**	**241,429**

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TABLE 5.3.5

TABULATION OF THE MONTHLY FLOWS AND LOADINGS AT THE SOUTHEAST WATER POLLUTION CONTROL PLANT 1989-1991

Month/Year	Flow (mgd)	SS Influent (mg/l)	Plant SS Loadings (lb/day)	BOD_5 Influent (mg/l)	Plant BOD_5 Loadings (lb/day)
January 1989	106.17	119	105,369	118	104,484
February	105.30	127	111,532	129	113,288
March	105.98	111	98,110	115	101,645
April	101.98	105	89,304	107	91,005
May	106.65	127	112,962	75	66,710
June	112.72	136	127,852	80	75,207
July	111.64	127	118,247	69	64,244
August	110.99	166	153,659	71	65,722
September	112.63	91	85,479	60	56,360
October	108.43	106	95,856	76	68,727
November	104.26	110	95,648	81	70,432
December	104.08	133	115,448	105	91,143
Year Ave.	**107.57**	**122**	**109,122**	**91**	**80,747**
January 1990	102.36	122	104,149	88	75,124
February	89.70	105	78,550	96	71,817
March	97.56	121	98,452	101	82,179
April	96.90	134	108,292	91	73,541
May	102.92	181	155,362	89	76,393
June	106.62	147	130;714	77	68,469
July	109.15	127	115,722	51	46,426
August	109.28	116	113,787	50	45,570
September	104.95	130	105,524	74	64,771
October	98.85	128	114,751	78	64,304
November	102.68	134	104,569	84	71,934
December	99.51	126	104,569	82	68,053
Year Ave.	**101.71**	**131**	**111,290**	**80**	**67,382**
January 1991	103.78	97	83,956	72	62,318
February	106.65	99	85,580	83	71,749
March	107.67	139	124,818	98	88,001
April	107.36	122	109,237	81	72,526
May	109.09	115	104,628	68	61,867
June	118.58	120	118,675	67	66,260
July	113.93	144	136,825	58	55,110
August	124.87	135	140,591	64	66,651
September	115.71	157	151,508	78	75,272
October	104.72	121	105,677	71	62,009
November	103.07	126	108,310	77	66,189
December	108.97	121	109,966	87	79,006
Year Ave.	**110.37**	**126**	**114,981**	**75**	**68,918**
3-Year Ave.	**106.55**	**126**	**111,798**	**82**	**72,349**

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TABLE 5.3.6

TABULATION OF THE MONTHLY FLOWS AND LOADINGS AT THE SOUTHWEST WATER POLLUTION CONTROL PLANT 1989-1991

Month/Year	Flow (mgd)	SS Influent (mg/l)	Plant SS Loadings (lb/day)	BOD_5 Influent (mg/l)	Plant BOD_5 Loadings (lb/day)
January 1989	175.39	129	188,695	112	163,828
February	175.98	133	195,201	114	167,315
March	183.64	134	205,229	113	173,066
April	191.06	161	256,544	122	194,400
May	207.50	139	240,546	104	179,977
June	198.32	153	253,060	94	155,475
July	206.88	150	258,807	75	129,403
August	181.54	149	255,592	80	121,123
September	182.10	132	200,470	85	129,091
October	187.32	122	190,594	84	131,229
November	180.25	133	199,937	102	153,335
December	176.14	148	217,413	121	177,750
Year Ave.	**187.18**	**140**	**219,341**	**101**	**156,333**
January 1990	197.37	140	230,449	101	166,253
February	184.66	140	215,609	101	155,547
March	171.92	140	200,734	101	144,815
April	187.24	140	218,621	101	157,720
May	193.44	140	225,861	101	162,942
June	196.17	140	229,048	101	165,242
July	186.74	140	218,038	101	157,299
August	195.06	140	227,752	101	164,307
September	178.09	140	207,938	101	150,012
October	169.47	140	197,873	101	142,751
November	160.36	140	187,236	101	135,078
December	175.65	140	206,089	101	147,957
Year Ave.	**183.01**	140	**213,687**	101	**154,160**
January 1991	190.87	140	222,860	101	160,777
February	171.96	140	200,780	101	144,849
March	186.51	140	217,769	101	157,105
April	189.34	140	221,073	101	159,489
May	183.03	140	213,706	101	154,173
June	184.04	140	214,885	101	155,024
July	213.88	140	249,726	101	180,160
August	209.17	140	244,227	101	176,192
September	206.83	140	241,495	101	174,221
October	193.75	140	226,223	101	163,203
November	193.17	140	225,545	101	162,715
December	206.25	140	240,818	101	173,733
Year Ave.	**194.07**	140	**226,598**	**101**	**163,470**
3-Year Ave.	**188.09**	140	**219,873**	101	**157,988**

Figure 5.3-7
Northeast Water Pollution Control Plant
Monthly Flow and Loadings

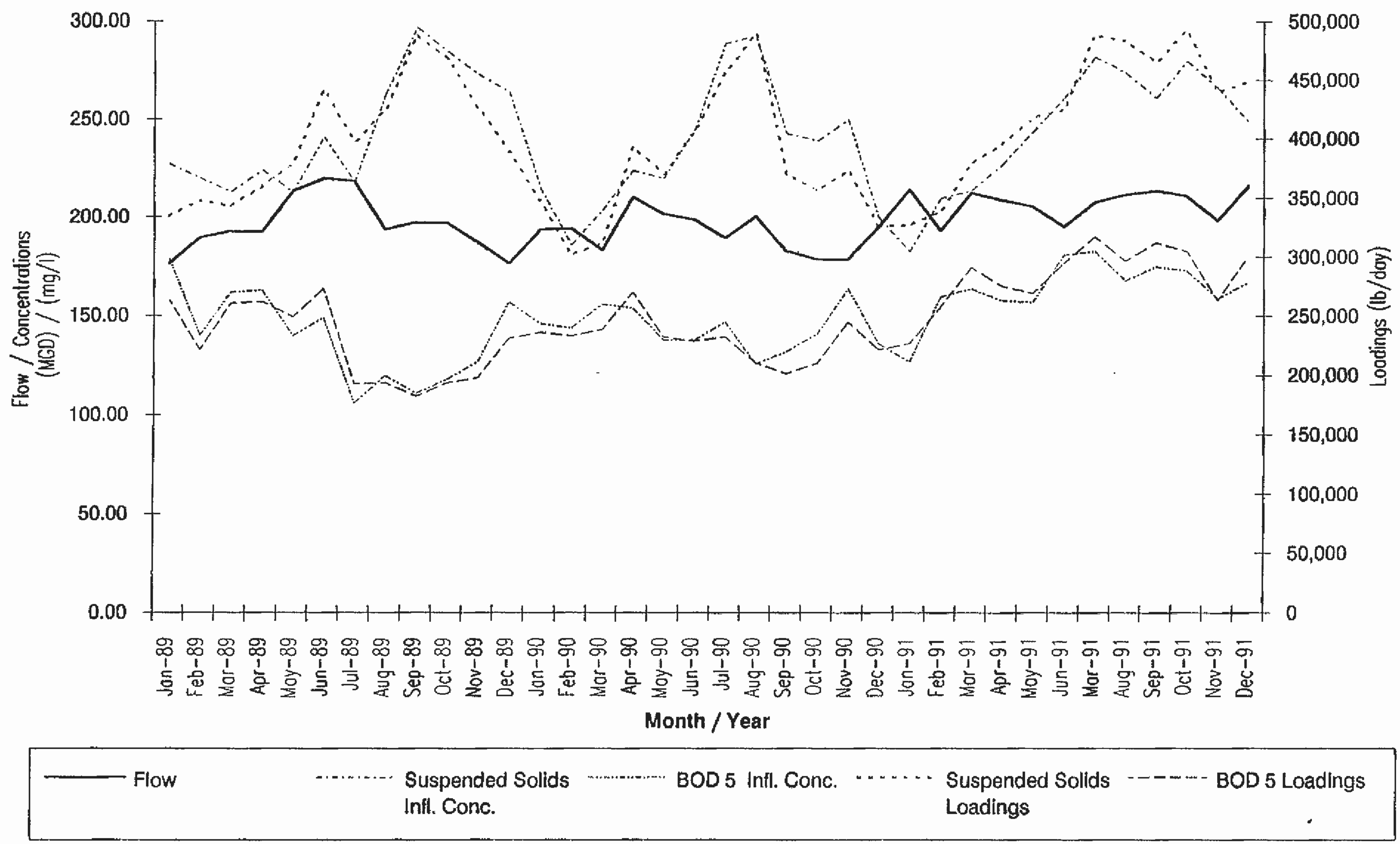

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Figure 5.3-8
Southeast Water Pollution Control Plant
Monthly Flow and Loadings

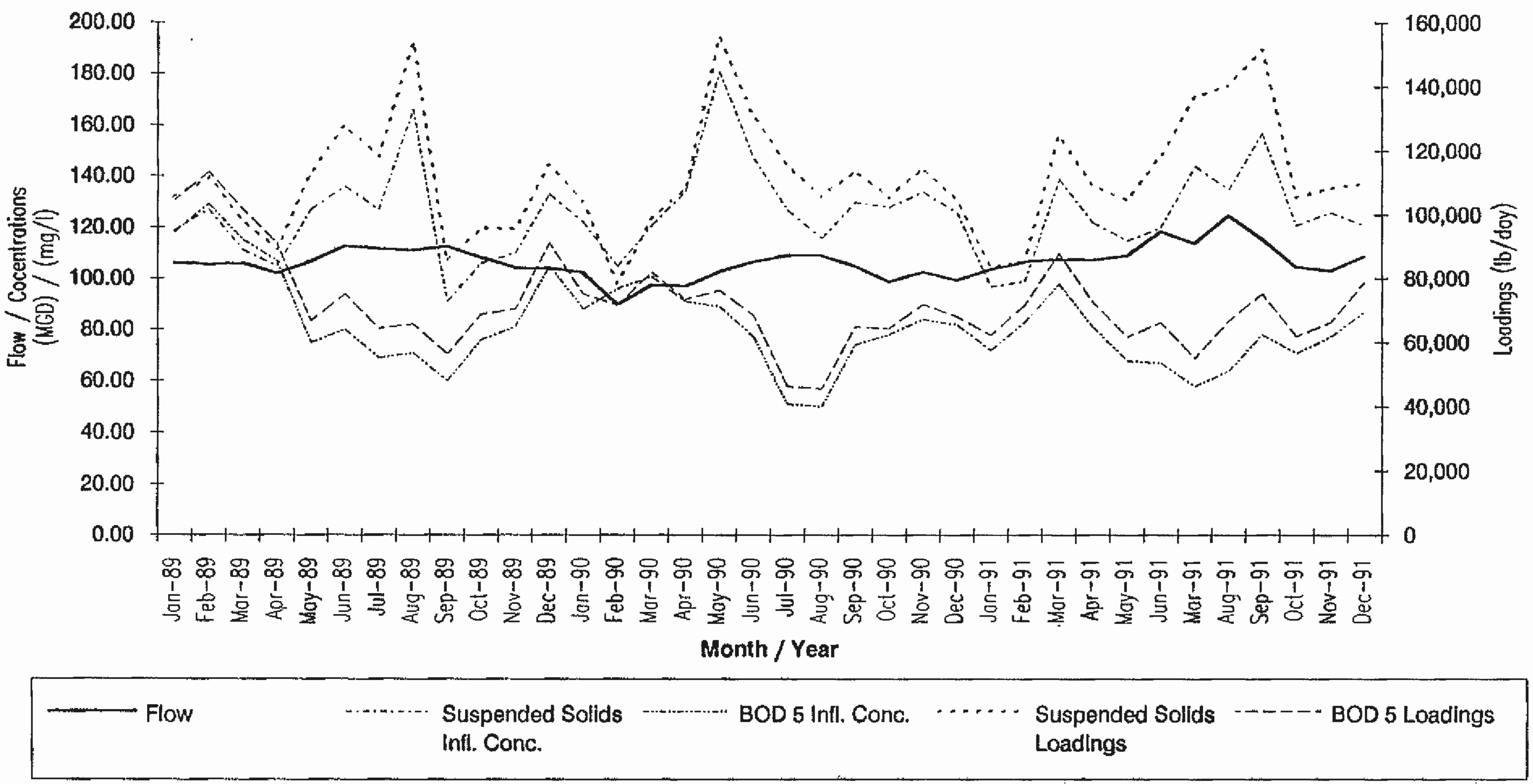

Figure 5.3-9
Southwest Water Pollution Control Plant
Monthly Flow and Loadings

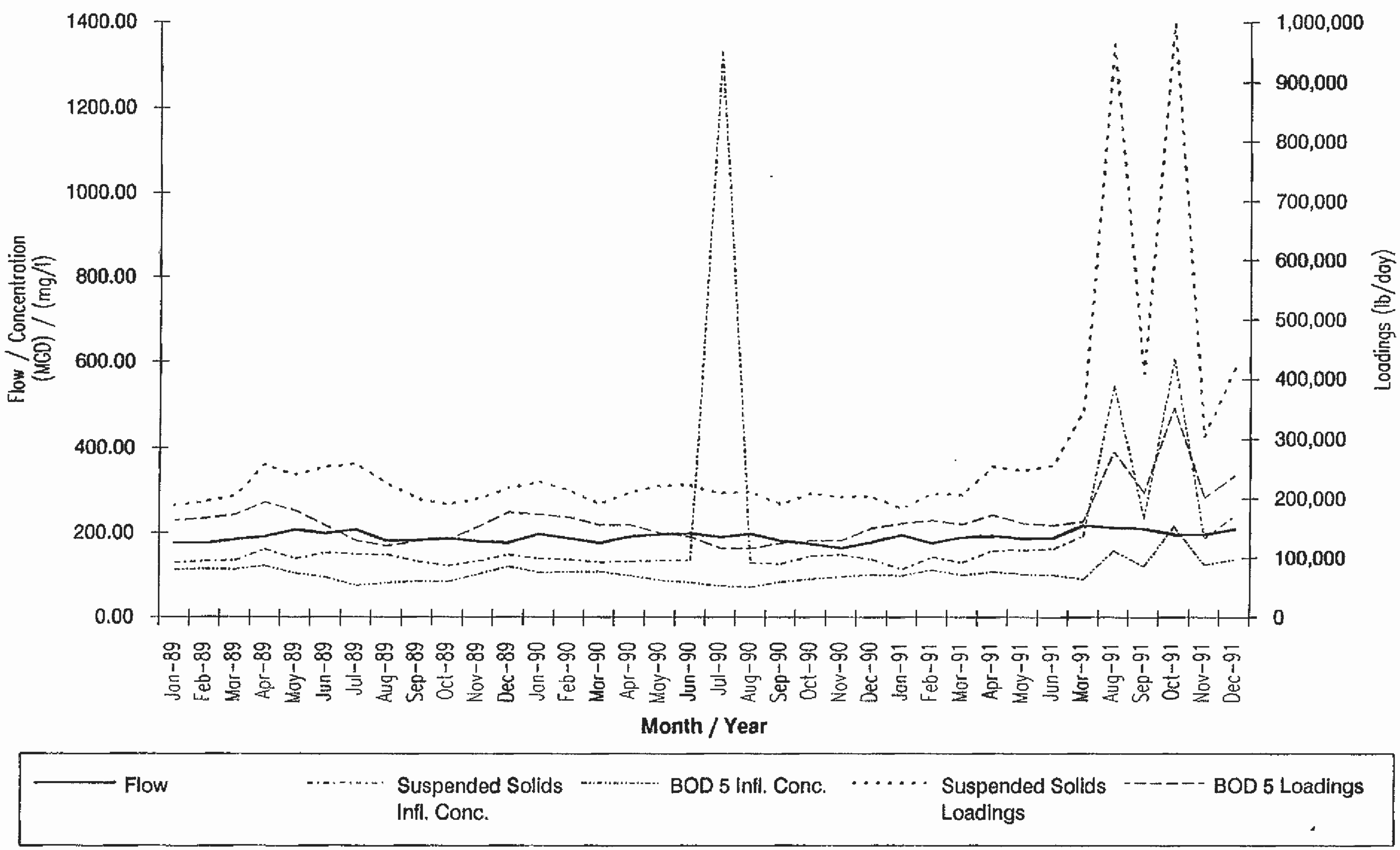

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TABLE 5.3.7
COMPARISON OF DESIGN vs. ACTUAL LOADINGS

	BOD (mg/l)	**SS (mg/l)**	**BOD lb/day**	**SS lb/day**
NEWPCP				
- Projected Facility Report - 250 mgd	245	323	510,000	674,000
- Rev. to Projections for NEWPCP of SWWPCP - 210 mgd	201	271	350,343	472,353
- Average (1989 - 1991)	149	242	241,429	391,829
- Max Month (1989 - 1991)	183	297	297,201	490,312
% Use of Design at NEWPCP	---	---	58.3%	72.7%
SEWPCP				
- Projected Facility Report - 140 mgd	168	178	196,000	208,000
- Projected SPDC Report - 120 mgd	156	181	156,000	181,150
- Average (1989 - 1991)	82	126	72,349	111,798
- Max Month (1989 - 1991)	129	181	113,288	155,362
% Use Design at SEWPCP			57.8%	74.7%
SWWPCP				
- Projected Facility Report - 210 mgd	193	279	339,000	488,000
- Rev. to Projections for NEWPCP of SWWPCP - 200 mgd	117	214	194,220	355,240
- Average (1989 - 1991)	101	140	157,988	219,873
- Max Month	122	161	194,400	258,807
% Use of Design at SWWPCP			57.3%	74.7%
Total SPDC Design Criteria			700,563	983,593
Total Average (1989 - 1991) % Use of Design at SPDC			485,910 69.4%	788,85 80.1%

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The loadings of these pollutants in pounds per day is a more significant indicator of potential problems at the SPDC since this facility is designed to handle the combined loadings removed from the wastestreams at all three WPCPs. As summarized at the bottom of Table 5.3.7, the total loadings from the three WPCPs are 69.4 percent of the design loading for BOD and 80.1 percent of the SS. Again, since the actual loadings measured at the WPCPs are less than the design loadings, we expect no overall capacity problems at the SPDC.

5.3.4 Projected Flows from the Outlying Municipalities/Authorities

A detailed description of the relationship between Philadelphia and the 10 outlying municipalities/authorities with regards to the transport, treatment, and disposal of wastewater is presented in Section 3.2. Philadelphia is contractually committed to supplying wastewater services to these neighboring bodies for varying periods of time; however, these relationships with varying conditions and needs are expected to continue indefinitely. In order to provide a comprehensive and meaningful evaluation of the potential needs of the Philadelphia wastewater system, it is essential to give adequate consideration to the potential demands that the outlying municipalities/authorities will have in the future. However, a detailed categorization of the wastewater flows and a projection of these flows based upon component sources is beyond the scope of this report. The following methodology was developed to provide an effective and conservative consideration of the potential impact of the needs of the outlying municipalities/authorities as to Philadelphia wastewater system.

The potential impact on future needs of the Philadelphia wastewater system by the outlying municipalities/authorities is considered in the context of the following criteria.

- Philadelphia must reserve capacity to accommodate those flows and loadings that is has contractually agreed to accept.

- What is the potential a municipality/authority would need additional flow and/or loading capacities and the contractual amounts within the planning period?

- In order to ascertain whether there may be any future need to revisit these capacities, information regarding each municipality/authority that contributes to the WPCP collection/conveyance system was compiled from the Planning Commissions of Bucks, Delaware, and Montgomery Counties, and the Delaware Valley Regional Planning Commission.

As can be seen in Table 3.2.1, most of the outlying municipalities/authorities contribute wastewater flows well below those flow limits defined in their respective contractual agreements. Indeed, as can be seen below in Table 5.3.8, flow averaged over our study period 1989 to 1991 from the outlying municipalities/authorities for each of the WPCPs is significantly below the contractual limited volumes.

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TABLE 5.3.8

COMPARISON OF ACTUAL OUTLYING FLOWS TO CONTRACTUAL LIMITS PER WPCP 1989 - 1991

WPCP	Flow from Outlying Municipalities/Authorities Averaged 1989 - 1991 (mgd)	Contractual Limits[1] (mgd)	Percent Utilization (%)
NEWPCP	33.2	51.9	64.0
SEWPCP	0.8	1.0	80.0
SWWPCP	62.0	83.8	74.0

[1]Contractual limits for each WPCP based upon individual intermunicipal agreements.

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Since it is not expected that a significant increase in flows is expected from the outlying municipalities/authorities, the maximum contractual amount will be assumed for each of the WPCPs. While this will result in a conservative evaluation with regard to forecasting wastewater flow at the WPCPs, PWD must have reserve capacity available equal to that which it is contractually obligated to provide. Therefore, the amount of forecasted flows will actually be less than that presented below; however, considerations as to the amount of reserve capacity must exclude that capacity which must be in reserve for the outlying municipalities/authorities.

5.4 FORECASTS OF WASTEWATER FLOWS AND LOADINGS

Based upon the above and the projected population decline outlined in Section 5.2, the projected wastewater base flows for 1996, 2000, and 2010 are presented in Table 5.4.1, Projected Wastewater Flows.

As discussed in this table, these projected flows are exclusive of rainfall induced flows that have a significant impact on flows at each of the WPCPs. Based upon these projected flows, the WPCPs have the theoretical reserve capacity presented in Table 5.4.2.

As mentioned in Table 5.4.2, the decrease in wastewater base flows is forecasted primarily based upon the decline in domestically generated flow. As discussed, the ICI generated flow is assumed to remain constant. In order to evaluate the reasonableness of this assumption, we have evaluated how much theoretical office space/industrial space would have to be generated in any of the WPCPs to provide a noticeable effect on plant capacity. In order to conduct this evaluation, some gross assumptions are necessary, namely that a proposed commercial/industrial institutional facility would generate 0.125 gallons per day per square foot. This results in 125,000 gpd/million square feet. Conversely, there would need to be 8 million square feet of ICI development to generate 1 mgd at any of the WPCPs. In order to have a significant impact on the WPCPs, the amount of ICI development needed is presented in Table 5.4.3.

It should be noted that each of these amounts of development represent significantly more development than is potentially considered reasonable. The 20-year average represents the amount of development for each of the 20 years to be absorbed to make an impact on the reserve wastewater production for each of the WPCPs. Indeed, it is not expected that the entire City will absorb 50 to 70 million square feet within the planning period, let alone one of the WPCP's service areas.

Furthermore, the reserve capacities used in this evaluation are based on a maximization of flows from the outlying municipalities/authorities, thus further representing a conservative estimate. The PWD is contractually obligated to retain enough reserve capacity at each WPCP to handle to maximum amounts of flow and loadings as allocated in the intermunicipal agreements. The premise that the total allocated capacity for the outlying municipalities is added to the projected City flows results in the projected increase in WPCP flows from 1990 to 1996. The subsequent decline in projected flows from 1996 to 2010 reflects the projected decline in the City's population over this period of time as discussed previously. Based upon this evaluation and wastewater flow

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TABLE 5.4.1

PROJECTED WASTEWATER FLOWS (DRY WEATHER)

Water Pollution Control Plant	Philadelphia					Outlying Municipalities	Total
	Domestic Base Flow		Industrial Commercial Institutional	Infiltration (B)(C)(D)	Total City Flow		
	Total (mgd)	Per Capita (gpcpd)	(mgd)	(mgd)	(mgd)	(mgd)	(mgd)
1990							
Northeast	54.5	71.7	16.8	74.9	149.8	33.2 (A)	179.4(A)
Southeast (E)	22.0	63.5	34.9	45.8	102.7	0.8 (A)	103.5(A)
Southwest	26.4	55.2	18.7	62.4	107.5	62.0 (A)	169.5(A)
1996							
Northeast	53.8	71.7	16.8	74.9	149.1	51.9	197.4
Southeast (E)	21.2	63.5	34.9	45.8	101.9	1.0	102.9
Southwest	25.8	55.2	18.7	62.4	106.9	83.75	190.7
2000							
Northeast	53.4	71.7	16.8	74.9	148.7	51.9	197.0
Southeast (E)	20.6	63.5	34.9	45.8	101.3	1.0	102.3
Southwest	25.3	55.2	18.7	62.4	106.4	83.75	190.2
2010							
Northeast	52.2	71.7	16.8	74.9	147.5	51.9	195.8
Southeast (E)	19.4	63.5	34.9	45.8	100.1	1.0	101.1
Southwest	24.3	55.2	18.7	62.4	105.4	83.75	189.2

(A) Mean of average low month flow 1989-1991.

(B) Final Report and Task B Reports for Sewer System Evaluation, Northeast Drainage District, City of Philadelphia, December 1981.

(C) Final Report and Task B Reports, Sewer System Evaluation Survey, Southeast Drainage District, City of Philadelphia, August 1981.

(D) Phase II Evaluation of Sewer Infiltration/Inflow, Part F - Cost Effective NE Analysis and Final Report and Task B Reports, Southwest Drainage District, City of Philadelphia, June 1983.

(E) Domestic flow derived from average of calculated per capita production rates derived for the Northeast and Southwest Water Pollution Control Plants.

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TABLE 5.4.2

WPCP RESERVE CAPACITIES

WPCP/Year	Existing Projected Dry Weather Flow (mgd)	Current Permitted Flow (mgd)	Reserve Capacity (mgd)
NEWPCP			
1990	179.4	210.0	30.6
1996	197.4	210.0	12.6
2000	197.0	210.0	13.0
2010	195.8	210.0	14.2
SEWPCP			
1990	103.5	112.0	8.5
1996	102.9	112.0	9.7
2000	102.3	112.0	9.1
2010	101.1	112.0	10.9
SWWPCP			
1990	169.5	200.0	30.5
1996	190.7	200.0	9.3
2000	190.2	200.0	9.8
2010	189.2	200.0	10.8

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TABLE 5.4.3

ICI DEVELOPMENT NECESSARY TO HAVE A SIGNIFICANT IMPACT ON WPCP RESERVE CAPACITY

WPCP	Reserve Capacity (Worst Case) (mgd)	ICI Development (million square feet)	20-Year Average (million square feet)
NEWPCP	12.6 (1996)	72	3.6
SEWPCP	9.1 (2000)	57	2.9
SWWPCP	9.3 (1996)	58	2.9

forecasts, such flows are not expected to have any significant impact on the reserve capacity of the Philadelphia WPCPs.

There is no data or information which would suggest that the SS and BOD concentrations of the waste flows to the Philadelphia WPCPs might increase significantly through 2010. Therefore, the monthly average SS and BOD concentrations recorded at the WPCPs from 1989 - 1991 were used with the projected wastewater flows, as discussed above and presented in Table 5.4.1, to derive projected SS and BOD wasteloadings. Tables 5.4.4 and 5.4.5 illustrate the projected SS and BOD loadings, respectively, for 1996, 2000 and 2010, to the individual WPCPs to derive the projected loadings for the SPDC. As with the projected wastewater flows from which they were derived, these loadings are based on the assumption that the outlying municipalities contribute up to their contractually allocated capacities as soon as 1996. As with the projected flows, this results in a conservative estimate of projected wastewater loadings. By comparing these projected loadings with the design criteria established in the Facility Reports for each WPCP and SPDC, we can see that the projected loadings are well within the design criteria for all these facilities.

In order to project a worst case scenario, Tables 5.4.4 and 5.4.5 also tabulate the potential high loadings for the WPCPs by calculating projected loadings using the projected waste flows and maximum loadings from our three year study period of 1989 to 1991. A worst case scenario for the SPDC is also calculated in these tables by totalizing the loadings for the WPCPs; however, this derivation is not truly reflective of a real potential loading since the maximum monthly loadings recorded at each WPCP, and subsequently used to calculate projected maximum loadings did not occur concurrently at the WPCPs. Even with this very conservative approach to these projected maximum loadings, a comparison with the design loadings as presented in the Facility Reports and SPDC show that there is reserve loading capacity at these facilities through 2010.

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TABLE 5.4.4

PROJECTED SUSPENDED SOLIDS LOADINGS 1990 - 2010

Water Pollution Control Plant	Projected Flow (mgd)	Average Concentration		Maximum Month Concentration	
		Projected Concentration (mg/l)	Projected Concentration (lbs/day)	Projected Concentration (mg/l)	Projected Loading (lbs/day)
1990					
Northeast	179.4	242(1)	362,079	297(4)	453,534
Southeast	103.5	125(2)	108,821	181(5)	156,322
Southwest	169.5	141(3)	197,908	161(6)	227,594
SPDC			668,808		837,450(7)
1996					
Northeast	197.4	242	398,408	297	736,654
Southeast	102.9	125	107,273	181	155,416
Southwest	190.7	140	222,661	161	256,061
SPDC			728,342		1,148,131(7)
2000					
Northeast	197.0	242	397,601	297	487,965
Southeast	102.3	125	106,648	181	154,416
Southwest	190.2	140	222,078	161	255,389
SPDC			726,327		897,864(7)
2010					
Northeast	195.8	242	395,179	297	484,998
Southeast	101.1	125	105,397	181	152,698
Southwest	189.2	140	220,910	161	254,046
SPDC			721,486		891,742(7)

Notes:

(1) Average Monthly Flow January 1989 - December 1991 (Typ).
(2) Average Monthly Flow January 1989 - December 1991 (Typ).
(3) Average Monthly Flow January 1989 - July 1991 (Typ).
(4) Maximum Monthly Concentration from January 1989 - December 1991 (Typ).
(5) Maximum Monthly Concentration from January 1989 - December 1991 (Typ).
(6) Maximum Monthly Concentration from January 1989 - July 1991 (Typ).
(7) Not reflective of true projected loading conditions since maximum monthly loadings recorded at each WPCP and used to calculate projected maximum loadings did not occur concurrently at the WPCPs.

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TABLE 5.4.5

PROJECTED BOD LOADINGS 1990 - 2010

Water Pollution Control Plant	Projected Flow (mgd)	Average Concentration: Projected Concentration (mg/l)	Average Concentration: Projected Concentration (lbs/day)	Maximum Month Concentration: Projected Concentration (mg/l)	Maximum Month Concentration: Projected Loading (lbs/day)
1990					
Northeast	179.4	149(1)	222,933	183(4)	273,804
Southeast	103.5	82(2)	70,820	129(5)	111,412
Southwest	169.5	101(3)	154,160	122(6)	172,463
SPDC			447,913		557,679(7)
1996					
Northeast	197.0	149	245,301	183	301,276
Southeast	102.3	82	70,410	129	110,766
Southwest	190.2	101	160,634	122	194,033
SPDC			476,345		606,075
2000					
Northeast	195.8	149	245,301	183	300,665
Southeast	101.1	82	69,999	129	110,120
Southwest	189.2	101	160,213	122	193,525
SPDC			475,513		604,310(7)
2010					
Northeast	199.4	149	243,313	183	298,834
Southeast	101.1	82	69,178	129	108,829
Southwest	191.3	101	159,371	122	192,507
SPDC			471,862		600,170(7)

Notes:

(1) Average Monthly Flow January 1989 - December 1991 (Typ).
(2) Average Monthly Flow January 1989 - December 1991 (Typ).
(3) Average Monthly Flow January 1989 - December 1991 (Typ).
(4) Maximum Monthly Concentration from January 1989 - December 1991 (Typ).
(5) Maximum Monthly Concentration from January 1989 - December 1991 (Typ).
(6) Maximum Monthly Concentration from January 1989 - July 1991 (Typ).
(7) Not reflective of true projected loading conditions since maximum monthly loadings recorded at each WPCP and used to calculate projected maximum loadings did not occur concurrently at the WPCPs.

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6.0 DEVELOPMENT AND ASSESSMENT OF NEEDS

6.1 FIVE-YEAR NEEDS

This section of the Act 537 Plan will develop and assess the short-term needs for the PWD wastewater collection and treatment system. Planning and Research (P&R) Section of the PWD, which is responsible on an ongoing basis for needs assessment and prioritization.

The development of conclusions herein relies in large part on information made available for this report. The needs will be discussed first for the WPCPs and thereafter for the collection system and Sludge Processing and Distribution Center (SPDC).

As regards the assessment of needs for treatment, there are primarily four general sources of information that have been utilized in this evaluation:

- A general unit process evaluation at each plant that compares the basis of design as well as existing and projected loadings to PaDER criteria

- The PWD's Capital Improvement Plan (CIP) for the WPCPs

- Recent studies on the WPCPs

- The findings of field investigations at the WPCPs

6.1.1 NEWPCP

6.1.1.1 Process Evaluation

A general approach to evaluation of WPCP capacity can be accomplished by comparison of plant design and operating criteria to PaDER design guidelines; incorporated into this approach is a determination of reserve capacity based upon current and projected dry weather loadings. This evaluation does not consider detailed aspects of design in the case of each unit process and is not intended to be used in lieu of any final design assessments; however, it does provide an effective summary evaluation of the WPCPs.

Table 6.1.1 is a process evaluation summary for the NEWPCP that compares the plant's basis of design to PaDER design criteria. As discussed in Section 2.5 of this report, the design capacity prior to the last upgrade was based upon 250 mgd. The plant is currently rated at a monthly flow of 210 mgd. As developed in Section 5.0, current dry weather flows for this plant over the past three years have averaged 179.4 mgd, which is well below the annual average (design) flow. Based upon the existing combined sewer overflow (CSO) operations, the following summarizes the NEWPCP loading conditions:

TABLE 6.1.1

NEWPCP PROCESS EVALUATION SUMMARY

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Unit	Number	Dimensions	Existing Capacity	Design Parameter	NEWPCP Design Basis	PADER Guidelines
Mechanical Sewage Screens	8	8 ft. channel width 1 inch bar spacing	1.70 cf/MG screenings removed	Bar spacing Velocity	1 inch 3.0 FPS minimum	5/8 - 1-3/4 inches 1.25 - 3.0 FPS
Grit Removal	4	55' x 56'	6.4 cf/MG Grit removal	Velocity Maximum flow	---- 125 MGD	1 FPS ---
Primary Sedimentation				Surface loading rate		
Set 1	8	240' x 65 x 10' swd	105 MGD	Average	840 gpd/ft^2	<1,000 gpd/ft^2
Set 2	4	250' x 125' x 10' swd	105 MGD	Peak	1,680 gpd/ft^2	<2,500 gpd/ft^2
				BOD removed	22.5%	30-35%
Aeration Tanks	7	372' x 22' x 15' swd	23 MGD			
Rotating Biological Contactors	280	25' x 12' diameter		Loading rate	7.5 gpd/ft^2	1-3 gpd/ft^2
Final Sedimentation Tanks						
Set 1	8	214' x 75' x 11' swd	105 MGD	Design surface loading rate	815 gpd/ft^2	<800 gpd/ft^2
Set 2	8	231' x 70' x 13' swd	105 MGD		810 gpd/ft^2	<800 gpd/ft^2
				Weir loading	15,200 gpd/ft	<15,000 gpd/ft
Disinfection	6	300' x 28' x 11' swd	4.11 MG	Contact period		
				Average	35 minutes	30 minutes
				Peak	---	15 minutes
				chlorine dose	8 mg/l	8 mg/l
Sludge Thickening	12	90' x 20' x 12' swd	237,600 ft^3	Solids loading Hydraulic loading	11.0 ppd/ft^2 420 gpd/ft^2 (0.29 gpm/ft^2)	20 lbs/day/ft^2 0.8 gpm/ft^2
Sludge Digesters						
Set 1	8	110' diameter x 30' swd	17.95 MG	Side water depth	30'	>20'
				Volatile solids loading	99 lbs VSS/1,000 cf/day	<100 lbs VSS/1,000 cf/day

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NEWPCP	Flows (MGD)		Peak
	Average Monthly	Maximum Day	
Original Design	250		
Design/Permit	210	315	420
Current	179.4*	---	---
Projected 5-year	197.4*	---	---

Note: Current Flows based upon 3-year (1989-1991) average
*Denotes dry weather flows

As can be seen, the plant capacity, based upon dry weather flows, appears to be satisfactory for both current and projected conditions. It should be noted that the projected wet weather flows will be more dependent upon CSO Operations (storm flow) than on the projected domestic flow and therefore cannot be predicted.

6.1.1.2 Plant Improvements

Budgeted Improvements

Improvements to the NEWPCP facilities are required on an ongoing basis to maintain the reliable operation of current equipment, implement upgrades to the existing equipment, and ensure compliance with discharge (regulatory) requirements. Forecasting of improvements allows the inclusion of such necessary improvements into projected operating budgets for future years. The PWD has forecasted improvements for the NEWPCP that are included in the projected operating budgets for fiscal years up to and including 1996. These budgeted improvements include, for example: mechanical equipment maintenance for such items as pumps, blowers, mixers, RBCs, and sedimentation tank sludge/scum removal equipment; grit incinerator refractory and mechanical rebuild; and general instrumentation/control and maintenance equipment necessary to assess the integrity of key process equipment. The following summarizes funding above the Fiscal Year 1993 base budget that has been budgeted for ongoing improvements to the NEWPCP:

BUDGETED IMPROVEMENT COSTS	FISCAL YEAR		
	1994	1995	1996
	$850,000	$625,000	$530,000

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Non-Budgeted Improvements

Frequently, improvements to equipment or facilities are not of a routine matter and therefore cannot be anticipated or the implementation of an improvement may have been postponed from previous years. A partial listing of key items which have been identified by the PWD that are recommended for a future budget are summarized in the following paragraphs. An indication of the rationale for such improvements and the suggested fiscal year in which the improvement should be implemented are also presented:

- Dissolved Air Flotation Polymer Addition System (FY 93) - Installation of a polymer system for the DAF tanks if testing determines polymer addition would improve the solids removal and reduce the volume of sludge produced.

- Furnish and Install a Flow Control Valve for Final Sedimentation Tanks (FST) Set 1 (FY 94) — A flow control valve is required for FST Set 1 to better balance flow to both sets of tanks.

- Redesign and Replace Mixers in the Chlorine Retention Basins (FY 94) — Mixers in the chlorine retention basin have failed.

- Aeration Tank Odor Control (FY 94) — Citizen complaints of odor from the NEWPCP have resulted in considerations to install an odor control system on the aeration tanks.

- Odor Control System for Primary Sedimentation Tanks (PST) (FY 96) — Citizen complaints have resulted in considerations to install an odor control system for the PSTs.

More stringent discharge limitations or other Regulatory requirements that may be instituted in the future could require the installation of new treatment facilities that have not been forecasted in the Capital Budget Program. Some potential capital improvement requirements are summarized below:

- Nutrient Removal - A requirement to remove phosphorus and/or nitrogen from the discharged water may precipitate the installation of additional treatment processes that would require investigations into the best means of removal.

- Dechlorination - A requirement to remove free chlorine from the effluent after disinfection could require the installation of additional treatment facilities.

- Odor Control - Additional odor control requirements could be instituted depending upon the effectiveness of current and planned odor control projects. Alternative evaluations should be initiated in the near future.

6.1.1.3 Rehabilitation of Four Primary Clarifiers at the Northeast Water Pollution Control Plant

A major rehabilitation effort of the original primary clarifiers to ensure the continued successful operation and adequate treatment of wastewater is currently underway at the NEWPCP. This project, which was bid out in September 1990, includes:

1. The comprehensive structural, mechanical, and electrical rehabilitation of the four original primary clarifiers (Set 2) and replacement of the influent channels

2. Construction of a new Scum Pumping Station to service the primary clarifiers

The upgrade of the NEWPCP from primary to secondary treatment (Section 2.5.1.1) included the installation of eight new primary clarifiers to augment the four existing primary clarifiers constructed in the late 1940s as part of the original plant. The newer clarifiers have been referred to as Set 1, while the original clarifiers are identified as Set 2. Both sets of clarifiers are shown on Figure 3. The design criteria and dimensions for each set of clarifiers is presented here in Table 6.1.2.

The four primary clarifiers of Set 2 have been in use since the initiation of operation of the NEWPCP in 1951. PWD recognized that these clarifiers were approaching their design life and initiated plans for their rehabilitation in order to avoid loss of treatment capability and possible degradation of effluent quality. Several considerations make the rehabilitation of Set 2 of the primary clarifiers the logical and effective solution to the degraded state of these facilities, including:

- The present configuration has established a historical record of meeting the established NPDES permitted limits; thus, the existing system has proven to be effective.

- The property requirements and treatment train were already laid out and set aside for these facilities.

- The footprint of the clarifiers will not be changed, thus minimizing adverse environmental impacts.

- The footprint of the new Scum Pumping Station is very small and includes no additional property acquisition or major modification to the NEWPCP.

- All previous and contemporary planning and facility documents are consistent with this plant treatment train and capability.

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TABLE 6.1.2

NEWPCP - DESIGN CRITERIA AND DIMENSIONS OF THE PRIMARY CLARIFIERS

Primary Clarifiers	Set 1	Set 2
Waste Flow - MGD	105	105
Number of Tanks	8	4
Size Each Tank (feet)	240L x 65W	250L x 125W
Average Water Depth (feet)	10	10
Total Surface Area (square feet)	125,000	125,000
Total Volume (cubic feet) (MG)	1,250,000 9.35	1,250,000 9.35
Surface Loading (gal/sq ft/ day)	1,200	800
Displacement - Hours	1.5	2.25
Wier Length (feet)	3,360	758
S.S. Loading - lbs/day (Annuual Average) Percent Removed lbs/day Removed	306,0000 25 76,000	204,000 30 61,000

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- Rehabilitation is cost-effective in that some components of the facility are salvageable, thus conserving potential sunk funds monies in the Rehabilitation Funds.

In general, it was determined by PWD that the rehabilitation of the primary clarifiers was the most effective way of maintaining the treatment capacity and effluent quality of the NEWPCP.

Notice-to-proceed was given on December 27, 1990, with a scheduled length of construction of 1365 days. Furthermore, the construction is staged with only two clarifiers under rehabilitation at a time to provide adequate hydraulic capacity of the treatment train throughout the construction period. The project was initiated for a contracted construction cost of $14,494,768.

PWD continues to seek funding assistance for this project through PennVest. A Letter of Non-Prejudice has been issued by the PaDER for the rehabilitation of the primary clarifiers, which has allowed the project to proceed into the construction stage without jeopardizing this funding option.

As this project consists of rehabilitation of an effective and proven treatment system, as opposed to a new facility, extensive planning was not required for this project. Several standard considerations as a part of funding through the federal Water Pollution Control Revolving Fund (WPCRF), which may be applicable, are addressed herein briefly:

1. Projects must apply best practicable waste treatment technology.

   This project includes the rehabilitation of an existing, proven, and effective system, which is conducive and specifically applicable to this treatment train.

2. Projects must consider utilizing alternative and innovative technologies.

   As this is not a new system, but rather the rehabilitation of a proven facility, innovative and alternative treatment systems would not be applicable.

3. Project's related wastewater collection system must be evaluated and cannot be subject to excessive infiltration and inflow.

   As discussed in Section 2.5.2, extensive SSESs were performed previously for each of three wastewater drainage basins within the City of Philadelphia. PaDER subsequently concurred with the PWD in its determination that elimination or reduction of infiltration and inflow was not cost effective. Furthermore, as previously noted in this report, the flows at the Philadelphia WPCPs are affected more significantly by storm water inflows associated with the combined sewer system than with base infiltration and inflow.

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4. Recreation and open space opportunities must be analyzed during the planning of the proposed facility.

   The project does not include the acquisition of new property, and will result in only a minor change in the property's current use. There is no significant opportunity for recreation or open space activities at the NEWPCP.

5. Development of a user charge system and sewer use ordinance.

   The PWD has a well established user charge system and sewer use ordinance for the area to be served by this facility.

6. The project's recommended alternative must be cost effective. Include an analysis that indicates the project's chosen alternative is cost effective.

   Rehabilitation of the existing facility is cost-effective in that some components of the existing facility can be reused, thus preserving potential sunk funds (such as geotechnical investigations, foundations, excavations, site preparation, property acquisition, etc.)

7. An environmental impact assessment must be prepared that describes the project's positive and negative consequences and the mitigative steps taken for unavoidable negative consequences for a variety of environmental systems.

   This project comprises the rehabilitation of an existing facility, such that no environmental impacts than might otherwise already impact the region are expected. The regional environment, specifically the Delaware River, will continue to benefit from this WPCP and its current wastewater treatment capability. Furthermore, the project provides assurance of continued protection of the City's surface waters. Temporary environmental impacts due to construction are currently being mitigated by standard construction techniques including, but not limited to, sediment and erosion control.

8. Davis-Bacon prevailing wage rates must be included in the facility's construction cost estimates.

   The project is already under construction. The costs provided above represent bid prices.

9. Development of a capital financing plan.

   The PWD maintains a capital financing plan for all of its facilities. The latest are summarized most recently in the City of Philadelphia, Water and Sewer Revenue Bonds, Sixteenth Series, dated May 15, 1991.

Furthermore, NEWPCP has been an integral part of all of the past and contemporary regional and City plans to provide adequate wastewater treatment for the Northeast wastewater drainage district. This project only ensures that this facility continues to meet those goals established in other wastewater planning documents and thus is consistent with all other appropriate planning and facility plans.

6.1.2 SEWPCP

6.1.2.1 Process Evaluation

Table 6.1.3 is a process evaluation summary for the SEWPCP that compares the plant's basis of design to PaDER design criteria. As discussed in Section 2.0, the design capacity prior to the last upgrade was based upon 120 mgd. The plant is currently rated at a monthly flow of 112 mgd. As developed in Section 5.1.3, current dry weather flows for this plant over the past three years have averaged 103.5 mgd which is well below the permitted and design capacity. Based upon the existing CSO operations, the following summarizes the SEWPCP hydraulic loading conditions:

	Flows (MGD)		
SEWPCP	**Average Monthly**	**Maximum Day**	**Peak**
Original Design	120	---	---
Design/Permit	112	---	---
Current	103.5*	---	---
Projected 5-year	102.9*	---	---

Note: Current flows based upon 3-year (1989-1991) average
*Denotes dry weather flows

As can be seen, the plant capacity based primarily upon dry weather flows, appears to be satisfactory even for the projected flows.

6.1.2.2 Plant Improvements

Budgeted Improvements

The PWD has forecasted improvements for the SEWPCP that are included in the operating budget for fiscal years up to and including 1996. These budgeted improvements include, for example: mechanical equipment maintenance for the Waste Activated and Primary Sludge Transfer Pumps; sedimentation tank sludge/scum removal equipment replacement with non-metallic chain, flights, wear shoes, and drive sprockets; and general instrumentation/control and

TABLE 6.1.3

SEWPCP PROCESS EVALUATION SUMMARY

Unit	Number	Dimensions	Existing Capacity	Design Parameter	SEWPCP Design Basis	PADER Guidelines
Mechanical Sewage Screens	6	8.5' channel width 1 inch bar spacing	0.85 ft^3/MG screenings removed	Bar spacing Velocity	1 inch 2.3 FPS maximum	5/8 - 1-3/4 inches 1.25 - 3.0 FPS
Grit Removal	6	10'W x 140'L	3.7 ft^3/MG Grit removal	Velocity	----	1 FPS
Primary Sedimentation	4	250' x 125' x 12' swd	---	Surface settling rate Average Peak BOD removed Wier loading	 960 gpd/ft^2 --- 40% 4,700 gpd/ft	 <1,000 gpd/ft^2 <1,500 gpd/ft^2 30-35% <15,000 gpd/ft
Aeration Tanks	8	210 x 52.5' x 14.3 swd	---	Minimum retention period	1.9 hours	2 hours
				Maximum organic loading	93.5 lbs BOD_5/1000 ft/day	160 lbs BOD_5/1000 ft/day
				FM ratio	---	0.3-1.0 lbs BOD_5/lbs MLVSS/day
				MLSS	4,000 mg/l	3,000 - 5,000 mg/l
				Dissolved oxygen	---	2.0 mg/l
				Return sludge rate	---	15% - 75%

TABLE 6.1.3 (Continued)

Unit	Number	Dimensions	Existing Capacity	Design Parameter	SEWPCP Design Basis	PADER Guidelines
Final Sedimentation Tanks	12	214' x 68' x 11' swd	---	Surface settling rate		
				Average	685-1030 gpd/ft^2	<1,000 gpd/ft^2
				Peak	---	<1,500 gpd/ft^2
				Wier loading	12,700 gpd/ft	<15,000 gpd/ft
				Hydraulic loading		
				Average	---	<800 gpd/ft^2
				Peak	---	<1,200 gpd/ft^2
				Solids loading		
				Average	---	<40 lbs solids/day/ft^2
				Peak	---	<50 lbs solids/day/ft^2
Disinfection	---	Effluent Conduit	---	Contact period		
				Average	37.2 minutes	30 minutes
				Peak	18.9 minutes	15 minutes
				chlorine dose	8 mg/l	8 mg/l

maintenance equipment necessary to assess the integrity of key process equipment. The following summarizes funding above the Fiscal Year 1993 base budget that has been budgeted for ongoing improvements to the SEWPCP:

BUDGETED IMPROVEMENTS COSTS	FISCAL YEAR		
	1994	1995	1996
	$162,000	$240,500	$185,500

Non-Budgeted Improvements

A partial listing of key items which have been identified by the PWD in need of improvement at the SEWPCP that are recommended for a future budget are summarized in the following paragraphs. An indication of the rational for such improvements and the suggested fiscal year in which the improvement should be implemented are also provided:

- Grit transporters and piping [ASAP] — The two grit transporters and the grit conveyance piping need to be replaced. This job is of an emergency nature.
- Process Air Blowers #1 and #3 [FY 93] — Two Sutorbilt process air blowers need to be rebuilt.
- Influent Pumps [FY 93] — Five influent pump motors and two variable speed drives need to be maintained and have the bearings replaced.
- Maintenance Group Building [FY 94] — A new steel fabricated building is needed to house the Building Maintenance Group.
- Outdoor Switchgear Ventilation [FY 94] — The outdoor switchgear for the incoming power must have a ventilation system and temperature control system installed.
- Flocculation Tank Repair [FY 95] — The concrete channels on the flocculation tanks require repairs and the stop logs should be replaced with sluice gates.
- Replacement of Chlorination Equipment [FY 96] — The chlorinators, evaporators, instrumentation, and piping in the southeast chlorination room of the effluent pumping station are in need of repairs.
- Oregon Avenue CSO Level Sensors [FY 93] — To prevent combined sewer overflows, a level sensor must be installed in the Oregon Avenue combined sewer overflow discharge line. The sensor must transmit information to the SE

Process Computer and the Influent Pumping Station Operation Control Station.

- Pumping Station Diversion Channel Influent Sampling Station [FY 95] — A new influent sampling station is required on the pumping station diversion channel.

- Replace JYC 5000 Process Computer [FY 96] — The JYC 5000 process computer is obsolete. It needs to be replaced with a modern PC-based system.

More stringent discharge limitations or other regulatory requirements that may be instituted in the future could require the installation of additional treatment facilities that have not been forecasted in the Capital Budget Program. Some potential Capital Improvement requirements are summarized below:

- Nutrient Removal — A requirement to remove phosphorus and/or nitrogen from the plant effluent may require the installation of additional treatment processes and require investigation into the best means of removal.

- Dechlorination — A requirement to remove the free chlorine from the effluent after disinfection could require the installation of additional treatment facilities.

6.1.3 SWWPCP

6.1.3.1 Process Evaluation

Table 6.1.4 is a process evaluation summary for the SWWPCP that compares the plant's basis of design to PaDER design criteria. As discussed in Section 2.5, the design capacity prior to the last upgrade was based upon 210 mgd. The plant is currently rated at a monthly flow of 200 mgd. As developed in Section 5.0, current dry weather flows for this plant over the past 3 years have averaged 169.5 mgd, which is well below the permitted and design capacity. Based upon the existing CSO operations, the following summarizes the SWWPCP loading conditions:

SWWPCP	FLOWS (MGD) Average Monthly	Maximum Day	Peak
Original Design	210	300	400
Design Permit	200		
Current	169.5*		
Projected 5-year	190.7*		

Note: Current flows based on 3-year (1989-1991) average
*Denotes dry weather flows

TABLE 6.1.4

SWWPCP PROCESS EVALUATION SUMMARY

Unit	Number	Dimensions	Existing Capacity	Design Parameter	SWWPCP Design Basis	PADER Guidelines
Mechanical Bar Screens	6	6' channel width	570 MGD	Bar spacing Maximum velocity	1 inch 3.2 FPS	5/8 - 1-3/4 inches 1.25 - 3.0 FPS
Grit Removal	4	60' x 60'	5.20 ft^3/MG	Velocity	----	1 FPS
Primary Sedimentation	5	250' x 125' x 12' swd	210 MGD	Surface settling rate Average Peak BOD removed Wier loading	 1,350 gpd/ft^2 --- 25% 45,700 gpd/ft	 <1,000 gpd/ft^2 <15,000 gpd/ft 30-35% <15,000 gpd/ft
Aeration Tanks	10	14,500 ft^2 x 16' swd	210 MGD	Minimum retention period	1.96 hours (wastewater flow)	2 hours
				Maximum organic loading	106 lbs BOD_5/1000 ft/day	160 lbs BOD_5/1000 ft/day
				FM ratio	0.45 lbs BOD_5/lbs MLVSS/day	0.3-1.0 lbs BOD_5/lbs MLVSS/day
				MLSS	4,900 mg/l	3,000 - 5,000 mg/l
				Dissolved oxygen	---	2.0 mg/l
				Return sludge rate	---	15% - 75%

TABLE 6.1.4 (Continued)

Unit	Number	Dimensions	Existing Capacity	Design Parameter	SWWPCP Design Basis	PADER Guidelines
Final Sedimentation Tanks	20	76' x 260' x 11' swd	210 MGD	Surface settling rate		
				Average	530-795 gpd/ft	<1,000 gpd/ft2
				Peak	---	<1,500 gpd/ft2
				Wier loading	12,800 gpd/ft	<15,000 gpd/ft
				Hydraulic loading		
				Average	---	<800 gpd/ft2
				Peak	---	<1,200 gpd/ft2
				Solids loading		
				Average	---	<40 lbs solids/day/ft2
				Peak	---	<50 lbs solids/day/ft2
Disinfection				Contact period		
				Average	32.8 minutes	30 minutes
				Peak	24.5 minutes	15 minutes
				chlorine dose	8 mg/l	8 mg/l
Sludge Thickening	8	18' x 70' x 8' swd		Solids loading	17 lbs/day/ft2	20 lbs/day/ft2
				Hydraulic loading	---	0.8 gpm/ft2
Sludge Digesters	12	110' diameter x 30' swd	373,000 lbs/day	Side water depth	30'	>20'
				Volatile solids loading	88 lbs VSS/1,000 cf/day	<100 lbs VSS/1,000 cf/day

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As can be seen, the plant capacity based primary upon dry weather flows, appears to be satisfactory even for the projected flows.

6.1.3.2 Plant Improvements

Budgeted Improvements

The PWD has forecasted improvements for the SWWPCP that are included in the projected operating budgets for fiscal years up to and including 1996. The budgeted improvements include, for example: mechanical equipment maintenance such as for effluent pumps, main plant air compressors, sludge gas compressors, bar screens, influent screw pumps, cryogenic plant, scum pumps; replacement of equipment that has served out its useful life, such as sludge pumps, boilers, primary tank pumps and valving, controls for ash handling system, and VFD's for miscellaneous pump controls; primary tank overhaul, including flights, chains, wear shoes, sprockets, etc.; grit incinerator overhaul; rehabilitation of scum pumping station, digester mixing system, and heating system; miscellaneous spare parts and equipment purchase; and many other elements.

Not included in this list are several major projects consisting of lagoon closure and engineering for possible future treatment requirements. The following summarizes funding above the Fiscal Year 1993 base budget that has been budgeted for ongoing improvements to the SWWPCP:

	FISCAL YEAR		
	1994	**1995**	**1996**
BUDGETED IMPROVEMENT COSTS	$7,770,000	$5,167,000	$1,875,000

Non-Budgeted Improvements

Frequently, improvements to equipment or facilities cannot be forecasted or the implementation of an improvement may have been held over from previous years. A partial list of items have been identified that should be added to the projected budget are summarized below:

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Project
Replacement of Chlorine Pipeline
DAF polymer system
Install high capacity Waste Sludge Pumps
Digester Mixing Rehab
New roofing on South Digesters
Install VFDs for DSPs #2 & #3
Raise flights on influent end of tanks
Upgrade Grit-Handling System - Incinerator Bypass System
Rehabilitation of Heating Equipment
Rehab 70th & Dicks Gates
Lagoon Closure
Purchase hardware/software for CMMS
Plant Water Pump Overhaul
Influent Sampling and Metering
Rehab Scum Pumping Station
Waste Gas Overhauls
Install Sludge Thickening Equipment - RST
Conversion of Dig. Tanks #1 & 2 to Sludge Storage Tanks
Upgrading of UNOX Reactor Purge System & LOX

In addition, more stringent discharge limitations or regulatory requirements that may be instituted in the future could require the installation of new treatment facilities that have not been forecasted in the Capital Budget Program. Some potential Capital Improvement requirements are summarized below:

- Nutrient Removal - A requirement to remove phosphorus and/or nitrogen from the plant effluent may require the installation of additional treatment processes and require investigation into the best means of removal.

- Dechlorination - A requirement to remove free chlorine from the effluent after disinfection could require the installation of additional treatment facilities.

- Lagoons - Several lagoons were used in the past for sludge storage/disposal. Closure of these lagoons may be required in the near future. Closure activities could vary potentially from providing security and performing groundwater sampling to removing the lagoons and remediating groundwater in the vicinity.

6.1.3.3 Consent Order Program - SWWPCP

The EPA and PaDER have taken legal action against the PWD under the Clean Water Act, in response to violations in the late 1980's of the NPDES permit issued to the SWWPCP. The terms of settlement under this action include a specific, sequential, program for corrective actions, intended to ensure consistent long-term compliance with the NPDES permit. A report conducted by an independent consultant was proposed and subsequently issued as a final report on July 8, 1991. This section of the Act 537 Plan will summarize the findings of that report and outline the corrective measures required over the course of the next several years. These are binding obligations on the SWWPCP.

In summary, there are three areas that have been developed in the consultant's report:

- Remedial Action Plan
- Staffing Plan
- Maintenance Management System

Remedial Action Plan

The Remedial Action Plan (RAP) of the July 8, 1991 Report revised the PWD's 1988 Remedial Action Plan by incorporating additional corrective actions and schedules. A brief summary of this RAP is as follows:

- A LABOR RELATIONS binding recommendation that the PWD retain a labor/management consultant to identify plans and impacts

- NPDES sampling QA/QC, chain-of-custody, and NPDES reporting protocol binding recommendations that serve to ensure the integrity of the sampling, analysis, and DMR reporting programs for the SWWPCP

- Augmentation of the PWD's Septage Haul Program through binding recommendations, including requirements for a new septage receiving facility at the SWWPCP and septage management plan, including haulers' manifests and laboratory analysis of septage

- A Process Control Plan binding recommendation that requires SWWPCP established performance criteria, process control parameters and strategies, standard operating procedures (SOPs), process sampling and laboratory analyses, and process performance monitoring for each major unit process in the plant

- Remedial Action binding recommendations to ensure that the SWWPCP meets its NPDES discharge requirements for each of the following six critical unit processes:

    - waste sludge system
    - SPDC dewatering
    - cryogenic oxygen plant
    - return activated sludge pumping system
    - dissolved air flotation thickening
    - anaerobic digester cleaning

In addition, there were numerous binding recommendations made in the area of process control.

- A Process Equipment binding recommendation to manage and ensure that, throughout the plant, certain major pieces of equipment are always in-service with adequate reserve equipment available.

Staffing Plan

The Staffing Plan as outlined in this report included the following corrective actions:

- A recommendation that the existing maintenance organization be reorganized to consolidate existing staff under a single Maintenance Manager and to organize the unit in functional areas

- Staff the SWWPCP by filling vacancies

- An Operations and Maintenance Training binding recommendation that calls for immediate training in specific areas of management, skilled trades, and operations; determination of the skills and educational requirements for various positions; and an overall long-term program for both remedial and ongoing training

- A recommendation for a full-time industrial safety professional who is to develop, implement, and administer a plant-specific safety program

Maintenance Management System

Finally, the third area addressed in this report is that of Maintenance Management. The recommendation is for an evaluation of the existing maintenance programs and modifications to ensure improved maintenance productivity and reduced equipment breakdowns.

6.2 WASTEWATER COLLECTION SYSTEM - 5-YEAR NEEDS

The Planning and Research Group within the PWD is responsible for evaluating the collection system, determining improvements, and establishing priorities for improvements to be undertaken. Needs are established through maintenance and inspection reports, resident complaints, and internal review and evaluation. Alternative solutions are developed and evaluated within the Planning and Research Group and the most effective and economical alternative is either forwarded to the PWD Design Group or contracted out to a consulting engineering firm for implementation. The planned improvements are cataloged and prioritized to establish a budget in any given year.

6.2.1 Gravity Sewers

The Water Department has budgeted $13.5 million per year for the 5-year period from 1992 to 1996 for the reconstruction of the collection system. An additional $100,000 has been budgeted for the construction of new sewer lines. The projects to be completed over the next several years are included in the Planning and Research Group's Capital Improvements Plan (CIP). At this point in time, the CIP includes 185 projects involving sewer line reconstruction either solely or in conjunction with a water line project. Projects with an estimated construction cost over $500,000 are listed in Table 6.2.1

The CIP is only established for the next 5-year period; therefore, the projects budgeted for Fiscal Year 1996 also include those projects that will be rescheduled for implementation after 1996.

It is important to note that many projects also include water line rehabilitation since the SSES studies pointed to water main leakage as one of the significant sources of I/I.

6.2.2 Pumping Stations

As mentioned in Section 4.2, the pumping stations undergo a regular maintenance regimen that includes periodic, comprehensive overhauls. The Central Schuylkill Pumping Station, by far the largest station in the City, is slated for a complete overhaul, including the replacement of the motors and electrical work. This work has been estimated at $4 million and was to be competitively bid in autumn of 1992. Due to the expense of this rehabilitation effort, this is the only major project scheduled by the Wastewater Pumping Station Group through 1996.

6.2.3 Combined Sewer System

As discussed in Section 4.2, the PWD recently completed a series of contracts to automate eight and monitor 45 regulators in the Northeast Drainage District.

The draft NPDES permit (currently under negotiations with PADER) issued for the Northeast Water Pollution Control Plant provides a detailed survey of the combined sewer control that may be mandated for the PWD over the next five years. As noted in the following section, the state strategy on combined sewer overflows (CSOs) is intended to provide for stricter regulation over the next two permit periods. However, the pending NPDES permit, as with the existing permit, will allow combined sewer overflows only when the hydraulic capacity of the conveyance or treatment facilities are exceeded. Dry weather overflows are prohibited.

At a minimum, best management practices and other non-capital intensive measures to minimize the impact on the receiving water will be required: PADER has outlined program requirements for the Philadelphia system which will develop and implement a CSO program for all CSO discharges in each of the three WPCPs. These program requirements include:

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TABLE 6.2.1

PLANNING AND RESEARCH COLLECTION SYSTEM CAPITAL IMPROVEMENTS PLAN 1992 - 1996 (PROJECTS OVER $500,000 ONLY)

Location	Water	Sewer
Budget Year 1993		
48th - Wyalusing to Lancaster	•	•
Lehigh - Aramingo to Trenton	•	•
Total Major Sewer Projects 1993		**$1,311,900**
Budget Year 1994		
York - Mascher to 2nd	•	•
Dobson's Run		
Wissahickon to Stokely		•
Total Major Sewer Projects 1994		**$4,843,100**
Budget Year 1995		
Beaumont - 57th and 58th		•
Allegheny - Jasper to Emerald		
24th - Huntington to Lehigh		•
52nd - Paschall to Grays		•
Total Major Sewer Projects 1995		**$7,171,200**
Budget Year 1996 and Beyond		
Wolf - Delaware to 2nd	•	•
Wolf - 3rd to 6th	•	•
Walnut - 3rd to 4th	•	•

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Table 6.2.1 (Continued)

Location	Water	Sewer
Mantua Tunnel		
Zoological to Mantua	•	•
Shedwick to 35th	•	•
Sedgwick - Lincoln to Cresheim	•	•
Shunk - 18th to 19th	•	•
Belfield - Wister to Penn		•
Ogontz - Somerville to Olney		•
21st - Somerset to Indiana		•
Ogontz - Olney to Church		•
Dobson's Run - Roberts to Kelly		•
Juniata - Reading R.R. to 250 N. Dobson		•
Paul's Run - Norwalk to Welsh		•
21st - Sedgley to Somerset		•
Torresdale - Adams to Church		•
Mill Creek - Lancaster to Monticello		•
Monticello - Wilton to 53rd		•
Lancaster - 52nd to 52nd		•
Princeton - Keystone to State		•
Total Major Sewer Project 1996 and Beyond		**$68,596,400**

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Minimum Technology-based Control Measures - Plan of Action - Philadelphia will be required to submit, obtain State and Federal approval, and begin to implement, and evaluate a Minimum Technology-based Limitation Plan of Action within 38 to 52 months of reissuance of its NPDES permit. This Minimum Technology-based Limitation Plan of Action will include as a minimum the following measures:

Identification at each of the regulator facilities:

- Latitude and longitude of each discharge point
- Narrative description of the location of each outfall with respect to a street intersection location map
- Description of the size and type of regulator mechanism, including an engineering drawing
- Description of the size and type of outfall structure
- Vertification of the presence or absence of a backwater flow prevention device in each regulator
- Name of the receiving water
- Development of a visual identification system on all outfalls
- Identification of continuous or chronic dry weather overflows

System Inventory - This plan shall identify all overflow points, control structures, sewer sizes, control structure dimensions, industrial contributors, and key hydraulic monitoring control points. This inventory is required to include system maps, hydraulic analyses, and flow measurements. Also required is characterization of all overflows in terms of both frequency, quantity and quality, and identification of the intensity and duration of the storm event that triggers an overflow. In addition, a determination is necessary for the volume discharged from each overflow for various size storms, number of events, and total volume discharged per year based on historical rainfall records.

Operational Status and Assessment - This requirement includes the physical inspection of each of the CSO regulators and an engineering evaluation with respect to the adequacy and functionality of each. This effort will result in a report recommending remedial measures to bring each regulator up to optimal functionality with the goal to eliminate all dry weather overflows.

Inspection and Maintenance - The development of a written Operations and Maintenance Plan to ensure that:

- deposition of solids do not cause obstructions that will result in overflows
- continuous dry weather discharges are not occurring
- regulators are in good working order and adjusted to minimize overflows

High Flow Management - Development of a High Flow Management Plan with the two following two goals:

- maximization of storage capacity of the collection system without causing surcharging or backups

- maximization of the amount of flow to the treatment plants without upsetting normal plant operations

Ordinance Revisions - Modification to the sewer use ordinance to ensure the prohibitions of:

- dry weather overflows
- construction of new combined sewers, except where sewer separation is not feasible
- inflow sources in the wastewater collection system
- dumping of motor oil and excessive grease into the collection system

Source Reduction - Initiation of a program to minimize the discharge of solids and floating material by:

- regular cleaning of the streets and catch basins
- installation of screens in the CSO regulators
- reduction of infiltration and inflow where feasible

Pretreatment Program - Review of the Industrial Pretreatment Program to ensure CSO impacts are minimized.

Minimization of CSOs Near Sensitive Areas - Examine the elimination or minimization of CSO discharges near drinking water intakes, recreational areas, or unique ecological habitats.

Water Quality Impacts and Plan of Action - PWD will be required to prepare a water quality impact plan in response to those findings of the Delaware River Basin Commission (DRBC) CSO Comprehensive Study of the Delaware Estuary, currently being prepared. This plan will be required within 12 months from the completion of the DRBC study.

Report Requirements - PWD will be required to submit to PaDER and EPA, a semi-annual report of the following subjects:

- Development and Implementation of the Minimum Technology-based Control Measures Plan of Action
- Development of the Water Quality Plan

Furthermore, PWD will be required to submit additional information germane to the CSO system in the annual Chapter 94 - Wasteload Management Report:

- Compilation of monthly monitoring reports of priority CSO overflow points
- Summary of the frequency, duration, and volume of the CSOs for the previous calendar year
- Operational status of major overflow points and identification of known/potential instream water quality impacts and their causes
- Actions taken in implementing the approved Plan of Action

These permitted requirements will represent a major effort on the part of PWD to maximize the effectiveness of its CSO system. It also indicates the prioritization of CSO control on the part of the regulating agencies that is sure to become more intense in the future.

6.3 SLUDGE MANAGEMENT SYSTEMS - 5-YEAR NEEDS

This section of the 537 Plan address the needs of the Philadelphia Sludge Processing and Distribution Center (SPDC) through the next five years.

As a prelude to the discussion, below it is important to note that currently digested biosolids are not achieving the centrifuge feed solids concentrations necessary to maximize biosolids cake production. An increase in feed solids concentration by optimizing any of the steps in the biosolids processing train could significantly improve plant performance through increased operating throughput and save the City of Philadelphia operations costs associated with biannual handling, equipment use, and landfilling tipping fees.

6.3.1 Upgrade of Dewatering Equipment

The most pressing need for the SPDC is to raise the solids concentration in the biosolids cake produced. The increase in cake solids would reduce the volume of material to be composted and cut down on the amount of time necessary for compost processing and the area necessary for composting and curing. The current Bird centrifuges are outfitted with eddy-current backdrives that have been proven to be less than efficient at SPDC. Other facilities using the same equipment have had similar problems. A dewatering evaluation is necessary to see if existing equipment can be retro-fitted (with mechanical backdrives) with any success or if the outright purchase of high solids machines (such as the Humboldt Hydropress) would be more economical.

6.3.2 Assess the Impact of New 40 CFR Part 503

40 CFR Part 503 was signed November 25, 1992, and will be published in the *Federal Register* in the first quarter of 1993. These new regulations will impact the potential end uses of biosolids and biosolids products (compost). An assessment of the impact these regulations will have on the SPDC is necessary to determine any changes on the processing needs and end uses of biosolids. This assessment must gather additional data on pathogens, volatile solids reduction, certain elements in end products, and process performance. Also additional input from EPA is needed on implementation of the Rule.

6.3.3 Meet Market Demands

Capacity studies on compost processing, screening, storage and on biosolids processing storage and utilization is needed to determine the optimum means of meeting market demands.

6.3.4 Digester Performance

Some questions persist as to the digester performance and subsequent partially digested biosolids being sent to the SPDC for processing by the three WPCPs. This puts more pressure on the equipment since partially digested biosolids have more volume, a higher percentage of oxygen consuming organisms, and are responsible for greater odor potential. Volatile solids are not reduced to any great extent in poorly digested biosolids and may result in problems meeting new Part 503 requirements.

6.3.5 Grit Removal

Grit removal is inefficient and excess grit is causing the bowl and scroll assemblies in the centrifuges to require complete rehabilitation (costing $50,000) every two years. Excess grit also adds volume to the biosolids being processed. An evaluation of the grit removal processes at the WPCPs is needed to eliminate grit from the biosolids stream.

6.3.6 Evaluate Contract Operations

The potential for contract operations should be evaluated. The process control operation manager has made several man hour evaluations of current work practices. Along these lines, a need for specific production goals has been identified. A study on this subject could set standards for the SPDC as a whole and may serve to identify problem areas or establish quality control procedures.

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6.3.7 Storage Evaluation

Liquid storage at SPDC could provide flexibility in biosolids processing. A study evaluating the need for additional storage locations and life cycle costing is recommended.

6.3.8 Market Study

Due to the current economic situation in the Philadelphia area, the City should re-evaluate biosolids marketing. The cost of fertilizers has been increasing and this should make the substitution of compost or other biosolids products an attractive alternative. Conversely, competition from other compost generators could limit marketability and/or revenues. Studies on all end uses and their respective financial burdens to the City should be examined.

6.3.9 Agricultural Use Study

Another need is a study on the potential quantities of liquid or cake that can be utilized through site-specific agricultural permitting. The purpose of such a study is to maximize the use of those lower cost biosolids management alternatives.

One of the problems facing the City of Philadelphia concerning land application of its biosolids products is the PaDER land application permitting process. It is possible that PaDER will revise the regulations to allow for general permits to land apply the biosolids in a manner that makes beneficial use easier with less "red tape" involved for the City, contractors, and end users. A proactive approach should be taken to pending changes in PaDER rules, guidelines, and policy. This can be facilitated through participation in Professional Associations and communications with respective PaDER and environmental interest groups, legislators, and regulators in New York, New Jersey, Delaware, and Maryland. The City should proceed into educating these groups and bringing to light the problems of past regulations and policy. It is extremely important to implement guidelines immediately as many states will be modifying their policies and regulations in response to EPA regulations. This is probably the City's last opportunity to significantly influence rulemakers for the coming decade.

6.3.10 Water Treatment Residuals

A portion of the City's potable water treatment residuals are currently being processed at the SPDC. An economic analysis should be performed to determine if this is the most cost-effective management option, considering effects of these residuals on the WPCP and SPDC operations.

6.3.11 Composting Operations

General

An evaluation of the current instrumentation and monitoring scenarios in place at the SPDC is needed. This should include spare parts and availability, new instrumentation on the market, maintenance on existing instrumentation, appropriateness of monitoring locations, and compliance with new EPA Regulations.

Pathogen Reduction Requirements

All biosolids products that are given away or marketed for use in public access sites, i.e., earthlife sales, give away bins, non-profit organizations, ballfields, city parks, state parks, etc., must meet Class A pathogen reduction. This requires monthly monitoring for Fecal Coliform or *Salmonella* and time/temperature recordkeeping.

Changes in composting procedures should be instituted to:

A. Ensure all of the composting mass achieves the time/temperature requirements

B. Take accurate time temperature measurements

C. Avoid regrowth by segregating Class A and Class B compost handling equipment

D. Apply a blanket of woodchips or finished compost on active compost windrows to improve pathogen reduction.

The utilization of non-composted products, such as liquid biosolids, dewatered biosolids, and mine mix, will be less restricted if Class B pathogen reduction is achieved. No data is available at this time to determine if the fecal coliform limit of 2,000,000 MPN per gram limit is met through digestion alone. If this limit is not achieved consistently, then an evaluation of the anaerobic digester process at the Southwest and Northeast WPCPs should be undertaken.

Vector Attraction Reduction

For compost products that are utilized on a lawn or home garden and distributed in bulk or in bags, the average temperature must be maintained between 45°C and 60°C for 14 days or longer to achieve vector attraction reduction. It is believed SPDC can achieve this if operations are modified to:

1. Cover the compost windrows with finished compost or recycled woodchips

2. Install an automated temperature monitoring system to document temperatures and control blowers.

For non-composted products, vector attraction reduction can be achieved through one of the following:

A. Injecting liquid biosolids beneath the soil surface

B. Incorporation of the biosolids into the soil within six hours of land application

C. Reduction of volatile solids by 38 percent in anaerobic digesters

D. Using laboratory procedures to show that volatile solids cannot be reduced by more than 17 percent over 40 days at temperatures between 30 and 37 degrees Celsius

6.3.12 Future Sludge Quality and Quantity

In the future, new NPDES permit limits may be added by in Delaware River Basin Commission (DRBC), including nitrogen and phosphorous limits on WWTP effluent. This possible permit addition may require some form of tertiary treatment. A preliminary evaluation of the impact of tertiary treatment at the various WPCFs and the impact on the biosolids quality and quantity produced may be needed in the next 5 years.

6.3.13 Develop a Memorandum of Agreement MOA

In order to expand the land application program to contiguous states, PWD should develop a Memorandum of Agreement (MOA) with the state of Delaware and its regulatory agency (DNREC) similar to the MOA PWD has with the Camden County Municipal Utilities Authority (CCMUA). This would better enable the City to utilize biosolids in this nearby agricultural state.

6.3.14 Rail Transportation Evaluation

New bladder containers are available for hauling biosolids by rail and a rail siding at SPDC could increase opportunities to utilize biosolids at remote locations. From the information available, these bladders are reusable and appear to be a viable alternative to trucking. A more detailed analysis should be undertaken.

6.3.15 Current Sludge Quality

From a review of analytical data of Philadelphia biosolids products, it appears that the only metal that occasionally exceeds the concentrations shown in Table 1 is lead. Although this would not limit SPDC's ability to produce marketable material or material for home use, limitations on the amount applied could make marketing more difficult. It is also possible that PaDER will revise its guidelines to similarly limit lead concentrations in agriculture and reclamation. In order to avoid exceedances, Philadelphia should first re-evaluate its local limits with respect to lead. If this does not reveal any significant point source contributers (including water filtration plant direct discharges), then the impact of the Lead and Copper Rule (drinking water corrosion control) should be evaluated. It is possible, but not highly probable, that the problem could be corrected through improved corrosion control.

Monitoring of metals of concern must be conducted on a monthly basis. Selenium, molybdenum, and arsenic are the only elements that must be added to the monthly monitoring list.

6.4 TWENTY-YEAR NEEDS (LONG-TERM)

The Act 537 regulations mandate that all 5-year needs be identified and evaluated, and that long-term (20-year planning period) projections be made. Generally, such long-term planning is prudent to justify any capital facility requirements and the financing period thereof. In the case of this City of Philadelphia Act 537 Plan, the major planning is ongoing and budgeted by the PWD and an integral part of the existing rate structure; long-term planning, to the extent that new facilities are to be defined, is not a part of this scope of work. However, given the projected population, flows, and loadings provided in Section 5 and the evaluation of needs in Section 6, it is apparent that there are no significant long-term facilities required of either the collection system or treatment facilities in view of the projections for declining wastewater needs under dry weather conditions. Indeed the WPCPs have reasonable reserve capacity for the 20-year period under dry weather conditions.

This report will indicate that the focus for sewerage needs in the future will revolve around the wet weather treatment requirements, in particular the CSO and SWWPCP Consent Order issues, and other regulatory requirements that may impact the system.

As an overview of pending legislation or regulations, the following sections of the Act 537 Plan will briefly discuss the following:

- CSO Strategies and Regulations
- Pretreatment Regulations
- Clean Air Act
- Storm Water NPDES Permitting and
- Biosolids Part 503 Regulations

Based primarily on the following regulations and PADER or DRBC mandates, future facility needs can only be evaluated in the context of further studies. Such studies are outlined in the following Section 7.2.

6.4.1 Combined Sewer Overflow Control Regulations and Strategy (Bibliography Reference)

6.4.1.1 Application of CWA to CSOs

The National Pollutant Discharge Elimination System (NPDES) permit program, established by Congress under the Clean Water Act (CWA) in 1972, controls point source discharges of pollutants into waters of the United States. As specified within the CWA, EPA has traditionally issued individual permits to regulate point-source discharges of pollutants from individual facilities. In addition, discharges from separate storm sewer systems are regulated under Section 402(p) of the CWA, and EPA is implementing regulations under this section to develop systemwide municipal storm water management programs to reduce pollutants from municipal storm sewers.

Effluents from combined systems are not specifically regulated under the standards for sanitary systems nor under the requirements for discharges from separate storm sewers. NPDES regulations, however, provide for the issuance of general permits and the use of individual control strategies to regulate a category or subcategory of point source discharges warranting similar pollution control measures. Thus, locations of CSOs are documented in NPDES permits for publicly owned treatment works (POTW).

6.4.1.2 National CSO Control Strategy

In September 1989 EPA issued a National Combined Sewer Overflow Control Strategy designed to control all CSO effluents. This strategy was designed to compliment control programs for sanitary sewers and separate storm waters by establishing a nationally consistent and uniform approach to develop and issue NPDES permits for CSOs. These NPDES permits are to be issued expeditiously to minimize potential environmental and human-health impacts by establishing technology-based and water quality-based requirements for CSOs.

The 1989 National CSO Control Strategy has three objectives:

1. To ensure that if CSO discharges occur, they are only as a result of wet-weather

2. To bring all wet weather CSO discharge points into compliance with the technology-based requirements of the CWA and applicable state water quality standards

3. To minimize water quality, aquatic biota, and human health impacts from wet-weather overflow

The strategy emphasizes that CSO point sources currently discharging without a permit are unlawful and must be permitted or eliminated. Therefore, regions or states were to have developed and implemented approved permitting strategies by March 31, 1990. Under these individual strategies, all communities with combined sewer systems and all CSO points in these systems were to be identified, with steps taken to permit any CSO discharge points not previously permitted. Also, the status of compliance with technology- and water quality-based permit requirements were to be provided for each discharge point.

When permitting CSOs, technology-based permit limits are to be established for best practicable control technology currently available (BPT), best conventional pollutant control technology (BCT), and best available technology economically achievable (BAT) based on best professional judgment (BPJ). It is important to note, however, that CSOs are not subject to the secondary treatment regulations, that are applicable to publicly owned treatment works. It is also important to emphasize that this strategy does not apply to sewer system bypasses (i.e., intentional diversions of the waste stream from any portion of a treatment facility, which are prohibited unless certain criteria defined in 49 CFR 122.41(m) (4) are satisfied)

Minimum BCT/BAT technology-based limitations required for all CSO permits, based on a BPJ basis [cf. 40 CFR 125.3(d)], should include:

- Proper operation and regular maintenance programs throughout the system
- Maximum use of the collection system for storage
- Review and modification of pretreatment to minimize potential CSO impacts
- Maximum flow delivery to the POTW for treatment
- Prohibition of dry-weather overflows
- Control of solid and floatable materials in CSO discharges

Combined sewer systems and CSOs also can require case-specific examinations to identify additional control measures necessary to remedy particular discharge problems. Drawing from Section 301(b)(1) (C) of the CWA, the Strategy allows that additional permits limits may be used when necessary to comply with state water quality standards. Further drawing from that Section, permittees are allowed to select and use the most cost-effective technology-based control measures to assure compliance with state standards. Alternative technology-based options available to control wet-weather discharges from CSOs include:

- Comprehensive systemwide storm water management programs
- Supplemental pretreatment
- Sewer ordinances
- Local limits program modifications
- Identification and elimination of illegal discharges
- Pollutant-specific limitations
- Compliance schedules
- Flow minimization and hydraulic improvements
- Direct treatment or overflows
- Sewer rehabilitation
- In-line and off-line storage
- Reduction of tidewater intrusion
- Construction of CSO controls within the sewer system or at CSO discharge points
- Sewer separation
- New or modified wastewater treatment facilities
- Monitoring or modeling requirements

Monitoring requirements for wet-weather overflows from CSOs can vary to meet the circumstances of the individual combined sewer system overflow point(s). In all cases, however, monitoring should be cost-effective and it should serve three purposes:

- Document CSO discharge frequencies and their characteristics
- Evaluate actual water quality impacts resulting from CSOs
- Determine compliance with CSO permit requirements

The strategy indicates that discharge monitoring and/or modeling, waste load allocations that address CSO-related hydrological events, and instream surveys are often necessary to assess how CSO discharges may violate technology-based limitations or water quality standards.

This information also often is needed to design corrective actions. In addition, compliance monitoring requirements should be included in all CSO permits, with required data including incidents and magnitudes of individual CSO events and sufficient data to assess compliance with permit limits and state water quality standards.

Finally, in January 1993, the EPA issued a draft guidance document entitled "Combined Sewer Overflow Control Policy."

6.4.1.3 Pennsylvania Combined Sewer Overflow Strategy

In April 1991, the PADER issued a document entitled "Strategy for Controling Combined Sewer Overflows in Pennsylvania." PaDER's overall goal is to bring all existing CSO discharges into compliance with the State water quality standards. Except for emergencies, PaDER does not allow dry weather CSO discharges. No new CSO systems will be permitted.

The implementation of the strategy is through permitting, compliance monitoring, and (where necessary) enforcement. Existing CSO systems are reviewed and permitted over a 5-year period following PaDER's watershed permitting process.

The initial focus of the CSO strategy will be to require each CSO system to develop and submit a plan of action to identify and eliminate and/or control CSOs and related water quality impacts. The plan will include identification and characterization of these discharges, their current status, effectiveness of existing control measures, known or potential effects on the receiving waters, and identification of needed additional structural and/or non-structural controls with an implementation schedule. Upon approval by PaDER, the permittee shall implement the plan in accordance with the approved schedule. At least once every five years, this strategy will be reviewed and updated as necessary.

Reliable data on discharge volume, frequency, duration, and quality are not available for any CSO systems. However, each CSO system has been prioritized as high, medium, or low priority using the best available data. The initial priorities were established using one or more of the following general considerations:

- Documented instream water quality impact or public health hazards
- Discharges to special protection High Quality/Exceptional Value (HQ/EV) waters
- Potential for instream or public health impact
- Proximity to public potable water supply

- Esthetics and other considerations
- Ongoing and/or planned CSO control projects

All PWD discharges are considered a high priority.

At the present time, PaDER requires municipalities to submit CSO and related information during the NPDES permitting process. In municipalities having both the collection sewers and treatment facilities, the CSO information is required in the permit application and reviewed before the NPDES (Part I) permit is issued and/or renewed. The CSO requirements are reviewed every five years.

CSOs are considered point sources and as such are subject to BAT/BPT/BPJ technology-based treatment requirements and compliance with state water quality standards. However, the minimum technology-based requirements are not defined and necessary data for conducting water quality impact evaluations are not available at the present time.

All CSO systems will be required to record and maintain data on flow, frequency, and duration of discharges occurring from the systems. The data should be summarized and submitted annually and/or made available to PaDER earlier upon request. These systems will be required to include a CSO status report in their annual wasteload management Report (Chapter 94) report. As a minimum, the Chapter 94 report should provide current operational status of major overflow points, a summary of the last 12 months of CSO data, known water quality impacts, and actions taken and/or planned to reduce or eliminate the CSO discharges.

In addition to the above general requirement applicable to all CSO systems, high priority CSO systems may be required to perform additional special data collection, monitoring, analysis, and quarterly reporting, as generally outlined in the NPDES permit.

Controlling and/or eliminating the CSOs and their water quality impacts is a ambitious goal and viewed as a long-term program, i.e., over several permitting cycles. As a starting point, a minimum 10 years (two permitting cycles) program will be used to completely implement the CSO strategy. This approach will provide sufficient time to collect and evaluate data to require any cost-intensive control measures.

During the first permitting cycle, each CSO will be required to submit a plan of action and, upon PaDER's approval, begin to implement certain minimum best management practices identified in the plan. The <u>second</u> phase of the CSO implementation will build upon the progress and results of the first phase control practices and activities. This phase may result in additional refinements to the plan of action and where necessary, may result in requiring additional structural and/or non-structural controls.

The only exception to the above two-phase implementation approach will be the high priority systems where the PaDER has documented evidence of significant problems and water body degradation and other areas where existing CSO controls and other improvement programs are already underway or are planned. In the case of the PWD, this determination is presently underway by the DRBC Delaware estuary water quality model.

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6.4.2 Future EPA Pretreatment Regulations

In the near future (5- to 10-year horizon) the EPA will be working on several Acts and programs that will effect the Philadelphia Industrial Pretreatment Program. The following represents a synopsis of the most pertinent points from the EPA agenda:

1. New categorical pretreatment guidelines are currently being developed by the EPA. These new guidelines will effect a variety of industries. Other categorical pretreatment standards are being designated for study. A summary of those categories effected and proposed completion dates can be found in Table 6.4.1.

2. In the next 12 to 18 months, NPDES permit applications Short Form A and Standard Form A will be replaced by Form 2A. Form 2A will cover municipal permits and combined sewer overflows (CSO). More specific chemical effluent monitoring requirements are to be proposed and will accompany Form 2A.

3. The long awaited EPA Biosolids Regulation (40 CFR 503) was issued in December 1992. This will affect biosolids management practices and land application (agricultural use, reclamation, horticulture, and landscaping) in general. This is discussed further in the next section.

4. The 33/50 Program is an EPA voluntary industrial program that encompasses 17 pollutants. Goals are 33 percent reduction (in 1992) and 50 percent reduction (in 1995). This is based on the Toxics Release Inventory (TRI) and reporting requirements mandated by the Act.

5. Three major programs that will impact the IPP include the Storm Water Program, Clean Air Act, and the reauthorization of the Clean Water Act.

6. EPA has begun a push to expand industrial user permitting to include commercial and small industrial discharges that do not fall under the Significant Industrial User (SIU) heading.

7. More emphasis is to be placed on toxic organics by EPA. EPA wants to start using Toxic Organic Management Plans (TOMPs).

8. A recent addition to IPPs has been an added emphasis on slug discharges. Sludge Discharge Prevention and Control Plans are now a required item in all IPPs. The IPP is required to evaluate each SIU at least once every two years to determine if a plan to control slug discharges is needed. EPA further recommends that the IPP evaluate all industrial users, including commercial users, for the need for such a plan. Users which have the potential to discharge slugs and may not be considered SIUs include radiator shops,

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TABLE 6.4.1

CATEGORICAL PRETREATMENT STANDARDS GUIDELINES CURRENTLY UNDER DEVELOPMENT

Point Source Category	Proposal Date	Final Action Date
Pesticide Chemicals (Manufacturing)	Published April 1992	July 1993
Pesticide Chemicals (Formulating and Packaging)	January 1994	August 1995
Waste Treatment, Phase 1	April 1994	January 1996
Metal Products and Machinery	November 1994	May 1996
Pharmaceutical Manufacturing	August 1994	February 1996
Organic Chemicals, Plastics and Synthetic Fibers (Remand Issues)	Published December 1991	May 1993
Coastal Oil and Gas Extraction January 1995	July 1996	
Pulp, Paper, and Paperboard	Dates Subject to additional litigation	
Offshore Oil and Gas Extraction	Dates Subject to additional litigation	

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printers, industrial laundries, chemical storage facilities and suppliers, and railroad and truck cleaning facilities.

9. EPA requires periodic revisions to the technically-based local limits analysis, which sets the maximum concentrations for pollutants discharged to the WWTP. Conditions which might require local limits revisions include changes in environmental criteria, availability of additional monitoring data, and changes in plant processes, or capacity or configuration. EPA also wants IPPs to develop local limits for organics and oil and grease (O&G) as an additional requirement.

Although not an EPA pretreatment regulation, the Commonwealth of Pennsylvania recently passed the Publicly Owned Treatment Works Penalty Law or Act 9 (April 25, 1992). Under its provisions the City of Philadelphia, in addition to proceeding under any other act or local ordinance, may proceed to assess a civil penalty against an industrial user. The civil penalty may be as high as $25,000/day for each violation, whether or not the violation was willful or negligent. More importantly, the penalty may be addressed irrespective of jurisdictional boundaries.

Civil penalties collected under this act shall be placed in a restricted account and shall only be used by the City of Philadelphia to repair damage, to pay any additional costs imposed as a result of the violation for which the penalty was imposed, to pay any penalties imposed on the City of Philadelphia by the Federal or State Government for the violation of pretreatment standards, to pay costs incurred to investigate an enforcement action, and to pay for monitoring the discharges and capital improvements to the treatment works. Any remaining funds may be used for capital improvements to the treatment works.

6.4.3 Clean Air Act Amendments of 1990

The 1990 Clean Air Act Amendments (CAAA), signed into law by Congress in October 1990, affect the City in three of the key provisions. These three are Title I - Nonattainment, Title III - Hazardous Air Pollutants, and Title V - Permits.

Title I establishes air pollution requirements in areas that do not meet the National Ambient Air Quality Standards for ozone, carbon monoxide, particulate matter, sulfur oxides, nitrogen oxides, and lead. Areas within the United States are classified as marginal, moderate, serious, severe, and extreme. The Delaware Valley is designated severe and must include reasonably available control technology (RACT) on air pollution sources of 25 tons per year of more. The State Implementation Plan (SIP) for the Delaware Valley allows for emission from one source to be increased, if it is offset by decreasing emissions from another source by a factor of 1.3 to 1.0.

Title III of the CAAA provides a list of 189 hazardous air pollutants (HAPs), with a schedule for reduction or elimination of such hazardous pollutants from major source of these pollutants. Large treatment plants - emitting more than 10 tons per year of any hazardous pollutant or 25 tons combined - are defined as a major source. The CAAA call for EPA to set standards for such treatment plants by November 1995. In addition, EPA is to set a threshold for substances known to cause adverse health or environmental effects, including chlorine and sulfur dioxide. Treatment plants with above-threshold levels will be required to submit risk management plans and comply with the regulations by November 1996.

Title V of CAAA requires states to develop and submit a permit program to EPA by November 1993. Regulated pollutants will include volatile organic compounds (VOCs), hazardous air pollutants, and pollutants specified under the National Ambient Air Quality Standards. The comprehensive permit program will include a compliance plan to describe how the Clean Air Act requirements will be achieved, and annual certification will be required to ensure that the facility is in compliance.

6.4.4 Potential Effect Of Final Rule On Biosolids (40 CFR Part 503) On The Philadelphia Sludge Management Unit

The Final Rule on Biosolids (40 CFR 503) was finalized on November 25, 1992. Based on a review of this rule, the following management practices are affected:

- Sludge Incineration

- Land Application (Agricultural Use, Reclamation, Horticulture, and Landscaping)

- Surface Disposal (sludge - only landfilling, trenching, spreading of sludge in excess of agronomic rates, material stored for more than 2 years).

Incineration is affected to a great degree; however, the City of Philadelphia does not utilize incineration as a sludge management practice.

The land application portion of the Final Rule has the greatest effect on the Philadelphia Sludge Management Unit.

The final Rule sets standards for disinfection, vector attraction reduction, loading rates for nutrients and certain elements (metals or pollutants to EPA), monitoring, recordkeeping and reporting requirements, and acceptable management practices. These standards vary depending on the end use of Biosolids. For example, standards for biosolids used in the home garden are more stringent than for biosolids used in strip-mine reclamation.

The land application of certain elements contained in biosolids is regulated through 4 sets of numbers:

1. A "ceiling limit" for each element that cannot be exceeded in any biosolids that are land applied. EPA has indicated that these numbers will resemble those that are less than 95 percent to 98 percent of sludges sampled in the National Sewage Sludge Survey (NSSS). These values along with existing state limitations are shown in Table 6.4.2. It should be noted that the most

restrictive limitations apply. EPA recommends that the generators plan to meet a concentration 20 percent less than this ceiling in order to assure compliance.

2. Cumulative lifetime loading rate and maximum annual loading rates have been set for each element that cannot be exceeded starting from the day the Final Rule becomes effective. A list of Maximum Lifetime Loading rates is included in Table 6.4.2 Column Nos. 3 and 7.

3. The "No Observable Adverse Effects Level" (NOAEL) Sludge or "Alternate Pollutant Levels" defines maximum concentrations for Biosolids that can be utilized at agronomic rates for 100 years without degrading soils, surface water, groundwater, crops, wildlife, livestock, or human health. The limits for this highest quality biosolids, i.e., suitable for distribution and marketing (D&M) from the September 1992 draft rule are listed in Table 6.4.2 Column 6. These concentrations are used to define Class A biosolids, those that may be sold to homeowners for example.

4. The City of Philadelphia through its Memorandum of Agreement (MOA) with the Camden County Municipal Utilities Authority (CCMUA) and the New Jersey Department of Environmental Protection and Energy (NJDEPE) can land apply its compost product on New Jersey land application sites. However, the New Jersey State laws will still predominate. Currently, Philadelphia is only applying its biosolids as landfill cover in New Jersey. New Jersey biosolids quality criteria for land application is also shown on Table 6.4.2 Column 4. New Jersey has proposed draft modifications to its land application limits from its Science and Technology Section of NJDEPE. However, they were so stringent and inner-department comments so negative that NJDEPE has decided to wait for the final 503 Rule before any modifications are made.

Pathogen and vector attraction reduction requirements will be modified and will have an effect on Philadelphia. The new rule will have similar requirements as in Part 257.

<u>Vector Attraction Reduction</u>

All biosolids that are land applied must meet **one** of the following vector attraction reduction requirements:

- Volatile Solids Remediation of 38 percent or greater (this is calculated across the digestion process). If the anaerobic digesters cannot achieve this, there is a second test for hard to digest sludges. A laboratory digestion that does not further reduce volatile solids by more than 17 percent will demonstrate vector attraction reduction.

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TABLE 6.4.2

LAND APPLICATION CRITERIA OF CERTAIN ELEMENTS IN BIOSOLIDS

1	2	3	4	5	6	7
Element	EPA Ceiling mg/kg	EPA[1] Lifetime Loading kg/ha	Current NJ Biosolids Quality Criteria mg/kg	PA Ag Use Guideline mg/kg	EPA[1] D&M[2] mg/kg	EPA[1] Annual Loading Rate kg/ha
As	54	39	10	NL	39	1.9
Cd	58	39	40	25	39	1.9
Cr	3,000	3,000	1,000	1,000	840	150
Cu	3,300	1,600	1,200	1,000	1,600	80
Pb	630	300	4,800	1,000	300	15
Hg	38	18	10	10	18	0.9
Mo	54	32	NL	NL	32	1.6
Ni	500	500	1,250	200	290	25
Se	250	250	NL	NL	27	12
Zn	5,700	3,200	2,400	2,500	3,200	160
PCB's	NL	NL	NL	10	NL	NL

NL = Not limited

kg/ha - kilogram per hectare

[1]Source - September 3 Draft of 40 CFR Part 503
[2]Biosolids with concentrations less than those shown will not have to comply with recordkeeping on annual or lifetime loading rates. This quality is recommended for those products which are used in Distribution and Marketing (D&M) program used with at sites with high public access.

- Specific Oxygen Uptake Rate > 1.5 mg/hr/gr at 20 percent

- 14 days of aerobic conditions at 45 percent or greater (always 45° - 60° C) (this may be the method by which compost achieves vector attraction reduction)

- pH 12 for 2 hours and pH 11.5 after 22 hours

- ≥75% Total Solids (TS) (With no primary sludge)

- ≥90% TS (With primary sludge)

- Subsurface Injection

Pathogen Reduction

Pathogen Reduction Requirements of Part 503 vary depending on end use of the biosolids. EPA has also set interim performance criteria, until November 23, 1994, during which Process to Further Reduce Pathogens (PFRP) and Process to Significantly Reduce Pathogens (PSRP) definitions are used for Class A and Class B, respectively.

Class A Pathogen Reduction is required if bulk biosolids are applied to a lawn or home garden, or if biosolids are bagged and sold or given away.

Class B Pathogen Reduction is required if bulk biosolids are applied to agricultural land, forests, a public contact site, or a reclamation site.

Class A

The regulations offer six alternatives for meeting Class A criteria, but the easiest for Philadelphia to meet is the existing EPA definition of a PFRP criteria until November 23, 1994 and Alternative 1. Alternative 1 requires:

- Fecal coliform less than 1000 MPN per gram of total solids (TS)

- *Salmonella* sp. less than 3 MPN per 4 grams of total solids (TS)

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- Temperatures must be maintained for a specified time, the following equation defines these requirements:

$$D = \frac{131,700.0}{10^{0.1400t}}$$

where D = time in days

and t = temperatures in degrees Celsius

Temperatures and time most likely in static pile compost piles are listed as follows:

50°C	13.17 days
51°C	9.54 days
52°C	8.91 days
53°C	5.01 days
54°C	3.63 days
55°C	2.63 days
56°C	1.90 days
57°C	1.38 days
58°C	1.00 days

If these tests do not demonstrate Class A pathogen reduction, then there are three other combinations of testing and performance criteria which could be used. The frequency of pathogen indicator monitoring for a wastewater treatment plant producing greater than 15,000 metric tons per year is once per month.

Under the current composting practices at the Sludge Processing and Distribution Center (SPDC) it is not likely that Class A Pathogen reduction will be achieved in Philadelphia compost. SPDC will have until November 24, 1994, to come into compliance with the Class A pathogen reduction requirements.

The new regulations will require separate recordkeeping until PaDER modifies its regulations and/or becomes a delegated authority for Pennsylvania sludge programs.

Class B

Sludge and sludge products that are utilized for agriculture, silviculture, reclamation, and in general, sites with little public access, must meet PSRP requirements through November 23, 1994, and EPA new Class B requirements thereafter. There are also best management practices required for sites using Class B material, such as restrictions on the length of time from application to land and harvesting of certain crops, grazing, and public access.

The new Class B status may be achieved for Philadelphia sludge products by demonstrating that the mean density of fecal coliforms is less than 2 million MPN per gram of sludge solids, or less than 2 million Colony Forming Units per gram of sludge solids.

Monitoring must be conducted monthly and a minimum of seven samples must be analyzed. It is not clear at this time if each product must be sampled and analyzed separately, i.e., liquid, cake, mine mix, etc., or if just liquid is sufficient. It is also not clear whether samples must be analyzed if during that month no liquid, cake, or mine mix is land applied.

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7.0 PLAN IMPLEMENTATION AND INSTITUTIONAL EVALUATION

7.1 GENERAL

This section of the Act 537 Plan will provide the information necessary to ensure understanding of the continued development, evaluation, and selection of Plan alternatives for implementation in each of the needs areas, specifically referring to areas such as OLDS, conveyance, treatment, and biosolids handling and disposal. Furthermore, the following information will outline the institutional and financial framework for accomplishing the objectives of the selected Plan.

It is necessary at this point in outlining the selected plan and implementation to comment on the approach utilized in development of this Act 537 Plan, as agreed upon with PADER at the Task Activity Report phase; specifically, the focus of this regional Plan is on the City of Philadelphia and its associated sewerage needs. The Philadelphia Water Department (PWD) provides this essential service for the greater Philadelphia metropolitan area, as has been outlined in this Plan heretofore, in particular Sections 3.2 and 3.3, with the primary planning responsibility beyond the City being with the outlying communities and authorities.

The regional conveyance and treatment system currently in place in Philadelphia is a result of, and consistent with, the planning for large scale regional facilities that was conducted from the 1950s to the mid-1980s. These regional facilities have served the needs of the area well, treating flows from over 2.2 million people in 1990 with a high level of reliability in meeting discharge requirements. This Act 537 will continue with this general planning concept of regional facilities; a few reasons for this approach include, but are not limited to:

- The existence of a current and longstanding institutional and financial framework for facilitating the significant capital investments in existing facilities and the presence of a correspondingly significant infrastructure

- The current trend of declining population and concomitant wastewater capacity needs in the City of Philadelphia.

As outlined in prior sections of this report, the regional Philadelphia facilities currently serve ten outlying authorities and/or municipalities by agreement. Specifically, as mentioned in Section 5 of this Plan, these municipalities/authorities have generally established long-term planning for regional treatment, with many of the parties: 1) having planned for capacity based upon saturation growth, and/or 2) having long-term agreements established, and finally 3) with all parties having sufficient reserve capacity available under their agreements to meet at least their 5-year needs. Furthermore, most parties require that a relatively small percentage of flow be treated at the PWD's WPCPs by comparison; the two largest users are Delaware County Regional Authority (DELCORA) and Bucks County Water and Sewer Authority, both of which are at approximately 80 percent of their allocated capacity and are currently or have recently completed facility planning to manage future flows.

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Finally, this section of the Plan will outline not only the recommended plan for the continued operation of the City of Philadelphia's sewerage facilities but will also, in combination with the previous information in Sections 2.4.4. and 3.3, provide that the PWD has the ability to implement the recommended plan. This plan is summarily outlined below, with the institutional and implementation aspects defined more fully.

7.2 SELECTED PLAN

7.2.1 Unsewered Needs Areas

Within the City of Philadelphia, it has been noted that only approximately 0.4 percent of the residents are currently utilizing On-Lot Disposal Systems (OLDS). Areas with the greatest concentration of OLDS have been identified through discussions with Health Department and a search of its files as well as records of the PWD. These area are shown on Figure 4.1-1 of the Plan. At this time, there are no comprehensive plans to provide service to these areas for the following reasons:

1. Most, if not all, of the OLDS locations are provided with public water from the Water Department, thereby eliminating the health threat normally associated with the occurrence of contaminated well water in rural areas.

2. Based upon an extensive search of Health Department records, all areas of concentrated OLDS have less than a 5 percent rate of reported malfunction.

3. Although the soils in these areas generally may be categorized as unsuitable, based upon the predominance of Urban Land geologic formation, individual site inspections often result in the availability of suitable land (larger lots) for replacement systems.

4. The Health Department has a successful program in place to enforce compliance with the State and City regulations governing OLDS.

5. Many of the areas of concentrated OLDS are in areas where public sewers are not readily accessible or would be prohibitively costly to install due to the presence of rock and/or rolling terrain that precludes gravity sewer service studies by which to evaluate such interceptors.

6. The PWD, in association with the Department of Licenses and Inspections, currently regulates septage haulers within the City, requiring such elements as a City license and verifying, through sampling and testing procedures, the general nature of such wastes before acceptance into a PWD WPCP.

7. Furthermore, under the current Consent Order, the SWWPCP will be provided with a new septage receiving and handling facility.

The PWD, in association with the Health Department, currently has a limited policy and procedure for evaluating malfunctions and the ability to provide for sewer extensions into the unsewered areas; there is an annual budgeted line item to accommodate such work.

Furthermore, the PWD, in conjunction with the Health Department will endeavor to:

1. develop a more rigorous evaluation of the actual magnitude of current malfunctions in focused areas

2. prioritize the seven concentrated areas addressed herein to evaluate public health hazard

3. assess the need to implement a more formal sewage management program for the remaining unsewered areas

These efforts will be part of the implementation of this Plan.

7.2.2 Collection and Conveyance System

As discussed in Section 4.2 of this Plan, the collection and conveyance system is approximately 60 percent combined (storm and sanitary) and approximately 40 percent separate sanitary sewers. As discussed, the interceptors in the system have been conservatively designed to handle 110 percent of all theoretical dry weather flows, based upon predicted population densities in each subbasin. Although a hydraulic model of the system exists and an evaluation of it indicates that there are segments of the collector system which are overloaded, these results must be further scrutinized before taking any corrective actions based upon the following:

1. That a review of the population density statistics indicates that the actual density is significantly below the design density

2. That the design criteria were very conservative in that the interceptor capacities were rated on the basis of one half and two thirds full, not on full pipe design

3. That no actual flow data exists, nor is easily determined without actually conducting metering

In practice, the PWD staff evaluate the condition of the system based upon maintenance and repair records, customer records, and other available data. It is on the basis of these evaluations that a Capital Improvements Program (CIP) prioritizes rehabilitation and replacement of collectors and interceptors. Details of the proposed CIP program are provided in Section 6.2 of this Plan. Overall sewer funding, over the next five years, is budgeted as follows:

Fiscal Year	Total Budgeted Sewer (million $)
1993	14.1
1994	13.5
1995	13.5
1996 (and beyond)	13.5

It should be noted that the fiscal year 1996 CIP listing includes all remaining identified projects, which will extend the planning period further.

With regard to the 12 wastewater pumping stations within the City, preliminary investigations indicate that all stations have sufficient rated capacity both for present and future conditions and are generally refurbished on at least a 25-year period. The only scheduled work is refurbishment of the Central Schuylkill Pumping Station.

7.2.3 Combined Sewer Overflows (CSO's)

As discussed in various sections of this Act 537 Plan, the 175 CSOs currently existing in the regional Philadelphia sewerage system have and will continue to be a significant issue relating to the operation of the system. Previous facility plans have conducted evaluations and the development of the Northeast CSO Network has laid the frame-work for the City's current position on the CSOs. Specifically, due to the number of overflows and the magnitude of the existing combined sewer infrastructure, current design and operating strategy rely on a remote monitoring system for forty-five (45) discharges and control of eight selected CSOs to maximum wet weather storage within the combined sewer system and optimize the hydraulic capacity of the sewer and treatment system through such control. Whereas the present system is still somewhat in the development and optimization stage, the automated control to meet all possible regulations is not a part of PWD's plans at this time.

Indeed, the primary emphasis in the planning of any future CSO modifications will be in two areas in particular:

- continued optimization of the eight controllable and forty-five (45) monitored CSOs in the Northeast Drainage District

- particular studies on the CSOs as mandated by the recent EPA and Pennsylvania strategies on CSOs

This latter area has been further outlined in Section 6.2.3 of this Act 537 Plan and will be a condition of the forthcoming NPDES permit for each WPCP. As such, it will require that a plan of action be developed for implementation of best management practices and other noncapital intensive control measures to minimize the impact of CSOs on the receiving waters. In general, the PWD is being required to assess, develop, and implement the following most significant control strategies for CSOs in each of the WPCP service areas:

1. Minimum Technology Based Control Measures, Plan of Action and initiate Implementation within 38 to 52 months of new NPDES permit issuance

2. A High Flow Management Plan to maximize storage in the combined sewer system and flows to be treated at the WPCPs without causing system backups or upsetting the WPCPs' normal plant operations, respectively.

3. Source Reduction Measures, possibly considering, in addition to other measures, screening of CSOs to eliminate the discharge of solids and floating material and also reduction of infiltration and inflow in the separate sewer system

4. Pretreatment Program Review

5. Minimization of CSOs near sensitive areas

6. Water Quality Impact Plan, which will be required to be completed within 12 months of the completion of DRBC's study of the Delaware River.

Other efforts have also been identified by PADER to date, but the above represent the most significant requirements, all of which may result in future modifications to PWD operations and/or facilities.

7.2.4 Water Pollution Control Plants

This Act 537 Plan has developed and projected both current and future (5-year and 20-year) flows and loadings onto the WPCPs. These flows and loadings are based upon a distinction between dry and wet weather conditions, necessitated by consideration of the unique combined sewerage system in the City of Philadelphia. Accordingly, as discussed in Sections 4.3, 5.3, and 6.1 of this Plan, the three WPCPs have all been determined to have both current and future reserve capacity for wastewater flows and loadings. This reserve capacity, which is shown on Table 5.4.2, is based upon dry weather flow conditions and has made allowances for utilization of the maximum contractual allocations from the outlying municipalities. Preliminary population projections for the outlying communities confirm the validity of this assumption, indeed indicating that short-term needs will be conservatively estimated. Current reserve dry weather capacities are 27.0 mgd, 8.5 mgd, and 28.4 mgd for the NEWPCP, SEWPCP, and SWWPCP, respectively. Future reserves drop to estimates of 10.6 mgd, 10.9 mgd, and 8.7 mgd in the year 2010 for the three treatment plants, respectively; this is primarily due to an increase in loadings from the outlying communities up to the contracted amounts, given the drop in domestic wasteloads anticipated from the City of Philadelphia over this planning period.

Additionally, the PWD has developed and is implementing a 6-year Capital Improvements Program (CIP) to ensure that each WPCP has needed improvements identified, prioritized, and funded to ensure the continued reliable operation of current equipment, and ensure compliance with discharge (regulatory) requirements. This Act 537 Plan has generally outlined both budgeted and nonbudgeted improvements and associated costs through Fiscal Year 1996, the end of the current CIP plan. These improvements are indicated in Sections 6.1.1.2, 6.1.2.2, and 6.1.3.2 for the NEWPCP, SEWPCP, and SWWPCP, respectively. Furthermore, (1) the NEWPCP is currently embarking on a Primary Sedimentation Tank Rehabilitation Program that has been mandated by a Consent Order with PADER and has a letter of Nonprejudice on file with PENNVEST, and (2) the SWWPCP is currently in the midst of a mandated Consent Order improvement program that is described in detail in Section 6.1.3.3 of this Plan.

Finally, the concerns related to present and future loadings at the WPCPs, as influenced by storm and wet weather conditions must be dealt with by the PWD. It is important to understand this problem in the context of the following points:

1. Although the WPCPs are each rated in their NPDES permit on the basis of average monthly flow, this permit parameter is specifically not considered as a violation if and when exceeded.

2. The reason for the above includes the facts that (1) the sewerage systems are uniquely a combined system with both controllable and noncontrollable CSO discharges, and (2) that the ability to treat the wastewater is related not only to the flows but also to the organic and solids loadings, both of which have been shown to be substantially below the design basis.

3. That each WPCP has in its permit, in addition to the monthly average flows, maximum daily and peak flows that are to be considered in order to ensure that no treatment upsets are experienced during storm and/or wet weather conditions.

These wet weather loadings onto the treatment plants are not readily controllable under current plant operations, but they are very much related to the operating policies and physical framework of the CSOs. Indeed the goals involving operations of the conveyance system and CSOs are to ensure not only that the conveyance system storage is maximized but also that the WPCPs are not hydraulically overloaded. Therefore, it is imperative that the hydraulic loadings onto each WPCP be considered in the context of optimizing the CSO issues. Indeed, the detailed investigations that were outlined for the CSOs, specifically the:

- High Flow Management Plan
- Source Reduction Program
- Water Quality Impacts Plan

Should all address, from an overall system management approach, these wet weather and storm-related capacity problems for the WPCPs as well as the conveyance system. It should be noted that, as a part of these studies, there may be a benefit to considering the additional primary treatment capacity at both the NEWPCP and SWWPCP (above the rated capacity) for purposes of possible future bypassing of storm flows which otherwise exceed the plant's capacity.

Additional near-term requirements for the plants include: chlorine minimization studies, sludge handling and thickening optimization, odor control work at NEWPCP, pretreatment program implementation, biomonitoring, and other related operations.

7.2.5 Biosolids Management

The PWD currently has developed a focused approach to handling sludges and biosolids from the three WPCPs. Whereas the primary and secondary sludges are thickened and digested at the NEWPCP and the SWWPCP (which includes SEWPCP sludges), all dewatering is currently handled at the Sludge Processing and Distribution Center (SPDC). Three one million gallon sludge storage tanks at the SPDC receive and hold the sludge which is barged from the NEWPCP and pumped from the SWWPCP. At the SPDC, the biosolids are dewatered in 10 scroll centrifuges and are then composted via static pile composting, described in Section 4.3.4 of this Plan. The disposal of these biosolids has developed into 4 different disposal products: (1) sludge cake for agricultural applications, (2) mine mix, (3) Phillymulch, and (4) Earthlife.

As discussed in Section 6.3, although the framework of biosolids management has been extensively developed over the last decade since the ocean disposal of sludge was abandoned, there are areas in which significant improvement and optimization are needed. The PWD is committed to both maintaining the general processing regimen of current biosolids management as well as improving on these operations and facilities. Accordingly, the following areas have been identified for additional study:

- Improved sludge handling and thickening at the WPCPs
- Upgrade of dewatering equipment to improve effectiveness
- Assessing the impact of Part 503 on biosolids disposal
- Ongoing and focused marketing studies and strategy
- Investigate digester performance
- Improved grit removal
- Potential for contract operations at the SPDC
- Optimize composting operations further

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7.3 INSTITUTIONAL AND FINANCIAL EVALUATION

7.3.1 General Institutional

The Philadelphia Water Department (PWD) was established by the Philadelphia Home Rule Charter (previously mentioned in Section 2.4) as one of the ten operating departments of the City. Through the Charter, the Water Department was granted the power and duty to operate, maintain, repair, and improve the City's water and wastewater system. The Charter requires the City Council to establish standards for setting rates and charges for the supplying of water and sewage treatment services. Pursuant to the Charter and the Philadelphia Code of General Ordinances, the Water Department has the authority to fix and regulate water and sewer rates and charges. As a requirement of the City Council's Standards, the Water Department must give written notice to the City Council prior to filing notice of any proposed change in water or sewer rates and submit financial, engineering, or other data upon which the proposed charges are based. The rates and charges are established to yield an amount at least equal to the Water Department's operating expenses. These expenses could include interest and sinking fund charges on the City's obligations in respect to water and wastewater systems and additional amounts as required to comply with rate covenant and sinking fund reserve requirements. Also, proportionate charges for all services performed for the Water Department by all officers, departments, boards, or commissions of the City would be included as operating expenses.

The Charter also authorized the Water Department to enter into contracts for sewer and sewage disposal services to users outside the limits of the City with the authorization of the City Council. As previously discussed, contracts for wastewater treatment services have been established with ten neighboring municipalities and authorities. These contracts provide for quarterly billings based on the operating costs associated with the volume and strength of the wastewater received. Additionally, the municipalities or authorities are either billed quarterly for depreciation and capital payments on allocated wastewater conveyance and treatment facilities or a capital contribution is made to the Water Department for their allocated share of the cost of treatment facilities.

The operations of the Water Department are accounted for in the Water Fund, which is an enterprise fund of the City. The Water Fund is an accounting convention established for the purpose of segregating bond proceeds and project revenues from other funds of the City not held exclusively for Water Department purposes. The Water Fund was established as a requirement of the Sixteenth Supplemental Ordinance and is maintained with the Fiscal Agent for as long as the Sixteenth Series Bonds are outstanding. The Water Department's operating budget is developed annually for the ensuing fiscal year.

The Home Rule Charter requires the City Council to adopt annually, on or prior to May 31, a capital budget for the ensuing fiscal year, and a capital program showing the capital expenditures planned for each of the six ensuing fiscal years. The City Council may change the elements or financial schedule of the Capital Improvements Budgets developed by the operating departments.

Financing for the Water Department's Capital Improvement Program is expected to be funded with the proceeds of debt to be incurred during the six-year planning period. The City expects most of this debt to be in the form of water and sewer revenue bonds. A portion of the debt may also be provided by loans to the City from the Pennsylvania Infrastructure Authority (PENNVEST). The PENNVEST program was established by the Commonwealth to provide low interest cost financing for water and wastewater projects within the Commonwealth.

7.3.2 Financing

7.3.2.1 Current Bond Authorization

The Sixteenth Series Bonds are issued under The First Class City Revenue Bond Act, P.L. 955, Act No. 234 of the General Assembly of the Commonwealth of Pennsylvania, approved October 18, 1972 (the "Act"), and the General Water and Sewer Revenue Bond Ordinance of 1974, as amended and supplemented by the Sixteenth Supplemental Water and Sewer Revenue Bond Ordinance, approved on May 2, 1991.

Under the Act, cities of the first class are authorized to issue revenue bonds to finance revenue-producing projects and to refund certain outstanding bonds, including revenue bonds issued under the Act, but the bonds must be payable directly or indirectly solely from Project Revenues (as defined in the Act). The 1974 General Ordinance is the governing ordinance under which all outstanding Water and Sewer Revenue Bonds have been issued.

On May 18, 1989, Philadelphia's City Council enacted the General Water and Wastewater Revenue Bond Ordinance of 1989 (the "1989 General Ordinance"). The 1989 General Ordinance was enacted to modernize the requirements applicable to the City's Water and Sewer Revenue Bonds. The 1989 General Ordinance allows the City flexibility to address new developments in financing techniques and to adapt its financing to developments in federal tax law. The 1989 General Ordinance establishes a rate covenant requiring that net revenues of the City's Water and Wastewater Systems exceed debt service requirements on bonds, including the Sixteenth Series Bonds, by 20 percent, and establish a Rate Stabilization Fund. The 1989 General Ordinance became effective upon the payment or defeasance in full of all Water and Sewer Revenue Bonds issued prior to the Water and Sewer Revenue Bonds, Fourteenth Series. The provisions of the 1989 General Ordinance supersede the provisions of the 1974 General Ordinance and are applicable to the Sixteenth Series Bonds. However, the obligation of the City under the Sixteenth Supplemental Ordinance to maintain the segregation of Bond proceeds and Project Revenues in the Water Account held by the Fiscal Agent will continue if and for so long as the Sixteenth Series Bonds are outstanding.

Additional information and details on the Sixteenth Series Bonds are provided in excerpts of the Bond Prospects, Appendix N.

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As of April 15, 1991, the City had outstanding $1,052,000 aggregate principal amount of Water and Sewer Revenue Bonds, including variable rate bonds in the aggregate principal amount of $35,400,000. The City also had outstanding $96,200,000 of bond anticipation notes payable from concurrently with the Bond Anticipation Notes. In addition, as of April 15, 1991, the City had outstanding $41,112,413 aggregate principal amount of general obligation bonds attributable to the Water and Wastewater Systems. These general obligation bonds, issued for Water and Wastewater Systems improvements prior to enactment of the 1974 General Ordinance, were determined to be self-liquidating by the Court of Common Pleas of Philadelphia County and are payable from Project Revenues.

7.3.2.2 Federal Grants

The Water Department has received federal grant funds from EPA to upgrade its three WPCPs. The upgrades are estimated to cost approximately $850 million. To date, the Water Department has received federal grant funds in the amount of approximately $580 million. The payment of additional grant funds will be determined by EPA during the closeout process and audit of these grants.

To date, 15 of the total 34 grant agreements have been audited. An audit of an additional 11 grant agreements for the Northeast WPCP was started in March 1991. The remaining eight grant agreements for the Southwest WPCP and the Sludge Processing and Disposal Center are awaiting audit by the EPA.

The Water Department has received approximately $7.5 million in innovative/alternative grant commitments for the Northeast and Southwest WPCPs related to cogeneration projects. The receipt of these funds is predicated on the Water Department's construction and operation of cogeneration facilities that utilize at least 90 percent of the excess methane gas produced by the WPCPs. These facilities go on line in May of 1993.

7.3.2.3 State Grants

Pursuant to the Pennsylvania Clean Streams Law, Act. No. 339 of the Commonwealth of Pennsylvania, approved August 20, 1953 ("Act 339"), the Water Department receives annual grants from the Commonwealth toward the costs of operating, maintaining, repairing, and replacing its wastewater system that are equal to two percent of the cost of acquisition and construction of eligible wastewater treatment facilities. Costs funded by EPA grants and other nonreimbursed federal and state grant programs are not included in the calculation of the costs of acquisition and construction. Act 339 payments are included in nonoperating revenue of the Water Department.

7.3.2.4 Current Rate Structure

The Philadelphia Code requires the Water Department to give written notice to City Council at least 30 days in advance of the filing of notice of any proposed change in water or sewer rates or charges and to submit with such written notice financial, engineering, and other data upon which the proposed changes are based. After the filing of the proposed regulations providing for changes in rates or charges with the City's Department of Records, the Department of Records is required to give public notice that the regulations have been filed and that any person affected by the proposed regulations may request a public hearing before the Water Department and the City Solicitor. Revised rates and charges become effective 10 days after filing of a report by the Water Department at the conclusion of hearings.

On April 23, 1990, the Water Commissioner formally notified City Council of his intention to raise rates for Water Department customers by an average 56 percent on December 1, 1990. This notification set a rate process in motion that included extensive public hearings conducted by an independent hearing examiner. This process culminated eight months later in the Water Commissioner's Rate Decision, which increased charges to the Water Department's typical residential customers by an average 33 percent, effective January 1, 1991. Large users experienced higher rate increases as certain fixed costs were spread on a volumetric basis for the first time.

The City's general service customers' water rate consists of a service charge related to the size of the meter, plus a schedule of quantity charges for all water use. The sewer rate is similar in form. All general service customers are billed on a monthly basis. Special charges are imposed for processing high-strength effluents.

The Water Department estimates that a typical customer has a 5/8-inch meter and uses 10.0 thousand cubic feet (Mcf) of water per year, which, based on the current rate schedule, results in an annual charge of $301.20 for sewer service.

Contracts for wastewater treatment service with ten neighboring municipalities and authorities provide for the quarterly billing of charges based on operating costs attributable to the volume and strength of wastewater received. Capital costs are handled by one of two different methods - five contract customers are billed quarterly for depreciation and capital payments on allocated wastewater conveyance and treatment facilities, while five contracting entities have made capital contributions to the Water Department for their share of the cost of facilities.

In order to maintain and improve the level and timing of collections, the Water Department, in conjunction with independent consultants, conducted a study of its billing and collection procedures in 1985. Results indicated relative stability in collection factors, with overall collections averaging approximately 95 percent of gross billings and 97 percent of net billings during the three-year period after billing, with the bulk of collections in the first year. First year collections from general service customers averaged approximately 90 percent of net billings. The collection experience of the Water Department since the date of the study is consistent with the results of the study.

Increased charges for wastewater service effective January 1, 1991, are estimated to produce an additional $27,328,000 in Fiscal Year 1991 and $80,000,000 in each fiscal year thereafter. This rate increase has resulted in an increase of approximately 33 percent in a typical customer's bill. This rate increase has been appealed by a consumer group.

7.3.2.5 Operating Budget

The Charter requires City Council to adopt a balanced Operating Budget for the fiscal year on or before May 31 of each year. The Mayor presents his operating budget proposal to City County on or about March 31 of each year. The Mayor's operating budget is developed from proposed budgets submitted by the various departments of the City, including the Water Department. The Water Department begins preparation of its proposed operating budget each September, when all divisions are supplied with documentation to complete and return to the Finance Division reflecting their budgetary requests for the next fiscal year. The Water Department has developed and installed a computerized budgeting system to prepare budget requests based on historical and current operating experience. Divisional budget proposals setting forth estimated obligations for the ensuing fiscal year are submitted to the Finance Division in November of each year. Revenue estimates are prepared by the Revenue Department under the direction of the City's Finance Department and Water Department. The Water Commissioner reviews all divisional budget proposals with the assistance of the Finance Division and submits the Water Department's proposed budget to the City's Managing Director in January of each year, who in turn submits all departmental proposed budgets to the Finance Director for the Mayor's approval for inclusion in the Mayor's proposed budget.

Under the City's "Legally Enacted Basis" of accounting, a reservation of funds is established for the estimated maximum contract limit, prior to the initiation of the delivery of services, supplies, or equipment for each contract. This reservation of funds or "encumbrance" accounting system requires that the Water Department budget a slightly higher level of funds than its actual annual requirements might be under a cash basis of accounting, since the actual costs of each contract cannot be determined, in many instances, until after the fiscal year has ended. These "excess" encumbered funds are returned to the fund balance when the contract is liquidated, usually early in the ensuing fiscal year. The proposed Fiscal Year Operating Budget proposed by the Mayor includes an adjustment to the estimated fund balance at the close of the current Fiscal Year due to cancellation of commitments encumbered and not expended.

7.3.2.6 Capital Budget and Future Funding

The Charter requires the City Council to adopt annually, on or prior to May 31, a capital budget for the ensuing fiscal year and a capital program showing the capital expenditures planned for each of the six ensuing fiscal years. The Capital Improvement Program of the Water Department for the Fiscal Years 1993 to 1997 and the Water Department's 1992 capital budget described below were submitted for City Council's approval as part of the City's capital program and capital budget. The City may change the elements of the Capital Improvement Program from time to time and may change the proposed financing schedule reflected in the Capital Improvement Program.

Table 7.3.1 sets forth major elements of the Water Department's proposed Capital Improvement Program for Fiscal Years 1992-1997. The capital budget adopted by City Council on May 30, 1991, included an additional $28,200,000 for the Water Department's Capital Improvement Program. Additional Water and Sewer Revenue Bonds would need to be issued if the Water Department were to utilize this additional capital allocation.

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TABLE 7.3.1

Fiscal Year 1992-1997
Capital Improvement Program

ELEMENTS	
Engineering and Administration	$ 73,847,000
Water Conveyance System	108,560,000
Sewage Collector System	81,600,000
Storm Flood Relief	14,900,000
Water Treatment Plants	49,745,000
Wastewater Treatment Plants	39,917,000
Vehicle Acquisition	20,000,000
TOTAL	$388,596,000
FUNDING SOURCES	
Debt Financing	$328,580,000
Project Revenues	60,016,000
TOTAL	$388,596,000

Estimated debt requirements for Fiscal Years 1991-1996 based on the 1991-1996 Capital Improvement Program.

Fiscal Year	Assumed Issued Date	Assumed Bond Principal
1991	6/6/91	$289,695,000*
1992	---	---
1993	---	---
1994	7/1/93	65,000,000
1995	7/1/94	85,000,000
1996	7/1/95	100,000,000

*Represents the estimated par value of the Sixteenth Series Bonds as of April 26, 1991.

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Approximately 85 percent of the costs of the Capital Improvement Program are expected to be funded with the proceeds of debt to be incurred during the 6-year period. The City expects most of such debt to be in the form of Water and Sewer Revenue Bonds issued under the Act and the 1974 General Ordinance and the 1989 General Ordinance. A portion of the debt may be evidenced by loans to the City from the Pennsylvania Infrastructure Investment Authority ("PENNVEST"), established by the Commonwealth to provide low interest cost financing for water and wastewater projects within the Commonwealth. The Water Department has received a commitment for and is negotiating the terms of a loan from PENNVEST in the amount of $20 million for water system projects. The Water Department anticipates that, if the PENNVEST loan transaction is consummated, the City's obligation to PENNVEST with respect to this loan will be evidenced by a Seventeenth Series of Water and Sewer Revenue Bonds. Any loans received by the Water Department from PENNVEST will reduce the amount of future Water and Sewer Revenue Bonds sold to the public.

7.4 IMPLEMENTATION SCHEDULE

This regional Act 537 Plan for the City of Philadelphia has evaluated sewerage facilities, developed recommendations, and selected a Plan for implementation. Discussion on this Selected Plan is incorporated into Section 7.2 of this report. A capsular implementation schedule is as follows:

Item	Selected Plan	Schedule
1. Unsewered Needs Areas	• Further detailed (field) evaluations	• Start within 3 months of Plan approval.
2. Collection & Conveyance	• Continue with CIP	• As approved by PWD and City Council
3. CSO's	• Develop Plan of Action (Conceptual Plan)	• As mandated by PADER in forthcoming NPDES permits.
4. WPCP's	• Continue with CIP	• As approved by PWD and City Council
	• Rehab NEWPCP Primaries	• Ongoing
	• SWWPCP Mods	• Maintain Consent Order Schedule
	• High Flow Management (CSO Plan of Action/Plant Rerate)	• Begin within 3 months of Act 537 approval or as otherwise required.
5. Biosolids Management	• Optimize through additional studies	• Begin within 3 months of Act 537 approval.

It should be noted that there are many more activities discussed in the Act 537 Plan; however, the above are the primary areas of focus. The future milestone dates for implementation, for example for CSO's and Biosolids, will be based upon and incorporated into the findings of these further studies.

MEMORANDUM

CITY OF PHILADELPHIA

WATER DEPARTMENT
CONSTRUCTION BRANCH

DATE: March 1, 1995

TO: DISTRIBUTION

FROM: LEONARD K. BERNSTEIN, SPECIAL PROJECTS COORDINATOR

SUBJECT: ACT 537 PLAN

As you might be aware, the Water Department was required to prepare a Sewage Facilities Plan in accordance with Pennsylvania Act 537. This plan, known as the Act 537 Plan, was prepared by BCM Engineers and contains much valuable information about our wastewater system.

The Plan consists of two volumes. The first volume contains most of the important information. The second volume contains a number of appendices. The appendices are listed on page xii of the Table of Contents in the first volume. Due to the cost of the copies, I am not providing everyone with a copy of Volume 2. If you, after reviewing the list of appendices, feel that you would like to have copies of some of the appendices, let me know and I'll have copies of those specific appendices made for you.

Leonard K Bernstein

LEONARD K. BERNSTEIN
Special Projects Coordinator

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Water Commissioner - 1 (Kumar Kishinchand)
Deputy Water Commissioner - 2 (Dean A. Kaplan and Richard E. Roy)
Legal Services - 2 (David Katz and J. Barry Davis)
Library - 5
* Public Affairs Division Manager - 1 (Joanne Dahme)
* Finance Division Assistant Manager - 1 (Bernard Brunwasser)
Rates Manager - 1 (James Palladino)
* Special Accounting Systems Manager - 1 (Joseph Clare)
* Accounting Manager - 1 (Thomas Gallagher)
* Planning and Engineering Division Manager - 1 (Thomas Kulesza)
Planning and Research Unit - 2
Water and Sewer System Planning Unit Supervisor - 1 (J. Eugene Mudry)
* Capital Programs Manager - 1 (Daniel McCusker)
Design Branch - 2
* Construction Branch - 2
Special Projects Coordinator -2 (Leonard K. Bernstein and 1 for PADER)
* Chief Surveyor - 1 (Francis Bevenour)
* Data Management Center Manager - 1 (Stephen Ballay)
* Bureau of Laboratory Services - 1
* Operations Division Assistant Manager - 1 (Bruce Aptowicz)
* Water Conveyance Manager - 1 (Charles Zitomer)
* Water Treatment Manager - 1 (William Wankoff)
* Collection Systems Manager - 1 (Drew Mihocko)
* Collector System Support Manager - 1 (Raymond Staniec)
* Drainage Information Supervisor - 1 (Richard Williams)
* Water Main Records Chief - 1 (Gregory McCullough)
* Operations Engineering Specialist - 1 (Thomas Day)
* Industrial Waste Unit Manager - 1 (Thomas Healey)
* Biosolids Recycling Center Manager - 1 (Guru Bose)
* BRC Utilization Manager - 1 (William Toffey)
* BRC Operations and Maintenance Plant Manager - 1 (James Golembeski)
* Water Pollution Control Treatment Manager - 1 (James Nicolo)
Northeast Water Pollution Control Plant Manager - 1 (William McKeon)
Southwest Water Pollution Control Plant Manager - 1 (Debra McCarty)
Southeast Water Pollution Control Plant Manager - 1 (M. Stewart Cameron)

* Volume I only

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City of Philadelphia
Water Department
Wastewater Treatment Service Agreements
and
Approval Procedure for Requests for Exemption From Planning

The Philadelphia Water Department has contractual agreements to provide wastewater treatment services with ten municipalities or authorities. The following is a listing of the municipalities or authorities and the areas covered by the respective service agreements:

Abington Township: the drainage area includes the area of the Pennypack Creek watershed in Abington Township and Rockledge Borough and portions of the Tacony Creek watershed in Rockledge Borough and Abington Township.

Bensalem Township Authority: the drainage area includes the area of Bensalem Township within the Poquessing Creek watershed.

Bucks County Water and Sewer Authority: the drainage area covers those areas within the Bucks County Water and Sewer Authority serviced by the Neshaminy Interceptor system and the Totem Road Pumping Station. This includes all or parts of the following municipalities:

Bensalem Township	Lower Southampton Township
Bristol Township	Middletown Township
Falls Township	Newtown Borough
Hulmeville Borough	Newtown Township
Langhorne Borough	Northampton Township
Langhorne Manor Borough	Penndel Borough
Lower Makefield Township	Wrightstown Township

Cheltenham Township: the drainage area includes areas of the Tacony Creek watershed in Cheltenham Township, Abington Township, and Jenkintown Borough.

The Delaware County Regional Water Quality Control Authority (DELCORA): the drainage area includes areas in the Darby, Crum, Ridley, and Chester Creek watersheds and once coincided with the service boundaries of the Muckinipates, Central Delaware County, Darby Creek Joint, and Radnor-Haverford-Marple Authorities. This includes all or parts of the following municipalities:

Aldan Borough	Lansdowne Borough	Ridley Township
Clifton Heights	Marple Township	Rutledge Borough
Collindale Borough	Morton Borough	Sharon Hill Borough
Colwyn Borough	Nether Providence Twp	Springfield Township
Darby Borough	Newtown Township	Swarthmore Borough
Darby Township	Norwood Borough	Tredyffrin Township (Chester County)
Folcroft Borough	Prospect Park Borough	Upper Darby Township
Glenolden Borough	Radnor Township	Yeadon Borough
Haverford Township	Ridley Park Borough	

Lower Merion Township: the drainage area includes all of Lower Merion Township and the portions of Radnor, Haverford, and Narberth within the drainage basin of the Schuylkill River.

Lower Moreland Township and the Lower Moreland Township Authority: the drainage area includes portions of Lower Moreland within both the Pennypack and Poquessing Creek watersheds.

Lower Southampton Municipal Authority: the drainage area includes the areas of Lower Southampton within the Poquessing Creek watershed.

Springfield Township, Montgomery County: the drainage area includes the areas of Springfield, Cheltenham, Upper Dublin, and Whitemarsh Townships within the Wissahickon Creek watershed.

Upper Darby Township: the drainage area includes those portions of Upper Darby Township not included in the DELCORA agreement and parts or all of East Lansdowne Borough, Haverford Township, Millbourne Borough, and Yeadon Township.

Since we provide wastewater treatment services on a contractual basis to these municipalities and authorities, we require that all Requests for Exemption from planning and the submission of Act 537 Sewage Facilities Planning Modules from these service areas be approved by our contracted municipality or authority before our review of the Request for Exemption. We must be assured that we can accommodate the additional flows and that they are permitted under our service agreements before we can allow additional flows into our system or approve exemption requests. Furthermore, we will return any submissions that do not indicate an acceptance of the additional flows by the municipality or authority under contract with us.

Requests for Exemption must include a Project Narrative and letter of acceptance. Completed Requests for Exemption are to be submitted to:

Leonard K. Bernstein, P.E.
Special Projects Coordinator
Philadelphia Water Department
ARAMARK Tower, 2nd Floor
1101 Market Street
Philadelphia, PA 19107-2994

Revised: 2/23/00